NC Nutrient Criteria Development Plan – Scientific Advisory Council (SAC)

6/27/2019

Attendees

SAC members in attendance:

Lauren Petter
Bill Hall (phone)
Linda Ehrlich
James Bowen
Hans Paerl (phone)
Alix Matos (alt. Clifton Bell)
Marco Philera (alt. Astrid Schnetzer)
Michael O'Driscoll
Martin Lebo (phone)
Deanna Osmond
Nathan Hall (alt. Hans Paerl)
Katie Martin (alt. Marcelo Ardon)

SAC meeting facilitator:

Jenny Halsey (Triangle J Council of Governments)

NCDEQ DWR staff in attendance:

Jim Hawhee
Connie Brower
Christopher Ventaloro
Nora Deamer
Leigh Stevenson
Elizabeth Fensin
Qais Banihani
Heather Jennings

Criteria Implementation Committee (CIC) members in attendance:

In person:

Andy McDaniel
Douglas Durbin
Anne Coan
Bill Kreutzberger

Meeting materials can be found on the Division of Water Resources Nutrient Criteria Development Plan Scientific Advisory Council webpage. Click here for a direct link.

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Meeting notes

All questions, comments and answers are paraphrased

i. **Convene** (Jenny Halsey, Jim Hawhee)
   a. Desired outcomes for today's meeting:
      i. Shared understanding of the Chlorophyll-*a* document status.
      ii. Shared understanding of the APNEP Phase I report.
      iii. Shared understanding of recent and upcoming research in the Chowan/Albemarle.
      iv. Shared understanding of the NCDP document revisions.
   b. Administrative business (Jim Hawhee)
      i. SAC members approve the meeting notes from the November 2018 and December 2019 (SAC retreat) meeting minutes.

ii. **Update on EPA cyanotoxin recreation criteria** (Chris Ventaloro)
   i. EPA finalized the cyanotoxin recreational criteria/swimming advisory criteria May 2019. Considers microcystins (as a group) and cylindrospermopsin toxins.
   ii. Document provides recommended criteria that states may use to establish Clean Water Act compliant recreational water quality standards, or that can serve as health protective values for the issuing of swimming advisories in recreational waters.
   iii. Criteria magnitudes are the same for both water quality standard and swimming advisory applications and are 8 ug/L for microcystins and 15 ug/L for cylindrospermopsin.
   iv. Duration is one day for swimming advisories. For water quality standards the duration considers multiple 10-day assessment periods across a recreational season (as defined by the state).
   v. Frequency is "not to be exceeded" for swimming advisories. For water quality standards impairment is considered to occur when there are more than 3 excursions in a recreational season and that occurs more than one year in a number of years defined by the state (ex: not more than once in 5 years). An excursion is considered to be a 10-day assessment period that has a toxin

3. Deanna O.: So not necessarily something like Fall's Lake that has designated recreational beaches, but any water that is used for swimming.
4. Chris V.: This gets into the management side of how these criteria might be used. The criteria have the option to apply as state-wide water quality standards and/or as swimming advisories. DWR doesn't usually get involved with the routine monitoring of swimming beaches. We have waters classified for recreation. As part of our routine ambient monitoring we might have samples from these waters but they are not necessarily designated swimming beaches. If we were to adopt this as a water quality standard it would apply to any water body classified as Class B.
5. Deanna O.: This looks like it would require intensive monitoring efforts.
6. Chris V.: The assignment of the 10-day assessment periods is a preferred approach. There is flexibility. EPA acknowledges that many states will not have the resources to do this. They provide some options in the document such as starting a 10-day assessment period only when a bloom is observed. There is a trade-off there as it is likely that bloom events would be missed. A lot of how this is implemented will need to be worked out prior to adoption.
7. Deanna O.: Would the state do the testing?
8. Chris V.: The state is working on the capability to do this type of analysis.
9. Connie B.: EPA recognizes that these criteria recommendation present cost and resource challenges. From my work on a national work group it seems that most states are not going to adopt the criteria as water quality standards but rather as beach notifications.
10. James B.: Seems like sampling is every 10-days. Is that one sample each day? One sample within 10-days?
11. Chris V.: There's flexibility there. One sample each day for 10-days is the best case scenario. For states with well established swimming beach monitoring programs this may fit in well with their regular sampling efforts.

criteria for either application. That being said there is a lot of public concern related to cyanotoxins.

15. Bill H.: Usually samples are averaged over the duration period to determine if there is an excursion. Here it looks like a sample that is above the magnitude on any given day is considered an excursion. Is that correct?
16. Chris V.: Yes. Any samples above the magnitude count as an excursion in that 10-day assessment period.
17. Nathan H.: I'd be curious how many local health departments are measuring for cyanotoxins.
18. Connie B. and Lee S.: None that we know of right now. I would say that most health departments are not necessarily aware of this.
19. Connie B.: It would be a big leap for states to do this. We know there are potential issues with toxins but how do we address that? Even for a single beach it would be challenging.

iii. **Chlorophyll-a document update** (James Bowen)

- a. Background information: SAC members agreed to work together to produce this document so that all members contribute to the final product. A shared Google account has been set up for SAC members to share information and converse.
- b. In the February 2019 SAC meeting we provided an outline of the document structure.
- c. The goal is to have the draft document completed by August 2019. Progress to date:
  - i. Chapter 1 (introduction) is more or less finished
  - ii. Chapter 2 & 3 are the farthest from being done at this point
    1. Source materials (such as tables and charts provided by Jing Ling) for chapter 3 are available. The information just needs to be organized.
    2. Nathan is looking at literature related to how chlorophyll-a impacts aquatic life. Marcelo and Hans are also working on this section.
       - a. Nathan presents information from some recent research papers that the SAC has not discussed. See slides for more information.
       - b. Shows figures from recent papers have information obtained from surveys of different lakes and show metrics of fish abundance, biomass and conditions of largemouth bass

e. There is some impact associated with submerged aquatic vegetation (SAV) impacts. Have not pulled that literature together yet. Need to look into literature related to freshwater SAVs.
    i. James B.: States there is literature on freshwater SAV from Lake Washington. Cleaned up lake and SAV returned.
f. Looking into studies in piscivorous fish that discuss how water clarity can change trophic structures.
g. Light infiltration regulated the heat budget of lakes. This can determine hypoxia volume. Haven't read much about this yet. Study from Smith Mountain lake indicates this may have played a role in an increase of hypoxic conditions.
    i. Linda E.: Higher turbidity leads to increased light scatter which can increase infrared wavelengths that lead to warming.
h. Trophic interactions
    i. Focused on sports fish fishery as that is what SAC determined to be the sensitive use in High Rock Lake.
    ii. Meta-analysis looked at trophic indicators vs. fishery response. In almost every case the relationship between chlorophyll-a and fish production is positive.
    iii. One study did show a decrease in fish production at high chlorophyll-a levels. Fish body index (fish mass vs. length) pattern was lowest in two lakes with the highest chlorophyll-a concentrations. Based only on two data points that are unusually high (~120 & 140 ug/L).
    iv. A case study in Georgia showed a decrease in fish biomass with a shift from about 40 ug/L chlorophyll-a to 20 ug/L chlorophyll-a. Another paper showed a flat response in sports fish (bluegill, largemouth bass) with chlorophyll-a concentrations while benthivores and

better about our upper bound of 35 ug/L, which is kind of high. Literature shows that as it goes lower there will be decreases in fish production (with respect to sports fish). Another study also showed that as the chlorophyll in a lake was reduced, the largemouth bass population declined and was replaced with an increase in the spotted bass population. Overall fish population did not change, but the largemouth bass are the more desirable sports fish species.

1. Lauren P.: Are these studies based on a variety of durations? May need to keep that in mind since we are using an instantaneous duration for chlorophyll-a. Concerned that this may not apply to the long-term geometric mean we are recommending in HRL.
2. James B.: Regarding the duration, the relationship between fish growth and chlorophyll-a can change when comparing instantaneous to a geometric mean. Not sure how much it might change.
3. Nathan H.: Not sure. Will need to look at the studies again. It is a good question. I will look into it.

i. Cyanotoxins
   i. We've talked a lot about toxins in HRL. Mostly looking at microcystins.
   ii. Sub-lethal effects have been shown but there are not a lot of studies out yet. Changes in behavior and swimming in fish and crayfish. These types of studies are just starting to come out.
   iii. Relationship between chlorophyll-a and cyanotoxins is weak to non-existent. There are some site-specific instances that show correlations. Hard to find

samples intentionally trying to get the highest concentrations.

iii. Chapter 4 (derivation of criteria recommendation) has a draft out for review
    1. Alex M.: shares notes that Clifton has provided
        a. The agreement from December 2018 cited April-October as the growing season. Even though it wouldn't be required to have data from every month you would need 5 separate months with that range. The reference in the chapter four draft to use May-October data isn't completely consistent with the agreement.
            i. James B.: I think this comes from the December meeting minutes.
        b. Important we justify the 35 ug/L geometric mean target independent of the statistical analyses documented in chapter four as that wasn't why the 35 ug/L was selected. Wants to rephrase the reference to a target concentration of 34 ug/L at the max chlorophyll-a lake location. Understands where that comes from but thinks that it may be confusing to the reader because the criteria is 35 ug/L and not 34 ug/L.
        c. Remove language that says the SAC agreed to 40 ug/L as a not to exceed target. SAC discussed this as an upper bound of the geometric mean range. We never agreed to it as a not to exceed target.
            i. Martin L.: The use of the 40 is as a geometric mean and is not based on an individual sample.
            ii. Lauren P.: All of the values in the chart are geometric means?
            iii. Martin L.: Except for the distribution of values that came from monitoring data. The results of the Monte Carlo analysis are as a geomean of ten samples.
        d. Table 4-4 cites chlorophyll-a criterion as a not to exceed value. This can be confusing because the phrase not-to-exceed usually indicates an instantaneous minimum.

term mean. Can make a recommendation as to what confidence should be or to a statistical method that should be used?

ii. Lauren P.: Is the long-term geomean a 6-year geomean with a minimum of 10 samples?

iii. Martin L.: We didn't specify what the assessment period would be. It's assessment period by assessment unit. We can make recommendation on what that might be.

iv. Lauren P.: Trying to figure out how long of a period can be averaged?

v. Martin L.: Would be the assessment cycle, but if don't have ten datapoints, NC goes back to get additional points past the 5-years.

vi. Lauren P.: So, the long-term geomean can represent a different number of years in each assessment cycle depending on the amount of available data?

vii. Pam B.: That's when we're looking at impairing waters using the 10% exceedance with 90% confidence. The SAC needs to define what they want to recommend for how to calculate a geomean for this criterion. We can do a geomean with five samples.

viii. Martin L.: Can you do the statistics on five samples, though? You chose ten samples as the minimum for assessment.

ix. Lauren P.: We are supposed to come up with what is the protective criterion and DWR will figure out how to appropriately assess that. Over [for example] seven years you might have a certain average and you might have certain numbers that help keep it from going crazy. You first need to define what long-term is. What is the protective duration and then the assessment can be worked out? It doesn't need to be influenced by

xi. Lauren P.: But it needs to have a year period.
xii. James B.: Hopefully there is something in the notes that will show what was discussed.
xiii. Nathan H.: Don't think it was decided on. (others agree). Nathan states he preferred a t-test on the geometric mean.
xiv. James B.: We might need to resolve this.
xv. Lauren P.: Along lines of Clifton's comment, statistical analysis shouldn't be the only thing proving the number.
xvi. Nathan H.: Think the previous chapters (2 & 3) will define the basis of the number.
xvii. Martin L.: Those chapters will show that the 35 ug/L is protective. No bright line where impact occurs.
xviii. Lauren P.: In absence of a bright line we need to best document the line that we are picking as the criteria. Even if there isn't a line there is a range that we are picking the protective value from. That needs to be justified. Information sources are supplied in chapters 2 & 3, but don't need those chapters to comment on chapter 4. Goes back to the duration component mentioned before. If the literature is a certain way, the criteria being developed needs to match that format.
xix. James B.: regarding Clifton's comment on independently justifying the value of 35 ug/L so that it is not only based on statistics, is there a way to do that? That's where the number came from. Did you take it the same way?
xx. Martin L.: Not hearing a bright line. 35 ug/L allows for enough chlorophyll to support a productive fishery. Going below reduces the fishery.
xxi. Lauren P.: Reading chapter 4 what I see is, we took lake data, did a Monte Carlo analysis, came up with a

xxiv. Martin L.: To keep most of the space between the 25 to 40 range [from Clifton's lake framework].
xxv. Lauren P.: So, you were trying to fit it to a range. Instead of trying to make the data fit the range the distribution should have been reduced relevant to what was the right endpoint within that range so it would be independent of the statistics.
xxvi. Jim H.: Going back to the two-day meeting in December 2018, SAC came to resolution on what the criteria was going to be. Discussion are recorded in the notes and the SAC went through use-by-use and agreed that you were each ok with the criteria being protective. Might be helpful to go back to the notes first and then come back for more discussion if there are unanswered questions.
xxvii. Jenny H.: Makes a motion to put this on the August agenda.

iv. Chapter 5 (Clifton's chlorophyll-a lake framework proposal) will be in draft by the end of this week

iv. **APNEP Phase I report review** (Jim Hawhee)

a. Jim provides a refresher on the Albemarle Sounds Phase I report
   i. With the work on HRL ending, DWR has selected the Albemarle Sound as the next water body to work on.
   ii. APNEP workgroup discussed nutrient criteria and developed the Phase I report
   iii. The APNEP Phase I proceedings are accessible at https://files.nc.gov/apnep/documents/files/past-committees/Albemarle-Sound-Report_combined.pdf
   iv. Phase I summary:
      1. The APNEP facilitated workgroup held 9 meetings from 2016 to 2016.
      2. Nutrient related parameters discussed were pH, DO, clarity, TSS, turbidity, phytoplankton & cyanotoxins, chlorophyll-a, nitrogen and phosphorus.
      3. Supporting projects undertaken in 2015 to 2016.

7. Criteria development case studies.

vi. Workgroup did fact-finding work in early 2016 and member-generated criteria proposals were evaluated by late 2016. Following proposal review, workgroup proposed future research projects to fill information gaps.

vii. Phase II prioritized research goals:

1. Additional algal toxin surveys. Some are currently underway.
2. Clarity optical model. Not currently underway. TSS data is being collected for calibration purposes.
3. Evaluation/summarization of historical clarity data. DWR staff has begun this.
4. Nutrient bioassays. A grant proposal has been submitted.
5. Quantification of historical SAV coverage. APNEP has mostly completed mapping efforts. Evaluation of potential habitat has not begun.
6. Evaluation of correlations between oxygen-sensitive fish species, habitat utility and seasonality. There are existing NOAA resources, but this may require further evaluation.

viii. Next steps:

1. Consideration of nutrient criteria by DWR, SAC & CIC
2. Areas of discussion include application and implications of a clarity standard, chlorophyll-a as a seasonal average, discussion of setting N & P criteria, and use of a bioconfirmation approach.

ix. Comments/questions:

1. Bill H.: What's meant by a bioconfirmation approach?
2. Jim H.: It's a shorthand way of saying integrated criteria. Incorporates numeric N & P criteria that are applied in combination with other criteria such as chlorophyll-a. For example, N might be high, but if chlorophyll-a is below criteria then water is okay. This helps to address the concern that causal criteria on their own may lead to assessing false impairments.

v. **Searching for drivers of a system-wide change in trophic status of the greater Albemarle Sound ecosystem** (Nathan Hall)

a. See presentation slides for images, charts and graphs.
b. Blooms were common in the Chowan and Albemarle systems around 30-years ago.

d. Recently the frequency and severity of blooms have increased throughout the system. This involves an ecosystem-wide shift in phytoplankton with a predominance of nitrogen-fixing species.
    i. James B.: Are these occurring in a range of salinities?
    ii. Nathan H.: Salinity is basically 0 parts per thousand where the blooms are occurring. The Albemarle is a very low salinity system. Usually less than 2 ppt in tributaries. I've been measuring 0 ppt.
e. Are these blooms symptom of a larger change in the trophic status of the system?
    i. There is a lot of historical data for this system available from the DWR ambient monitoring system (goes back to the 1970's)
    ii. There is a strong upwards trend of chlorophyll-a at the mouth of the Chowan River and in the main-stem, but not as much in the tributaries. Trend seems to have been occurring before problems with blooms became apparent.
    iii. Total nitrogen also appears to be trending upwards in this location and is occurring at other locations in the system especially in the tributaries.
    iv. These upward trends in chlorophyll-a and total nitrogen are appearing all over the Albemarle.
    v. Total phosphorus, however, is mostly flat throughout the sound but is increasing in certain places.
        1. James B.: Are trends explainable by typical N to chlorophyll-a (algal biomass) relationship?
        2. Nathan H.: A lot of the total nitrogen is in the algae. There is very little inorganic nitrogen in these samples except for a few hotspots.
f. NOAA imagery is being used to look at historic biomass for the past 20-years. Using a cyanobacteria index developed at NOAA. This has confirmed the trends we are seeing in sampling efforts. Good for looking at areas that we don't normally sample.
g. Recap:
    i. Blooms are recurrent and awful.
    ii. 6 of 10 DEQ stations have increasing chlorophyll-a levels.
    iii. 10 of 10 stations show increasing trend in total nitrogen.
    iv. 2 of 10 stations have increasing phosphorus.
h. Questions are:
    i. What is driving these changes and,

j. The Sea Grant sponsored Community Collaborative Research Project with the Chowan/Edenton Environmental Group (May 28-30, 2019) also conducted a bioassay study.
    i. Data is being processed now.
    ii. Two main species of identified:
        1. *Dolichospermum* sp. (Anabaena) – toxin producing
        2. *Aulacoseira* sp. (diatom)

k. If nitrogen is limiting, where is it coming from?
    i. There has been no major increase from the Chowan River and no major changes in the Roanoke.
    ii. No changes in major nutrient inputs.
    iii. The Potecasi Creek tributary has been increasing in Nitrogen. It runs through agriculture lands and has a strong agriculture signature (~1 mg/L NO_3).
    iv. Atmospheric deposition is unlikely as there have been no big changes in sources and measured N & P levels.
    v. Swamp forest loss is a potential nutrient source.
        1. ~15,000 acres are lost each year.
        2. This may be having an impact on nutrient loads.
        3. Literature review found two papers that looked at the nutrient yield of swamp forests when they are cut down. Shows that there is a load increase, but that it only occurs right after the forest is cut down. The forests are self-regenerating.

l. Conclusions so far:
    i. Albemarle Sound is experiencing a system-wide change in trophic status
    ii. There are small increases in TN in the rivers. Creeks need to be looked at more closely.
    iii. Nutrient loads from swamp forest loss are not a major issue but require more study.
    iv. Nitrogen fixation is a possible explanation for increases in TN and chlorophyll-a. This requires further study to get actual measurements of N fixation to confirm.
    v. The factors underlying the shift to higher levels of N fixing cyanobacteria are not clear.

iv. Nathan H.: There are a lot of possibilities. Not a lot of data from which to draw conclusions at this time.
v. Nathan H.: Cyanobacteria like warm temperatures. Overall increasing temperature in this part of the U.S. There may also be some sampling bias.
vi. Katie M.: What we are seeing is that the minimum surface water temperatures are increasing more quickly that the maximum temperatures in this part of the U.S. There are also higher temperatures at night. Remote sensing data can be used to assess this. Growing season are also lengthening (starting earlier and ending later).
vii. Linda E.: The loss of swamp forests can also contribute to heat gain.
viii. Hans P.: In general, extremes are becoming more extreme. Hydrology also plays a role: storms and droughts are worse. Should also consider N & P loading in the tributaries. May not be seeing a lot of N in these areas because the algae are utilizing it. There are also legacy N & P that need to be considered. There are N & P accumulations in the system. As the system changes this may lead to a change in water column/sediment interaction and exchange.
ix. Deanna O.: Regarding the downstream tributaries, is most of the development there on septic?
x. Jim H.: Not sure about that. It's difficult to determine how much might be due to population increase and how much is due to climate related changes. Need to better understand the dynamics of the system better. The Chowan River Basin Plan is currently being worked on. This may help characterize some of the changes in the system.
xi. Hans P.: Also need to consider the balance between nitrification and denitrification.
xii. Nora D.: Based on land use data from 2016 there has been little change in development in the region.
xiii. Mike O.: Sea level rise may also play a role as saltwater begins to intrude farther up the system.

vi. **Identifying pollution trends for management prioritization in the Albemarle** (Michael O'Driscoll)
   a. See presentation slides here.

iii. Who are the stakeholders/relevant landowners that might participate?

d. Began with InVEST and SPARROW models. (See slide #4 for model comparison)
   i. Calculated nitrogen hotspots for each model and could focus on areas with higher than average export of nitrogen.
      1. Comparison between InVEST and SPARROW hotspots can be used to narrow down focus areas.
   ii. TNC evaluated riparian buffers, ditch retention and cover crops as potential options for management. This was based on implementation potential.
   iii. Trade-offs for each management option were identified based on efficiency vs. greatest potential for reducing nitrogen. Examples:
      1. Restoring peat lands would be most efficient, but less impactful since there is not much of this is occurring.
      2. Cover crops may be inherently less efficient, but, since there is so much existing cropland, could have a greater overall effect.
      3. Buffers were less efficient than peatland restoration but more efficient than cover crops. They had about as much impact as cover crops and much more impact that peatland restoration.

e. Parcel optimization
   i. TNC wanted to develop a way to prioritize which landowners to contact.
   ii. Scored each parcel over 150 acres based on a few variables including parcel size, acres of agriculture, acres of peatland, and ditches.

f. Conclusions:
   i. Nutrient concentrations vary across the landscape
   ii. Focusing conservation efforts with nutrient hot spots can maximize reductions.
   iii. Appropriate management options may be very site-specific.
   iv. There are limitations in the models such as: (1) InVEST doesn't account for point sources, (2) SPARROW accuracy is better when there is more flow and concentration data, and (3) models are only as good as the data used to calibrate them. There are few gauging stations in the coastal plain.

vii. **Existing Data for Evaluating Coastal Plain Ecological Flows in the Albemarle-Pamlico Basin** (Michael O'Driscoll)

a. See presentation slides here.
b. Outline

ii. Evidence shows groundwater inputs and low flows declining in coastal plain.
iii. Climate, land use and water use changes affect stream flow and quality.
iv. Session Law 2010-143, DEQ required to develop basinwide hydrological models for each NC river basin to predict places, times, and frequencies at which ecological flows may be adversely affected in NC (NC DEQ 2013).

c. Data availability
   i. More than 100 websites with flow related data
   ii. Still a lot of data gaps related to small streams, tidal areas, groundwater, salinity, evapotranspiration, ecological response, water use, and water quality. Some specifics:
      1. Heavy reliance on groundwater in the coastal plain counties. The coastal plain uses the most groundwater (62%) in NC. Less reliant on surface water.
      2. Groundwater pumping is most common in the coastal plain. This can lead to reduced inputs to streams. Not a lot of data available to determine if recent low-flow conditions are being influenced by groundwater removal.
      3. Groundwater use difficult to track due to varying reporting requirements over time. Online data not available for periods before 1997.
      4. States and watershed managers recognizing need for improved water accounting. Several major questions require this type of information:
         a. Why are low-flows declining over the past few decades?
         b. What is the role of meteorological controls and water withdrawals on these declines?
         c. What role does groundwater pumping and surface water withdrawal play?
         d. At what magnitude will ecological integrity be impacted?
         e. How do declines in low-flow decline affect water quality and HABs?
      5. Evidence for low-flow decline:
         a. USGS low-flow characterization - all coastal plain stream gauge sites had recent decline in 7Q10 baseflow.

d. Increased water temperature and reduced DO

d. Comments/questions:

i. Hans P.: Who is using the groundwater? Is withdrawal data describing per person use or large volume users?

ii. Mike O.: Mining is a big user. There is growing use with aquaculture. Agriculture and water supply use is about the same. Groundwater use generally increases during good economic periods. Data showed reduced use during the last recessions, though there was also a bad drought during that period. USGS 2015 data should be out soon.

iii. Jim H.: Regarding low-flow and future projects, timing of low-flow occurrence can impact HAB occurrence and intensity.

iv. Mike O.: This work was focused on addressing data needs and didn't get too into ecological impacts.

viii. **Food web transfer of cyanobacterial toxins in the Chowan River and western Albemarle Sound, North Carolina** (Marco Philera, alt. for Astrid Schnetzer)

a. See presentation slides here.

b. Marco provides information on cyanobacterial blooms and cyanotoxin dynamics in the Chowan River

i. Monthly testing completed for anatoxin, cylindrospermopsin, microcystin, and saxitoxin at seven locations. Some event-driven data also collected.

ii. Analysis of spatiotemporal toxin dynamics underway.

iii. Information was gathered using SPATT filters at seven sites.

iv. Results:

1. Microcystin, cylindrospermopsin, anatoxin and BMAA present between July 2016 and January 2018. No Saxitoxin detected.

2. Data indicates possible low-level chronic exposure to multiple toxins (microcystin and cylindrospermopsin most commonly detected)

v. Current study is testing cyanotoxin loads in commonly caught fish species and clams. Focus is on analyzing viscera, liver and tissue. Also analyzing temporal toxin dynamics (dissolved, cellular and SPATT) compared to animal loads.

ix. **NCDP document updates** (Jim Hawhee)

a. See presentation slides here.
b. The NCDP document was originally agreed on in 2014.
c. Updates include:
    i. Expanded role for DWR in the NCDP process. DWR will now serve as the lead for developing nutrient criteria.
    ii. Revised role for the SAC. The SAC will no longer be charged with development of criteria. The SAC will serve to provide expertise and guidance for criteria development done by DWR.
    iii. Including the Chowan River with the development of nutrient criteria for the Albemarle Sound.
    iv. Officially recognizing the CIC as part of the NCDP.
    v. Re-establishment of criteria development timelines.
d. Transition period
    i. We are approaching the end of the HRL criteria development process.
    ii. Do current SAC members wish to serve further?
    iii. DWR is also looking to bring in new SAC members that have expertise of the Chowan River/Albemarle system. Focus will be on coastal oriented scientists.
    iv. DEQ Director Linda Culpepper thanks SAC members for their service as part of the HRL nutrient criteria development process. Informs the SAC that EPA has approved of the revised NCDP document and that DEQ wants to work with scientists that have more focused expertise in coastal issues as we transition to the nutrient criteria development in the Chowan River/Albemarle Sound. DEQ also wants to strengthen state-academic relationships moving forward. Stresses that there will be other venues available for people to participate in the nutrient development process. Also states that DEQ appreciates all of the work that has gone into the HRL criteria proposal document and that she hopes work on it continues.

x. **Wrap up** (Jenny Halsey, Jim Hawhee)

a. Jim H.: Hope the HRL effort will continue. We will update SAC members on future appointments.
b. Linda E.: Does this mean our term is ending?
c. Jim H.: Since we are switching systems the SAC membership will change to reflect the