

Rocky Gorge Reservoir Phosphorus TMDL

Source Document: MDE (Maryland Department of the Environment). 2008. Total Maximum Daily Loads of Phosphorus and Sediments for Triadelphia Reservoir (Brighton Dam) and Total Maximum Daily Loads of Phosphorus for Rocky Gorge Reservoir, Howard, Montgomery, and Prince George's Counties, Maryland. Document Version June 13, 2008.

Water Body Type: Non-tidal stream reaches draining to the Rocky Gorge Reservoir (basin code 02-13-11-07)

Pollutant: Phosphorus

Designated Uses: Use I-P – Water Contact Recreation and Protection of Aquatic Life and Use IV-P – Recreational Trout Waters and Public Water Supply

Size of Watershed: 35,000 acres (55 square miles); excluding drainage to Triadelphia Reservoir

Water Quality Standards: Chlorophyll *a* endpoint consistent with the boundary between mesotrophic and eutrophic conditions (average 10 µg/L)

Analytical Approach: Linked HSPF – CE-QUAL-W2 modeling framework

Date Approved: Approved November 24, 2008

- Volume: 17,000 acre-feet
- Drainage Area: 132 square miles (including drainage to Triadelphia Reservoir)
- Average Discharge: 85.9 feet per second

Only a small portion of the drainage area lies in Prince George's County. This fact sheet provides summary data related to the TMDL and includes specific information related to allocations made for Prince George's County, Maryland, regulated stormwater sources.

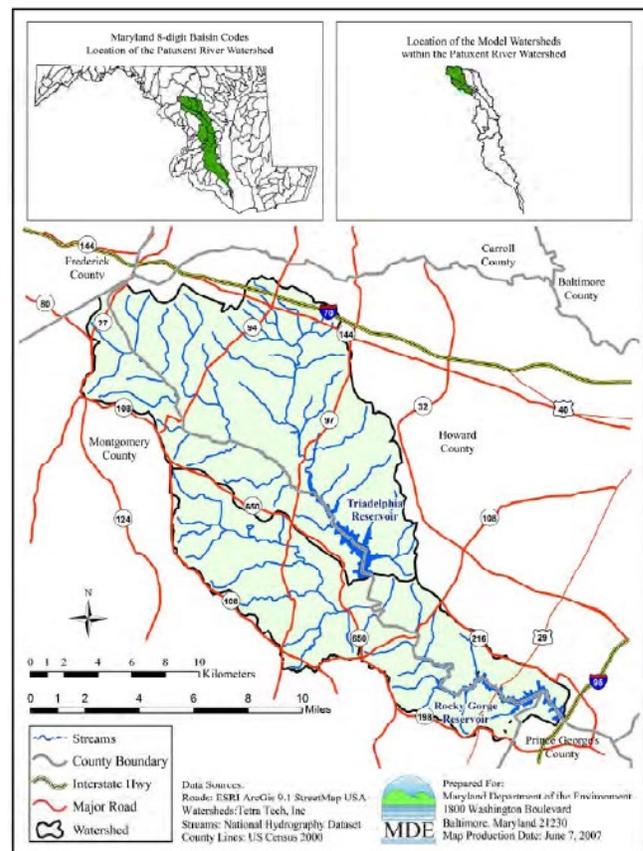


Figure 1. Rocky Gorge Reservoir in the Patuxent River watershed

Source: MDE 2008.

Introduction

This Total Maximum Daily Load (TMDL) was developed for the Rocky Gorge Reservoir (Figure 1) to address eutrophication issues attributed to excess phosphorus inputs. Basic physical characteristics are as follows:

- Surface Area: 773 acres
- Normal Reservoir depth: 74 feet

Problem Identification and Basis for Listing

The Rocky Gorge Reservoir has been included by the Maryland Department of the Environment (MDE) on its

303(d) list as impaired by the following (years listed in parentheses):

- Nutrients (1998) – due to signs of eutrophication, expressed as high chlorophyll *a* levels
- Impacts to biological communities (2002 and 2004)

The reservoir regularly stratifies in late spring lasting through early fall, during which time bottom waters become hypoxic. Epilimnion depth in summer is generally no greater than 4 feet. Dissolved oxygen (DO) levels in the reservoir are usually above 5 mg/L in surface waters except for times when mixing occurs because of seasonal turnover or reservoir drawdowns.

Data also showed median total phosphorus (TP) concentrations at the surface exceeded 0.034 µg/L, which is the Carlson Trophic Index boundary between mesotrophic and eutrophic conditions. Observed ammonia concentrations did not exceed Maryland’s criteria; however, they were observed to increase significantly during summer months likely due to sediment diagenesis. About 23 percent of samples taken in the reservoir exceeded 10 µg/L chlorophyll *a*; only once did chlorophyll *a* concentrations exceed 30 µg/L.

Applicable Data

Washington Suburban Sanitary Commission (WSSC) and MDE performed reservoir sampling at three locations from 1998–2003.

From March or April through October or November, WSSC conducted generally monthly sampling with some semi-monthly sampling during summer months. Physical parameters measured include temperature and DO at each meter of depth. Water quality samples are collected at the surface, bottom, and middle of the reservoir. During stratification, a middle sample is collected in the metalimnion; otherwise, it is collected at the midpoint of reservoir depth.

Water quality samples are analyzed for ammonia, nitrite, nitrate, total Kjeldahl nitrogen, phosphate, TP, total organic carbon, chlorophyll *a*, iron, manganese, turbidity, and alkalinity. Secchi depth measurements are made at each sampling location.

In 2000 MDE also conducted reservoir sampling to support development of the TMDL at four locations. Parameters measured were generally the same as those measured by WSSC; MDE also measured dissolved and particulate nitrogen, phosphorus, organic carbon species, BOD₅, and total suspended solids.

Sources

Sources of phosphorus in the watershed are associated with nonpoint sources and urban runoff. Modeling for the TMDL represents both nonpoint source and urban stormwater loads and integrates all natural and human-induced sources, including direct atmospheric deposition, and loads from septic tanks, which are associated with river baseflow during low-flow conditions.

Model Appendix A provides loading rates by land use by reservoir segment that could be averaged together for purposes of estimating TP loading rates for developed land uses (Table 1). Alternatively, if it were understood which segments of the reservoir model correspond to the County’s area, the loading rates for those segments could be considered.

Table 1. Modeled TP land use loading rates to Rocky Gorge Reservoir

Segment	TP Loading Rate (lbs/yr)	
	Developed	Impervious
20	1,138	3,718
30	530	518
50	431	791
51	62	185
52	87	209
53	37	126
54	38	44
55	97	110
56	77	75
57	114	140
Total	2,610	5,915

Source: MDE 2008.

Technical Approach

Based on the data analysis and problem conditions, the target for the Rocky Gorge TMDL was set as chlorophyll *a* levels consistent with a desired trophic state. Specifically, “the chlorophyll *a* endpoints are (1) a ninetieth percentile instantaneous chlorophyll *a* concentration not to exceed 30 µg/L in the surface layers, and (2) a 30-day moving average concentration not to exceed 10 µg/L in the surface layers. A concentration of 10 µg/L corresponds to a score of approximately 53 on the Carlson Trophic State Index (TSI). This is the approximate boundary between mesotrophic and eutrophic conditions, which is an appropriate trophic state at which to manage these reservoirs” (MDE 2008).

The TMDL was developed using a linked modeling framework of Hydrological Simulation Program—FORTRAN (HSPF) to simulate watershed contributions of flow, nutrients and sediment and CE-QUAL-W2 to simulate effects of loadings in the reservoir.

A laterally averaged two-dimensional CE-QUAL-W2 (version 3.2) reservoir model was used to simulate hydrodynamics, temperature, DO, and eutrophication

dynamics. The simulation period was 1998–2003. Existing loads from nonpoint sources, urban runoff, and the one wastewater treatment plant (WWTP) in the watershed were determined from the calibrated HSPF model of the Patuxent River watershed, which was also set up to include the same simulation period as the CE-QUAL-W2 model. Setup and parameterization of the HSPF model were performed by adapting an HSPF model of the Patuxent River watershed completed by Tetra Tech in 2000 and using many of the same assumptions as the Chesapeake Bay Program watershed model related to pollutant parameterization.

Allocations

The TMDL provides a TP allocation to the Rocky Gorge Reservoir on an average annual basis (Table 2). General source allocations are provided in the TMDL (Table 3).

Table 2. Rocky Gorge total phosphorus baseline, TMDL and percent reduction

TP Baseline Load (lb/yr)	TP TMDL (lb/yr)	% Reduction
50,846	24,406	48

Source: MDE 2008.

Table 3. TMDL components

Allocation	Rocky Gorge Reservoir (lb/yr)
NPS	15,757
PS	7,429
MOS	1,220
TMDL	24,406

Source: MDE 2008.

Note: NPS= nonpoint source; PS = point source; MOS = margin of safety.

Finally, the Point Source Technical Memo produced by MDE to accompany the TMDL further allocates the point source allocation among the various National Pollutant Discharge Elimination System (NPDES)-regulated entities (Table 4).

Table 4. PGC MS4 Allocation

Point Source	NPDES ID	TP Load (lb/yr)
FEMA WWTP	MD0025666	182
Howard County	MD0068322	1,512
Montgomery County	MD0068349	5,581
Prince George's County	MD0068284	154
Total		7,429

Source: MDE 2008.

TMDL Appendix E provides the distribution of loads among sources and jurisdictions for the baseline scenario, as well as one possible scenario for distributing the TMDL allocated loads among various sources for the jurisdictions. Table 5 presents the baseline load and TMDL loads for the County. Based on these distributions, the average percent reduction to TP loads from developed lands in the County is 15 percent.

Table 5. Baseline and TMDL loads for Prince George's County

Source Type	Baseline Load (lbs/yr)	TMDL (lbs/yr)
Crop	0	0
Developed (MS4)	181	154
Forest	97	97
Animal Waste	0	0
Pasture	0	0
Scour	24	8
Total	302	259

Source: MDE 2008.

References

MDE (Maryland Department of the Environment). 2008. Technical Memorandum: Significant Phosphorus and Sediment Point Sources in the Triadelphia Reservoir and Rocky Gorge Reservoir Watersheds. Document Version June 13, 2008.