Chesapeake Bay Program
Science. Restoration. Partnership.

Integrated Trends Analysis Team (ITAT)

Wednesday, April 23rd, 2025

10:00 AM – 11:30 AM

Meeting Materials: Link

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

MINUTES

10:00 – 10:05 AM *Welcome – Breck Sullivan (U.S. Geological Survey, USGS) and Kaylyn Gootman (Environmental Protection Agency, EPA)*

Announcements:

- Choose Clean Water Conference, May 19th-21st, 2025. Harrisonburg, VA. ***Registration is now open!***
- Coastal & Estuarine Research Federation (CERF) 28th Biennial Conference, November 9-13th, 2025. Richmond, VA. ***Call for Abstracts – due April 28th.***
- ITAT Webinar: Tributary Summaries – Gabriel Duran, Kaylyn Gootman & Breck Sullivan. ***Thursday, May 29th, 12-1 PM.***

10:05 – 10:30 AM *Tributary Summary and Story Map – Lower Eastern Shore*

Presenter(s): *Eva Smith (Franklin & Marshall College, F&M)*

Description: Eva Smith, ITAT intern for the Spring 2025 Semester, spent her time developing and drafting the Lower Eastern Shore Tributary Summary and Story Map. She will present her work this past semester.

Eva Smith: F&M has a unique community partnership program called "F&M Works". It runs each fall and spring and allows students to intern with nonprofits and other organizations in Lancaster and the broader East Coast. There's an application and interview process, and if selected, students are matched with a partner organization of interest. We work 10 hours per week and meet regularly as a cohort to reflect on our experiences. I've completed the program twice. Last spring, I interned with the City of Lancaster on GIS mapping and sustainable transportation, and this semester I've been interning with ITAT at the Chesapeake Bay Program.

My work has focused on story maps and the Lower Eastern Shore tributary summaries. Specifically, I've been updating the Lower Eastern Shore tributary summary to reflect 2023 data. This involved reaching out to partners for updated figures, drafting descriptive language, and updating the story map using GIS. The story maps are a great way to make the data more accessible and interactive. First, I updated the map to focus on the Lower Eastern Shore and added charts and graphs to help explain which regions are included. I also included maps showing land use boundaries and water features in the area. One of my favorite parts of the story maps is how they include interactive videos and background information to help community members better understand water quality beyond just the figures.

Most of my work focused on the long-term water quality parameters. I updated the maps with data from 1985 to 2023, as well as a short-term comparison from 2014 to 2023. I categorized each monitoring station as significantly improving, possibly improving, showing an unlikely trend, possibly degrading, or significantly degrading. These categories are interactive—clicking a station shows the percentage change and station name. For total nitrogen in the long term, most stations are improving, with a few showing unlikely trends. For total phosphorus, the pattern is similar, with most stations improving and a few outliers. For spring surface chlorophyll, the trends are more mixed, with some stations degrading and others showing no clear trend. Summer chlorophyll also had many degrading trends, with only one possibly improving. In the short term (2014–2023), the patterns for total nitrogen remain generally improving, while total phosphorus shows more stations with unlikely or degrading trends. For spring chlorophyll, the trends are more balanced than the long-term data, while summer chlorophyll remains largely degrading. I also updated the graphs on nutrient and sediment loads and pollutant sources, showing how they've changed from 1985 to 2023. One notable shift was in phosphorus sources from 2009 to 2023. Overall, sediment, nitrogen, and phosphorus trends remained relatively consistent in terms of their primary sources.

Finally, I updated the "For the Community" section by contacting the Wicomico Environmental Trust, who provided literature to feature. This section highlights local environmental groups and their sustainability efforts in the Lower Eastern Shore. Links to their websites are included to encourage community involvement.

10:30 - 11:00 AM *Chesapeake Water Watch: Putting Eyes in the Skies and Feet on the Ground.*

Presenter(s): *Rachel Terracina and Tara Sill (Smithsonian Environmental Research Center, SERC)*

Description: *The Smithsonian Environmental Research Center's (SERC) Chesapeake Water Watch (CWW) is a participatory science project that aims to improve remote sensing water-quality monitoring across the Chesapeake Bay. To make this possible, the team has developed methods that allow for more accessible data collection, opening water quality monitoring to a whole new group of people. Project Manager, Ray Terracina, will discuss the methodology that enables volunteers to collect data from a wide geographical region and how we have validated these methods.*

Rachel Terracina: We are a relatively young project. We started back in 2021 where our main goal is perfecting data collection methods, though we weren't designed to produce long-term trends. That said, we do have some trend data to share today. Most importantly, I'll be highlighting one of our key collaborative projects around the Bay.

Chesapeake Water Watch is a participatory science project, or citizen science. At the core, three organizations make this possible: the Smithsonian Environmental Research Center (SERC), the City University of New York (CUNY) and NASA's Citizen Science for Earth Systems Program, which fully funds us. SERC and CUNY are small teams of about four people each, and we cover a vast area with the help of satellite data and volunteer partnerships across the Bay. We collaborate with a wide range of partners, like community colleges, environmental justice organizations, riverkeepers, and others. This diversity is essential because the Chesapeake Bay is enormous and challenging to monitor due to its constant changes from blooms, pollution, sedimentation, and weather.

To address this, we use remote sensing to provide a comprehensive, top-down view of the Bay. This complements the on-the-ground monitoring done by riverkeepers. However, satellite sensors designed for open ocean environments don't work well in the Bay's dynamic estuarine system. That's why our project has two goals: 1) train satellites to accurately monitor the Bay using trusted ground-based data, and 2) develop accessible, low-cost methods for volunteers to monitor water quality.

If our model proves successful, we aim to apply it to other coastal regions and countries with fewer resources. Currently, we use Landsat 9 (NASA/USGS), Sentinel 2 (ESA), and OLCI (European Space Agency). Landsat and Sentinel offer high-resolution images every 5–8 days, while OLCI provides daily lower-resolution imagery.

The satellite images require processing through algorithms to produce interpretable data. For instance, we generate turbidity maps showing clearer or murkier areas based on color gradients. Our algorithms are still being refined and focus on three key metrics: chlorophyll-a, colored dissolved organic matter (CDOM), and turbidity.

To collect matching ground data, volunteers use one of two methods. The first involves taking a water sample, which is tested using two machines: a turbidimeter (for turbidity) and an Aquafluor (for chlorophyll-a and CDOM). This process takes about 10 minutes and is accessible to trained volunteers or via drop-off sites. However, the equipment is expensive (~$6,000) making it inaccessible to many individuals.

To address this, we use HydroColor, a smartphone app that estimates turbidity through photographs of a gray card, the water, and the sky. The app is free, but volunteers must purchase a $10 gray card. Despite this cost being significantly lower than lab equipment, it can still be a barrier. We try to provide cards when possible.

The data collected, whether via sampling or HydroColor, is uploaded to FieldScope, our open-access online database. Volunteers retain ownership of their data, but they agree to share it publicly. FieldScope is also used by our satellite calibration team and is available to organizations like Riverkeepers.

HydroColor has one limitation: it doesn't work well in shallow waters where the bottom is visible, because it relies on light backscatter to estimate turbidity. This limitation means we encourage volunteers to collect data from piers or boats. We've validated our methods extensively. For chlorophyll-a, we compared Aquafluor readings with EPA Method 445. For

CDOM, we used absorbance measurements via spectrophotometry. For turbidity, we compared HydroColor readings with turbidimeter results and checked against total suspended solids.

Our data show strong agreement between field and lab results. For chlorophyll and CDOM, the correlation is tight with low relative error. With turbidity, we noticed a secondary trend in some HydroColor readings—possibly due to shallow sites or seasonal changes—which we're still investigating. Despite this anomaly, the error margin remains within an acceptable range (±4 NTU), so we consider HydroColor valid but continue to test with scientific rigor. While our data can potentially be used for long-term trend analysis, that is not our primary purpose. We are entering only our fourth year, and our project was not established for that use. However, if others want to use our data or replicate our methods, we fully welcome that.

That said, we are an inquisitive team and have started exploring other relationships within the Bay. Internally, we refer to these as "side quests." For example, we're investigating whether surface turbidity correlates with light attenuation and if there's a link to bacterial levels—something that could be useful for public health monitoring. These are exploratory efforts, and no conclusions have been drawn yet.

Lastly, for anyone interested, our data is fully open-access and free. You can find it by going to FieldScope and searching for Chesapeake Water Watch. We're one of the few SERC projects on the platform. As of yesterday, we had 3,687 data points available. We encourage everyone to explore and make use of this resource. To conclude, Chesapeake Water Watch is focused on developing scalable, accessible water quality monitoring methods that integrate satellite and ground-based data.

Discussion:

Comment: *Carl Friedrichs:* Turbidity defined in the Chesapeake Bay Program monitoring is in FTUs and not NTUs. Second, under Scientific, Technical Assessment and Reporting (STAR) there is a participatory science program too. I was wondering if there's potential for overlap or confusion between your effort and other Bay-wide participatory science programs. Were you aware of the Chesapeake Monitoring Cooperative (CMC) Data Explorer and their efforts before launching your own site for participatory science data?

- ***A:*** *Rachel Terracina:* Yes, we were aware of the CMC and have been in contact with them. I joined midway through the project last year, so I wasn't part of the early conversations. As I understand it, CMC was supportive of our efforts and indicated interest in data sharing once our methods were validated. We're using FieldScope primarily as a platform for data delivery, allowing others to use the data for monitoring and analysis. The Smithsonian doesn't interpret those results at this point. Our methods were initially different from CMC's, and we didn't want to introduce inconsistencies. But now that we have a validated paper, we're working on combining data to avoid conflicting reports. From the CMC perspective, we're actively discussing how to streamline these participatory science data resources.

We've spoken with CRC and others at CMC. Initially, their protocols differed too much from ours to merge data cleanly. But now we're exploring ways to leverage what each of us offers. Hosting both datasets on the same platform like the CMC Data Explorer might be feasible long-term. One idea I discussed this week with others at CBP is creating a Bay-wide participatory science symposium open to the public. We need a forum for collaboration and sharing resources. That's a dream of mine for the next year or two.

We're already working with SAV Watchers to train volunteers on HydroColor. Hopefully, this leads to more turbidity data. Now that our methods are validated, I think more organizations will adopt them, especially if they're recognized by CMC. There's a robust data-tiering framework we could integrate with, which aligns with how Virginia Department of Environmental Quality (VADEQ) handles regulatory decision-making. There's definitely a place for our turbidity data to be hosted alongside CMC datasets.

Q from chat: *Elgin Perry:* Would it be feasible to develop an app for turbidity based on using a photograph of water in a transparent cell?

- ***A:*** *Rachel Terracina:* That concept could be the next evolution of the turbidimeter—a device that does it all in one. The challenge is cost: commercial turbidimeters are around $1,200, which many people, even those doing local monitoring, don't want to spend. So yes, I do feel like your idea could work. Maybe it's less of an app and more of an integrated tool, but we'd need a bigger push to make it happen. There are a lot of variables to control for, like lighting and angle. Even with HydroColor, our volunteers must position it very specifically so the sunlight hits correctly. Adding an external light that volunteers control would introduce more bias. I'm not a developer, but I think it's feasible, it would just be a lot of work.
- ***Comment:*** *Carl Friedrichs:* There's a little-used but useful method for shallow water situations called a horizontal Secchi. It uses a prism in the device, which is placed in the water. You look through the prism to view the Secchi disk from the side. These devices aren't commonly made, but if someone were to manufacture them, they wouldn't be too expensive. They're a bit bulky since you can't rely on gravity to lower them like traditional Secchi disks. But they provide valid measurements in shallow water where normal Secchi disks hit the bottom before giving a reading. It's a simple and reliable method, especially when the water is turbid enough. Because of exponential decay, you can't get it too wrong, and it's widely used and understood. In terms of inexpensive methods that don't require a phone, this is probably one of the best.
- ***Response:*** *Elgin Perry:* turbidity meter from Zoro.
- ***Response:*** *Rachel Terracina:* I wasn't part of the team when the current turbidimeter was selected, but we knew we wanted something that could measure in NTUs. That could have influenced our choice. I'm not speaking negatively about other options out there, it's just that for physical sample collection, the context matters. Currently, our drop-off sites are listed on the website with addresses, but we don't provide a

map. That's intentional because our partners have changing schedules. We have set hours at four permanent locations, but during collection events, we open around seven or eight additional sites. We keep it vague to avoid confusion about which sites are always available.

11:00 - 11:30 AM *Outcome Review Update*

Presenter(s): *Breck Sullivan (USGS)*

<u>Description</u>: The 2014 Watershed Agreement is being revised. This includes an update to the Water Quality Standards Attainment and Monitoring Outcome which is supported by ITAT. STAR Leadership has been working on refining and drafting the Outcome language for submission to the Management Board meeting for its consideration on April 25th, alongside the development of a logic model to facilitate our thinking of the new Outcome language. ITAT and other STAR WGs have received emails requesting feedback on the drafted language. Breck will provide an overview of the feedback received and updated draft outcome language.

Breck Sullivan: The Chesapeake Bay Watershed Agreement is currently undergoing revision, with ten goals and thirty-one outcomes under review. ITAT plays a key role in supporting the Water Quality Standards Attainment and Monitoring (WQSAM) outcome through Bay-wide trend analyses, tributary summaries, and collaborative research that enhances understanding of water quality patterns. These efforts contribute to a broader goal of sharing information to support informed decisions about estuarine health.

The current outcome language emphasizes monitoring and annual reporting, but it lacks clarity and does not explicitly reflect the ultimate goal of achieving water quality standards. In response, the Management Board (MB) approved an update that better communicates the desired endpoint of attainment of water quality standards, while incorporating both tidal and non-tidal monitoring. The MB also encouraged consideration of a broader range of parameters beyond those in the Bay Total Maximum Daily Load (TMDL), using existing tools rather than creating new monitoring networks.

Although there was a recommendation to combine the WQSAM and Watershed Implementation Plan (WIP) outcomes, the MB preferred keeping them separate. To improve outcome structure, it was decided that outcomes should now include a general summary followed by SMART (specific, measurable, achievable, realistic, and time-bound) objectives. The revised structure integrates what were formerly separated outcomes and outputs, offering more cohesive guidance.

Survey feedback from ITAT and STAR workgroups informed this process. Respondents generally supported the inclusion of parameters like temperature, salinity, plastics, and PFAS, and highlighted the importance of modeling and emerging technologies such as AI. However, concerns were raised about the use of aspirational terms like "full attainment," which may not be realistic across all segments. Suggestions included clarifying vague language, avoiding redundancy with the WIP outcome, and better organizing outputs by themes.

Ultimately, five key perspectives emerged from stakeholder feedback: focus on monitoring capacity, caution around overlapping with WIP language, support for tidal and non-tidal inclusion, preference for goal-style language, and interest in expanding beyond TMDL. Many of these insights aligned with MB expectations. Moving forward, the outcomes will remain separate but may share a SMART bullet to demonstrate alignment.

11:30 AM Adjourn

Next Meeting: Wednesday May 28th, 2025, from 10 AM – 12 PM

Attendees:

Eva Smith (F&M), Gabriel Duran (CRC), Allison Welch (CRC), Breck Sullivan (USGS), Jon Harcum (TetraTech), Rebecca Murphy (UMCES), Roger Stewart (VADEQ), Gregory Noe (USGS), Andrew Keppel (MDDNR), Amanda Shaver (VADEQ), Helen Golimowski (Devereux Consulting), Anthony Timpano (VADEQ), Renee Karrh (MDDNR), George Onyullo (DOEE), Qian Zhang (UMCES), Mukhtar Ibrahim (MWCOG), Carl Friedrichs (VIMS), Rachel Terracina (SERC), Claire Buchanan (ICPRB), Stephanie Nummer (ICPRB), Efeturi Oghenekaro (DOEE), Blessing Edje (DOEE), Elgin Perry (CBPO), Carol Cain (MDDNR), Kaylyn Gootman (EPA), Cynthia Johnson (VADEQ).