UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029
11/6/2007

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 Wills Creek in Garrett and Allegany Counties, Maryland*. The TMDL Report was submitted by the Maryland Department of the Environment's (MDE) letter dated September 7, 2006, to EPA for review and approval. The TMDL was developed and submitted in accordance with Sections 303(d)(1)(c) and (2) of the Clean Water Act to address impairments of water quality as identified in Maryland's Section 303(d) list of impaired waters. The MDE identified the Wills 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) designed to attain and maintain the applicable water quality standards; (2) include a total allowable loading and as appropriate, wasteload allocations for point sources and load allocations for nonpoint sources; (3) consider the impacts of background pollutant contributions; (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated); (5) consider seasonal variations; (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and in-stream water quality); and (7) be subject to public participation. The Fecal Bacteria TMDLs for the Non-Tidal Wills Creek satisfied each of these requirements. In addition, the Wills Creek TMDLs considered reasonable assurance that the allocations assigned to the nonpoint sources can be reasonably met. A copy of EPA's Decision Rationale for approval of these TMDLs is included with this letter.

As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL wasteload allocation pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

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Decision Rationale
Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Wills Creek Watershed in Garrett and Allegany Counties, Maryland

Signed

Jon M. Capacasa, Director
Water Protection Division

Date: 11/6/2007

Decision Rationale
Total Maximum Daily Loads of Fecal Bacteria
for the Non-Tidal Wills Creek Watershed
in Garrett and Allegany Counties, Maryland

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those waterbodies identified as impaired by the state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited waterbody.

This document sets forth the U.S. Environmental Protection Agency's (EPA) rationale for approving the TMDLs for fecal bacteria in the Wills Creek Watershed. The TMDLs were established to address water quality impairments caused by bacteria as identified in Maryland's 2002 Section 303(d) list of impaired waters. The Maryland Department of the Environment (MDE), submitted to EPA for final review, the *Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Wills Creek in Garrett and Allegany Counties, Maryland*, dated September 7, 2006. The MDE has identified Wills Creek Non-Tidal Watershed (basin number 02-14-10-03) including Wills Creek and its tributaries, North Branch Jennings Run, Jennings Run, and Braddock Run, on the State of Maryland's Section 303(d) List as impaired by nutrients (1996), sediments (1996), toxics-cyanide (1996), low pH (1998), fecal bacteria (2002), and impacts to biological communities (2002). This document proposes to establish a TMDL for fecal bacteria in Wills Creek that will allow for attainment of the beneficial use designation, primary contact recreation. The listings for nutrients, suspended sediments, impacts to biological communities, and toxics will be addressed separately at a future date. The TMDLs described in this document were developed to address fecal bacteria non-tidal water quality impairments.

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

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

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

II. Summary

There are National Pollutant Discharge Elimination System (NPDES) permitted Combined Sewer Overflow sources within the watershed. MDE provided adequate land use and in-stream bacteria data in the TMDL report and allocated the TMDL loads to specific sources. The TMDL allocations shown in Table 1-b require up to and including 96 percent reduction from existing or baseline conditions.

Table 1-a. Wills Creek Bacteria Non-Tidal TMDL Maximum Daily Loads Summary

Wills Creek Fecal Bacteria TMDL Allocations

Subwatershed	TMDL	LA	WLA CSOs
	Billion MPN *E. coli*/day		
Wills Creek upstream of Maryland/PA line (WIL0067)	629	629	N/A
North Branch Jennings Run (NJE0014)	62	62	N/A
Jennings Run upstream of the confluence with North Branch Jennings Run (JEN0036)	23	23	0
Braddock Run (BDK0000)	543	543	0
Wills Creek between Maryland/PA line and the confluence with Braddock Run (WIL0013sub)	61	61	N/A
Wills Creek between the confluence with Braddock Run and the confluence with the North Potomac River (WIL0000sub)	191	136	55
TOTAL	1,509	1,454	55

MPN = Most Probable Number
WLA-CSOs = Wasteload Allocation for Combined Sewer Overflows
LA = Load Allocation

Table 1-b. Wills Creek Bacteria Non-Tidal TMDL Reductions Summary

Subwatershed ID	Baseline Load *E. Coli* (Billion MPN/day)	TMDL Load *E. Coli* (Billion MPN/day)	% Target Reduction
WIL0067	1,133	629	45%
NJE0014	203	62	69%
JEN0036	255	23	91%
WIL0013sub	1,106	61	94%
BDK0000	7,175	543	92%
WIL0000sub	5,241	191	96%
Total	15,113	1,509	

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 Wills Creek Watershed is located in Allegany and Garrett Counties in Maryland (MD); and Bedford and Somerset Counties in Pennsylvania (PA). The total drainage area of Wills Creek is approximately 253.6 square miles (162,284 acres), with 24% in MD and 76% in PA. Wills Creek Watershed includes Wills Creek, Jennings Run, North Branch Jennings Run and Braddock Run. Wills Creek and all its tributaries are non-tidal. The watershed is located in MD and PA (see Figure 1).

The headwaters of Wills Creek originate in the Big Savage Mountains in PA, flowing east toward the city of Hyndman where the creek turns and continues south, entering MD at the town of Ellerslie and eventually emptying into the North Branch Potomac at Cumberland, MD.

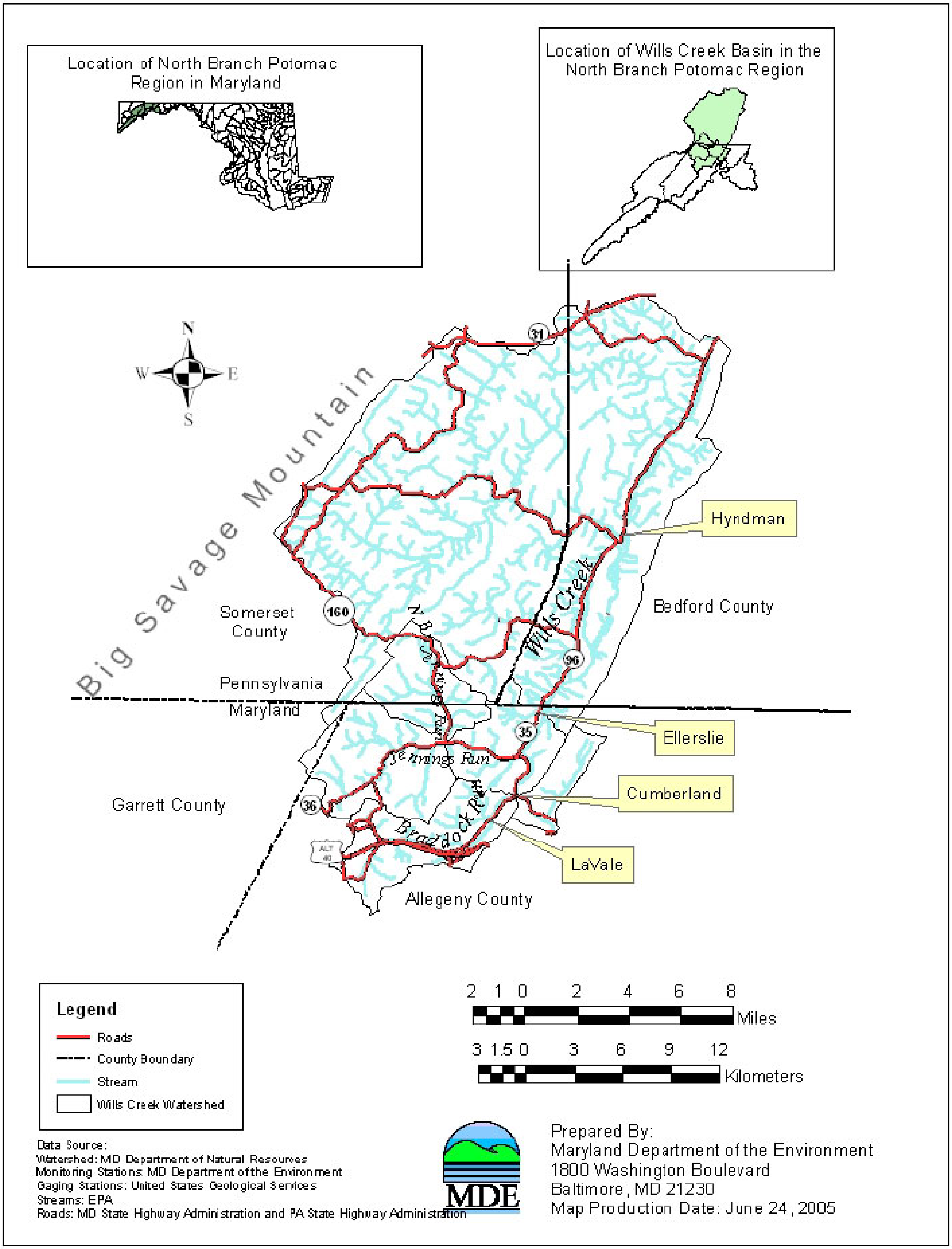

Figure 1 - Location Map of the Wills Creek (TMDL Report Figure 2.1.1)

The Wills Creek lies in the Valley and Ridge district of the Appalachian physiographic province. The Appalachian region in the Wills Creek area is underlain by thick layers of sedimentary rocks of limestone and shale. The Wills Creek Watershed lies predominantly in the Gilpin-Dekalb-Cookport and Welkert-Calvin-Lehew soil series in MD. Soils in this series are gently sloping to very steep, well-to moderately well-drained and shaly to very stony soils over sandstone and shale.

The 2002 Maryland Department of Planning (MDP) land use/land cover data show that the watershed can be characterized as primarily forested for MD. Regional Earth Science Application Center (RESAC) shows that the Wills Creek basin is also primarily forested in the PA portion of the basin. There seems to be minimal impact from wildlife sources and little, if any, impact from rural septic systems. As Wills Creek enters Maryland, it encounters a more urban environment. It receives water from Jennings Run and Braddock Run. The land use percentage distribution for Wills Creek is shown in Table 2, and spatial distributions for each land use are shown in Figure 2.

Table 2. Land Use Area and Percentages in Wills Creek (TMDL Report Table 2.1.1)

Land Type	Maryland Acreage	Maryland Percentage	Pennsylvania Acreage	Pennsylvania Percentage
Forest	28,885	74.6 %	103,981	84.2 %
Urban	6,495	16.8 %	2,922	2.4 %
Crops	1,905	4.9 %	14,010	11.3 %
Pasture	1,411	3.6 %	2,631	2.1 %
Water	26	0.1 %	18	0.0 %
Totals	**38,722**	**100.0%**	**123,562**	**100.0%**

MDE estimated the total population in the Wills Creek Watershed to be 32,017 people based on a weighted average from the Geographic Information System (GIS) 2000 Census Block, the MDP Land Use 2002 Cover, and the RESAC coverage for PA that includes the Wills Creek Watershed. Since the Wills 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 and MDP land use cover (2002) and RESAC within the watershed.

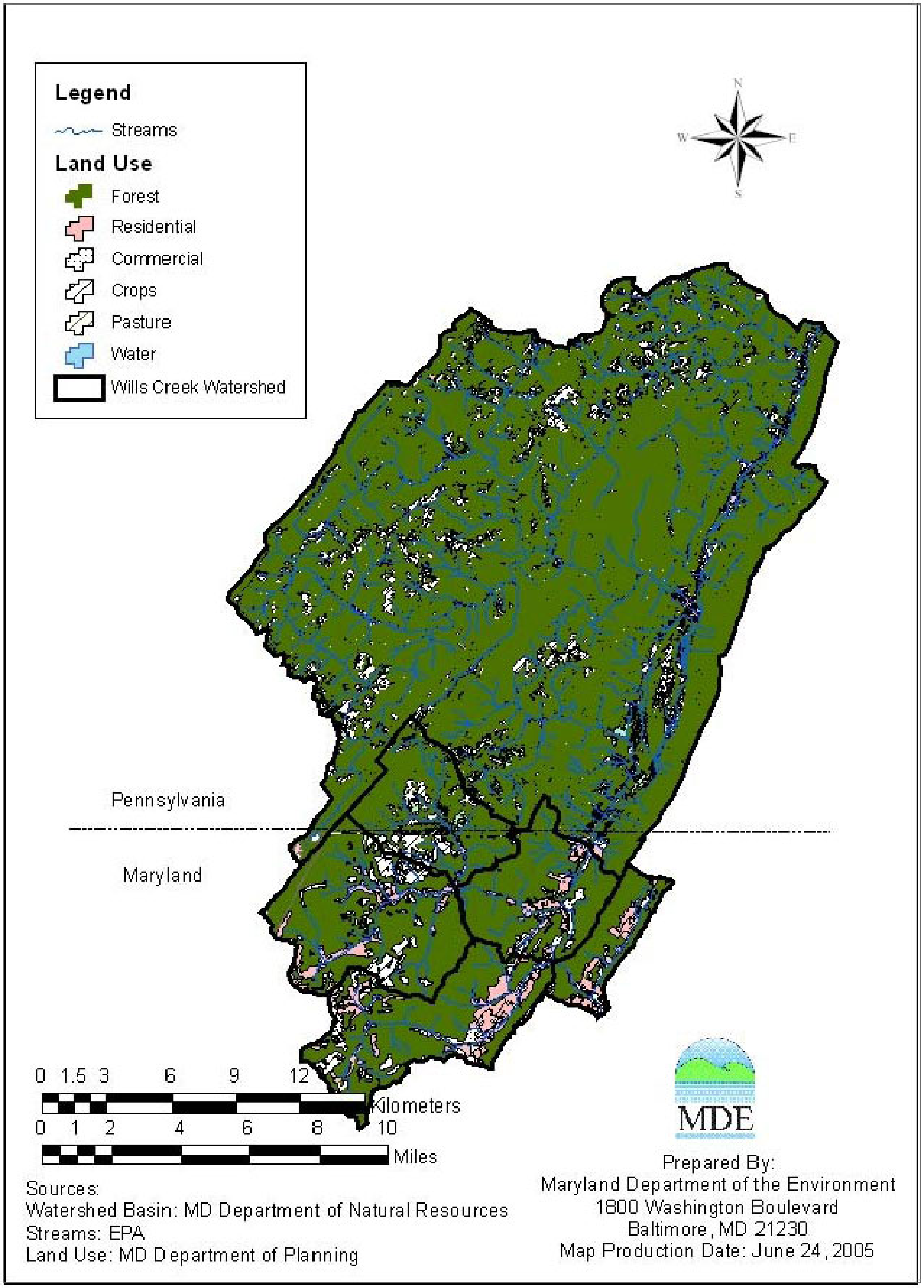

Figure 2 - Land Use in the Wills Creek Watershed (TMDL Report Figure 2.1.3)

IV. Computational Procedure

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

General

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

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

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

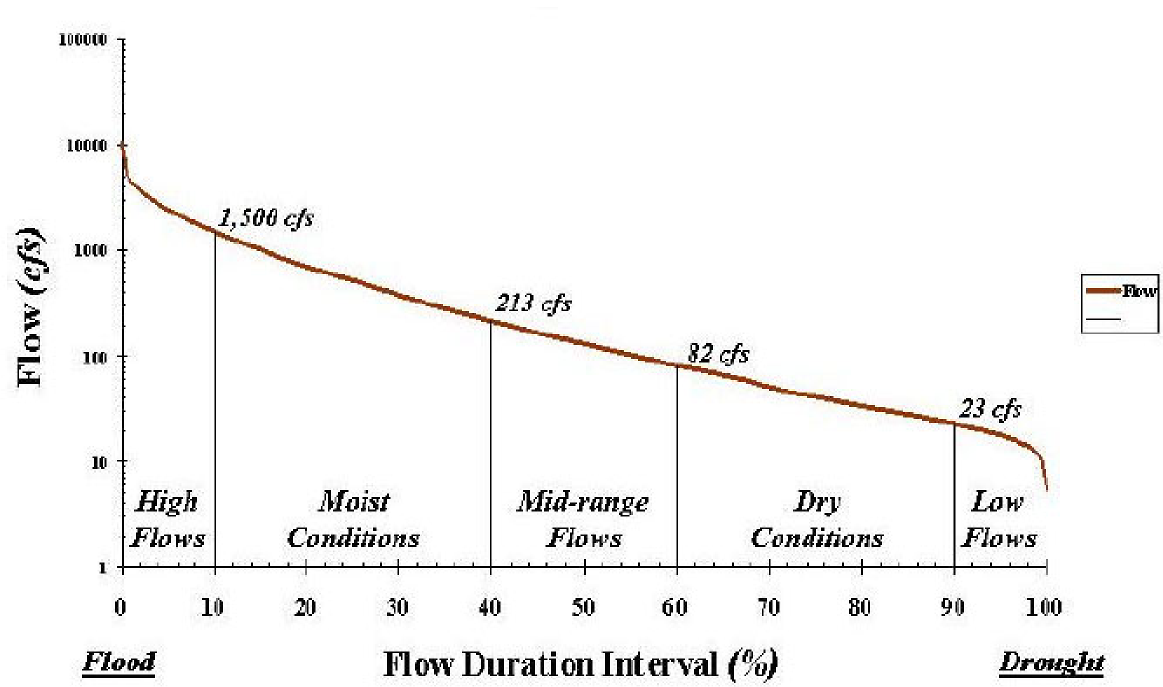

Figure 3 – Example Flow-Duration Curve

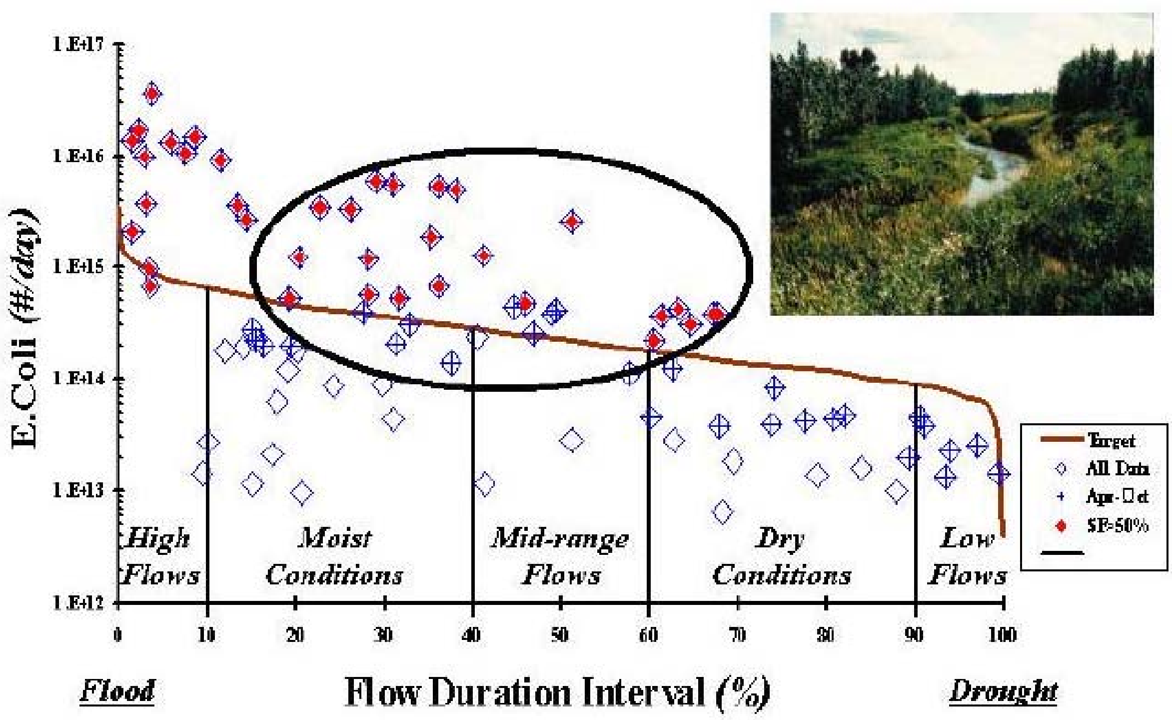

Figure 4 – Example Load-Duration Curve

Frequently the target load shown in Figure 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.

<u>Wills Creek Computational Method</u>

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 gauging stations located within the Wills Creek Watershed which were used to estimate the surface flow. The three monitoring USGS stations (i.e., 01596500, 01599000, and 01601500) have observations from 1988 to 2003.

MDE then used a hydrograph separation program, the USGS HYSEP, to analyze the daily flow record to separate surface water flow to Wills Creek from interflow[2] and groundwater to the stream. MDE determined that flows below the 25 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.

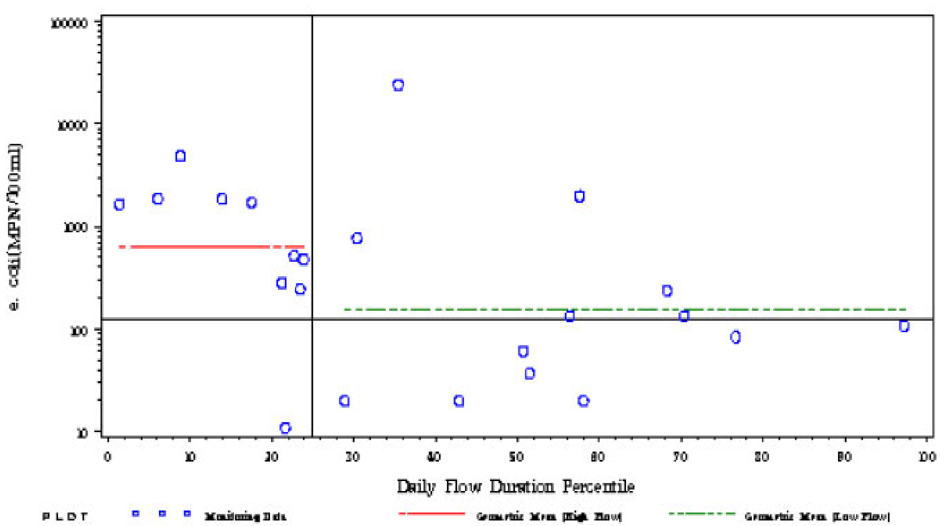

Figure 5 – *E. coli* Concentration vs. Flow Duration for Wills Creek Monitoring Station WIL0000 (TMDL Report, Appendix B, Figure B-5)

[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 0.25 times the $\log_{10}$ high-flow geometric mean plus 0.75 times the $\log_{10}$ low-flow geometric mean changed back into a geometric mean. The high-flow, low-flow, and representative geometric mean are shown in Table 3 below. Note that some of the geometric means in the table exceed the 126 MPN/100ml criterion for *E. coli*.

Table 3. Existing/Baseline Conditions (TMDL Report Table 2.3.3)
Annual Steady State Geometric Mean by Stratum per Subwatershed

Tributary Station	Flow Stratum	# of Samples	*E. coli* Minimum Concentration (MPN/100ml)	E. coli Maximum Concentration (MPN/100ml)	Annual Steady-State Geometric Mean (MPN/100ml)	Annual Weighted Geometric Mean (MPN/100ml)
North Branch Jennings NJE0014	High	9	6.3	1,396	223	149
	Low	14	20	1,785	130	
Jennings Run JEN0036	High	9	97	399	201	270
	Low	14	35.4	5,794	298	
Braddock Run BDK0000	High	9	20	41,060	4,499	372
	Low	14	8.5	24,192	162	
Wills Creek WIL0067	High	10	3.1	384	88	76
	Low	13	10	1,421	73	
Wills Creek WIL0013	High	10	7.4	1,076	146	80
	Low	13	10	1,439	65	
Wills Creek WIL0000	High	10	11	4,884	626	218
	Low	13	20	24,192	154	

Table 4. **Existing Seasonal Period Steady State Geometric Mean by Stratum per Subwatershed (TMDL Report Table 2.3.4)**

Tributary Station	Flow Stratum	# of Samples	*E. coli* Minimum Concentration (MPN/100ml)	E. coli Maximum Concentration (MPN/100ml)	Seasonal Steady-State Geometric Mean (MPN/100ml)	Seasonal Weighted Geometric Mean (MPN/100ml)
North Branch Jennings	High	4	246	933	395	358
NJE0014	Low	6	85	1,785	346	
Jennings Run	High	4	132	399	284	668
JEN0036	Low	6	226	5,794	887	
Braddock Run	High	4	175	41,060	3,522	1,201
BDK0000	Low	6	275	24,192	839	
Wills Creek	High	4	85	384	178	160
WIL0067	Low	6	51	1,421	154	
Wills Creek	High	4	161	1,076	367	190
WIL0013	Low	6	41	1,439	152	
Wills Creek	High	4	479	4,884	1,228	635
WIL0000	Low	6	84	24,192	510	

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 5. **Baseline Load Calculations (TMDL Report Table 4.3.1)**

Station	Area (sq. miles)	USGS Reference Gage	Unit flow (cfs/sq. mile)	Q (cfs)	*E. Coli* Concentration (MPN/100ml)	Unit flow (cfs/sq. mile)	Q (cfs)	*E. Coli* Concentration (MPN/100ml)	Baseline Load (Billion MPN/day)	Weighted Geometric Mean Conc. MPN/100ml
WIL0067	187.7	1601500	4.121	773	88	0.540	101.4	73	46,313	76
NJE0014	12.9	1596500	4.676	60	223	0.578	7.4	130	8,315	149
JEN0036	20.1	1599000	3.459	69	201	0.482	9.7	298	10,414	270
WIL0000	257.9	1601500	4.121	1063	626	0.540	139.3	154	582,997	218
WIL0000sub	6.1			37	4,946		4.4	2,506	214,206	2,971
BDK0000	18.5	1599000	3.459	64	4,499	0.482	8.9	162	293,247	372
WIL0013	233.4	1601500	4.121	962	146	0.540	126.1	65	87,898	80
WIL0013sub	12.8			59	1,119		7.6	766	45,187	842

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. If the flow record covers more than a year, 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 as shown below.

Table 6. Critical Time Periods (TMDL Report, Table 4.4.1)

Hydrological Condition		Averaging Period	Water Quality Data Used	Subwatershed	Fraction High Flow	Fraction Low Flow	Period
Annual	Average Condition	365 days	All	All	0.25	0.75	Long Term Average
Annual	High	365 days	All	WIL0067; WIL0013; WIL0013; WIL0000; WIL0000sub	0.54	0.46	April 22nd, 2001– April 23rd, 2002
				NJE0014	0.57	0.43	Feb 22st, 1990 – Feb 23st, 1991
				JEN0036; BDK0000	0.56	0.44	Jan 8th, 1997 – Jan 7th, 1998
Annual	Low	365 days	All	WIL0067; WIL0013; WIL00000	0.08	0.92	Dec 28st, 1995 – Dec 28th, 1996
				NJE0014	0.14	0.86	Dec 28st, 1995 – Dec 28th, 1996
				JEN0036; BDK0000	0.06	0.94	May 28th, 1995 – May 27th, 1996
Season	High	May 1st – Sept 30th	May 1st – Sept 30th	WIL0067; WIL0013; WIL0000	0.44	0.56	May 1st - Sept 30th, 1996
				NJE0014	0.51	0.49	May 1st - Sept 30th, 1996
				JEN0036; BDK0000	0.46	0.54	May 1st - Sept 30th, 2003
Season	Low	May 1st – Sept 30th	May 1st – Sept 30th	WIL0067; WIL0013; WIL0000	0.0	1.0	May 1st – Sept 30th, 1991
				NJE0014	0.0	1.0	May 1st – Sept 30th, 1991
				JEN0036; BDK0000	0.0	1.0	May 1st – Sept 30th, 2002

Six subwatersheds were used in the analysis. The upper subwatershed's fecal bacteria load's contribution to the total fecal bacteria load at the end point 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's, Department of Biological Sciences and Environmental Health Services, BST report, *Identifying Sources of Fecal Pollution in Shellfish and Nontidal Waters in Maryland Watersheds.* For purposes of the TMDL, the sources were separated into domestic animals, human, livestock, and wildlife. A fifth classification of "unknown" results from the analysis when the source could not be identified. The source percentage for each sample is shown in TMDL Report, Appendix C, Table C-8, Percentage of Sources per Station by Date.

Table 7. Distribution of Fecal Bacteria Source Loads in the Wills Creek for the Annual Condition (TMDL Report Table 2.4.4)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
NJE0014	High Flow	11.1	41.3	2.0	16.6	29.0
	Low Flow	7.7	26.3	17.0	32.3	16.7
	Weighted	8.5	30.0	13.2	28.4	19.8
JEN0036	High Flow	8.7	57.4	2.3	9.4	22.2
	Low Flow	5.7	24.0	10.2	24.5	35.6
	Weighted	6.5	32.3	8.26	20.7	32.2
BDK0000	High Flow	10.1	73.4	0.0	7.5	9.0
	Low Flow	19.4	25.3	4.2	26.8	24.3
	Weighted	17.1	37.3	3.13	22.0	20.5
WIL0067	High Flow	8.3	31.4	0.0	30.6	29.7
	Low Flow	6.1	25.5	11.7	28.2	28.5
	Weighted	6.6	27.0	8.7	28.8	29.0
WIL0013	High Flow	5.4	33.3	6.1	27.6	27.7
	Low Flow	10.8	32.5	6.2	16.1	34.4
	Weighted	9.5	32.7	6.2	19.0	32.7
WIL0000	High Flow	9.3	69.1	0.5	9.6	11.5
	Low Flow	11.8	33.5	7.0	24.1	23.7
	Weighted	11.1	42.4	5.3	20.4	20.6

Table 8. Distribution of Fecal Bacteria Source Loads in the Wills Creek Basin for the Seasonal Period May 1 - September 30 (TMDL Report Table 2.4.5)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
NJE0014	High Flow	8.3	45.8	0.0	20.9	25.0
	Low Flow	12.0	31.2	4.6	32.5	19.7
	Weighted	11.0	34.9	3.4	29.6	21.0
JEN0036	High Flow	30.4	8.7	4.3	21.7	34.8
	Low Flow	5.6	23.4	8.1	36.8	26.1
	Weighted	11.8	19.7	7.2	33.0	28.2
BDK0000	High Flow	20.8	62.5	0.0	12.5	4.2
	Low Flow	20.5	26.1	2.3	30.4	20.7
	Weighted	20.5	35.2	1.7	25.9	16.6
WIL0067	High Flow	16.7	4.2	0.0	66.6	12.5
	Low Flow	7.5	24.5	12.1	33.0	22.9
	Weighted	9.7	19.4	9.0	41.2	20.3
WIL0013	High Flow	0.0	21.7	0.0	60.9	17.4
	Low Flow	9.0	27.2	9.3	14.2	40.3
	Weighted	6.8	25.8	6.9	25.9	34.6
WIL0000	High Flow	8.3	75.0	0.0	8.3	8.3
	Low Flow	15.9	32.1	2.5	24.1	25.4
	Weighted	14.0	42.8	1.9	20.1	21.1

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

Bacteria from human sources are presumed to present a larger risk to humans than bacteria from other sources, and bacteria from wildlife presents the lowest risk to humans. TMDL Report, Section 4.7, Practicable Reduction Targets, page 35, identified the assumed risk factors shown in Table 9 below. Table 10, Maximum Practical Reduction Targets, shown below, identifies the practicable reductions and the rationale for selecting them.

Table 9. Relative Risk Factors

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

Table 10. Maximum Practical Reduction Targets (TMDL Report, Table 4.6.1)

	Human	Domestic Animals	Livestock	Wildlife
Max Practicable Reduction per Source	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 (Table 6); individually for each subwatershed, together with the results of the BST analysis, to minimize the final risk. First, the reductions were not allowed to exceed the practicable reductions in the above table. The water quality criterion for *E. coli* could not be achieved.

Table 11. Practical Reductions Results (TMDL Report Table 4.7.3)

Subwatershed	Applied Reductions				Achievable?
	Domestic %	Human %	Livestock %	Wildlife %	
WIL0067	75%	95%	75%	0%	Yes
NJE0014	75%	95%	75%	0%	No
JEN0036	75%	95%	75%	0%	No
WIL0013sub	75%	95%	75%	0%	No
BDK0000	75%	95%	75%	0%	No
WIL0000sub	75%	95%	75%	0%	No

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

Table 12. Required Reductions to Achieve Water Quality Criterion up to 98% Reductions (TMDL Report, Table 4.7.4)

Station	Domestic %	Human %	Livestock %	Wildlife %	Target Reduction %
WIL0067	30%	95%	46%	0%	45%
NJE0014	98%	98%	98%	17.5%	69%
JEN0036	98%	98%	98%	75%	91%
WIL0013sub	98%	98%	98%	82%	94%
BDK0000	98%	98%	98%	78%	92%
WIL0000sub	98%	98%	98%	91%	96%

* For subwatersheds not meeting WQS with MPRs

The TMDL load is then divided into WLA, WLA-CSOs and LA portions. MDE developed allocation rules summarized in Table 13 below. The "unknown" BST source category is deleted and the other categories increased.

Table 13. Source Contributions for TMDL Allocations (TMDL Report, Table 4.8.1)

Allocation Category	LA	WLA		
		CSOs	MS4s	WWTPs (N/A)
Human	X	X	N/A	N/A
Domestic	X			
Livestock	X			
Wildlife	X			

There are four jurisdictions with NPDES combined storm sewers (CSSs) within the Wills Creek Watershed. Three of these four jurisdictions with CSOs permitted to discharge in Wills Creek have developed their Long Term Control Plans (LTCP). The LTCPs of three jurisdictions (Allegany County, City of Frostburg, and Town of La Vale) state that CSOs are to be eliminated by the dates noted in the LTCPs. Therefore, no allocation is assigned to CSOs in these jurisdictions, and the final human load in the corresponding subwatersheds is allocated to the LA. The fourth jurisdiction with a NPDES CSS permit in the watershed is the City of Cumberland. Cumberland's LTCP is not finalized at the time of the development of this TMDL, but the city has informed MDE that the LTCP will not propose the complete elimination of CSOs. Therefore, part of the final human load in the subwatershed where the City of Cumberland is located (WIL0000sub) will be assigned to the WLA-CSOs.

V. Discussion of Regulatory Conditions

EPA finds that Maryland has provided sufficient information to meet all of the seven basic requirements for establishing bacteria TMDLs for Wills Creek. Therefore, EPA approves the TMDLs for the Wills 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 Use I – Water Contact Recreation and Protection of Non-Tidal Warm Water Aquatic Life (COMAR 26.08.02.08D).

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

Table 14. Water Quality Criteria

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

[1]MPN - Most Probable Number

The standards do not specify either a minimum number of samples required for the geometric mean or timeframe such as the commonly used 30-day period. However, the *2006 List of Impaired Surface Waters [303(d) List] and Integrated Assessment of Water Quality In Maryland*, dated April 2006, Section B.3.2.1.3.1, Recreational Waters, contains MDE's interpretation of how bacteria data will be used for assessing waters for general recreational use. A steady State geometric mean will be calculated with available data where there are at least five representative sampling events. The data shall be from samples collected during steady state conditions and during the beach season (Memorial Day through Labor Day) to be representative of the critical condition. Furthermore, according to Section B.3.2.1.3.2, Beaches, "(t)he single sample maximum criteria applies only to beaches and is to be used for closure decisions based on short-term exceedances of the geometric mean portion of the standard." Since warm temperatures can occur early in May and last until the end of September or early October, a longer seasonal period than the official beach season (Memorial Day through Labor Day) was used for the water quality assessment, as a conservative assumption in the analysis.

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

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

EPA finds that the TMDLs for bacteria will ensure that the designated use and water quality criteria for Wills 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 in-stream long-term geometric mean of *E. coli* bacteria. EPA's regulations at 40 CFR §130.2(i), also define "total maximum daily load (TMDL)" as the "sum of individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background." As the total loads provided by Maryland equal the sum of the individual WLAs for point sources and the land-based LAs for nonpoint sources set forth below, the TMDLs for fecal bacteria for Wills Creek are consistent with 40 CFR §130.2(i).

The WLAs are assigned to permitted point sources. There are four jurisdictions with NPDES CSSs within the Wills Creek watershed. Three of these four jurisdictions with CSOs permitted to discharge in Wills Creek have developed their Long Term Control Plans (LTCP). The LTCPs of three jurisdictions (Allegany County, City of Frostburg, and Town of La Vale) state that CSOs are to be eliminated by the dates noted in the LTCPs. Therefore, no allocation is assigned to CSOs in these jurisdictions, and the final human load in the corresponding subwatersheds is allocated to the LA. The fourth jurisdiction with a NPDES CSS permit in the watershed is the City of Cumberland. Cumberland's LTCP is not finalized at the time of the development of this TMDL, but the city has informed MDE that the LTCP will not propose the complete elimination of CSOs. Therefore, part of the final human load in the subwatershed where the City of Cumberland is located (WIL0000sub) will be assigned to the WLA-CSOs. The Table 4.8.1 in the TMDL report indicates the LA contributions from all four bacteria source categories and the potential WLA-CSOs contribution from the human bacteria sources.

EPA realizes that the bacteria allocations shown in Table 1a is one allocation scenario designed to meet in-stream 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-CSOs and LA allocations are feasible and/or cost effective. Any subsequent changes, however, must ensure that the in-stream water quality standards are met.

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

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

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

4. The TMDLs consider critical environmental conditions.

EPA regulations at 40 CFR §130.7(c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that Wills 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 (1988-2003) 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 can be warm and swimming may occur. The corresponding critical period dates are shown in the TMDL Report Table 4.4.1 and Table 6 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 Wills 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 waterbodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection.

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

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

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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)

7. The TMDLs have been subject to public participation.

MDE conducted a public review of the Wills Creek TMDLs. The public comment period was July 28, 2006 to August 28, 2006. MDE received no written comments from the comment period.

VI. Discussion of Reasonable Assurance

There is a reasonable assurance that the TMDLs can be met. According to 40 CFR §122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge which is prepared by the state and approved by EPA. Therefore, any WLAs will be implemented through the NPDES permit process. Based on the point source permitting information, there are no NPDES stormwater permits that are required to regulate the stormwater discharge of fecal bacteria directly into the Wills Creek Watershed, Garrett and Allegany Counties.

The most significant planned implementation measures in the Wills Creek Watershed involve the upgrade or separation of combined sewer systems in the City of Frostburg, the Town of LaVale, Allegany County, and the city of Cumberland. Each of these jurisdictions is obligated under a judicial consent decree to adopt and implement a long term control plan (LTCP) to eliminate dry weather flows and minimize wet weather overflows. The City of Cumberland has not finalized its LTCP yet, but the City proposes to meet its legal obligations through the construction of a storage facility that will contain storm-related flows until the Cumberland Wastewater Treatment Plant can treat them.

In Wills 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. Therefore, MDE intends to implement an iterative approach that addresses those sources with the largest impact on water quality and human health risk, with consideration given to ease of implementation and cost.

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

MDE's implementation plan is not only based on reductions to total fecal bacteria, it is based on reductions by sources of bacteria. MDE used the results of its BST monitoring from November 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 15. Distribution of Fecal Bacteria Source Loads in the Wills Creek for the Annual Condition (Includes TMDL Report, Table 2.4.4)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
NJE0014	High Flow	11.1	41.3	2.0	16.6	29.0
	Low Flow	7.7	26.3	17.0	32.3	16.7
	Weighted	8.5	30.0	13.2	28.4	19.8
JEN0036	High Flow	8.7	57.4	2.3	9.4	22.2
	Low Flow	5.7	24.0	10.2	24.5	35.6
	Weighted	6.5	32.3	8.26	20.7	32.2
BDK0000	High Flow	10.1	73.4	0.0	7.5	9.0
	Low Flow	19.4	25.3	4.2	26.8	24.3
	Weighted	17.1	37.3	3.13	22.0	20.5
WIL0067	High Flow	8.3	31.4	0.0	30.6	29.7
	Low Flow	6.1	25.5	11.7	28.2	28.5
	Weighted	6.6	27.0	8.7	28.8	29.0
WIL0013	High Flow	5.4	33.3	6.1	27.6	27.7
	Low Flow	10.8	32.5	6.2	16.1	34.4
	Weighted	9.5	32.7	6.2	19.0	32.7
WIL0000	High Flow	9.3	69.1	0.5	9.6	11.5
	Low Flow	11.8	33.5	7.0	24.1	23.7
	Weighted	11.1	42.4	5.3	20.4	20.6

Table 16. Distribution of Fecal Bacteria Source Loads in the Wills Creek for the Seasonal Period May 1 - September 30 (TMDL Report Table 2.4.5)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
NJE0014	High Flow	8.3	45.8	0.0	20.9	25.0
	Low Flow	12.0	31.2	4.6	32.5	19.7
	Weighted	11.0	34.9	3.4	29.6	21.0
JEN0036	High Flow	30.4	8.7	4.3	21.7	34.8
	Low Flow	5.6	23.4	8.1	36.8	26.1
	Weighted	11.8	19.7	7.2	33.0	28.2
BDK0000	High Flow	20.8	62.5	0.0	12.5	4.2
	Low Flow	20.5	26.1	2.3	30.4	20.7
	Weighted	20.5	35.2	1.7	25.9	16.6
WIL0067	High Flow	16.7	4.2	0.0	66.6	12.5
	Low Flow	7.5	24.5	12.1	33.0	22.9
	Weighted	9.7	19.4	9.0	41.2	20.3
WIL0013	High Flow	0.0	21.7	0.0	60.9	17.4
	Low Flow	9.0	27.2	9.3	14.2	40.3
	Weighted	6.8	25.8	6.9	25.9	34.6
WIL0000	High Flow	8.3	75.0	0.0	8.3	8.3
	Low Flow	15.9	32.1	2.5	24.1	25.4
	Weighted	14.0	42.8	1.9	20.1	21.1

The following reductions (Table 17) are necessary to achieve water quality standards.

Table 17. TMDL Reduction Results: Optimization Model up to 98% (TMDL Report, Table 4.4.2)

Subwatershed	Hydrological Condition		Domestic Animals %	Human %	Livestock %	Wildlife %
WIL0067	Annual	Average	0%	0%	0%	0%
		High Flow	0%	0%	0%	0%
		Low Flow	0%	0%	0%	0%
	Seasonal	High Flow	30%	95%	46%	0%
		Low Flow	0%	70%	0%	0%
	Maximum Source Reduction		30%	95%	46%	0%
NJE0014	Annual	Average	53%	18%	43%	0%
		High Flow	0%	69%	0%	0%
		Low Flow	0%	41%	0%	0%
	Seasonal	High Flow	98%	98%	98%	9%
		Low Flow	98%	98%	98%	17.5%
	Maximum Source Reduction		98%	98%	98%	17.5%
JEN0036	Annual	Average	73%	85%	72%	0%
		High Flow	0%	86%	0%	0%
		Low Flow	61%	98%	98%	0%
	Seasonal	High Flow	98%	98%	98%	49%
		Low Flow	98%	98%	98%	75%
	Maximum Source Reduction		98%	98%	98%	75%
WIL0000sub	Annual	Average	98%	98%	91%	62%
		High Flow	98%	98%	98%	59%
		Low Flow	98%	98%	98%	59%
	Seasonal	High Flow	98%	98%	98%	92%
		Low Flow	98%	98%	98%	91%
	Maximum Source Reduction		98%	98%	98%	92%

Subwatershed	Hydrological Condition		Domestic Animals %	Human %	Livestock %	Wildlife %
BDK0000	Annual	Average	%	%	%	%
		High Flow	98%	98%	98%	51%
		Low Flow	3%	98%	60%	0%
	Seasonal	High Flow	98%	98%	98%	78%
		Low Flow	98%	98%	98%	66%
	Maximum Source Reduction		98%	98%	98%	78%
WIL0013sub	Annual	Average	0 %	0 %	0 %	0 %
		High Flow	0%	0%	0%	0%
		Low Flow	0%	0%	0%	0%
	Seasonal	High Flow	98%	98%	98%	82%
		Low Flow	98%	98%	98%	65%
	Maximum Source Reduction		98%	98%	98%	82%

The TMDLs must specify LAs that will meet the water quality standards. In the practicable reduction targets scenarios, five out of the six subwatersheds did not meet water quality standards based on MPRs during both annual and seasonal conditions.

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

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

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

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,

Signed

Jon M. Capacasa, Director
Water Protection Division

Enclosure

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