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

AUG 0 2 2016

Mr. D. Lee Currey, Director
Science Services 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 Bush River Oligohaline Segment, Harford County, Maryland.* The TMDL report was submitted by the Maryland Department of the Environment (MDE) to EPA for final review on April 6, 2016, and received on April 12, 2016. 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 Bush River Oligohaline Segment (MD- BSHOH) was listed in the State's 2014 Integrated Report as impaired by nitrogen (1996, Open-Water Fish and Shellfish Use; 2012, Seasonal Migratory Fish Spawning and Nursery Use), phosphorus (1996, Open-Water Fish and Shellfish Use; 2012, Seasonal Migratory Fish Spawning and Nursery Use) and PCBs in fish tissue (2002). The Chesapeake Bay TMDL, which was established by the EPA on December 29, 2010, addressed the nutrients listings for the Bush River Oligohaline segment. The TMDL established herein by MDE will address the PCBs (total PCB) listing for the Bush River Oligohaline Segment.

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 TMDL for the Bush River Oligohaline Segment satisfies 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 Bush River Oligohaline Segment, Harford County, Maryland

Jon M. Capacasa, Director
Water Protection Division

Date: 8/2/2016

Decision Rationale
Total Maximum Daily Load of Polychlorinated Biphenyls in the Bush River Oligohaline Segment, Harford 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 Bush River Oligohaline Segment. This TMDL is established to address impairments of water quality, caused by PCBs, as identified in Maryland's 2014 Integrated Report (fish tissue 2002). The Maryland Department of the Environment (MDE) submitted the report, *Total Maximum Daily Load of Polychlorinated Biphenyls in the Bush River Oligohaline Segment, Harford County, Maryland,* dated March 2016, to EPA for final review on April 6, 2016, and was received on April 12, 2016.

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 Bush River Oligohaline Segment, Harford County, Maryland,* unless otherwise noted.

II. Summary

Since the Bush River Oligohaline Segment 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 tPCB loading to the Bush River Oligohaline Segment. The annual average TMDLs and maximum daily loads (MDLs) for tPCBs for the Bush River Oligohaline Segment are presented in Table 1 below. A list of all the National Pollutant Discharge Elimination System (NPDES) regulated stormwater permits within the Bush River watershed that could potentially convey tPCB loads to the river is presented in Table 2 below. In addition, individual NPDES regulated permits for wastewater treatment plants (WWTP) are included in Table 4 of the background section below.

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

Source	Baseline Load (g/year)	Baseline Load (%)	TMDL (g/year)	Load Reduction (%)	MDL (g/day)
Direct Atmospheric Deposition	48.9	24.0%	18.58	62%	0.075
Contaminated Site	2.4	1.2%	2.37	0%	0.010
Maryland Non-regulated Watershed Runoff	82.5	40.6%	29.88	64%	0.121
Nonpoint Sources	***133.8***	***65.8%***	***50.83***	***62%***	***0.206***
NPDES Regulated Municipal WWTPs[1]	19.9	9.8%	7.56	62%	0.064
NPDES Regulated Stormwater[2]	49.7	24.4%	18.89	62%	0.077
Point Sources	***69.6***	***34.2%***	***26.45***	***62%***	***0.141***
MOS	-	-	4.07		0.016
Total	**203.4**	**100.0%**	**81.35**	**60%**	**0.363**

Note: [1] See Table 2 below for individual tPCB WLAs for each Municipal WWTP
[2] See Table 3 below for a list of NPDES Regulated Stormwater Permits

Table 2: Individual tPCB WLAs (g/day and g/year) for each Municipal WWTP

Facility Name	NPDES #	Baseline Load (g/year)	Reduction (%)	TMDL (g/year)	MDL (g/year)
Harford County - Sod Run WWTP	MD0056545	18.4	62%	6.99	0.059
US Army Aberdeen Proving Ground – Edgewood Area WWTP	MD0021229	1.5	62%	0.57	0.005

Table 3. NPDES Regulated Stormwater Permit Summary for the Bush River[1]

MDE Permit	NPDES	Facility	County
11-DP-3313	MD0068276	State Highway Administration(MS4)	All Phase I (Harford)
14-GP-0000	MDRC	MDE General Permit to Construct	All
11-DP-3310	MD0068268	Harford County Phase I MS4	Harford
03-IM-5500	MDR055500	Aberdeen Phase II MS4	Harford
03-IM-5500	MDR055500	Bel Air Phase II MS4	Harford
02-SW-2190	MDR002190	American Auto Recyclers	Harford
02-SW-0164	MDR000164	American Color Graphics	Harford
02-SW-0935	MDR000935	Crouse Construction Co., Inc.	Harford
12-SW-1597	MDR001597	Crown Specialty Packaging	Harford
02-SW-0188	MDR000188	Citrus And Allied Essences, Ltd.	Harford
12-SW-1727	MDR001727	Harford County - Sod Run Wastewater Treatment Plant	Harford
12-SW-1271	MDR001271	Harford County Transportation Services Facility	Harford
12-SW-2042	MDR002042	MDTA - JFK Memorial Highway Maintenance Facility #1	Harford
12-SW-1714	MDR001714	Harford County Hickory II Highway Maintenance Facility	Harford
02-SW-0738	MDR000738	Modular Components National Inc	Harford
12-SW-0016	MDR000016	Town of Bel Air - DPW	Harford
12-SW-2095	MDR002095	Harford County Dept of Parks and Recreation	Harford
12-SW-2094	MDR002094	Parks & Recreation Jarrettsville Maintenance Facility	Harford
02-SW-0539	MDR000539	Auto Wreckers Of Edgewood	Harford
02-SW-1470	MDR001470	Smiths Detection Edgewood, Inc.	Harford

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 Bush River is a tidal estuary in Harford County, Maryland, located about 15 miles (24 km) northeast of Baltimore. The Bush River Oligohaline Segment is approximately 9 miles (14 km) in length to the Chesapeake Bay mainstem, with a watershed area of approximately 336.2 square kilometers (km^2). The watershed of the Bush River Oligohaline Chesapeake Bay Tidal Segment (MD-BSHOH) includes three watersheds: Bush River watershed (MD-02130701, with exclusion of Romney Creek drainage area), Winters Run watershed (Lower Winters Run, MD-02130702 and Atkisson Reservoir, MD-02130703) and Bynum Run watershed (MD-02130704). 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, urban land occupies approximately 36.9% of the Bush River watershed, while 34.5% is forest, 7.5% is water/wetland, and 21.1% 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 2014a). The designated use of the waters of the Bush River is Use II – *Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting* (COMAR 2014b). There are two "high quality", or Tier II, stream segments (Benthic Index of Biotic Integrity [BIBI] and Fish Index of Biotic Integrity [FIBI] aquatic life assessment scores > 4 [scale 1-5]) located within the Bush River watershed. Within the Winters Run sub-watershed, Otter Point Creek is a Tier II stream, and in the Bynum Run sub-watershed, an unnamed tributary of Bynum Run is also a Tier II stream. (COMAR 2014c).

MDE has identified the waters of the Bush River (MD-BSHOH) on the State's 2014 Integrated Report as impaired by nitrogen (1996, Open-Water Fish and Shellfish Use; 2012, Seasonal Migratory Fish Spawning and Nursery Use), phosphorus (1996, Open-Water Fish and Shellfish Use; 2012, Seasonal Migratory Fish Spawning and Nursery Use) and PCBs in fish tissue (2002). Four 8-Digit watersheds drain to the Bush River; Bush River (Integrated Report Assessment Unit ID: MD-02130701), Lower Winters Run (MD-02130701), Atkisson Reservoir (MD-02130703), and Bynum Run (MD-02130704). The non-tidal streams of Bush River were identified as impaired by sulfates (2014), chlorides (2014) and total suspended solids (2014) on the 2014 Integrated Report (MDE 2014a). The non-tidal streams of lower Winters Run and Atkisson Reservoir watersheds were both listed for biological impairments (2002). The Bynum Run watershed was listed as impaired for sediment (2012) and an unnamed tributary of Bynum Run (MD-MD-021307041131-UTBynum_Run) was identified as being impaired due to temperature (2014). The Chesapeake Bay TMDL, which was established by the EPA on December 29, 2010, addressed the nutrients listings for the Bush River. EPA approved a TMDL

for sediment in the Bynum Run watershed on September 30, 2011. The TMDL established herein by MDE will address the tPCB listing for the Bush River Oligohaline Segment (MD-BSHOH), for which a data solicitation was conducted, and all readily available data have been considered.

PCBs do not occur naturally in the environment. Therefore, MDE identifies 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 tPCB TMDL submitted by MDE is designed to allow for the attainment of the Bush River Oligohaline 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 Bush 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 field observations and a multi-segment water quality model. The model incorporates the influences of tide, atmospheric deposition, freshwater inputs, and exchanges between the water column and bottom sediments, thereby representing realistic dynamic transport within the area.

In 2013 and 2014, monitoring surveys were conducted by MDE to measure water column tPCB concentrations in the Bush River. Tidal monitoring was conducted at five stations in the Bush River. In addition to providing assessment data, the monitoring plan was developed in order to fully characterize the impairment and inform model development. One of the tidal stations was located at the boundary between the Bush River and the main stem of the Chesapeake Bay, to evaluate the tidal influences from the Bay. Sediment samples were also collected at each tidal station, including the boundary station, to characterize tPCB sediment concentrations. Non-tidal water column monitoring was conducted concurrently with the tidal monitoring at two stations in the direct drainage watershed of the Bush River, one station in Bynum Run and one station in Winters Run. These data were required to estimate loadings from the watersheds.

In addition, MDE collected 6 fish tissue composite samples (30 total fish) for PCB analysis in the Bush River in May and June 2014. The tPCB concentrations for all of the fish tissue composite samples exceeded the listing threshold, demonstrating that a PCB impairment exists within the Bush River.

As part of the analysis, both point and nonpoint sources of PCBs have been identified throughout the Bush River watershed. Nonpoint sources of PCBs include: 1) Chesapeake Bay mainstem tidal influence, 2) direct atmospheric deposition to the river, 3) contaminated sites (areas with known PCB soil contamination, as documented by state or federal hazardous waste cleanup programs) and 4) runoff from non-regulated watershed area. 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 Bush River watershed include two municipal wastewater treatment plants (WWTP), three industrial process water discharges, and twenty 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 tidal influence from the Chesapeake Bay mainstem serves as a source of PCBs to the Bush River, but 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 – There is no recent study of the atmospheric deposition of PCBs to the surface of the Bush 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 37% of the Bush 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 Bush 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 336.2 km^2, which results in a load of 538 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 Bush River from the watershed is approximately 5.38 g/year. 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 NPDES Regulated Stormwater loads described below.

Similarly, the direct atmospheric deposition load to the surface of the Bush River of 48.9 g/year was calculated by multiplying the surface area of the river (30.5 km^2) and the deposition rate of 1.6 $\mu g/m^2$/year.

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. Within the Bush River watershed, only one site has been identified with PCB soil concentrations at or above method detection levels, as determined via soil sample results contained within MDE Land Management Administration's (LMA) contaminated site survey and investigation records. Details about this site are in Table 4 below. The median tPCB concentration of the site samples was multiplied by the soil loss rate, which is a function of soil type, pervious area, and land cover, to estimate the tPCB edge of field (EOF) load. A sediment delivery ratio was applied to calculate the final edge-of-stream (EOS) load. The contaminated site tPCB baseline load is estimated to be 2.37 g/year. A detailed description of the methodology used to estimate the contaminated site tPCB baseline load is presented in Appendix H of the TMDL report.

Table 4: Summary of Contaminated Site tPCB Baseline Loads

Site Name	Watershed	Area (acres)	EOS Load (g/year)
MD 446 Union Road Dump	Bush River	18.4	2.37

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. To calculate total baseline watershed loads, MDE collected water column samples for PCB analysis at 4 non-tidal monitoring stations in the Bush River Watershed in August and October of 2013, and March of 2014. To calculate the watershed flow, the daily flow rates from October 1, 2007 through September 30, 2014 at the USGS station located in Bel Air in the Bush River watershed (USGS 01581500) were averaged. The Bush River was divided into 5 segments and the flow from each corresponding subwatershed was calculated by multiplying the monthly mean unit area flow of the station by the subwatershed area. The Bush River watershed baseline tPCB loading (37g/year) is the sum of loads from each subwatershed calculated by multiplying the subwatershed flow with the average of the measured tPCB concentration (0.49 ng/L) at the two non-tidal stations located at the Bush River watershed. The same process was conducted for the Bynum Run and Winters Run watersheds separately. The total baseline tPCB load from Bush River watershed (134.6g/year) is the sum of the baseline loads from the Bush River watershed, the Bynum Run watershed and the Winters Run watershed. Atmospheric deposition to the land surface of the above three watersheds are inherently captured within this total.

Using the total baseline load, the non-regulated watershed runoff tPCB baseline load was estimated by multiplying the percentage of non-urban land use (63.1%) within the Bush River watershed by the total Bush River watershed tPCB baseline load (134.6 g/year). The non-

regulated watershed runoff tPCB baseline load for the Bush River watershed is 84.9 g/year. The one contaminated site, MD 466 Union Road Dump, is located within the non-urbanized area, and so its tPCB load (2.37 g/year) is subtracted from this total load, resulting in a non-regulated watershed runoff tPCB baseline load of 82.5 g/year. The remaining load corresponds to the NPDES-regulated stormwater area of the watershed.

Resuspension and Diffusion from Bottom Sediments – The water quality model, applying observed tPCB concentrations in the water column and sediment, predicts a gross tPCB load of 3,328 g/year from bottom sediment to the water column through re-suspension and diffusion in the Bush River. This load contribution is resultant from other point and nonpoint source inputs (both historic and current). 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 internal loading and is not assigned a baseline load or allocation.

Point sources include loads from:

Industrial Process Water Facilities – Three industrial process water facility discharges were identified within the Bush River watershed. One industrial process water facility has a standard industrial classification (SIC) code defined in Virginia's guidance as having no potential to discharge PCBs. The other two facilities have SIC codes defined as having potential to discharge PCBs, but considered *de minimis* based on average flow. Therefore these three facilities were not assigned a baseline load or allocation within this TMDL.

Wastewater Treatment Plants – There are two municipal WWTPs within the Bush River watershed. The outfall from one of the facilities, Sod Run WWTP, was sampled by MDE for PCB analysis. As no tPCB effluent concentration data is available for the other facility (US Army Aberdeen Proving Ground – Edgewood Area), the tPCB concentration from this facility was estimated based on the median tPCB effluent concentration from 13 WWTPs monitored by MDE in the Chesapeake Bay watershed (MDE 2006). Their baseline tPCB loadings were calculated based on their daily monitoring record (DMR) average discharge flows and the tPCB concentration. Table 2 above provides the tPCB baseline loads for the individual municipal WWTPs.

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 Bush River watershed is entirely located within Harford County, Maryland. The NPDES stormwater permits within the watershed include: (i) the area covered under Harford County's Phase I jurisdictional MS4 permit, (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 (see Table 3, above). The load for all NPDES Stormwater permittees is presented as an aggregate load.

The NPDES regulated stormwater tPCB baseline loads of the Bush River watershed (49.7 g/year) was estimated by multiplying the percentage of urban land use (36.9%) within the Bush River watersheds by the total Bush River watershed tPCB baseline loads (134.6 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 Bush River and the Chesapeake Bay. The system was divided into 5 segments and the watershed into 5 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. 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.

To determine what percent reduction of the total load is necessary for the Bush River to meet its water quality and sediment TMDL endpoints, different model scenario runs were conducted (See Appendix D of the TMDL report). Model scenarios predict that with the natural attenuation of tPCB concentrations in the Chesapeake Bay mainstem (declining at an annual rate of 6.5%), and an overall 60% load reduction of total baseline loads from the Bush River watershed, from direct atmosphere deposition to the River surface and from two municipal WWTPs, both tPCB TMDL endpoints in both water column (0.12 ng/L) and sediment (1.14 ng/g) of the Bush River embayment will be met in about 81 years (29,744 days).

The dominant tPCB sources to the water column of the Bush River are from sediment. However, under the framework of this TMDL, the tPCB loads from sediment are considered to be internal source, therefore no baseline or load allocation is assigned to this load. 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 Bush River Oligohaline Segment. 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 Bush River is Use II – *Support of*

Estuarine and Marine Aquatic Life and Shellfish Harvesting (COMAR 2014b). There are two "high quality", or Tier II, stream segments (Benthic Index of Biotic Integrity [BIBI] and Fish Index of Biotic Integrity [FIBI] aquatic life assessment scores > 4 [scale 1-5]) located within the Bush River watershed. Within the Winters Run sub-watershed, Otter Point Creek is a Tier II stream, and in the Bynum Run sub-watershed, an unnamed tributary of Bynum Run is also a Tier II stream. (COMAR 2014c). As discussed above, the tPCB TMDL established for the Bush River Oligohaline Segment is protective of all designated uses for this segment.

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). As the Bush River is a tidal system, both the human health criterion and saltwater aquatic life chronic criterion are applied for assessing these waters. Since the human health criterion is more stringent than the fresh water aquatic life criteria, if the human health criterion is met, all applicable water quality criteria would be satisfied. The water column mean tPCB concentration in the Bush 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 6 fish tissue composite samples (30 total fish) for PCB analysis in the Bush River in May and June 2014. The tPCB concentrations for all of the fish tissue composite samples (several species of fish including white perch, brown bullhead catfish and channel catfish) exceeded the listing threshold, demonstrating that a PCB impairment exists within the Bush River.

Since the overall objective of the tPCB TMDL for the Bush 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 327,333 L/kg for the Bush 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 0.12 ng/L, derived from the tPCB fish tissue listing threshold and the channel catfish tissue data, is selected as the TMDL endpoint for the Bush River. This endpoint 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 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 34.08 (unitless) for the Bush River, 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 level of 1.14 ng/g derived from the fish tissue listing threshold and the channel catfish tissue data is set as the sediment TMDL endpoint in the Bush River. (Appendix B).

The CWA requires TMDLs to be protective of all the designated uses applicable to a particular waterbody. The water column endpoint tPCB concentrations that are used in the Bush River tPCB TMDL analysis and derived as described above, are more stringent than Maryland's saltwater 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 Bush River Oligohaline 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 81.35 g/year for the Bush 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 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). Assuming that the tPCB concentrations in the Chesapeake Bay mainstem will continue to decline, at or above the current rate of 6.5% per year, the resultant TMDL scenario requires an overall 60% load reduction of total baseline loads from the point and non-point source categories in the Bush River in order to achieve the sediment and water column TMDL endpoint tPCB concentrations.

Load Allocations

The TMDL summary in Table 1 above contains the LAs for the Bush 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 tPCBs identified in the Bush River Watershed include the Chesapeake Bay mainstem tidal influence, the direct atmospheric deposition to the river, one contaminated site, and the runoff from non-regulated watershed areas within the Bush 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. The transport of PCBs into the Bush River due to tidal influences from the Chesapeake Bay mainstem is a source of PCBs to the system; however, this load contribution results from other point and nonpoint source inputs (both historic and current) and is not considered to be a directly controllable source. Therefore this load is not assigned a baseline load or allocation within the TMDL.

Model simulation results show that both the water column and sediment tPCB targets will be met in about 81 years with natural attenuation of tPCB concentrations and reductions in total

baseline loads from all sources. Only Direct Atmospheric Deposition and Non-regulated Watershed Runoff are assigned a 62% and 64% load reduction, respectively, in the final TMDL scenario.

Wasteload Allocations

As mentioned above, there are numerous permitted point sources within the Bush River watershed that could potentially convey tPCBs loads to the Bush River Oligohaline Segment. Point Sources include two municipal WWTPs, and 20 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 three industrial process water facilities in this watershed which have either been determined to have no potential to discharge PCBs, or *de minimis* sources of PCBs that are not assigned baseline or wasteload allocations.

The WWTP and NPDES Regulated Stormwater WLA for the Bush River Watershed is 7.56 g/year and 18.89 g/year, respectively. Point source loads account for 34.2% of the total tPCB baseline load. See discussion above on how the baseline loads were calculated. Wasteload allocations assigned to point sources in the final TMDL scenario represent a 62% reduction from the point source tPCB baseline load.

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 TMDL for the Bush River Oligohaline Segment is protective of human health at all times; thus it implicitly accounts 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 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 Bush River.

5) The TMDLs consider seasonal environmental variations.

The TMDL for the Bush River Oligohaline Segment is protective of human health at all times; thus it implicitly accounts 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 Bush River 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 Bush River.

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[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.

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. 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 tPCB TMDL for the Bush River Oligohaline Segment. The public comment period was open from February 10, 2016, through March, 2016. MDE received one written comment during the public comment period and adequately responded. 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 re-suspension and diffusion from the bottom sediments have been identified as the major source of PCBs to the Bush River. However, the loads from re-suspension 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 it is assumed that the tPCB concentrations in the Chesapeake Bay mainstem are decreasing at a rate of 6.5% 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 Bush River 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, and an overall 60% load reduction of total baseline load from the Bush River watershed, from direct atmosphere deposition to the River surface and from two municipal WWTPs, the tPCB TMDL endpoints in both water column and sediment of the Bush River embayment will be met in about 81 years.

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 Bush 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. If the PCB-contaminated sediments were removed, load reductions would still be required under the TMDL, since PCBs would continue to enter the Bush River from the mainstem of the Chesapeake Bay and from the Bush River watershed. 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 Bush 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 Bush 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 Bush 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), among others. 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.

Given the persistent nature of PCBs, the difficulty in removing them from the environment and the significant watershed load reductions necessary in order to achieve water quality goals in the Bush River, 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.