Draft Outline May 31, 2019

# Summary of Jurisdictional Efforts to Monitor and Manage Mercury in the Chesapeake Watershed

## Introduction

CBP plans to address mercury: take from the TCW research strategy P 18

Mercury: For the revised Management Strategy, efforts will be made to improve the understanding of baseline conditions by compiling information on the extent of mercury impairments across the watershed. The jurisdictions will work through the TCW to display the information on story maps similar to those prepared for PCBs. The TCW will also work with jurisdictions to inventory mercury data and assess if information exists to document changes in mercury in response to air controls. The results will be used to help jurisdictions consider if additional efforts are needed to reduce the impacts of mercury.

Purpose of paper: summary discussions from TCW calls during April-May, 2019, which included:

* Status of impairments due to mercury in the Chesapeake watershed
* Status of TMDLs and management addressed to address mercury
* Summary of jurisdictional monitoring efforts for mercury
* Overview of current understanding of mercury baseline conditions
* Implications for management approaches

## Status of impairments due to mercury in the Chesapeake watershed

* Present and describe the map of impairments that has been compiled based on information provided by jurisdictions
  + List impaired waterbodies in each jurisdiction (and if possible, date of listing and impaired use, e.g fishing)

## Status of TMDLs and management addressed to address mercury

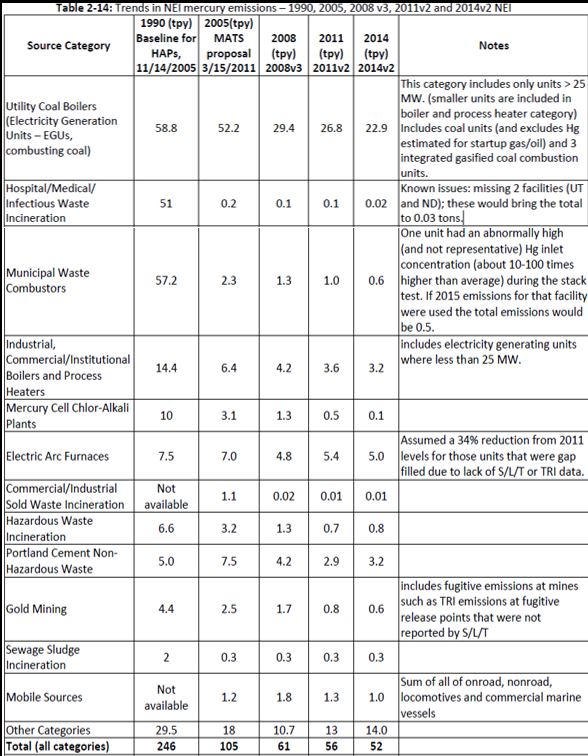
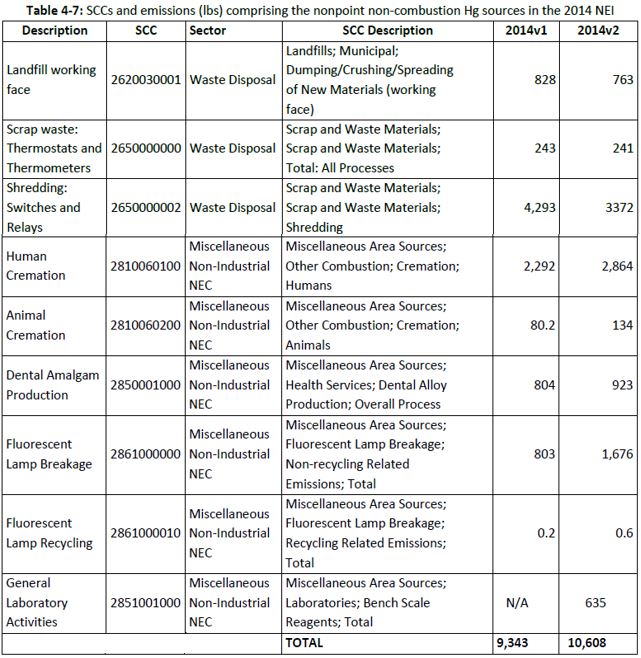
* Present and describe the map of TMDLs that has been compiled based on information provided by jurisdictions
  + List TMDLs published in each jurisdiction (and date of publication, if possible)
* Present and describe the map of impairments with no published TMDLs
  + List impaired waterbodies with no TMDLs in each jurisdiction
* Present and describe map of segments that have been delisted, reason, and date if possible (all delistings are in MD)
* Summarize that primary management approach is to reduce air emissions of mercury, which is assumed to reduce amounts in environment and fish—where direct sources of Hg are unknown and assumed to be from multiple air sources (as opposed to direct sources from contaminated sites—e.g DuPont site in Shenandoah).

## Summary of jurisdictional monitoring efforts for mercury

This section provides the data inventory described in our management approach.

* Mercury Fish Data Inventory:
  + DE two-year studies on fish tissue in Chesapeake drainage:
    - 2016-2017?
    - 2006-2007?
  + MD Young of the Year Studies: includes rivers, lakes, reservoirs, tidal areas in MD:
    - Standardized young-of-the-year (YOY) predatory fish sampling and analysis project was initiated to assess year-to-year and long-term trends in methylmercury (MeHg) bioaccumulation in nine freshwater sites using largemouth bass (*Micropterous salmoides*) and four estuarine sites using white perch (*Morone americana*).
    - Annual monitoring since 2008 (10 years as of 2017).
  + PA 5-year rotation of fish tissue monitoring: the 2018 report is being prepared as of spring 2019.
    - 5 year monitoring cycle makes trend analysis difficult.
  + VA fish tissue monitoring: pre-2008 and in 2017. Between 2008 and 2017 there was no observable decline in MeHg in fish tissue.
  + VA annual probabilistic monitoring
* Mercury in Terrestrial Wildlife
  + Barnett Rattner’s work on Hg in Chesapeake water birds
  + USGS database, Contaminants Exposure and Effects—Terrestrial Vertebrates: <https://www.pwrc.usgs.gov/contaminants-online/pages/CEETV/CEETVintro.htm>
    - Searchable database of documented contaminants studied in terrestrial vertebrates, mostly birds. Many contaminants, including Hg.
    - Records span US and Canada, 1960s through early 2000s.Database last updated 2014.
* Mercury Sediment Data Inventory:
  + VA 2006-2016, and 2018 sediment monitoring: Found statistically significant decrease in sediment Hg between 2006-2016, but 2018 data did not continue the previous downward trend.
* Atmospheric Mercury Data Inventory:
  + NADP Mercury Deposition Network (MDN): weekly monitoring of wet deposition and precipitation, sites across the US, annual maps and weekly raw data mid 1990s-present.
    - No monitoring network exists for dry deposition. Current approaches for estimating dry deposition are modeled at a handful of US sites based on air Hg concentration, precipitation and wet deposition, with no standard modeling approach.
    - “The annual composite precipitation surfaces are derived from an adapted version of a high resolution precipitation model developed by the PRISM Climate Group, and supplemented with NADP precipitation observations. PRISM stands for "Parameter-elevation Regression on Independent Slopes Model". The PRISM modeled precipitation estimates incorporate point observation data, a reliable digital elevation model (DEM), and expert knowledge of complex climatic variables that result in high resolution, continuous, digital grid estimates of total annual precipitation” [(National Atmospheric Deposition Program, 2019)](http://nadp.slh.wisc.edu/data/mapProcess.aspx)
  + NADP Atmospheric Mercury Network (AMNet) is a “network of monitoring stations for the purpose of measuring atmospheric mercury fractions which contribute to dry and total mercury deposition. Sites will collect concentrations of atmospheric mercury species from automated, continuous measuring systems, concentrations of total mercury in precipitation, and meteorological measurements.” ([National Atmospheric Deposition Monitoring Network, 2019](http://nadp.slh.wisc.edu/AMNet/))
* Potential modeling tools which can be used to estimate atmospheric fate and transport:
  + Eulerian modeling approaches calculate particle movement through gridded cells (e.g. CMAQ) –the “grid” method (Cohen et al, 2011)
  + Langrangian modeling approaches model downwind dispersion from point sources based on wind speed and direction (e.g. CALPUFF) –the “plume” method
  + Hybrid approaches: Lagrangian functionality is sometimes introduced into Eulerian models – e.g., the so-called “Plume-in-Grid” capability (Vijayaraghavan et al., 2008). Eulerian computational approaches can also be introduced into a Lagrangian model, in what could be called a “Grid-in-Plume” approach (Cohen et al, 2011).
* Should also say if trend or change analysis is possible based on types and frequency of data
* Have summary table of types of samples collected, and dates, for addressing mercury

## Overview of current understanding of mercury baseline conditions and national monitoring efforts

* This section would summarize the findings that were provided by the jurisdictions during the April-May 2019 TCW calls.
  + Mercury Fish Tissue Results:
    - DE two-year study on fish tissue in Chesapeake drainage: 2017 results showed 1 out of 12 composite fish tissue samples exceeded the screening threshold of 0.3 ppm for Hg (largemouth bass and catfish). Additional composite samples will be collected to confirm the 2017 findings. The 2006 fish tissue study found 2 out of 10 composite fish tissue samples exceeded the screening value. 2017 report will be released soon.
    - MD YOY study: includes rivers, lakes, reservoirs, tidal areas in MD. The YOY study was inconclusive despite confirmed reductions in atmospheric deposition; it’s possible that there is some lag time between emissions reductions and reductions of MeHg uptake in fish. Lower MeHg in channel catfish and smallmouth bass are driving delisting activities in some areas, but there are not clear trends across species for the sampling period.
    - PA 5-year rotation of fish tissue monitoring: the 2018 report is being prepared as of spring 2019. A Hg advisory remains in effect for the entire PA portion of the Susquehanna River for channel catfish and flathead catfish. 5 year monitoring cycle makes trend analysis difficult.
    - VA fish tissue monitoring: pre-2008 and 2017. Between 2008 and 2017 there was no observable decline in MeHg in fish tissue.
    - VA annual probabilistic monitoring
  + Mercury Sediment Monitoring Results:
    - VA 2006-2016, and 2018 sediment monitoring: Found statistically significant decrease in sediment Hg between 2006-2016, but 2018 data did not continue the previous downward trend.
* Summary of available literature findings on trends in air emissions and deposition nationally, regionally and locally, and relationship between air deposition and methylHg uptake in fish.
* National Emissions Inventory (2014 version, updated July 2018).
  + Supporting data (raw and summarized) available here: <https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data>
  + Table 2.14 below contains data used to develop the graph in Fig 2-4, shown in story map panel 5 (source: NEI 2014 v2)
  + 
  + Data sources for the NEI included state, local and tribal agencies, EPA Toxic Release Inventory (TRI), EPA NATA, EPA HAP augmentation, EPA Electricity Generation Units (EGU) data, and EPA mobile sources (includes onroad, nonroad, CMV and locomotive emissions).
  + “Point sources are included in the inventory as individual facilities, usually at specific latitude/longitude coordinates, rather than as county or tribal aggregates. These facilities include large energy and industrial sites, such as electric generating utilities (EGUs), mines and quarries, cement plants, refineries, large gas compressor stations, and facilities that manufacture pulp and paper, automobiles, machinery, chemicals, fertilizers, pharmaceuticals, glass, food products, and other products. Additionally, smaller points sources are included voluntarily by S/L/T agencies, and can include small facilities such as crematoria, dry cleaners, and even gas stations.”
  + Nonpoint sources “are reported/generated at the county level, though some sources such as rail lines and shipping lanes and ports are more-finely resolved to the county/shape identifier (ID) (polygon) level.” Some nonroad sources include trains and commercial marine vessels.
  + Other nonpoint sources of Hg are included in table 4-7. These categories are not “distinct regulatory sectors” and are listed in the “EPA Other” category:

## Implications for management approaches

* Summarize what jurisdictions intend to do:
  + MD: Has delisted or will delist several waterbodies based on recent reduced MeHg in YOY studies. MD will determine whether a TMDL approach is necessary for the 6 remaining Hg listings. MD TMDL approach is currently stalled to determine if Hg emissions controls are effective in reducing MeHg uptake.
  + VA: conducting annual probabilistic monitoring. VA has developed TMDLs where there are clear direct sources of Hg contamination in surface waters. VA officials are in discussion to determine whether a TMDL approach is needed for listings with indirect Hg sources.
  + DE: Releasing 2017 two-year comprehensive study in 2019. Will focus additional monitoring in Nanticoke watershed to determine if a Hg listing is necessary for Marshyhope Creek.
  + PA: releasing 5-year monitoring report from 2018 in 2019. More communication between water monitoring and air monitoring divisions is needed.
  + DC: one existing Hg TMDL for Rock Creek. No monitoring program for Hg.
  + WV: No Hg listings in Chesapeake drainage. However, there are no plans to develop TMDLs for any current Hg listings in WV.
* Assume mercury will be reduced based on air emissions controls.
  + Highlight need for robust atmospheric monitoring and modeling to look at emissions, deposition and concentration. While there is some information nationally, very little information is available at the Chesapeake regional level.
* Other approaches
  + DuPont site remediation in Shenandoah, VA?

## Proposed Appendices

1. Sources cited
2. Links to data sources for integrated reports and jurisdiction points of contact
3. Comments and Responses on Mercury Story Map
4. Python script for spatial data processing in ArcPro
5. Draft Literature Summary
6. April 10 and May 8 TCW meeting minutes