Chesapeake Bay Program Hypoxia Collaborative Meeting Minutes

Friday, May 13 · 12:00 – 1:00pm

This meeting was recorded for internal use to assure the accuracy of meeting notes.

Attendance: Peter Tango (USGS), Justin Shapiro (CRC), Amy Goldfischer (CRC), Durga Ghosh (USGS), Cindy Johnson (VA DEQ), Mark Trice (MD DNR), CJ Pellerin (NOAA), Carl Friedrichs (VIMS), Jay Lazar (NOAA), Kevin Schabow (NOAA), Marjy Friedrichs (VIMS), Doug Wilson (NOAA), Bruce Vogt (NOAA), Max Ruehrmund (NOAA), Rebecca Murphy (UMCES), Jeremy Testa (UMCES)

Action Items:

- ✓ The NOAA team will update the group after Monday's (5/23) re-deployment of the arrays and share the links to the data.
- ✓ The NOAA team is aiming to have a draft QAPP available by the end of June to review with the CBP QA Coordinator.
- ✓ At the next hypoxia collaborative meeting, the group will continue to discuss:
    - Location for a third sensor
    - Any updates on funding commitments to address items in the PSC monitoring review
    - Any updates on the development of the 4-Dimensional Interpolator

12:00 – Introduction *(Peter Tango (USGS) and Bruce Vogt (NOAA): 5 minutes)*

- Members of the group introduced themselves and their roles and interests.
- Max Ruehrmund (NOAA) updated the group that the third hypoxia array has been painted and is currently drying, and the Quality Assurance Project Plan (QAPP) is being written. CJ Pellerin has been doing data management.
- Rebecca Murphy noted that she is looking forward to using this data in the 4-Dimensional Interpolator project.

12:10 - Summary of Monitoring Review to the Chesapeake Bay Program's Principals' Staff Committee *(Peter Tango, USGS)*

- Peter Tango gave an update on the monitoring review requested by the Principals' Staff Committee in March of 2021.

    - The structure of the water quality monitoring program was not originally designed with assessment of water quality standards attainment in mind. It focused on monthly, seasonal and annual level measures. The spectrum of temporal resolutions in our present water quality criteria are not part of our normal assessment - measures like instantaneous minimum estimates, one day mean conditions, or 7 day mean conditions, are now part of our monitoring expectations without having established a suitable monitoring program component to evaluate them. There was a bit of a mismatch when folks went with the program designed in 1984 to what was anticipated in terms of the needs in the 2000s. Leveraging some of the work from Aaron Bever et al. about how can we improve our monitoring efficiencies and to get information on the scales of time and space necessary to fill the temporal resolution gaps and address monitoring frequency and locations, we have worked on designing the hypoxia monitoring network to put the foundations of a network in place to address criteria attainment which is based on fisheries, shellfish and habitat needs, as well as Habitat Suitability Index assessments and more. Modelers are excited about spatially and temporally detailed information to tune our dynamic understanding of water quality.
    - The community review process on the PSC monitoring review report is completed, the draft report went out to community review and feedback. The review team is in the process of responding to comments and finalizing the report. Several partnerships have already formed or are forming to address monitoring priorities in need of investment as a result of what people have heard over last year and based on different items in the report.

- We agreed on generalized locations of importance for likely future deployments of sensor arrays based on sampling uncertainty over time for some regions and areas of habitat and fisheries importance. The duration is something being discussed - which locations would benefit from seasonal versus all year focused. Investments on the analysis and data resolution side, and vertical resolution at these locations is important. We've discussed vertical density sensor density of these fixed array systems and how that plays into eventual deployment and maintenance.
- The recommendation was for 11 arrays considering the MD DNR fishing Bay study area as part of that. There are 10 arrays we targeted through discussions plus that one. The recommendation is to complement everything that's out there through the PSC report, an investment need based on 8 new locations for arrays. Credit to the NOAA team working to understand operations and maintenance, backup equipment needed, and helping target the integrity of that data set over time. This was the core of the open water proposals in offshore waters.

- Peter showed a graphic. The two yellow points in the middle represent stations on the east shore and west shore of the mainstem bay that have been recommended to support deployment of sensor arrays already in hand. Something we haven't spoken about is how complementary work and boundary condition assessments at tidal-nontidal boundaries fit into the river input monitoring network. This occurs at the 9 major river systems which are inputs to the bay and where we have long term monitoring sites set up. There are 5 continuous monitors; typically have a system supported by continuous river flow at 9 sites, plus monthly monitoring and stormflow monitoring. USGS is very busy with storm flows right now. That helps us get flows and loads which are informative to a suite of understanding of how the Bay is behaving and how management actions are responding. There has been a gradual buildout of not just discretes connected to river flow but also continuous water quality connected to continuous river flow. There are 5 stations in operation and a desire for 5 more. The James river is getting an additional one in the Richmond area.
- Jeremy Testa: Are just talking about continuous NO3 (nitrate) at the River Input Monitoring sites? Or temperature, salinity, and dissolved oxygen (DO)? Peter responded yes to all of those metrics.
- Peter: Modeling and assessment are both important to trying to understand different spatial dependence. If we had 3 mobile units deployed in strategic places such as if there are segments close to meeting attainment, more intensive data could identify if they are in attainment. The question is whether we don't know because of low resolution monitoring, or are we farther away than expected? There is a line item for completing the River Input Monitoring (RIM) network with continuous monitoring, so all major river sites are outfitted. We are working on the 4-Dimensional interpolator meant to ingest this information and put it to use in terms of giving us spatial temporal resolution of DO and habitat conditions to give us beyond what we have from monitoring data. Trying to get monitoring information and build an assessment tool with it.
- The network vision was presented and welcomed. Budgets have been developed. Agencies are already using these findings to plan investments. EPA and NOAA are having meetings on how do we do this, and USGS is also talking about it.
- The RIM items are the first time this group has seen the concept of joining the boundary high frequency information with Bay high frequency information. There is a Pennsylvania Department of Environmental Protection (PA DEP) investment at the head of Conowingo pool to have 3 continuous monitors (con-mons) in that location to better understand the relationship between what's coming into the Conowingo pool and conditions coming out of the Conowingo pool. There is some upstream connectivity building off con-mons. This could further connect the Bay and watershed.

- Jeremy Testa: What was behind the rationale to do oxygen and conductivity monitoring at the RIM sites? Was there a well-defined need for that or was it just consistent with idea that if we're going to have high frequency monitoring in the estuary it would help to have high frequency monitoring of the rivers?
- Peter: The second part was the most fundamental reason he was given, to connect resolution of DO, etc, coming into the Bay with those in the Bay.
- Jeremy: Initial reaction is that more data is always better but investing here for those particular variables, I don't know how much more information we'll get out of it. How much is DO at RIM sites going to inform what's being measured out in the tributaries and mainstem? So much will change as it transits to where these sites are. More information isn't bad as long as it doesn't suck resources from something that could be argued as a more valuable place to put resources.
- Peter: Appreciate that, given the nature of budget discussions going on, people thinking about give and take. If that's an area of give and take and priorities within the priorities in terms of where resources do land then that's helpful. It is helpful to know if there are sites less valuable at this time and sites that are more informative.
- Marjy Friedrichs: Do the RIM sites include salinity, temperature, oxygen, and were there nutrients as well?
- Peter: Nitrates sensors were included in recommendations.
- Marjy: Nitrate would be potentially useful because that's what coming in there and farther downstream and there's a lot happening between those two. In terms of salinity, temperature, oxygen, it's river water so it's pretty fresh; for temperature, it's shallow, so atmospheric temperature; for oxygen, in these shallow waters there's not a lot of productivity. I agree with Jeremy for the temperature, salinity, and oxygen may not be as useful but nitrate would be the most useful.
- Jeremy: I agree. Temperature and salinity and DO may not pay off in relation to other investments. Joel Blomquist has been doing continuous nitrate monitoring. We used it when putting nitrate sensors out in the mainstem to look at their relationship. Think I heard Joel say they looked at what their load estimates look like with traditional sampling versus high frequency nitrate and he said they didn't really change their loading but they did give a good picture of what's happening now. Marjy's forecast model could use it. But those are expensive and I don't know what maintenance is like. Maybe you can check in with Joel.
- Carl Friedrich: Another type of sensor that would be useful would be some sort of CDOM sensor with many wavelengths. There's been a lot of neat work in statistical analysis between different optical signatures of the water and organics that are present. Dissolved organic matter can be important coming in through rivers. Consider this if there are reliable instruments of that type that are out of the pure research realm. There is a student at VIMS working with Elizabeth Canuel and Iris Anderson – Derek Detweiler. He's been doing work on spectra signature of optics. Guess he has to do that

back in the lab and it's not ready for placing into a river. Carl will report back if he finds out more information.

12:25 - Update on NOAA's Winter Array Deployment *(Jay Lazar & Kevin Schabow, NCBO)*

- Jay Lazar gave an update on the fall 2021 deployment and overview of the data from it. The fall 2021 deployment took place between December 1-15. It was shorter than hoped for but it was the time we had. The deployment was in the locations CB4.3w and CB4.3e. CBIB COOS's reef is in between doing some similar things and measurements. The array was built out in the warehouse. They used biofouling measures including some biofouling paint on the bottom of the buoy, and the sensor back was wrapped in copper tape. The front cage was wrapped in copper mesh to attempt to cut back on what grows there. They'll be monitoring that this season.
- The visualization tool was created by Axium data science and is a plug and play. This site is also where you would access the data.
- CJ Pellerin gave a live demonstration of the site. He showed the landing page for accessing the data and demonstrated how to look at it at different time periods.
    - To see the color legend, click on where it says legend and it will pop up.
    - Links to site: 2F1 (CB4.3W): https://sensors.ioos.us/#metadata/111248/station/data
    - 2GM (CB4.3E): https://sensors.ioos.us/#metadata/111249/station/data

- Jay said the legend will identify small and large changes. He wondered if there is an option to have a fixed ramp so the colors are consistent if you're doing a quick check. Jay said the data download provides any format anyone could possibly want. We'll see everything on this page. This can be used as a quick check for anomalies.
- Peter commented that fixed ramp is a nice option.
- Doug: for those who want to use the data, it is going directly into an ERDDAP server. If you've used ERDDAP before you know it's a really expansive format. It's got all the metadata and allows downloading of selected data into any format you want.
- Jay: 5 minutes after the array went in they took a Conductivity-Temperature-Depth (CTD) measurement when they deployed this on December 1, and the black lines are the measurements from the array every two meters and a much higher vertical resolution of the CTD upcast and downcast. The upcast is the one more accurately mapping in the DO and temperature graphs for the array. Doug did this work and provided feedback. These are pretty good; they're happy with it. They did a pretty quick cast. The plan is to redeploy them on Monday (5/23) and they'll give them a little more time to soak before taking that validation cast. They'll take the validation cast in discrete meter intervals to get a little more time at each depth measurement and see how that plays out. In the middle plot there is jaggedness. There is something in the conductivity coefficients that is off a little. It seems like it's in every other sensor there. That

translates to the striations we see. That's one of our first lines of quality control along with the cartog measurements that are in place, this validation piece. Given that these were put in for two weeks and taken back out we'll be redeploying them and taking that cast and the idea is to evaluate these coefficients and adjust them to the CTD measurement for this deployment. They'll be calibrated at the end and see if anything changes. That's the reasonable approach given the CTD was recently calibrated and doesn't sit in the water. The jagged salinity graph is leading to those more subtle jogs in the DO. The validation cast did their job, it identified something. Doug did the first quality control (QC) and this validated it and will result in action.

- Doug: The plan is to work with the manufacturer to do a more thorough job on calibrating the CTD. Because we just got a standard full conductivity range calibration and we'll have to get more data points in the estuarine range in the future. The next pass will have that. We will try to substitute some of the validation data and see if we can improve it in short term. But in the long term do a better job of conductivity calibration. Temperature and oxygen look pretty good.
- Jay: In the mid term they plan to invest in a local set of tanks that have a range of salinities and calibrate each of the sensors to the appropriate salinity they anticipate observing depending on where they are located in the Bay. This came out of a discussion from the STAC advanced monitoring workshop.
- Max is working on the QAPP. Their goal is to have a draft for review by mid-June. They plan to put the arrays out on Monday. With that deployment there will be a new set of links to this deployment. Once those are out and they're in the water and those links are active they will share them with this group. Then feedback and testing to ensure quality of the data will begin.

12:40 - Site Options for a Third Array to be Deployed in Fall, 2022 *(Jay Lazar, NCBO)*

- Jay: They ordered a third array and intend to get a fourth array for backup for phase one (mid Bay). The goal of the first three phase one arrays is hypoxic volume model validation which is a direct link to living resources and assuming will be in a location further south as suggested by Aaron's paper. Questions to group: what sites of those are our options? We have time to figure that out. Does this require any movement of the existing two, or keep those two as we initially discussed as long terms deployments, does that change at all? Peter's talked about a reference array with higher vertical resolution. Where do you think that reference array needs to be? If segment/attainment delisting is the goal, would you put this some place else given these two are currently in the southern end of upper mid bay segment?
- Kevin: We'll come back to the group for on your consultation again. In terms of timing we have a while. We have a third array on order but don't want to put this third array out until we get a fourth backup since we always want to have one in reserve. So for third site, that's probably not until late this calendar year or next year. We want the expertise of this group to guide where that's going.

- Peter: Aaron had two locations. If we could get an account of what Aaron's suggestions are relative to where we are now and use that as a jump off point for consideration.
- Jay: The two-array optimal would be 4.2 and 5.1 which is down between Patuxent and Potomac. If you have a third, it's the north one, something above where the second would be and something down in VA. It spans the Bay; the minimum of two is deeper upper mid Bay.
- Jeremy: If the priority here is to be better at habitat, to put this in a place that prioritizes getting another estimate of hypoxia volume - I don't know if that's the most valuable metric to have versus putting in a place for new information, a place we have monitored in the past. Really helpful because they help us see across the lateral variability in the Bay which we haven't had in the past. Maybe if this is staying in the main Bay, going south makes sense. Those places are different, the channels are pretty deep and the shoals are different on either side. Prioritizing new information as opposed to another estimate of hypoxic volume seems more useful.
- Carl: My impression is this isn't so much hypoxic volume as it is attainment. The way attainment is calculated we don't have the information to know if it's right because attainment is based on one measurement every two weeks or month. This continual data will show if it's in attainment over the various timescales that are indicated in the attainment rules.
- Peter: What's been important to attainment is spatial distribution. How much volume is out there in bulk is one important measure. However, important to attainment is how well we know, over space and time, where the DO is (and is not). Don't know if the detail and resolution of that is where the attainment folks are in most of need of information. Would be great if we just needed to know overall volume but for the regulations as they are, it's important to understand the spatial detail.
- Carl: I hadn't thought the goal was just to have a better estimate of hypoxic volume, I thought it was to have a better estimate of the temporal variation of the oxygen field so you could evaluate attainment more accurately.
- Peter: That's well stated.
- Carl: Don't know if we want to say this investment is aimed at hypoxic volume; I'd say it's aimed at understanding attainment since that's what the Clean Water Act requires.
- Peter: Fisheries in general are interested in a refined look at spatial field in higher temporal resolution than what we have. I'm not working with those models but people are interested in that fine scale in terms of understanding the fish distributions relative to habitat conditions and its variability.
- Bruce Vogt: I think that's right. We're not always linking it to attainment. We're interested in multi species or single species thresholds and looking at how those thresholds are being met or not for species to develop habitat suitability maps. We are linking fishery survey data we have to spatial resolution of hypoxia measurements. Moving outside of those deeper channels and looking at important nursery habitat for fish in tributaries is where we're interested in going.

- Peter: Places like the lower Potomac, lower Rappahannock have been of significant interest but less understanding, is that higher priority than next mainstem work if we had to pick somewhere to start sooner?
- Jay: I'd ask can you target a species for the reasons that Bruce mentioned within a particular segment that works toward the delisting or attainment that Carl mentioned. From our investment in phase one, initial 3-4 sensors going out, we want them to be focused on a living resource issue while recognizing the value of all of the other things. I translated hypoxic volume to living resource. We want to consider as this year is still a pilot with longer duration to understand operational needs and work out kinks, we ultimately do want to move forward as quickly as we can on living resource focused deployments.
- Bruce: That's a good question. There's an area we could check the box. Main stem arrays providing better volume measurement. If there's another place we could address both living resource and attainment question together that would be of interest. Is there a place where we might want to have better measurements for striped bass in terms of spatial extent of hypoxia? Could we pair that place with investigating attainment or delisting questions?
- Marjy: Going back to the original goals, when we were talking about this, it came from Aaron's paper that pointed out we could get this volume of poor habitat that came largely from fisheries based on these two stations and we needed one in the north and one in the south. Maybe we don't want to look at the volume and want to shift it. I think the volume of hypoxic water is critical for fisheries.
    - Marjy showed a study her student Ike Irby did where if the TMDLs were met where they would have attainment and where they would not. One model was the Bay program's model and the other was a different model. There were some places where the models disagreed. One of those places is the central location at the end of the Potomac. One model says we will be in attainment with TMDLs and the other one says we won't. Seems like it would be a good idea to get a better understanding of that particular segments. Whereas with other segments we know with more certainty that we will or we won't be in attainment.
- Peter: We have a couple reasons the more southern location in the Bay would be good. To follow through with original inspiration, building out the network. When we have confirmation there are others coming online, might be a matter of recognizing 2-3 years down the line the system might expand to 6-7-8-9-10 sensors strong. That's a good reason to prioritize the next two sites of what would be most helpful.
- Jay: We won't get this third sensor until sometime this summer and when and where it gets deployed is to be determined. More importantly the two that are going out are going out based on recommendations from last year to continue in these two locations. As much as it can facilitate understanding of longitudinal variation in this area it's great. Still a pilot, relatively easy to get in and out of. Once we get it up and running we'll be looking to this group to guide what that priority is. These are the right conversations to

have and should continue when it's time to move them into their more permanent location.

- Peter: From the 4-D interpolator perspective it won't hurt if that place off the Potomac is chosen. Any additional information will be informative and if it's complementary to what's already deemed valuable to help with fish habitat understanding, there is reason to be looking there as a high value site but also consider other sites.
- Jay: If our initial contributions could be considered a backbone to other components we're looking at whether that's Potomac or Rappahannock or mobile arrays complementing shallow water work in this area, so long as it maintains living resource connection that's something we want to consider as an option.

Adjourn