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

JUL 19 2016

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

Dear Lee 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 Severn River, Mesohaline Chesapeake Bay Tidal Segment, Anne Arundel County, Maryland*. The TMDL report was submitted by the Maryland Department of the Environment (MDE) to EPA for final review on September 14, 2015, and received on October 5, 2015. 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 in Maryland's Section 303(d) List.

The Severn River Mesohaline Chesapeake Bay Tidal Segment (MD-SEVMH) was included on Maryland's 2012 Integrated Report as impaired by nutrients (1996), sediments (1996), fecal coliform in tidal portions of the basin (1996), PCBs in fish tissue (2006) and impacts to biological communities (2008) (MDE 2012). The fecal coliform TMDLs for the restricted areas in the Severn River watershed were approved by EPA in 2006. The Chesapeake Bay nutrient and sediment TMDLs, which were approved by the EPA in December 2010, addressed the nutrient and sediment impairment listings for the Severn River Mesohaline Chesapeake Bay Segment. The TMDL established herein by MDE will address the total PCB (tPCB) listing for the Severn River Mesohaline.

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 PCB TMDL for the Severn River Mesohaline Chesapeake Bay Tidal Segment 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, or your staff may contact Angie Garcia at 215-814-3199.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure

cc: Melissa Chatham, MDE-SSA
Jay Sakai, MDE-WMA

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Decision Rationale
Total Maximum Daily Load of Polychlorinated Biphenyls in the Severn River, Mesohaline Chesapeake Bay Tidal Segment, Anne Arundel County, Maryland

Jon M. Capacasa, Director
Water Protection Division

Date: 7/19/16

Decision Rationale
Total Maximum Daily Load of Polychlorinated Biphenyls in the Severn River, Mesohaline Chesapeake Bay Tidal Segment, Anne Arundel County, 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 Severn River Mesohaline Chesapeake Bay Tidal Segment. This TMDL is established to address impairments of water quality, caused by PCBs, as identified in Maryland's 2012 Integrated Report (fish tissue 2006). The Maryland Department of the Environment (MDE) submitted the report, *Total Maximum Daily Load of Polychlorinated Biphenyls in the Severn River, Mesohaline Chesapeake Bay Tidal Segment, Anne Arundel County, Maryland,* dated September 2015, to EPA for final review on September 14, 2015 and received on October 5, 2015.

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.

II. Summary

Since the Severn River was 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. The TMDL specifically allocates the allowable total PCB (tPCB) loading to the Severn River Mesohaline Chesapeake Bay Tidal

Segment. The annual average TMDLs and maximum daily loads (MDLs) for tPCBs for the Severn River are presented in Table 1. A list of all the NPDES regulated stormwater permits within the Severn River watershed that could potentially convey tPCB loads to the river is presented in Table 2.

Table 1. Summary of tPCB Baseline Loads, TMDL Allocations, Load Reductions, and MDLs in the Severn River

Source	Baseline Load (g/year)	Baseline Percentage (%)	TMDL (g/year)	Load Reduction (%)	MDL (g/day)
Chesapeake Bay Mainstem Influence	6,155.7	98.17	574.4	90.7	3.389
Direct Atmospheric Deposition	47.0	0.75	47.0	0	0.277
Non-regulated Watershed Runoff	29.0	0.46	29.0	0	0.171
Nonpoint Sources	***6,231.7***	***99.38***	***650.4***	***89.6***	***3.838***
WWTP	17.1	0.273	17.1	0	0.145
NPDES Regulated Stormwater	21.5	0.343	21.5	0	0.127
Point Sources	***38.6***	***0.62***	***38.6***	***0***	***0.272***
MOS (5%)	-	-	***36.3***	-	***0.216***
Total	**6,270.3**	**100.00**	**725.3**	**88.4**	**4.326**

Note: Columns may not precisely add to totals due to rounding.
Note: MDL numbers are rounded numbers calculated from rounded conversion factors.

Table 2. NPDES Regulated Stormwater Permit Summary for the Severn River Watershed [1]

MDE Permit	NPDES	Facility	City	County
05-SF-5501	Phase I Permit	State Highway Administration (MS4)	State-wide	All Phase I (Anne Arundel)
09-GP-0000	MDR100000	MDE General Permit to Construct	All	All
04-DP-3316	MD0068306	Anne Arundel Phase 1 MS4	County-wide	Anne Arundel
03-IM-5500	MDR05550	City of Annapolis MS4	City-wide	Anne Arundel
02-SW-1798	MDR001798	Annapolis Bus Company, Inc	Annapolis	Anne Arundel

02-SW-1182	MDR05550	Anne Arundel County-St. Margrets	Annapolis	Anne Arundel
02-SW-1680	MDR001680	Earle's Moving Printing of Annapolis	Annapolis	Anne Arundel
02-SW-1488	MDR001488	Frank Gumpert Printing of Annapolis	Annapolis	Anne Arundel
02-SW-1473	MDR001473	Garman Brothers Lumber	Crownsville	Anne Arundel
02-SW-0051	MDR000051	Gomoljack Block Company	Annapolis	Anne Arundel
02-SW-1279	MDR001279	Hi-Tech Color, Inc	Odenton	Anne Arundel
02-SW-1472	MDR001472	L & W Recycling, Inc	Odenton	Anne Arundel
02-SW-0940A	MDR000940	Lonergans Charter Service, Inc	Millersville	Anne Arundel
02-SW-2047	MDR002047	MDTA-William Preston Lane Jr. Memorial Bridge	Annapolis	Anne Arundel
02-SW-1304	MDR001304	Millersville Landfill & Resource Recovery Facility	Severna Park	Anne Arundel
02-SW-2000	MDR002000	Northrop Grumman-Undersea Systems	Annapolis	Anne Arundel
02-SW-1943	MDR001943	USPS-Annapolis DDU	Annapolis	Anne Arundel
02-SW-2026	MDR002026	US Food Service Inc. – Baltimore Division	Severn	Anne Arundel

Note: [1] Although not listed in this table, some individual process water permits incorporate stormwater requirements and are accounted for within the NPDES Stormwater WLA, as well as additional Phase II permitted MS4s, such as military bases, hospitals, etc.

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 a MOS value. 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 Severn River is located in Anne Arundel County, Maryland, on the Western Shore of the Chesapeake Bay. The Severn River is approximately 12.5 miles in length, with a watershed area of approximately 43,985 acres (178 square kilometers). The City of Annapolis is located southwest of the Severn River mouth. The dominant tide in this region is the lunar semi-diurnal tide. According to the United States Geological Survey's (USGS) 2006 land cover data (USGS 2013), which was specifically developed to be applied within the Chesapeake Bay Program's (CBP) Phase 5.3.2 watershed model, land use in the Severn River watershed is a mixture of forest, urban, and agriculture. Forest occupies approximately 29.1% of the watershed, while 25.1% is water/wetland, 42.6% is urban, and 3.2% is agriculture.

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 2015a). The designated use of the waters of the Severn River is Use II – *Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting* (COMAR 2015b).

The Maryland Department of the Environment (MDE) has identified the waters of the Severn River (Integrated Report Assessment Unit ID: SEVMH-02131002) on the State's 2012 Integrated Report as impaired by nutrients (1996), sediments (1996), fecal coliform in tidal portions of the basin (1996), and PCBs in fish tissue (2006). The fecal coliform TMDLs for the restricted areas in the Severn River watershed were approved by the EPA in 2006. The Chesapeake Bay nutrient and sediment TMDLs, which were approved by the EPA in December 2010, has addressed the nutrient and sediment impairment listings for the Severn River. The TMDL established herein by MDE will address the total PCB (tPCB) listing for the Severn River.

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. The linkage between the "fishing" designated use and PCB concentrations in the water column is via the uptake and bioaccumulation of PCBs by aquatic organisms. Humans can be exposed to PCBs via consumption of aquatic organisms, which over time have bioaccumulated PCBs.

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 PCB TMDL submitted by MDE is designed to allow for the attainment of the Severn River Mesohaline Chesapeake Bay Tidal Segment's designated uses, and to ensure that there will be no PCB impacts affecting the attainment of these uses. Refer to Table 1 above for a summary of allowable loads.

Since the Severn River was identified as impaired for PCBs in fish tissue, the overall objective of the tPCB TMDL established in this document 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. This

objective was achieved via the use of extensive field observations and a multi-segment tidally-averaged one-dimensional transport model. This water quality model simulates the tPCB dynamic interactions between the water column and bottom sediments within the Severn River embayment and the Chesapeake Bay mainstem (MDE 2005, Kuo et al. 2005).

In 2011 and 2012, monitoring surveys were conducted by MDE to measure water column tPCB concentrations at seven tidal and six non-tidal monitoring stations throughout the Severn River and its watershed. One of the tidal stations is located at the boundary of the Severn River and the main stem of the Chesapeake Bay. The tPCB water column concentration data from this station is required to characterize tidal influences from the Bay. Sediment samples were collected at tidal stations, including the boundary station, in 2011 to characterize tPCB sediment concentrations. Also, MDE collected fish tissue samples for PCB analysis in the Severn River and its watershed in 2002, 2004, 2007, 2011, and 2012. The tPCB concentrations for 4 out of 6 fish tissue composite samples collected in 2002, 2004 and 2007 exceed the listing threshold; 5 out of 6 fish tissue composite samples collected in 2011 and 2012 (white perch and yellow perch) exceed the listing threshold, demonstrating that PCB impairment exists within the Severn River.

As part of the analysis, both point and nonpoint sources of PCBs have been identified throughout the Severn River watershed. Nonpoint sources of PCBs include: 1) Chesapeake Bay mainstem tidal influence, 2) direct atmospheric deposition to the river, and 3) runoff from non-regulated watershed areas within the Severn River's direct drainage. The transport of PCBs from bottom sediments to the water column through resuspension and diffusion can also be a major source of PCBs in estuarine systems; however under the framework of this TMDL it is not considered a source. Point Sources in the Severn River watershed include two wastewater treatment plants (WWTP), five industrial process water discharges, and eighteen storm water discharges regulated under Phase I and Phase II of the NPDES stormwater program.

Nonpoint sources include loads from:

Chesapeake Bay Mainstem Tidal Influence – The Severn River embayment is highly influenced by tidal exchange of PCBs from the Chesapeake Bay mainstem. Based on the tPCB concentrations measured at the mouth of the Severn River and the dispersion coefficient calculated and calibrated from the available salinity data, the Chesapeake Bay tPCB baseline load of 6,155.7 g/year is the major source of tPCB to the Severn River embayment.

Atmospheric Deposition – There is no recent study of the atmospheric deposition of PCBs to the surface of the Severn River. Based on a Chesapeake Bay Program (CBP) 1999 study, a 1.6 $\mu g/m^2$/year tPCB depositional rate was estimated for non-urban areas and a 16.3 $\mu g/m^2$/year tPCB depositional rate was estimated for urban areas. 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) $\mu g/m^2$/year of tPCBs (DRBC 2003). While urban land use accounts for 43% of the Severn River watershed the land area is comprised primarily of low and medium density residential land uses. Therefore, the 1.6 $\mu g/m^2$/year tPCB depositional rate for non-urban areas resultant from CBP's 1999 study were applied in the Severn River watershed. Therefore, the atmospheric deposition

load to the direct watershed can be calculated by multiplying 1.6 µg/m2/year by the watershed area of 148.2 km2, which results in a load of 237.12 g/year. However, according to Totten et al. (2006), only a portion of the atmospherically deposited tPCB load to the terrestrial part of the watershed is expected to be delivered to the embayment. Applying the PCB pass-through efficiency estimated by Totten et al. (2006) for the Delaware River watershed of approximately 1%, the atmospheric deposition load to the Severn River from the watershed is approximately 2.4 g/year. However, this load is accounted for within the loading 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 loads described below.

Similarly, the direct atmospheric deposition load to the surface of the river of 47.0 g/year was calculated by multiplying the surface area of the river (29.4 km^2) and the deposition rate of 1.6 $\mu g/m^2$/year.

Non-Regulated Watershed Runoff – The non-regulated watershed runoff tPCB load corresponds to the non-urbanized areas (*i.e.*, primarily forest, agricultural and wetland areas) of the watershed. MDE collected water column samples for PCB analysis at 6 non-tidal monitoring stations in the Severn River on May, June, July, and October of 2011 and March of 2012. To calculate the watershed flow, the daily flow rates from January 1, 2004 to December 31, 2013 at the United States Geological Survey (USGS) station located at South Fork Jabez Branch at Millersville in the Severn River watershed (USGS 01589795) were averaged. The direct drainage of the Severn River was divided into six subwatersheds. The flow of each subwatershed was calculated by dividing the USGS 01589795 station mean flow by the USGS drainage area, and multiplying this quotient by the subwatershed area. A tPCB load for each sample was then calculated based on the observed tPCB concentration and average daily flow, and the relationship between loads and flows was developed via regression analysis for the monitoring station. With this relationship, the tPCB load corresponding to any flow can be estimated. The total direct drainage watershed baseline load of the Severn River (50.5 g/year) is the sum of the loads of the 6 direct drainage subwatersheds. As mentioned above, about 2.4 g/year of the Severn River watershed's baseline load is attributed to atmospheric deposition to the land surface of the direct drainage, and is inherently captured within the total watershed tPCB baseline load of 50.5 g/year. The non-regulated watershed runoff tPCB baseline load (29.0 g/year) was estimated by multiplying the percentage of non-urban land use (57.4 %) within the watershed by the total watershed baseline load (50.5 g/year).

Resuspension and Diffusion from Bottom Sediments –Under current conditions (due to elevated particulate tPCB concentrations resultant from PCB adsorption to the organic carbon component of suspended sediment in the water column when compared to tPCB concentrations in the bottom sediment) there is a net transport of PCBs to the bottom sediment from the water column in the Severn River through settling and deposition. The water quality model, applying observed tPCB concentrations in the water column and sediment, predicts a net tPCB transport of 5,191 g/year from the water column to the bottom sediment in the Severn River under baseline conditions.

Point sources include loads from:

Industrial Process Water Facilities – Five industrial process water facility discharges were identified within the Severn River watershed; their permit subcategories are "cooling water," "dewatering non-construction", "groundwater remediation chemical" and marinas. These five facilities have SIC codes defined in Virginia's guidance as having no potential to discharge PCBs. Therefore, there is no baseline PCB load from these five industrial facilities.

Wastewater Treatment Plants – There are two wastewater treatment plants (WWTP) in the Severn River Watershed: Annapolis Water Reclamation Facility and Naval Support Activity Annapolis WWTP. No tPCB effluent concentration data is available for the Annapolis Water Reclamation Facility or the Naval Support Activity Annapolis WWTP, so the concentration was estimated based on the median tPCB effluent concentration from 13 WWTPs monitored by MDE in the Chesapeake Bay watershed (MDE 2006). The baseline tPCB load for these facilities were calculated based on the design flow from these facilities and the estimated median tPCB concentration from the 2006 study. Table 3 provides information on the data used in calculating the baseline loads.

Table 3: Summary of Municipal WWTP tPCB Baseline Loads

Facility Name	NPDES #	Average Concentration (ng/L)	Design Flow (MGD)	tPCB Baseline Load (g/year)
Naval Support Activity Annapolis WWTP	MD0023523	0.906 [1]	0.700	0.876
Annapolis Water Reclamation Facility	MD0021814	0.906 [1]	13.000	16.273

1 These concentration are based off of a 2006 MDE study that analyzed PCB concentrations from the effluent of 13 WWTPs in Maryland

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 Severn River watershed is entirely located within Anne Arundel County, Maryland. The NPDES stormwater permits within the watershed include: (i) the area covered under Anne Arundel County's Phase I jurisdictional MS4 permit, (ii) Phase II MS4 permit for the City of Annapolis, (iii) the State Highway Administration's Phase I MS4 permit, (iv) state and federal general Phase II MS4s, (v) industrial facilities permitted for stormwater discharges, and (vi) construction sites.

The NPDES Regulated Stormwater tPCB Baseline Load (21.5 g/year) was estimated by multiplying the percentage of urban land use (42.6%) of the direct drainage by the total direct drainage baseline load (50.5 g/year).

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 Severn River embayment and the Chesapeake Bay mainstem (MDE 2005, Kuo et al.2005).

The river was divided into 6 segments and the direct drainage watershed into 6 subwatersheds. The observed average tPCB concentrations in each segment were used as the model input representing baseline conditions. 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 study assumes a PCB attenuation rate of 5.0% per year at the boundary between the Severn River and the Chesapeake Bay mainstem. All other inputs (i.e., fresh water inputs, tidal exchange rates, sediment and water column exchange rates, atmosphere deposition, and burial rate) were kept constant.

The model was initially run for 40,000 days to predict the time needed for the water column tPCB concentration to meet the site-specific tPCB water column TMDL endpoint. The results indicated that when the site-specific water column TMDL endpoint (0.195 ng/L) was met the site-specific sediment TMDL endpoint (18.3 ng/g) was met as well. The average PCB concentration of the six segments was used in assessing both the water column and the sediment results. Consequently, the model was run again for 40,000 days to predict the time needed for the sediment concentrations to reach the TMDL endpoint. After 16,878 days (about 46.2 years) the water column concentration reached 0.195 ng/l, at which time the sediment tPCB concentration was equal to 6.5 ng/L, well below the sediment TMDL endpoint of 18.3 ng/g.

The Chesapeake Bay mainstem tidal influence is the primary source of tPCB baseline loads resulting in the PCB impairment in the Severn River embayment. The transport of PCBs from bottom sediments to the water column through resuspension and diffusion can also be a major source of PCBs in estuarine systems; however, under the framework of this TMDL it is not considered a directly controllable source and it is considered as an internal load within the modeling framework of the TMDL, therefore they are not included in the tPCB baseline load and TMDL allocation. Attainment of the site-specific tPCB water quality TMDL endpoints is expected to take place over time as 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). Assuming that the tPCB concentrations in the Chesapeake Bay mainstem will continue to decline, at or above the current rate of 5% per year, no additional tPCB reductions will be necessary to meet the "fishing" designated use in the Severn River embayment.

IV. Discussion of Regulatory Conditions

EPA finds that MDE has provided sufficient information to meet all of the seven basic requirements for establishing a PCB TMDL for the Severn River watershed. 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.

Water Quality Standards consist of three components: designated and existing uses; narrative and/or numerical water quality criteria necessary to support those uses; and an anti-

degradation statement. 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 2015a). The designated use of the waters of the Severn River is Use II – *Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting* (COMAR 2015b). There are no "high quality," or Tier II, stream segments located within the direct drainage portions of the Severn River (COMAR 2015d).

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 (14ng/L) and salt water (30ng/L) chronic tPCB criteria for the protection of aquatic life (COMAR 2015c; US EPA 2013a). As the Severn River is a tidal system, both the human health criterion and saltwater aquatic life chronic criterion are applied for assessing these waters. The water column mean tPCB concentration in the Severn River exceeds the human health tPCB criterion of 0.64 ng/L; however, none of the water column samples exceed the salt water aquatic life tPCB criterion of 30 ng/L.

In addition to the water column criteria described above, fish tissue monitoring can serve as an indicator of PCB water quality conditions. The Maryland fish tissue monitoring data is used to issue fish consumption advisories/recommendations and determine whether Maryland waterbodies are meeting the "fishing" designated use. Currently Maryland applies a tPCB fish tissue listing threshold of 39 ng/g. 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 2012). MDE collected fish tissue samples for PCB analysis in the Severn River and its watershed in 2002, 2004, 2007, 2011, and 2012. The tPCB concentrations in 4 out of 6 fish tissue composite samples collected in 2002, 2004 and 2007 exceed the listing threshold; 5 out of 6 fish tissue composite samples collected in 2011 and 2012 (white perch and yellow perch) exceed the listing threshold, demonstrating that PCB impairment exists within the Severn River.

Since the overall objective of the tPCB TMDL for the Severn River is to ensure the support of the "fishing" designated use, the tPCB fish tissue listing threshold (39 ng/g) was translated into an associated water column tPCB threshold concentration to apply within this analysis as the water column TMDL endpoint. The tPCB fish tissue listing threshold was translated into an associated tPCB water column concentration as 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 Factor (Adj-tBAF) of 199,953 L/kg for the Severn River, 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 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

concentration of 0.195 ng/L, derived from the tPCB fish tissue listing threshold, is selected as the TMDL endpoint for the Severn river, which is more stringent than the value of 0.64 ng/L for human health, and the fresh and salt water chronic aquatic life tPCB criteria of 14 ng/L and 30 ng/L, respectively.

Similarly, in order to establish a tPCB TMDL endpoint for the sediment in the River, a target tPCB sediment concentration was derived from the tPCB fish tissue listing. This was done using the Adjusted Sediment Bioaccumulation Factor (Adj-SediBAF) of 2.13 (unitless) for the Severn River. 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. The most environmentally conservative of the Adj-SediBAFs is then selected to calculate the sediment TMDL endpoint tPCB concentration. Based on this analysis, the tPCB level of 18.3 ng/g derived from the fish tissue listing threshold is set as the sediment TMDL endpoint.

EPA believes 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 *that 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 Severn River Mesohaline Chesapeake Bay Tidal Segment 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 725.3 g/year for the Severn River.

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/year for the average annual load and in grams/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.

Attainment of the site-specific tPCB water quality TMDL endpoints is expected to take

place over time as 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). Assuming that the tPCB concentrations in the Chesapeake Bay mainstem will continue to decline, at or above the current rate of 5% per year, no additional tPCB reductions will be necessary to meet the "fishing" designated use in the Severn River embayment.

Load Allocations

The TMDL summary in Table 1 contains the LAs for the Severn River. 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 PCBs identified in the Severn River Watershed include the Chesapeake Bay mainstem tidal influence, the direct atmospheric deposition to the river, and the runoff from non-regulated watershed areas within the Severn River's direct drainage. The transport of PCBs from bottom sediments to the water column through resuspension and diffusion can also be a major source of PCBs in estuarine systems; however under the framework of this TMDL it is not considered a controllable source and thus is not assigned a tPCB baseline load or TMDL allocation.

Model simulation results show that both the water column and sediment tPCB targets will be met in about 46.2 years with only natural attenuation of tPCB concentration in the Chesapeake Bay mainstem. Therefore, no reduction is assigned to the watershed loads, including nonpoint source loads from the watershed.

Wasteload Allocations

There are 20 permitted point sources within the Severn River watershed that could potentially convey tPCBs loads to the Severn River Mesohaline Chesapeake Bay Tidal Segment. Point Sources include two WWTP, and 18 stormwater discharges regulated under Phase I and Phase II of the NPDES stormwater program, industrial facilities permitted for stormwater discharges, and construction sites. There are five industrial process water facilities in this watershed which have been determined to have no potential to discharge PCBs.

The WWTP and NPDES Regulated Stormwater WLA for the Severn River Watershed is 17.1 g/year and 21.5 g/year, respectively. Point source loads only account for 0.62% of the total tPCB baseline load. See discussion above on how the baseline loads were calculated. No reduction was assigned to the point source loads from the watershed.

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 condition 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 TMDL is protective of human health at all times; thus it implicitly accounts for

[1] EPA memorandum regarding 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.

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 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 Severn River.

5) The TMDLs consider seasonal environmental variations.

The TMDL is protective of human health at all times; thus it implicitly accounts for seasonal variations. 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 Severn River.

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 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. In order to account for these uncertainties, MDE applied an explicit 5% MOS, in order to provide an adequate and environmentally protective TMDL.

7) The TMDLs have been subject to public participation.

MDE provided an opportunity for public review and comment on the PCB TMDL for the Severn River Mesohaline Chesapeake Bay Tidal Segment. The public comment period was open from July 29, 2015 through August 27, 2015. MDE received no written comments during the public comment period.

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.

As discussed above, the Chesapeake Bay mainstem tidal influence and resuspension and diffusion from the bottom sediments have been identified as the two major sources of PCBs to the Severn River embayment. However, the loads from resuspension and diffusion from bottom sediments are not considered to be directly controllable (reducible) loads and it is considered as an internal load 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, and a conservative estimation, it is assumed that the tPCB concentrations in the Chesapeake Bay mainstem are decreasing at a rate of 5% per year. Given this rate of decline, and that PCBs are no longer manufactured and their use has been substantially restricted, the tPCB levels in the Severn River embayment 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 targets in both water column and sediment of the Severn River embayment will be met in about 46.2 years. No reduction is needed from the watershed loads as they account for only 1.83% of the total tPCB baseline load.

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 toxic contaminant 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 Severn River.

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. In the case of the Severn River, by allowing for natural attenuation of PCBs in the sediment, water quality supportive of the "fishing" designated use will be achieved within 46.2 years while avoiding disturbance of the benthic habitat.

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 Severn River watershed.

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 Severn River, 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 Severn River watershed 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 WWTP 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 watershed including Municipal Phase I MS4, the SHA Phase I MS4, industrial facilities, and any construction activities on area greater than 1 acre.

An example of one jurisdiction with a PCB TMDL implementation plan is Montgomery County. The current Montgomery County Phase I MS4 permit requires that the jurisdiction develop implementation plans to meet its assigned NPDES Regulated Stormwater WLAs. In this TMDL, because the watersheds load was estimated at only 0.27% of the total PCB baseline load, the Anne Arundel County Phase I MS4 permit was not assigned a reduction and therefore no PCB implementation plan will be required. Development of implementation plans by regulated stormwater dischargers within other jurisdictions in the Chesapeake Bay watershed would also contribute additional reductions to PCB loadings from the Chesapeake Bay and provide progress towards achieving the TMDL.

PCBs are still being released to the environment via accidental fires, leaks, disposal of PCB containing products, etc. Therefore, MDE will continue to periodically monitor and evaluate concentrations of contaminants in recreationally caught fish, shellfish, and crabs throughout Maryland. MDE will use these monitoring programs to evaluate the PCB impairment in the Severn River embayment on an ongoing basis.

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