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

Dr. Richard A. Eskin, Director
Technical & Regulatory Services Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 540
Baltimore, MD 21230-1718

MAR 1 4 2007

Dear Dr. Eskin:

We are in receipt of your letter dated October 23, 2006, requesting the U.S. Environmental Protection Agency's (EPA) approval of a revised bacteria TMDL for the Anacostia River Basin in Montgomery and Prince George's Counties, Maryland. The original bacteria TMDL for the Anacostia River Basin was approved by EPA on September 19, 2006. The revision proposed for EPA approval includes modified language for the storm water section of the report, specifically as it concerns the MS4 (Municipal Separate Storm Sewer System) areas.

EPA has reviewed the modified language and believes that the language is consistent with EPA policies and procedures as they relate to the allocation considerations for MS4 areas. Therefore, EPA approves the revised bacteria TMDL for the Anacostia River Basin as submitted.

If you have any questions, please call Mr. Thomas Henry, Program Manager, at (215) 814-5752.

Sincerely,

Jon Capacasa, Director
Water Protection Division

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

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SEP 19 2006

Dr. Richard Eskin, Director
Technical and Regulatory Services Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 540
Baltimore, Maryland 21230-1718

Dear ~~Mr.~~ Rich Eskin:

The Environmental Protection Agency (EPA) Region III is pleased to approve the *Total Maximum Daily Loads of Fecal Coliform for the Anacostia River Basin in Montgomery and Prince George's Counties, Maryland.* The TMDL Report was submitted to EPA for review and approval on June 8, 2006. 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. Maryland identified the Anacostia River as impaired by fecal coliform.

In accordance with Federal regulations at 40 CFR § 130.7, a TMDL must comply with the following requirements: (1) 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 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), (7) consider reasonable assurance that the TMDL can be met, and (8) be subject to public participation. The enclosure to this letter describes how the TMDL for the fecal coliform impairment for the Anacostia River satisfies each of these requirements.

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 at 215-814-5752 or Mary F. Beck at 215-814-3429.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure

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

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
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Decision Rationale
Total Maximum Daily Loads of Fecal Bacteria for Anacostia River Basin in Montgomery and Prince George's Counties Maryland

Jon M. Capacasa, Director
Water Protection Division

9/19/06
Date

Decision Rationale

Total Maximum Daily Loads of Fecal Bacteria for the Anacostia River Basin in Montgomery and Prince George's Counties, Maryland

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies 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, that may be discharged to a water quality-limited water body.

This document sets forth the United States Environmental Protection Agency's (EPA) rationale for approving the TMDLs for fecal bacteria in the Anacostia River watershed. The TMDL was established to address water quality impairments caused by bacteria as identified in Maryland's 2002 and 2004 Section 303(d) lists of impaired waters. The Maryland Department of the Environment (MDE), submitted the *Total Maximum Daily Loads of Fecal Bacteria for the Anacostia River Basin in Montgomery and Prince George's Counties, Maryland*, dated May 2006 (TMDL Report), to EPA for final review on June 8, 2006. The Anacostia River watershed (02-14-02-05) was first identified on Maryland's 1996 Section 303(d) list for nutrients and sediments with fecal bacteria for non-tidal waters and toxics, including poly-chlorinated biphenyls and heptachlor epoxide, added on the 2002 Section 303(d) list. Fecal bacteria for tidal waters was added in 2004. The TMDLs described in this document were developed to address fecal bacteria tidal and non-tidal water quality impairments. The suspended sediment, nutrient, and toxics impairments will be addressed by MDE in a separate TMDL document at a future date.

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 eight 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 waste load allocations and load allocations.
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 margin of safety.
7. There is reasonable assurance that the TMDLs can be met.
8. The TMDLs have been subject to public participation.

There are two National Pollutant Discharge Elimination System (NPDES) permitted sources and two municipal separate stormwater systems (MS4s) within the watershed. 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 approximately 90 percent reduction from existing or baseline conditions.

Table 1- Fecal Bacteria Tidal and Non-Tidal TMDL Summary

Subwatershed	Baseline	TMDL	WLA-PS	WLA-MS4[2]	LA[3]	MOS[4]
	Billion MPN Enterococci/day					
Upstream of Confluence of Northwest Branch and Northeast Branch	3,194	310	1	179	130[6]	5 % explicit
Downstream of Confluence of Northwest Branch and Northeast Branch and Upstream of MD/DC line	106,447	47	0	31	16	implicit
TOTAL (Derived from CD's TMDL)		357	1	210	146	

1 MPN = Most Probable Number
2 WLA-PS = Waste Load Allocation for non MS4 systems (municipal or industrial)
3 WLA-MS4 = Waste Load Allocation for MS4 systems
4 LA = Load Allocation
5 MOS = Margin of Safety
6 Including allocation to DC
7 Based on DC's required 97% reduction

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. Conditions, available data and the understanding of the natural processes can change more than anticipated by the margin of safety. The option is always available to the State to refine the TMDL for re-submittal to EPA for approval.

Background

There are three major drainage areas comprising the Anacostia River watershed: the Northwest Branch, the Northeast Branch, and the tidal drainage. The Northwest and Northeast Branches are free-flowing (non-tidal) streams, and their confluence forms the tidal Anacostia River in the vicinity of Bladensburg, Maryland. The many smaller tributaries of the branches form a broad, fan-shaped drainage basin of 17 square miles. Just below Bladensburg, the Anacostia River drops to near sea level and changes from a free-flowing river into a tidal freshwater embayment of the Potomac estuary. See Figure 1.

The tidal drainage area consists of the tidal river and its floodplain, as well as small Coastal Plain streams that flow directly to the tidal river. Most of these streams are enclosed in storm sewer systems. The tidal reach of the Anacostia River is 8.4 miles in length from the confluence of the Northwest and Northeast branches downstream to the Potomac River. The river joins the Potomac approximately 108 miles upstream of the Chesapeake Bay.

The vast majority of the tidal section of the Anacostia River is located in Washington DC, while the free-flowing segments are primarily within the State of Maryland, specifically Prince George's and Montgomery Counties. This document will address the free-flowing (non-tidal) sections of the Anacostia River watershed of approximately 80,000 acres, and the tidal Anacostia

River between the confluence of the Northwest Branch and Northeast Branch and the MD/DC line, an area of approximately 13,726 acres. The head of tide is just upstream of the Alternate Route 1 Bridge crossing in Bladensburg and immediately downstream of the confluence of the Northeast and Northwest Branches.

The Northwest Branch watershed is approximately 32,000 acres, with the land use being almost exclusively heavily developed urban and suburban areas. The topography of the area is gently rolling hills. Eighty percent of the drainage area is within the eastern portion of Montgomery County, with the remaining lower reaches in Prince George's County and the District of Columbia.

The Northeast Branch watershed is approximately 48,000 acres, with land use ranging from urban to Federal Agricultural Research areas. The Federal Agricultural Research Centers are large tracts of land containing animal grazing fields, feed lots, barns, forested areas, clusters of institutional buildings, and two wastewater treatment facilities, the permitted point sources. The topography of the area is gently rolling hills. The majority of the watershed is located within Prince George's County. Only a small portion of the headwater regions is located in Montgomery County, and a couple of minor headwater areas are located in DC.

This region downstream of the Northeast and Northwest Branches includes the tidal portion of the watershed and is approximately 35,890 acres, with the land use being almost exclusively heavily developed urban and suburban areas. The topography of the area is gently rolling hills. Approximately 13,726 acres are located in Maryland and another 22,163 acres are located in Washington DC.

The tidal and non-tidal Anacostia River watershed was listed on the Maryland 2002 and 2004 Section 303(d) lists of impaired waters using fecal coliform as the indicator organism. The State of Maryland used the 1986 EPA guidance as the basis of a 2004 water quality standards change from an indicator organism of fecal coliform to *E.coli*/enterococci to fulfill requirements of the Beaches Act of 2000. Enterococci is the indicator organism used in the Anacostia River fecal bacteria TMDL analysis.

The TMDLs are based on 25 or 26 enterococci samples taken between October 2002 and October 2003, and 11 or 12 bacteria source tracking (BST) samples taken at six stations from November 2002 through October 2003. See Figure 2.

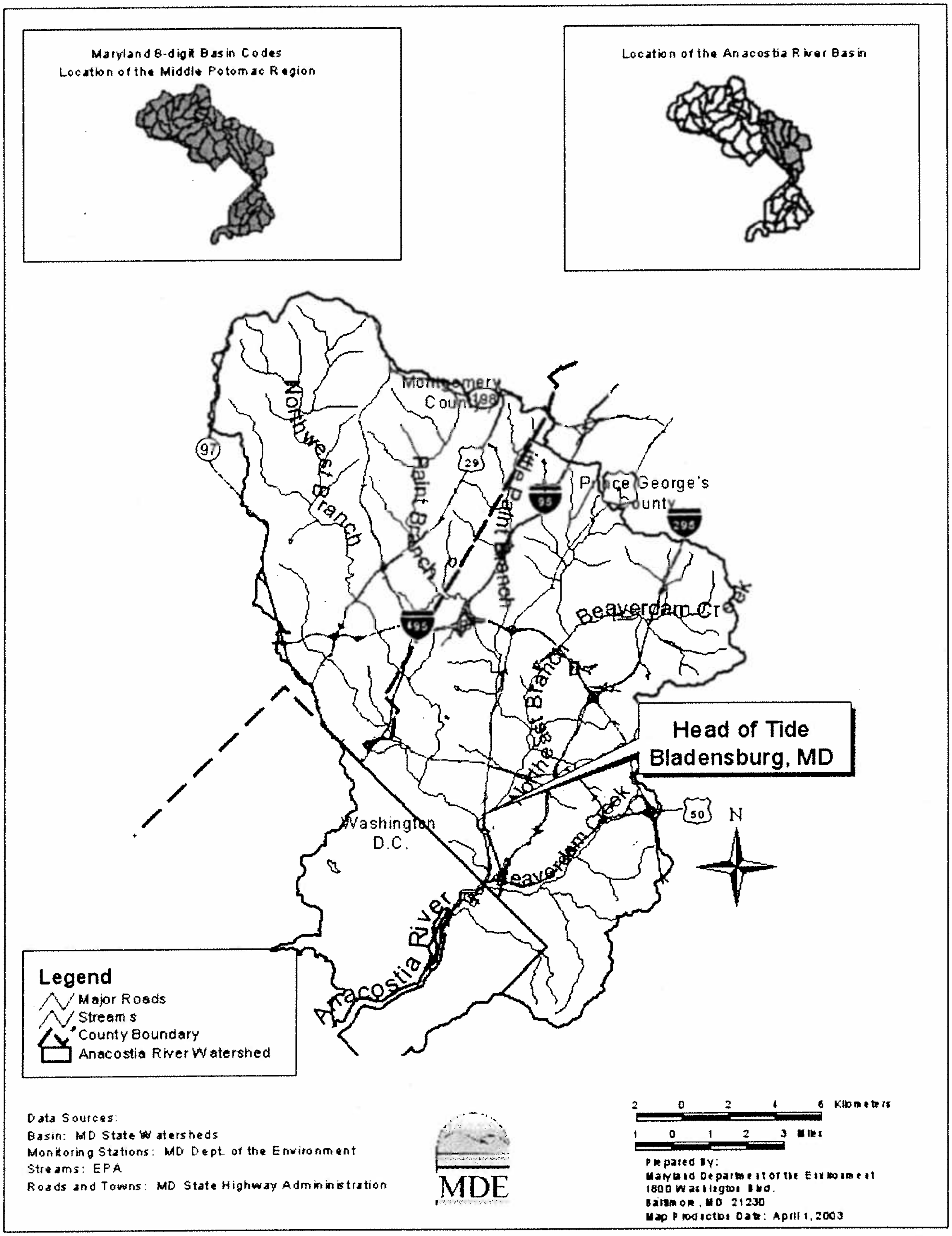

Figure 1 - TMDL Report Figure 2.1.1: Location Map of the Anacostia River Basin

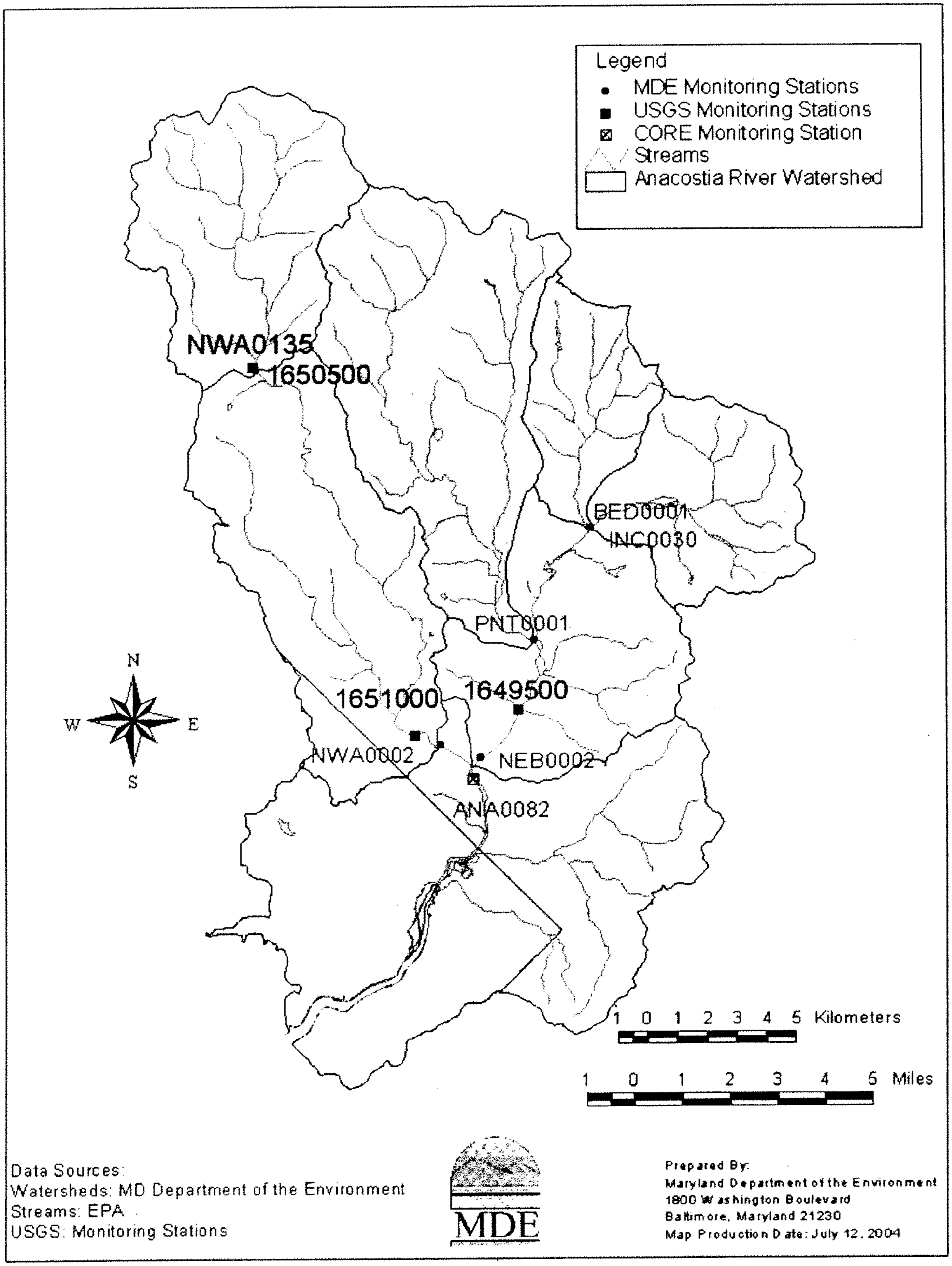

Figure 2 - TMDL Report Figure 4.2.2.1: Monitoring Stations and Subwatersheds in the Anacostia River Basin

II. **Computational Procedure**

From the MD/DC line to the confluence of the Northwest and Northeast Branches, the Anacostia River is tidal, above the confluence the river is non-tidal or free flowing. MDE developed a method described below to determine for non-tidal TMDLs. MDE then used the non-tidal TMDL and information in the District of Columbia's TMDL Report for bacteria in the Anacostia River approved by EPA on August 28, 2002, to determine the tidal subwatershed allocation and the TMDL for Maryland's Anacostia River.

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 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 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 condition 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.[1]

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

Figure 3- Example Flow-Duration Curve

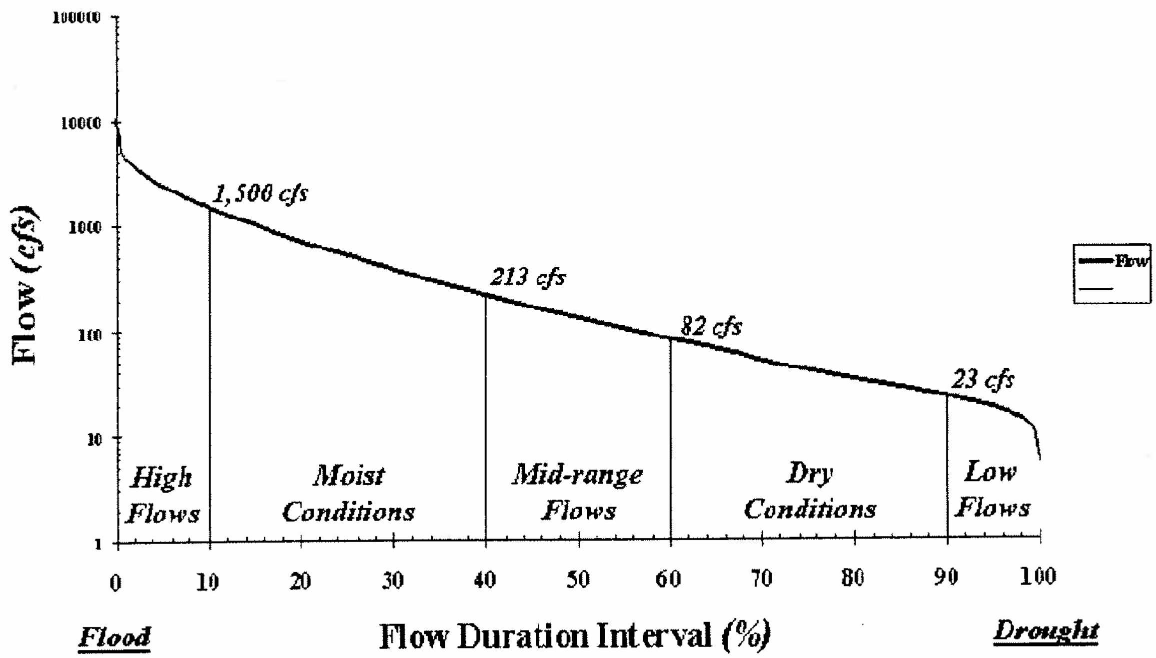
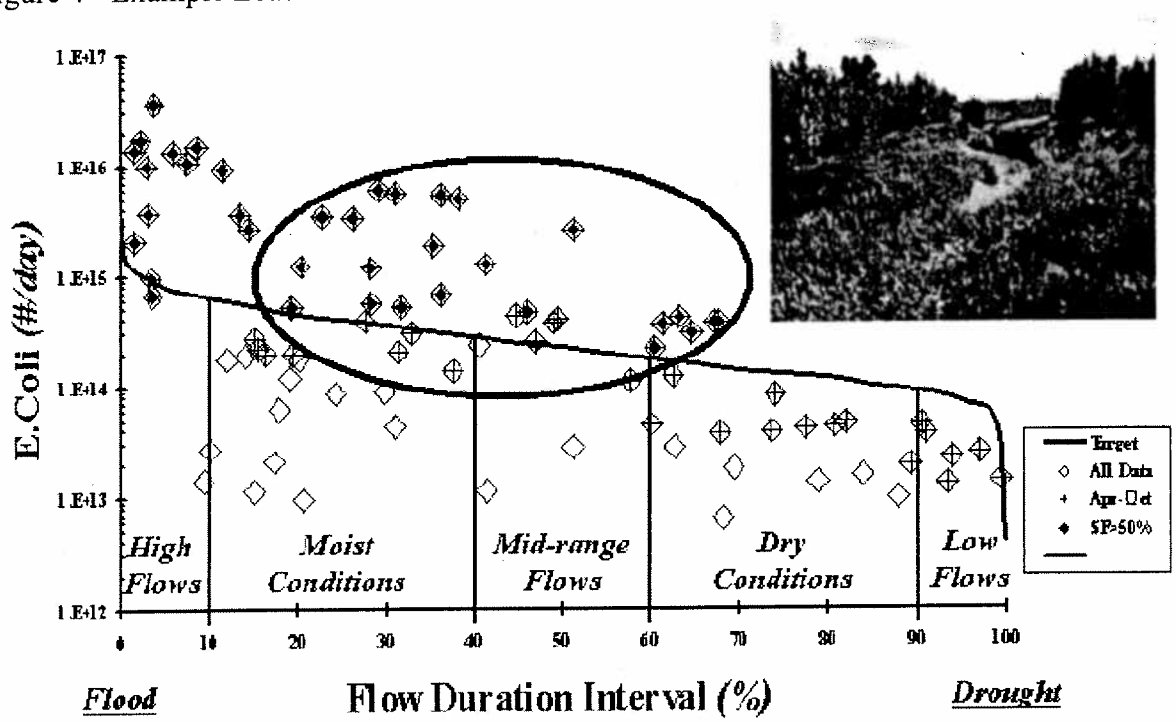


Figure 4 - Example Load-Duration Curve



Frequently the target load shown in Figure 3 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.

Anacostia River Computational Method

Area above the confluence of the Northeast and Northwest Branches

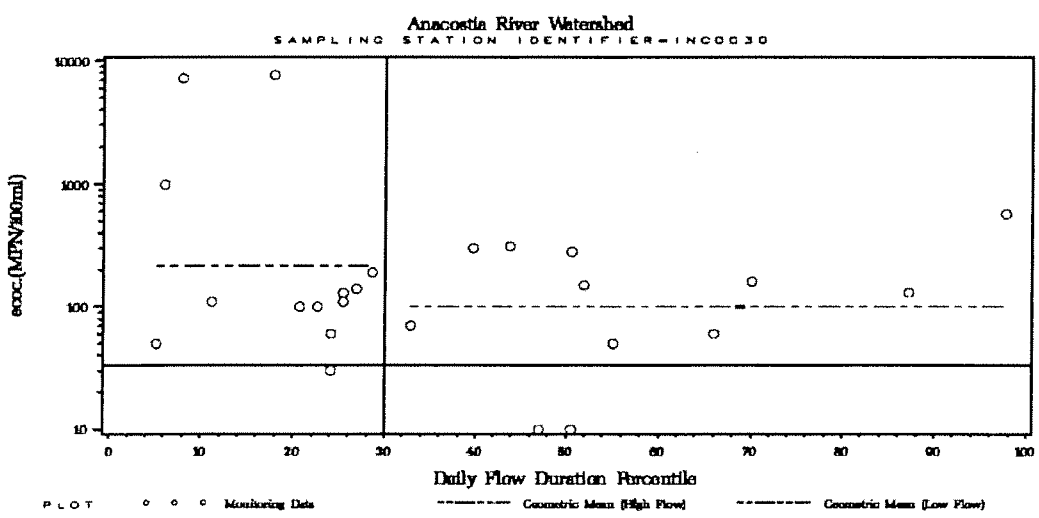
In order for EPA to conduct a thorough review of MDE's method, MDE provided EPA with Microsoft Excel® files and, therefore, the following description of MDE's computational method refers to information not necessarily contained in the TMDL Report.

There are three USGS gaging stations located within the Anacostia River watershed, one each located upstream of the confluence of the Northeast and Northwest Branches above the tidal influence and one located upstream on the Northwest Branch. The upstream Northwest Branch monitoring station 01650500 has observations from November 1997 to date while the stations upstream of the confluence have observations from October 1988 to date. Therefore, the record for 01650500 was extended using the downstream gage.

There are six subwatersheds used to determine the TMDLs corresponding to the fecal coliform monitoring stations. The flow for each subwatershed was estimated from the appropriate USGS gaging station.

MDE then used a hydrograph separation program, the USGS HYSEP, to analyze the daily flow record to separate surface water flow to Anacostia River from interflow[2] and groundwater to the stream. MDE determined that flows below the 30 percent daily flow interval (high stream flow) represent surface water flow and are likely to have higher bacteria loads than interflow or groundwater. Instead of calculating the geometric mean using all data, MDE calculates a geometric mean using the monitoring data taken when the stream flow is high and a geometric mean using the monitoring data taken when the stream flow is not high. An example plot from the TMDL Report, Appendix B, is shown below.

Figure 5 - Enterococci Concentration vs. Flow Duration for Anacostia River Monitoring Station NWA0135 (TMDL Report, Appendix B, Figure B-6)



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[2]Interflow is that portion of infiltrated rainfall that discharges to a waterbody prior to reaching the groundwater table.

The resulting existing geometric means for high flow and low flow are shown as dashed horizontal lines in Figure 5. The representative geometric mean for the station is equal to 0.3 times the high-flow geometric mean plus 0.7 times the low-flow geometric mean. The high-flow, low-flow, and representative geometric mean are shown in Table 2 below. Note that geometric means in the table except for low-flow Paint Creek exceed the 33 MPN/100ml criterion for enterococci.

Table 2 - Existing/Baseline Conditions (TMDL Report, Tables 2.3.3 and 2.3.4)
Annual Steady State Geometric Mean by Stratum per Subwatershed

Tributary	Station	Stratum	Geometric Mean	Steady State Geometric Mean
Beaverdam Creek	BED0001	High Flow	325.4	345.8
		Low Flow	354.9	
Indian Creek	INC0030	High Flow	214.9	125.6
		Low Flow	99.8	
Northeast Branch	NEB0002	High Flow	295.5	91.2
		Low Flow	55.1	
Northwest Branch	NWA0002	High Flow	385.7	133.4
		Low Flow	84.6	
Northwest Branch	NWA0135	High Flow	284.4	127.6
		Low Flow	90.5	
Paint Branch	PNT0001	High Flow	206.1	51.2
		Low Flow	28.2	

Table 2 continued
Seasonal Period Steady State Geometric Mean by Stratum per Subwatershed

Subwatershed	Station	Stratum	Geometric Mean	Steady State Geometric Mean
Beaverdam Creek	BED0001	High Flow	154	250
		Low Flow	307	
Indian Creek	INC0030	High Flow	175	186
		Low Flow	190	
Northeast Branch	NEB0002	High Flow	148	67
		Low Flow	48	
Northwest Branch	NWA0002	High Flow	306	165
		Low Flow	127	
Northwest Branch	NWA0135	High Flow	212	258
		Low Flow	281	
Paint Branch	PNT0001	High Flow	126	54
		Low Flow	38	

The seasonal period 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, the Northwest and Northeast Branches baseline bacteria loads are 2,839.7 and 1,354.8 billion MPN (TMDL Report Table 4.2.2.1) respectively.

In order to analyze the flow record for periods that might produce higher overall geometric means and loads, each day of the flow record was assigned to either the high flow or low flow regime. MDE used a rolling one-year period to find a year with the most high-flow days and a year with the most low-flow days, and examined each year's swimming season to find the one with the most high-flow days and most low-flow days, and a 30-day period with the most and least high flow days as shown below.

Table 3 - Critical Time Periods (TMDL Report, Table 4.2.3.1)

Hydrological Condition		Averaging Period	Water Quality Data Used	Subwatershed	Fraction High Flow	Fraction Low Flow	Period
Annual	Average Condition	365 days	All	All	0.30	0.70	Long Term Average
	High Flow	365 days	All	BED0001; INC0030; NWA0135	0.55	0.45	April 8th, 1996 – March 23rd, 1997
				PNT0001; NEB0002; NEB0002sub	0.53	0.47	Nov 1st, 2002 – Oct 31st, 2003
				NWA0002; NWA0002sub	0.55	0.45	Jan 8th, 1996 – Jan 7th, 1997
	Low Flow	365 days	All	BED0001; INC0030; NWA0135	0.07	0.93	October 1st, 2002 – Sept 30th, 2003
				PNT0001; NEB0002; NEB0002sub	0.08	0.92	Sept 28th, 2002 – Sept 27th, 2003
				NWA0002; NWA0002sub	0.09	0.91	Sept 28th, 2002 – Sept 27th, 2003
Season	High Flow	May 1st – Sept 30th	May 1st – Sept 30th	BED0001; INC0030; NWA0135	0.52	0.48	May 1st - Sept 30th, 2003
				PNT0001; NEB0002; NEB0002sub	0.50	0.50	May 1st - Sept 30th, 2003
				NWA0002; NWA0002sub	0.52	0.48	May 1st - Sept 30th, 2003
	Low Flow	May 1st – Sept 30th	May 1st – Sept 30th	BED0001; INC0030; NWA0135	0.11	0.89	May 1st – Sept 30th, 2002
				PNT0001; NEB0002; NEB0002sub	0.12	0.88	May 1st – Sept 30th, 1991
				NWA0002; NWA0002sub	0.13	0.87	May 1st – Sept 30th, 1991
30-day	High Flow	30 days	All	BED0001; INC0030; NWA0135	1.00	0.00	Several occurrences during both Winter and Summer
				PNT0001; NEB0002; NEB0002sub	1.00	0.00	
				NWA0002; NWA0002sub	1.00	0.00	
	Low Flow	30 days	All	BED0001; INC0030; NWA0135	0.00	1.00	Several occurrences during both Winter and Summer
				PNT0001; NEB0002; NEB0002sub	1.00	0.00	
				NWA0002; NWA0002sub	1.00	0.00	

Although MDE does not use the 30-day geometric mean in their non-tidal fecal bacteria TMDLs, the District of Columbia does. Therefore, MDE included the 30-day critical period in their analysis.

There are two subwatersheds on the Northwest Branch and four subwatersheds on the Northeast Branch. The upper subwatershed's fecal bacteria load's contribution to the total fecal bacteria load at the confluence of the two branches was estimated by determining the travel time between the two points and applying a die-off factor.

Bacteria source tracking (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 Anacostia River Watershed, Maryland. Enterococci* isolates were obtained from known sources, which included human, dog, cow, goat, horse, pig, sheep, chicken, deer, 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 per Date.

The TMDL Report, Section 4.2.6, Source Distributionfor the Watershed Located Upstream of the Northwest Branch and Northeast Branch Confluence, explains MDE's procedure to obtain Table Tables 4 and 5 below.

Table 4 - Source Distribution for the Watershed Located Upstream of the Northwest and Northeast Branches Confluence Using All Data (TMDL Report Table 4.2.6.1)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
BED0001	High Flow	35.6	3.0	4.2	24.3	32.9
	Low Flow	24.3	11.7	6.2	17.7	40.2
	Weighted	27.7	9.1	5.6	19.7	38.0
INC0030	High Flow	26.3	2.9	15.1	29.0	26.7
	Low Flow	20.9	23.5	7.6	22.5	25.5
	Weighted	22.5	17.3	9.9	24.4	25.9
NEB0002	High Flow	35.6	3.6	8.0	33.7	19.1
	Low Flow	9.4	7.9	25.2	23.7	33.7
	Weighted	17.3	6.6	20.1	26.7	29.3
NWA0002	High Flow	21.6	9.0	9.4	23.6	36.4
	Low Flow	18.5	11.0	2.8	28.9	38.8
	Weighted	19.4	10.4	4.8	27.3	38.1
NWA0135	High Flow	28.4	26.0	3.9	7.0	34.6
	Low Flow	14.6	40.9	3.7	8.0	32.8
	Weighted	18.8	36.4	3.7	7.7	33.3
PNT0001	High Flow	12.5	12.4	8.4	34.5	32.2
	Low Flow	23.8	18.0	4.0	26.7	27.6
	Weighted	20.4	16.3	5.3	29.0	29.0

Table 5 - Source Distribution for the Watershed Located Upstream of the Northwest and Northeast Branches Confluence Using Seasonal Data (TMDL Report Table 4.2.6.2)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
BED0001	High Flow	26.7%	1.1%	6.4%	26.6%	39.2%
	Low Flow	29.3%	6.6%	6.2%	31.3%	26.5%
	Weighted	28.5%	5.0%	6.3%	29.9%	30.3%
INC0030	High Flow	26.9%	16.1%	4.3%	10.5%	42.2%
	Low Flow	14.0%	30.1%	11.6%	14.0%	30.3%
	Weighted	17.9%	25.9%	9.4%	13.0%	33.8%
NEB0002	High Flow	24.7%	3.4%	7.9%	44.4%	19.7%
	Low Flow	18.7%	4.9%	15.6%	9.8%	50.9%
	Weighted	20.5%	4.5%	13.3%	20.2%	41.5%
NWA0002	High Flow	32.8%	5.7%	10.1%	24.1%	27.2%
	Low Flow	23.4%	17.5%	2.2%	36.4%	20.5%
	Weighted	26.2%	14.0%	4.6%	32.7%	22.5%
NWA0135	High Flow	32.7%	38.8%	1.1%	5.5%	22.0%
	Low Flow	9.7%	71.0%	0.0%	0.0%	19.3%
	Weighted	16.5%	61.3%	0.34%	1.6%	20.1%
PNT0001	High Flow	13.5%	15.9%	8.1%	21.1%	41.4%
	Low Flow	12.6%	30.2%	1.8%	23.5%	31.9%
	Weighted	12.8%	25.9%	3.7%	22.8%	34.7%

The target reduction for each condition is the reduction necessary in the geometric mean from Table 2 to meet the criterion. A five percent MOS was used so that the geometric mean was reduced to 95 percent of 33 MPN/100ml or 31.5 MPN/100ml. In determining the final 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 4.2.6, Practicable Reduction Targets, page 47, identified the assumed risk factors shown in Table 6 below. In addition, some bacteria sources are more easily controlled. Table 7, Maximum Practicable Reduction Targets, shown below, identifies the practicable reductions and the rationale for selecting them.

Table 6- Relative Risk Factors

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

Table 7 - Maximum Practicable Reduction Targets (TMDL Report, Table 4.2.6.4)

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 each of the above 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 enterococci could not be achieved.

Next, the analysis was performed allowing greater reductions for each fecal bacteria as shown in Table 8 source until the water quality criterion for enterococci was achieved.

Table 8 - Required Reductions to Achieve Water Quality Criterion (TMDL Report, Table 4.2.6.6)

Station	% Domestic Animals	% Human	% Livestock	% Wildlife	% Target Reduction
BED0001	98%	98%	98%	81%	91%
INC0030	98%	98%	98%	66%	88%
PNT0001	98%	98%	98%	72%	87%
NEB0002sub	98%	95%	98%	49%	79%
NWA0135	98%	98%	98%	14%	88%
NWA0002sub	98%	98%	98%	53%	78%

The TMDL load is then divided into WLA, WLA-MS4 and LA portions. MDE developed allocation rules summarized in Table 9 below. The "unknown" BST source category is deleted and the other categories increased.

Table 9 - Source Contributions for TMDL Allocations (TMDL Report, Table 4.2.7.1)

Allocated to	Human	Domestic Animals	Live Stock	Wildlife
WLA - WWTP	X		X[1]	
WLA - MS4		X		X
LA	X		X	X

[1]Special condition for USDA permit

There are two wastewater treatment plants (WWTPs) present in the Anacostia River basin and the human allocation is assigned to the WLA and LA.

The MS4 permits issued to the counties cover the whole county although the entire watershed is regulated by MS4 permits, the physical extent of the MS4 systems is unknown and, in the future, it may be determined that loads currently considered part of the WLA-MS4 are actually part of the LA. MDE has allocated loads to the LA based on land use, *i.e.*, land uses not expected to lie within the actual MS4 service area.

Where the entire watershed is covered by a MS4 permit(s), the domestic pet allocation is assigned to the MS4 WLA. Livestock is not covered by MS4 permits and will therefore be part of the LA. Wildlife is split between WLA-MS4 and LA. This wildlife ratio is estimated based on the amount of urban pervious land (*e.g.*, residential) compared to other pervious land (*e.g.*, pasture, forest).

Anacostia River Watershed Between the Northwest and Northeast Branches Confluence and the Maryland/DC Line

On August 28, 2002, EPA approved the District of Columbia's *TMDL Report for Fecal Coliform Bacteria in the Upper and Lower Anacostia River* and nine tributaries. A summary of the approved TMDLs follows in Table 10. The TMDLs and Maryland's allocation are average annual loads of fecal coliform in MPN per year based on a three-year simulation period using the TAM/WASP computer model. The years 1988, 1989, and 1990 were used with total rainfalls of 31.74, 50.32, and 40.84 inches. The model simulated daily rain falls and loads to the Anacostia River and demonstrated that instream water quality standards were met each and every day.

Table 10 - District of Columbia's Fecal Coliform TMDL Summary Total Annual Loads - MPN[1]					
Segment	TMDL	WLA[2]	LA[3]	Upstream	MOS[4]
Upper Anacostia	1.99×10^{15}	1.63×10^{15}	1.11×10^{13}	3.48×10^{14}	Explicit
Lower Anacostia	8.27×10^{14}	8.21×10^{14}	5.98×10^{12}		Implicit
Total	2.83×10^{15}	2.46×10^{15}	1.71×10^{13}	3.48×10^{14}	

[1]Most Probable Number is a statistical estimation of bacteria count based on a specific analytical method
[2]Wasteload Allocation
[3]Load Allocation
[4]Margin of Safety

MDE used the upstream fecal coliform allocation of 3.48×10^{14} MPN/year as the TMDL for the entire Maryland Anacostia River watershed. MDE then compared results of a correlation analysis performed on paired 1999-2000 monitoring results of fecal coliform and enterococci. The enterococci/fecal coliform geometric mean ratio was deemed the most appropriate to use in the conversion because it more accurately represents the bacteria loading rates in the three areas of concern than either the median or mean. The areas of concern were:

- The Anacostia River watershed within DC's boundaries.
- The Anacostia River watershed above the confluence.
- The Anacostia River watershed below the confluence.

The allocation to Maryland's tidal Anacostia River subwatershed is equal to DC's allocation to Maryland less the loads at the confluence of the Northwest and Northeast Branches, 47.2 billiion enterococci MPN/day.

III. Discussion of Regulatory Conditions

EPA finds that Maryland has provided sufficient information to meet all of the eight basic requirements for establishing bacteria TMDLs for the Anacostia River. EPA therefore approves the TMDLs for the Anacostia River. 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 within this watershed include uses I-P – Water Contact Recreation, and Protection of Aquatic Life and Public Water Supply, II - Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting, III - Nontidal Cold Water, and IV - Recreational Trout Waters (COMAR 26.08.02.08O). The bacteria criteria for all identified uses are the same as for Use I waters.

The standards for bacteria used for Use I Waters—Water Contact Recreation and Protection of Nontidal Warmwater 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) is as follows:

Table 11 - 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 time frame 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 to Labor Day) was used for the water quality assessment, as a conservative assumption in the analysis.

As the upstream state, Maryland is responsible for meeting the downstream state's water quality standards. At the time the District of Columbia's fecal coliform TMDL was approved, the District's only bacteriological criterion for Class A waters was that the 30-day geometric mean based on five samples was equal to or less than 200 MPN/100 ml. Since then the water quality standards have been revised, and approved by EPA, to establish *E. coli* as the indicator fecal bacteria with a five sample, 30-day geometric mean equal to or less than 126 MPN/100 ml, although the fecal coliform will continue to be a standard until December 31, 2007.

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

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

The TMDL is expressed as MPN per day and is based on meeting the instream long-term geometric mean of enterococci 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 wasteload allocations for point sources and the land-based load allocations for nonpoint sources set forth below, the TMDL for bacteria for Anacostia River is consistent with § 130.2(i).

The waste load allocations are assigned to permitted point sources and the MS4 systems. Both Montgomery County and Prince George's County have MS4 permits, and although the physical extent of the systems are unknown, MDE has made an initial distribution of source loads to WLA and LA. All of the domestic load and none of the human or livestock loads were assigned to the WLA-MS4 load. The wildlife loads were apportioned between the WLA and LA based on the ratio of impervious area in the sewered and unsewered area.

Table 12 - Fecal Bacteria Tidal and Non-Tidal TMDL Summary

Subwatershed	Baseline	TMDL	WLA-PS	WLA-MS4[2]	LA[3]	MOS[4]
	Billion MPN/100ML Enterococci/day					
Upstream of Confluence of Northwest Branch and Northeast Branch	3,194	310	1	179	130	5 % explicit
Downstream of Confluence of Northwest Branch and Northeast Branch and Upstream of MD/DC line	106,447[6]	47	0	31	16	implicit
TOTAL (Derived from DC's TMDL)		357	1	210	146	

1 MPN = Most Probable Number
2 WLA-PS = Waste Load Allocation for non MS4 systems (municipal or industrial)
3 WLA-MS4 = Waste Load Allocation for MS4 systems
4 LA = Load Allocation
5 MOS = Margin of Safety
6 Based on DC's required 97% reduction

Table 13 - NPDES Permitted Facility WLAs

Permittee/ Allocation	Permit Number	Location	WLA Billion MPN /Day	WLA-MS4 Billion MPN /Day
BARC East Side	MD0020842	Prince George's	0.77	
Beltsville USDA West	MD0020851	Prince George's	0.25	
Montgomery County	MD0068349	Montgomery		60
Prince George's County	MD0068284	Prince George's		114
Allocation to DC		District of Columbia		5

EPA realizes that the bacteria allocations shown in Table 12 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-MS4 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 Anacostia River TMDLs for bacteria are consistent with the regulations and requirements of 40 CFR Section 130. Pursuant to 40 CFR 130.6 and 130.7(d)(2), these TMDLs should be incorporated into Maryland's current water quality management plan.

3. The TMDL considers the impacts of background pollutant contributions.

Maryland's Anacostia River watershed is comprised of seven 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 subwatershed are considered on the downstream subwatershed. Above the confluence of the Northwest and Northeast Branches, a decay factor and estimated time of travel was used to estimate the effect of the upstream subwatersheds on the downstream subwatershed.

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 Anacostia River 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. In addition, MDE examined a 30-day period because the District's standards use a 30-day period. The corresponding critical period dates are shown in the TMDL Report Table 4.2.3.1 and Table 3 of this document.

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 Anacostia River by dividing them in to 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 margin of safety (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.

For the watershed above the confluence of the Northwest and Northeast Branches, MDE chose an explicit five percent MOS, *i.e.*, in determining the required reduction the allowable geometric mean was 95 percent of the criterion, or a geometric mean equal to 31.35 MPN/100 ml.

For the subwatershed below the confluence, an implicit MOS was used. MDE used the allocation given to Maryland in the District of Columbia's TMDL for fecal coliform bacteria approved by EPA August 28, 2003, as the basis for the allowable loads from the subwatershed located between the MD/DC line and the confluence. The District used the TAM/WASP computer model which has sufficient detail to allow the use of an implicit MOS.

7. There is a reasonable assurance that the TMDLs can be met.

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. 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 wasteload allocation for the discharge which is prepared by the state and approved by EPA. Therefore, any wasteload allocations will be implemented through the NPDES permit process. The permitted point sources within Anacostia

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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)

River watershed include permitted point sources and municipal separate stormwater systems (MS4s).

Although Maryland has several well-established programs that will be drawn upon (the NPDES permit limits will be based on the TMDL loadings, MDE's Managing for Results work plan, the State's Chesapeake Bay Agreement's Tributary Strategies) and MDE has adopted procedures to assure that future evaluations are conducted for all established TMDLs, MDE cannot assure the required bacteria reduction will be achieved and proposed a phased implementation plan.

To achieve water quality standards at the confluence of the Northwest and Northeast Branches, an approximately 90 percent reduction in total fecal bacteria is required with subwatershed reductions ranging from 78 to 91 percent. The District of Columbia identified a 97 percent reduction in total fecal bacteria to meet water quality standards at the MD/DC line. However, MDE's implementation is not based on reduction to total fecal bacteria, it is based on the 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. The sources are human, domestic animals, livestock, and wildlife with source reductions ranging from 14 to 98 percent. The domestic animal, human, and livestock source reductions are 98 percent and the wildlife reductions range from 14 to 81 percent.

MDE does not consider it practical to require wildlife source reductions. MDE identifies the maximum practicable reduction per source as:

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

Above the confluence of the Northwest and Northeast Branches, the existing fecal bacteria source distribution is estimated to be as follows:

Table 14 - Existing Fecal Bacteria Sources (TMDL Report, Table 4.2.6.3)

Station	% Domestic Animals	% Human	% Livestock	% Wildlife
BED0001	98%	98%	98%	81%
INC0030	98%	98%	98%	66%
PNT0001	98%	98%	98%	72%
NEB0002sub	98%	95%	98%	49%
NWA0135	98%	98%	98%	14%
NWA0002sub	98%	98%	98%	53%

The following reductions are necessary to achieve water quality standards.

Table 15 - Fecal Bacteria Source Reductions to Meet Criteria (TMDL Report, Table 4.2.6.6)

Station	% Domestic Animals	% Human	% Livestock	% Wildlife	% Total
BED0001	45%	15%	9%	32%	100%
INC0030	30%	23%	13%	33%	100%
PNT0001	29%	23%	7%	41%	100%
NEB0002sub	24%	9%	28%	38%	100%
NWA0135	28%	55%	6%	12%	100%
NWA0002sub	31%	17%	8%	44%	100%

Achieving the reductions results in a final TMDL source distribution of:

Table 16 - Source Distribution Meeting Criteria

Station	% Domestic Animals	% Human	% Livestock	% Wildlife
BED0001	10.3	3.4	2.1	84.3
INC0030	4.9	3.8	2.1	89.2
PNT0001	4.6	3.6	1.2	90.6
NEB0002sub	7.2	2.7	8.3	81.8
NWA0135	4.8	9.3	1.0	85.0
NWA0002sub	8.7	4.7	2.1	84.5

Source: Spreadsheet provided by MDE

From July 2002 through March 2003 the District of Columbia also did BST sampling at several locations within the District although the results were not incorporated into their fecal coliform TMDL Report. The results were grouped into five categories, birds, human, livestock (horse), pets, and wildlife. Grouping the birds into the wildlife category results in the following table:

Table 17 - Fecal Bacteria Source Distribution Downstream of Confluence
(TMDL Report, Table 4.3.3.1)

Source Category	Domestic Animals	Human	Livestock	Wildlife	Total
%	21.1%	22.2%	0.3%	56.5%	100.0

MDE allocated the allowable load at the MD/DC line in the same manner as for the area above the confluence of the Northwest and Northeast Branches.

Although much of the Anacostia River watershed is covered by the MS4 permit, the loads are generated by stormwater runoff with the initial implementation goals based on reductions that meet the maximum practicable reduction (MPR) targets. These MPR targets were defined based on a literature review of BMP effectiveness and assuming a zero reduction for wildlife sources. The uncertainty of BMP effectiveness for bacteria, reported within this literature, is quite large. As an example, pet waste education programs have varying results based on stakeholder's involvement. Additionally, the extent of wildlife reduction associated with various BMP methods (*e.g.*, structural, non-structural, etc) is uncertain. Therefore, 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.

MDE estimates that a 95 percent reduction in the human source is practicable through its Managing for Results work plan strategies to reduce the human component from sanitary sewer overflows as described in Section 5.0, Assurance of Implementation. In addition, the State of Maryland is party to a suit against the Washington Suburban Sanitary Commission (WSSC) to remedy recurrent SSOs from the WSSC system.

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 completed successfully or whether an alternate action should be pursued.

8. The TMDLs have been subject to public participation.

MDE conducted two public reviews of the Anacostia River TMDLs. The first pubic comment period was August 5, 2005, to September 6, 2005, and the second March 20, 2006, to April 18, 2006. The second public comment period was because of several comments received by MDE during the first comment period. Six sets of written comments were received from the first comment period, including EPA's, and five sets from the second public comment period. MDE provided responses to EPA on June 8, 2006, with the final submittal.

In a response to comment, MDE further identifies public participation actions. MDE conducted a number of meetings with stakeholders in the Anacostia River Basin. The meetings included presenting information to the Middle Potomac Tributary Team Members, Anacostia Stakeholder Group, and County and Municipality staff. In addition, stakeholders who have identified themselves as interested parties have received information as the project progressed.