UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

SEP 19 2017

Mr. Lee Currey, Director
Water and Science Administration
Maryland Department of the Environment
1800 Washington Blvd., Suite 540
Baltimore, Maryland 21230-1718

Dear Mr. Currey:

The U.S. Environmental Protection Agency (EPA), Region III, is pleased to approve the Total Maximum Daily Load (TMDL) report, *Total Maximum Daily Load of Polychlorinated Biphenyls in the Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay Segments*. The TMDL report was submitted by the Maryland Department of the Environment (MDE) to EPA for final review on August 31, 2017. The TMDL was established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address impairments of water quality as identified on Maryland's Section 303(d) List.

The Maryland Department of the Environment (MDE) identified the tidal portion of the "Patuxent River Lower" 8-digit basin (basin code – 02131101), which includes the waters of the Patuxent River Mesohaline and Oligohaline tidal segments, on the State's 2014 Integrated Report of surface water quality as impaired by PCBs in fish tissue (first listed in 2008). In addition, recent fish tissue data has demonstrated that the Patuxent River Tidal Fresh segment is impaired for PCBs in fish tissue. The TMDL established herein by MDE will address total PCB (tPCB) listing for the Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay segments.

The State's 2014 Integrated Report also lists the Patuxent River Mesohaline and Oligohaline tidal segments as impaired with impacts to the biological community. Future development of TMDLs to address these impacts are needed. Additional impairment listings in the Patuxent River Mesohaline and Oligohaline tidal segments for fecal coliform were addressed by fecal coliform TMDLs, which were approved by the EPA in 2005, 2007, and 2009.

Impairment listings in the Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay segments for nutrients, sediment, and total suspended solids (TSS) were addressed by the Chesapeake Bay nutrient and sediment TMDLs, which were established by the EPA on December 29, 2010.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) be designed to attain and maintain the applicable water quality standards; (2) include a total allowable loading and as appropriate, wasteload allocations for point sources and load allocations for nonpoint sources; (3) consider the impacts of background pollutant contributions; (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated); (5) consider seasonal variations; (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality); and (7) be subject to public participation. In addition, these TMDLs considered reasonable assurance that the TMDL allocations assigned to the nonpoint sources can be reasonably met. The enclosure to this letter describes how the tPCB TMDLs for the Patuxent River Mesohaline, Oligohaline, and Tidal Fresh Chesapeake Bay segments satisfy each of these requirements.

As you know, any new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL's wasteload allocation pursuant to 40 CFR §122.44(d)(1)(VII)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please do not hesitate to contact me. Additionally, your staff may contact Jillian Adair at 215-814-5713.

Sincerely,

Signed

Kate McManus, Acting Director
Water Protection Division

Enclosure

cc: Melissa Chatham, MDE-WSA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

# Decision Rationale
# Total Maximum Daily Load of Polychlorinated Biphenyls in the Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay Segments, Maryland

Signed

**Kate McManus, Acting Director**
**Water Protection Division**

**Date:** 9/19/2017

**Decision Rationale**
**Total Maximum Daily Load of Polychlorinated Biphenyls in the Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay Segments, Maryland**

## I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those waterbodies identified as impaired by the State where technology based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be present in a waterbody without exceeding water quality standards.

This document sets forth the U.S. Environmental Protection Agency's (EPA) rationale for approving the TMDL for total Polychlorinated Biphenyls (tPCB) in the Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay Segments. This TMDL is established to address impairments of water quality, caused by PCBs, as identified in Maryland's 2014 Integrated Report (first listed in 2008). The Maryland Department of the Environment (MDE) submitted the report, *Total Maximum Daily Load of Polychlorinated Biphenyls in the Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay Segments,* to EPA for final review on August 31, 2017.

EPA's review determined that the TMDLs meet the following seven regulatory requirements pursuant to 40 CFR Part 130:

1. The TMDL is designed to implement applicable water quality standards.
2. The TMDL includes a total allowable load as well as individual wasteload allocations (WLAs) and load allocations (LAs).
3. The TMDL considers the impacts of background pollutant contributions.
4. The TMDL considers critical environmental conditions.
5. The TMDL considers seasonal environmental variations.
6. The TMDL includes a MOS.
7. The TMDL has been subject to public participation.

In addition, this TMDL considered reasonable assurance that the TMDL allocations assigned to nonpoint sources can be reasonably met.

From this point forward, all references in this rationale can be found in the TMDL report, *Total Maximum Daily Load of Polychlorinated Biphenyls in the Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay Segments,* unless otherwise noted.

## II. Summary

Since the Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay Segments were identified as impaired for PCBs in fish tissue, the overall objective of the tPCB TMDLs is to ensure that the "fishing" designated use, which is protective of human health related to the consumption of fish, is supported. However, this TMDL will also ensure the protection of all other applicable designated uses. The TMDL specifically allocates the allowable tPCB loading to the Patuxent River Mesohaline (PAXMH), Oligohaline (PAXOH), and Tidal Fresh (PAXTF) Chesapeake Bay segments. The baseline loads, annual average TMDLs, load reductions, and maximum daily loads (MDLs) for tPCBs are presented in Table 1. Permitted facilities within the watersheds include 21 wastewater treatment plants (WWTPs), NPDES regulated stormwater discharges, and one industrial process water facility; however, only regulated stormwater discharges and 8 major WWTPs are prescribed WLAs.

**Table 1. Summary of tPCB Baseline Loads, TMDL Allocations, Load Reductions, and MDLs in the Patuxent River Mesohaline (PAXMH), Oligohaline (PAXOH), and Tidal Fresh (PAXTF) Segments**

| Tidal Segment | Source | Baseline Load (g/year) | Baseline Load (%) | TMDL (g/year) | Load Reduction (%) | MDL (g/day) |
|---|---|---|---|---|---|---|
| PAXMH | Non-regulated Watershed Runoff | 119.2 | 40.62% | 119.2 | 0.0% | 2.453 |
| | Atmospheric Deposition | 172.1 | 58.64% | 172.1 | 0.0% | 3.541 |
| | ***Nonpoint Sources*** | ***291.4*** | ***99.26%*** | ***291.4*** | ***0.0%*** | ***5.993*** |
| | NPDES Regulated Stormwater[4] | | | | | |
| | Prince George's | 0.6 | 0.20% | 0.6 | 0.0% | 0.012 |
| | Calvert[2] | 0.0 | 0.01% | 0.0 | 0.0% | 0.000 |
| | St. Mary's | 0.1 | 0.02% | 0.1 | 0.0% | 0.001 |
| | Charles | 1.5 | 0.52% | 1.5 | 0.0% | 0.031 |
| | ***Point Sources*** | ***2.2*** | ***0.74%*** | ***2.2*** | ***0.0%*** | ***0.045*** |
| | ***MOS (5%)*** | - | - | | | |
| | ***Total PAXMH*** | ***293.6*** | ***100.00%*** | ***293.6*** | ***0.0%*** | ***6.038*** |
| PAXOH | Non-regulated Watershed Runoff | 73.5 | 74.93% | 73.5 | 0.0% | 0.952 |
| | Atmospheric Deposition | 22.9 | 23.30% | 22.9 | 0.0% | 0.296 |
| | ***Nonpoint Sources*** | ***96.4*** | ***98.23%*** | ***96.4*** | ***0.0%*** | ***1.248*** |
| | NPDES Regulated Stormwater[4] | | | | | |
| | Anne Arundel | 0.3 | 0.31% | 0.3 | 0.0% | 0.004 |
| | Calvert[2] | 0.0 | 0.01% | 0.0 | 0.0% | 0.000 |
| | Prince George's | 1.4 | 1.44% | 1.4 | 0.0% | 0.018 |
| | ***Point Sources*** | ***1.7*** | ***1.77%*** | ***1.7*** | ***0.0%*** | ***0.022*** |
| | ***MOS (5%)*** | - | - | | | |
| | ***Total PAXOH*** | ***98.1*** | ***100.00%*** | ***98.1*** | ***0.0%*** | ***1.271*** |
| PAXTF | Non-regulated Watershed Runoff[3] | 1,118.9 | 65.32% | 1.0 | 99.9% | 0.011 |
| | Atmospheric Deposition | 7.1 | 0.41% | 0.0 | 99.9% | 0.000 |
| | Contaminated Sites[1,2] | 0.0 | 0.00% | 0.0 | 0.0% | 0.000 |
| | ***Nonpoint Sources*** | ***1,126.0*** | ***65.74%*** | ***1.0*** | ***99.9%*** | ***0.011*** |
| | NPDES Regulated Stormwater[3,4] | | | | | |
| | Anne Arundel | 100.4 | 5.86% | 0.1 | 99.9% | 0.001 |
| | Frederick[1] | 0.2 | 0.01% | 0.2 | 0.0% | 0.002 |
| | Howard | 228.6 | 13.35% | 0.1 | 99.9% | 0.001 |
| | Montgomery | 32.2 | 1.88% | 0.0 | 99.9% | 0.000 |
| | Prince George's | 154.6 | 9.03% | 0.1 | 99.9% | 0.001 |
| | WWTPs | 70.8 | 4.13% | 75.2 | -6.3% | 0.639 |
| | ***Point Sources*** | ***586.9*** | ***34.26%*** | ***75.7*** | ***87.1%*** | ***0.645*** |
| | ***MOS (5%)*** | - | - | ***4.0*** | - | ***0.035*** |
| | ***Total PAXTF*** | ***1,712.9*** | ***100.00%*** | ***80.7*** | ***95.3%*** | ***0.690*** |

[1]Contaminated sites, and Frederick NPDES regulated stormwater tPCB baseline loads are considered insignificant (less than 0.01% of the total baseline load) and no reductions are assigned.

[2]Baseline load, TMDLs andMDLs appear as zero since their actual values are less than the number of significant decimal digits.

[3]Baseline loads from WWTPs which discharge to the PAXTF watershed have been subtracted proportionally from the non-regulated watershed runoff and NPDES regulated stormwater baseline load to avoid double counting.

[4]NPDES regulated stormwater baseline loads and WLAs are an aggregate of loadings from areas covered under the following permits: (i) Phase I & II jurisdictional MS4 permits, (ii) the State Highway Administration's Phase I MS4 permit, (iii) industrial facilities permitted for stormwater discharges, and (iv) MDE general permit to construction sites.

Note: Columns may not precisely add to totals due to rounding.

The TMDL is a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically based strategy that considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of an explicit and implicit MOS. The option is always available to refine the TMDL for resubmittal to EPA for approval if environmental conditions, new data, or the understanding of the natural processes change more than what was anticipated by the MOS.

## III. Background

The Patuxent River is a 70-kilometer-long tidal tributary of the Chesapeake Bay located in Maryland's Western Shore that drains portions of eight counties. The Patuxent River consists of three tidal segments: Mesohaline (PAXMH), Oligohaline (PAXOH), and Tidal Fresh (PAXTF). PAXTF represents the largest drainage area of 1,505 square kilometers ($km^2$), while the PAXOH and PAXMH drain areas of 299 and 472 square kilometers ($km^2$), respectively, for a total watershed area of 2,276 square kilometers ($km^2$). From this point on, the "Patuxent River Mesohaline, Oligohaline, and Tidal Fresh Chesapeake Bay Tidal Segments" will be referred to as the "PAXMH, PAXOH, and PAXTF tidal segments" and the corresponding "Patuxent River Mesohaline, Oligohaline, and Tidal Fresh Chesapeake Bay Segmentsheds" will be referred to as the "PAXMH, PAXOH, and PAXTF watersheds".

According to the United States Geological Survey's (USGS) 2006 land cover data (USGS 2014), which was specifically developed to be applied within the Chesapeake Bay Program's (CBP) Phase 5.3.2 watershed model, forest occupies approximately 43% of the land area in the PAXMH, PAXOH, and PAXTF watersheds, followed by urban with 25%, agriculture with 23%, and water/wetlands with 9%.

Maryland WQSs specify that all surface waters of the State shall be protected for water contact recreation, fishing, and protection of aquatic life and wildlife (COMAR 2016a). Additionally, the designated use class of the waters of the PAXMH, PAXOH, and PAXTF tidal segments is Use Class II – Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting (COMAR 2016b).

PCBs are a class of man-made compounds that were manufactured and used for a variety of industrial applications from the 1940s to the 1970s. Despite the U.S. government's action to cease PCB production, restrict use, and regulate storage and disposal, PCBs are still released into the environment via leaks from old PCB containing equipment, accidental spills, burning of PCB containing oils, leaks from hazardous waste sites, or the inadvertent production during manufacturing processes. PCBs are persistent pollutants that bioaccumulate in aquatic organisms, including fish. PCBs are a concern to human health, as regular consumption of fish containing elevated levels of PCBs will cause bioaccumulation within the fatty tissue of humans, which can potentially lead to the development of cancer.

The Maryland Department of the Environment (MDE) identified the tidal portion of the "Patuxent River Lower" 8-digit basin (basin code – 02131101), which includes the waters of the PAXMH and PAXOH tidal segments, on the State's 2014 Integrated Report of surface

water quality as impaired by PCBs in fish tissue (first listed in 2008). In addition, recent fish tissue data has demonstrated that the PAXTF tidal segment is impaired for PCBs in fish tissue. The TMDL established herein by MDE will address the total PCB (tPCB) listing for the PAXMH, PAXOH, and PAXTF tidal segments.

The State's 2014 Integrated Report also lists the PAXMH and PAXOH tidal segments as impaired with impacts to the biological community. Future development of TMDLs to address these impacts will ensue. Additional impairment listings in the PAXMH and PAXOH tidal segments for fecal coliform were addressed by fecal coliform TMDLs, which were approved by the EPA in 2005, 2007, and 2009. Impairment listings in the PAXMH, PAXOH, and PAXTF tidal segments for nutrients, sediment, and total suspended solids (TSS) were addressed by the Chesapeake Bay nutrient and sediment TMDLs, which were established by the EPA on December 29, 2010.

CWA Section 303(d) and its implementing regulations require that TMDLs be developed for waterbodies identified as impaired by the State where technology based and other controls do not provide for attainment of water quality standards. The tPCB TMDLs submitted by MDE are designed to allow for the attainment of the PAXMH, PAXOH, and PAXTF tidal segments' designated uses, and to ensure that there will be no PCB impacts affecting the attainment of these uses.

The CWA requires TMDLs to be protective of all the designated uses applicable to a particular waterbody. Within the PAXMH, PAXOH, and PAXTF tidal segments, these designated uses, include "water contact recreation," "fishing," "the protection of aquatic life and wildlife," and the "support of estuarine and marine aquatic life and shellfish harvesting". Since the PAXMH, PAXOH, and PAXTF tidal segments were identified as impaired for PCBs in fish tissue, the overall objective of the tPCB TMDL is to ensure that the "fishing" designated use, which is protective of human health related to the consumption of fish, is supported. However, this TMDL will also ensure the protection of all other applicable designated uses. The objective was achieved via extensive field observations, the development of a scientifically-sound TMDL endpoint tPCB concentration, and a multi-segment tidally-averaged one-dimensional transport model. The water quality model simulated tPCB dynamic interactions between the water column and bottom sediments within the tidal segments and the Chesapeake Bay mainstem.

In 2013 and 2014, water quality monitoring surveys were conducted by MDE to measure water column tPCB concentrations in the PAXMH, PAXOH, and PAXTF tidal segments. Tidal water column sampling was conducted at eight stations, including a station located at the boundary between the PAXMH tidal segment and the main stem of the Chesapeake Bay, to evaluate the tidal influences from the Bay. Sediment sampling was also conducted at each tidal station to characterize tPCB sediment concentrations. Non-tidal water column sampling was conducted concurrently with tidal monitoring at six stations throughout the PAXMH, PAXOH, and PAXTF watersheds and was required to estimate loads from the watersheds. Mean water column tPCB concentrations for tidal samples in each of the three tidal segments exceed the human health tPCB criterion of 0.64 ng/L, indicating a PCB impairment within the river.

In addition to the water column criteria described above, fish tissue monitoring was also used as an indicator for PCB water quality conditions. Maryland regularly collects and analyzes fish tissue data in order to issue fish consumption advisories and recommendations, and determine whether Maryland waterbodies are meeting the "fishing" designated use. MDE collected 11 fish tissue composite samples (55 total fish) in the PAXMH tidal segment, 9 fish tissue composite samples (43 total fish) in the PAXOH tidal segment, and 4 fish tissue composite samples (20 total fish) in the PAXTF tidal segment. Samples were collected in September 2009, May 2014, and September 2015 and analyzed for tPCBs. The tPCB concentrations for 15 out of 24 composite samples exceeded the listing threshold of 39 ng/g and several exceedances were observed in each tidal segment, indicating a PCB impairment in the PAXMH, PAXOH, and PAXTF tidal segments.

PCBs do not occur naturally in the environment. Therefore, unless MDE identifies existing or historical anthropogenic sources, natural background levels of PCBs are expected to be zero. As part of the analysis, both point and nonpoint sources of PCBs have been identified throughout the PAXMH, PAXOH, and PAXTF watersheds. Nonpoint sources of PCBs include: 1) Chesapeake Bay mainstem tidal influence, 2) direct atmospheric deposition to the river, 3) contaminated sites, and 4) runoff from non-regulated areas within the watersheds. The transport of PCBs from bottom sediments to the water column through resuspension and diffusion can also be a major, nonpoint source of PCBs in estuarine systems. However, under the framework of this TMDL, it is not considered a source. Point Sources in the PAXMH, PAXOH, and PAXTF watersheds include: 1) 21 municipal wastewater treatment plants (WWTPs), 2) one industrial process water facility, and 3) NPDES regulated stormwater discharges.

Nonpoint sources include loads from:

*Chesapeake Bay Mainstem Tidal Influence* – The water quality model, applying the observed tPCB concentrations measured near the mouth of the PAXMH tidal segment, predicts a net tPCB transport of 519 g/year from the Bay to the PAXMH tidal segment. Even though the tidal influence from the Chesapeake Bay mainstem serves as a source of PCBs to the PAXMH tidal segment, the load contribution is resultant from other point and nonpoint source inputs (both historic and current) from the upper Chesapeake Bay watershed and is not considered to be a directly controllable (reducible) source. Therefore, this load will not be assigned a baseline load or allocation within the TMDL. Although no allocation is assigned, the modeling of this TMDL does account for the attenuation of PCBs in Chesapeake Bay water that is expected to occur over time due to natural processes such as the burial of contaminated sediment.

*Atmospheric Deposition* – PCBs enter the atmosphere through volatilization. There is no recent study of the atmospheric deposition of PCBs to the surface of the PAXMH, PAXOH, and PAXTF tidal segments. An Atmospheric Deposition Study by the Chesapeake Bay Program (CBP) estimated a net deposition of 16.3 micrograms/square meter/year (µg/m2/year) of tPCBs for urban areas and a net deposition of 1.6 µg/m2/year of tPCBs for regional (non-urban) areas (US EPA 1999). The urban deposition rate defined in CBP's study is a result of heavily urbanized areas comprised primarily of high density residential, industrial and commercial land uses. In the Delaware River estuary, an extensive atmospheric deposition monitoring program

conducted by the Delaware River Basin Commission (DRBC) found PCB deposition rates ranging from 1.3 (non urban) to 17.5 (urban) µg/m2/year of tPCBs (DRBC 2003).

Non-urban land use accounts for the majority of the watersheds: 85.2%, 87.7%, and 68.8% of the PAXMH, PAXOH, and PAXTF watersheds, respectively. Thus, the tPCB depositional rate of 1.6 µg/m2/year for non-urban areas observed in CBP's 1999 study will be applied for the entire watershed. The atmospheric deposition tPCB load directly to the surface of the watershed was calculated by multiplying the non-urban depositional rate of 1.6 µg/m2/year by the PAXMH, PAXOH, and PAXTF watershed areas along with a terrestrial pass through efficiency to the embayment of 1 percent, which was estimated by Totten et al. (2006) for the Delaware River watershed and applied here. The atmospheric deposition tPCB baseline loads from the PAXMH, PAXOH, and PAXTF watersheds to the river segments are 7.5 g/year, 4.8 g/year, and 24.1 g/year, respectively. This load is accounted for within the estimated load from the watershed and is inherently modeled as part of the non-regulated watershed runoff and the National Pollutant Discharge Elimination System (NPDES) regulated stormwater tPCB loads described below.

Similarly, the direct atmospheric deposition tPCB loads to the surface of the PAXMH, PAXOH, and PAXTF tidal segments were calculated by multiplying the surface area of the tidal segments and the deposition rate of 1.6 µg/m2/year. These tPCB baseline loads to the PAXMH, PAXOH, and PAXTF segments are 172.1 g/year, 22.9 g/year, and 7.1 g/year, respectively.

*Contaminated Sites*– Contaminated sites refer to areas with known PCB soil contamination, as documented by state or federal hazardous waste cleanup programs (i.e., state or federal Superfund programs). When compared against the human health screening criteria for soil and groundwater exposure pathways, PCBs are not necessarily a contaminant of concern at these sites, but they have been screened for, reported, and detected during formal site investigations. Potentially contaminated sites were identified based on information gathered from MDE's Land Restoration Program Geospatial Database (LRP-MAP) (MDE 2016). Within the PAXMH, PAXOH, and PAXTF watersheds, only one site, the Patuxent Wildlife Research Center (located in the PAXTF watershed), was identified with tPCB soil contamination. Soil concentration data was obtained from MDE Land Management Administration's (LMA) contaminated site survey and investigation records. The median soil tPCB concentration was multiplied by the soil loss rate, which is a function of soil type, pervious area, and land cover, to estimate the tPCB baseline load. The contaminated site tPCB baseline load is 0.012 g/year.

*Non-Regulated Watershed Runoff*– The non-regulated watershed runoff tPCB load corresponds to the non-urbanized areas (i.e., primarily agriculture and forest) and non-regulated urbanized areas (St. Mary's and Calvert County) of the watershed.

The PAXMH, PAXOH, and PAXTF watersheds were divided into 15 subwatershed segments to estimate tPCB loads into the corresponding tidal subsegments in the water quality model. To estimate the non-regulated watershed runoff load, first the total tPCB baseline load from each subwatershed is calculated by multiplying the subwatershed flow by the average tPCB concentration of the corresponding non-tidal monitoring stations. The total (regulated and

nonregulated) PAXMH, PAXOH, and PAXTF watershed baseline tPCB loads (119.3 g/year, 73.5 g/year, and 1,148.8 g/year, respectively) are calculated from adding the corresponding subwatershed tPCB loads. Then, the non-regulated watershed runoff tPCB baseline loads were estimated by multiplying the percentage of non-urban and non-regulated urban land use within the PAXMH, PAXOH, and PAXTF watersheds and the corresponding watershed tPCB baseline loads. The non-regulated watershed runoff tPCB baseline loads from the PAXMH, PAXOH, and PAXTF watersheds are 119.3 g/year, 73.5 g/year, and 1,148.8 g/year, respectively.

*Resuspension and Diffusion from Bottom Sediments* – The transport of PCBs from bottom sediments to the water column through resuspension and diffusion can be a major source of PCBs in estuarine systems; however, under the framework of this TMDL it is not considered a source. The water quality model developed for this TMDL simulates conditions within the water column and sediment as a single system, therefore exchanges between the sediment and water column are considered an internal load. Only external sources to the system are assigned a baseline load within the TMDL.

The water quality model, applying observed tPCB concentrations in the water column and sediment, predicts a net tPCB load of 1,527.1 g/year, 292.9 g/year, and 116.8 g/year from the water column to the bottom sediment in the PAXMH, PAXOH, and PAXTF tidal segments, respectively. Under initial conditions, there is a net load of PCBs from the water column to the sediment in the tidal segments. The gross tPCB load from settling exceeds the gross tPCB load from diffusion and resuspension.

Point sources include loads from:

*Municipal WWTPs* – There are 21 municipal WWTPs located in the PAXOH (1 minor facility) and PAXTF (20 facilities) watersheds. Of the 21 municipal WWTPs, eight are major facilities (discharge flow greater than 1 MGD) and 13 are minor facilities (discharge flow less than 1 MGD). The tPCB baseline loads from the WWTPs are calculated by multiplying the average discharge flow and estimated tPCB effluent concentration. The average daily discharge flows from the facilities were based on a Discharge Monitoring Report (DMR) flow record for the period January 2011 through May 2016. No tPCB effluent concentration data are available for the WWTPs, so the effluent concentration was estimated based on the median tPCB effluent concentration (0.91 ng/L) from 13 WWTPs monitored by MDE in the Chesapeake Bay watershed (MDE 2006). The WWTP tPCB baseline loads are presented in Table 2. The table includes the facility name, NPDES permit, tidal segment, average flow, and tPCB baseline loads. The total WWTP loads from the minor facilities, 0.01 g/year in the PAXOH watershed and 1.07 g/year in the PAXTF watershed, only account for a relatively small percentage (0.01% and 0.06%) of their respective total watershed loads. Therefore, these loads from the minor facilities are considered insignificant and will not be assigned baseline loads or allocations as no appreciable environmental benefit would be gained from reducing these loads.

**Table 2. Municipal WWTP tPCB Baseline Loads in the PAXMH, PAXOH, and PAXTF Watersheds**

| Facility Name | NPDES Permit | Permit Type | Tidal Segment | Average Flow (MGD*) | WWTP tPCB Load (g/year) |
|---|---|---|---|---|---|
| WSSC - Western Branch WWTP | MD0021741 | Major | PAXTF | 20.065 | 25.11 |
| Dorsey Run Advanced WWTP | MD0063207 | Major | PAXTF | 1.344 | 1.68 |
| Little Patuxent Water Reclamation Plant | MD0055174 | Major | PAXTF | 17.950 | 22.47 |
| Patuxent River Water Reclamation Plant | MD0021652 | Major | PAXTF | 5.298 | 6.63 |
| Fort Meade WWTP | MD0021717 | Major | PAXTF | 2.416 | 3.02 |
| Maryland City Water Reclamation Facility | MD0062596 | Major | PAXTF | 1.114 | 1.39 |
| Bowie WWTP | MD0021628 | Major | PAXTF | 1.862 | 2.33 |
| WSSC - Parkway WWTP | MD0021725 | Major | PAXTF | 6.500 | 8.14 |
| Total WWTP Load (Majors) | | | | | 70.78 |
| Northern High School WWTP | MD0052167 | Minor | PAXOH | 0.008 | 0.01 |
| Boones Mobile Estate WWTP | MD0050903 | Minor | PAXTF | 0.064 | 0.08 |
| Lyons Creek Mobile Home Park WWTP | MD0053511 | Minor | PAXTF | 0.054 | 0.07 |
| Maryland Manor WWTP | MD0024333 | Minor | PAXTF | 0.052 | 0.07 |
| Henson Valley Motessori School WWTP | MD0052680 | Minor | PAXTF | 0.005 | 0.01 |
| Patuxent Mobile Estates WWTP | MD0024694 | Minor | PAXTF | 0.013 | 0.02 |
| Tracey's Elementary School | MD0069582 | Minor | PAXTF | 0.001 | 0.001 |
| Waysons Mobile Court WWTP | MD0023647 | Minor | PAXTF | 0.049 | 0.06 |
| Federal Support Center WWTP | MD0025666 | Minor | PAXTF | 0.002 | 0.002 |
| Piney Orchard WWTP | MD0059145 | Minor | PAXTF | 0.605 | 0.76 |
| Southern Senior High School | MD0023728 | Minor | PAXTF | 0.006 | 0.01 |
| National Wildlife Visitor Center WWTP | MD0065358 | Minor | PAXTF | 0.007 | 0.01 |
| Total WWTP Load (Minors) | | | | | 1.08 |

*Million gallons per day
Note: Columns may not precisely add to totals due to rounding

*Industrial Process Water Facilities* – Industrial process water facilities are included in Maryland's PCB TMDL analyses if: 1) they are located within the applicable watershed and 2) they have the potential to discharge PCBs. Guidance developed by the Commonwealth of

Virginia identifies specific types of permitted industrial and municipal facilities based on their Standard Industrial Classification (SIC) codes as having the potential to contain PCBs within their process water discharge (VADEQ 2009). This methodology has been applied previously within several of Maryland's EPA approved PCB TMDLs (e.g., MDE 2011b).

Within the PAXMH, PAXOH, and PAXTF watersheds, one industrial process water facility, Genon Mid-Atlantic, LLC. – Chalk Point Generation Station (NPDES # MD0002658), has a SIC Code (4931) defined in Virginia's guidance as having the potential to discharge PCBs. This facility is in the PAXMH watershed and discharges directly to the tidal segment. The tPCB load from this facility is calculated by multiplying the average discharge flow and average tPCB effluent concentration. The average discharge flow from the facility was based on a DMR flow record for the period January 2011 through May 2016. The average tPCB effluent concentration was based on effluent samples collected from the facility's noncontact cooling water outfall for tPCB analysis in November and December 2015. The industrial process water facility tPCB load is 1,448.8 g/year.

The facility is a coal-fired power plant which withdraws water directly from the PAXMH tidal segment for non-contact cooling processes. The water contains elevated levels of PCBs already present in the PAXMH tidal segment and simply re-circulates the contamination back to the tidal segment at the outfall discharge upstream of the facility. The average tidal water column tPCB concentrations at the nearest monitoring station upstream and downstream of the facility are 3.0 ng/L and 1.4 ng/L, respectively. The tPCB concentrations decrease downstream from the power plant indicating that the facility does not contribute additional PCBs to the system. Since the tPCB load of 1,448.8 g/year is being re-circulated within the PAXMH tidal segment and does not represent an additional load into the system, it will not be assigned a baseline load or allocation within this TMDL.

*NPDES Regulated Stormwater* – MDE estimates pollutant loads from NPDES regulated stormwater areas based on urban land use classification within a given watershed. The 2006 USGS spatial land cover, which was used to develop CBP's Phase 5.3.2 watershed model land use, was applied in this TMDL to estimate the NPDES regulated stormwater tPCB baseline load.

The PAXOH, PAXTF and portions of the PAXMH watersheds are located within the following counties regulated under Phase I of the NPDES stormwater program: Anne Arundel, Charles, Frederick, Howard, Montgomery, and Prince George's County, Maryland. The NPDES stormwater permits within the watershed include: (i) the area covered under Phase I jurisdictional MS4 permit for these counties, (ii) the State Highway Administration's Phase I MS4 permit, (iii) industrial facilities permitted for stormwater discharges, and (iv) MDE general permit to construction sites. The loads for all NPDES stormwater permittees are presented as an aggregate under the Phase I MS4 counties within the PAXMH, PAXOH, and PAXTF watersheds.

The NPDES regulated stormwater tPCB baseline loads were estimated by multiplying the percentage of regulated urban land use area within the regulated county portions of the PAXMH, PAXOH, and PAXTF watersheds by the corresponding county portions of the watershed tPCB baseline loads. The NPDES regulated stormwater tPCB baseline loads from the PAXMH,

PAXOH, and PAXTF watersheds are presented in Table 3. The table includes the watershed, county, urban land use percentage, and NPDES regulated stormwater tPCB baseline loads.

**Table 3. Aggregate Regulated Stormwater tPCB Baseline Loads in the PAXMH, PAXOH, and PAXTF Watersheds**

| Watershed | County | Watershed tPCB Load (g/year) | County Portion of Watershed tPCB Load (g/year) | Regulated Urban Landuse (%) | NPDES Regulated Stormwater tPCB Load (g/year)[2] |
|---|---|---|---|---|---|
| PAXMH | Prince George's | 121.4 | 6.0 | 9.6% | 0.6 |
| | Calvert[1] | | 51.6 | 0.0% | 0.0 |
| | St. Mary's | | 45.3 | 0.1% | 0.1 |
| | Charles | | 18.5 | 8.3% | 1.5 |
| PAXOH | Anne Arundel | 75.2 | 3.2 | 9.5% | 0.3 |
| | Calvert[1] | | 46.6 | 0.0% | 0.0 |
| | Prince George's | | 25.4 | 5.5% | 1.4 |
| PAXTF | Anne Arundel | 1,680.7 | 338.0 | 30.9% | 104.4 |
| | Frederick | | 0.4 | 41.2% | 0.2 |
| | Howard | | 746.7 | 31.6% | 235.7 |
| | Montgomery | | 241.0 | 13.4% | 32.2 |
| | Prince George's | | 348.7 | 45.7% | 159.4 |

[1]Some figures appear as zero since their actual values are less than the number of significant decimal digits.
[2]NPDES regulated stormwater baseline loads are an aggregate of loadings from areas covered under the following permits: (i) Phase I & II jurisdictional MS4 permits, (ii) the State Highway Administration's Phase I MS4 permit, (iii) industrial facilities permitted for stormwater discharges, and (iv) MDE general permit to construction sites.

A tidally-averaged multi-segment one-dimensional transport model was applied to simulate the tPCB dynamic interactions between the water column and bottom sediments within the PAXMH, PAXOH, and PAXTF tidal segments and the Chesapeake Bay mainstem. The tidal system was divided into 14 segments and the watershed into 15 subwatersheds. In general, tidal waters are exchanged through their connecting boundaries. Within the PAXMH, PAXOH, and PAXTF system, the dominant processes affecting the transport of PCBs throughout the water column include: dispersion induced by tide and concentration gradient between the Bay and the embayment, fresh water discharge from upstream rivers and adjacent watershed, atmospheric exchange due to volatilization and deposition, and exchange with the bottom sediments (through diffusion, re-suspension, and settling). Burial to deeper inactive layers and the exchange with the water column (through diffusion, resuspension, and settling) are the dominant processes affecting the transport of PCBs in the bottom sediments.

The observed average tPCB concentrations in the sediment and water column in each segment were used to characterize the initial (baseline) model conditions. If the segment did not

have any PCB observations a linear interpolation of tPCB concentrations from the adjacent up- and down-stream segments was applied. Based on the study of Ko and Baker (2004), on average the tPCB concentrations in the upper Chesapeake Bay are decreasing at a rate of 6.5% per year. As a conservative estimation, this TMDL assumes a PCB attenuation rate of 5.0% per year at the boundary between the PAXMH tidal segment and the Chesapeake Bay mainstem (MDE 2011a). For establishing the TMDL, scenarios are run in which all other model inputs (i.e., fresh water discharge, dispersion coefficients, sediment and water column exchange rates, atmospheric deposition, and burial rate) were kept constant.

The water quality model is initially run for a simulation period of 109.5 years (40,000 days) to determine whether the TMDL endpoints for the PAXMH, PAXOH, and PAXTF tidal segments can be achieved under baseline conditions and a rate of decline at the Chesapeake Bay boundary of 5%. The sediment PCB TMDL endpoint in the PAXMH will be met within about 20 years (7,300 days) under baseline conditions as the boundary concentration declines at a rate of 5%. In order to meet TMDL endpoints in the PAXOH and PAXTF tidal segments a reduction to watershed loads will be required as the declining tPCB concentration at the Chesapeake Bay boundary alone is not sufficient to achieve the TMDL endpoints.

To determine the TMDL in which the PAXMH, PAXOH, and PAXTF tidal segments will meet the corresponding water quality and sediment tPCB TMDL endpoints, model reduction scenarios were run with incremental increases in total load reduction. It was demonstrated that a minimum reduction of 95.3 % of the total baseline loads from nonpoint and point sources to the PAXTF tidal segment was required to achieve the TMDL. The assigned reductions to the PAXTF tidal segment result in the water column and sediment tPCB TMDL endpoints being met for all tidal segments. Therefore, no load reductions are required in the PAXMH and PAXOH tidal segments. It will take approximately 57.25 years (20,917 days) and 11.5 years (4,215 days) to meet both the water column and sediment TMDL endpoints in the PAXTF and PAXOH tidal segments, respectively, following implementation of load reductions necessary to support designated uses.

Attainment of the site-specific tPCB water quality TMDL endpoints is expected to take place over time as watershed reductions are implemented and the Chesapeake Bay mainstem tPCB concentrations continue to decline, which also results in the natural attenuation of tPCB levels in the surface layer of the sediments (i.e., the covering of contaminated sediments with newer, less contaminated materials, flushing of sediments during periods of high stream flow, and biodegradation).

## IV. Discussion of Regulatory Conditions

EPA finds that MDE has provided sufficient information to meet all of the seven basic requirements for establishing a tPCB TMDL for the Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay segments. Additionally, MDE provided reasonable assurance that the TMDL can be met. EPA's approval is outlined according to the regulatory requirements listed below.

*1) The TMDLs are designed to implement applicable water quality standards.*

Maryland Water Quality Standards specify that all surface waters of the State shall be protected for water contact recreation, fishing, and the protection of aquatic life and wildlife (COMAR 2014a). The designated use of the waters of the PAXMH, PAXOH, and PAXTF tidal segments is Use II – *Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting* (COMAR 2014b).

The State of Maryland has adopted three separate water column tPCB criteria: a criterion for the protection of human health associated with the consumption of PCB contaminated fish (0.64 ng/L), as well as fresh water (14 ng/L) and salt water (30 ng/L) chronic tPCB criteria for the protection of aquatic life (COMAR 2014d; US EPA 2014a). The State defines the waters of the "Patuxent River Area" (MD 6-Digit Code: 021311) as fresh water above a line connecting Chalk Point and God's Grace point which is the boundary between the PAXMH and PAXOH tidal segments (COMAR 2016e). Thus, the saltwater aquatic life criterion will be applicable to the PAXMH tidal segment and the freshwater aquatic life criterion will be applicable to the PAXOH and PAXTF when assessing water quality. Since the human health criterion is more stringent than the fresh water and salt water aquatic life criteria, if the human health criterion is met, all applicable water quality criteria would be satisfied. Water quality data analysis indicates that the mean water column tPCB concentrations for tidal samples in the PAXMH, PAXOH, and PAXTF tidal segments exceed the human health tPCB criterion of 0.64 ng/L, but do not exceed either the fresh water (14 ng/L) or saltwater (30 ng/L) chronic aquatic life criteria for tPCBs, demonstrating a PCB impairment in the PAXMH, PAXOH, and PAXTF tidal segments.

In addition to the water column criteria described above, fish tissue monitoring is also used as an indicator of PCB water quality conditions. Maryland regularly collects and analyzes fish tissue data in order to issue fish consumption advisories and recommendations, and determine whether Maryland waterbodies are meeting the "fishing" designated use. The State's tPCB fish tissue listing threshold of 39 ng/g is based on a fish consumption limit of 4, 8-ounce meals per month, and is applied to the skinless fillet of the fish, the edible portion typically consumed by humans. When tPCB fish tissue concentrations exceed this threshold, the waterbody is listed as impaired for PCBs in fish tissue in Maryland's Integrated Report as it is not supportive of the "fishing" designated use (MDE 2014a). MDE collected 11 fish tissue composite samples (55 total fish) in the PAXMH tidal segment, 9 fish tissue composite samples (43 total fish) in the PAXOH tidal segment, and 4 fish tissue composite samples (20 total fish) in the PAXTF tidal segment. Samples were collected in September 2009, May 2014, and September 2015 and analyzed for tPCBs. The tPCB concentrations for 15 out of 24 composite samples in the PAXMH, PAXOH, and PAXTF tidal segments exceeded the listing threshold, indicating a PCB impairment within the tidal segments.

The overall objective of the tPCB TMDL for the PAXMH, PAXOH, and PAXTF tidal segments is to ensure the support of the "fishing" designated use, so the tPCB fish tissue listing threshold (39 ng/g) was translated into an associated water column tPCB threshold concentration to apply as the water column TMDL endpoint since the water quality model only simulates tPCB water column and sediment concentration and does not incorporate a food web model to predict

tPCB fish tissue concentrations. This was accomplished using the Adjusted Total Bioaccumulation Factors (Adj-tBAF) of 108,659 L/kg, 96,365 L/kg, and 65,457 L/kg for the PAXMH, PAXOH, and PAXTF tidal segments, respectively; the derivation of which follows the method applied within the Potomac River tPCB TMDLs (Haywood and Buchanan, 2007). A total Bioaccumulation Factor (tBAF) is calculated per fish species, and subsequently the tBAFs are normalized by the median species lipid content and median dissolved tPCB water column concentration in their home range to produce the Adj-tBAF per species. The most environmentally conservative of the Adj-tBAFs is then selected to calculate the TMDL endpoint water column concentration. This final water column tPCB concentration was then subsequently compared to the water column tPCB criteria concentrations, to ensure that all applicable criteria within the embayment would be attained. Based on this analysis, the water column tPCB concentrations of 0.36 ng/L, 0.40 ng/L, and 0.60 ng/L derived from the tPCB fish tissue listing threshold, are selected as the TMDL endpoints for the PAXMH, PAXOH, and PAXTF tidal segments, respectively. These endpoints are more stringent than the value of 0.64 ng/L for the human health tPCB criterion, 14 ng/L for the freshwater chronic aquatic life tPCB criterion, and of 30 ng/L for the saltwater chronic aquatic life tPCB criterion.

Similarly, to establish a tPCB TMDL endpoint for the sediment in the PAXMH, PAXOH, and PAXTF tidal segments, a target tPCB sediment concentration was derived from the tPCB fish tissue listing threshold, as the water quality model only simulates tPCB sediment concentrations and not tPCB fish tissue concentrations. This was done using the Adjusted Sediment Bioaccumulation Factor (Adj-SediBAF) of 15.61 (unitless), 28.76, and 75.68 for the PAXMH, PAXOH, and PAXTF tidal segments, respectively; the derivation of which follows the method applied within the Potomac River tPCB TMDLs (Haywood and Buchanan 2007). Similar to the calculation of the water column Adj-tBAF, a sediment Bioaccumulation Factor (SediBAF) is calculated per fish species, and subsequently the SediBAFs are normalized by the median species lipid content and median organic carbon tPCB sediment concentration in their home range to produce the Adj-SediBAF per species. Based on this analysis, the tPCB levels of 2.50 ng/g, 1.36 ng/g, and 0.52 ng/g, derived from the fish tissue listing threshold, are set as the sediment TMDL endpoints in the PAXMH, PAXOH, and PAXTF tidal segments, respectively.

The CWA requires TMDLs to be protective of all the designated uses applicable to a particular waterbody. In addition to the "fishing" designated use, the TMDL is also supportive of the other applicable designated uses within the impaired waters including "marine and estuarine aquatic life", "shellfish harvesting", and "water contact recreation". The water column endpoint tPCB concentrations that are used in the PAXMH, PAXOH, PAXTF tidal segments tPCB analysis are more stringent than Maryland's saltwater and freshwater aquatic life chronic criterion tPCB water column concentration. This indicates that the TMDLs are protective of the "aquatic life" designated use, specifically the protection of "marine and estuarine aquatic life and shellfish harvesting". The designated use for "water contact recreation" is not associated with any potential human health risks due to PCB dermal exposure.

EPA finds these are reasonable and appropriate water quality goals.

*2) The TMDLs include a total allowable load as well as individual wasteload allocations and*

*load allocations.*

**Total Allowable Load**

EPA regulations at 40 CFR §130.2(i) state *the total allowable load shall be the sum of individual WLAs for point sources, LAs for nonpoint sources, and natural background concentrations.* The TMDL for tPCBs for the PAXMH, PAXOH, and PAXTF tidal segments are consistent with 40 CFR §130.2(i), because the total loads provided by MDE equal the sum of the individual WLAs for point sources and the LAs for nonpoint sources.

The allowable load was determined by first estimating a baseline load calculated from model-estimated tPCB loads from point and nonpoint sources using monitoring data. The tidally averaged multi-segment one-dimensional transport model developed for simulating ambient sediment and water column tPCB concentrations was used to determine the specific load reductions that would result in simulated tPCB concentrations in the sediment and water column that meet the TMDL endpoints. The allowable load was calculated as 293.6 g/year, 98.1 g/year, and 80.7 g/year for the PAXMH, PAXOH, and PAXTF tidal segments, respectively.

This load is considered the maximum allowable load the watershed can assimilate and still attain water quality standards. The allowable load was reported in units of grams per year for the average annual load and in grams per day for the maximum daily load. Expressing TMDLs using these units is consistent with Federal regulations at 40 CFR §130.2(i), which states that *TMDLs can be expressed in terms of either mass per time, or other appropriate measure.* The average annual and maximum daily tPCB TMDLs are presented in Table 1 above.

Attainment of the site-specific tPCB water quality TMDL endpoints is expected to take place over time as watershed reductions are implemented and the Chesapeake Bay mainstem tPCB concentrations continue to decline, which also results in the natural attenuation of tPCB levels in the surface layer of the sediments (i.e., the covering of contaminated sediments with newer, less contaminated materials, flushing of sediments during periods of high stream flow, and biodegradation). According to the resultant TMDL scenario, a minimum reduction of 95.3 % of the total baseline loads from all source categories of nonpoint and point sources to the PAXTF tidal segments was required in order to achieve the TMDL. The assigned reductions to the PAXTF tidal segments result in the water column and sediment tPCB TMDL endpoints being met for all tidal segments. Therefore, no load reductions are required in the PAXMH and PAXOH tidal segments. It will take approximately 57.25 years (20,917 days) and 11.5 years (4,215 days) to meet both the water column and sediment TMDL endpoints in the PAXTF and PAXOH tidal segments, respectively, following implementation of load reductions necessary to support designated uses. For the PAXMH tidal segment, the water column and sediment TMDL endpoints are achieved under baseline conditions with a boundary concentration decline of 5%.

**Load Allocations**

The TMDL summaries in Table 1 contain the LAs for the PAXMH, PAXOH, and PAXTF tidal segments. According to Federal regulations at 40 CFR §130.2(g), LAs are best

estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loadings should be distinguished.

The nonpoint sources of tPCBs identified in the PAXMH, PAXOH, and PAXTF watersheds include the Chesapeake Bay mainstem tidal influence, direct atmospheric deposition to the river, one contaminated site, and runoff from non-regulated watershed areas.

LAs are established for the runoff from non-regulated watershed areas and atmospheric deposition in each of the PAXMH, PAXOH, and PAXTF tidal segments. LAs for non-regulated watershed areas for the PAXMH, PAXOH, and PAXTF segments are 119.2 g/year, 73.5 g/year, and 1.0 g/year, respectively. LAs for atmospheric deposition for the PAXMH, PAXOH, and PAXTF segments are 172.1 g/year, 22.9 g/year, and 0.0 g/year, respectively. Additionally, an LA of 0.0 g/year is established for the contaminated site in the PAXTF segment. Nonpoint source loads account for 99.26%, 98.23%, and 65.74% of the total tPCB baseline loads for the PAXMH, PAXOH, and PAXTF segments, respectively. Load reductions are only called for in the PAXTF tidal segment, in which a 99.9% load reduction is required in both non-regulated watershed runoff and atmospheric deposition. No load reductions are called for in the PAXMH and PAXOH segments.

**Wasteload Allocations**

The TMDL summaries in Table 1 contain the WLAs for the PAXMH, PAXOH, and PAXTF tidal segments. As mentioned above, there are numerous permitted point sources within the PAXMH, PAXOH, and PAXTF watersheds including NPDES-regulated stormwater runoff within the watersheds, one NPDES permitted industrial process water facility, and 21 NPDES permitted municipal WWTPs.

WLAs are established for NPDES regulated stormwater discharges in each of the PAXMH, PAXOH, and PAXTF tidal segments. WLAs for NPDES regulated stormwater discharges are presented as aggregated loads by county which total to 2.2 g/year, 1.7 g/year, and 0.5 g/year, for the PAXMH, PAXOH, and PAXTF segments, respectively. Additionally, a WLA of 75.2 g/year is established for the major WWTPs in the PAXTF segment. Point source loads account for 0.74%, 1.77%, and 34.26% of the total tPCB baseline loads for the PAXMH, PAXOH, and PAXTF segments, respectively. Load reductions are only called for in the PAXTF tidal segment, in which an 87.1% load reduction is required for point sources. No load reductions are called for in the PAXMH and PAXOH segments.

Federal regulations at 40 CFR §122.44(d)(1)(vii)(B) require that, for an NPDES permit for an individual point source, the effluent limitations must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA. There is no express or implied statutory requirement that effluent limitations in NPDES permits necessarily be expressed in daily terms. The CWA definition of "effluent limitation" is quite broad (effluent limitation is "any restriction … on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point

sources...)." See CWA 502(11). Unlike the CWA's definition of TMDL, the CWA definition of "effluent limitation" does not contain a "daily" temporal restriction. NPDES permit regulations do not require that effluent limits in permits be expressed as maximum daily limits or even as numeric limitations in all circumstances, and such discretion exists regardless of the time increment chosen to express the TMDL. For further guidance, refer to Benjamin H. Grumbles memorandum (November 15, 2006) titled *Establishing TMDL Daily Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA, et al.,No. 05-5015 (April 25, 2006) and implications for NPDES Permits.*

EPA has authority to object to the issuance of an NPDES permit that is inconsistent with WLAs established for that point source. It is also expected that MDE will require periodic monitoring of the point source(s) through the NPDES permit process, in order to monitor and determine compliance with the TMDL's WLAs. Based on the foregoing, EPA has determined that the TMDL is consistent with the regulations and requirements of 40 CFR Part 130.

*3) The TMDLs consider the impacts of background pollutant contributions.*

PCBs do not occur naturally in the environment. Therefore, unless existing or historical anthropogenic sources are present, their natural background levels are expected to be zero.

*4) The TMDLs consider critical environmental conditions.*

Federal regulations require that TMDL analysis take into account the impact of critical conditions and seasonality on water quality (CFR 2015b). The intent of these requirements is to ensure that load reductions required by this TMDL, when implemented, will produce water quality conditions supportive of the designated use at all times.

EPA regulations at 40 CFR § 130.7(c)(1) require TMDLs to account for critical conditions for stream flow, loading, and water quality parameters. The intent of the regulations is to ensure that: (1) the TMDLs are protective of human health, and (2) the water quality of the waterbodies is protected during the times when they are most vulnerable. Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[1]. Critical conditions are a combination of environmental factor (e.g. flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical condition in the waterbody, an attempt is made to use a reasonable worst-case scenario condition.

The TMDLs for the PAXMH, PAXOH, and PAXTF tidal segments are protective of human health at all times; thus they implicitly account for seasonal variations as well as critical conditions. Bioaccumulation of PCBs in fish is driven by long-term exposure through respiration, dermal contact, and consumption of lower order trophic level organisms. The critical condition defined by acute exposure to temporary fluctuations in PCB water column concentrations during

[1]Memorandum: EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

storm events is not a significant pathway for uptake of PCBs. Since PCB levels in fish tissue become elevated due to long-term exposure, it has been determined that the selection of the annual average tPCB water column and sediment concentrations for comparison to the endpoints applied within the TMDL adequately considers the impact of critical conditions on the "fishing" designated use in the PAXMH, PAXOH, and PAXTF tidal segments.

*5) The TMDLs consider seasonal environmental variations.*

The TMDLs for the PAXMH, PAXOH, and PAXTF tidal segments are protective of human health at all times; thus they implicitly account for seasonal variations. Monitoring of PCBs was conducted on a quarterly basis to account for seasonal variation in establishing the baseline condition for ambient water quality in the PAXMH, PAXOH, and PAXTF tidal segments and estimation of watershed loadings. Since PCB levels in fish tissue become elevated due to long-term exposure, it has been determined that the selection of the annual average tPCB water column and sediment concentrations for comparison to the endpoints applied within the TMDL, adequately considers the impact of seasonal variations on the "fishing" designate use in the PAXMH, PAXOH, and PAXTF tidal segments.

*6) The TMDLs include a Margin of Safety.*

The requirement for a MOS is intended to add a level of conservatism to the modeling process in order to account for uncertainty. Based on EPA guidance, the MOS can be achieved through two approaches. One approach is to reserve a portion of the loading capacity as a separate term (i.e. explicit), and the other approach is to incorporate the MOS into the TMDL through conservative assumptions in the analysis (i.e. implicit).

Uncertainty within the model framework used in this study includes the estimated rate of decline in tPCB concentrations within the Chesapeake Bay mainstem, as well as the initial condition of mean tPCB concentrations that was selected for the model. A study by Ko and Baker (2004) estimated that tPCB concentrations in the upper Chesapeake Bay decrease at a rate of 6.5% per year. As a conservative estimation, this TMDL assumes a PCB attenuation rate of 5.0% per year at the boundary between the PAXMH tidal segment and the Chesapeake Bay mainstem. In addition, and to account for uncertainties, MDE applied an explicit 5% MOS to the PAXTF tidal segment, in order to provide an adequate and environmentally protective TMDL. After the PAXTF tidal segment TMDL is achieved, tPCB concentrations in the PAXMH and PAXOH tidal segments will be well below the water column and sediment TMDL endpoints, as shown in Figures 8 and 9 of the TMDL Report. This level of conservatism functions as an implicit MOS for the PAXMH and PAXOH tidal segments.

*7) The TMDLs have been subject to public participation.*

MDE provided an opportunity for public review and comment on the tPCB TMDLs for the PAXMH, PAXOH, and PAXTF tidal segments. The public comment period was open from March 2, 2017 to March 31, 2017. MDE received one set of two written comments during this period, and the comments were adequately addressed. A copy of the comment response

document was included in the final TMDL submittal to EPA.

## V. Discussion of Reasonable Assurance

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR §122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA. Furthermore, EPA has the authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source. For nonpoint sources, MDE includes a discussion of how LAs will be implemented.

As discussed in the previous sections, the resuspension and diffusion from the bottom sediments have been identified as the major source of PCBs to the PAXMH, PAXOH, and PAXTF tidal segments. However, the loads from resuspension and diffusion from bottom sediments are not considered to be directly controllable (reducible) loads and are considered as internal loads within the modeling framework of the TMDL, so they are not included in the tPCB baseline load and TMDL allocation.

Based on the Ko & Baker study (2004), it is assumed that the tPCB concentrations in the Chesapeake Bay mainstem are decreasing at a rate of 6.5% per year. As a conservative estimation, this TMDL assumes a PCB attenuation rate of 5.0% per year at the boundary between the PAXMH tidal segment and the Chesapeake Bay mainstem as applied in the Back River PCB TMDL (MDE 2011a). Given this rate of decline, and that PCBs are no longer manufactured and their use has been substantially restricted, the tPCB levels in the PAXMH, PAXOH, and PAXTF tidal segments are expected to decline over time due to natural attenuation through processes such as the burial of contaminated sediments with newer, cleaner materials, flushing of sediments during periods of high stream flow, and biodegradation. Model scenarios predict that with the natural attenuation of tPCB concentrations in the Chesapeake Bay mainstem, the tPCB TMDL endpoints in both water column and sediment of the PAXMH, PAXOH, and PAXTF tidal segments will be met in about 57.25 years after a combined load reduction of 95.3% from both point and nonpoint sources within the PAXTF segment.

A new Chesapeake Bay Watershed Agreement was signed on June 16, 2014 which includes goals and outcomes for toxic contaminants including PCBs (CBP 2014). The toxic contaminant goal is to "ensure that the Bay and its rivers are free of effects of toxic contaminants on living resources and human health." Implementation of the goal and outcomes under the new Bay agreement as well as discovering and minimizing any existing PCB land sources throughout the Chesapeake Bay watershed via future TMDL development and implementation efforts could further help to meet water quality goals in the PAXMH, PAXOH, and PAXTF tidal segments.

One alternative for reducing the tPCB concentrations in the water column that MDE may consider is removal of PCB-contaminated systems (i.e., dredging). However, when considering dredging as an option, the risk versus benefit must be weighed as the removal of contaminated sediment may potentially damage the habitat and health of existing benthic and fish

communities. If the PCB-contaminated sediments were removed, load reductions would still be required under the TMDL, since PCBs would continue to enter the Patuxent River tidal segments from the mainstem of the Chesapeake Bay and from the PAXMH, PAXOH, and PAXTF watersheds. However, the removal of these sediments could also mean that water quality supportive of the "fishing" designated use would be achieved in a shorter time frame.

Additionally, discovering and minimizing any existing PCB land sources throughout the Chesapeake Bay watershed via future TMDL development and implementation efforts could further help to meet water quality goals in the PAXMH, PAXOH, and PAXTF watersheds.

Under certain conditions, EPA's NPDES regulations allow the use of non-numeric, Best Management Practices (BMP) water quality based effluent limits (WQBELs). BMP WQBELs can be used where "numeric effluent limitations are infeasible; or the practices are reasonably necessary to achieve effluent limitations and standards or to carry out the purposes and intent of the CWA" (CFR 2015c). For example, MDE's Phase I MS4 permits require restoration targets for impervious surfaces (*i.e.*, restore 10% or 20% of a jurisdiction's total impervious cover with no stormwater management/BMPs), and these restoration efforts have known total suspended solids (TSS) reduction efficiencies. Since PCBs are known to adsorb to sediments and their concentrations correlate with TSS concentrations, the significant restoration requirements in the MS4 permits, which will lead to a reduction in sediment loads entering the PAXMH, PAXOH, and PAXTF tidal segments, will also contribute toward tPCB load reductions and meeting PCB water quality goals. Implementation of similar restoration measures within other jurisdictions in the Chesapeake Bay watershed would also contribute additional reductions to PCB loadings from the PAXMH, PAXOH, and PAXTF watersheds and provide progress towards achieving the TMDL. Other BMPs that focus on PCB source tracking and elimination at the source rather than end-of-pipe controls are also warranted.

Where necessary, the source characterization efforts will be followed with pollution minimization and reduction measures that will include BMPs for reducing runoff from urban areas, identification and termination of ongoing sources (*e.g.*, industrial uses of equipment that contain PCBs), etc. The identified NPDES regulated WWTPs and stormwater control agency permits will be expected to be consistent with the WLAs presented in this report. Numerous stormwater dischargers are located in the PAXMH, PAXOH, and PAXTF watersheds including Phase I and II jurisdictional MS4s, the State Highway Administration's Phase I MS4, industrial facilities, and any construction activities covered through MDE general permits.

Given the persistent nature of PCBs, the difficulty in removing them from the environment and the significant watershed load reductions necessary to achieve water quality goals in the PAXMH, PAXOH, and PAXTF tidal segments, effectiveness of the implementation effort will need to be reevaluated throughout the process to ensure progress is being made towards reaching the TMDLs. MDE also periodically monitors and evaluates concentrations of contaminants in recreationally caught fish, shellfish, and crabs throughout Maryland. MDE will use these monitoring programs to evaluate progress towards meeting the "fishing" designated use.

For more details about Reasonable Assurance for this TMDL, refer to Section 6.0 of the TMDL report.