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

Decision Rationale
Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Piscataway Creek Basin in Prince George's County, Maryland

Signed

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Jon M. Capacasa, Director
Water Protection Division

Date: *9/20/2007*

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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 Piscataway 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[1] the *Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Piscataway Creek Basin in Prince George's County, Maryland*, dated May 2006 (TMDL Report), to EPA for final review, which was received on May 24, 2006. The Piscataway Creek Non-Tidal Watershed (02-14-02-03) was first identified on Maryland's 1996 section 303(d) list as impaired by nutrients and sediments, with fecal bacteria added to the 2002 section 303(d) list and biological communities added to the 2004 section 303(d) list. The TMDLs described in this document were developed to address fecal bacteria non-tidal water quality impairments.

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

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

[1]By letter dated May 19, 2006.

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

II. Summary

There is one National Pollutant Discharge Elimination System (NPDES) permitted source (MD0023931) 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 up to and including 99 percent reduction from existing or baseline conditions.

Table 1 – Piscataway Creek Watershed Non-Tidal TMDL Summary

Subwatershed	Baseline	TMDL	WLA-PS[2]	WLA-MS4[3]	LA[4]
	Billions MPN[1]/day *E. coli*				
PIS0045	352	136.5	0.09	46.0	90.4
TIN0006	139	64.1	0.0	36.8	27.3
TOTAL	490	200.6	0.1	82.8	117.7

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

The TMDL is a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically-based strategy which considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a "margin of safety" value. For this TMDL, the MOS was incorporated as conservative assumptions used in the TMDL analysis. The loading capacity of the stream was estimated based upon a reduced (more stringent) water quality criterion concentration. The *E.coli* water quality criterion concentration was reduced by 5%, from 126 *E. coli* MPN/100ml to 119.7 *E. coli* MPN/100 ml.

III. Background

The Piscataway Creek Watershed comprises approximately 69 square miles (36,000 acres) in Prince George's County (Figure 1). Piscataway Creek headwaters originate to the west and east of Andrews Air Force Base (AFB) in the vicinity of Camp Springs, Clinton, and Woodyard. On the southwest side of Andrews AFB, two branches join to form Tinkers Creek, a major tributary to Piscataway Creek. Surface water flows into Tinkers Creek, to Piscataway Creek, and eventually to the Potomac River.

The northern region (between Andrews AFB and Louise F. Cosca Regional Park) of the Piscataway Creek Watershed is much more developed than the southern region of the watershed. The major land use in the northern region is Andrews AFB. The population density is high, and a source of potential microbial loading is from failing septic systems in older homes and facilities.

The southern region (between Louise F. Cosca Regional Park to Piscataway Creek drainage) is much more forested and agricultural than the northern region, with encroachment of rural development and many new home estates. Potential sources of microbial loading are failing septic systems and wildlife.

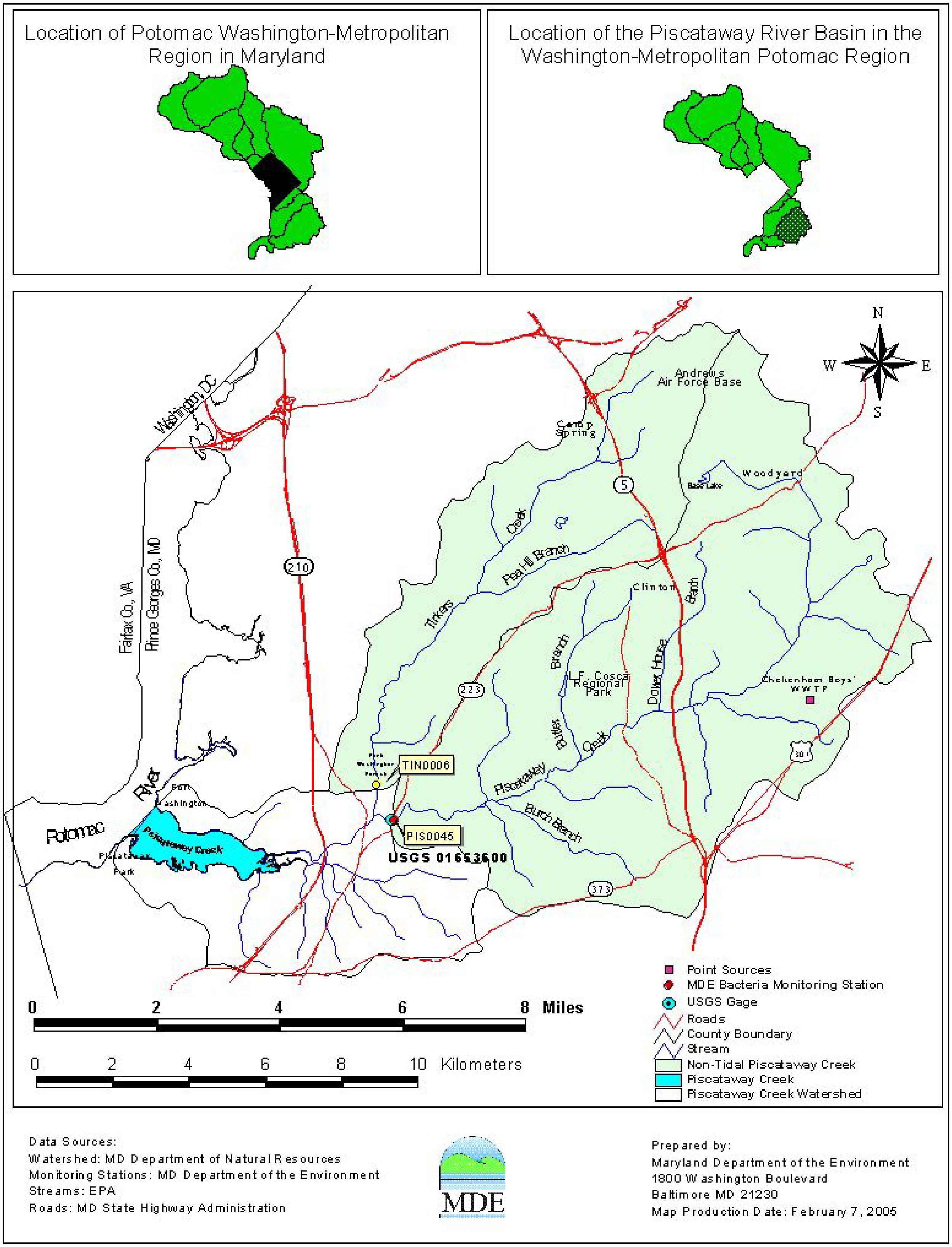

Figure 1 - Location Map of the Piscataway Creek Basin (TMDL Report, Figure 2.1.1)

The Piscataway Creek Basin lies in the Coastal Plain physiographic province, draining to the Potomac River. The mainstem of the non-tidal Piscataway Creek and its tributaries lie predominantly in the Beltsville, Bibb soil series. Beltsville soils are well drained to poorly drained. Bibb association consists of poorly drained soils (of floodplains/marshes).

The 2002 Maryland Department of Planning (MDP) land use/land cover data shows that the watershed can be characterized as residential and forested. The land use percentage distribution for Piscataway Creek Basin is shown in Table 2, and spatial distributions for each land use are shown in Figure 2.

Table 2 - Land Use Area and Percentages in Piscataway Creek Basin (TMDL Report, Table 2.1.1)

Land Use	Acreage	Percent of Total
Forest	15,590	43%
Residential	10,728	30%
Commercial	5,014	14%
Crops	3,230	9%
Pasture	1,367	4%
Water	77	0.2%
Total	36,006	100%

MDE estimated the total population in the Piscataway Creek Watershed to be 58,991 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 Piscataway Creek Watershed.

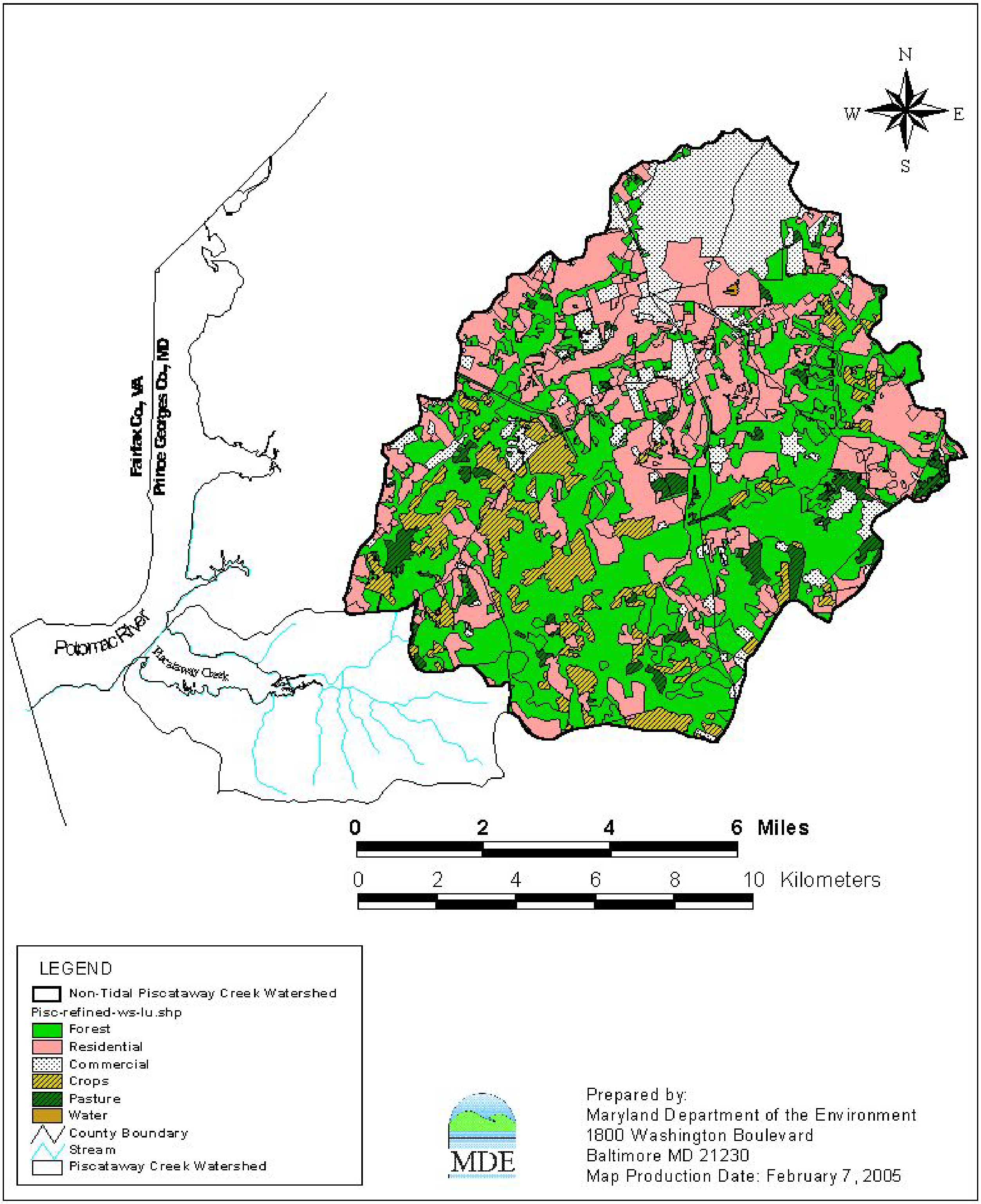

Figure 2 - Land Use of the Piscataway Creek Watershed (TMDL Report, Figure 2.1.3).

IV. Computational Procedure

The length of Piscataway 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 sampling data to determine the bacteria load reductions necessary to meet water quality standards. MDE then uses bacteria source tracking (BST) results to allocate the TMDL loads to various sources (i.e., domestic animals, human sources, livestock, and wildlife).

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

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

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

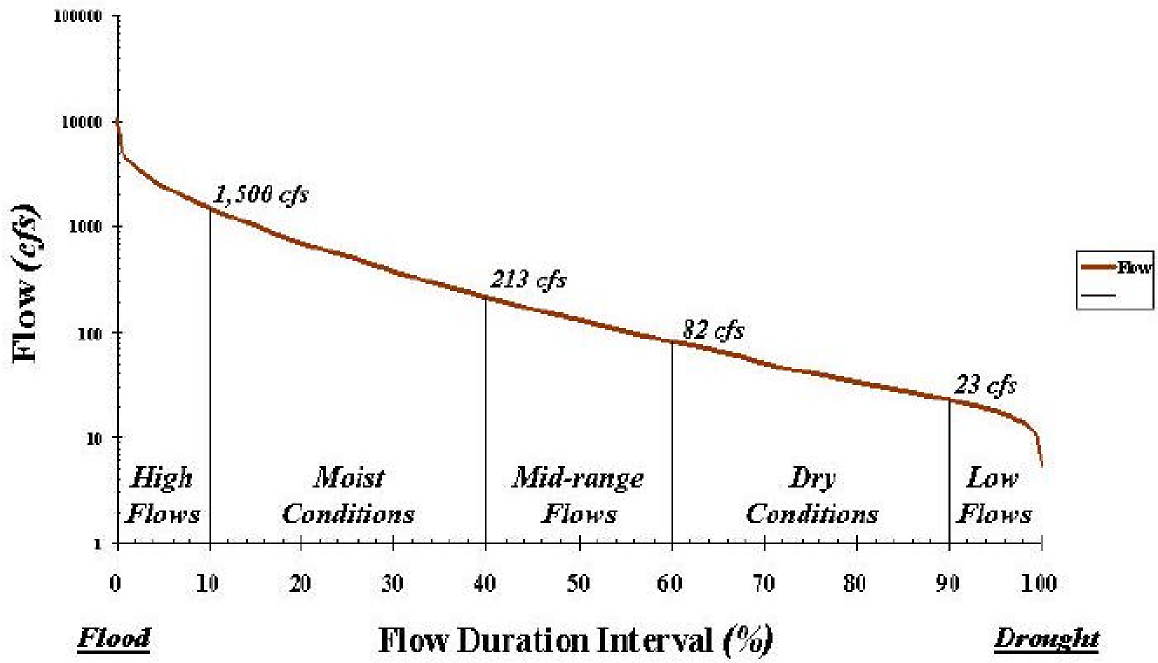

Figure 3 – Example Flow-Duration Curve

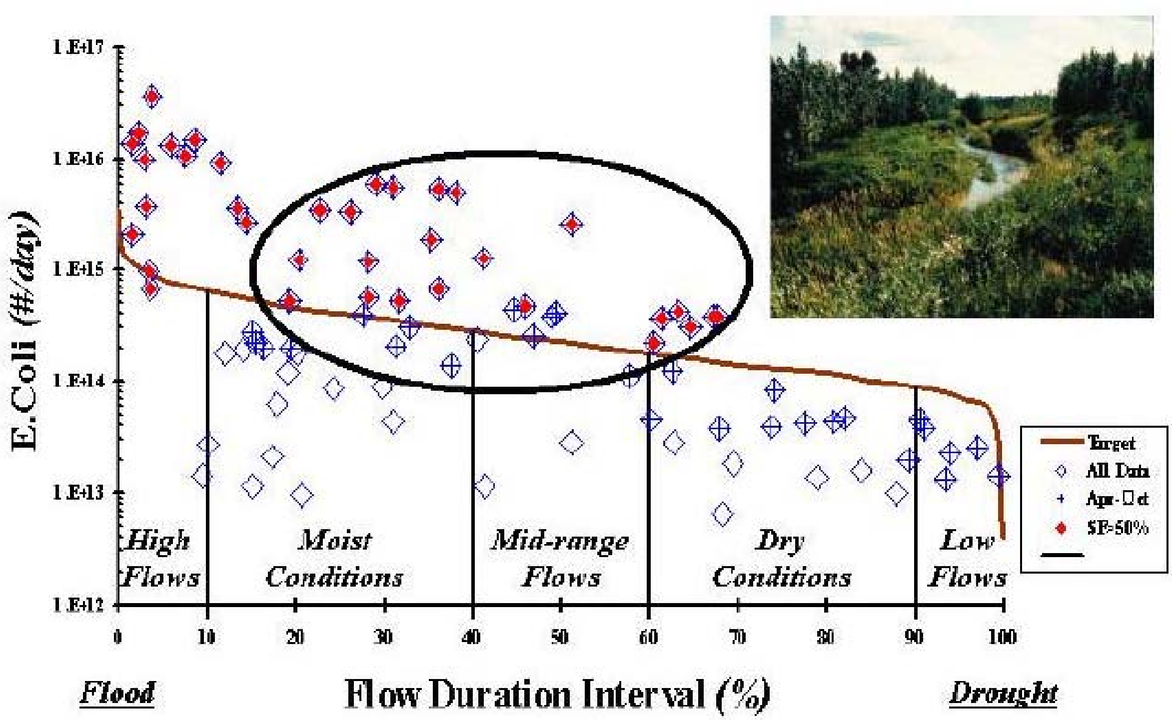

Figure 4 - Example Load-Duration Curve

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

<u>Piscataway Creek Basin 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.

In addition to two bacteria monitoring stations, there is one USGS gaging station located within the Piscataway Creek Watershed which was used to estimate surface flow in Piscataway Creek.

MDE then used a hydrograph separation program, the USGS HYSEP, to analyze the daily flow record to separate surface water flow to Piscataway 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.

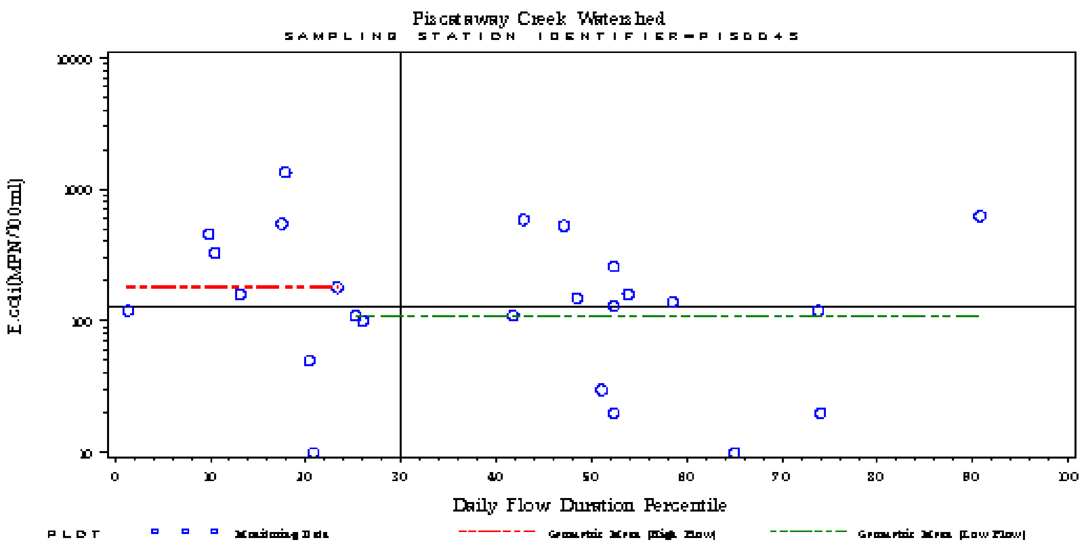

Figure 5 – *E. coli* Concentration vs. Flow Duration for Piscataway Creek Monitoring Station P1S0045 (TMDL Report, Appendix B, Figure B-3)

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[3]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 $\log_{10}$ 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 mean are shown in Table 3 below. Note that 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	Annual Steady State Geometric Mean (MPN/100ml)	Annual Weighted Geometric Mean (MPN/100ml)
Piscataway Creek	PIS0045	High	180	123
		Low	109	
Tinkers Creek	TIN0006	High	203	108
		Low	87	

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

Tributary	Station	Flow Stratum	Seasonal Steady State Geometric Mean (MPN/100ml)	Seasonal Weighted Geometric Mean (MPN/100ml)
Piscataway Creek	PIS0045	High	358	232
		Low	200	
Tinkers Creek	TIN0006	High	395	183
		Low	141	

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 as Table 5.

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

Station	Area (sq. miles)	USGS Reference Gage	High Flow			Low Flow			Baseline Load (Billion MPN/day)
			Unit flow (cfs/sq, mile)	Q (cfs)	*E. coli* Concentration (MPN/100ml)	Unit flow (cfs/sq. mile)	Q (cfs)	*E. coli* Concentration (MPN/100ml)	
PIS0045	39.2	1653600	3.36	131.9	180	0.45	17.9	109	351.51
TIN0006	17.1	1653600	3.36	57.4	203	0.45	7.8	87	138.84

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.

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

Hydrological Condition		Averaging Period	Water Quality Data Used	Fraction High Flow	Fraction Low Flow	Condition Period
Annual	Average	365 days	All	0.25	0.75	Long Term Average
Annual	Wet	365 days	All	0.56	0.44	May 1996 – May 1997
Annual	Dry	365 days	All	0.03	0.97	Nov 2001 - Nov 2002
Seasonal	Wet	May 1st – Sept 30th	May 1st – Sept 30th	0.58	0.42	May 2003 - Sep 2003
Seasonal	Dry	May 1st – Sept 30th	May 1st – Sept 30th	0.01	0.99	May 2002 - Sep 2002

BST was used to identify the relative contribution of the various sources to the instream water samples. In 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 Piscataway Creek Watershed*, *Maryland.* Enterococci isolates were obtained from known sources, which included human, cat, dog, horse, beaver, deer, raccoon, rabbit, skunk, 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 the TMDL Report, Appendix C, Table C-8, Percentage of Sources per Station per Date.

Table 7 - Distribution of Fecal Bacteria Source Loads in the Piscataway Creek Basin for the Annual Condition (TMDL Report, Table 2.4.3)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
PIS0045	High Flow	23	37	8	27	5
	Low Flow	5	29	20	42	5
	Weighted	9	31	17	38	5
TIN0006	High Flow	38	23	2	29	7
	Low Flow	5	29	11	45	10
	Weighted	14	28	9	41	9

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

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
PIS0045	High Flow	26	25	7	40	3
	Low Flow	2	31	12	51	3
	Weighted	8	29	11	48	3
TIN0006	High Flow	38	21	2	37	2
	Low Flow	5	31	7	55	2
	Weighted	13	29	6	51	2

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 34, 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 4.7.2)

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

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

The required reductions were determined by analyzing 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)

Station	Applied Reductions				Achievable
	Domestic %	Human %	Livestock %	Wildlife %	
PIS0045	75.0%	95.0%	75.0%	0.0%	No
TIN0006	75.0%	95.0%	75.0%	0.0%	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 99% Reductions (TMDL Report, Table 4.7.4)

Station	Domestic %	Human %	Livestock %	Wildlife %	Target Reduction
PIS0045	82.3%	95.0%	79.3%	20.7%	61.2%
TIN0006	81.6%	95.0%	76.2%	12.4%	53.8%

The TMDL load is then divided into WLA, WLA-MS4 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	Human	Domestic	Livestock	Wildlife
WWTP	X			
MS4		X		X
LA	X		X	X

The load reduction scenario results in a load allocation that will achieve water quality standards. The state reserves the right to revise these allocations provided such allocations are consistent with the achievement of water quality standards.

Where the entire watershed is covered by an MS4 permit, 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 when it is not included as part of a Concentrated Animal Feeding Operation (CAFO). Wildlife is split between 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 seven basic requirements for establishing bacteria TMDLs for Piscataway Creek. Therefore, EPA approves the TMDLs for the Piscataway 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 – P – Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply (COMAR 26.08.02.08O(1)).

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

Table 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 conditions loads in the Piscataway Creek TMDL was determined by assessing monitoring data for all stations located in the Piscataway 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 Piscataway 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 *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 the Piscataway Creek are consistent with §130.2(i).

The WLAs are assigned to permitted point sources and the MS4 systems. Prince George's County has an MS4 permit and MDE has made an initial distribution of source loads to WLA and LA. Where the entire watershed is covered by MS4 permits, 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 when it is not included as part of a CAFO. Wildlife is apportioned between MS4 and LA based on the amount of urban pervious land (e.g., residential) compared to other pervious land (e.g., pasture, forest).

Table 15 (also Table 1) – Piscataway Creek Bacteria Non-Tidal TMDL Summary

Subwatershed	Baseline	TMDL	WLA-PS[2]	WLA-MS4[3]	LA[4]
	Billions MPN[1]/day *E. coli*				
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[1]MPN = Most Probable Number
[2]WLA-PS = Wasteload Allocation for non MS4 systems (municipal or industrial)
[3]WLA-MS4 = Wasteload Allocation for MS4 systems
[4]LA = Load Allocation

Table 16 - NPDES Permitted Facility WLAs

Permittee/ Allocation	Permit Number	Location	WLA-PS MPN /Day
Cheltenham Boy's Village	MD0023931	Prince George's	1.87E+07

EPA realizes that the bacteria allocations shown in Table 15 is one allocation scenario designed to meet instream water quality standards. As implementation of the established TMDLs proceed or more detailed information becomes available, Maryland may find other combinations of dividing the TMDL loads between WLA-PS and LA allocations are feasible and/or cost effective. Any subsequent changes, however, must ensure that the instream water quality standards are met.

Based on the foregoing, EPA has determined that the Piscataway 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 Piscataway Creek Watershed is comprised of two distinct subwatersheds. While the monitoring data used in developing the TMDL is from instream sampling which integrates the effects of all loads, the effects of the upstream subwatershed are considered 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 Piscataway 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. 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[4]. MDE's statistical method analyzed flows in Piscataway 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.[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.

For this TMDL, the MOS was incorporated as conservative assumptions used in the TMDL analysis. The loading capacity of the stream was estimated based upon a reduced (more stringent) water quality criterion concentration. The *E.coli* water quality criterion concentration was reduced by 5%, from 126 *E. coli* MPN/100ml to 119.7 *E. coli* MPN/100 ml.

7. The TMDLs have been subject to public participation.

MDE conducted a public review of the Water Quality Analysis (WQA) of Fecal Bacteria for the Non-tidal Piscataway Creek Basin. The public comment period was August 12, 2005 to September 12, 2005, during which two sets of written comments were received. The referenced WQA document was found inadequate to fulfill the TMDL Program's requirements. Accordingly, a TMDL has been developed. The revised draft TMDL was made available for a second public comment period, open from April 3, 2006 to May 2, 2006. MDE received no comments during this second public comment period.

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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)

VI. Discussion of Reasonable Assurance

In addition to the seven outlined elements above, there is a reasonable assurance that the TMDLs can be met. According to 40 CFR §122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge which is prepared by the state and approved by EPA. Therefore, any WLAs will be implemented through the NPDES permit process. Based on the point source permitting information, there is one NPDES point source facility, Cheltenham Boy's Village, with a permit regulating the discharge of fecal bacteria directly into the Piscataway Creek Watershed.

In Piscataway 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 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 17 (also Table 7) – Distribution of Fecal Bacteria Source Loads in the Piscataway Creek Basin for the Annual Condition (TMDL Report, Table 2.4.3)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
PIS0045	High Flow	23	37	8	27	5
	Low Flow	5	29	20	42	5
	Weighted	9	31	17	38	5
TIN0006	High Flow	38	23	2	29	7
	Low Flow	5	29	11	45	10
	Weighted	14	28	9	41	9

Table 18 (also Table 8)- Distribution of Fecal Bacteria Source Loads in the Piscataway Creek for the Seasonal Period May 1 - September 30 (TMDL Report, Table 2.4.4)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
PIS0045	High Flow	26	25	7	40	3
	Low Flow	2	31	12	51	3
	Weighted	8	29	11	48	3
TIN0006	High Flow	38	21	2	37	2
	Low Flow	5	31	7	55	2
	Weighted	13	29	6	51	2

The following reductions (Table 19) are necessary to achieve water quality standards.

Table 19 (also Table 12) – TMDL Reduction Results: Optimization Model up to 99% (TMDL Report, Table 4.7.4)

Station	Domestic %	Human %	Livestock %	Wildlife %	Target Reduction
PIS0045	82.3%	95.0%	79.3%	20.7%	61.2%
TIN0006	81.6%	95.0%	76.2%	12.4%	53.8%

The TMDLs specify LAs that will meet the water quality standards. In the practicable reduction targets scenario, the two subwatersheds could not meet water quality standards.

To further develop the TMDLs, the constraints were relaxed in the two subwatersheds where the water quality attainment was not achievable with the MPRs. The maximum allowable reduction was increased to 99% for all sources, including wildlife.

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

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