Upper Patuxent River Sediment TMDL

Source Document:	MDE (Maryland Department of the Environment). 2011. Total Maximum Daily Load of Sediment in the Patuxent River Upper Watershed, Anne Arundel, Howard and Prince George's Counties, Maryland. Document Version September 30, 2011.
Water Body Type:	Non-tidal stream reaches of the Upper Patuxent River watershed (basin number 02131104)
Pollutant:	Sediment
Designated Uses:	Use I-P – Water Contact Recreation and Protection of Aquatic Life
Size of Watershed:	56,446 acres (88 square miles)
Water Quality Standards:	Non-numeric; aquatic life assessed using Maryland's biocriteria protocol, which evaluates both the amount and diversity of the benthic and fish community through the use of the Index of Biotic Integrity (IBI)
Analytical Approach:	Used the Chesapeake Bay Watershed Model (Phase 5.2) in a reference watershed analysis to calculate land use-specific loading rates and losses from edge of field to the main channel. Spatially aggregated to Maryland's 8-digit watersheds.
Date Approved:	Approved September 30, 2011

Introduction

The Total Maximum Daily Load (TMDL) addresses the 1996 sediment impairment. To support the TMDL, a data solicitation was issued and data collected for the prior 5 years were considered. The TMDL's objective was to ensure that watershed sediment loads are at a level to support the Use I designation for the Upper Patuxent River watershed (Figure 1), and more specifically, at a level to support aquatic life.

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.

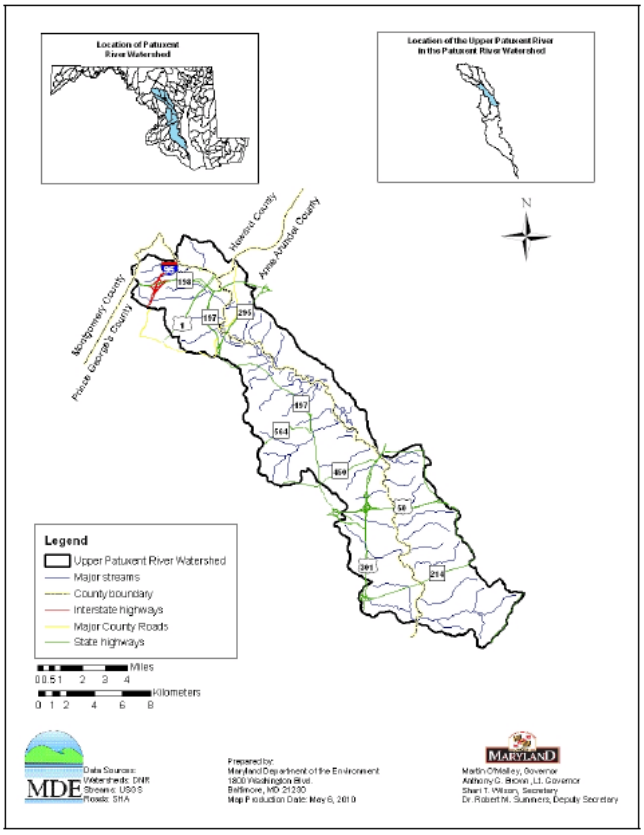

Figure 1. Upper Patuxent River watershed

Source: MDE 2011.

Problem Identification and Basis for Listing

Biological community impairments were identified, prompting placement of the Upper Patuxent River on Maryland's 303(d) list in 1996. The impairment is supported by the results of two Maryland Biological Stream Surveys (MBSS) performed from 1995–1997 and again from 2000–2004. From the surveys, 11 of 15 stations were listed as having Benthic Index of Biotic Integrity (BIBI)

scores significantly lower than 3 (on a scale of 1–5). Data from the second MBSS round were used in performing the biological stressor analysis for the TMDL. The stressor analysis confirmed that individual stressors within the sediment and habitat parameter groupings were contributing to the biological impairment in the watershed and were statistically significantly associated with biologically impaired communities at approximately 40 percent and 65 percent, respectively, of the sites with BIBI scores significantly less than 3.0 (on 1 to 5 scale) throughout the watershed.

Applicable Data

For listing, the biological stressor identification analysis (BSID) was based primarily on the MBSS. The MBSS is a statewide probability-based sampling survey for assessing the biological conditions of wadeable, non-tidal streams. For purposes of developing the TMDL, the data set has the following benefits: (1) in-stream biological data are paired with chemical, physical, and land use data variables that could be identified as possible stressors; and (2) it uses a probabilistic statewide monitoring design. The impairment listing made use of all 15 stations with physical and biological monitoring data in the Upper Patuxent River watershed in the MBSS program (both rounds).

The BSID analysis (stressor identification) made use of the biological and physical monitoring data collected at the 10 stations in the watershed under the Round Two MBSS in 2004. The BSID analysis combines the individual stressors (physical and chemical variables) into three generalized parameter groups to assess how the resulting impacts of these stressors can alter the biological community and structure. The three generalized parameter groups include sediment, habitat, and water chemistry.

Sources

Nonpoint sources addressed by the TMDL include unregulated stormwater runoff and streambank erosion. Unregulated runoff includes runoff from agricultural and forested land uses. Point sources include regulated stormwater and six facilities with total suspended solid-limited National Pollutant Discharge Elimination System (NPDES) permits that continuously discharge process water. The TMDL also accounts for two upstream sources, the Little Patuxent (from the Little Patuxent Sediment TMDL) and Rocky Gorge Reservoir upstream loads. Table 1 presents the baseline loads for sources determined by the modeling approach used to develop the TMDL.

Table 1. Baseline sediment loads

Source	Baseline Sediment Load (ton/yr)
Little Patuxent-Upstream watershed	37,066.5
Rocky Gorge-Upstream watershed	7,689.0
Nonpoint Source (unregulated stormwater)	11,956.1
Regulated Stormwater (MS4)[a]	9,102.0
Process Water	607.5
Total Baseline	66,421.1

Source: MDE 2011.

Note: [a] Includes barren, pervious, and impervious surfaces.

The majority of the sediment load is from urban land (42 percent) and crop land (41 percent). The next largest sediment sources are forest (10.3 percent) and pasture (1.7 percent). Land use-specific loads are presented on page 16 of the TMDL. Individual land use edge-of-stream loads are calculated as a product of the land use area, land use target loading rate, and loss from the edge-of-field (EOF) to the main stream channel. The loss from the EOF to the main channel is the sediment delivery ratio and is defined as the ratio of the sediment load reaching a basin outlet to the total erosion within the basin. A sediment delivery ratio is estimated for each land use type based on the proximity of the land use to the main channel. Thus, as the distance to the main channel increases, more sediment is stored within the watershed (i.e., sediment delivery ratio decreases). Details of the data sources for the unit loading rates can be found in the TMDL report.

Technical Approach

The TMDL was developed using a modeling approach to identify a sediment loading threshold consistent with support of aquatic life. Average annual edge-of-stream loading rates was identified for six reference (unimpaired) watersheds using the Chesapeake Bay Program's Phase 5.2 watershed model.

Because the Patuxent watershed lies almost entirely within the Coastal Plain region, reference watersheds which were identified as supporting aquatic life were selected from the same region (non-tidal Coastal Plain). The reference watershed loads were all normalized by a constant background condition, the all-forested watershed condition. The normalized load represents how many times greater the current watershed sediment load is than the all-forested sediment load. The forest-normalized sediment load for this TMDL is calculated as the current watershed sediment load divided by the all-forested sediment load.

Six reference watersheds were selected and the forest-normalized sediment loads were calculated using CBP P5.2 2000 land (to maintain consistency with MBSS sampling years). The median value of the reference watershed forest-normalized sediment loads (4.8) was calculated and established as the sediment loading threshold for the TMDL. Appendix A of the TMDL provides additional discussion of the methodology.

The forest-normalized sediment load for the Upper Patuxent River watershed (estimated as 5.1) was calculated using CBP P5.2 2005 land use, to best represent current conditions. A comparison of the Upper Patuxent River watershed forest-normalized sediment load to the forest-normalized reference sediment load (also referred to as the sediment loading threshold) demonstrates that the watershed exceeds the sediment loading threshold, indicating that it is receiving loads that are above the maximum allowable load that it can sustain and still meet water quality standards.

Allocations

The future conditions of maximum allowable sediment loads that will be at a level to support aquatic life (TMDL scenario) is calculated as the product of the sediment loading threshold (determined from watersheds with a healthy biological community) and the Upper Patuxent River all-forested sediment load. Table 2 provides the watershed baseline and TMDL loads and percent reduction. These were averaged at the 8-digit watershed scale; some subbasins might require higher reductions than others.

Table 2. Baseline and TMDL loads and percent reduction

Baseline Load (ton/yr)	TMDL (ton/yr)	Percent reduction
66,421.1	56,607.1	14.8%

Source: MDE 2011.

Urban land, high-till crops, low-till crops, and hay were identified as the predominant controllable sources in the watershed. In addition, all urban land in the Upper Patuxent River watershed is considered to represent regulated stormwater sources (i.e., all urban stormwater is regulated via a permit).

Table 3 provides the baseline and wasteload allocation (WLA) for the regulated stormwater sediment load. In the accompanying technical memorandum related to significant point sources in the Upper Patuxent River watershed, a specific WLA is specified for the Prince George's County Phase I municipal separate storm sewer system (MS4) and the jurisdictional Phase II MS4 WLA is specified (Table 4). To determine these further breakdowns of the WLA by MS4, the Maryland Department of Planning (MDP) urban land use was applied to further refine the CBP P5.2 urban land use. The methodology associates MDP urban land use classifications with the different types of NPDES-regulated stormwater Phase I and II permits (MDE 2009).

Table 3. MS4 sediment baseline load, WLA, and percent reduction

Baseline Load (ton/yr)	WLA (ton/yr)	Percent reduction
9,102.0	8,064.6	11.4%

Source: MDE 2011.

Table 4. Specific WLAs for MS4s

	Baseline Load (ton/yr)	WLA (ton/yr)	Percent reduction
PGC Phase I MS4	1,680.7	1,489.2	11.4%
Phase II Jurisdictional MS4s	3,473.3	3,077.4	11.4%

Source: MDE 2011.

References

MDE (Maryland Department of the Environment). 2009. Memorandum: Maryland's Approach for Calculating Nutrient and Sediment Stormwater Wasteload Allocations in Local Nontidal Total Maximum Daily Loads and the Chesapeake Bay Total Maximum Daily Load.

MDE (Maryland Department of the Environment). 2011. Technical Memorandum: Significant Sediment Point Sources in the Patuxent River Upper Watershed. Document Version September 30, 2011.