UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029
9/22/2003

Dr. Richard Eskin
Director, MDE - TARSA
1800 Washington Boulevard, Suite 540
Baltimore, MD 21230-1718

Dear Dr. Eskin:

The U. S. Environmental Protection Agency (EPA) is pleased to approve Total Maximum Daily Loads (TMDLs) for Southeast Creek Watershed, submitted to EPA for review and approval by the Maryland Department of the Environment (MDE), by letter dated December 27, 2002. The TMDLs were established and submitted in accordance with Sections 303(d)(1)(c) and 303(d)(2) of the Clean Water Act. The TMDLs were established to address impairments of water quality as identified in Maryland's 1996 Section 303(d) lists of impaired waters still needing TMDLs.

If you have any further questions, please call me or have your staff contact Ms. Susan Sciarratta, EPA Region III Maryland TMDL Coordinator, at (215) 814-5733.

Sincerely,

/S/

Jon M. Capacasa, Director
Water Protection Division

Enclosure

Decision Rationale

Total Maximum Daily Loads of Phosphorus to Southeast Creek, Queen Anne's County, Maryland

I. Introduction

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

This document sets forth the United States Environmental Protection Agency's (USEPA) rationale for approving the TMDLs for phosphorus in Southeast Creek watershed. The TMDL was established to address impairments of water quality, caused by nutrients as identified in Maryland's 1996 Section 303(d) lists. The Maryland Department of the Environment (MDE), submitted the *Total Maximum Daily Loads of Phosphorus to Southeast Creek, Queen Anne's County, MD*, dated December 2002, to USEPA for final review on December 27, 2002. Southeast Creek watershed was first identified on Maryland's 1996 Section 303(d) list for nutrients, suspended sediments and fecal coliform. Suspended sediments and fecal coliform impairments will be addressed by MDE in a separate TMDL document.

The USEPA's approval rationale is based on the TMDL Report and information contained in the report's Appendix. USEPA's review has determined that the TMDLs have met the following eight regulatory requirements pursuant to 40 CFR Part 130.

1) The TMDLs are designed to implement applicable water quality standards.
2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3) The TMDLs consider the impacts of background pollutant contributions.
4) The TMDLs consider critical environmental conditions.
5) The TMDLs consider seasonal environmental variations.
6) The TMDLs include a margin of safety.
7) There is reasonable assurance that the TMDLs can be met.
8) The TMDLs have been subject to public participation.

There is one point source in this watershed, the Church Hill Waste Water Treatment Plant. The remainder of the impairments stem from nonpoint source loadings. Maryland's TMDL report provides land use and loading data along with a distribution of the total load allocation to specific land use categories. The allocations are included in the Technical Memorandum, which breaks down the load allocation to specific land uses. Maryland's gross waste load allocations for the low-flow and average-flow TMDLs correspond with those values given in the Technical Memorandum. Similarly, in the Technical Memorandum, the gross load allocations for average annual flow are segmented according to land use category. Both low flow and average flow waste load and load allocations are presented in Tables 1 and 2. Table 3 exhibits nonpoint source loading allocations according to land use for average annual flow. Nonpoint source

loading rates represent a cumulative impact from all sources, including naturally occurring and human-induced sources.

Table 1- Phosphorus TMDLs Summary for Low Flow, May 1 through October 31

Parameter	Rate	TMDL	WLA[1]	LA[2]	MOS[3]
Phosphorus	lbs/month	259	122	130	7

[1] WLA = Waste Load Allocation
[2] LA = Load Allocation
[3] MOS = Margin of Safety

Table 2 - Phosphorus TMDLs Summary Average Annual Flow

Parameter	Rate	TMDL	WLA[1]	LA[2]	MOS[3]
Phosphorus	lbs/year	21,113	1,462	19,078	572

[1] WLA = Waste Load Allocation
[2] LA = Load Allocation
[3] MOS = Margin of Safety

Table 3 - Nonpoint Source Phosphorus Average Annual TMDL Loads Attributed to Significant Land Use

Land Use Category	Percentage of Non point Source Load (%)	Nonpoint Source Load (lbs/yr)
Mixed Agricultural	96.32	18,376
Urban	2.05	391
Forest and Other Herbaceous	1.10	210
Atmosphere Deposition	0.54	103
Total	100	19,078

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 by including a "margin of safety" value. Conditions, available data and an understanding of the natural processes can be significantly altered by the margin of safety. The State always retains the option to refine the TMDL and resubmit it to USEPA for approval.

Summary

Southeast Creek is located within Queen Anne's County, Maryland (TMDL report Figure 1). It drains into the Chester River, which in turn drains to Chesapeake Bay. The creek is approximately 5.1 miles (8.1 kilimeters) in length, form its confluence wht the Chester River to the tidal upper reaches of its headwaters. The Southeast Creek watershed has an area of approximately 34, 994 acres (141.6 km^2). The land use in the watershed consists of mixed agriculture (23,560 acres or 67.3%), forest and other herbaceous cover (9,835 acres or 28.1%), urban (961 acres or 2.8%) and water (638 acres or 1.8%).

In response to the requirements of Section 303(d) of the Clean Water Act (CWA), MDE listed

Southeast Creek on the 1996 Section 303(d) list of impaired waterbodies. It was listed for nutrient impariments due to signs of eutrophication, expressed as high chlorophyll *a* concentrations. Eutrophication is the over-enrichment of aquatic systems by excessive inputs of nutrients (phosphorus). The nutrients act like fertilizer, which leads to excessive growth of aquatic plants, their eventual death and decomposition, and subsequent bacterial consumption of dissolved oxygen (DO). The resulting DO concentrations reside beneath levels necessary to support the creek's designated use.

MDE developed Southeast Creek's TMDLs to address the excessive levels of nutrient enrichment. These TMDLs are designed to satisfy the water quality standards and designated uses of Southeast Creek for nutrients. Impairments due to suspended sediments are not addressed by these TMDLs.

In order to address the impairments of Southeast Creek from the Section 303(d) list, MDE believes it is necessary to control excessive nutrient input to the system. Phosphorus and BOD are factors which exert influence on not only the concentrations of DO in a waterbody but also biomass (typically characterized as algae or phytoplankton and measured as chlorophyll-a for modeling purposes). Figure 1 (taken from EPA 823-B-97-002, page 2-14) illustrates the interrelationship of major kinetic processes for BOD, DO, and nutrient analysis.

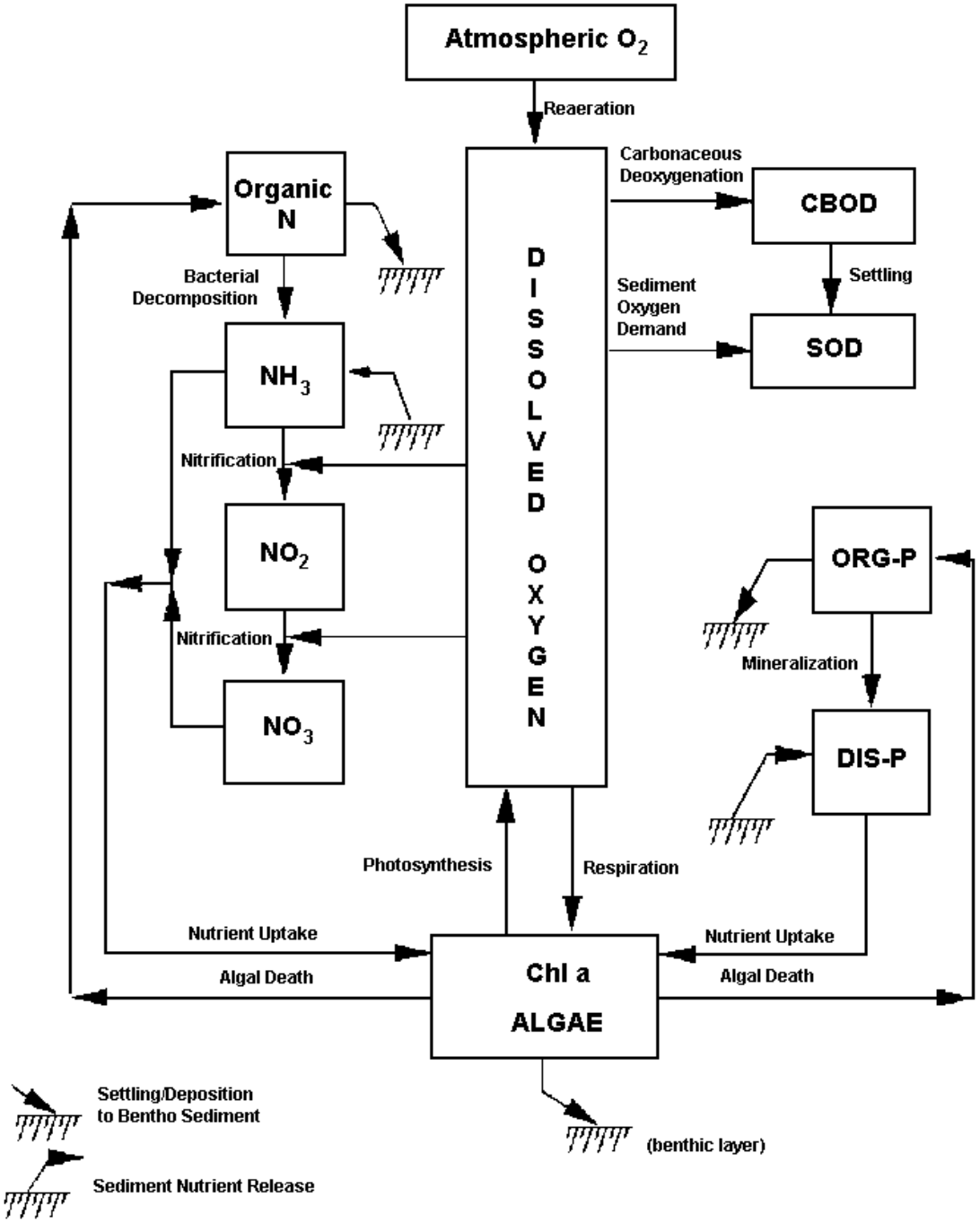

Figure 1 - Illustration of the interrelationship of major kinetic processes for BOD, DO, and nutrient analysis

Nutrient enrichment and subsequent algal growth are a concern in rivers and streams because of their effect on DO concentrations. Growing plants provide a net addition of DO to the stream on an average daily basis, yet respiration can cause low DO levels at night that can affect the survival of less tolerant fish species. Also, if environmental conditions cause a die-off of either microscopic or macroscopic plants, the decay of biomass can cause severe oxygen depressions. Therefore, excessive plant growth can affect a stream's ability to meet both average daily and instantaneous DO standards. In addition, excessive nutrients lead to an overabundance of

aquatic plant growth.

MDE uses the Water Quality Analysis Simulation Program version 5.1 (WASP5.1) model to evaluate the link between nutrient loadings, algal growth, and DO. This water quality simulation program provides a generalized framework for modeling contaminant fate and transport in surface waters and is based on the finite-segment approach (Di Toro *et al.,* 1983). WASP5.1 is supported and distributed by U.S. EPA's Center for Exposure Assessment Modeling (CEAM) in Athens, Georgia (Ambrose *et al.,* 1993).

The model analysis is based on representing current conditions within Southeast Creek and determining the necessary reductions in nutrient loadings from various sources to achieve and maintain water quality standards. WASP5.1 is a general-purpose modeling system for assessing the fate and transport of conventional and toxic pollutants in surface waterbodies (Ambrose, 1987). The model can be applied in one, two, or three dimensions and includes two sub-models (EUTRO5 and TOXI5) to investigate water quality/eutrophication and toxics impairments. EUTRO5 can simulate the transport and transformation of eight state variables including DO, carbonaceous BOD, phytoplankton carbon and chlorophyll-a, ammonia, nitrate, organic nitrogen, organic phosphorus, and orthophosphate.

The WASP5.1 model was implemented in a steady-state mode. This mode of using WASP5.1 simulates constant flow, and average water body volume over the tidal cycle. The tidal mixing is accounted for using dispersion coefficients, which quantify the exchange of substances between WASP5.1 model segments. The model simulates an equilibrium state of the water body, which in this case, considered low flow and average flow conditions, described in more detail below.

WASP5.1 has been previously applied in a number of regulatory and water quality management applications and is an appropriate linkage evaluation tool for Southeast Creek. Based on this analysis, MDE has determined that the levels of nutrient input to Southeast Creek specified by the TMDLs will ensure that water quality standards are achieved by controlling algae blooms and maintaining the DO water quality criterion. See Tables 1 and 2 for a summary of the allowable loads.

The spatial domain of Southeast Creek Eutrophication Model Model (SCEM) extends from the confluence of Southeast Creek for about 8 km up the mainstream.. Twenty WASP5.1 model segments represent this modeling domain; however, supplemental computations of potential algal growth under the TMDL control scenarios were performed for a nontidal tributary located outside of the WASP modeling domain. Concentrations of relevant water quality parameters observed in 1999 serve as the model's upstream boundaries, with regards to freshwater flows and NPS loadings, according to the following assignments: station XHH9772 for segment 1; station BWN0021 for segments 3, 8 and 14; station SEB0047 for segments 5 and 20; and the average for stations ILS0042 and GFB0018 for segment 2. A diagram of the WASP5.1 model segmentation is presented in Appendix A of the TMDL report. Point source loadings, which discharge directly into Southeast Creek (water quality model, segment 20) are calculated from actual Church Hill WWTP maximum allowable limit effluent concentrations.

III. Discussion of Regulatory Conditions

The EPA finds that Maryland has provided sufficient information to meet all of the eight basic requirements for establishing phosphorus TMDLs for Southeast Creek. EPA therefore approves the TMDLs, and supporting documentation for phosphorus in Southeast Creek. The EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to implement the applicable water quality standards.

The designated use of Southeast Creek is Use I. The DO water quality criterion to support this use indicates that DO concentrations may not be less than 5 milligrams per liter (mg/L) at any time. Maryland does not have numeric water quality criteria for phosphorus, but interprets its General Water Quality Criteria to provide numerical objectives for phosphorus which will support the DO water quality criterion as well as a surrogate indicator (chlorophyll-a) to determine acceptable algae levels in Southeast Creek. In order to ensure that the DO concentration of 5 mg/L is met at all times, MDE calculates both the daily average DO concentrations and the minimum diurnal DO concentrations as a result of photosynthesis and respiration of phytoplankton using the WASP5.1 model.

MDE also utilizes chlorophyll-a, a surrogate indicator for algal biomass, to evaluate the link between nutrient loadings and aquatic plant levels necessary to support the designated uses of Southeast Creek. Their General Water Quality Criteria establishes a numeric chlorophyll-a goal of 50 μg/L and uses the WASP5.1 model to determine acceptable levels of nutrient loadings.

EPA finds that the TMDLs for phosphorus will ensure that the designated use and water quality criteria for Southeast Creek are met and maintained.

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

A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs can be expressed in terms of mass per time or by other appropriate measures. TMDLs are comprised of the sum of individual wasteload allocations (WLAs) for point sources, LAs for nonpoint sources, and natural background levels. In addition, the TMDL must include a MOS, either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving stream. Conceptually, this definition is denoted by the following equation.

$$\text{TMDL} = \text{Sum of WLAs} + \text{Sum of LAs} + \text{MOS}$$

Section 4.8 of the TMDL presents the WLA and LA according to the low flow and average annual flow for Southeast Creek. Summer low flow, average annual flow and MOS values are taken from Tables 6 through 8 of the TMDL report, respectively. The TMDL report states a 61% reduction for average flow loads and 19% reduction for low flow loads. These load reductions are based on reductions in controllable loads.

EPA regulations require that an approvable TMDL include individual waste load allocations for each point source. The watershed that drains to Southeast Creek has one

permitted point source nutrient discharger, Church Hill WWTP. However, the absence of a point source reduction is quite apparent. Although it represents nearly half of the allocation for the low flow TMDL condition, allocation values are overstated with respect to actual phosphorous outflows from Church Hill WWTP because of MDE's conservative assumptions. Whereas maximum allowable concentrations (TMDL *Technical Memorandum*, Table 2) of total phosphorus equaling 6.0 mg/l are used in the baseline conditions scenario, the concentration of total phosphorous measured at the plant outfall was 1.95 mg/l in 1999. Additionally, average annual reductions will decrease phosphorous groundwater flows, subsequently leading to lower in-stream concentrations during summer low flow periods.

Based on the foregoing, EPA has determined that the TMDLs for phosphorus for Southeast Creek are consistent with the regulations and requirements of 40 CFR Section 130. Pursuant to 40 CFR 130.6 and 130.7(d)(2), these TMDLs and the supporting documentation, should be incorporated into Maryland's current water quality management plan.

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

In terms of the low-flow and average-flow TMDL analyses, Maryland used 1999 field data which would adequately consider pollutant contributions from baseflow, which is considered to be most influential during low-flow periods, as well as other nonpoint source contributions such as atmospheric deposition and loads from septic tanks.

4) The TMDLs consider critical environmental conditions.

Allocations were made to provide consistency with the technical and regulatory requirements of 40 CFR Section 130. The water quality model was calibrated to reproduce observed water quality characteristics for both observed low flow and observed high flow conditions. The calibration of the model for these two flow regimes establishes an analysis tool that may be used to assess a range of scenarios with differing flow and nutrient loading conditions. Observed water quality data collected during 1999 was used to support the calibration process, as explained further in the "Nonpoint Source Loadings" section of Appendix A of the TMDL report.

5) The TMDLs consider seasonal environmental variations.

Seasonal variation involve changes in streamflow 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 snowmelt and spring rain, while low flow typically occurs during warmer summer and early fall drought periods. Consistent with EPA's discussion regarding critical conditions , the WASP5.1 model and TMDL analysis will effectively consider seasonal environmental variations.

6) The TMDLs include a margin of safety.

A margin of safety (MOS) is required as part of a TMDL in recognition of many uncertainties in the understanding and simulation of water quality in natural systems. 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.

In terms of the low-flow TMDL analysis for phosphorus, Table 8 of the TMDL report shows that MDE explicitly allocates for NPS low flow and average flow phosphorous MOS. In addition, safety factors are built into the TMDL. These include conservative temperature and solar condition assumptions, and the low-flow analysis, which sets a goal of 50 µg/l for chlorophyll-a.

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

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. Wasteload allocations will be implemented through the NPDES permit process.

For the TMDLs, Maryland has several well-established programs that will be drawn upon: the Water Quality Improvement Act of 1998 (WQIA), and the EPA-sponsored Clean Water Action Plan of 1998 (CWAP), and the State's Chesapeake Bay Agreement's Tributary Strategies for Nutrient Reduction. Also, Maryland has adopted procedures to assure that future evaluations are conducted for all TMDLs that are established.

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 and EPA to determine whether these TMDLs have been implemented successfully.

8) The TMDLs have been subject to public participation.

The MDE has conducted a public review of the TMDL for phosphorus loadings in Southeast Creek. The public comment period was open from October 11, 2001 to November 9, 2001. Only one set of written comments was received by MDE. This was provided along with MDE's response document with the TMDL report. EPA finds that MDE has addressed our comments on the Southeast Creek TMDL and has conducted adequate public participation.

EPA initiated informal consultation with the United States Fish and Wildlife Service (USFWS) and the United States National Marine Fisheries Service (USNMFS) on March 28, 2002. EPA received concurrence from the USFWS dated July 29, 2003 and from the USNMFS dated December 21, 2003 on the proposed TMDLs for Southeast Creek.