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

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

MAY 7 2013

Dear Mr. Currey:

The U.S. Environmental Protection Agency (EPA), Region III, is pleased to approve the report, *Total Maximum Daily Loads of Phosphorus in the Upper Monocacy River Watershed, Frederick and Carroll Counties, Maryland.* The TMDL report was submitted by the Maryland Department of the Environment (MDE) to EPA for final review on September 26, 2012 and received on October 2, 2012. 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 Maryland Department of the Environment (MDE) has identified the waters of the Upper Monocacy River (MD-02140303) on the State's 303(d) List as impaired by nutrients (1996) and impacts to biological communities (2002) (MDE 2010). All impairments are listed for non-tidal streams. The 1996 nutrients listing was refined in the 2008 Integrated Report to identify phosphorus as the specific impairing substance. A TMDL for fecal coliform and a TMDL for sediment were approved by the US EPA in 2009. The listing for impacts to biological communities will be addressed separately at a future date. This TMDL addresses the Phosphorus listing only.

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 Phosphorus TMDL for the Upper Monocacy River Watershed 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 Ms. Helene Drago, TMDL Program Manager, at 215-814-5796.

Sincerely,

s/n

for Jon M. Capacasa, Director
Water Protection Division

Enclosure

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

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

Decision Rationale
Total Maximum Daily Load of Phosphorus in the Upper Monocacy River Watershed Frederick and Carroll Counties, Maryland

S/n

for **Jon M. Capacasa, Director**
Water Protection Division

Date: 5/7/13

Decision Rationale
Total Maximum Daily Load of Phosphorus
in the Upper Monocacy River Watershed
Frederick and Carroll Counties, 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 discharged to a water quality limited waterbody.

This document sets forth the U.S. Environmental Protection Agency's (EPA) rationale for approving the TMDL for Phosphorus in the Upper Monocacy River watershed. The TMDL was established to address impairments of water quality, caused by phosphorus, as identified in Maryland's Section 303(d) List for water quality limited segments. The Maryland Department of the Environment (MDE) submitted the report, *Total Maximum Daily Load of Phosphorus in the Upper Monocacy River Watershed, Frederick and Carroll Counties, Maryland,* dated August 2012, to EPA for final review on September 26, 2012 and was received on October 2, 2012. The TMDL in this report addresses the Phosphorus impairment in the Upper Monocacy River watershed as identified on Maryland's Section 303(d) List. The basin identification for the Upper Monocacy River watershed is MD-02140303.

EPA's rationale is based on the TMDL Report and information in the computer files provided to EPA by MDE. EPA's review determined that the TMDL meets 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

The TMDL specifically allocates the allowable Phosphorus loading to the Upper Monocacy River watershed. There are thirty four permitted point sources and an allocation for

general permit for Concentrated Animal Feeding Operations (CAFOs) which are included in the WLA. The fact that the TMDL does not assign WLAs to any other sources in the watershed should not be construed as a determination by either EPA or MDE that there are no additional sources in the watershed that are subject to the National Pollutant Discharge Elimination System (NPDES) program. In addition, the fact that EPA is approving this TMDL does not mean that EPA has determined whether some of the sources discussed in the TMDL, under appropriate conditions, might be subject to the NPDES program. The Phosphorus TMDL is presented as an average annual load in pounds per year because it was calculated so as to not cause any Phosphorus related impacts to aquatic life. The maximum daily Phosphorus Load is presented in pounds per day. The calculation of the maximum daily loads is explained in Appendix B of the TMDL report. The average annual Upper Monocacy River watershed TMDL is summarized in Table 1 below. The TMDL is the sum of the LAs (Pennsylvania Upstream LA (LA_{PA}), Double Pipe Creek Upstream LA (LA_{DPC}), and Upper Monocacy River Watershed LA (LA_{UMR})), CAFO WLA, NPDES Stormwater WLA, Process Water WLA, and MOS. The LA_{UMR} include nonpoint source loads generated within the Upper Monocacy River watershed. The maximum daily load is presented in Table 2. Individual annual and maximum daily WLAs for permitted point sources are provided in Table 3.

Table 1. Upper Monocacy River Watershed Average Annual TMDL of Phosphorus (lbs/yr)

		LA						WLA							
TMDL (lbs/yr)	=	**LA_{PA}[1,2]**	+	**LA_{DPC}[3]**	+	**LA_{UMR}**	+	**CAFO WLA_{UMR}**	+	**NPDES Stormwater WLA_{UMR}**	+	**Process Water WLA_{UMR}**	+	**MOS**
606,530	=	300,004	+	128,328	+	149,673	+	379	+	23,741	+	4,406	+	Implicit
		Upstream Load Allocation[2]				MD 8-digit Upper Monocacy River Watershed TMDL Contribution								

[1] LA_{PA} includes both (1) the PA load entering Maryland through the mainstem, which is receiving an allocation based on current loads, and (2) the load from those sections of PA which require phosphorus reductions because they drain to MD small order streams. See Sections 2.4 and 4.5 of the TMDL Report.

[2] Although for the purpose of this analysis the upstream load is referred to as an LA, it could include loads from point and nonpoint sources.

[3] LA_{DPC}: Double Pipe Creek TMDL, it could include loads from point and nonpoint sources

Note: Individual load contributions may not add to total load due to rounding.

Table 2. Upper Monocacy River Watershed Maximum Daily Loads of Phosphorus (lbs/day)

		LA						WLA							
TMDL (lbs/day)	=	**LA_{PA}[1,2]**	+	**LA_{DPC}[3]**	+	**LA_{UMR}**	+	**CAFO WLA_{UMR}**	+	**NPDES Stormwater WLA_{UMR}**	+	**Process Water WLA_{UMR}**	+	**MOS**
3,883	=	1,854	+	918	+	925	+	2	+	147	+	37	+	Implicit
		Upstream Load Allocation[2]				MD 8-digit Upper Monocacy River Watershed TMDL Contribution								

[1] LA_{PA} includes both (1) the PA load entering Maryland through the mainstem, which is receiving an allocation based on current loads, and (2) the load from those sections of PA which require phosphorus reductions because they drain to MD small order streams.

[2] Although for the purpose of this analysis the upstream load is referred to as an LA, it could include loads from point and nonpoint sources.

[3] LA_{DPC}: Double Pipe Creek TMDL, it could include loads from point and nonpoint sources

Table 3. Wasteload Allocations for Point Sources in the Upper Monocacy River Watershed

Facility	NPDES ID Number	WLA (lbs/yr)	MDL (lbs/day)
Process Water Point Source			
Emmitsburg WWTP	MD0020257	685	5.8
Taneytown WWTP	MD0020672	1,005	8.5
Thurmont WWTP	MD0021121	914	7.8
Crestview Estates WWTP	MD0022683	1,802	15.3
Lewistown School WWTP	MD0022900		
Mount Saint Mary's University	MD0023230		
Victor Cullen Center WWTP	MD0023922		
White Rock WWTP	MD0025089		
Foxville US Naval Support WWTP	MD0025119		
Shamrock Restaurant	MD0058050		
Shuffs Meat Market, Inc.	MD0050245		
Redland Brick, Inc.	MD0052345		
Hunting Creek Fisheries	MD2637K00		
Walsh Fuel	MDG344550		
Knott Athletic Complex	MDG766135		
Ole Mink Farm Rec. Resort	MDG766215		
Sheetz Store # 132	MDG912397		
NPDES Regulated Stormwater Point Sources			
Municipal Phase II MS4	MDR055500	9,878	61.0
Carroll County Phase I MS4	MD0068331	1,353	8.4
Frederick County Phase I MS4	MD0068357	7,131	44.1
SHA Phase I MS4	MD0068276	2,404	14.9
"Other NPDES Regulated Stormwater"[1]	--	2,976	18.4
NPDES Regulated Animal Feeding Operations		379	2

1 See Table 4 below for the list of Other NPDES Regulated Stormwater Facilities

Table 4. NDES Regulated Stormwater Permits in the Upper Monocacy River Watershed

Permit Number	Facility	NPDES Group
MDR055500	Town of Thurmont MS4	Municipal Phase-II
MDR055500	Town of Emmitsburg MS4	Municipal Phase-II
MD0068276	Frederick County Highways - Thurmont	County Phase-I
MD0068331	Carroll County MS4	County Phase-I
MD0068357	Frederick County MS4	County Phase-I
MD0068276	State Highway Administration MS4	SHA Phase I
	MDE General Permit to Construct	Other NPDES Reg SW
02SW0062	Flowserve Corporation	Other NPDES Reg SW
02SW0458	Evapco, Inc.	Other NPDES Reg SW
02SW1743	Taneytown WWTP	Other NPDES Reg SW

Permit Number	Facility	NPDES Group
02SW1812	Chaz's Used Auto Parts & Towing, Inc.	Other NPDES Reg SW
02SW0443	Moore Business Communication Services	Other NPDES Reg SW
02SW0991	Home Run, Inc.	Other NPDES Reg SW
02SW1188	Federal Stone Industries, Inc.	Other NPDES Reg SW
02SW1882	Thurmont WWTP	Other NPDES Reg SW
02SW1229	Rockville Fuel & Feed Company – Montgomery Vault	Other NPDES Reg SW
02SW1344	SHA - Thurmont Shop	Other NPDES Reg SW

The TMDL is a written plan 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 Upper Monocacy River watershed is located in the Potomac River Sub-basin in Frederick and Carroll Counties, Maryland. The Upper Monocacy River is a free-flowing stream that originates in Pennsylvania and flows 58 miles within Maryland where it finally empties into the Potomac River in Maryland. The watershed area within Frederick and Carroll Counties covers 156,638 acres. The Upper Monocacy River watershed encompasses areas within both Maryland and Pennsylvania; however, the assessment unit identified on the Maryland 303(d) list and consequently addressed by this TMDL consists only of the Maryland portion of the watershed, otherwise referred to as the MD 8-digit Upper Monocacy River watershed. Phosphorus loads generated within the Pennsylvania portion of the watershed as well as the phosphorus load transported via Double Pipe Creek, a tributary to the Upper Monocacy River, are included in the analysis, but will be referred to as upstream loads.

The Upper Monocacy River watershed landuse was evaluated separately for Maryland and Pennsylvania. The landuse distribution in Maryland consists primarily of forest (44.7%) and crop land (34.0%), followed by regulated urban (13.3%), and pasture (7.1%). All developed land in Maryland is regulated. In Pennsylvania, the landuse also consists primarily of forest (39.4%) and crop land (36.4%), with smaller amounts of non-regulated developed land (17.0%), pasture (6.2%), and regulated urban land (0.8%).

The Maryland Department of the Environment (MDE) has identified the waters of the Upper Monocacy River on the State's 303(d) List as impaired by nutrients (1996) and impacts to biological communities (2002) (MDE 2010). All impairments are listed for non-tidal streams. Because scientific community supports that phosphorus is generally the limiting nutrient in freshwater aquatic systems, the 1996 nutrients listing was refined in the 2008 Integrated Report to identify phosphorus as the specific impairing substance (MDE 2008). Therefore, the listed impairment of phosphorus will henceforth be referred to in this report and the term "nutrients" should be read as interchangeable with "phosphorus" in this case. A TMDL for fecal coliform

and a TMDL for sediment were approved by the US EPA in 2009. The listing for impacts to biological communities will be addressed separately at a future date. This TMDL addresses the Phosphorus listing only.

The Maryland Surface Water Use Designation in the Code of Maryland Regulations (COMAR) for the mainstem of the Upper Monocacy River and tributaries is Use IV-P (*Water Contact Recreation, Protection of Aquatic Life Recreational Trout Waters and Public Water Supply*) except for Fishing Creek, Hunting Creek, Owens Creek, Tuscarora Creek, and Friends Creek, which are designated as Use III-P (*Water Contact Recreation, Protection of Nontidal Cold Water Aquatic Life, and Public Water Supply*) (COMAR 2012a,b,c).

The Upper Monocacy River watershed aquatic health scores, consisting of the Benthic Index of Biotic Integrity (BIBI) and Fish Index of Biotic Integrity (FIBI), indicate that the biological metrics for the watershed exhibit a significant negative deviation from reference conditions (Roth *et al.* 2005). The Biological Stressor Identification (BSID) analysis for the Upper Monocacy River watershed identified both phosphorus and nitrogen as potential stressors. Both total phosphorus and orthophosphate show a significant association with degraded biological conditions; as much as 33% of the biologically impacted stream miles in the watershed may be degraded due to high total phosphorus and 33% degraded due to high orthophosphate. Similarly, according to the BSID analysis, 20% of the biologically impacted stream miles in the Upper Monocacy River watershed are associated with high total nitrogen concentrations. An analysis of observed TN:TP ratios show, however, that phosphorus is the limiting nutrient in Upper Monocacy River. Because nitrogen generally exists in quantities greater than necessary to sustain algal growth, excess nitrogen *per se* is not the cause of the biological impairment in Upper Monocacy River, and the reduction of nitrogen loads would not be an effective means of ensuring that the Upper Monocacy River watershed is free from impacts on aquatic life from eutrophication. Therefore, load allocations for the Upper Monocacy River Nutrient TMDL will apply only to total phosphorus.

Biological results from both the Department of Natural Resources (DNR) CORE/TREND and Maryland Biological Stream Survey (MBSS) stations along the mainstem of the MD 8-digit Upper Monocacy River indicate that the mainstem water quality can be classified as Good to Very Good. Consequently, the nutrient impairment is only within the lower order (smaller) streams in the Maryland portion of the watershed. Pennsylvania's portion of the watershed, therefore, is divided into two sections: (1) the section of the watershed in Pennsylvania that enters Maryland only through mainstem Upper Monocacy River, upstream of monitoring station MON0528, will receive an informational TMDL based on current loading conditions, while (2) the section of Pennsylvania's portion of the watershed that drains into Maryland's lower order streams downstream of station MON0528 will require reductions in phosphorus loads to address the impairment.

Currently, in Maryland there are not specific numeric criteria that quantify the impact of nutrients on the aquatic health of nontidal streams systems; therefore, a reference watershed TMDL approach was used, which resulted in the establishment of a *phosphorus loading threshold.* This threshold is based on a detailed analysis of phosphorus loads from watersheds that are identified as supporting aquatic life (i.e., reference watersheds) based on Maryland's

biocriteria (Roth *et al.* 1998, 2000; Stribling *et al.* 1998; MDE 2008). The resulting loads are considered the maximum allowable loads the watershed can receive without causing any nutrient related impacts to aquatic health.

A data solicitation for information pertaining to pollutants, including nutrients, in the Upper Monocacy River watershed was conducted by MDE in November 2009 and all readily available data from 1998 up to the time of the data solicitation were considered. MDE conducted surveys along the Upper Monocacy River from October 2000 through October 2004. The Department of Natural Resources (DNR) collected data in the watershed from January 1998 through June 2007. Data from Maryland Biological Stream Survey (MBSS) sampling conducted in March and April 2000; March 2001; March 2003; and March 2004 were also used. A total of 56 water quality monitoring stations were used to characterize the Upper Monocacy River watershed.

Low levels of dissolved oxygen are sometimes associated with the decay of excess primary production and therefore nutrient over-enrichment. The dissolved oxygen (DO) concentration to protect Use I-P waters "may not be less than 5 milligrams per liter (mg/l) at any time" and to protect Use III-P waters "may not be less than 5 mg/l at any time, with a minimum daily average of not less than 6 mg/l" (COMAR 2012e). The monitoring data indicate that under current conditions, the water quality standard for DO is being met in Upper Monocacy River watershed.

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 required controls do not provide for attainment of water quality standards. The objective of the TMDL is to ensure that there will be no Phosphorus impacts affecting aquatic life, thereby establishing a Phosphorus load that supports the Use III-P/Use IV-P designations for the Upper Monocacy River watershed.

The computational framework chosen for the Upper Monocacy River watershed TMDL was the Chesapeake Bay Program Phase 5.3.2 (CBP P5.3.2) Watershed Model. The spatial domain of the CBP P5.3.2 Watershed Model segmentation aggregates to the Maryland 8-digit watersheds which is consistent with the impairment listing.

In order to quantify the impact of phosphorus on the aquatic health of non-tidal stream systems, a reference watershed TMDL approach was used, that resulted in the establishment of a *phosphorus loading threshold* for watersheds within the Highland and Piedmont physiographic regions. Reference watersheds were determined based on Maryland's biocriteria methodology. The biocriteria methodology assesses biological impairment at the 8-digit watershed scale based on the percentage of MBSS monitoring stations, translated into watershed stream miles, which are degraded. Individual monitoring station impairment is determined based on BIBI/FIBI scores lower than the Minimum Allowable IBI Limit (MAL), which is calculated based on the average annual allowable IBI value of 3.0 (on a scale of 1 to 5). Applying the MAL threshold helps avoid classification errors when assessing biological impairment (Roth *et al.* 1998, 2000, Stribling *et al.* 1998, MDE 2010).

Comparison of watershed phosphorus loads to loads from reference watersheds requires that the watersheds be similar in physical and hydrological characteristics. To satisfy this requirement, Currey *et al.* (2006) selected reference watersheds only from the Highland and Piedmont physiographic regions. This region is consistent with the non-coastal region that was identified in the 1998 development of FIBI and subsequently used in the development of BIBI (Roth *et al.* 1998, Stribling *et al.* 1998).

To reduce the effect of the variability within the Highland and Piedmont physiographic regions, the watershed phosphorus loads were then normalized by a constant background condition: the all forested watershed condition. This new normalized term, defined as the *forest normalized phosphorus load*, represents how many times greater the current watershed phosphorus load is than the *all forested phosphorus load.* The *forest normalized phosphorus load* for this TMDL is calculated as the current watershed phosphorus load (calculated using the CBP P5.3.2 2009 Progress Scenario) divided by the *all forested phosphorus load.* The *forest normalized phosphorus load* for the Upper Monocacy River watershed is 7.62.

Twelve reference watersheds were selected from the Highland/Piedmont region. Reference watershed *forest normalized phosphorus loads* were calculated using CBP P5.3.2 2009 Progress Scenario landuse and phosphorus loads. The median and 75th percentile of the reference watershed *forest phosphorus loads* were calculated and found to be 7.18 and 8.71 respectively. The median value of 7.18 was established as the *phosphorus loading threshold* as an environmentally conservative approach to develop this TMDL. The Upper Monocacy River's forest normalized load exceeds the *forest normalized reference phosphorus load* (also referred to as the *phosphorus loading threshold*), indicating that the Upper Monocacy River watershed is receiving loads above the maximum allowable load the watershed can sustain without causing any phosphorus related impacts to aquatic health.

The Upper Monocacy River watershed baseline nutrient loads are estimated using the landuse and EOS phosphorus loading rates from the CBP P5.3.2 2009 Progress Scenario. The 2009 Progress Scenario represents current land-use, loading rates, and BMP implementation simulated using precipitation and other meteorological inputs from the period 1991-2000 to represent variable hydrological conditions, thereby addressing annual changes in hydrology and capturing wet, average and dry years. The period 1991-2000 is the baseline hydrological period for the Chesapeake Bay TMDL. Watershed loading calculations, based on the CBP P5.3.2 segmentation scheme, are represented by multiple CBP P5.3.2 model segments within each MD 8-digit watershed. The Maryland point source nutrient loads are estimated based on discharge monitoring data and existing permit information. The total baseline phosphorus load from the PA portion of the Upper Monocacy River watershed is 325,555 lbs per year (lbs/yr) while the load from Maryland portion is 390,952 lbs/yr, comprising a phosphorus load of 201,916 lbs/yr from the Double Pipe Creek watershed and a phosphorus load of 189,036 lbs/yr from the MD 8-digit Upper Monocacy River watershed.

The allowable load for the impaired watershed is calculated as the product of the *phosphorus loading threshold* (determined from watersheds with healthy biological communities) and the Upper Monocacy River *all forested phosphorus load.* The resulting load is considered the maximum allowable load the watershed can sustain without causing any

nutrient related impacts to aquatic health. The MD 8-digit Upper Monocacy River watershed average annual TMDL of Phosphorus is 606,530 lbs/yr. The TMDL consists of allocations attributed to loads generated outside the assessment unit (Upstream Load Allocations): a Pennsylvania Upstream Load Allocation (LA_{PA}) of 300,004 lbs/yr and a Double Pipe Creek Upstream Load Allocation (LA_{DPC}) of 128,328 lbs/yr; and allocations attributed to loads generated within the assessment unit - an MD 8-digit Upper Monocacy River watershed TMDL contribution of 178,199 lbs/yr. The MD 8-digit Upper Monocacy River TMDL contribution is further subdivided into point and nonpoint source allocations and is comprised of a LA_{UMR} of 149,673 lbs/yr, a CAFO WLA_{UMR} of 379 lbs/yr, an NPDES Stormwater WLA_{UMR} of 23,741 lbs/yr, and a Process Water $WLA_{UMR)}$ of 4,406 lbs/yr.

IV. Discussion of Regulatory Conditions

EPA finds that MDE has provided sufficient information to meet all seven of the basic requirements for establishing a Phosphorus TMDL for the Upper Monocacy River watershed. EPA, therefore, approves this Phosphorus TMDL for the Upper Monocacy River watershed. This approval is outlined below according to the seven regulatory requirements.

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. The Maryland Surface Water Use Designation in the Code of Maryland Regulations (COMAR) for the mainstem of the Upper Monocacy River and tributaries is Use IV-P (*Water Contact Recreation, Protection of Aquatic Life Recreational Trout Waters and Public Water Supply*) except for Fishing Creek, Hunting Creek, Owens Creek, Tuscarora Creek, and Friends Creek, which are designated as Use III-P (*Water Contact Recreation, Protection of Nontidal Cold Water Aquatic Life, and Public Water Supply*) (COMAR 2012a,b,c).

Currently in Maryland, there are no specific numeric criteria that quantify the impact of nutrients on the aquatic health of non-tidal stream systems; therefore, a reference watershed TMDL approach was used. Phosphorus loads compatible with water quality standards are determined by comparing current phosphorus loading rates (lbs/ac/yr) in the Upper Monocacy River watershed with the nutrient loading rates in unimpaired watersheds in the Piedmont and Highland ecoregions of Maryland. The Chesapeake Bay Program's (CBP) Phase 5.3.2 Watershed Model (P5.3.2) was used to determine the phosphorus loads in both Upper Monocacy River and the unimpaired watersheds that were used to set the phosphorus TMDL for Upper Monocacy River

Low levels of dissolved oxygen are sometimes associated with the decay of excess primary production and therefore nutrient over-enrichment. The dissolved oxygen (DO) concentration to protect Use I-P waters "may not be less than 5 milligrams per liter (mg/l) at any time" and to protect Use III-P waters "may not be less than 5 mg/l at any time, with a minimum daily average of not less than 6 mg/l" (COMAR 2012e). The monitoring data indicate that under current conditions, the water quality standard for DO is being met in the Upper Monocacy River watershed.

This TMDL will establish phosphorus loads that will be protective of the Use III-P/Use IV-P designations for the Upper Monocacy River watershed, and more specifically, these loads will be at a level the watershed can sustain without causing nutrient related impacts to aquatic health. The TMDL, however, will not completely resolve the impairment to biological communities within the watershed. Because the BSID watershed analysis identifies other possible stressors (*i.e.*, sediment, in-stream habitat, and riparian habitat) as impacting the biological conditions, this impairment remains to be fully addressed through the Integrated Report listing process and the TMDL development process, such that all impairing substances identified as impacting biological communities in the watershed are reduced to levels that will meet water quality standards, as established in future TMDLs for those substances (MDE 2009a).

The objective of this TMDL is to establish phosphorus loads that will be protective of the Use III-P/Use IV-P designations for the Upper Monocacy River watershed, and more specifically, these loads will be at a level the watershed can sustain without causing nutrient related impacts to aquatic health. 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 Phosphorus for the Upper Monocacy River watershed is 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 land based LAs for nonpoint sources.

As discussed above, the allowable load for the impaired watershed is calculated as the product of the *phosphorus loading threshold* (determined from watersheds with healthy biological communities) and the Upper Monocacy River *all forested phosphorus load.* The Phosphorus TMDL for the Upper Monocacy River watershed was calculated to be 606,530 lbs/yr. This load is considered the maximum allowable load the watershed can sustain and support aquatic life. The Phosphorus TMDL and allocations are presented as mass loading rates of pounds per year for the average annual load and pounds per day for the maximum daily load. Expressing TMDLs as annual average and maximum daily mass loading rates 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, toxicity, or other appropriate measure.* The annual average and maximum daily Phosphorus loads are presented in Tables 1 and 2, respectively.

In order to attain the TMDL loading cap calculated for the watershed, reductions to phosphorus baseline loads will be applied to the controllable sources. Significant phosphorus reductions will be required in the Upper Monocacy River watershed to meet the phosphorus allocations assigned to the Potomac Tidal Fresh Bay Water Quality Segment by the Chesapeake

Bay TMDL, established by the EPA on December 29, 2010. To ensure consistency with the Bay TMDL, and therefore efficiency in the reduction of phosphorus loads, reductions will be applied to the same controllable sources identified in Maryland's Watershed Implementation Plans (WIPs) for the Bay TMDL. The controllable sources include: (1) regulated developed land; (2) high till crops, low till crops, hay, and pasture; (3) harvested forest; (4) unregulated animal feeding operations and CAFOs; and (5) industrial process sources and municipal wastewater treatment plants. Additional sources might need to be controlled in order to ensure that the water quality standards are attained in Chesapeake Bay as well as Upper Monocacy River. An overall reduction of 15% for phosphorus from current estimated loads will be required to meet TMDL allocations and attain Maryland water quality standards.

Load Allocations

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 TMDL summary in Table 1 contains the LA for the Upper Monocacy River watershed.

The nonpoint source nutrient loads generated within the Upper Monocacy River watershed are calculated as the sum of corresponding land-use edge-of-stream (EOS) loads within the watershed and represent a long-term average loading rate. Individual land-use EOS loads are calculated as a product of the land-use acreage and the average annual simulated phosphorus yields (lbs/ac/yr), 1991-2000 from the 2009 Progress Scenario (US EPA, 2010). The 2009 Scenario represents current land-use, loading rates, and BMP implementation simulated using precipitation and other meteorological inputs from the period 1991-2000 to represent variable hydrological conditions. The 1991-2000 simulation period represents the baseline loading rates in the TMDL for Chesapeake Bay segments.

In the Upper Monocacy River watershed, crop, pasture, unregulated animal feeding operations, and nurseries were identified as the predominant nonpoint source controllable sources. Forest is the primary non-controllable source, as it represents the most natural condition in the watershed. Direct atmospheric deposition on water is a minor source which to a large extent originates outside the watershed and is not considered for reduction within the scope of this TMDL analysis.

The Upper Monocacy River Phosphorus TMDL requires a 3% reduction in phosphorus loads from nonpoint sources. Table 5 provides one possible scenario for the distribution of the annual phosphorus nonpoint source loads between different land use categories in the Upper Monocacy River watershed. The source categories in Table 1 represent aggregates of multiple sources (e.g., crop source is an aggregate of high till, low till, hay, animal feeding operations, and nursery sources).

Table 5: Upper Monocacy River Phosphorus TMDL Allocation by Nonpoint Source Category

General Category	Nonpoint Source Category	Baseline Load (lbs/yr)	TMDL (lbs/yr)	Reduction (%)
Forest	Forest	10,983	10,983	0%
	Harvested Forest	452	452	0%
AFOs	AFOs	7,225	7,225	0%
Pasture	Pasture	20,055	19,891	1%
Crop	Crop	94,801	91,173	4%
Nursery	Nursery	19,460	19,211	1%
Septic	Septic	0	0	0%
Atmospheric Deposition	Non-tidal Atmospheric Deposition	737	737	0%
Total		**153,714**	**149,673**	**3%**

Note: Individual load contributions may not add to total load due to rounding.

Wasteload Allocations

There are thirty four permitted point sources in this watershed. Detailed allocations are provided for those point sources included within the NPDES process WLA and the regulated stormwater WLA. The WLA also includes an allocation to CAFOs. The types of permits identified include NPDES regulated individual industrial, individual municipal, individual municipal separate storm sewer systems (MS4s), general industrial stormwater, and general MS4 permits in the Upper Monocacy River watershed. The permits can be grouped into two categories, process water and stormwater.

The NPDES process water category includes those loads from major publically-owned Waste Water Treatment Plants (WWTPs), minor municipal WWTPs and industrial facilities whose permits have total phosphorus limits, minor municipal WWTPs with no phosphorus permit limits, and industrial facilities which based on the process involved are expected to discharge nutrients.

There are ten municipal WWTPs in the Upper Monocacy River watershed. Municipal WWTPs are assigned phosphorus WLAs as follows: (1) if the design flow of a facility is greater than 0.5 MGD and therefore is slated for upgrade to 'Enhanced Nutrient Reduction' (ENR), then the facility is given a WLA based on its design flow and the anticipated average annual ENR concentrations of 0.3 mg/l Total Phosphorus (TP); (2) if the design flow of the facility is 0.5 MGD or less and has TP concentration limits, then that facility is assigned a WLA based on its Maryland Tributary Strategy Cap flow and the permit limit; and (3) if the facility does not have permit limits, it is assigned a WLA based on its Maryland Tributary Strategy Cap flow and an assumed maximum average annual concentration of 3 mg/l TP. The Tributary Strategy Cap flow is the design flow of the facility or the projected 2020 flow (projected from 2003 actual discharge flows and Maryland Department of Natural Resources growth rates by county), whichever is less.

Seven industrial facilities discharging process water in the Upper Monocacy River watershed were judged to have the capacity to discharge TP in their process water. All of these

industrial facilities are minor. Under the Chesapeake Bay TMDL, industrial facilities capable of discharging phosphorus in their process water were given a WLA based on the results of monitoring required by their permits or professional judgment. In addition, allocations for minor municipal WWTPs (with design flows less than 0.5 MGD) and for minor industrial facilities are presented in the Chesapeake Bay TMDL as a watershed-wide aggregate WLA. A similar approach was adopted for the Upper Monocacy River Phosphorus TMDL, and all minor municipal and minor industrial process water facilities' allocations are represented as a watershed-wide WLA.

Based on the Maryland Tributary Strategy Cap flow and permit limits or the allocation under the Chesapeake Bay TMDL, applied to the Upper Monocacy River Phosphorus TMDL, it will result in a 58% reduction in phosphorus loads from process water sources.

The stormwater category includes all NPDES regulated stormwater discharges. There are seventeen NPDES Phase I and Phase II stormwater permits identified in the Upper Monocacy River watershed. These include both general Phase I and II stormwater permits. These stormwater permits are regulated based on Best Management Practices (BMPs) and do not include nutrient limits. In the absence of nutrient limits, the baseline loads for these NPDES regulated stormwater discharges are calculated using phosphorus loading rates and acreages from developed land-uses within the watershed. Individual WLAs have been calculated for each of the Phase I county MS4 permits and the SHA Phase I MS4 permit. An aggregate WLA has been calculated for the general municipal Phase II NPDES stormwater permits for the cities of Thurmont and Emmitsburg. Other NPDES permits include stormwater from federal, state, mining and extractive operations, and land under construction, which are aggregated into one WLA and are referred to as the "Other NPDES regulated stormwater" WLA.

The Upper Monocacy River NPDES stormwater WLA is based on reductions applied to the controllable phosphorus loads from the regulated developed landuse in the watershed, with credit provided to existing BMPs in place. The Upper Monocacy River NPDES stormwater WLA requires an overall reduction of 3% for phosphorus.

Under the Clean Water Act, CAFOs require NPDES permits for their discharges or potential discharges (CFR 2011c). In January, 2009, Maryland implemented new regulations governing CAFOs (COMAR 26.08.01, 26.08.03, and 26.08.04), which were approved by the EPA in January, 2010. Under these regulations, CAFOs are required to fulfill the conditions of a general permit. These conditions include instituting a Comprehensive Nutrient Management Plan (CNMP) that meets the 'Nine Minimum Standards to Protect Water Quality'. The general permit also prohibits the discharge of pollutants, including nutrients, from CAFO production areas except as a result of an event greater than the 25-year, 24-hour storm. Based on the TMDL methodology approach of applying an equal percent reduction to all controllable loads, the Upper Monocacy River Phosphorus TMDL does not require a reduction in phosphorus loads from CAFOs.

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 memo (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 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 TMDLs are consistent with the regulations and requirements of 40 CFR Part 130.

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

The TMDLs consider the impact of background pollutants by considering the Phosphorus load from natural sources such as forested land. The CBP P5.3.2 model also considers background pollutant contributions by incorporating all land uses.

4) The TMDLs consider critical environmental conditions.

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 factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable worst-case scenario condition.

Since the premise of the reference watershed approach is that the reference watershed is meeting water quality standards even under critical conditions, then the phosphorus loading rates derived from the reference watershed protects water quality standards under critical conditions. Also, the loading rates used in the TMDL were determined using the HSPF model, which is a continuous simulation model with a simulation period 1991-2000. The ten year simulation

[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.

period encompasses seasonal variations and a range of hydrological and meteorological conditions. Also, the biological monitoring data used to determine the reference watersheds also integrates the stress effects over the course of time and thus inherently addresses critical conditions.

5) The TMDLs consider seasonal environmental variations.

In the Upper Monocacy River watershed Phosphorus TMDL, seasonality is captured in two respects. First, it is implicitly included through the use of the biological monitoring data. Second, the MBSS dataset included benthic sampling collected in the spring and fish sampling collected in the summer. Thus, this analysis has captured both spring and summer flow conditions.

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, and the other approach is to incorporate the MOS as part of the design conditions. MDE has adopted an implicit MOS for this TMDL.

It is proposed that the estimated variability around the reference watershed group used in this analysis already accounts for such uncertainty. Analysis of the reference watershed group *forest normalized phosphorus loads* indicates that approximately 75% of the reference watersheds have a value less than 8.71. Also, 50% of the reference watersheds have a value less than 7.18. Based on this analysis the *forest normalized reference phosphorus load* (also referred to as the *phosphorus loading threshold*) was set at the median value of 7.18. This is considered an environmentally conservative estimate, because 50% of the reference watersheds have a load above this value (7.18), which when compared to the 75% value (8.71), results in an implicit MOS of approximately 18%.

7) The TMDLs have been subject to public participation.

MDE provided an opportunity for public review and comment on the Phosphorus TMDL for the Upper Monocacy River watershed. The public review and comment period was open from July 26, 2012 through August 24, 2012. MDE received four sets of written comments. The comments were considered and addressed appropriately.

A letter was sent to the U.S. Fish and Wildlife Service pursuant to Section 7(c) of the Endangered Species Act, requesting the Service's concurrence with EPA's findings that approval of this TMDL does not adversely affect any listed endangered and threatened species, and their critical habitats.

V. Discussion of Reasonable Assurance

EPA requires that there be a reasonable assurance that the TMDLs 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.

The Upper Monocacy River phosphorus TMDL is expected to be implemented as part of a staged process recently developed by Maryland. This staged process is designed to achieve both the nutrient reductions needed within the Upper Monocacy River watershed and to meet target loads consistent with the Chesapeake Bay TMDL, established by EPA in 2010 (US EPA 2010a) and scheduled for full implementation by 2025. The Bay TMDL requires reductions of nitrogen, phosphorus and sediment loads throughout the Bay watershed to meet water quality standards that protect the designated uses in the Bay and its tidal tributaries. The nutrient reductions for the Bay TMDL are independent of those needed to implement any TMDLs developed to address nutrient-related impairments in Maryland's non-tidal waterbodies, although their reduction goals and strategies do overlap. For example, the implementation planning framework, developed by the Bay watershed jurisdictions in partnership with EPA, provides a staged approach to achieving Bay TMDL nutrient reduction goals that is also applicable to implementation of nutrient TMDLs in local non-tidal watersheds. In short, nutrient reductions required to meet the Chesapeake Bay TMDL will also support the restoration and protection of local water quality.

Once the Bay TMDL nutrient target loads for the Upper Monocacy River watershed have been met, MDE will revisit the status of nutrient impacts on aquatic life in Upper Monocacy River, based on any additional monitoring data available and any improvements in the scientific understanding of the impacts of nutrients on aquatic life in free-flowing streams. The results of this reassessment will determine whether additional phosphorus reductions are needed in the watershed, or whether the Upper Monocacy River phosphorus TMDL goals have in fact been met.

In addition, MDE plans to use a series of legislative actions and funding programs to support TMDL implementation. Some of these include:

- Maryland recently enacted significant new legislation that requires Phase I MS4 jurisdictions to establish, by July 1, 2013, an annual stormwater remediation fee and a local watershed protection and restoration fund to support implementation of local stormwater management plans. Maryland has made a commitment to include provisions in Phase I and II MS4 permits, due for issuance in 2012, to implement the State's WIP strategies to reduce nutrient and sediment loads from urban stormwater sources.

- Maryland has also enacted significant new legislation to increase the Bay Restoration Fund to provide financing for wastewater treatment plant upgrades and on-site septic system improvements, as well as legislation to guide growth of central sewer and septic systems.

- In response to the WIP and the increased burden on local governments to achieve nutrient

reduction goals, Maryland has continued to increase funding in the Chesapeake and Atlantic Coastal Bays Trust Fund.

- Additional potential funding sources for implementation include Maryland's Agricultural Cost Share Program (MACS) which provides grants to farmers to help protect natural resources, and the Environmental Quality and Incentives Program, which focuses on implementing conservation practices and BMPs on land involved with livestock and production.

For more details about these and other legislative actions and funding programs, refer to Section 5.0 of the TMDL report.