



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

3/10/2011

Richard Eskin, Ph.D., Director  
Technical and Regulatory Service Administration  
Maryland Department of the Environment  
1800 Washington Blvd., Suite 540  
Baltimore, Maryland 21230-1718

Dear Dr. Eskin:

The U.S. Environmental Protection Agency (EPA) is pleased to approve the *Total Maximum Daily Loads of Bacteria for Impaired Recreational Areas in Marley Creek and Furnace Creek of Baltimore Harbor Basin in Anne Arundel County, Maryland*. The TMDL report was submitted by the Maryland Department of the Environment's letter dated September 9, 2010. The TMDL was established and submitted in accordance with Section 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.

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 for point sources and load allocations for nonpoint sources; (3) consider the impacts of background pollutant contributions; (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated); (5) consider seasonal variations; (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality); and (7) be subject to public participation. In addition, the TMDL considered reasonable assurance that the TMDL allocations assigned to the nonpoint sources can be reasonably met. The enclosure to this letter describes how the bacteria TMDL for impaired recreational areas in Marley Creek and Furnace Creek of Baltimore Harbor Basin satisfies each of these requirements.

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.

If you have any questions or comments concerning this letter, please do not hesitate to contact María García, Maryland TMDL coordinator, at 215-814-3199.

Sincerely,

Jon M. Capacasa, Director  
Water Protection Division

Enclosure

cc: Lee Curry, MDE-TARSA  
Melissa Chatham, MDE-TARSA



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**Decision Rationale**  
**Total Maximum Daily Loads of Bacteria**  
**Impaired Recreational Areas**  
**Marley Creek and Furnace Creek of**  
**Baltimore Harbor Basin**  
**Anne Arundel County, Maryland**

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**Jon M. Capacasa, Director**  
**Water Protection Division**

**Date: 3/10/11**

**Decision Rationale**  
**Total Maximum Daily Loads of Bacteria**  
**Impaired Recreational Areas in Marley Creek and**  
**Furnace Creek of Baltimore Harbor Basin**  
**Anne Arundel County, Maryland**

## **I. Introduction**

The Clean Water Act (CWA) requires that 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 the 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 TMDL for bacteria for Impaired Recreational Areas in Marley Creek and Furnace Creek of Baltimore Harbor Basin. The TMDL was established to address impairments of water quality, caused by bacteria, as identified in Maryland's 1998 Section 303(d) List for water quality-limited segments. The Maryland Department of the Environment (MDE) submitted the report, *Total Maximum Daily Loads of Bacteria for Impaired Recreational Areas in Marley Creek and Furnace Creek of Baltimore Harbor Basin in Anne Arundel County, Maryland*, dated July 2010, to EPA for final review on September 09, 2010. The basin identification for the Marley Creek and Furnace Creek of Baltimore Harbor Basin is MD-02130903, AU-IDs: MD-PATMH-FURNACE\_CREEK and PATMH-MARLEY\_CREEK.

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 TMDL meets the following seven regulatory requirements pursuant to 40 CFR Part 130.

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

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

## **II. Summary**

The TMDL specifically allocates the allowable loading to the known sources of *enterococci* bacteria in Marley Creek and Furnace Creek of Baltimore Harbor Basin. There are 16 stormwater permitted point sources of bacteria which were included in the WLA of the TMDL. The fact that the TMDL does not assign WLAs to any other source in the watershed

should not be construed as a determination by either EPA or MDE that there are no additional sources in the watershed that are subject to the National Pollutant Discharge Elimination System (NPDES) program. In addition, the fact that EPA is approving this TMDL does not mean that EPA has determined whether some of the sources discussed in the TMDL, under appropriate conditions, might be subject to the NPDES program.

Table 1 presents the bacteria TMDL for Marley Creek and Furnace Creek of Baltimore Harbor Basin. The TMDL allocation is presented in counts per day and is based on geometric mean data collected during steady-state, dry weather conditions during the beach season.

**Table 1. Bacteria TMDL for Marley Creek and Furnace Creek of Baltimore Harbor Basin (*Enterococci* load counts per day)**

Waterbody	TMDL		LA		Stormwater WLA		MOS
Marley Creek	$1.50 \times 10^{12}$	=	$5.93 \times 10^{11}$	+	$9.08 \times 10^{11}$	+	Implicit
Furnace Creek	$8.14 \times 10^{11}$		$1.99 \times 10^{11}$		$6.15 \times 10^{11}$		Implicit

**Table 2. Summary of Permitted Point Sources**

Facility Name	NPDES Permit Number	MDE Permit Number	Stormwater WLA <i>Enterococci</i> load (counts per day)
Gable Signs & Graphics, Inc.	--	02SW1504	$1.52 \times 10^{12}$
EJ Enterprises, Inc.	--	02SW1283	
J & R Bus Service, Inc.	--	02SW0925	
Maryland Recycle Company, Inc.-Glen Burnie	--	02SW1285	
DLA/DNSC Curtis Bay Depot	--	02SW0692	
Glen Burnie Landfill and Convenience Center	--	02SW0298	
Reliable Contracting Company, Inc.	--	02SW0964	
Interstate Brands Corp. - Glen Burnie	--	02SW1080	
Hubers Bus Service, Inc.	--	02SW0823	
Maisel Brother, Inc.	--	02SW0962	
Solley Road Sanitary Landfill	--	02SW0625	
Sha-Glen Burnie Shop	--	02SW1332	
MTA-Cromwell Light Rail Maintenance Facility	--	02SW1951	
Ann Arundel County MS4	MD0068306	--	
State Highway Administration MS4	MD0068276	99DP3313	
MDE General Permit to Construct	--	--	

This 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 that considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a MOS value. The option is always available to refine the TMDL for resubmittal to EPA for approval if environmental conditions, new data, or the understanding of the natural processes change more than what was anticipated by the MOS.

### III. Background

Marley Creek and Furnace Creek are located in Anne Arundel County, Maryland. Furnace Creek drains to Marley Creek, and the latter drains to Curtis Creek, which eventually discharges to the Patapsco River. The drainage area affecting the water quality of the impaired area of Marley Creek and Furnace Creek is 16,728 acres. The Marley Creek and Furnace Creek watershed can be primarily characterized as urban (68%) followed by forest (25%).

The dominant tide in this region is the lunar semi-diurnal ( $M_2$ ) tide, with a tidal range of 0.335 m at the nearby tidal station-Fort Carroll, with a tidal period of 12.34 hours. Because of tidal fluctuation, loading discharged from the subwatersheds located upstream and downstream have an effect on the impaired area. The drainage basin of the impaired area is determined based on the characteristics of tidal induced bacteria transport in the area.

The Surface Water Use Designation for Marley Creek and Furnace Creek is Use I: *Water Contact Recreation and Protection of Nontidal Warmwater Aquatic Life* (COMAR 26.08.02.02). Marley Creek and Furnace Creek were first identified on the 1998 303(d) List. The designated use in the creeks were listed as impaired by elevated levels of bacteria. In the *2008 Integrated Report of Surface Water Quality*, the bacteria impairment (*enterococci*) was clarified for these creeks. The designated uses in Baltimore Harbor were listed as impaired by sediments (1996), nutrients (1996), bacteria (1998), polychlorinated biphenyls (PCBs, 1998), various metals (1998), impacts to biological communities (2002) and debris/floatables/trash (2008). A TMDL was completed for the nutrient listing in 2007. The listings for sediments, impacts to biological communities, PCBs, metals and debris/floatables/trash in the Baltimore Harbor Basin will be addressed at a future date.

CWA Section 303(d) and its implementing regulations require that TMDLs be developed for waterbodies identified as impaired by the State where technology based and other required controls do not provide for the attainment of water quality standards. The *enterococci* bacteria TMDL submitted by MDE is designed to allow for the attainment of the Marley and Furnace Creeks of the Baltimore Basin's designated use and to ensure that there will be no bacteria impacts affecting the attainment of this use. Refer to Table 1 above for a summary of allowable loads.

For this TMDL analysis, an inverse modeling approach using a three-dimensional model, the Environmental Fluid Dynamic Code (EFDC), was used to estimate current bacteria loads and to establish allowable loads for the waters of the impaired recreational areas in Marley Creek and Furnace Creek. The inverse three-dimensional model incorporates influences of freshwater discharge, tidal and density-induced transport, and bacteria decay, thereby representing the fate and transport of bacteria in the area. The loadings from potential sources were assessed based on bacteria source tracking (BST) data.

The allowable load for the area was computed using a geometric mean concentration water quality criterion for *enterococci* of 35 colony forming units (cfu)/100 ml for steady-state, dry weather conditions during the beach season (from Memorial Day to Labor Day).

The TMDL for Marley Creek is  $1.50 \times 10^{12}$  counts per day and it represents a reduction of 75.75% from the baseline load of  $6.19 \times 10^{12}$  counts per day. The TMDL for Furnace Creek is  $8.14 \times 10^{11}$  counts per day and it represents a reduction of 77.79% from the baseline load of  $3.66 \times 10^{12}$  counts per day.

#### **IV. Discussion of Regulatory Conditions**

EPA finds that MDE has provided sufficient information to meet all seven of the basic requirements for establishing a bacteria (*enterococci*) TMDL for Marley Creek and Furnace Creek of Baltimore Harbor Basin. EPA, therefore, approves the bacteria TMDL for Marley Creek and Furnace Creek. This approval is outlined below according to the seven regulatory requirements.

##### ***1) The TMDLs are designed to implement applicable water quality standards.***

TMDLs are established to achieve and maintain water quality standards. In the State of Maryland, water quality standards consist of two components: (1) designated uses and (2) the water quality criteria designed to protect those uses. The Surface Water Use Designation for Marley Creek and Furnace Creek is Use I: *Water Contact Recreation and Protection of Nontidal Warmwater Aquatic Life* (COMAR 26.08.02.02). The water quality criterion for bacteria (*enterococci*) designed to protect the Use I waters of Marley Creek and Furnace Creek is 35 cfu/100 ml.

The impairment of bacteria in Marley Creek and Furnace Creek was identified based on monitoring data collected from six monitoring stations, three in each creek. MDE used steady-state monitoring data collected during beach seasons from 2005 to 2008. The maximum two-year-rolling geometric means of *enterococci* concentration from 2005 to 2008 for Marley Creek and Furnace Creek were chosen to estimate the baseline load for conservative purposes.

The goal of this TMDL is to determine an allowable load for the watershed that will ensure the attainment of the water quality standard. In Marley Creek and Furnace Creek, the allowable load for the watershed was computed using the geometric mean concentration for *enterococci* and the EFDC model. The allowable load was reported in counts per day. In the laboratory analysis of fecal indicator bacteria, using membrane filtration analysis, plate counts are direct counts of living organisms to estimate bacteria counts and are expressed in Colony Forming Units (cfu). The data collected for the report are reported in MPN/100 ml and are directly compared to the water quality standard presented in cfu/100 ml. Because both cfu and MPN are estimating bacteria counts, the TMDL is reported in counts/day. Appendix A of the TMDL Report provides a detailed description of the modeling procedures used for this TMDL. Refer to Table 1 above for a summary of allowable loads.

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

###### Total Allowable Load

The Marley Creek and Furnace Creek of Baltimore Harbor Basin watershed was segmented into 22 subwatersheds and the load from each subwatershed was discharged into its corresponding segment of the river. The inverse method was used to compute the watershed loads discharged to the river based on the least-square criterion between the observations and model simulation of bacteria concentrations in the river. The data from six monitoring stations (from 2005 to 2008) were used to determine the existing loads. According to water quality standards for bacteria in Use I waters, the computation of a TMDL and load reduction requires analyses of steady-state geometric mean from previous two to five years' data. For conservative

purposes, the load estimation scenario using the maximum two-year-rolling geometric mean concentration of *enterococci* was chosen for the baseline load since this scenario will require the greatest reduction to meet water quality criteria.

The allowable load is calculated using the water quality criterion of a geometric mean bacteria density, i.e., *enterococci* of 35 cfu/100 ml. The 3-D EFDC model was used to compute the allowable load for each subwatershed by reducing the existing loads from the watershed so that the bacteria concentrations in the receiving water meet the appropriate water quality standards. The total load discharged into Furnace Creek or Marley Creek is the summation of loads discharged from its subwatershed. The load reduction needed for the attainment of the criteria is determined as follows:

$$\text{Load Reduction} = \frac{\text{Current Load} - \text{Allowable Load}}{\text{Current Load}} \times 100\%$$

EPA regulations at 40 CFR §130.2(i) state, *that the total allowable load shall be the sum of individual WLAs for point sources, LAs for nonpoint sources, and natural background concentrations*. The TMDL for bacteria in Marley Creek and Furnace Creek of Baltimore Harbor Basin is consistent with 40 CFR §130.2(i), because the total loads provided by MDE equal the sum of the individual WLAs for point sources and the land based LAs for nonpoint sources.

#### Load Allocations

According to Federal regulations at 40 CFR §130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loadings should be distinguished.

In order to better identify potential sources of bacterial contamination that may be impacting the water quality of Marley Creek and Furnace Creek, the MDE conducted a fecal pollution source identification survey in the area from December 2007 to November 2008 (See Appendix B of the TMDL Report). BST technology was used to distinguish the origins of bacteria found in environmental waters. Under the premise that bacteria isolated from different hosts can be discriminated based on differences in the selective pressure of microbial populations found in the gastrointestinal tract of the hosts, i.e., humans, livestock, pets, and wildlife, a biochemical method called Antibiotic Resistance Analysis (ARA). Based on the ARA results, the largest category of potential sources in Furnace Creek was wildlife, followed by human and pet. The largest category of potential sources in Marley Creek was pet, followed by human and wildlife.

#### Wasteload Allocations

There are 16 stormwater permitted point sources in Marley Creek and Furnace Creek of Baltimore Harbor Basin (See Table 2 above). Bacteria loads attributable to MS4 Phase I and Phase II NPDES-regulated stormwater entities in the watershed, including Anne Arundel County Phase I MS4, the MD State Highway Administration Phase I MS4, Phase II State and Federal MS4s, and the industrial stormwater permittees, are combined in aggregate stormwater wasteload allocation (SW-WLAs) in this TMDL. The NPDES Phase I or Phase II stormwater permits identified throughout the Marley Creek and Furnace Creek watersheds are regulated based on Best Management Practices (BMPs) and do not include bacteria limits.



There are four NPDES permitted process water point sources discharging bacteria to the downstream of Marley Creek and Furnace Creek: two individual industrial permits, and two individual municipal permits. Model tests indicate that impact to the bacteria impairments upstream from these point source discharges are negligible; therefore the loads from these facilities are not included in the WLA portion of the TMDL.

Federal regulations at 40 CFR §122.44(d)(1)(vii)(B) require that, for an NPDES permit for an individual point source, the effluent limitations must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA.

There is no express or implied statutory requirement that effluent limitations in NPDES permits necessarily be expressed in daily terms. The CWA definition of “effluent limitation” is quite broad (effluent limitation is “any restriction...on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources...”). See CWA 502(11). Unlike the CWA’s definition of TMDL, the CWA definition of “effluent limitation” does not contain a “daily” temporal restriction. NPDES permit regulations do not require that effluent limits in permits be expressed as maximum daily limits or even as numeric limitations in all circumstances, and such discretion exists regardless of the time increment chosen to express the TMDL. For further guidance, refer to Benjamin H. Grumbles memo (November 15, 2006) titled *Establishing TMDL Daily Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA, et al., No. 05-5015 (April 25, 2006) and implications for NPDES Permits.*

EPA has authority to object to the issuance of an NPDES permit that is inconsistent with WLAs established for that point source. It is expected that MDE will require periodic monitoring of the point source(s) for bacteria, through the NPDES permit process, in order to monitor and determine compliance with the TMDL’s WLAs. Based on the foregoing, EPA has determined that the TMDLs are consistent with the regulations and requirements of 40 CFR Part 130.

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

The TMDL considers the impact of background pollutants by considering the bacteria loads from natural background sources, such as wildlife.

**4) *The TMDLs consider critical environmental conditions.***

EPA regulations at 40 CFR §130.7(c)(1) require TMDLs to account for critical conditions for stream flow, loading, and water quality parameters. The intent of the regulations is to ensure that (1) the TMDLs are protective of human health, and (2) the water quality of the waterbodies is protected during the times when they are most vulnerable. Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable worst-case scenario condition.

In Marley Creek and Furnace Creek, the data used in the development of the TMDL were collected during beach season (Memorial Day through Labor Day) and during steady-state, dry weather conditions, to be representative of the critical condition, when maximum water contact is expected. Also, the TMDL allocation is developed based on the worst-case scenario in which the greatest reduction was needed to meet the water quality standard, in this case, the scenario using the maximum two-year-rolling geometric mean concentration of *enterococci*. This scenario was selected for the calculation of the baseline load for the watershed. Therefore, the critical conditions requirement is met for the TMDL development in Marley Creek and Furnace Creek.

**5) *The TMDLs consider seasonal environmental variations.***

In the bacteria TMDL for Marley Creek and Furnace Creek of Baltimore Harbor Basin, seasonality is implicitly included in the data used for the TMDL analysis. The data used in the development of the TMDL was collected during the beach season (Memorial Day through Labor Day) and during steady-state, dry weather, which is the time period when maximum water contact is expected.

**6) *The TMDLs include a Margin of Safety.***

The requirement for a MOS is intended to add a level of conservatism to the modeling process in order to account for uncertainty. Based on EPA guidance, the MOS can be achieved through two approaches. One approach is to reserve a portion of the loading capacity as a separate term, and the other approach is to incorporate the MOS as part of the design conditions.

MDE has adopted an implicit MOS for this TMDL. The decay rate is one of the most sensitive parameters in the model. For a given system, the higher the decay rate, the higher the assimilative capacity. The value of the decay rate varies from 0.7 to 3.0 per day in salt water. A decay rate of 0.7 per day was used as a conservative estimate in the TMDL calculation. Further literature review supports this assumption as a conservative estimate of the decay rate. Therefore, the MOS is implicitly included in the TMDL calculation.

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

MDE provided an opportunity for public review and comment on the bacteria TMDL for the Impaired Recreational Areas in Marley Creek and Furnace Creek of Baltimore Harbor Basin. The public review and comment period was open from June 22, 2010 through July 21, 2010. MDE received no written comments.

A letter was sent to the U.S. Fish and Wildlife Service pursuant to Section 7(c) of the Endangered Species Act, requesting the Service's concurrence with EPA's findings that approval of this TMDL does not adversely affect any listed endangered and threatened species, and their critical habitats.

**V. Discussion of Reasonable Assurance**

The bacteria TMDL for Marley Creek and Furnace Creek of Baltimore Harbor Basin provides reasonable assurance that the maximum allowable load will be achieved and maintained. The appropriate measures to reduce bacteria (*enterococci*) levels in this watershed include, where appropriate, the use of better treatment technology or the installation of best management practices. MDE intends for these required reductions to be implemented in an

iterative process that first addresses those sources with the greatest impact on water quality, with consideration given to the ease of implementation and cost. The identification of the potential source contributions from the BST may be used as a tool to target and prioritize initial implementation efforts.

The Marley and Furnace Creek watershed is managed under NPDES Phase I and II stormwater permits of the Anne Arundel County Phase I MS4, the MD State Highway Administration Phase I MS4, Phase II State and Federal MS4s, and industrial facilities regulated for stormwater discharges. MDE states that this provides regulatory assurances that urban stormwater sources will be managed to the maximum extent practicable. Stormwater BMPs and programs implemented, as required by MS4 permits, shall be consistent with available WLAs developed under the TMDL. Where fecal bacteria transported through an MS4 conveyance system, stormwater BMPs implemented to control urban runoff should help in reducing fecal bacteria loads in the Marley Creek and Furnace Creek watershed.

MDE is also relying on requirements for pumpout stations in some marinas. Additionally, although not directly linked, it is assumed that the nutrient management plans from the Water Quality Improvement Act of 1998 will result in some reduction of bacteria from manure application practices.

For assurance of implementation, MDE plans on utilizing the following funding sources: Maryland's Agricultural Cost Share Program (MACS), Environmental Quality and Incentives Program, MDE's Linked Deposit Program, the Bay Restoration Fund, State Water Quality Revolving Loan Fund, and the Stormwater Pollution Cost Share Program. Details on these programs and additional funding sources can be found at <http://www.dnr.state.md.us/bay/services/summaries.html>.

It is expected that, due to significant contribution of bacteria from wildlife sources in the watershed, some waterbodies will not be able to meet water quality standards even after all anthropogenic sources are controlled. Changing of a natural background condition is not the intended goal of this TMDL. MDE, therefore, will address the controllable sources of fecal bacteria (human, livestock and pets) first especially those that have the largest impacts on water quality and create the greatest risks to human health, with consideration given to ease the cost of implementation.

Following the initial implementation stage, MDE expects to re-assess the water quality to determine if the designated use is being attained. If water quality standards can not be attained after this approach, other sources may need to be controlled. A Use Attainability Analysis is also an option to reflect the presence of naturally high bacteria levels from uncontrollable sources.