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

SEP 20 2007

Dr. Richard Eskin, Director
Technical and Regulatory Services Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 450
Baltimore, MD 21230-1718

Dear Dr. Eskin:

The U.S. Environmental Protection Agency (EPA), Region III, is pleased to approve the *Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Wicomico River Headwaters Basin in Wicomico County, Maryland.* The TMDL Report was submitted by the Maryland Department of the Environment's (MDE) letter dated January 31, 2006, to EPA for review and approval. The TMDL was developed and submitted in accordance with sections 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 of impaired waters. The MDE identified the Wicomico River Headwaters Basin as impaired by fecal bacteria.

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 (WLAs) for point sources and load allocations (LAs) 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. The non-tidal fecal bacteria TMDLs for the Wicomico River Headwaters Watershed satisfied each of these requirements. In addition, the non-tidal fecal bacteria TMDLs considered reasonable assurance that the allocations assigned to the nonpoint sources can be reasonably met. A copy of EPA's Decision Rationale for approval of these TMDLs is included with this letter.

As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA 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 Mr. Thomas Henry, TMDL Program Manager, at (215) 814-5752 or Mr. Kuo-Liang Lai at (215) 814-5473.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure

cc: Nauth Panday, MDE-TARSA
Melissa Chatham, MDE-TARSA

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Decision Rationale
Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Wicomico River Headwaters Basin in Wicomico County, Maryland

Jon M. Capacasa, Director

Date: 9/20/2017

Decision Rationale

Total Maximum Daily Loads of Fecal Bacteria
for the Non-Tidal Wicomico River Headwaters Basin
in Wicomico 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 discharged to a water quality-limited waterbody.

This document sets forth the U.S. Environmental Protection Agency's (EPA) rationale for approving the TMDLs for fecal bacteria in the Wicomico Watershed. The TMDLs were established to address water quality impairments caused by bacteria as identified in Maryland's 1996 section 303(d) list of impaired waters. The Maryland Department of the Environment (MDE), submitted[1] the *Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Wicomico River Headwaters Basin in Wicomico County, Maryland*, dated January 2006 (TMDL Report), to EPA for final review, which was received on February 3, 2006. The Wicomico River Non-Tidal Watershed (02-13-03-04) was first identified on Maryland's 1996 section 303(d) list as impaired by fecal bacteria, with biological communities added to the 2004 section 303(d) list. The TMDLs described in this document were developed to address fecal bacteria non-tidal water quality impairments.

EPA's rationale is based on the TMDL Report and information contained in the computer files provided to EPA by MDE. EPA's review determined that the TMDLs meet the following seven regulatory requirements pursuant to 40 CFR Part 130.

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

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

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[1] By letter dated January 31, 2006.

II. Summary

There are two National Pollutant Discharge Elimination System (NPDES) permitted sources within the watershed (permit numbers MD0020532 and MD0000060). MDE provided adequate land use and instream bacteria data in the TMDL report and allocated the TMDL loads to specific sources. The TMDL shown in Table 1 requires up to and including 98 percent reduction from existing or baseline conditions.

Table 1 - Wicomico River Headwaters Bacteria Non-Tidal TMDL Summary

Subwatershed	Baseline	TMDL	WLA-PS[2]	WLA-MS4[3]	LA[4]	
	Billions MPN[1]/day *E. coli*					
					Maryland	Delaware
NLO0003	7.6	29.9	0.0	0.0	26.9	3.0
LPR0028	2.6	11.0	0.0	0.0	11.0	0.0
WIW0241sub	54.2	43.0	3.1	0.0	31.2	3.0
BWB0010	41.8	18.8	0.0	0.0	8.7	0.0
MNC0010	105.9	20.6	0.8	0.0	13.5	0.0
TOTAL	212.1	123.3	3.9	0.0	91.3	6.0

[1]MPN = Most Probable Number
[2]WLA-PS = Wasteload Allocation for non MS4 systems (municipal or industrial)
[3]WLA-MS4 = Wasteload Allocation for MS4 systems
[4]LA = Load Allocation

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 which considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a "margin of safety" value. It was decided that the known low bias of the back transformed concentrations would be used as an implicit MOS when estimating the assimilative capacity of the stream systems. This bias will provide and environmentally conservative estimate of the load required to attain water quality standards. The option is always available to the State to refine the TMDL for re-submittal to EPA for approval.

III. Background

The Wicomico River Headwaters Watershed comprises approximately 38.3 square miles (24,540 acres). Wicomico River Headwaters starts just upstream of State Route 50 at the spillage of Johnson Pond, which is the largest of five impoundments collecting freshwater flow from the Wicomico River Headwaters. It continues north for approximately eight miles, on average 6 miles from east to west. Johnson Pond receives the spillage of Leonard Mill Pond, another impoundment collecting Wicomico River Headwaters drainage. The Leonard Mill Pond drainage area reaches as far as the Delaware state line, just north of the jointly held community of Delmar (Figure 1).

Leonard Mill Pond has a perennial but variable discharge, which flows eventually to the head of Johnson Pond. Johnson Pond is a fairly large impoundment located at the outlet of the Upper

Wicomico River. The dam at Johnson Pond is the designated dividing line between tidal and non-tidal waters in the Wicomico River. Discharge from the pond is to the Wicomico River, which flows southwest to the Chesapeake Bay.

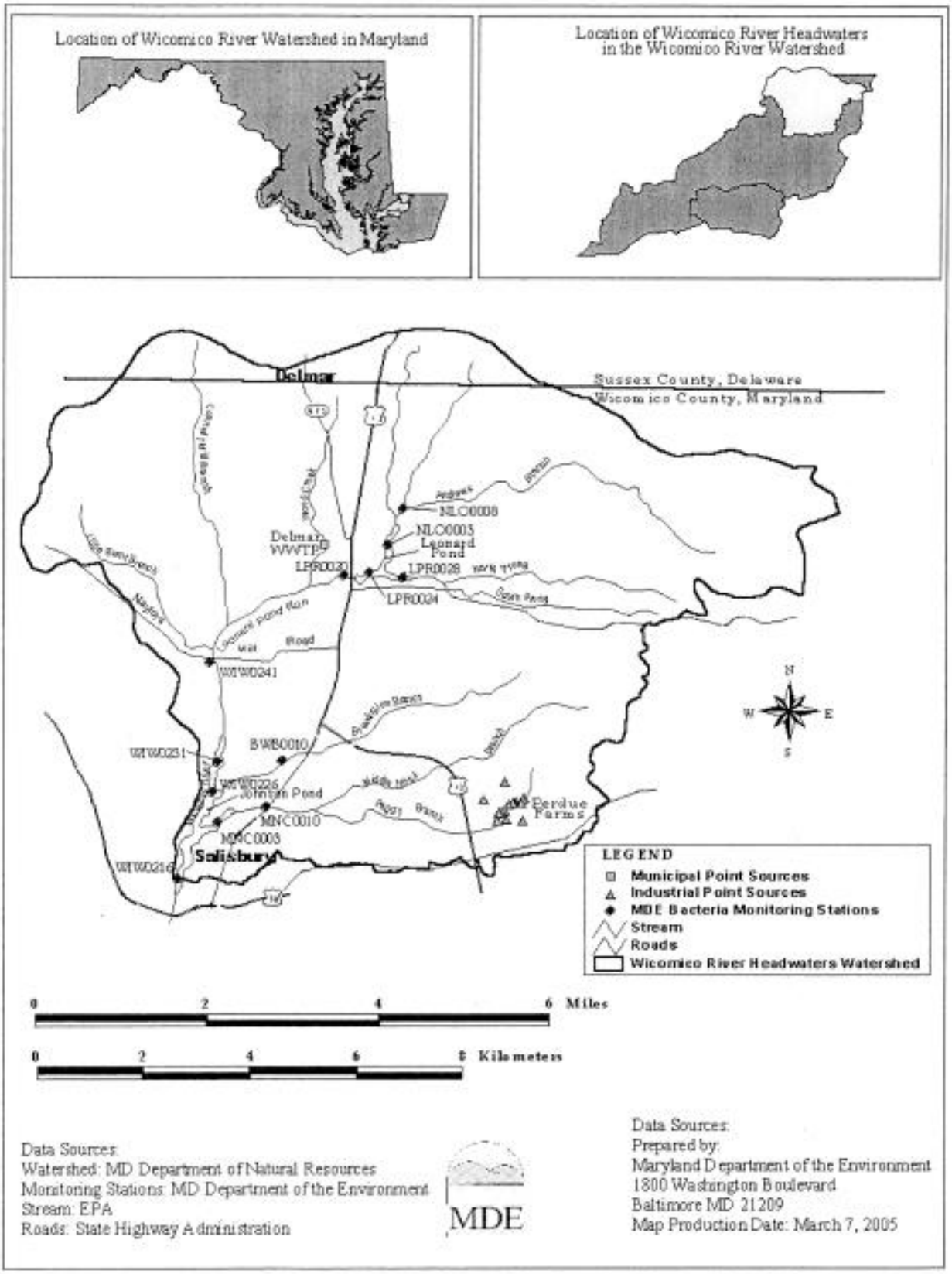

Figure 1 - Location Map of the Wicomico River Headwaters Basin (TMDL Report, Figure 2.1.1)

The Wicomico River Headwaters Basin lies in the Coastal Plain physiographic province. Soils immediately surrounding Johnson Pond are the Evesboro-Klej association – excessively drained to somewhat poorly drained sands – and are easily eroded. The outer watershed is comprised of soils of the Matawan-Norfolk association (moderately well-drained soils) while the eastern section of the watershed contains soils of the Elkton-Matawan-Bayboro association (very poorly drained to moderately well-drained).

Figure 1 shows the locations of the twelve MDE water quality monitoring stations primarily clustered around Leonard Pond Run, Johnson Pond, North Prong, Middle Neck Branch, and Brewington Branch.

The 2000 Maryland Department of Planning (MDP) land use/land cover data shows that the watershed is evenly distributed between developed, agricultural, and forested land uses. The land use percentage distribution for Wicomico River Headwaters Basin is shown in Table 2, and spatial distributions for each land use are shown in Figure 2.

Table 2 - Land Use Area and Percentages in Wicomico River Headwaters Basin (TMDL Report, Table 2.1.1)

Land Use	Acreage	Percent of Total
Residential	4,530	18%
Commercial	2,340	10%
Forest	8,730	36%
Crops	7,600	31%
Pasture	840	3%
Water	500	2%
Total	24,540	100%

MDE estimated the total population in the Wicomico River Headwaters Watershed to be 9,460 people, based on a weighted average from the Geographic Information System (GIS) 2000 Census Block and the MDP Land Use 2002 Cover that includes the Wicomico River Watershed. Since the Wicomico River Headwaters Watershed is a sub-area of the Census Block, percentages of each land use within the watershed were used to extract the areas from the 2000 Census Block within the watershed.

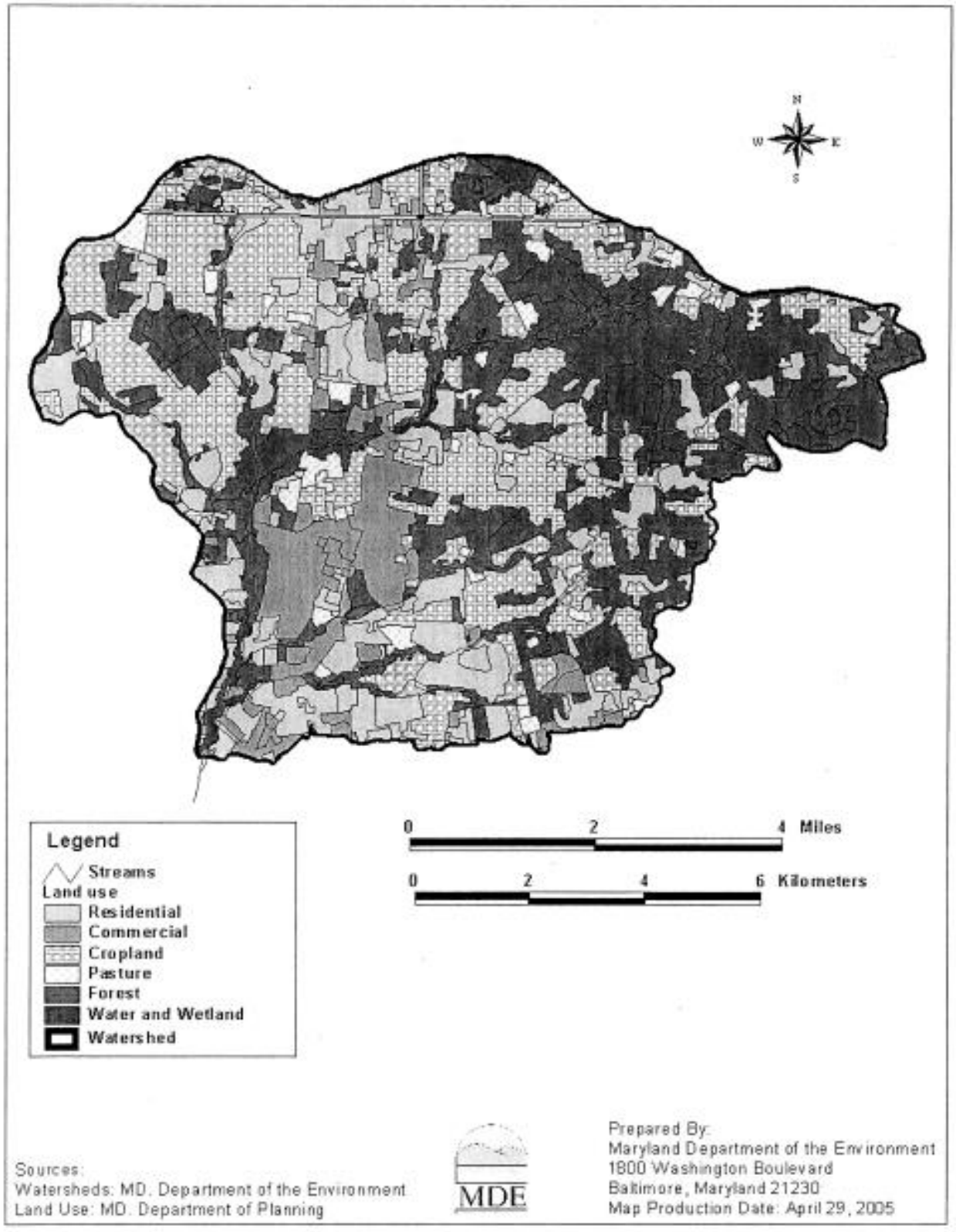

Figure 2 - Land Use in the Wicomico River Headwaters Watershed (TMDL Report, Figure 2.1.3)

IV. Computational Procedure

The length of Wicomico River Headwaters within Maryland is non-tidal or free flowing. MDE developed the method described below to determine non-tidal TMDLs.

General

In addition to the TMDL Report provided during the public notice period, MDE provided EPA with computer files in Microsoft Excel® for review. MDE's procedure uses a variation of the load-duration curve method which is also used by several states and by EPA. MDE uses stream flow data from United States Geological Survey (USGS) gages and sampling data to determine the bacteria load reductions necessary to meet water quality standards. MDE then uses bacteria source tracking (BST) results to allocate the TMDL loads to various sources (i.e., domestic animals, human sources, livestock, and wildlife).

The load-duration curve method uses sampling data combined with a long-term stream flow record, frequently from a USGS gaging station, to provide insight into the flow condition under which exceedances of the water quality standard occur. Exceedances that occur under low-flow conditions are generally attributed to loads delivered directly to the stream such as straight pipes, sanitary sewer overflows, livestock with access to the stream, and wildlife. Exceedances that occur under high-flow conditions are typically attributed to loads that are delivered to the stream in stormwater runoff. A flow-duration curve is shown in Figure 3 below. The flow duration interval shown across the bottom is the percent of time that a given flow is exceeded. For example, flows at the gaging station exceed 1,500 cubic feet per second (cfs) 10 percent of the time.[2]

The flow-duration curve is converted to a load-duration curve by multiplying the flow by the bacteria count and the appropriate unit conversion factor (100 ml to cubic feet). An example load-duration curve is shown in Figure 4.

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[2] *TMDL Development From the "Bottom Up" – Part III: Duration Curves and Wet-Weather Assessment*, 2003, Bruce Cleland.

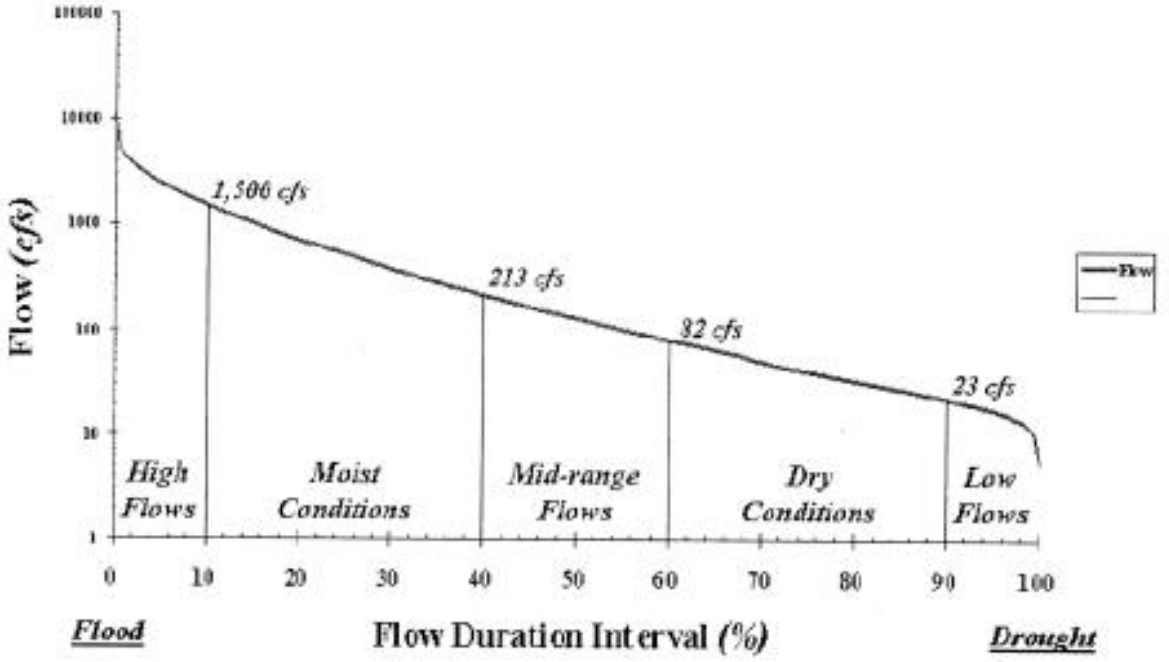

Figure 3 – Example Flow-Duration Curve

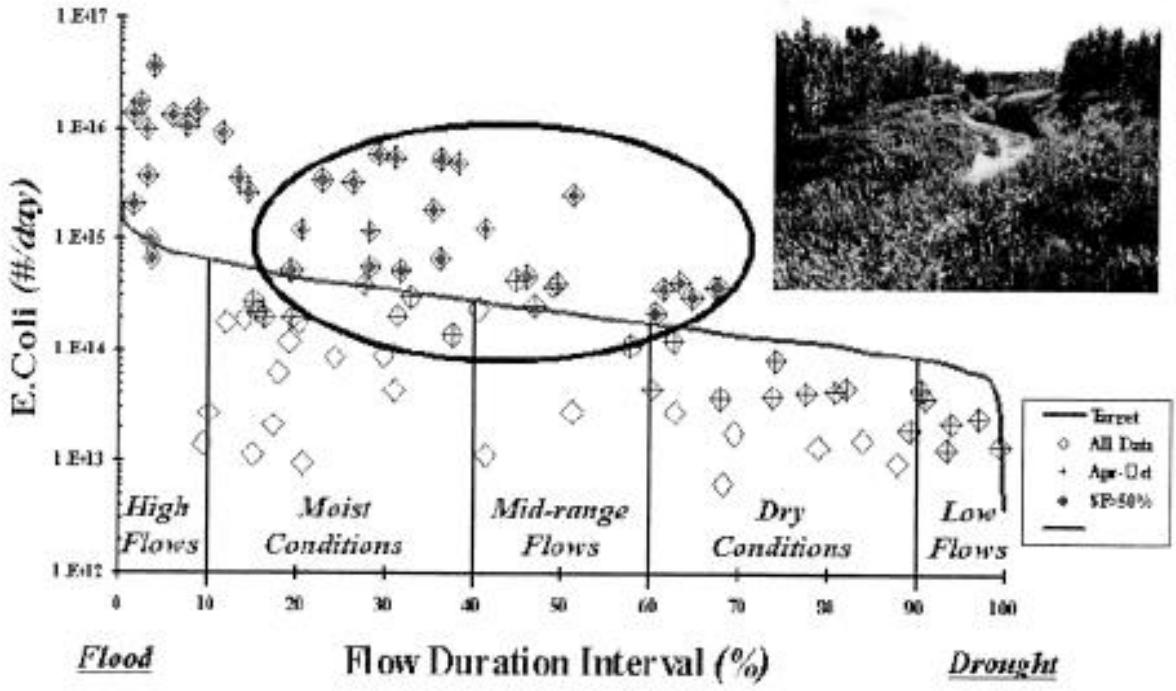

Figure 4 - Example Load-Duration Curve

Frequently the target load shown in Figure 4 is based on the single-sample maximum value from the state's water quality standards. The required load reduction at all flows is equal to the difference between the target load and a line parallel to the target load line which passes through the highest sample value. However, MDE's water quality standards do not contain a single-sample maximum number and, therefore, modified the above procedure.

Wicomico Headwaters Basin Computational Method

In order for EPA to conduct a thorough review of MDE's method, MDE provided EPA with Microsoft Excel® files and, therefore, the following description of MDE's computational method refers to information not necessarily contained in the TMDL Report.

The Wicomico River Headwaters Watershed has no active USGS flow gages. Flow data from several flow gages in the Wicomico River Watershed, Pocomoke River Headwaters Watershed, and in the Chicamacomico River Watershed were analyzed to determine their possible use in the Wicomico River Headwaters watershed flow analysis. The flow gages analyzed had less than 10 years of flow data and only one of them covers the same date period as the bacteria monitoring data. Because accurate flow estimates should be based upon at least 10 years of continuous gaged flow data, the aforementioned factors, it was determined that none of these gages were suitable for use in this analysis. Finally, average flows were estimated in the five subwatersheds of the Wicomico River Headwaters using the flow regression equations from Versar's study, "Development of Regional Flow Duration Curves in Maryland, 2004".

The water quality impairment was assessed by comparing the steady state geometric mean concentrations of *E.coli* with the water quality criterion. Steady state geometric means of the monitoring data for annual and critical conditions and the water quality criterion are shown in Tables 3 and 4 below.

Table 3 - Existing/Baseline Conditions (TMDL Report, Table 2.3.2)
Annual Steady State Geometric Mean by Stratum per Subwatershed

Watershed	Tributary	Station	# Samples	Minimum *E. coli* Concentration MPN/100ml	Maximum *E. coli* Concentration MPN/100ml	Annual Condition Steady State Geometric Mean *E. coli* Concentration MPN/100ml	*E. coli* Criterion MPN/100 ml
02130304	Wicomico River	WTW0216	26	31	782	114	126
02130304	Wicomico River	WTW0226	24	10	2,005	94	126
02130304	Wicomico River	WTW0231	24	10	2,005	147	126
02130304	Wicomico River	WTW0241	22	64	1,445	184	126
02130304	Leonard Mill Pond	LPR0020	26	10	531	58	126
02130304	Leonard Pond Run	LPR0024	23	10	429	25	126
02130304	Leonard Pond Run	LPR0028	23	10	504	30	126
02130304	North Prong	NLO0003	22	10	478	32	126
02130304	North Prong	NLO0008	21	10	192	51	126
02130304	Brewington Branch	BWB0010	21	20	2,880	280	126
02130304	Middle Neck Branch	MNC0003	24	10	1,013	109	126
02130304	Middle Neck Branch	MNC0010	21	10	20,050	650	126

Table 4 - Existing Seasonal Period Steady State Geometric Mean by Stratum per Subwatershed (TMDL Report, Table 2.3.3)

Watershed	Tributary	Station	# Samples	Minimum *E. coli* Concentration MPN/100ml	Maximum *E. coli* Concentration MPN/100ml	May 1st – September 30th Steady State Geometric Mean *E. coli* Concentration MPN/100ml	*E. coli* Criterion MPN/100 ml
02130304	Wicomico River	WIW0216	14	53	271	124	126
02130304	Wicomico River	WIW0226	14	10	831	59	126
02130304	Wicomico River	WIW0231	14	10	2,005	107	126
02130304	Wicomico River	WIW0241	14	75	1,445	208	126
02130304	Leonard Mill Pond	LPR0020	14	10	531	84	126
02130304	Leonard Pond Run	LPR0024	14	10	99	24	126
02130304	Leonard Pond Run	LPR0028	14	10	344	31	126
02130304	North Prong	NLO0003	14	10	478	26	126
02130304	North Prong	NLO0008	13	10	192	65	126
02130304	Brewington Branch	BWB0010	14	42	2,880	495	126
02130304	Middle Neck Branch	MNC0003	14	10	384	97	126
02130304	Middle Neck Branch	MNC0010	14	10	20,050	1,086	126

The seasonal period in Table 4, above, uses only data from May 1 through September 30, a critical period for the recreational use.

Using the average flow for the high-flow and low-flow regimes, and the high-flow and low-flow regime bacteria concentrations, the baseline loads were estimated as explained in Section 4.3 and shown in Table 4.3.1 of the TMDL Report, which is shown below as Table 5.

Table 5 - Baseline Load Calculations (TMDL Report, Table 4.3.1)

Stations	Area ($miles^2$)	Flow Source	Unit Flow ($cfs/miles^2$)	Q (cfs)	Annual Condition *E. coli* Geometric Mean Concentration MPN/100ml	Baseline Load in billions (or $x10^9$) MPN/day
NLO0003	9.4	Versar	1.031	9.7	32	7.6
LPR0028	3.6	Versar	1.007	3.6	30	2.6
WIW0241sub	13.1	Versar	1.061	13.9	159	54.2
BWB0010	5.9	Versar	1.028	6.1	280	41.8
MNC0010	6.5	Versar	1.031	6.7	650	105.9

BST was used to identify the relative contribution of the various sources to the instream water samples. The TMDL Report, Appendix C, is the Salisbury University, Department of Biological Sciences and Environmental Health Services, BST report, *Identifying Sources of Fecal Pollution in the Wicomico River Headwaters Watershed, Maryland. Enterococci* isolates were obtained from known sources, which included human, dog, horse, deer, raccoon, rabbit, fox, and goose. For purposes of the TMDL, the sources were separated into domestic animals, human, livestock, and wildlife. A fifth classification of "unknown" results from the analysis when the source could not be identified. The source percentage for each sample is shown in TMDL Report, Appendix C, Table C-8, Percentage of Sources per Station by Date. Tables 6 and 7, below, summarize this information for the average annual period and for the seasonal period (May 1- September 30), respectively.

Table 6 - Distribution of Fecal Bacteria Source Loads in the Wicomico River Headwaters Basin for the Annual Condition (TMDL Report, Table 2.4.3)

Tributary	Station	Domestic %	Human %	Livestock %	Wildlife %	Unknown %	Total %
Wicomico River	WIW0216	28.8%	22.9%	4.4%	32.9%	11.2%	100%
Wicomico River	WIW0226	20.5%	18.5%	16.3%	31.5%	13.4%	100%
Wicomico River	WIW0231	22.1%	25.9%	4.6%	29.9%	17.7%	100%
Wicomico River	WIW0241	20.4%	13.3%	5.1%	57.0%	4.3%	100%
Leonard Mill Pond	LPR0020	17.9%	14.5%	9.7%	48.9%	8.9%	100%
Leonard Pond Run	LPR0024	15.4%	19.1%	7.4%	45.2%	13.0%	100%
Leonard Pond Run	LPR0028	21.1%	8.8%	3.5%	53.5%	13.4%	100%
North Prong	NLO0003	15.1%	15.0%	6.6%	50.3%	13.1%	100%
North Prong	NLO0008	Use same BST % as NLO0003					
Brewington Branch	BWB0010	Use same BST % as WIW0231					
Middle Neck Branch	MNC0003	30.4%	21.6%	3.0%	34.0%	11.2%	100%
Middle Neck Branch	MNC0010	Use same BST % as MNC0003					

Table 7 - Distribution of Fecal Bacteria Source Loads in the Wicomico Basin for the Seasonal Period May 1 - September 30 (TMDL Report, Table 2.4.4)

Tributary	Station	Domestic %	Human %	Livestock %	Wildlife %	Unknown %	Total %
Wicomico River	WIW0216	27.1%	24.1%	5.3%	39.0%	4.5%	100%
Wicomico River	WIW0226	19.1%	21.6%	12.0%	44.7%	2.6%	100%
Wicomico River	WIW0231	19.1%	21.6%	12.0%	44.4%	2.6%	100%
Wicomico River	WIW0241	21.5%	9.8%	1.3%	64.7%	2.7%	100%
Leonard Mill Pond	LPR0020	18.2%	11.6%	5.4%	57.5%	7.2%	100%
Leonard Pond Run	LPR0024	13.5%	6.3%	4.1%	60.3%	15.8%	100%
Leonard Pond Run	LPR0028	18.2%	26.8%	3.5%	48.2%	3.4%	100%
North Prong	NLO0003	17.4%	20.7%	10.3%	48.6%	3.1%	100%
North Prong	NLO0008	Use same BST % as NLO0003					
Brewington Branch	BWB0010	Use same BST % as WIW0231					
Middle Neck Branch	MNC0003	38.9%	28.2%	1.2%	31.8%	0.0%	100%
Middle Neck Branch	MNC0010	Use same BST % as MNC0003					

The target reduction for each condition is the reduction necessary in the geometric mean from Table 3 to meet the criterion. In determining the initial reduction scenario, two additional factors were considered – risk and practicability.

Bacteria from human sources are presumed to present a larger risk to humans than bacteria from other sources, and bacteria from wildlife presents the lowest risk to humans. TMDL Report, Section 4.7, Practicable Reduction Targets, page 35, identified the assumed risk factors shown in Table 8 below. Table 9, Maximum Practical Reduction Targets, shown below, identifies the practicable reductions and the rationale for selecting them.

Table 8 - Relative Risk Factors

	Human	Domestic Animal	Livestock	Wildlife
Relative Risk to Humans	5	3	3	1

Table 9 - Maximum Practical Reduction Targets (TMDL Report, Table 4.7.2)

Max Practicable Reduction per Source	Human	Domestic Animals	Livestock	Wildlife
	95%	75%	75%	0%
Rationale	(1) Direct source inputs. (2) Human pathogens more prevalent in humans than animals. (3) Enteric viral diseases spread from human to human.[1]	Target goal reflects uncertainty in effectiveness of urban BMPs[2] and is also based on best professional judgment	Target goal based on sediment reductions from BMPs[3] and best professional judgment	No programmatic approaches for wildlife reduction to meet water quality standards. Waters contaminated by wild animal wastes presents a public health risk that is orders of magnitude less than that associated with human waste.[4]

1. EPA. 1984. Health Effects Criteria for Fresh Recreational Waters. EPA-600/1-84-004. U.S. Environmental Protection Agency, Washington, DC.
2. EPA. 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices. EPA-821-R-99-012. U.S. Environmental Protection Agency, Washington, DC.
3. EPA. 2004. Agricultural BMP Descriptions as Defined for The Chesapeake Bay Program Watershed Model. Nutrient Subcommittee Agricultural Nutrient Reduction Workshop.
4. Environmental Indicators and Shellfish Safety. 1994. Edited by Cameron, R., Mackeney and Merle D. Pierson, Chapman & Hall.

The required reductions were determined by analyzing critical time periods individually for each subwatershed, together with the results of the BST analysis, to minimize the final risk. First, the reductions were not allowed to exceed the practicable reductions in the above table. The water quality criterion for *E. coli* could not be achieved.

Table 10 - Practical Reductions Results (TMDL Report, Table 4.7.3)

Station	Applied Reductions				Achievable during Average Annual Condition?	Achievable during Seasonal Condition?
	Domestic %	Human %	Livestock %	Wildlife %		
NLO0003	0.0%	0.0%	0.0%	0.0%	Yes	Yes
LPR0028	0.0%	0.0%	0.0%	0.0%	Yes	Yes
WIW0241sub	75.0%	95.0%	75.0%	0.0%	Yes	No
BWB0010	75.0%	95.0%	75.0%	0.0%	No	No
MNC0010	75.0%	95.0%	75.0%	0.0%	No	No

Next, the analysis was performed allowing greater reductions for each fecal bacteria source until the water quality criterion for *E. coli* was achieved.

Table 11 - Required Reductions to Achieve Water Quality Criterion Up to 98% Reductions (TMDL Report, Table 4.7.4)

Station	Domestic %	Human %	Livestock %	Wildlife %	Target Reduction
NLO0003	0.0%	0.0%	0.0%	0.0%	0.0%
LPR0028	0.0%	0.0%	0.0%	0.0%	0.0%
WIW0241sub	95.1%	47.3%	69.9%	1.0%	31.11%
BWB0010	97.4%	97.7%	95.9%	47.7%	79.15%
MNC0010	98.0%	98.0%	79.7%	69.5%	86.50%

The TMDL load is then divided into WLA, WLA-MS4 and LA portions. MDE developed allocation rules summarized in Table 12 below. The "unknown" BST source category is deleted and the other categories increased.

Table 12 - Source Contributions for TMDL Allocations (TMDL Report, Table 4.8.1)

Allocated Category	Human	Domestic Animals	Live Stock	Wildlife
Municipal WWTP	X			
Industrial WWTP	X		X[1]	
LA	X	X	X	X

1. Special condition for industrial wastewater treatment plant (WWTP).

Wicomico County is not covered by an MS4 permit; therefore, the total domestic pet load is assigned to the LA. For the same reason, wildlife is also assigned to the LA. MS4 permits do not

cover livestock, so it will also be part of the LA when it is not designated as a concentrated animal feeding operation. Under special permit conditions, a WWTP may receive livestock sewage. The industrial discharge bacteria loading from chicken hatchery waste will be assigned in the WLA as livestock, while the domestic discharge will be assigned as human. A percentage of the total effluent from the Perdue plants is irrigated to a nearby agricultural field. As a conservative assumption, the flow from the plants is discharged to the surface waters year round.

Subwatersheds NLO0003 and WIW0241sub are located in the State of Delaware. For this reason, the LA in those subwatersheds is distributed between the State of Maryland and the State of Delaware based on the percentage of the total area that each state occupies in each subwatershed (i.e., NLO0003 is 90% Maryland and 10% Delaware; WIW024sub is 91.1% Maryland and 8.9% Delaware).

V. Discussion of Regulatory Conditions

EPA finds that Maryland has provided sufficient information to meet all of the seven basic requirements for establishing bacteria TMDLs for Wicomico River Headwaters. Therefore, EPA approves the TMDLs for the Wicomico River Headwaters Watershed. EPA's approval is outlined according to the regulatory requirements listed below.

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

The Maryland water quality standards Surface Water Use Designation for this watershed includes Use I – Water Contact Recreation and Protection of Non-Tidal Warm Water Aquatic Life (COMAR 26.08.02.08D).

The standards for bacteria used for Use I water – Water Contact Recreation and Protection of Non-Tidal Warm Water Aquatic Life – are contained in COMAR 26.08.02.03-3. For waters not designated natural bathing areas, the applicable criteria from Table 1, COMAR 26.08.02.03-3.A.(1)(a) are as follows:

Table 13 - Water Quality Criteria

Indicator	Steady State Geometric Mean Indicator Density
Freshwater	
E. coli	126 MPN[1]/100ml
Enterococci	33 MPN/100ml
Marine Water	
Enterococci	35 MPN/100ml

[1]MPN - Most Probable Number

The standards do not specify either a minimum number of samples required for the geometric mean or timeframe such as the commonly used 30-day period. However, the *2006 List of Impaired Surface Waters [303(d) List] and Integrated Assessment of Water Quality In Maryland*, dated April 2006, Section B.3.2.1.3.1, Recreational Waters, contains MDE's interpretation of how bacteria data will be used for assessing waters for general recreational use. A steady state geometric mean will be calculated with available data where there are at least five representative sampling events. The data

shall be from samples collected during steady state conditions and during the beach season (Memorial Day through Labor Day) to be representative of the critical condition. Furthermore, according to Section B.3.2.1.3.2, Beaches, "(t)he single sample maximum criteria applies only to beaches and is to be used for closure decisions based on short-term exceedances of the geometric mean portion of the standard." Since warm temperatures can occur early in May and last until the end of September or early October, a longer seasonal period than the official beach season (Memorial Day through Labor Day) was used for the water quality assessment, as a conservative assumption in the analysis.

In 1986, EPA published "Ambient Water Quality Criteria for Bacteria" whereby three indicator organisms, fecal coliform, *E. coli* and *Enterococci*, were assessed to determine their correlation with swimming-associated illnesses. Fecal coliform are a subgroup of total coliform bacteria and *E. coli* are a subgroup of fecal coliform. *Enterococci* are a subgroup of bacteria in the fecal streptococcus group. Fecal coliform, *E. coli* and *Enterococci* can all be classified as fecal bacteria. The statistical analysis found that the highest correlation to gastrointestinal illness was linked to elevated levels of *E. coli* and *Enterococci* in fresh water (*Enterococci* in salt water), leading EPA to propose that States use *E. coli* or *Enterococci* as pathogen indicators. Maryland has adopted the EPA recommended bacterial indicators, *E. coli* and *Enterococcus*. Although the criteria numbers are different, the risk to the recreational bathers at the criteria levels are the same.

Estimation of annual and seasonal conditions loads in the Wicomico River Headwaters TMDL was determined by assessing monitoring data for all stations located in the Wicomico River Headwaters Watershed over a sufficient temporal span (at least one year).

EPA finds that the TMDLs for bacteria will ensure that the designated use and water quality criteria for Wicomico River Headwaters are met and maintained.

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

The TMDL is expressed as MPN per day and is based on meeting the instream long-term geometric mean of *E. coli* bacteria. EPA's regulations at 40 CFR §130.2(i), also define "total maximum daily load (TMDL)" as the "sum of individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background." As the total loads provided by Maryland equal the sum of the individual WLAs for point sources and the land-based LAs for nonpoint sources set forth below, the TMDLs for fecal bacteria for Wicomico River Headwaters are consistent with §130.2(i). Pursuant to 40 CFR §130.6 and §130.7(d)(2), these TMDLs and supporting documentation, should be incorporated into Maryland's current water quality management plan.

The WLAs are assigned to permitted point sources. Wicomico County is not covered by an MS4 permit; therefore, the total domestic pet load is assigned to the LA. For the same reason, wildlife is also assigned to the LA. MS4 permits do not cover livestock and it will also be part of the LA when it is not designated as a CAFO.

Table 14 (also Table 1) - Wicomico River Headwaters Bacteria Non-Tidal TMDL Summary

Subwatershed	Baseline	TMDL	WLA-PS	WLA-MS4	LA	
	Billions MPN/day *E. coli*					
					Maryland	Delaware
NLO0003	7.6	29.9	0.0	0.0	26.9	3.0
LPR0028	2.6	11.0	0.0	0.0	11.0	0.0
WIW0241sub	54.2	43.0	3.1	0.0	31.2	3.0
BWB0010	41.8	18.8	0.0	0.0	8.7	0.0
MNC0010	105.9	20.6	0.8	0.0	13.5	0.0
TOTAL	212.1	123.3	3.9	0.0	91.3	6.0

Table 15 - NPDES Permitted Facility WLAs

Permittee/ Allocation	**Permit Number**	**Location**	**WLA-PS Billion MPN /Day**
Delmar WWTP	MD0020532	Wicomico	4.3
Perdue Farms	MD0000060	Wicomico	12.8

EPA realizes that the bacteria allocations shown in Table 14 is one allocation scenario designed to meet instream water quality standards. As implementation of the established TMDLs proceed or more detailed information becomes available, Maryland may find other combinations of dividing the TMDL loads between WLA-PS and LA allocations are feasible and/or cost effective. Any subsequent changes, however, must ensure that the instream water quality standards are met.

Based on the foregoing, EPA has determined that the Wicomico TMDLs for fecal bacteria are consistent with the regulations and requirements of 40 CFR Section 130.

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

Maryland's Wicomico Watershed is comprised of five distinct subwatersheds. While the monitoring data used in developing the TMDL is from instream sampling which integrates the effects of all loads, the effects of the upstream subwatersheds are considered on the downstream subwatersheds. A decay factor and estimated time of travel was used to estimate the effect of the upstream subwatersheds on the downstream subwatersheds.

4. The TMDLs consider critical environmental conditions.

EPA regulations at 40 CFR §130.7(c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that Wicomico River Headwaters' water quality is protected at all times.

MDE's water quality standards do not specify a time period for which the geometric mean is calculated. For the designated recreational use, the critical period for exposure is the summer months during the swimming season. To identify critical periods resulting from flow and rainfall

conditions, MDE developed a procedure to examine the 15-year flow record for critical high and low-flow periods of one year and for seasonal (May 1 to September 30) conditions. MDE's 2006 Section 303(d) listing methodology identifies the swimming period as Memorial Day to Labor Day, however, MDE used May through September because May and September may be warm and swimming may occur.

5. *The TMDLs consider seasonal environmental variations.*

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high-flow normally occurs during the colder period of winter and in early spring from snow melt and spring rain, while low-flow typically occurs during warmer summer and early fall drought periods[3]. MDE's statistical method analyzed flows in Wicomico River Headwaters by dividing them into high and low-flow regimes and calculated geometric mean bacteria concentrations for each regime in order to evaluate seasonal differences.

6. *The TMDLs include a margin of safety.*

A MOS is required as part of a TMDL in recognition of many uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural water bodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection.

Based on EPA guidance, the MOS can be achieved through two approaches.[4] One approach is to reserve a portion of the loading capacity as a separate term in the TMDL. The second approach is to incorporate the MOS as conservative assumptions used in the TMDL analysis.

MDE chose an implicit MOS (i.e., the known low bias of the back transformed concentrations will provide an environmentally conservative estimate of the load required to attain water quality standards).

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

MDE conducted two public reviews of the Wicomico River Headwaters TMDLs. The first public comment period was August 12, 2005 to September 12, 2005, and the second November 23, 2005 to December 22, 2005. The second public comment period was held because of several comments received by MDE during the first comment period, specifically with respect to critical conditions. Two sets of written comments were received from the first comment period, including EPA's, and five sets from the second public comment period. EPA received MDE's responses on February 3, 2006, with the final submittal.

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[3] Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2, Part 1, Section 2.33, (EPA 823-B-97-002, 1997)

[4] *Guidance for Water Quality-based Decisions: The TMDL Process,* (EPA 440/4-91-001, April 1991)

VI. Discussion of Reasonable Assurance

In addition to the seven outlined elements above, there is a reasonable assurance that the TMDLs can be met. 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 which is prepared by the state and approved by EPA. Therefore, any WLAs will be implemented through the NPDES permit process. Based on the point source permitting information, there are two NPDES point source facilities with permits regulating the discharge of fecal bacteria directly into the Wicomico River Headwaters Watershed – Delmar Municipal WWTP and Perdue Farms Industrial WWTP.

In Wicomico Headwaters Watershed, MDE's analysis indicates that required reductions to meet the water quality criteria are extremely large and are not feasible by implementing cost-effective and reasonable best management practices (BMP) to nonpoint sources. Therefore, MDE intends to implement an iterative approach that addresses those sources with the largest impact on water quality and human health risk, with consideration given to ease of implementation and cost.

Maryland has several well established programs that will be drawn upon such as the NPDES permit limits that will be based on the TMDL loadings, MDE's Managing for Results work plan, and MDE procedures adopted to assure that future evaluations are conducted for all established TMDLs.

MDE's implementation plan is not only based on reductions to total fecal bacteria, it is based on reductions by sources of bacteria. MDE used the results of its BST monitoring from October 2002 through October 2003 to estimate the required reduction in sources of bacteria. MDE does not consider it practical to require wildlife source reductions. MDE identifies the maximum practicable reduction (MPR) per source as:

- Human - 95 percent
- Domestic Animal - 75 percent
- Livestock - 75 percent
- Wildlife - 0 percent

Table 16 (also Table 7) – Distribution of Fecal Bacteria Source Loads in the Wicomico River Headwaters Basin for the Annual Condition (TMDL Report, Table 2.4.3)

Tributary	Station	Domestic %	Human %	Livestock %	Wildlife %	Unknown %	Total %
Wicomico River	WIW0216	28.8%	22.9%	4.4%	32.9%	11.2%	100%
Wicomico River	WIW0226	20.5%	18.5%	16.3%	31.5%	13.4%	100%
Wicomico River	WIW0231	22.1%	25.9%	4.6%	29.9%	17.7%	100%
Wicomico River	WIW0241	20.4%	13.3%	5.1%	57.0%	4.3%	100%
Leonard Mill Pond	LPR0020	17.9%	14.5%	9.7%	48.9%	8.9%	100%
Leonard Pond Run	LPR0024	15.4%	19.1%	7.4%	45.2%	13.0%	100%
Leonard Pond Run	LPR0028	21.1%	8.8%	3.5%	53.5%	13.4%	100%
North Prong	NLO0003	15.1%	15.0%	6.6%	50.3%	13.1%	100%
North Prong	NLO0008	Use same BST % as NLO0003					
Brewington Branch	BWB0010	Use same BST % as WIW0231					
Middle Neck Branch	MNC0003	30.4%	21.6%	3.0%	34.0%	11.2%	100%
Middle Neck Branch	MNC0010	Use same BST % as MNC0003					

Table 17 (also Table 8) - Distribution of Fecal Bacteria Source Loads in the Wicomico River for the Seasonal Period May 1 - September 30 (TMDL Report, Table 2.4.4)

Tributary	Station	Domestic %	Human %	Livestock %	Wildlife %	Unknown %	Total %
Wicomico River	WIW0216	27.1%	24.1%	5.3%	39.0%	4.5%	100%
Wicomico River	WIW0226	19.1%	21.6%	12.0%	44.7%	2.6%	100%
Wicomico River	WIW0231	19.1%	21.6%	12.0%	44.4%	2.6%	100%
Wicomico River	WIW0241	21.5%	9.8%	1.3%	64.7%	2.7%	100%
Leonard Mill Pond	LPR0020	18.2%	11.6%	5.4%	57.5%	7.2%	100%
Leonard Pond Run	LPR0024	13.5%	6.3%	4.1%	60.3%	15.8%	100%
Leonard Pond Run	LPR0028	18.2%	26.8%	3.5%	48.2%	3.4%	100%
North Prong	NLO0003	17.4%	20.7%	10.3%	48.6%	3.1%	100%
North Prong	NLO0008	Use same BST % as NLO0003					
Brewington Branch	BWB0010	Use same BST % as WIW0231					
Middle Neck Branch	MNC0003	38.9%	28.2%	1.2%	31.8%	0.0%	100%
Middle Neck Branch	MNC0010	Use same BST % as MNC0003					

The following reductions (Table 18) are necessary to achieve water quality standards.

Table 18 (also Table 11) – TMDL Reduction Results: Optimization Model up to 98% (TMDL Report, Table 4.7.4)

Station	Domestic %	Human %	Livestock %	Wildlife %	Target Reduction
NLO0003	0.0%	0.0%	0.0%	0.0%	0.0%
LPR0028	0.0%	0.0%	0.0%	0.0%	0.0%
WIW0241sub	95.1%	47.3%	69.9%	1.0%	31.11%
BWB0010	97.4%	97.7%	95.9%	47.7%	79.15%
MNC0010	98.0%	98.0%	79.7%	69.5%	86.50%

The TMDLs must specify LAs that will meet the water quality standards. In the practicable reduction targets scenarios, two subwatersheds (NLO0003 and LPR0028) met water quality standards. Subwatershed WIW0241sub met water quality standards based on MPRs during the annual condition but did not meet water quality standards during the seasonal condition.

Subwatersheds BWB0010 and MNC0010 did not meet water quality standards based on MPRs during both annual and seasonal conditions.

To further develop the TMDLs, in those subwatersheds not meeting criteria, the constraints on MPRs were relaxed in those two subwatersheds where the water quality attainment was not achievable with the MPRs. In three subwatersheds, the maximum allowable reduction was increased to 98% for all sources, including wildlife.

MDE intends for the required reductions to be implemented in an iterative process that first addresses those sources with the largest impact on water quality, with consideration given to ease of implementation and cost. The iterative implementation of BMPs in the watershed has several benefits: tracking of water quality improvements following BMP implementation through follow-up stream monitoring; providing a mechanism for developing public support through periodic updates on BMP implementation; and helping to ensure that the most cost-effective practices are implemented first.

Finally, Maryland has recently adopted a five-year watershed cycling strategy to manage its waters. Pursuant to this strategy, the State is divided into five regions and management activities will cycle through those regions over a five-year period. The cycle begins with intensive monitoring, followed by computer modeling, TMDL development, implementation activities, and follow-up evaluation. This follow-up monitoring will allow Maryland to determine whether the second stage TMDL implementation can be implemented successfully or whether an alternate action should be pursued.