UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029
7/30/2007

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 Rock Creek Basin in Montgomery County, Maryland*. The TMDL Report was submitted by the Maryland Department of the Environment's (MDE) letter dated January 20, 2006, to EPA for review and approval with a revised version submitted June 6, 2007. 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 Rock Creek 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); (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 bacteria impairment for Rock Creek 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, TMDL Program Manager, at (215) 814-5752 or Mr. Kuo-Liang Lai at (215) 814-5473.

Sincerely,

/S/

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 Rock Creek Basin in Montgomery County, Maryland

/S/

Jon M. Capacasa, Director
Water Protection Division

Date :7/30/2007

Decision Rationale

**Total Maximum Daily Loads of Fecal Bacteria
for the Non-Tidal Rock Creek Basin
in Montgomery 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 Rock Creek Watershed. The TMDLs were established to address water quality impairments caused by bacteria as identified in Maryland's 1996, 2002 and 2004 Section 303(d) lists of impaired waters. The Maryland Department of the Environment (MDE), submitted[1] the *Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Rock Creek Basin in Montgomery County, Maryland*, dated January 2006 (TMDL Report), to EPA for final review, which was received on January 25, 2006. Some modifications were made and the final document version was submitted and received on June 6, 2007. The Rock Creek Non-tidal Watershed (02-14-02-06) was first identified on Maryland's 1996 Section 303(d) list as impaired for nutrients and sediments, with fecal bacteria and impacts to biological communities added to the 2002 Section 303(d) list. The TMDLs described in this document were developed to address fecal bacteria non-tidal water quality impairments. The nutrient and biological 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 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. There is reasonable assurance that the TMDLs can be met.
8. The TMDLs have been subject to public participation.

II. Summary

There are no National Pollutant Discharge Elimination System (NPDES) permitted sources except the municipal separate stormwater system (MS4) within the watershed. MDE provided

[1] By letter dated January 20, 2006.

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 99 percent reduction from existing or baseline conditions.

Table 1- Rock Creek Fecal Bacteria Non-Tidal TMDL Summary

Subwatershed	Baseline	TMDL	WLA-PS	WLA-MS4[2]	LA[3]	MOS[4]
	Billion MPN Enterococci/day					
NBR0002us	1,786	37	0	13	24	5%
RCM0235us	497	32	0	12	20	5%
RCM0111sub	1,672	56	0	35	21	5%
TOTAL	3,955	125	0	60	65	5%

MPN = Most Probable Number
WLA-PS = Wasteload Allocation for non MS4 systems (municipal or industrial)
WLA-MS4 = Wasteload Allocation for MS4 systems

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.

III. Background

The Rock Creek Watershed comprises approximately 76 square miles (48,640 acres), with approximately 80% of the drainage area within Montgomery County, Maryland, and the remaining 20% within Washington, D.C. (District of Columbia Rock Creek TMDL, 2004). Rock Creek starts at Laytonsville, Maryland, and continues through Montgomery County, through Washington, DC, until it reaches the Potomac River. The North Branch of Rock Creek starts at Mount Zion, Maryland and discharges to Rock Creek in Rockville, Maryland. There are two surface impoundments located in the Rock Creek Watershed, Needwood Lake and Lake Bernard Frank (Figure 1).

There are three major drainage areas comprising the Rock Creek watershed: the mainstem of Rock Creek, the North Branch, and the tidal drainage area. The mainstem and North Branch are free-flowing (non-tidal) streams. The Rock Creek is 33 miles long with the downstream 9.3 miles running through the District of Columbia. Only the last quarter mile of the creek is tidally influenced with the head of tide located approximately where Pennsylvania Avenue crosses the creek (District of Columbia Rock Creek TMDL, 2004). The creek joins the Potomac River approximately 108 miles upstream of the Chesapeake Bay.

Rock Creek drainage area within Montgomery County drainage area is approximately 59 square miles (37,704 acres).

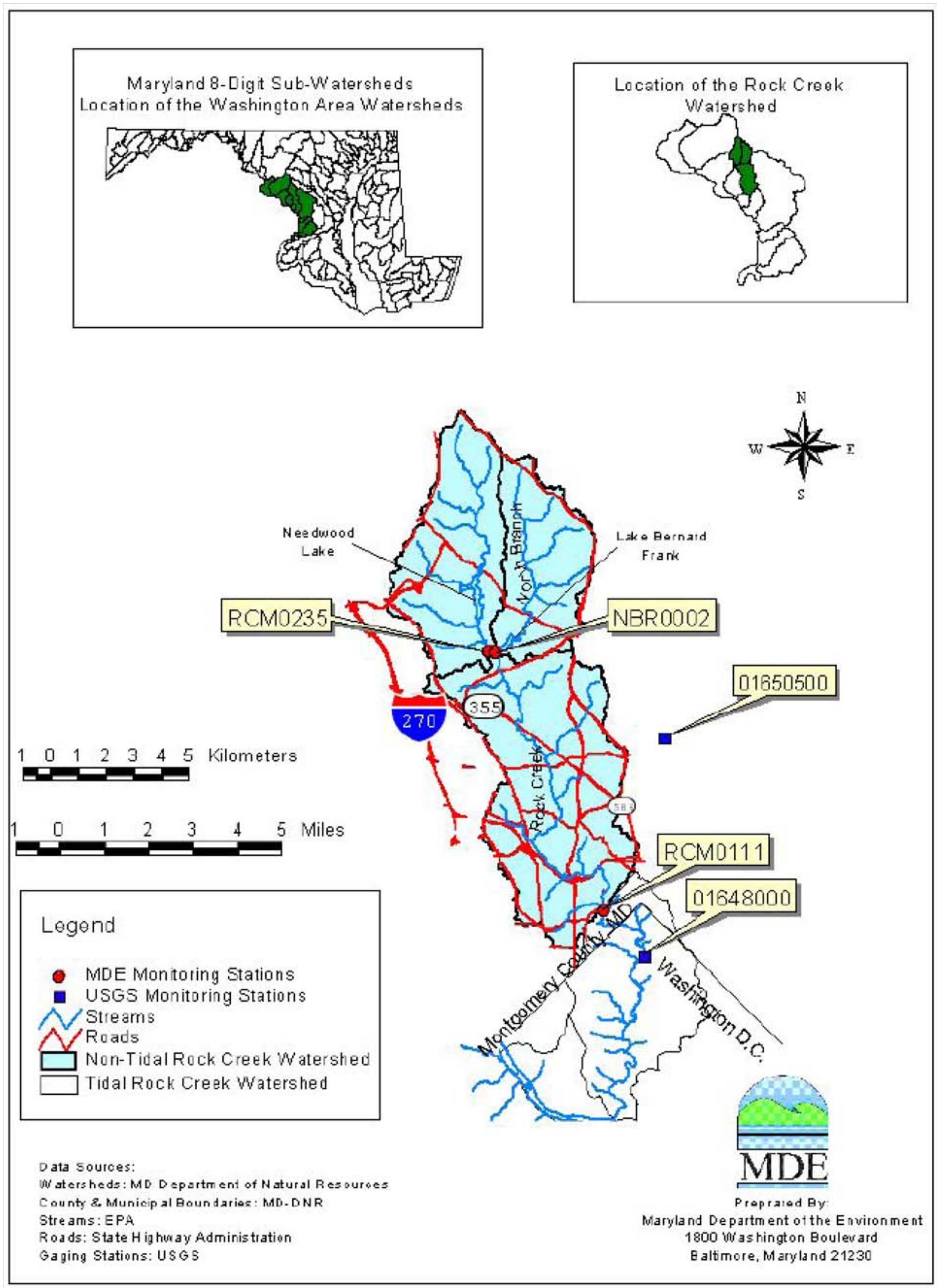

Figure 1 - Location Map of the Rock Creek Watershed (TMDL Report Figure 2.1.1)

The Rock Creek Watershed extends into two physiographic provinces. In Maryland, the Rock Creek Watershed is located in the Piedmont Province, where the bedrock consists of metamorphic rocks of Paleozoic age. The Rock Creek portion located in the Washington, DC, area is located in the Coastal Plain province. The Piedmont province is characterized by relatively narrow and steep sloped valleys of moderately thin soils, as compared to the undulating Coastal Plain which contains deeper sedimentary soil complexes and supports broader meandering streams (Anacostia watershed network: www.anacostia.net, February 14, 2005).

Figure 1 shows the locations of the United States Geological Survey (USGS) gaging stations 01650500 and 01648000, and the three water quality monitoring stations, RCM0111, RCM0235, and NBR0002, used to develop these TMDLs, and also indicates that Maryland's Rock Creek Watershed is divided into three sub-sheds. Monitoring station RCM0111 is located at/near the Maryland/District of Columbia border, monitoring station RCM0235 is located downstream of Needwood Lake, and monitoring station NBR0002 is located downstream of Lake Bernard Frank. The bacteria die-off in the lakes was considered when estimating bacteria loads upstream of the lakes. NBR0002us and RCM0235us refer to loads upstream of the lakes, and RCM0111sub refers to the drainage area upstream of RCM0111 and downstream of NBR0002 and RCM0235.

The 2000 Maryland Department of Planning (MDP) land use/land cover data show the watershed to be residential and commercial. The land use percentage distribution for Rock Creek Basin is shown in Table 1, and spatial distributions for each land use are shown in Figure 2.

Table 1 - Land Use Area and Percentages in Rock Creek Watershed (TMDL Report Table 2.1.1)

Land Use	Acreage	Percent of Total
Residential	22,467	59.6
Commercial	5,490	14.6
Forest	6,809	18.1
Crops	2,032	5.4
Pasture	746	1.9
Water	160	0.42
Total	37,704	100.0

MDE estimated the total population in the Rock Creek Watershed to be 196,790 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 Rock Creek Watershed. Since the Rock Creek 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.

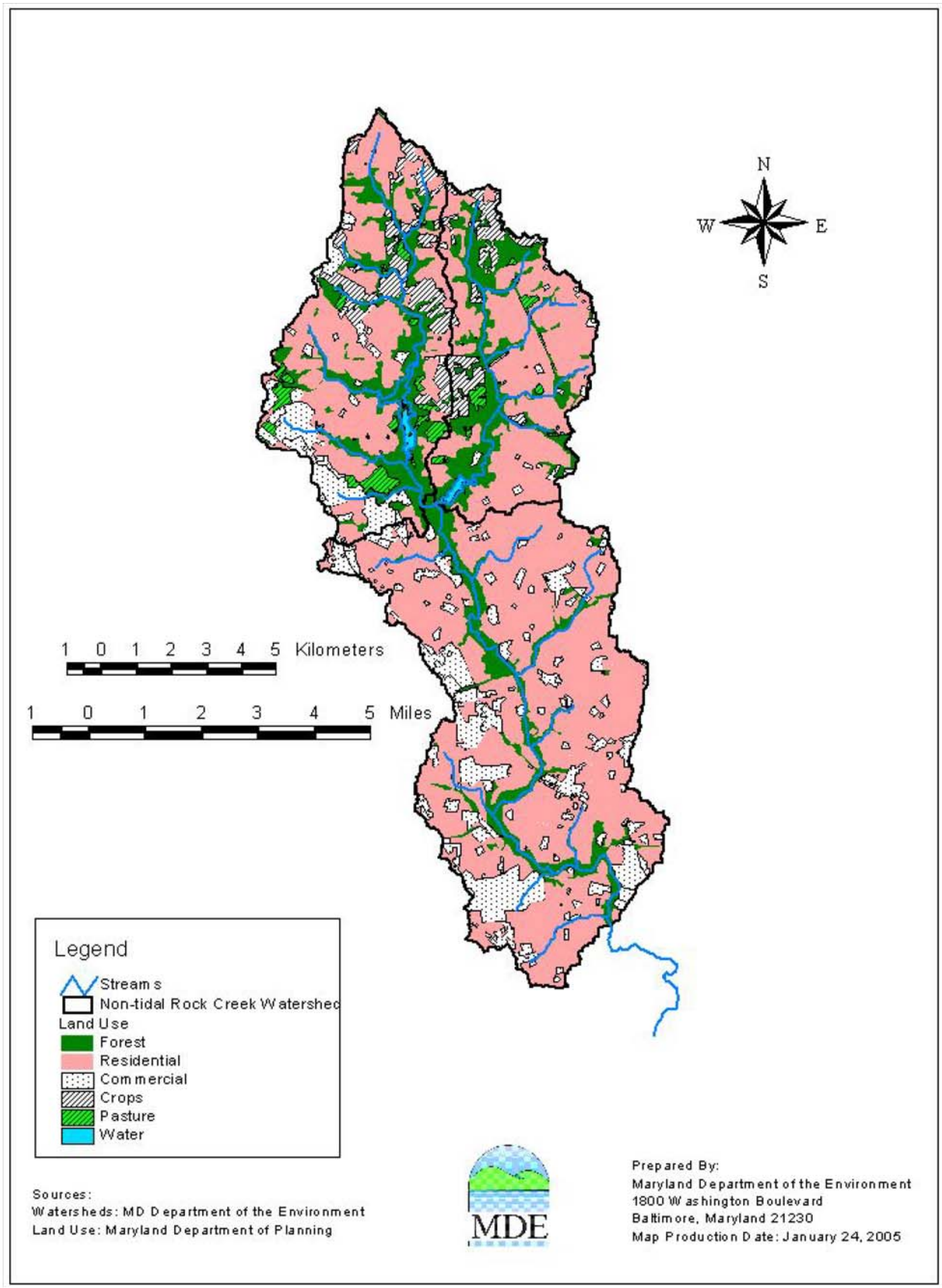

Figure 2 - Land Use in the Rock Creek Watershed (TMDL Report Figure 2.1.3)

IV. Computational Procedure

The entire length of Rock Creek within Maryland 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 District of Columbia's water quality standards to determine the TMDLs for Maryland's Rock Creek.

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 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.[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.

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

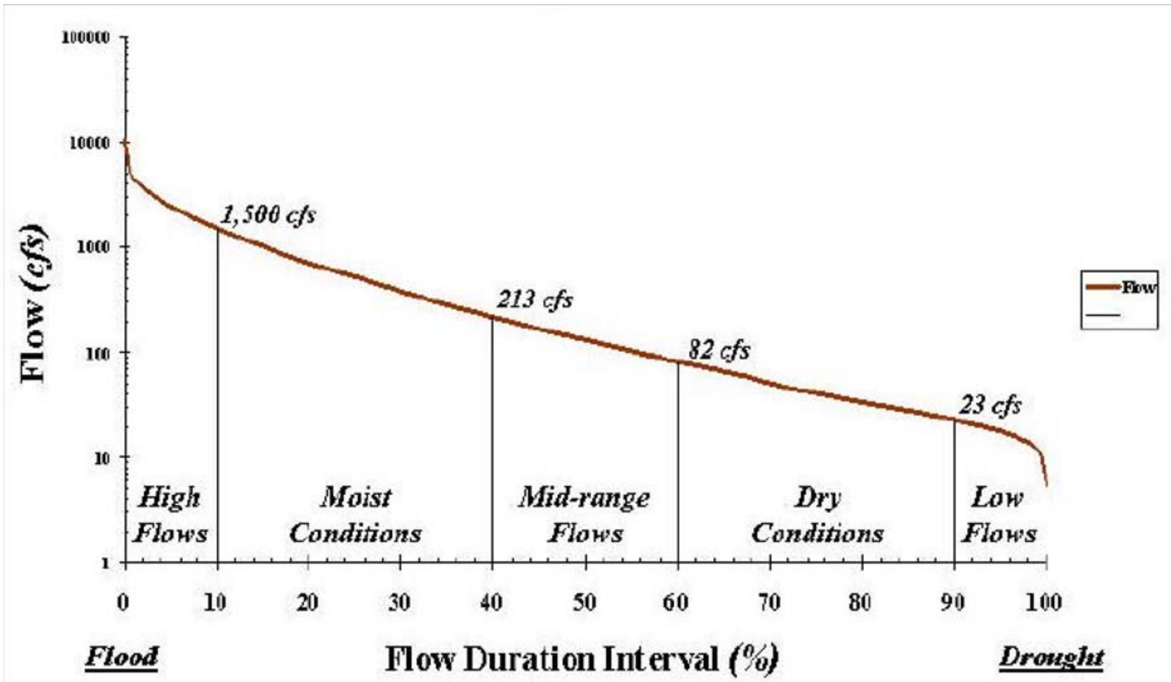

Figure 3 - Example Flow-Duration Curve

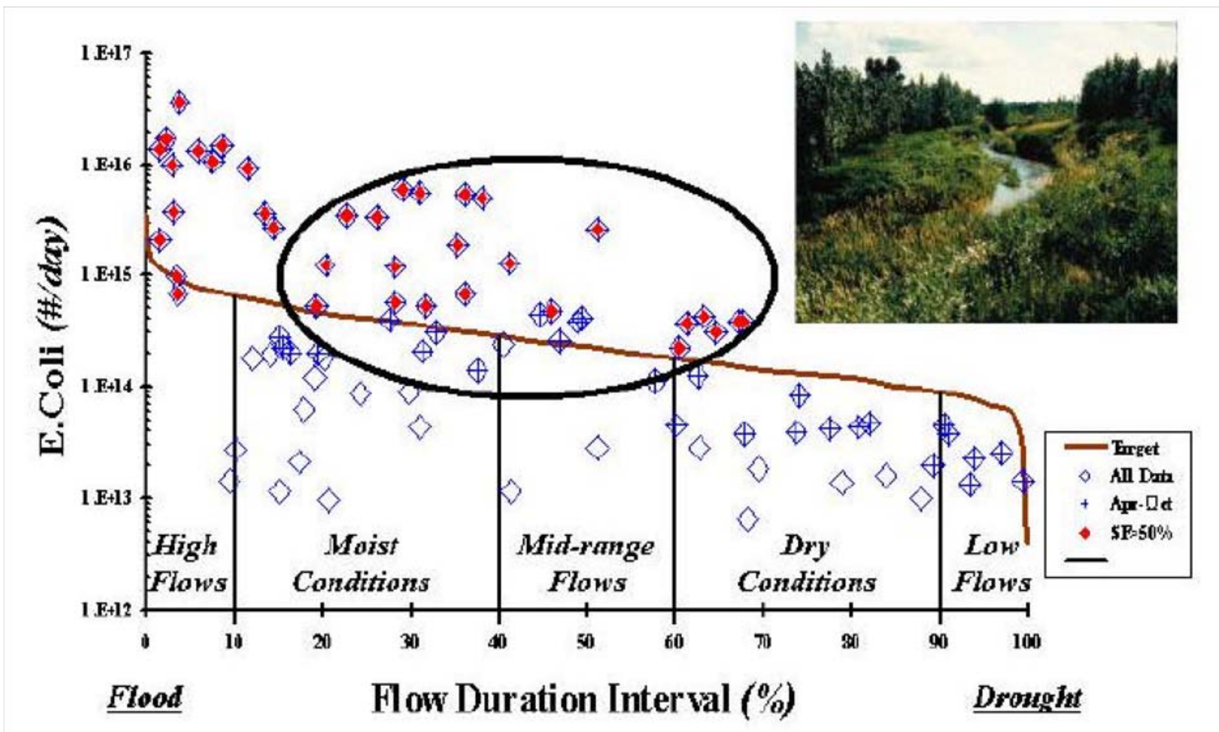

Figure 4 - Example Load-Duration Curve

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.

Rock Creek 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.

There is one USGS gaging station located within the Rock Creek Watershed in the District of Columbia which was used to estimate flows below the upstream monitoring points. A second USGS gaging station located in the Anacostia River watershed was used to estimate flows in Rock Creek and North Branch above the upstream monitoring points. The District of Colombia monitoring USGS station 01648000 and the Anacostia River Watershed USGS station 01650500 have observations from 1988 to date.

MDE then used a hydrograph separation program, the USGS HYSEP, to analyze the daily flow record to separate surface water flow to Rock Creek from interflow[3] 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.

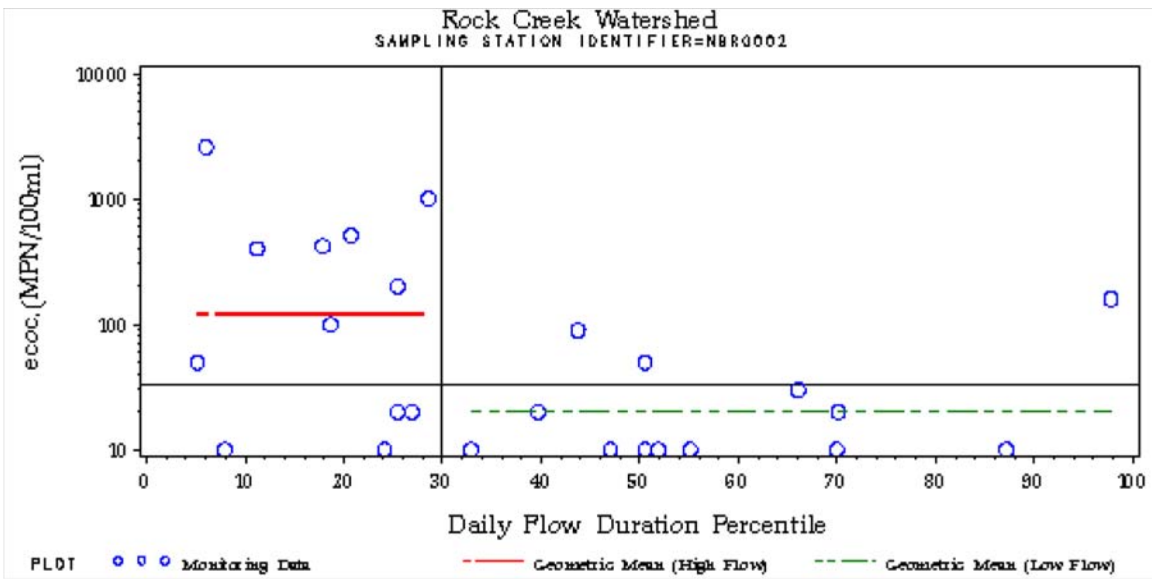

Figure 5 - Enterococci Concentration vs. Flow Duration for Rock Creek Monitoring Station NBR0002 (TMDL Report, Appendix B, Figure B-3)

The resulting existing geometric means for high-flow and low-flow are shown as dashed horizontal lines in Figures 5. The representative geometric mean for the station is equal to 0.3 times the $\log_{10}$ high-flow geometric mean plus 0.7 times the $\log_{10}$ low-flow geometric mean changed back into a geometric mean. The high-flow, low-flow, and representative geometric

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

mean are shown in Table 2 below. Note that geometric means in the table exceed the 33 MPN/100ml criterion for enterococci.

Table 2 - Existing/Baseline Conditions (TMDL Report Table 2.3.3)
Annual Steady State Geometric Mean by Stratum per Sub-watershed

Tributary	Station	Stratum	Annual Steady State Geometric Mean	Annual Overall Geometric Mean
North Branch	NBR0002	High Flow	120	34
		Low Flow	20	
Rock Creek	RCM0235	High Flow	123	40
		Low Flow	25	
Rock Creek	RCM0111	High Flow	429	190
		Low Flow	134	

Table 3 - Existing Seasonal Period Steady State Geometric Mean by Stratum per Sub-watershed (TMDL Report Table 2.3.4)

Tributary	Station	Stratum	Seasonal Steady State Geometric Mean	Seasonal Overall Geometric Mean
North Branch	NBR0002	High Flow	146	47
		Low Flow	28	
Rock Creek	RCM0235	High Flow	131	47
		Low Flow	30	
Rock Creek	RCM0111	High Flow	258	250
		Low Flow	246	

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, 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. Table 4.3.1 is shown below.

Table 4 - Baseline Load Calculations (TMDL Report Table 4.3.1)

Station	Area (sq. miles)	USGS Reference Gauge	High Flow			Low Flow			Baseline Load (billion MPN/day	Steady State Geometric Mean Conc. MPN/100ml
			Unit flow (cfs/sq. mile)	Q (cfs)	Enterococci Concentration (MPN/100ml)	Unit flow (cfs/sq mile)	Q (cfs)	Enterococci Concentration (MPN/100ml)		
NBR0002us	12.4	1650500	3.079	38	1,676	0.4192	5.2	281	1,786	480
RCM0235us	16.9	1650500	3.079	52	544	0.4192	7.1	110	497	178
NBR0002	12.4	1650500	3.079	38	120	0.4192	5.2	20	128	34
RCM0235	16.9	1650500	3.079	52	123	0.4192	7.1	25	113	40
RCM0111	58.9	1648000	2.660	157	429	0.4770	28.1	134	1,901	190
RCM0111sub	29.6			66	885		15.8	218	1,676	332

In order to analyze the flow record for periods that might produce higher overall geometric means and loads (critical conditions) and to account for seasonality, 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 5 - Critical Time Periods (TMDL Report, Table 4.2.3.1)

Hydrological Condition		Averaging Period	Water Quality Data Used	Sub-watershed	Fraction High Flow	Fraction Low Flow	Period
Annual	Average Condition	365 days	All	NBR0002us; RCM0235us	0.30	0.70	Long Term Average
				RCM0111subNEB0002	0.30	0.70	Long Term Average
	Wet	365 days	All	NBR0002us; RCM0235us	0.55	0.45	April 8th, 1996 – March 23rd, 1997
				RCM0111subNEB0002	0.58	0.42	April 1st, 1996 - March 31st, 1997
	Dry	365 days	All	NBR0002us; RCM0235us	0.07	0.93	October 1st, 2002 – Sept 30th, 2003
				RCM0111subNEB0002	0.10	0.90	Sept 1st, 2001 - August 31st, 2002
Season	Wet	May 1st – Sept 30th	May 1st – Sept 30th	NBR0002us; RCM0235us	0.51	0.49	May 1st – Sept 30th, 2003
				RCM0111subNEB0002	0.62	0.38	May 1st – Sept 30th, 2003
	Dry	May 1st – Sept 30th	May 1st – Sept 30th	NBR0002us; RCM0235us	0.09	0.91	May 1st – Sept 30th, 2002
				RCM0111subNEB0002	0.10	0.90	May 1st – Sept 30th, 1991
30-day	Wet	30 days	All	NBR0002us; RCM0235us	1.00	0.00	Several occurrences during both Winter and Summer
				RCM0111subNEB0002	1.00	0.00	Several occurrences during both Winter and Summer
	Dry	30 days	All	NBR0002us; RCM0235us	0.00	1.00	Several occurrences during both Winter and Summer
				RCM0111subNEB0002	0.00	1.00	Several occurrences during both Winter and Summer

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.

Three sub-watersheds were used in the analysis. The upper sub-watershed's fecal bacteria load's contribution to the total fecal bacteria load at the Maryland/District of Columbia line 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 Rock Creek 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 Table 4 below.

Table 6 - Distribution of Fecal Bacteria Source Loads in the Rock Creek Basin for the Average Annual Period (TMDL Report Table 2.4.2)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
NBR0002	High Flow	11	16	34	30	9
	Low Flow	9	6	37	44	4
	Weighted	10	9	36	40	5
RCM0235	High Flow	19	13	23	37	8
	Low Flow	8	7	23	51	11
	Weighted	11	9	23	47	10
RCM0111	High Flow	25	9	20	37	9
	Low Flow	19	10	32	31	8
	Weighted	21	10	28	33	8

Table 7 - Distribution of Fecal Bacteria Source Loads in the Rock Creek Basin for the Seasonal Period May 1 - September 30 (TMDL Report Table 2.4.3)

Station	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
NBR0002	High Flow	6	26	33	20	15
	Low Flow	4	6	41	45	4
	Weighted	5	12	39	37	7
RCM0235	High Flow	12	25	24	24	15
	Low Flow	2	8	21	55	14
	Weighted	5	13	22	46	15
RCM0111	High Flow	11	20	25	31	13
	Low Flow	10	15	34	35	6
	Weighted	10	17	31	34	8

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 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 37, identified the assumed risk factors shown in Table 8 below. In addition, some bacteria sources are more easily controlled. Table 6, Maximum Practicable 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 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.

Th e req uir ed reductions were determined by analyzing each of the above critical time periods (Table 5) individually for each sub-watershed, 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.

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

Station	Applied Reductions				Achievable
	Domestic %	Human %	Livestock %	Wildlife %	
NBR0002us	75	95	75	0	No
RCM0235	75	95	75	0	No
RCM0111	75	95	75	0	No

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

Table 11 - Required Reductions to Achieve Water Quality Criterion Up to 99% Reductions (TMDL Report, Table 4.7.4)

Station	Domestic %	Human %	Livestock %	Wildlife %	Target Reduction
NDR0002us	99.0	99.0	99.0	96.4	97.9
RCM0235us	98.0	98.0	98.0	88.7	93.7
RCM0111sub	98.0	98.0	98.0	94.3	95.0

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 4.2.7.1)

Allocated to	Human	Domestic Animals	Live Stock	Wildlif e
WLA - WWTP				
WLA - MS4		X		X
LA	X		X	X

There are no wastewater treatment plants (WWTPs) in Maryland's Rock Creek Watershed and the human allocation (septic systems) is assigned to the LA.

The MS4 permits issued to the county cover the whole county although the physical extent of the MS4 systems does not encompass the entire county. In the future, when more detailed data and information become available, MDE may revise the WLA-MS4 and LA. Note that the overall reductions in the TMDL will not change. MDE has allocated loads to the LA based on land use, *i.e.*, land uses not known 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).

V. 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 Rock Creek. Therefore, EPA approves the TMDLs for the Rock Creek 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 uses I-P – Water Contact Recreation, and Protection of Warmwater Aquatic; III – Non-tidal 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 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) is 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 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 District's 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.

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. The TMDL for Rock Creek was determined by assessing various hydrological conditions to account for critical conditions and seasonality. Furthermore, both MD and DC fecal bacteria water quality standards, independent of the bacteriological densities and/or indicator organism used in their corresponding analysis, are based on EPA's recommendations with an accepted illness rate of 8 illnesses/1,000 swimmers. Therefore, MD's proposed TMDL loads have been established to meet DC's water quality standards, and will be protective of downstream designated uses under any hydrological condition.

EPA finds that the TMDLs for bacteria will ensure that the designated use and water quality criteria for Rock Creek 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 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 WLAs for point sources and the land-based load allocations for nonpoint sources set forth below, the TMDLs for fecal bacteria for Rock Creek 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 and the MS4 systems. Montgomery County has a MS4 permit and 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 14 - Fecal Bacteria Summary

Sub-watershed	Baseline	TMDL	WLA-WWTP	WLA-MS4[2]	LA[3]	MOS[4]
	Billion MPN/100ML Enterococci/day					
NBR0002us	1,786	37	0	13	24	5 % explicit
RCM0235us	497	32	0	12	20	5 % explicit
RC0111sub	1,672	56	0	35	21	5 % explicit
Total	3,955	125	0	60	65	

MPN = Most Probable Number
WLA-PS = Wasteload Allocation for non MS4 systems (municipal or industrial)
WLA-MS4 = Wasteload Allocation for MS4 systems

Table 15 - NPDES Permitted Facility WLAs

Permittee/ Allocation	Permit Number	Location	WLA-MS4 Billion MPN /Day
Montgomery County	MD0068349	Montgomery	60

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-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 Rock Creek TMDLs for fecal bacteria are consistent with the regulations and requirements of 40 CFR Section 130.

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

Maryland's Rock Creek Watershed is comprised of three sub-watersheds. 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 sub-watershed are considered on the downstream sub-watershed. A decay factor and estimated time of travel was used to estimate the effect of the upstream sub-watersheds on the downstream sub-watershed.

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 Rock Creek's 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 the 30-day period because the District of Columbia's standards use a 30-day period. The corresponding critical period dates are shown in the TMDL Report Table 4.4.2 and Table 5 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[4]. MDE's statistical method analyzed flows in Rock Creek 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.[5] 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 explicit five percent MOS, (*i.e.*, in determining the required pollutant reductions, the allowable geometric mean was 95 percent of the criterion, or a geometric mean equal to 31.35 MPN/100 ml).

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 Montgomery County's municipal separate stormwater system (MS4) is the only permitted point source in Maryland's Rock Creek Watershed.

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

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

In Rock Creek 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, see Table 18 below. The only permitted point source is the MS4 which results from stormwater nonpoint sources. Therefore, MDE intends to implement a staged approach beginning with the MPR targets with regularly scheduled follow-up monitoring to assess the effectiveness of the implementation plan. Failure to achieve water quality criteria may require that MDE re-visit the TMDL or its implementation plan.

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, 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'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 - Existing Fecal Bacteria Sources for the Average Annual Period (Includes TMDL Report, Table 2.4.2)

Station	Flow	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown	Baseline Load*
NBR0002	High	11	16	34	30	9	416
	Low	9	6	37	44	4	4
	Weighted	10	9	36	40	5	128
RCN0235	High	19	13	23	37	8	356
	Low	8	7	23	51	11	8
	Weighted	11	9	23	47	10	113
RCM0111	High	25	9	20	37	9	5,523
	Low	19	10	32	31	8	348
	Weighted	21	10	28	33	8	1,901

*Billion Enterococci /day

Table 17 - Distribution of Fecal Bacteria Sources for the Seasonal Period May 1 - September 30 (TMDL Report Table 2.4.3)

Station	Flow Stratum	% Domestic Animals	% Huma n	% Livestoc k	% Wildlif e	% Unknown
NBR0002	High Flow	6	26	33	20	15
	Low Flow	4	6	41	45	4
	Weighted	5	12	39	37	7
RCM0235	High Flow	12	25	24	24	15
	Low Flow	2	8	21	55	14
	Weighted	5	13	22	46	15
RCM0111	High Flow	11	20	25	31	13
	Low Flow	10	15	34	35	6
	Weighted	10	17	31	34	8

The following reductions are necessary to achieve water quality standards.

Table 18 - Fecal Bacteria Source Reductions to Meet Criteria (TMDL Report, Table 4.4.2)

Subwatershed	Hydrological Condition		Domestic %	Human %	Livestock %	Wildlife %
NBR0002us	Annual	Average	99	99	99	91
		Wet	99	99	99	79
		Dry	99	99	99	92
	Seasonal	Wet	99	99	99	86
		Dry	99	99	99	96
	30-day	Wet	99	98	99	77
		Dry	99	99	99	91
	Maximum Source Reduction		**99**	**99**	**99**	**96**
RCM0235us	Annual	Average	98	98	98	78
		Wet	97	97	98	5
		Dry	98	98	98	78
	Seasonal	Wet	94	98	98	68
		Dry	98	98	98	89
	30-day	Wet	97	97	98	52
		Dry	98	98	98	78
	Maximum Source Reduction		**98**	**98**	**98**	**89**
RCM0111sub	Annual	Average	98	98	98	86
		Wet	98	98	98	67
		Dry	98	98	98	78
	Seasonal	Wet	98	98	98	50
		Dry	98	98	98	94
	30-day	Wet	98	98	98	61
		Dry	98	98	98	86
	Maximum Source Reduction		**98**	**98**	**98**	**94**

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

Table 19 - Source Distribution Meeting Criteria

Station	% Domestic Animals	% Human	% Livestock	% Wildlife	TMDL*
NBR0002us	4.83	4.64	18.26	72.28	37
RCM0235us	6.98	5.72	14.41	72.89	32
RCM0111us	15.41	6.79	19.99	57.81	56

*Billion Enterococci /day Source: Spreadsheet provided by MDE

Although much of the Rock Creek 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 MPR targets. These MPR targets were defined based on a literature review of BMPs effectiveness and assuming a zero reduction for wildlife sources. The uncertainty of BMPs 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 BMPs 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.

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.

8. The TMDLs have been subject to public participation.

MDE conducted two public reviews of the Rock Creek TMDLs. The first pubic comment period was August 12, 2005, to September 6, 2005, and the second November 22, 2005, to December 21, 2005. The second public comment period was because of several comments received by MDE during the first comment period, specifically with respect to critical conditions. Three sets of written comments were received from the first comment period, including EPA's, and one set from the second public comment period. EPA received MDE's responses on January 25, 2006, with the final submittal.