Discussion Paper: Enhancing Monitoring to Address the CBP Toxic Contaminant Outcomes

Updated Dec 20, 2021

Purpose: The Chesapeake Bay Program Principal Staff Committee (PSC) requested information to enhance the Chesapeake Bay Program (CBP) monitoring networks. While the request is focused on the existing CBP networks, information is being included on monitoring needs of selected outcomes in the Chesapeake Bay Watershed Agreement.

This paper summarizes potential enhanced monitoring to address the Toxic Contaminant Outcomes in the Chesapeake Bay Watershed Agreement. The goal and outcomes were developed because of the widespread occurrence of toxic contaminants in the Bay and its watershed (EPA, 2012). In tidal waters, the impairments from toxic contaminants increased between 2010 and 2016 (Fig. 1).

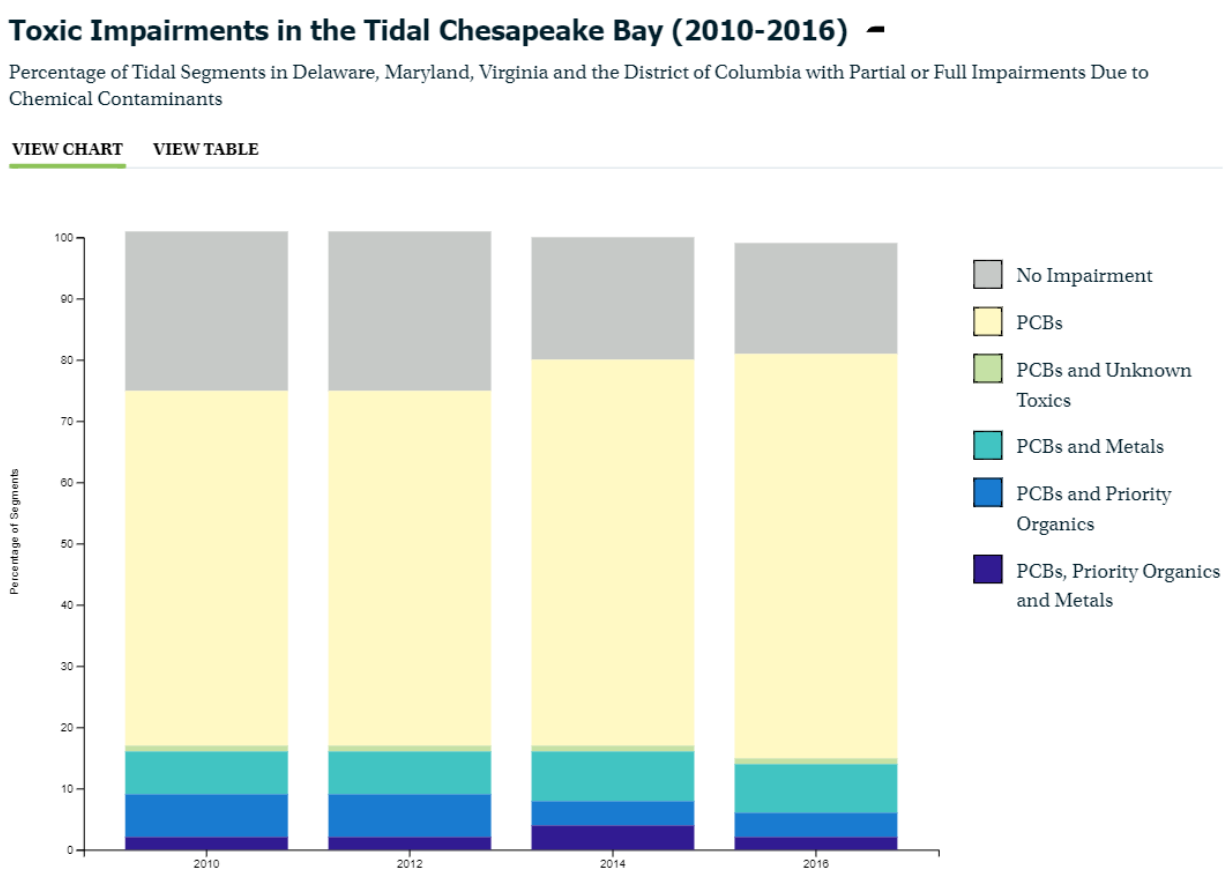

Figure 1 (from Chesapeake Progress) Toxic Impairments in the Tidal Chesapeake Bay (2010-2016) (PCBs, polychlorinated biphenyls)

Organization of the Discussion Paper

The Toxic Contaminant Workgroup (TCW) developed this paper based on the information requested by the CBP Science and Technical Assessment and Reporting (STAR) team, which included:

- *Need for enhanced monitoring*: how would the monitoring address CBP goals and outcomes. (explained further in section 1)
- *Objectives of enhanced monitoring*: The outcomes would be used to define monitoring objectives and priorities. (explained further in section 2)
- *Existing monitoring:* Assess monitoring that can be utilized to address the objectives and design considerations. (explained further in section 3)
- *Remaining gaps*: identify gaps that cannot be filled with existing monitoring. (explained further in section 4)
- *Monitoring design considerations and options*: These are general considerations for enhanced monitoring, not the design of a monitoring network, which would be a follow-up action if more funding became available. Identify options to address the gaps and recommend which may be most realistic. An estimate of funding needed to address the recommendations would be useful. (explained further in section 5)

The TCW undertook the effort during the summer and fall of 2021 and used these guiding principles for the discussions:

- A monitoring network for a wide range of contaminants would be extremely difficult and costly, so we need to prioritize the contaminant(s) to be addressed. For example, PCBs and mercury are listed in our outcomes so they could be a high priority.
- The monitoring objectives need to be specific to help focus the design considerations including the types of monitoring for different media.
- We need to take advantage of ongoing monitoring as a foundation for a network.

Section 1: Need for Enhanced Monitoring

The TCW reviewed the two toxic contaminant outcomes in the Chesapeake Bay Agreement to identify items related to monitoring. The outcomes are:

<u>Policy and Prevention Outcome:</u>

"Continually improve practices and controls that reduce and prevent the effects of toxic contaminants below levels that harm aquatic systems and humans. Build on existing programs to reduce the amount and effects of PCBs in the Bay and watershed. Use research findings to evaluate the implementation of additional policies, programs and practices for other contaminants that need to be further reduced or eliminated".

Research Outcome:
"Continually increase our understanding of the impacts and mitigation options for toxic contaminants. Develop a research agenda and further characterize the occurrence, concentrations, sources and effects of mercury, PCBs, and other contaminants of emerging and widespread concern. In addition, identify which best management practices might provide multiple benefits of reducing nutrient and sediment pollution as well as toxic contaminants in waterways"

The TCW identified four monitoring needs associated with the two outcomes:

- Changes in PCBs levels as total maximum daily loads (TMDLs) and associated management actions are implemented.
- Changes in mercury as TMDLs and associated management actions are implemented.
- Assessing contaminants of widespread concern (such as pesticides).
- Assessing contaminants of emerging concern (such as per and polyfluoroalkyl substances [PFAS] and microplastics).

These four needs were prioritized by the TCW as follows:

- Highest: Changes in PCB levels due to management actions; Assessing contaminants of emerging concern (focus on PFAS and microplastics)
- Middle: Assessing contaminants of known widespread concern (specifically, pesticides)

Lowest: Changes in mercury levels due to management actions

Section 2: Monitoring Objectives

The TCW developed an initial objective for each monitoring need:

- Enhance PCB monitoring to establish current conditions and determine if remediation or management actions are resulting in downstream reductions of PCBs.
- Determine occurrence or status of PFAS and microplastics in surface waters of the major tributaries of the Chesapeake Bay. Establish monitoring in different types of land use to establish baseline conditions to track concentration and loading changes through time using consistent methods and analyses.
- Determine if implementation of BMPs and conservation practices over time results in declines in pesticide concentrations using a prioritized/standardized list of pesticides, and consistent sampling and analytical methods.
- Determine if reductions in air deposition of mercury are reflected in fish tissue declines, with a focus on species important for recreation and human consumption.

The TCW decided to focus efforts on the first objective for PCBs since it was one of highest priority needs. The other high priority need for emerging contaminants is being addressed through other efforts including (1) a CBP plastic pollution action team (monitoring for microplastics), and (2) an upcoming STAC workshop with a focus on PFAS monitoring.

The PCB objective was expanded to have multi-pronged approach with several inter-related components (Figure 2): *"Enhance PCB monitoring to (1) assess current conditions and identify impairments, (2) better define sources to focus mitigation efforts, (3) characterize PCB response to mitigation efforts and (4) evaluate fish conditions in relation to consumption thresholds.*

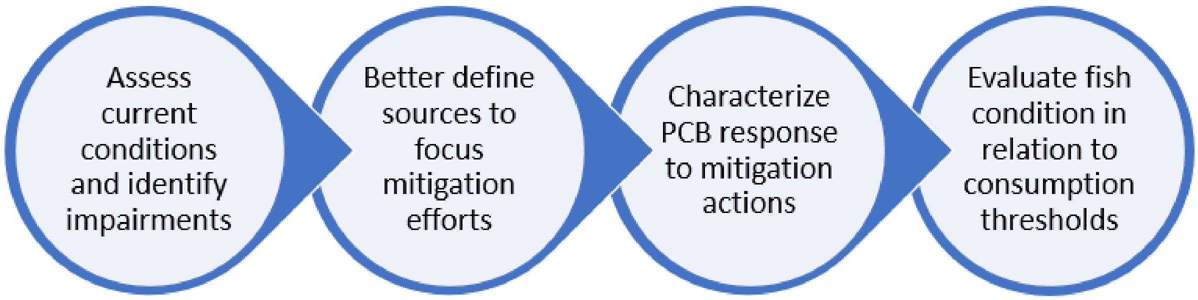

Figure 2: Components of the PCB monitoring objective.

Section 3: Existing Monitoring that Supports the PCB Objective

A data inventory for PCBs was conducted by USGS and additional information was requested from each jurisdiction and federal partners related to the components of the PCB monitoring objective. Some of the findings are summarized below and are presented in accordance with Figure 2 topics (shown in underlined italics in the paragraphs below).

<u>*Assess current conditions to identify impairments*</u>*:* Fish Tissue monitoring is done by all the jurisictions to assess current conditions and to track progress for fish consumption advisories. Sampling is usually done on a rotational basis to cover an entire jurisdction every several years. These results are used to establish baseline conditions and identify impaired waters in each state (Figure 3a), that is updated every two years, and development of local TMDLs to address the impairments (Figure 3b). In selected places with impairments, additional sampling is often conducted to help develop and implement a local TMDL.

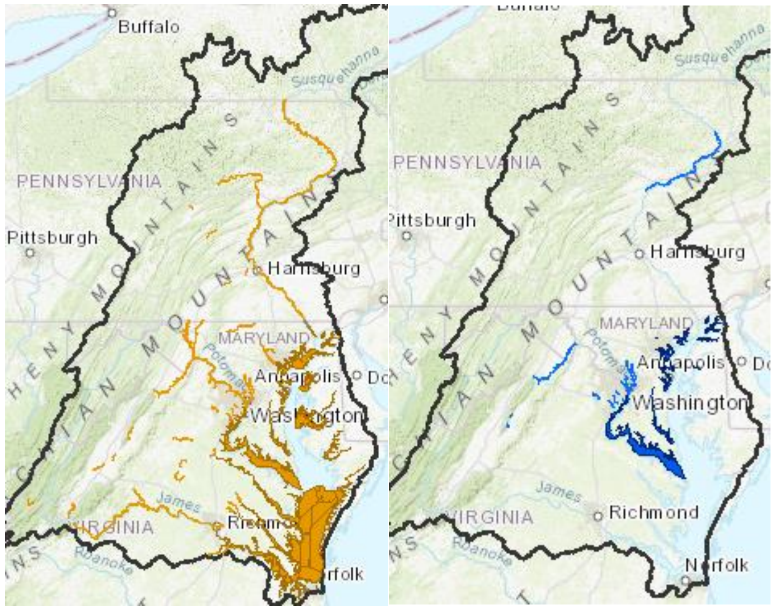

Figure 3a (left panel)—impaired waters based on PCBs, 3b (right panel)—TMDLs developed as of 2017.

__Better define PCB sources to focus mitigation efforts__: If a PCB TMDL is developed to address an impairment, “track-back studies” are often employed to better define the sources of PCBs to better focus mitigation efforts. The number of current track-back studies vary by jurisdiction. For example, MD has a strong focus on track-back studies in selected places where TMDLs have been approved and DC is conducting source studies in the Anacostia watershed. VA currently has a significant focus on TMDL development and has in some instances (such as the Potomac TMDL) identified loads associated with unknown sources that necessitate track-back studies, but these are just getting underway. No additional monitoring for PCBSs is planned at this time in PA.

__Characterize PCB response to migitation actions.__ In general, there is very limited monitoring for this component of the monitoring objective, particularly at a scale of interest to the CBP (i.e., broader than a single contaminated site). The primary reason is there are limited management actions being implemented for PCBs reductions at this time across the watershed.

Some additional considerations discussed by the TCW about this portion of the monitoring objective (PCB response to mitigation actions) included:

(1) a regional approach to detecting changes in PCBs is not practical for the entire Bay watershed.

(2) a more geographically targeted approach that focuses on areas where actions are being implemented or planned to address a local TMDL (including gray infrastructure improvements.

__Evaluate fish conditions in relation to consumption thresholds:__ Monitoring of PCBs in fish is usually done across a state through rotational sampling as part of their impaired waters identification and fish consumption advisories. Each jurisdiction uses a PCB threshold level (which varies between jurisdictions) to issue fish consumption advisories. In addition, TMDLs are based on the fish condition in the estuary, with sediment and surface water targets based on the bioaccumulation modeling and criteria to meet the fishing designated use for the waterway. While the criteria may differ between states, all approved TMDLs in the Chesapeake Bay watershed are based on the fishable designated use in the tidal estuary.

Section 4: Remaining Gaps to Address the PCB Objective

With the current monitoring programs focused on assessing impaired waters and condition of fish, *the primary remaining gap is addressing PCBs response to mitigation efforts.*

A synthesis of feedback from TCW contributing to the formation of gaps:

- Jurisdictions and federal agencies reported limited monitoring that directly assess changes in PCBs due to mitigation actions. Aside from limited assessments in DE and by District of Columbia Department of Energy and Environment (DOEE) in Anacostia, there are gaps in assessing PCB reductions from mitigation actions in places where TMDLs have been established or are planned.
- The PCB data for fish are more robust than surface water in terms of frequency and consistency of collection. A focus on fish data and sampling would provide more opportunities for leveraging existing monitoring efforts and in some cases a comparison to historical data but may take longer to detect the reduction in PCB concentrations.
- Lab methods for fish analyses differ across the jurisdictions. DE and D.C. are using EPA method 1668A for their fish analysis, which provides an ability to produce more detailed PCB "fingerprints" and low detection limits for PCB, which could be very helpful for assessing response. MD and VA use a modified EPA method 8082, which provides similar detection limits to method 1668A and quantifies about 140 of the 209 critical congeners. PA did not specify an analytical method. Historical data with differing methods are not comparable among jurisdictions.
- Methods to collect and analyze surface water samples also vary among jurisdictions and federal agencies (including both EPA methods 1668A and modified 8082). Types of field sample collection include both grab samples and use of passive polyethylene samplers. The lab methods and their detection limits are not consistent and would require the establishment of more comparable approaches among agencies.
- The number of monitoring stations are lacking in many places to detect a PCB response to mitigation efforts. The sampling locations near local TMDLs are limited both in number and frequency of samples are collected. Many non-tidal sites lack streamflow gages for calculation of PCB loads. Temporal and spatial variability in surface water is high and would require a considerable quantity of samples to establish a representative condition in surface water.

- Limited numbers of samples in sediment and other media (e.g., shellfish) exist in more spatially limited locations of the watershed.

Section 5: Monitoring Design Considerations and Options

The TCW brainstormed various approaches and their advantages and disadvantages to fill the primary gap described in Section 4. These approaches included (1) targeted head of tide sampling in surface water (similar to the proposed sampling program described by Delaware Natural Resources Environmental Control) to detect changes in either ambient contaminant concentrations or loads (with corresponding co-located flow information), (2) targeted fish species and analyses, or (3) a hybrid approach including various media. Each approach has distinct advantages and disadvantages that may differ between geographic areas depending on the conditions downstream (tidal, non-tidal, known flow rates, etc.), the desired observable response, or desired timeframe for response.

The TCW endorsed an overall approach for enhanced monitoring to help jurisdictions assess the PCB response to mitigation actions in selected geographic areas. If endorsed by the PSC, enhanced monitoring site selection would occur through the TCW according to steps in Figure 4. The primary recommendations for this monitoring design are summarized below.

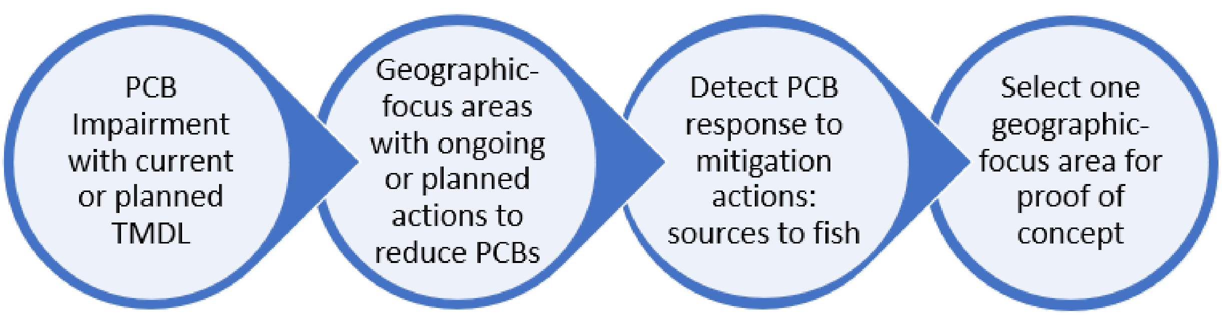

Figure 4. Components of Sampling Design

Recommendation 1: Focus monitoring in geographic focus-areas to help the jurisdictions assess PCB response where mitigation actions are being implemented or planned.

With enhanced monitoring, the jurisdictions working with the CBP, can tailor data collection in geographic focus-areas to help assess PCB response in places where mitigation actions are being implemented or planned for local TMDLs. Due to the variability discussed above, jurisdictions suggested providing some flexibility in the geographic focus-areas to allow for the consideration of variable ongoing or historical monitoring and specific activities in their respective locations. In general, the conceptual design would fill a gap that existing monitoring doesn't address, which could include adding monitoring sites to detect PCB response (Figure 4).

Recommendation 2: Have a monitoring design so PCB reductions resulting from mitigation actions can be detected.

Within a geographic focus-area, there should be a design so the PCB response to management actions can be detected. These areas would need to have enough action/mitigation for collective, predicted reductions of greater than 25% (or a more appropriate reduction later specified) in concentration and/or loading. Monitoring of these areas will fill the gaps associated with *addressing* <u>*PCBs response to mitigation efforts*</u> and help to answer the following questions:

- At what spatial scale can a response (PCB decline) be observed downstream of actions?
- At what timescale can a response (PCB decline) be observed downstream of actions?
- Are there observable differences in the mitigation actions taken and the resulting PCB response?

The monitoring design would need to:

- Have a "source to receptor" approach to detect if mitigation actions are reducing PCBs near the sources, along their transport pathways, and in fisheries (the primary receptors). The design could involve having several sample sites, with one site near the source-reduction activity, while the additional sites would be downstream but in close enough proximity to detect PCB changes.
    - For example, in an area such as the Anacostia River, there could be sampling sites distributed near the remediation activities in a subbasin, and sites further downstream to detect PCB reductions in water or fish.
- Detect a change in PCBs over time. The design could consider having observations over time to graphically illustrate a change, like the indicator representation. This design would require less frequent sample collection compared to a statical assessment to detect change.
- Each geographic focus-area will be individually assessed for appropriate media to be sampled, with a similar approach across media for different areas depending on conditions present in each area.
- Be opportunistic with ongoing monitoring efforts to supplement jurisdiction efforts.
- Emphasize field and analytical methods for low-level detection of PCBs.

Further considerations for set of sample sites in the geographic focus-area include media to be sampled and at what frequency, which include:

- Be focused on sampling fish or shellfish (as indicator) or surface water and the uniformity of field and analytical methods for low-level detection of PCBs.

- Each site would be sampled at a frequency that will detect a change over time, after establishment of a baseline sampling event. Options for different frequency and media include:
  - Sampling fish (or shellfish) every 1-2 years. Consideration should be given to young of the year collection at this time interval. For larger game fish, longer times may be required to observe a change (lesser frequency may be adequate).
  - Time-integrated surface-water samples every quarter to estimate annual variability for a specified timeframe, then possibly less frequent (biannual at times of highest noted variability). If variability in flow conditions (e.g., storm events) was to be considered, baseline costs would need to be updated. Current cost estimates assume passive sampling of the water column.
  - At this time, bulk sediment sampling as a stand-alone media is not being considered due to the inability to assess bioavailability of mass detected. Other considerations for sediment assessment include passive sampling of sediment porewater, which can assess bioavailability and inform sediment concentrations and passive sediment traps in non-tidal environments. (Current cost estimates do not include these alternate sediment considerations, are but noted here for consideration).

Recommendation 3: Initiate monitoring in a single geographic-focus area.

The TCW proposed to start in one geographic-focus area as a proof-of-concept. The initial monitoring in one area will help better understand the amount of PCB reduction required to detect a response, timeframe to detect a response, proximity to collection actions to detect a response in surface water, fish, or other designated media, we propose initiating monitoring in a single geographic-focus area as a pilot test. Lessons learned from this proof-of-concept could be translated to other geographic focus-areas.

Possible options for geographic focus-areas were identified by the TCW and reflect efforts to implement TMDLs and clean-up activities and WWTP upgrades (listed below). One consideration could be to align with the EPA-designated Urban Waters Federal Partnership locations in the watershed, including Patapsco and Anacostia.

Jurisdiction	**Potential Geographic-Focus Areas Identified by the Jurisdictions**
DC	Anacostia
MD	Tidal Patapsco River (Baltimore Harbor/Curtis Bay/Middle Branch), Anacostia tributaries (e.g., Lower Beaverdam Creek)
VA	Potomac tributaries at head of tide
DE	Nanticoke River

Estimated Costs

Given the site-specific nature of ongoing work and variability in geographic focus-areas already highlighted, it is possible that a hybrid approach may be adopted with mixed media sampling.

The following general cost estimates are provided by media for a geographic focus-area with a minimum of three new sites (using 2021 costs):

- For a focus on fish or shellfish sampling, the estimated cost of a single sample site would be approximately $22,000, for a total of $66,000 for three sites, sampled once. This cost includes analysis of 10 individual samples at each sample site with time for sample collection, processing, and analysis. Fish composites, instead of individual samples, could be considered to provide a representative sample and added cost-savings with loss of statistical power and should be considered depending on data use.
- For a focus on water samples collected quarterly at a sampling site, the estimate would be approximately $70,000 for one year. Assuming a minimum of three sites in a geographic focus-area, the annual cost would be $210,000. This assumes that there is not an existing streamflow gage for estimated loads, and this would have to be constructed and installed, and that passive, time integrated sampling methods would be employed.
- For one geographic-focus area (with a minimum of three new sites) the estimated annual cost would range from $66,000 for fish sampling to $210,000 for surface-water sampling.