UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
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Decision Rationale
Total Maximum Daily Loads
Anacostia River Basin Watershed
For Sediment/Total Suspended Solids
Montgomery and Prince George's Counties, Maryland
and the District of Columbia

Approved

Jon M. Capacasa, Director
Water Protection Division

Date:__________________

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Executive Summary

I. Introduction

The Clean Water Act requires that Total Maximum Daily Loads (TMDLs) be developed for those water bodies that will not attain water quality standards after application of technology-based and other required controls. A TMDL sets the quantity of a pollutant that may be introduced into a waterbody without causing an exceedence of the applicable water quality standard. EPA's regulations define a TMDL as the sum of the wasteload allocations (WLAs) assigned to point sources, the load allocations (LAs) assigned to nonpoint sources and natural background, and a margin of safety. The TMDL is commonly expressed as:

TMDL = WLAs + LAs + MOS

Where:

WLA = wasteload allocation
LA = load allocation
MOS = margin of safety

II. Summary

This document sets forth the United States Environmental Protection Agency's (EPA) rationale for approving the TMDLs for sediment and total suspended solids (TSS) in the tidal Anacostia River and its tributaries. The objectives of the sediment/TSS TMDLs are 1) to ensure that aquatic life is protected in the tidal and non-tidal waters of the Anacostia River; 2) to ensure that Maryland's and the District of Columbia's sediment-related water quality standards that support aquatic life are met in their respective portions of the watershed; and 3) to ensure in particular that the numeric criteria for water clarity are met in the tidal waters. The endpoint of the most restrictive the TMDL (the one that requires the most stringent reduction in sediment loads from the significant sources) is the District of Columbia's tidal Anacostia River water clarity criterion (0.8 meters). The spatial domain considered for the calculation of the TMDLs is the entire Anacostia River watershed that includes the waters of both Maryland and the District of Columbia. The TMDL addresses water clarity problems and associated impacts to aquatic life in the Anacostia caused by high sediment and TSS concentrations.

The allocations established in this TMDL were developed to attain and maintain the water quality standards related to sediment/TSS for the Anacostia River in both Maryland and the District. Due to 1) the District of Columbia Court of Appeals decision in Friends of the Earth, Inc (FOE) v. EPA TMDL must include daily loads, and 2) the fact that the applicable

Maryland and District water quality criteria for clarity are expressed in relation to growing season requirements, the allocations in this TMDL are expressed in terms of both daily loads and seasonal loads. The following tables summarize the allocations. The sediment TMDLs for both MD and DC tidal and non-tidal waters of the Anacostia are: 7097.6 tons/year annually (or 4302.65 tons/day maximum daily load) and 3396.1 tons/growing season for the growing season April 1 to October 31 (or 1632.27 tons/day maximum daily load). See the following tables for a summary of the annual, seasonal and daily loads. The loading caps constitute an 85% overall reduction of sediment/TSS from the baseline loads determined for the TMDL analysis period, 1995-1997 (46,906 tons/year and 22,312 tons/growing season). The TMDLs are distributed among: 1) waste load allocations (WLAs) to National Pollutant Discharge Elimination System (NPDES) municipal and industrial point source (PS) discharges, NPDES municipal separate storm sewers (MS4s) and other regulated stormwater (SW), and the District's combined sewer overflows (CSOs), and 2) load allocations (LAs) to forest and agricultural lands. The margin of safety was considered implicitly.

Summary of Annually-Based Maximum Daily Loads of Sediment/TSS for the Anacostia River Watershed (tons/day)

Non-Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max, avg)	MD Non-Tidal MS4-WLA	MD Non-Tidal Other PS-WLA	MD Non-Tidal LA	MOS	Non-Tidal TMDL (max, avg)
< 0.89	0.003, 0.002	0.505	0.349	0.0007	Implicit	0.858, 0.199
0.89 - 2.34	0.009, 0.003	2.581	0.349	0.016	Implicit	2.955, 0.381
2.34 - 3.48	0.020, 0.005	20.870	0.349	0.041	Implicit	21.28, 0.800
3.48 - 10.75	0.279, 0.013	44.617	0.349	0.459	Implicit	45.70, 3.016
> 10.75	19.23, 0.676	3828.51	0.349	244.45	Implicit	4092.54, 168.86

MD Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max, avg)	MD Tidal MS4-WLA	MD Tidal LA	MOS	TMDL to MD/DC Border (max, avg)
All	4092.54, 18.15	18.85	0.11	Implicit	4111.50, 18.95

Summary of Annually-Based Maximum Daily Loads of Sediment/TSS for the Anacostia River Watershed (cont'd.) (tons/day)

DC Tidal Upper Anacostia River

Non-Tidal Lower Beaverdam Creek

Flow Range (m^3/s)	Upstream (max, avg)	DC LBC MS4-WLA (max, avg)	DC LBC LA (max, avg)	MOS	Total TMDL (max, avg)
All	106.01, 1.324	0.0954, 0.0016	-, -	Implicit	106.105, 1.326

Non-Tidal Watts Branch

Flow Range (m^3/s)	Upstream (max, avg)	DC WB MS4-WLA (max, avg)	DC WB LA (max, avg)	MOS	Total TMDL (max, avg)
All	4.338, 0.1314	3.425, 0.1114	-, -	Implicit	7.763, 0.2428

DC Tidal Upper Anacostia

Flow Range (m^3/s)	Upstream (max, avg)	DC Upper Anacostia MS4-WLA (max, avg)	DC Upper Anacostia CSO-WLA (max, avg)	DC Upper Anacostia LA (max, avg)	MOS	TMDL to Upper / Lower Boundary (max, avg)
All	4111.50, 18.95	18.35, 0.78	84.61, 24.37	6.33, 0.28	Implicit	4220.79, 44.38

DC Tidal Lower Anacostia River

Flow Range (m^3/s)	Upstream (max, avg)	DC Lower Anacostia MS4-WLA (max, avg)	DC Lower Anacostia Other PS-WLA	DC Lower Anacostia CSO-WLA (max, avg)	DC Lower Anacostia LA (max, avg)	MOS	TOTAL TMDL (max, avg)
All	4220.79, 44.38	10.24, 0.43	0.0043	67.10, 25.85	4.52, 0.19	Implicit	4302.65, 70.85

Summary of Seasonally-Based Maximum Daily Loads of Sediment/TSS for the Anacostia River Watershed (tons/day during growing season)

Non-Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max, avg)	MD Non-Tidal MS4-WLA	MD Non-Tidal Other PS-WLA	MD Non-Tidal LA	MOS	Non-Tidal TMDL (max, avg)
< 0.89	0.003, 0.0023	0.500	0.302	0.0007	Implicit	0.806, 0.156
0.89 - 2.34	0.009, 0.0037	2.580	0.302	0.006	Implicit	2.897, 0.369
2.34 - 3.48	0.020, 0.0071	20.870	0.302	0.022	Implicit	21.21, 1.016
3.48 - 10.75	0.279, 0.0236	44.620	0.302	0.168	Implicit	45.37, 4.854
> 10.75	19.23, 1.0981	1393.24	0.302	9.500	Implicit	1422.27, 158.69

MD Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max, avg)	MD Tidal MS4-WLA	MD Tidal LA	MOS	TMDL to MD/DC Border (max, avg)
All	1422.27, 14.23	18.85	0.0005	Implicit	1441.12, 15.44

Summary of Seasonally-Based Maximum Daily Loads of Sediment/TSS for the Anacostia River Watershed (cont'd) (tons/day during growing season)

DC Tidal Upper Anacostia River

Non-Tidal Lower Beaverdam Creek

Flow Range (m^3/s)	Upstream (max, avg)	DC LBC MS4-WLA (max, avg)	DC LBC LA (max, avg)	MOS	Total TMDL (max, avg)
All	66.01, 1.403	0.0930, 0.0020	-, -	Implicit	66.10, 1.405

Non-Tidal Watts Branch

Flow Range (m^3/s)	Upstream (max, avg)	DC WB MS4-WLA (max, avg)	DC WB LA (max, avg)	MOS	Total TMDL (max, avg)
All	3.65, 0.1406	3.425, 0.1318	-, -	Implicit	7.075, 0.2724

DC Tidal Upper Anacostia

Flow Range (m^3/s)	Upstream (max, avg)	DC Upper Anacostia MS4-WLA (max, avg)	DC Upper Anacostia CSO-WLA (max, avg)	DC Upper Anacostia LA (max, avg)	MOS	TMDL to Upper / Lower Boundary (max, avg)
All	1441.12, 15.44	18.35, 1.18	84.61, 21.94	6.33, 0.41	Implicit	1550.41, 38.97

DC Tidal Lower Anacostia River

Flow Range (m^3/s)	Upstream (max, avg)	DC Lower Anacostia MS4-WLA (max, avg)	DC Lower Anacostia Other PS-WLA	DC Lower Anacostia CSO-WLA (max, avg)	DC Lower Anacostia LA (max, avg)	MOS	TOTAL TMDL (max, avg)
All	1550.41, 38.97	10.24, 0.66	0.0043	67.10, 25.85	4.52, 0.291	Implicit	1632.27, 65.77

Average Annual Sediment/TSS TMDLs for Anacostia River Watershed (tons/year)

MD Non-Tidal Anacostia

Upstream Load from DC	MD Non-Tidal WLA	MD Non-Tidal LA	MOS	MD Non-Tidal TMDL
27.0[1]	6355.8	246.8	Implicit	6629.6

MD Tidal Anacostia

Upstream Load	MD Tidal WLA	MD Tidal LA	MOS	MD Tidal TMDL (does not include non-tidal loads from Watts Br & LBC)
6117.4[2]	86.4	0	Implicit	6203.8

DC Tidal Upper Anacostia

Upstream Load (all MD loads including Watts Br & LBC)	DC Upper Anacostia MS4 WLA	DC Upper Anacostia CSO WLA	DC Upper Anacostia LA	MOS	DC Tidal Upper TMDL
6716.0[3]	109.4[4]	83.9	29.8	Implicit	6938.9

DC Tidal Lower Anacostia

Upstream Load	DC Lower Anacostia MS4 WLA	DC Lower Anacostia CSO WLA	DC PS WLA	DC Lower Anacostia LA	MOS	TOTAL TMDL
6938.9	46.4	90.8	0.5	20.7	Implicit	7097.4

[1]This load drains to MD waters from DC's portion of the NWB subwatershed

[2]Does not include MD non-tidal loads from Watts Branch (28.5) and Lower Beaverdam Creek (483.7). Since these drain to DC tidal waters, they are included in the upstream load to the DC Tidal Upper Anacostia.

[3]Upstream load comprises all MD tidal and non-tidal loads, including MD loads from Watts Branch (28.5) and LBC (483.7).

[4]Includes loads from DC non-tidal waters in Watts Branch (24.1) and LBC (0.6)

Growing Season Sediment/TSS TMDLs for Anacostia River Watershed (tons/season)

MD Non-Tidal Anacostia

Upstream Load from DC	MD Non-Tidal WLA	MD Non-Tidal LA	MOS	MD Non-Tidal TMDL
20.7[1]	3005.8	25.1	Implicit	3051.6

MD Tidal Anacostia

Upstream Load	MD Tidal WLA	MD Tidal LA	MOS	MD Tidal TMDL (does not include non-tidal loads from Watts Br & LBC)
2734.8[2]	62.0	0	Implicit	2796.8

DC Tidal Upper Anacostia

Upstream Load (includes all MD loads from Watts Br & LBC)	DC Upper Anacostia MS4 WLA	DC Upper Anacostia CSO WLA	DC Upper Anacostia LA	MOS	DC Tidal Upper TMDL
3113.5[3]	76.3[4]	61.7	20.9	Implicit	3272.5

DC Tidal Lower Anacostia

Upstream Load	DC Lower Anacostia MS4 WLA	DC Lower Anacostia CSO WLA	DC PS WLA	DC Lower Anacostia LA	MOS	TOTAL TMDL
3272.5	33.6	74.6	.3	14.9	Implicit	3395.8

[1]This load drains to MD waters from DC's portion of the NWB subwatershed

[2]Does not include MD non-tidal loads from Watts Branch (16.5) and Lower Beaverdam Creek (300.2). Since these drain to DC tidal waters, they are included in the upstream load to the DC Tidal Upper Anacostia.

[3]Upstream load comprises all MD tidal and non-tidal loads, including MD loads from Watts Branch (16.5) and LBC (300.2).

[4]Includes loads from DC non-tidal waters in Watts Branch (15.5) and LBC (0.4)

III. Background

A TMDL for total suspended solids was established for the District's portion of the Anacostia River by EPA in March 2002. The modeling structure that served as the foundation for this TMDL included only the DC portion of the Anacostia River drainage area. Allocations were established for the various sources within the District and a gross allocation was assigned to Maryland at the state boundary. These allocations were established as seasonal and annual loads. Following the establishment of this TMDL, an appeal was filed in the District of Columbia Court of Appeals by Friends of the Earth, contending, among other things, that the Clean Water Act requires TMDLs to be expressed in terms of a daily load and that this TSS TMDL failed to include daily allocations. The Court of Appeals agreed and remanded the TMDLs (and a biochemical oxygen demand (BOD) TMDL similarly developed) to the District Court with instructions to vacate. However, the Court of Appeals said the parties may move the District for a stay of vacature to allow time for replacement TMDLs to be developed. The District Court has stayed vacature of the TSS TMDL until July 15, 2007. The BOD TMDL revision is scheduled for completion by June 2008.

While EPA was litigating the TSS TMDL for the District portion of the Anacostia River, Maryland was beginning to develop a model for the Maryland portion of the Anacostia River in order to establish sediment TMDLs for Maryland's portion of the Anacostia River. The portion of the drainage area of the Anacostia River in Maryland is about 80% of the entire drainage, with the remaining 20% in the District. This TMDL was to be completed on the same basic time frame as that established for the District's revision to its TSS TMDL.

Following discussions between EPA, Maryland and the District, it was agreed that the most logical approach would be to complete a watershed-based TSS/sediment TMDL for the entire Anacostia River watershed. Although the decision of the District of Columbia Circuit did not include any TSS TMDL in Maryland's portion of the Anacostia River, Maryland recognized the importance of uniformity with respect to the way the TMDL's allocations are expressed and agreed to join EPA and the District in completing a watershed-based TSS/sediment TMDL for the Anacostia River with daily loads. This approach would allow all loading sources (point and nonpoint sources) in both jurisdictions to be considered in the allocations process instead of allocating a gross load to Maryland at the state line. A joint approach would also make sense in terms of the allocation process since Maryland's sediment TMDL would be designed to meet the District's water quality standards at the border and throughout the District's waters. Further, the District would not have to assess an allocation to Maryland without Maryland's input. It was also expected that cooperation in developing the joint TMDLs would assist in the mplementation of the final TMDLs.

The plan called for the revised TSS TMDLs (and the new sediment TMDL in Maryland's portion of the Anacostia River) to be completed jointly by the two jurisdictions and submitted to EPA for review and approval. An advisory group was established that included the District, Maryland, EPA Region III, EPA Headquarters, the Commission on the Potomac River Basin (ICPRB) and Washington Area Sewer Authority (WASA). Under the agreement, much of the technical work, such as the model development and allocation model runs, would be completed by ICPRB under contract with Maryland. In addition, EPA would provide support by contracting with LimnoTech, a consulting engineering firm that would assist in the development of the technical approach for establishing daily loads.

The Anacostia River watershed covers 176 square miles in the District of Columbia (DC) and Maryland. The watershed is highly urbanized, with a population of 804,500 and a population density of 4,570 per square mile in 1990[1]. Only 25 percent of the watershed is forested and another three percent is wetlands. The watershed includes highly urbanized areas in DC, old and newly developing suburban areas in the surrounding areas, including Maryland. Croplands and pastures are located in the upper reaches of the watershed.

The Anacostia River is formed by the confluence of the Northeast Branch and the Northwest Branch at Bladensburg, MD. The length of the tidal portion of the Anacostia River is 8.4 miles. The average tidal variation in water surface elevation is 2.9 feet all along the tidal river. The average depth at Bladensburg is six feet, while the average depth at the Anacostia River's confluence with the Potomac River is 20 feet. The average width of the river increases from 375 feet at Bladensburg to 1,300 feet at the mouth. Only 17 percent of the watershed lies within the District. Much of the drainage within the District is controlled by storm sewers or combined (storm and sanitary) sewers.

CSOs in the District contribute sediment to the tidal portion of the river. CSOs drain approximately 11 square miles of the Basin in the District of Columbia, and 17 CSO outfalls drain directly into the tidal Anacostia River.

In addition to the combined sewer system in the District, municipal separate stormwater systems (MS4) in both the District and Prince George's and Montgomery Counties in Maryland discharge to the Anacostia River and its major tributaries. Each MS4 system has a national pollutant discharge elimination system (NPDES) permit.

As the Anacostia River watershed is heavily urbanized, it has water quality problems associated with urban streams. The District and Maryland are also signatories to the Chesapeake Bay Agreement, whose goal is to address the sediment-related problems in the Chesapeake Bay and the tidal portions of its tributaries by the year 2010.

IV. History and use of the Tidal Anacostia Model/Water Quality Simulation Program (TAM/WASP)

The models used for the sediment/TSS TMDLs are upgraded versions of those used in previous studies of the Anacostia River watershed. These most recent versions take advantage of an extensive new set of Northeast Branch and Northwest Branch automated sampler data collected by the U.S. Geological Survey (USGS) in 2003 and 2004, with funding from MDE and Prince George's County. The previous version of the TAM/WASP sediment transport model, Version 2, was used by the U.S. Environmental Protection Agency (USEPA) Region 3 to compute TMDL allocations for sediment for the Anacostia (USEPA, 2002a). Version 2 of the

[1]Warner, A., D. Shepp, K. Corish, and J. Galli, 1997, *An Existing Source Assessment of Pollutants to the Anacostia Watershed.* Metropolitan Washington Council of Governments, Washington, DC.

TAM/WASP water clarity model (consisting of the sediment transport model coupled to the eutrophication model) was used by the DC Department of Health (DCDOH) in its draft TMDL for sediment in the Anacostia River (DCDOH, 2002). The previous version of the Anacostia HSPF model, Phase 2 (Mandel *et al.*, 2003), was constructed for MDE to estimate sediment loads to the tidal river from the Northeast Branch and Northwest Branch tributaries.

Maryland's non-tidal tributary flows were estimated using the HSPF[2] model to provide input to the TAM/WASP model.

V. Discussions of Regulatory Requirements

EPA has determined that these TMDLs are consistent with statutory and regulatory requirements and EPA policy and guidance. Based on this review, EPA determined that the following seven regulatory requirements have been met:

1. The TMDLs are designed to implement the 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. The TMDLs have been subject to public participation.

In addition, EPA considered whether there was reasonable assurance that the Load Allocations for the nonpoint sources in the TMDLs would be met.

VI. Implementation

Neither the Clean Water Act nor the EPA implementing regulations, guidance or policy requires a TMDL to include an implementation plan. However, several activities are taking place or are planned that will begin the Anacostia River watershed TSS/sediment TMDL implementation process. These activities were described in the TMDL report and are summarized here. Further, the District and Maryland understand the importance of coordinating the implementation activities for the watershed. In a series of e-mails between the District and Maryland, there was agreement that the two jurisdictions would meet subsequent to the approval of the TMDL to discuss implementation issues. These discussions would include state staff responsible for permitting as well as counties and most likely the soil conservation districts.

EPA regulations require that effluent limits in any National Pollutant Discharge Elimination System (NPDES) permit that is issued, reissued or modified be consistent with the

[2]Hydrologic Simulation Program - Fortran

assumptions and requirements of any available wasteload allocation for that discharge in an approved TMDL. This TMDL provides wasteload allocations for all permitted sources discharging to the Anacostia River, including the MS4 areas. Therefore, it is expected that the TMDL will be implemented under the NPDES program for all permitted discharges.

The District of Columbia Water and Sewer Authority (WASA) have established a Long Term Control Plan (LTCP) for the reduction of CSOs and the sediment loads associated with them. Under its MS4 NPDES permit, DC is implementing a stormwater management plan to control the discharge of pollutants from separate storm sewer outfalls. The MS4 permit requires the implementation of available waste load allocations. It is expected that the MD MS4 permits will also include requirements that fully consider the wasteload allocation requirements of this TMDL.

For the sources that are not permitted, the District is implementing a nonpoint source management plan through its Nonpoint Source management and Chesapeake Bay Implementation programs. Maryland and the District have several well-established programs to draw upon including, 1) the Water quality Improvement Act of 1998 (WQIA) in Maryland, 2) the Erosion and Sedimentation Control Amendment Act of 1994 and the District’s Law 5-188 (Storm Water Management Regulations – 1988) of the District of Columbia Water Pollution Control Act of 1984 in DC, and 3) the Federal Nonpoint Source Management Program (Section 319 of the Clean Water Act).

In order to control pollutant runoff from new construction, the Maryland Department of the Environment (MDE) requires an 80% reduction of sediments for new development. Additionally, for existing development, MDE’s NPDES stormwater permits require watershed assessments and restoration based on impervious surface area. Currently, Prince George’s and Montgomery Counties are required to restore 10% of their impervious areas. MDE conducts periodic reviews of local programs to ensure that implementation is acceptable and has the authority to suspend delegation and take over any program that does not meet State standards. There is also an active coalition of local, state, and federal agencies, environmental organizations and citizens groups working together to restore the river and its tributaries; this coalition can help to ensure the implementation of the sediment TMDLs. In 1987, the Anacostia Watershed Restoration Agreement was signed by Maryland, the District of Columbia, and Montgomery and Prince George’s Counties, resulting in the formation of the Anacostia Watershed Restoration Committee. Several sediment reduction strategies have been implemented and are ongoing under this agreement.

Decision Rationale
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Montgomery and Prince George's Counties, Maryland
and The District of Columbia

Decision Rationale

I. Introduction

The Clean Water Act (CWA) requires that Total Maximum Daily Loads (TMDLs) be developed for those waterbodies that will not attain water quality standards after application of technology-based and other required controls. A TMDL sets the quantity of a pollutant that may be introduced into a waterbody without causing an exceedance of the applicable water quality standard. EPA's regulations define a TMDL as the sum of the wasteload allocations (WLAs) assigned to point sources, the load allocations (LAs) assigned to nonpoint sources and natural background, and a margin of safety.

A TMDL is a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standards. A 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. TMDLs may be revised in order to address new water quality data, better understanding of natural processes, refined modeling assumptions or analysis and/or reallocation.

This document sets forth the United States Environmental Protection Agency's (EPA) rationale for approving the TMDLs for sediment/total suspended solids (TSS) in the tidal main stem Anacostia River in the District of Columbia and Maryland, and its non-tidal tributaries located in Maryland. These TMDLs were established to address impairment of water quality as identified in the District of Columbia's (DC or the District) 1998 Section 303(d) list of impaired waters and Maryland's 1996 Section 303(d) list of impaired waters. The District of Columbia Department of the Environment Water Quality Division and the Maryland Department of the Environment jointly submitted the *Total Maximum Daily Loads for Sediment/Total Suspended Solids for the Anacostia River Basin, Montgomery and Prince George's Counties, Maryland, and the District of Columbia*, dated June 2007 (TMDL Report), to EPA for final review by letter (a separate letter was included by the District and Maryland) dated June 22, 2007, which was received by EPA on June 25, 2007. The TMDL Report includes two Technical Memoranda, *Significant Sediment Point Sources in the Anacostia River Watershed* and *Significant Sediment/TSS Nonpoint Sources in the Anacostia Watershed*, and uses as its technical basis the draft report, *Anacostia Sediment Models: Phase 3 Anacostia HSPF Watershed Model and Version 3 TAM/WASP Water Clarity Model,* dated March 2007.

The TMDL report as submitted by the District of Columbia (the District or DC) and Maryland (MD) establishes TMDLs for sediment that: 1) are protective of aquatic life in the tidal and non-tidal waters of the Anacostia; 2) meet Maryland's and the District's sediment-related water quality standards in their respective portions of the river; and 3) specifically meet the numeric criteria for water clarity (a secchi depth of 0.8 meters averaged over the growing season) in the tidal waters.

Based on this review, EPA determined that the following seven regulatory requirements have been met:

1. The TMDLs are designed to implement the 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. The TMDLs have been subject to public participation.

In addition, EPA considered whether there was reasonable assurance that the Load Allocations for the nonpoint sources in the TMDLs would be met.

II. Impairments Identified by the District and Maryland

Table 1 presents the1998 Section 303(d) listing information for the water quality-limited waters of the Anacostia River and tributaries.

Table 1 - Section 303(d) Listing Information

Year Listed	Waterbody	Segment Number/ Basin Code	Pollutant of Concern	Source	Priority
District of Columbia					
1998	Lower Anacostia (below Pennsylvania Ave. Bridge)	1	BOD, Bacteria Organics, Metals, Total Suspended Solids, and oil & grease	CSO point and non-point pollution	High
1998	Upper Anacostia (above Pennsylvania Ave. Bridge	2	BOD, Bacteria Organics, Metals, Total Suspended Solids, and oil & grease	CSO point and non-point pollution	High
Maryland					
1996	Anacostia River Tidal	02140205	Sediments, nutrients, BOD	Non-point pollution, natural	Low
1996	Anacostia River Non-tidal	02140205	Sediments, nutrients, BOD	Non-point pollution, natural	Low
2002	Anacostia River	02140205	Bacteria	Point, non-	Medium,

	Non-tidal			point pollution, natural	
2002	Anacostia River Non-tidal	02140205	Toxics – PCBs, heptachlor epoxide	Unknown	Low
2002	Anacostia River Non-tidal Tributaries	02140205	Biological	Unknown	Low
2004	Anacostia River Tidal	02140205	Bacteria	Point, non-point pollution, natural	Medium,

CSO - combined sewer outfall

Although in some cases it may be efficient to address all of the identified impairments in a particular water body at the same time in a single TMDL, it is not a requirement of the Clean Water Act or EPA's regulations for TMDLs to be established that way. In this particular case, the TMDLs submitted by the District and Maryland were developed to address two issues; 1) the TSS (the District) and sediment (Maryland) impairments of aquatic life uses as identified in the section 303(d) list of impaired waters and 2) consistency with the 2006 holding of the DC Circuit Court of Appeals in Friends of the Earth v. EPA that TMDLs be expressed as daily loads. While impairment of other beneficial water uses such as primary recreation (swimming) and secondary (boating) contact recreation was neither the focus of the listed impairment nor the goal for these TMDLs, Maryland and the District note in their joint response to comments that "85% reductions of sediment loads…in the TMDL will significantly improve the water quality and make the river certainly more desirable for other uses such as primary and secondary contact recreation." The states also add that if after implementation of these TMDLs, those uses are impaired, additional measures, including possible development of additional or revised TMDLs would be undertaken.

EPA agrees that the impairment identified by both Maryland and the District on their respective section 303(d) lists of impaired waters was related to aquatic life use. EPA finds that these TMDLs designed to restore and maintain the aquatic life uses in their respective waters are in accordance with the Clean Water Act's Section 303(d) requirements to resolve the listed impairment and achieve the applicable water quality standards. EPA also agrees that the TMDLs, once implemented, will profoundly improve the water quality of the Anacostia River. Finally EPA also finds that the District's and Maryland's conclusion that the improvement of water quality after implementation of these TMDLs will substantially improve, if not achieve aesthetic, primary and secondary recreation water uses is a reasonable conclusion. EPA agrees with the plan of Maryland and the District to perform post-TMDL monitoring and take additional steps, as necessary, to address any additional concerns.

As discussed below the criteria used as the end points for the TMDLs are the secchi depth, or water clarity, criteria adopted by Maryland and the District, respectively. This criterion was developed for aquatic life protection. The District has a turbidity standard of 20 NTU above background but has explained that this criterion is designed to protect water quality from short-term localized impairment such as construction and/or dredging activities. The water clarity criteria, by contrast, was adopted specifically to attain and maintain the specific aquatic life use for the Anacostia River. EPA finds it appropriate that the District and Maryland have used the water clarity criteria as the applicable water quality standard for these TMDLs and not the turbidity criterion. In any case, in response to comments, the District and Maryland included an EPA analysis of the relationship between turbidity and secchi depth (see Figure 1 below) that shows that turbidity will remain under 20 NTU on a long-term basis if the secchi depth remains at or above the criteria of 0.8 meters.

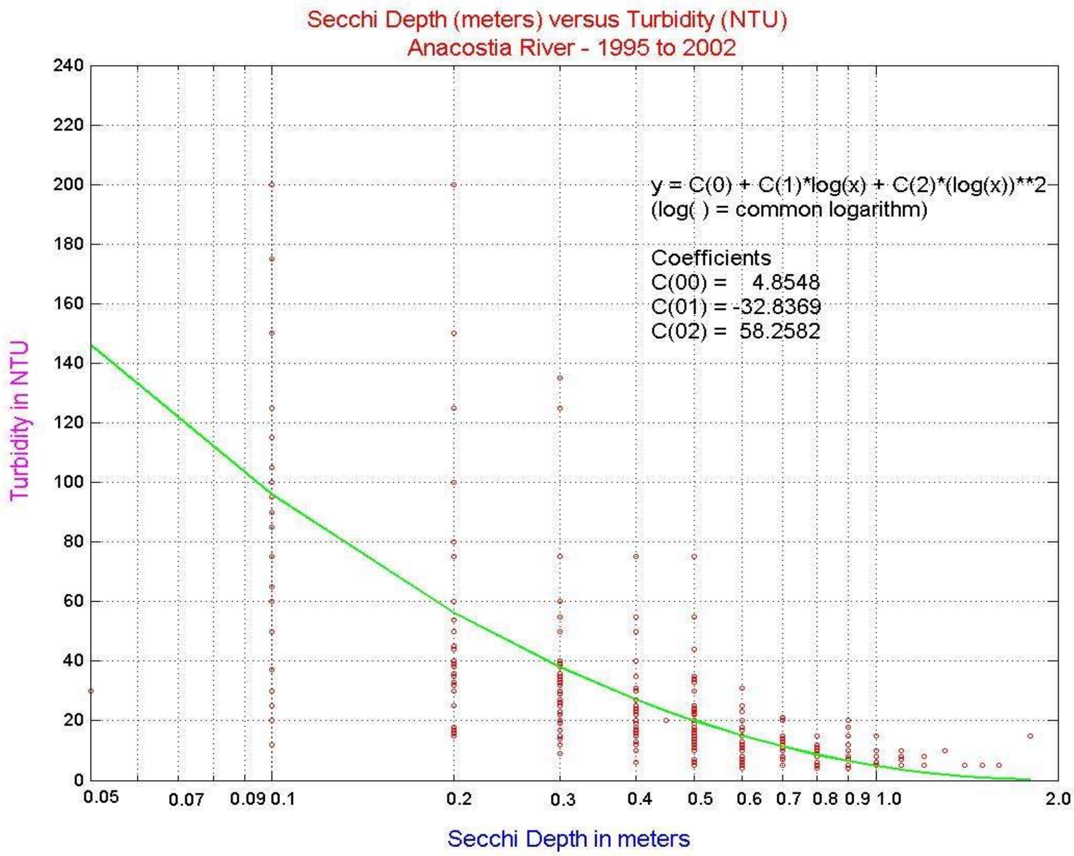

Figure 1 – Secchi Depth v Turbidity in the Anacostia River

III. Allocation Summary

TMDLs are established at a level necessary to attain and maintain existing applicable water quality standards. The sediment loadings allocations in these TMDLs were developed to assure that all applicable water quality standards related to aquatic life use would be attained and maintained. For these specific TMDLs, Maryland and the District determined that the applicable water quality is the secchi depth criteria in the District, i.e., meeting this criterion resulted in the most stringent load allocations. While Maryland's aquatic life use secchi depth criterion is 0.4 meters the more stringent DC criterion was used to determine the TMDLs allocations in order to assure that the aquatic life use would be attained and maintained throughout the entire Anacostia River.

As noted above this criterion is 0.8 meters as an average for each growing season (April through October). Therefore the goal of the TMDL analysis was to assure that the total loadings during this period would meet the seasonal average criterion. The water quality model used to develop the TMDL provides source loading output on a daily basis. These daily loads, when considered as an average over the growing season, are shown to meet the District's seasonal water clarity criterion. Because of the variability of storm loads, some daily loads during the dry weather conditions may be close to, if not, zero, while at other times, during extreme wet weather, the loadings will be quit high. On a daily basis these variable loads may exceed loadings necessary to achieve a certain secchi depth measurement for that day. However, the applicable criterion is not applied on a daily basis but rather on a seasonal basis. Therefore, potential periodic daily high excursions of the water clarity criteria are not relevant to determining whether the TMDLs allocations are set at a level necessary to implement the applicable water quality standards expressed as a seasonal average.

Tables 2, 3, 4 and 5 below summarize the allocations developed in this TMDL. In addition to the daily loads, the allocations are presented as annual loads and seasonal loads. Seasonal loads are presented since the secchi depth criterion is expressed as a growing season criterion. Maryland's allocations are based on meeting the District's applicable water quality standards. In addition to the following summary tables, technical memoranda were included with the TMDL that contain more specific allocations by source. These allocations are part of the TMDL and will be discussed in a later section of this Decision Rationale .

Figure 2: Annually-based Maximum Daily Loads for Sediment/TSS for the Anacostia River

Summary of Annually-Based Maximum Daily Loads of Sediment/TSS for the Anacostia River Watershed (tons/day)

Non-Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max, avg)	MD Non-Tidal MS4-WLA	MD Non-Tidal Other PS-WLA	MD Non-Tidal LA	MOS	Non-Tidal TMDL (max, avg)
< 0.89	0.003, 0.002	0.505	0.349	0.0007	Implicit	0.858, 0.199
0.89 - 2.34	0.009, 0.003	2.581	0.349	0.016	Implicit	2.955, 0.381
2.34 - 3.48	0.020, 0.005	20.870	0.349	0.041	Implicit	21.28, 0.800
3.48 - 10.75	0.279, 0.013	44.617	0.349	0.459	Implicit	45.70, 3.016
> 10.75	19.23, 0.676	3828.51	0.349	244.45	Implicit	4092.54, 168.86

MD Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max, avg)	MD Tidal MS4-WLA	MD Tidal LA	MOS	TMDL to MD/DC Border (max, avg)
All	4092.54, 18.15	18.85	0.11	Implicit	4111.50, 18.95

Summary of Annually-Based Maximum Daily Loads of Sediment/TSS for the Anacostia River Watershed (cont'd.) (tons/day)

DC Tidal Upper Anacostia River

Non-Tidal Lower Beaverdam Creek

Flow Range (m^3/s)	Upstream (max, avg)	DC LBC MS4-WLA (max, avg)	DC LBC LA (max, avg)	MOS	Total TMDL (max, avg)
All	106.01, 1.324	0.0954, 0.0016	-, -	Implicit	106.105, 1.326

Non-Tidal Watts Branch

Flow Range (m^3/s)	Upstream (max, avg)	DC WB MS4-WLA (max, avg)	DC WB LA (max, avg)	MOS	Total TMDL (max, avg)
All	4.338, 0.1314	3.425, 0.1114	-, -	Implicit	7.763, 0.2428

DC Tidal Upper Anacostia

Flow Range (m^3/s)	Upstream (max, avg)	DC Upper Anacostia MS4-WLA (max, avg)	DC Upper Anacostia CSO-WLA (max, avg)	DC Upper Anacostia LA (max, avg)	MOS	TMDL to Upper / Lower Boundary (max, avg)
All	4111.50, 18.95	18.35, 0.78	84.61, 24.37	6.33, 0.28	Implicit	4220.79, 44.38

DC Tidal Lower Anacostia River

Flow Range (m^3/s)	Upstream (max, avg)	DC Lower Anacostia MS4-WLA (max, avg)	DC Lower Anacostia Other PS-WLA	DC Lower Anacostia CSO-WLA (max, avg)	DC Lower Anacostia LA (max, avg)	MOS	TOTAL TMDL (max, avg)
All	4220.79, 44.38	10.24, 0.43	0.0043	67.10, 25.85	4.52, 0.19	Implicit	4302.65, 70.85

Figure 3: Seasonally-based Maximum Daily Loads for Sediment/TSS for the Anacostia River

Summary of Seasonally-Based Maximum Daily Loads of Sediment/TSS for the Anacostia River Watershed (tons/day during growing season)

Non-Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max, avg)	MD Non-Tidal MS4-WLA	MD Non-Tidal Other PS-WLA	MD Non-Tidal LA	MOS	Non-Tidal TMDL (max, avg)
< 0.89	0.003, 0.0023	0.500	0.302	0.0007	Implicit	0.806, 0.156
0.89 - 2.34	0.009, 0.0037	2.580	0.302	0.006	Implicit	2.897, 0.369
2.34 - 3.48	0.020, 0.0071	20.870	0.302	0.022	Implicit	21.21, 1.016
3.48 - 10.75	0.279, 0.0236	44.620	0.302	0.168	Implicit	45.37, 4.854
> 10.75	19.23, 1.0981	1393.24	0.302	9.500	Implicit	1422.27, 158.69

MD Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max, avg)	MD Tidal MS4-WLA	MD Tidal LA	MOS	TMDL to MD/DC Border (max, avg)
All	1422.27, 14.23	18.85	0.0005	Implicit	1441.12, 15.44

Summary of Seasonally-Based Maximum Daily Loads of Sediment/TSS for the Anacostia River Watershed (cont'd) (tons/day during growing season)

DC Tidal Upper Anacostia River

Non-Tidal Lower Beaverdam Creek

Flow Range (m^3/s)	Upstream (max, avg)	DC LBC MS4-WLA (max, avg)	DC LBC LA (max, avg)	MOS	Total TMDL (max, avg)
All	66.01, 1.403	0.0930, 0.0020	-, -	Implicit	66.10, 1.405

Non-Tidal Watts Branch

Flow Range (m^3/s)	Upstream (max, avg)	DC WB MS4-WLA (max, avg)	DC WB LA (max, avg)	MOS	Total TMDL (max, avg)
All	3.65, 0.1406	3.425, 0.1318	-, -	Implicit	7.075, 0.2724

DC Tidal Upper Anacostia

Flow Range (m^3/s)	Upstream (max, avg)	DC Upper Anacostia MS4-WLA (max, avg)	DC Upper Anacostia CSO-WLA (max, avg)	DC Upper Anacostia LA (max, avg)	MOS	TMDL to Upper / Lower Boundary (max, avg)
All	1441.12, 15.44	18.35, 1.18	84.61, 21.94	6.33, 0.41	Implicit	1550.41, 38.97

DC Tidal Lower Anacostia River

Flow Range (m^3/s)	Upstream (max, avg)	DC Lower Anacostia MS4-WLA (max, avg)	DC Lower Anacostia Other PS-WLA	DC Lower Anacostia CSO-WLA (max, avg)	DC Lower Anacostia LA (max, avg)	MOS	TOTAL TMDL (max, avg)
All	1550.41, 38.97	10.24, 0.66	0.0043	67.10, 25.85	4.52, 0.291	Implicit	1632.27, 65.77

Table 4: Average Annual Sediment/TSS TMDL for the Anacostia River

Average Annual Sediment/TSS TMDLs for Anacostia River Watershed (tons/year)

MD Non-Tidal Anacostia

Upstream Load from DC	MD Non-Tidal WLA	MD Non-Tidal LA	MOS	MD Non-Tidal TMDL
27.0[1]	6355.8	246.8	Implicit	6629.6

MD Tidal Anacostia

Upstream Load	MD Tidal WLA	MD Tidal LA	MOS	MD Tidal TMDL (does not include non-tidal loads from Watts Br & LBC)
6117.4[2]	86.4	0	Implicit	6203.8

DC Tidal Upper Anacostia

Upstream Load (all MD loads including Watts Br & LBC)	DC Upper Anacostia MS4 WLA	DC Upper Anacostia CSO WLA	DC Upper Anacostia LA	MOS	DC Tidal Upper TMDL
6716.0[3]	109.4[4]	83.9	29.8	Implicit	6938.9

DC Tidal Lower Anacostia

Upstream Load	DC Lower Anacostia MS4 WLA	DC Lower Anacostia CSO WLA	DC PS WLA	DC Lower Anacostia LA	MOS	TOTAL TMDL
6938.9	46.4	90.8	0.5	20.7	Implicit	7097.4

[1]This load drains to MD waters from DC's portion of the NWB subwatershed

[2]Does not include MD non-tidal loads from Watts Branch (28.5) and Lower Beaverdam Creek (483.7). Since these drain to DC tidal waters, they are included in the upstream load to the DC Tidal Upper Anacostia.

[3]Upstream load comprises all MD tidal and non-tidal loads, including MD loads from Watts Branch (28.5) and LBC (483.7).

[4]Includes loads from DC non-tidal waters in Watts Branch (24.1) and LBC (0.6)

Table 5: Growing Season Sediment/TSS TMDLs for the Anacostia River

Growing Season Sediment/TSS TMDLs for Anacostia River Watershed (tons/season)

MD Non-Tidal Anacostia

Upstream Load from DC	MD Non-Tidal WLA	MD Non-Tidal LA	MOS	MD Non-Tidal TMDL
20.7[1]	3005.8	25.1	Implicit	3051.6

MD Tidal Anacostia

Upstream Load	MD Tidal WLA	MD Tidal LA	MOS	MD Tidal TMDL (does not include non-tidal loads from Watts Br & LBC)
2734.8[2]	62.0	0	Implicit	2796.8

DC Tidal Upper Anacostia

Upstream Load (includes all MD loads from Watts Br & LBC)	DC Upper Anacostia MS4 WLA	DC Upper Anacostia CSO WLA	DC Upper Anacostia LA	MOS	DC Tidal Upper TMDL
3113.5[3]	76.3[4]	61.7	20.9	Implicit	3272.5

DC Tidal Lower Anacostia

Upstream Load	DC Lower Anacostia MS4 WLA	DC Lower Anacostia CSO WLA	DC PS WLA	DC Lower Anacostia LA	MOS	TOTAL TMDL
3272.5	33.6	74.6	.3	14.9	Implicit	3395.8

[1]This load drains to MD waters from DC's portion of the NWB subwatershed

[2]Does not include MD non-tidal loads from Watts Branch (16.5) and Lower Beaverdam Creek (300.2). Since these drain to DC tidal waters, they are included in the upstream load to the DC Tidal Upper Anacostia.

[3]Upstream load comprises all MD tidal and non-tidal loads, including MD loads from Watts Branch (16.5) and LBC (300.2).

[4]Includes loads from DC non-tidal waters in Watts Branch (15.5) and LBC (0.4)

IV. Background

Reasons for these Revised TMDLs

On April 25, 2006, the United States Court of Appeals for the District of Columbia Circuit remanded the TSS TMDLs established by EPA in March 2002 for that portion of the Anacostia River within the District to the District court with instructions to vacate. In doing so, the court recognized that neither Friends of the Earth (FOE) nor EPA wanted the Anacostia River to be without TSS TMDLs. The appeals court acknowledged that the district court retains some remedial discretion and said that the FOE and EPA may move to stay the district court's vacature order on remand to give the District of Columbia a reasonable opportunity to establish daily load limits for these TMDLs or EPA a chance to amend its regulation concerning pollutants that are appropriate for TMDL development. The FOE and EPA did request that the existing TMDL not be vacated and negotiated a stay of vacature of the TSS TMDLs until July 15, 2007, which the District Court approved.

Watershed Approach

While EPA was developing and defending the court challenge to the TSS TMDL for the District's portion of the Anacostia River, Maryland was beginning to develop a model in order to establish sediment TMDLs for the Maryland portion of the Anacostia River. The portion of the drainage area of the Anacostia River in Maryland is about 80% of the entire drainage area, with the remaining 20% in the District. Understanding the importance for a uniform approach to establishing TMDLs for the Anacostia river watershed and in the spirit of cooperation, Maryland has collaborated with the District of Columbia and EPA to develop a technical approach to express the average annual and seasonal TMDLs in "daily" terms for both the non-tidal and tidal portions of the Anacostia River that are designated as impaired for sediment and TSS on Maryland's and the District of Columbia's 303(d) lists.

Anacostia River Watershed

The Anacostia River watershed covers 176 square miles in the District of Columbia and Maryland.[1] The watershed lies in two physiographic provinces, the Atlantic Coastal Plain and the Piedmont. The division between the provinces lies roughly along the boundary between Prince George County and Montgomery County, both located in Maryland. The Basin is highly urbanized, with a population of 804,500 and a population density of 4,570 per square mile in 1990[2]. Only 25 percent of the watershed is forested and another three percent is wetlands. The Anacostia River is formed by the confluence of two branches, the Northeast Branch and the Northwest Branch at Bladensburg, MD. For all practical purposes the tidal portion of the Anacostia River can be considered to begin at their confluence, although the Northeast and Northwest Branches are tidally-influenced up to the location of the United States Geological

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[1]Much of the background information is taken from ICPRB, 2000.

[2]Warner, A., D. Shepp, K. Corish, and J. Galli, *An Existing Source Assessment of Pollutants to the Anacostia Watershed.* Metropolitan Washington Council of Governments (MWCOG), Washington, DC., 1997.

Survey gages on each branch: Station 01649500 at Riverdale Road on the Northeast Branch and Station 01651000 at Queens Chapel Road on the Northwest Branch.

The length of the tidal portion of the Anacostia River is 8.4 miles. The average tidal variation in water surface elevation is 2.9 feet all along the tidal river. The average depth at Bladensburg is 6 feet, while the average depth at the Anacostia's confluence with the Potomac River is 20 feet. The average width of the river increases from 375 feet at Bladensburg to 1,300 feet at the mouth. Average discharge to the tidal river from the Northeast and Northwest Branches is 133 cubic feet per second (cfs). Under average flow conditions, the mean volume of the tidal river is approximately 415 million cubic feet. Detention time in the tidal Anacostia under average conditions is thus over 36 days and longer detention times can be expected under low-flow conditions in summer months.

Just over 25 percent of the Anacostia Basin drains into the tidal river below the confluence of the Northwest and Northeast Branches. Much of this drainage is controlled by storm sewers or combined (storm and sanitary) sewers. The two largest tributaries are Lower Beaverdam Creek (15.7 sq. mi.) and the Watts Branch (3.8 sq. mi.). Table 3 shows the breakdown of land uses in the drainage areas of the Northwest Branch, the Northeast Branch, Lower Beaverdam Creek, and the Watts Branch.

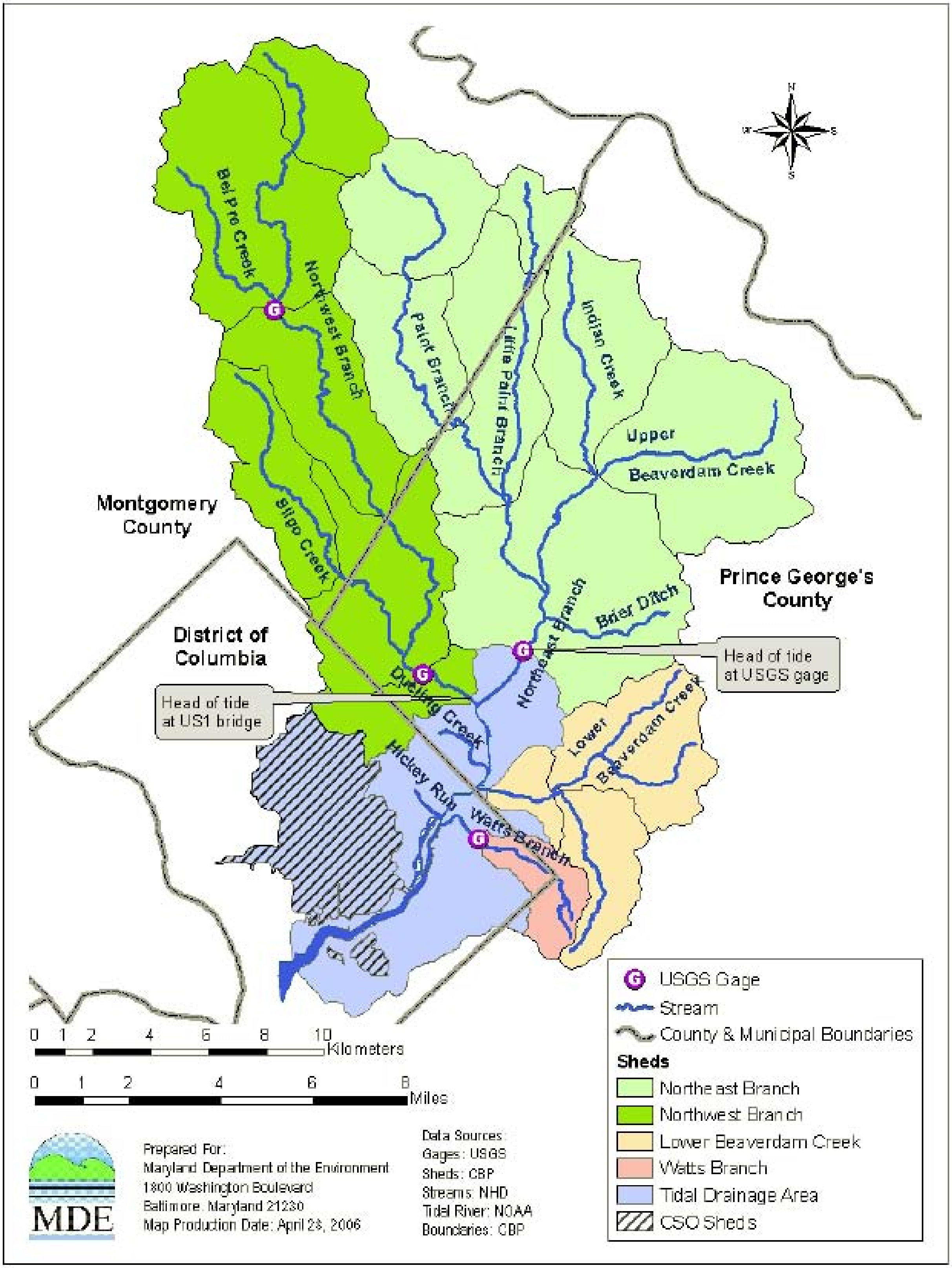
As Table 6 shows, the Anacostia River Watershed is heavily urbanized and can be expected to have the water quality problems associated with urban streams, such as excessive stormwater runoff and associated high sediment loadings as well as stream bank erosion caused by increased flow volume and velocity.

Table 6: Land Use in the Anacostia River Watershed

	Urban	Agricultural	Forest	Total	Impervious	Connected Impervious	%Connected Impervious
NWB	27,276	1,103	5,332	33,711	6,794	5,880	17%
NEB	28,326	3,756	14,210	46,291	8,490	7,710	17%
LBC	7,580	85	1,966	9,631	2,660	2,514	26%
Watts	1,823	28	269	2,119	578	558	26%
Tidal	19,155	0	166	19,321	7,447	7,447	39%
Total	84,160	4,971	21,943	111,073	25,968	24,108	22%
%Total	75%	5%	20%	100%			

Watts Branch is the largest tributary to the Anacostia River in the District of Columbia. Originating in Prince George's County, Maryland, Watts Branch travels for four miles to its mouth on the eastern side of the Anacostia. The watershed is 2,470 acres with 47 percent in the District and 53 percent in Maryland. Approximately 80 percent of the watershed exists as urban residential and commercial property. Less than 15 percent is forested, mainly along the parkside riparian stream corridor. Approximately five percent is light industrial property.

Figure 2: Anacostia River Watersheds



V. Technical Approach

When models are used to develop TMDLs, the model selection depends on many factors, including but not limited to, the complexity of the system being modeled, available data, and impact/importance/significance of the pollutant loading. In the development of the Anacostia TSS/sediment TMDL, a set of linked water quality models was developed to simulate the delivery, transport and fate of sediments from throughout the watershed to the non-tidal and tidal Anacostia River in Maryland and the District. The set of linked models included HSPF, TAM/WASP, ESTIMATOR and MOUSE[3].

The computer model Hydrological Simulation Program—Fortran (HSPF) was used to develop a computer simulation of the Northwest Branch, Northeast Branch, Lower Beaverdam Creek, Watts Branch, and other areas draining to the tidal Anacostia River. The model has three purposes. First, the model is used to quantify sediment loads by key source categories: forest, agriculture, developed land, and streambank erosion. Second, while the HSPF model is not used to provide sediment loads from the Northwest and Northeast Branches to the TAM/WASP model, it has been calibrated to agree with the sediment loads from ESTIMATOR for the tidal model's simulation period and used to provide sediment loads for the tidal model from Lower Beaverdam Creek, Watts Branch, and other areas contributing to the tidal Anacostia River. Third, since Maryland currently has no numerical water quality criteria for sediment for non-tidal waters, the HSPF model is used with the "reference watershed" approach in the development of MDE's Anacostia sediment TMDL, as part of a heuristic argument to demonstrate that the reductions required to meet water quality standards in the tidal Anacostia would be protective of non-tidal water quality.

Use of the Tidal Anacostia Model (TAM/WASP)

The TAM/WASP model is composed of three sub-models: (1) a hydrodynamic sub-model, which consists of the hydrodynamic portion of TAM, (2) a sediment exchange sub-model, which uses a modified version by Dr. Lung[4] of the sediment oxygen demand (SOD) model of DiToro[5], and (3) a water quality sub-model, which consists of a modified version of the WASP5 EUTRO eutrophication model. The hydrodynamic sub-model is used to simulate water flow velocity and depth, which govern the transport of constituents in the water column. The sediment exchange sub-model is used to simulate sediment/water column exchange processes related to SOD. The water quality sub-model is used to simulate eutrophication and other chemical and biological transformations which affect dissolved oxygen levels in the water column. Additionally, a variety of methods are used to simulate daily input flows and loads,

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[3] HSPF = Hydrologic Simulation Program – Fortran; TAM/WASP = Tidal Analysis Model/Water Quality Analysis Simulation Program; ESTIMATOR = U.S. Geological Survey model; MOUSE = proprietary model used for WASA's Long Term Control Plan

[4] Lung, W. *Incorporating a Sediment Model into the WASP/EUTRO Model*, Appendix A of the ICPRB, October 6, 2000, report.

[5] Di Toro, D. M., P. R. Paquin, K. Subburamu, and D. A. Gruber, 1990, *Sediment Oxygen Demand Model: Methane and Ammonia Oxidation,* Journal of Environmental Engineering 116: 945-986.

including use of a HSPF[6] model for the Watts Branch sub-watershed. The methods are explained in detail in the modeling report provided along with this TSS TMDL.

EPA established the *Total Suspended Sediment Total Maximum Daily Loads, Upper Anacostia River, Lower Anacostia River in the District of Columbia* on March 1, 2002. The TAM/WASP Version 2[7] model was modified from a 15-segment system to a 36-segment system by ICPRB to incorporate information from a 2000 dye study. The model also includes side embayments to model Kingman Lake, Kenilworth Marsh, and the tidal portions of the tributaries. The WASP TOXI5 model, modified by ICPRB simulated advective and dispersive transport and deposition and erosion patterns in the tidal Anacostia River, predicting sediment concentration in the water column. In addition to the TAM/WASP model used for EPA's TSS TMDL, ICPRB developed a light extinction module to convert the water column TSS concentrations to equivalent Secchi depth.[8] A light extinction module is used for the current TMDLs.

In order to better estimate the combined sewer overflow volumes and loads, a significant improvement was made by the use of the MOUSE® model[9]. This is a proprietary model used by the consultants to the Washington Area Sewer Authority (WASA). Previously the CSO loads were estimated based on the area draining to the sewer.

For the current TMDLs, the TAM/WASP Version 3 incorporates a number of upgrades. The TAM/WASP is a one-dimensional (1-D) modeling framework, which simulates hydrodynamic and water quality conditions along the length of the river, assuming that conditions are uniform throughout any channel segment (*i.e.* from left bank to right bank and from the water's surface to the channel bottom). Approximating the river as a one-dimensional system is reasonable based on the results of the summer 2000 SPAWAR study (Katz *et al*., 2000), which concluded that throughout a channel transect the water in the river was generally well-mixed, and current velocities were relatively homogenous and primarily directed along the axis of the channel. It is also supported by model simulations carried out subsequent to a dye study conducted in 2000 by LimnoTech, Inc. (LTI, 2000). These results showed that a 1-D model was capable of simulating the time evolution of dye concentrations in the tidal river fairly well (DC WASA, 2001; Schultz, 2003).

To support the Maryland Department of the Environment's (MDE) development of sediment TMDL load allocations for the tidal Anacostia River, the following four TAM/WASP components used to predict water clarity conditions (as measured by Secchi disk depth).

1. The Hydrodynamic component simulates the changes in water level and water flow velocities throughout the river due to the influence of tides and of flows from tributaries and sewer systems discharging into the tidal river.

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[6] Hydrologic Simulation Program - Fortran

[7] Schultz, C.L., 2003, *Calibration of the TAM/WASP Sediment Transport Model – Final Report*, Interstate Comission on the Potomac River Basin, Rockwille, Maryland, October 2001, Revised April 2003, ICPRB Report No. 03-01.

[8] *Technical Memo: The Development of a Light Extinction Module for the TAM/WASP Model of the Tidal Anacostia River*, undated, Ross Mandel, ICPRB.

[9] See the various reports associated with WASA's LTCP for more information on the MOUSE model.

2. The Load estimation component was constructed by ICPRB using Microsoft ACCESS®. Sediment loads enter the river from a variety of sources, including the upstream tributaries (the Northeast Branch and Northwest Branch), the tidal basin tributaries (Lower Beaverdam Creek, Watts Branch and others), CSOs, the minor tributaries, separate storm sewer systems, and ground water. The ICPRB load estimation component estimates daily water flows and pollutant loads into the river based on a variety of methodologies, using USGS gage data, available monitoring data, USGS ESTIMATOR model results (see TMDL Report, Appendix A), and Anacostia Phase 3 HSPF watershed model results, as described in the modeling report, Section 3.2.

3. The Sediment transport component simulates the physical processes transporting sediment, and estimates daily values of TSS in each model water column segment. The TAM/WASP Version 2 has been upgraded to Version 3 with 38 segments, and has undergone very minor adjustments to the calibration parameters used in Version 2 which govern erosion and settling.

4. The eutrophication component simulates the physical processes that affect dissolved oxygen levels in the river, and estimates daily concentrations of phytoplankton (algae), dissolved oxygen, and nutrients. The TAM/WASP Version 3 eutrophication model used for these TMDLs has been upgraded to 36 segments, and incorporates new modifications by ICPRB which couple it to the sediment transport model and allow it to estimate daily water clarity conditions based on TSS and algae concentrations. This coupled model is capable of simulating the effect of potential solids load reductions on algal growth.

The previous Anacostia River TSS TMDLs used a prediction period of 1988 to 1990 while MDE selected a prediction period of 1995 to 1997 when monitoring was performed for Maryland's sediment TMDL. Therefore, the District of Columbia Water and Sewer Authority (WASA) provided access through their contractor to MOUSE, a propriety computer program by the Danish Hydraulic Institute.

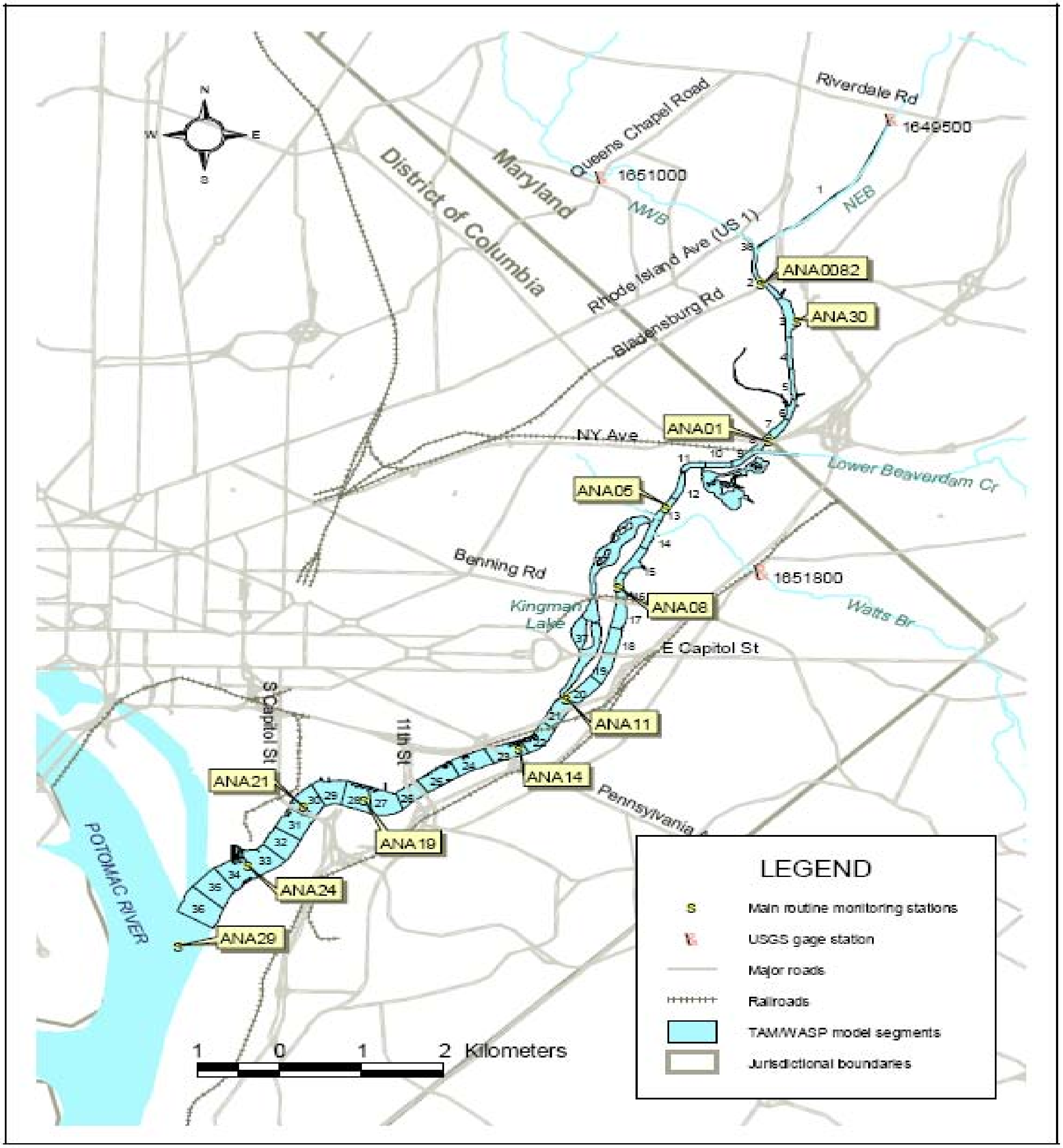
The District of Columbia Water and Sewer Authority (WASA) has established a Long Term Control Plan (LTCP) for the reduction of CSOs and the sediment loads associated with them. The CSO flows used for the LTCP are based on the extensive studies, flow and water quality monitoring, and modeling performed for the District's LTCP and documented in Study Memorandums and summarized in the final LTCP Report dated July 2002. Because a different prediction period is used, MOUSE was run using the physical configuration previously approved by EPA.

Anacostia River Non-tidal Watershed HSPF Model

The computer model Hydrological Simulation Program-Fortran (HSPF) was used to develop a computer simulation of the Northwest Branch, Northeast Branch, Lower Beaverdam Creek, Watts Branch, and other areas draining to the tidal Anacostia River. While MDE has not used HSPF for previously submitted TMDL Reports, the District of Columbia TMDLs have used HSPF in Watts Branch.

For more information on the model capabilities, data, structure, calibration, etc, please see the report "Anacostia Sediment Model: Phase 3 Anacostia HSPF watershed Model and Version 3 TAM/WASP Water Clarity Model", Schultz, Cheri et al, Interstate Commission on the Potomac River Basin, March 2007.

Figure 3: Water Quality Model Segmentation



Daily Load Determination

These TMDLs and their daily, seasonal, and annual load allocations have been established at levels that implement the applicable water quality standards for clarity in Maryland and the District. This has been done using sophisticated predictive models. These models are based on certain assumptions regarding flow rates and other variables, such as the design period of 1995 to1997 would represent a wide range of typical flow conditions.

While the model and resultant TMDL loads have been developed to statistically represent a range of hydrological events (e.g., high flows, low flows and average flows), it is possible that a measured individual daily load of TSS/sediment inputs to the Anacostia River might exceed a given modeling projection. However, the model has been set up to predict the loads (annual/seasonal/daily) that, are representative of the hydrological characteristics of the Anacostia River and, when considered cumulatively over time, will implement the District's and Maryland's water clarity criteria expressed as a seasonal average.

The modeling application developed for the TMDL analysis simulates daily values of both total suspended solids and sediment concentrations and water clarity on the basis of various inputs including: information on tides, precipitation and tributary flows, daily estimates of sediment loads from various sources, the District's MS4s, and CSOs from the District's combined storm sewer and sanitary sewer system.

Appendix D to the TMDL report documents the technical approach (summarized here) used to define the maximum daily loads of total suspended solids (TSS) necessary to assure that the applicable water quality standard for water clarity of 0.8 meters secchi depth will be met. The District's clarity criterion is determined as an average annual value and also as a value during the growing season (as expressed in the District's water quality standards regulations. The approach to daily loads builds upon the modeling analysis that was conducted to determine the loadings of TSS that implement the applicable water quality standards, and can be summarized as follows.

- The approach defines maximum daily loads for each of the source categories.

- The approach builds upon the TMDL modeling analysis that was conducted to ensure that compliance with average annual/seasonal loading targets will result in compliance with the applicable water quality standards. These average annual/seasonal loading targets were converted into allowable *daily* values by using the daily time-series loadings developed from the TMDL modeling analysis.

- The approach converts the daily time-series loadings into TMDL values in a manner that is consistent with available EPA guidance on generating daily loads for TMDLs.

- The approach uses policy input related to the expected level of resolution and probability level provided by an advisory group led by EPA Region 3[10].

[10] Members included representatives from the District, Maryland, the Interstate Commission on the Potomac River Basin, EPA region III, EPA HQs and WASA

The overall approach for development of daily loads was based upon the following factors:

• Daily time-series loadings developed for this TSS TMDL: These TSS/sediment TMDLs employed continuous simulation modeling to determine consistency with the applicable water quality standard(s), producing a time series of daily loads for each contributing source category for the 3-year period (i.e., 1995-97) that was simulated.

• Draft EPA technical guidance on developing and expressing daily loads for TMDLs: This guidance provides suggested options for defining maximum daily loads when using TMDL approaches that generate daily output.

In establishing the process for developing daily loads, the TMDL advisory group considered both the level of resolution and the probability level. The level of resolution pertains to the amount of detail used in specifying the maximum daily load. The draft EPA guidance on daily loads provides three categories of options for level of resolution, all of which were considered in this TMDL:

R1. **Representative daily load:** A single daily load (or multiple representative daily loads) is specified that covers all time periods and environmental conditions.

R2. **Flow-variable daily load:** The maximum daily load is allowed to vary based upon the observed flow condition.

R3. **Temporally-variable daily load:** The maximum daily load is allowed to vary based upon seasons or times of varying source or waterbody behavior.

The EPA preliminary draft daily load technical document stated that the probability component of the maximum daily load should be "based on a representative statistical measure" that is dependent upon the specific TMDL and best professional judgment of the developers. The primary options for selecting the appropriate level of protection would be as described below. For these TMDLs, all three options were used, the selection of which was based on the type of pollutant source. This is discussed below.

P1. **The maximum daily load reflects some central tendency: T**he maximum daily load is based upon the mean or median value of the range of loads expected to occur.

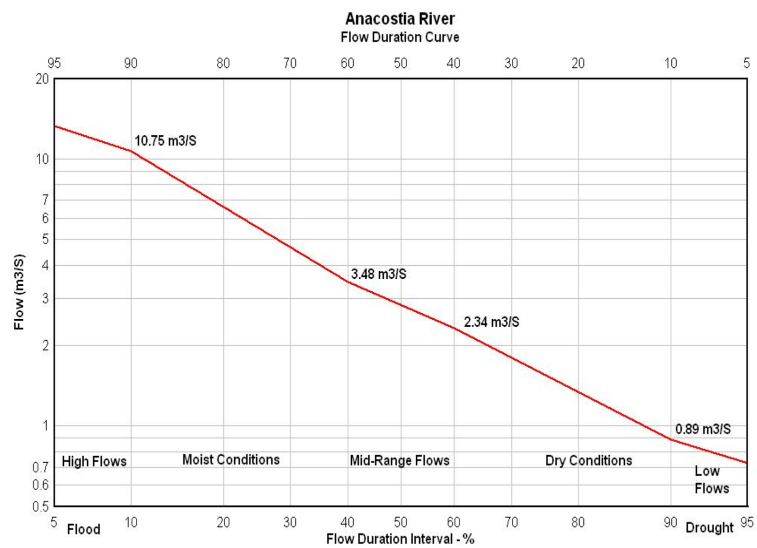
P2. **The maximum daily load reflects a level of protection implicitly provided by the selection of some "critical" period**: The maximum daily load is based upon the allowable load that is predicted to occur during some critical period examined during the analysis.

P3. **The maximum daily load is a value that will have a pre-defined statistical probability of attainment: A** "reasonable" upper bound percentile is selected for the maximum daily load based upon a characterization of the variability of daily loads.

After considering the above, the District and Maryland chose somewhat different approaches to developing daily loads, depending on tidal influences and the type of source. As an example, the variable flow approach used by Maryland for the non-tidal portion of the Anacostia River is not appropriate for tidally influenced waters. In addition, the District required both maximum daily loads as well as average daily loads while Maryland required only maximum daily loads. EPA believes that the approaches selected by each jurisdiction are consistent with each of their water quality standards and EPA regulations, policy and guidance. Appendix D of the TMDL report contains a complete description of the final approaches chosen.

Maryland's Approach to Daily Loads

In the non-tidal portion of the Anacostia River, in order to get a better representation of daily loads, the actual stream flows for the design period of 1995 to 1997 were divided into 5 different flow levels (flow quintiles). Ranking the flows from high flows (wet weather) to low flows (dry weather) can be used as a general indicator of hydrologic condition. The Anacostia River flows were divided by the commonly used flow duration intervals[11]; less than 10% (10% or less of the observed flows exceeded this value), 10% to 40%, 40% to 60%, 60% to 90% and greater than 90%. Daily maximum loads were then determined for each flow quintile, as described below.



• MS4 and Nonpoint Sources of sediment

The level of resolution selected for defining a daily maximum load for the Anacostia River is for a flow-variable (see the flow quintile discussion above) daily load for each loading source in the non-tidal Anacostia River, and a single representative load for each loading source in the tidal portions of the Anacostia River.

The probability level for the annual/seasonal TMDL determination was based on the use of a critical period approach. The critical period of 1995-1997 was selected as representing a range of wet, average and dry rainfall conditions. The maximum "daily" load for each contributing source was defined as the highest observed (or predicted) daily load for each loading source over the course of the critical period. These maximum daily loads were

[11] See the following references for more information on the flow duration approach: Cleland, B. 2002, *TMDL Development from the "Bottom Up" – Part II: Using Flow Duration Curves to Connect the Pieces*, America's Clean Water Foundation, Washington, DC and Cleland, B. 2003, , *TMDL Development from the "Bottom Up" – Part III: Duration Curves and Wet Weather Assessments*, America's Clean Water Foundation, Washington, DC

calculated for five different flow ranges for the Anacostia River and for the annual and seasonal loads.

• Approach for Other Point Sources (non-MS4 sources)

These sources are generally minor contributors to the overall sediment load. The calculation approach for point sources in Maryland is as follows:

- Municipal – Loads were calculated based on the USEPA (1991) guidance[12]. The annual and seasonal TMDL values were converted to a daily load and then multiplied by a conversion factor. The conversion factor was based on USEPA guidance (1991) assuming an effluent coefficient of variation of 0.6 and a probability of 99_{th} percentile.

- Industrial – Loads were calculated from the average reported flow and the daily maximum permitted TSS value.

The District's Approach to Daily Loads

• Approach for MS4 and Nonpoint Sources

The level of resolution selected for defining a daily maximum load for the Anacostia River is to provide representative maximum and daily average loads for each loading source. The probability level is based upon the representative load/central tendency and representative load/critical period options. The maximum "daily" load for each contributing source was defined as the highest observed (or predicted) daily load for each loading source over the course of the critical period (1995 to 1997). The daily average loads were based on the average daily loads for the critical period.

• Approach for CSOs

The CSO TMDL loads for the District of Columbia are also expressed using the representative load/central tendency and representative load/critical period options. The allowable CSO loads were developed in a manner consistent with the Long Term Control Plan (LTCP) for controlling combined sewer overflows (CSOs) in the District of Columbia (DC WASA, 2002).

• Approach for Other Point Sources (Other than MS4s or CSOs)

The daily load analysis held the maximum allowable seasonal/average loads for each of these sources constant at their existing technology-based NPDES permit limit for every day of the three-year simulation period. The approach used to convert these loads to maximum daily values was based upon maximum daily permit calculations provided in the EPA guidance, 1991. The constant loads used for the three-year simulation in the TMDL analysis were taken to represent the long-term average concentrations required for TSD calculations. These long-term

[12] Technical Support Document for Water Quality-based Toxics Control, EPA/505/2-90-001, March 1991

averages were then converted to maximum daily limits using Table 5-2 of the TSD assuming a coefficient of variation of 0.6 and a 99th percentile probability.

VI. Discussions of Regulatory Requirements

EPA has determined that these TMDLs are consistent with statutory and regulatory requirements and EPA policy and guidance. EPA's rationale for approval is set forth according to the regulatory requirements listed below.

The TMDL is the sum of the individual waste load allocations (WLAs) for point sources and the load allocations (LAs) for nonpoint sources and natural background and must include a margin of safety (MOS). The TMDL is commonly expressed as:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

Where:

WLA = waste load allocation
LA = load allocation
MOS = margin of safety

1. The TMDLs are designed to implement the applicable water quality standards.

For the tidal portion of the Anacostia River, water quality data related to water clarity were considered because water quality standards of both Maryland and the District of Columbia contain numeric criteria for water clarity in the tidal Anacostia. For the non-tidal watershed, suspended solids data provide a measure of the quantity of sediment discharged from non-tidal streams into the tidal river. Suspended solids can also serve as a surrogate measure of sediment-related water quality conditions that affect the health of aquatic organisms in non-tidal streams.

On August 29, 2005, the EPA approved revisions to Maryland's water quality standards, including a new standard related to sediment, the "Water Clarity Criteria for Seasonal Shallow-Water Submerged Aquatic Vegetation," supporting Maryland's Designated Use II: "Support of Estuarine and Marine Aquatic Life" for the tidal Anacostia River. Maryland's new water clarity standard for the tidal Anacostia is a numeric criterion based on secchi depth.

On February 15, 2006, EPA approved revisions to the District of Columbia's water quality standards, which include a numeric criterion for water clarity for uses categorized as Class C: "Protection & Propagation of fish, shellfish and wildlife." The District's water quality standards also specify a seasonal segment average (July-September) for chlorophyll '*a*' of 25μg/L.

The Maryland water quality standards Surface Water Use Designations for this watershed area are Use I-P – Water Contact Recreation, Protection of Aquatic Life and Public Drinking Supply; Use II - Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting; Use III – Natural Trout Waters; and Use IV – Recreational Trout Waters (COMAR 26.08.02.08 O). The District of Columbia has classified the Anacostia for current and designated uses including category Class C: "Protection & Propagation of fish, shellfish and wildlife." The State of

Maryland and the District of Columbia have both established water quality standards (WQSs) that protect the streams and estuaries in their respective portions of the Anacostia watershed and support the designated beneficial uses of these waters. A summary of the designated uses and WQSs applicable to the Anacostia are given in Table 7. Analyses done for this TMDL show that sediment load reductions necessary to meet the District of Columbia's water clarity criterion for the District of Columbia tidal waters are significantly larger than load reductions necessary to meet MD's water quality standards for sediment related to aquatic life in the Anacostia watershed. Because the Anacostia is an interstate watershed, and TMDLs developed by Maryland and the District were designed to meet both Maryland and the District of Columbia Water Quality Standards. Therefore, the more stringent District of Columbia's water clarity criterion for tidal waters was chosen as the standard that would determine the TMDL load reductions.

Tidal Waters

The water clarity standards of both Maryland and the District are designed to attain and maintain the aquatic life use by allowing the growth of healthy communities of submerged aquatic vegetation (SAV) in tidal waters. In both jurisdictions, water clarity standards were developed largely based upon the body of research and analysis done for and by the Chesapeake Bay Program (CBP) in its effort to promote the regeneration of SAV in Chesapeake Bay tidal waters, which include the Anacostia River. The CBP determined that one of the primary causes of the decline in SAV is "increased suspended sediments in the water and the associated reduction of light" (USEPA 2003b). Both Maryland's and the District of Columbia's water clarity criteria are based on Chesapeake Bay Program's determination of light requirements for underwater bay grasses.

Maryland Water Quality Standards are available in the Code of Maryland Regulations (COMAR) 26.08.02. Maryland has designated the tidal Anacostia for Use II: "Support of Estuarine and Marine Aquatic Life." The "Water Clarity Criteria for Seasonal Shallow-Water Submerged Aquatic Vegetation" specify that for the tidal Anacostia (CBP segment ANATF) a numeric water clarity criterion will be assigned based on an application depth of 0.5 meters. This results in a criterion for secchi depth of 0.4 meters, applicable throughout the growing season, defined in the Maryland regulations as April 1 to October 1. MDE has determined that three year growing season medians are appropriate to use to assess attainment of its secchi depth criterion, as indicated in CBP guidance documents (USEPA 2003b).

In the District's water quality standards, Chapter 11 of Title 21 of the District of Columbia Municipal Regulations (DCMR) specify a numeric criterion for water clarity, applicable to the tidal Anacostia River. The District classifies surface waters "on the basis of their (i) current uses, and (ii) future uses to which the waters will be restored." The District has classified the Anacostia for current and designated uses including category Class C: "Protection & Propagation of fish, shellfish and wildlife." The water clarity criterion, applicable to Class C waters, and limited to the Anacostia River, specifies a seasonal segment average (April-October 31) secchi depth of 0.8 meters. The District of Columbia has determined that the seasonal segment average applies to the growing season median for each year in a three-year study period to assess attainment of its secchi depth criterion as it relates to the CBP guidance document

(USEPA 2003b). The District's Water Quality Standards related to water clarity in the tidal Anacostia is the standard for Chl 'a'. The Water Quality Standards specify a seasonal segment average (July through September) for Chl 'a' of 25µg/L.

Non-tidal Waters

Section 1104.1 of the District's Water Quality Standards list several narrative criteria designed to protect existing and designated uses, including the following, which is specific to Class C designation: "The surface waters of the District shall be free from substances attributable to point or nonpoint sources discharged in amounts that…impair the biological community which naturally occurs in the waters or depends on the waters for their survival and propagation.". Maryland has designated its portion of the non-tidal Anacostia watershed as Use I-P – Water Contact Recreation, Protection of Aquatic Life and Public Drinking Supply; Use III – Natural Trout Waters; and Use IV – Recreational Trout Waters (COMAR 26.08.02.08O). Maryland's general narrative water quality criteria prohibit pollution of waters of the State by any material in amounts sufficient to create a nuisance or interfere with the designated uses (COMAR 26.08.02.03B(2)). The targeted water quality goal for all non-tidal waters in the Anacostia watershed is to ensure that the sediment loads and resulting effects support designated uses of the non-tidal Anacostia watershed and, more specifically, support aquatic health.

The TMDL as submitted by the District and Maryland establishes TMDLs for sediment that: 1) are protective of aquatic life in the tidal and non-tidal waters of the Anacostia; 2) meet MD's and the District's sediment-related water quality standards in their respective portions of the river; and 3) specifically meet the numeric criteria for water clarity in the tidal waters. The allocations were set so that the more stringent water quality standard – the District's 0.8 meters secchi depth, would be met. EPA finds that this TMDL is consistent with and achieves the District's and Maryland's water quality standards for aquatic life protection.

Daily Loads v Seasonal Average to Meet Standards

TMDLs are set at a level necessary to attain and maintain existing applicable water quality standards. For this particular TMDL, the applicable designated use is aquatic life protection and the applicable water quality criterion is the secchi depth criterion in the District, i.e., meeting this criterion resulted in the most stringent load allocations. As noted above this criterion is 0.8 meters as an average for each growing season (April through October). Therefore the goal of these TMDLs was to assure that the total loadings during this period would meet the seasonal average criterion. The water quality model used to develop the TMDL provides source loading output on a daily basis. These daily loads, when considered as an average over the growing season, are shown to meet the District's seasonal criterion. Because of the variability of storm loads, some daily loads during dry weather events may be close to, if not, zero, while at other times, during wet weather events, the loadings may be quite high. Because of the way the criteria are written these variable sediment loads may exceed levels necessary to achieve the secchi depth criterion of 0.8 meters on any given day. However, compliance with applicable water quality criterion is not evaluated on a daily basis but rather on a seasonal basis. Therefore, the potential for infrequent, periodic high daily sediment loadings does not mean that these

TMDLs have not been set at a level necessary to attain and maintain the applicable water quality criteria expressed as a seasonal average.

EPA believes that the allocations were properly developed to attain and maintain existing applicable water quality standards

Table 7: Water Quality Standards

	Designated Use	Waterbody	Water Quality Standards
MD non-tidal	Use I-P: Water contact recreation, protection of non-tidal warmwater aquatic life, public drinking supply	All non-tidal MD streams except those designated Use III and IV	Narrative criterion – protection of aquatic life
	Use III: Non-tidal cold water (supporting self-sustaining trout populations)	Paint Branch above Interstate 495 (Capital beltway)	Narrative criterion – protection of aquatic life
	Use IV: Recreational trout waters	NWB above highway 410	Narrative criterion – protection of aquatic life
MD tidal	Use II: Support of estuarine and marine aquatic life and shellfish harvesting – seasonal shallow water SAV subcategory	MD portion of tidal Anacostia	Secchi depth criterion: seasonal application depth greater than or equal to 0.4 meters (Apr 1 through Oct)
DC non-tidal	Class 3: Protection & propagation of fish, shellfish and wildlife	All non-tidal DC streams	Narrative criterion – protection of aquatic life
DC tidal	Class 3: Protection & propagation of fish, shellfish and wildlife	DC portion of tidal Anacostia	Secchi depth criterion: seasonal segment average greater than or equal to 0.8 meters (Apr 1 through Oct 31)

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

All of the significant sources of TSS/sediment were considered in establishing these TMDLs. Significant sources included stream bank erosion, overland flow, point sources, including MS4 areas and areas served by combined sewers and nonpoint sources such as agricultural and forested lands. Allocations were assigned to each source or type of source depending on the availability of data and techniques of prediction.

The allocations established in this TMDL were developed to attain and maintain the water quality standards related to sediment/TSS for the Anacostia River in both Maryland and the District. In response to the District of Columbia Court of Appeals decision in Friends of the Earth v. EPA and the fact that the applicable Maryland and District water quality standards are expressed in relation to growing seasons, the allocations in this TMDL are in expressed in variety of ways. These varied loading expressions not only satisfy all potential requirements of the Clean Water Act, they also are intended to facilitate a variety of implementation scenarios.

The tables in Section III, Allocation Summary of this rationale provides the daily, seasonal and annual loading allocations. The sediment TMDLs for both Maryland and the District of Columbia tidal and non-tidal waters of the Anacostia are: 4302.65 tons/day on an annual basis, 1632.27 tons/day on a seasonal basis, 7097.6 tons/year annually and 3396.1 tons/growing season for the growing season April 1 to October 31 (see the following tables for details). The loading caps constitute an 85% overall reduction of sediment/TSS from the baseline loads determined for the TMDL analysis period, 1995-1997 (46,906 tons/year and 22,312 tons/growing season). The TMDLs are distributed among: 1) waste load allocations (WLAs) to National Pollutant Discharge Elimination System (NPDES) municipal and industrial point source (PS) discharges, NPDES MS4s and other regulated stormwater (SW) sources, and the District of Columbia CSOs; and 2) load allocations (LAs) to forest and agricultural lands. Conservative assumptions provide an implicit margin of safety (MOS).

In the absence of numerical water quality criteria for sediment in non-tidal waters, the reference watershed approach was used to determine the sediment loads that can support designated uses of the non-tidal Anacostia watershed and, more specifically, to support aquatic health. In particular, MDE has identified two Anacostia subwatersheds which are not impaired due to sediment: the upper portion of the Paint Branch (above Fairland Road), located in the Piedmont province, and Upper Beaverdam Creek, in the Coastal Plain province (see details in Appendix C; also Mandel et al. 2007). The coupled hydrodynamic/water quality model, the Tidal Anacostia Model/Water Analysis Simulation Program (TAM/WASP), was used to simulate flows and water clarity conditions in the tidal Anacostia River. The TAM/WASP model was calibrated for the years 1995 through 2002, the portion of the study period for which tidal Anacostia water column data were available at the time this study was initiated. The results from these analyses show that the reductions necessary to meet MD's nontidal water quality standards were much smaller than those necessary in the TMDL to meet the District's water quality standards, specifically the water clarity criterion.

The objective of the tidal analysis was to determine what reductions in suspended sediment loads to the tidal Anacostia result in water clarity improvements sufficient to support growth of SAV, by meeting the water clarity standards of Maryland and the District of Columbia in their respective portions of the tidal river, i.e., a seasonal median Secchi depth of 0.4 meters in Maryland (three-year median) and 0.8 meters in the District (one-year medians for each of three years). The TAM/WASP computer simulation model of sediment transport and water clarity simulates daily values of both total suspended sediment concentrations and water clarity based on inputs including: tides, precipitation, and tributary flows; daily estimates of sediment loads from the various sources, including the NEB, NWB, LBC, and Watts Branch tributaries; the District's MS4; and combined sewer overflows (CSOs).

The TAM/WASP model was used to simulate baseline water clarity conditions during the three-year time period used for the TMDL analysis, 1995 through 1997. Model simulations of a variety of water quality parameters, including TSS, Chl ‘a’ and dissolved oxygen, are compared with observed values. Baseline conditions were determined for the TMDL analysis period, 1995-1997.

Tidal

Model simulations of sediment load reduction scenarios were run using hydrologic inputs for the 1995-1997 time period, in conjunction with hypothetically reduced daily sediment load inputs representing the effects of the implementation of watershed management practices. In the final TMDL scenario run, sediment loads were reduced by 85% from most sources. The exceptions were: (1) Watts Branch, which had reductions based on the District’s 2003 TMDL for TSS in Watts Branch; (2) CSOs, which had reductions based on predicted flows under the District of Columbia’s Long Term Control Plan; and (3) municipal and industrial point sources, which were simulated at their design flows and weekly or daily maximum concentration limits, respectively, to facilitate calculations of their daily maximum loads.

Nontidal

Two methods were used to estimate the magnitude of target sediment loads that would support a healthy aquatic ecosystem in the non-tidal Anacostia. First, target loads were estimated with HSPF model simulations based on conditions in two reference sub-watersheds, that is, sub-watersheds judged by biological characterization to be unimpaired by sediment. Second, quantile regression statistics were used to estimate pre-urbanization and post-urbanization NEB and NWB flow duration curves, and these were used in conjunction with sediment rating curves to estimate the portion of modern-day sediment loads due to altered hydrology. The results of both of these analyses indicate that the load reductions necessary by the tidal water clarity standard are as stringent, or more stringent, than the load reductions necessary in the non-tidal Anacostia. Therefore, the final TMDL allocations are based on results of the tidal analysis.

Recommended allocations, both annual and for the seven-month growing season, are given for agricultural and forest land uses, and streambank erosion; and for municipal and industrial facilities, MS4s and other regulated stormwater (SW) and the District of Columbia’s CSOs. See the technical memoranda entitled “Significant Sediment/TSS Nonpoint Sources in the Anacostia Watershed” and “Significant Sediment/TSS Point Sources in the Anacostia River Watershed” for details and further in this section for a summary of those allocations. Loads from urban land uses are broken down by MS4 jurisdiction. These urban loads also include loads from construction sites. The wastewater and industrial process water loads are estimated using permitted flows and TSS limits where available. If TSS limits are not specified, then TSS concentrations are estimated on a case-by-case basis.

Table 8: Recommended Allocations by Sub-watershed on an Annual Basis

Sediment/TSS TMDLs		Annual (tons/year)					
		MD WLA	MD LA	DC WLA	DC LA	MOS	TMDL
Non-tidal	NWB	2,254	23	27	0	Implicit	2,304
	NEB	3,595	218			Implicit	3,814
	LBC	479	5	1	0	Implicit	484
	Watts Br	28	1	24	0	Implicit	53
	NT Total	6,356	247	51	0	Implicit	6,655
Tidal		86	0	306	51	Implicit	443
TOTAL		**6,442**	**247**	**357**	**51**	**Implicit**	**7,097**

Table 9: Recommended Allocations by Sub-watershed on a Seasonal Basis

Sediment/TSS TMDLs		Growing season (Apr 1 - Oct 31) (tons/season)					
		MD WLA	MD LA	DC WLA	DC LA	MOS	TMDL
Non-tidal	NWB	1,216	3	21	0	Implicit	1,240
	NEB	1,473	22			Implicit	1,495
	LBC	300	0	0	0	Implicit	301
	Watts Br	17	0	16	0	Implicit	32
	NT Total	3,006	25	37	0	Implicit	3.068
Tidal		62	0	231	36	Implicit	328
TOTAL		**3,068**	**25**	**267**	**36**	**Implicit**	**3,396**

In addition to the above gross loadings, the "Technical Memorandum – Significant Sediment Point Sources in the Anacostia River Watershed" wasteload allocations have been assigned to National Pollutant Discharge Elimination System (NPDES)-regulated municipal and industrial wastewater treatment plants, municipal separate storm sewer system (MS4) discharges, and CSOs in the Anacostia watershed. Loads from urban land uses are broken down by MS4 jurisdiction. These urban loads also include loads from construction sites. The wastewater and industrial process water loads are estimated using permitted flows and total suspended solids (TSS) limits where available. If TSS limits are not specified, then TSS concentrations are estimated on a case-by-case basis. These are shown in Table 10.

Figure 10: Point Source Allocations

Loads Attributed to Point Sources

MD Point Source Name	*Permit Number*	*TMDL - Annual* (tons/year)	*TMDL - Growing Season* (tons/growing season)
BARC East Side WWTP	MD0020842	22.13	10.43
Beltsville USDA West WWTP	MD0020851	7.34	3.56
Laurel Sand & Gravel	MD0001953	0.05	0.03
UM Fire & Rescue	MD0059161	3.42	2.00
MD State Military Facility	MD0065625, MD0067717	4.10	2.39
National Archives at UMCP	MD0065871	0.68	0.40
NASA Goddard Center	MD0067482	3.65	2.13
Percontee, Inc	MDG499863	16.55	9.66
Montgomery County MS4 – NWB	MD0068349	758.8	421.4
Other Mont. Co. SW– NWB		256.7	142.5
Montgomery County MS4 – NEB	MD0068349	342.4	150.3
Other Mont. Co. SW– NEB		67.4	29.6
Prince George's County MS4 – NWB	MD0068284	1090.5	574.7
Other PG Co. SW-NWB		147.9	77.9
Prince George's County MS4 – NEB	MD0068284	2449.4	988.5
Other PG Co. SW-NEB		678.1	273.7
Prince George's County MS4 – LBC	MD0068284	421.0	263.9
Other MD SW-LBC		57.8	36.2
Prince George's Co. MS4–Watts Br	MD0068284	25.8	15.3
Other MD SW-Watts		2.1	1.2
Total MD Non-tidal PS Loads		**6355.8**	**3005.8**
Prince George's County MS4 – Tidal	MD0068284	77.3	55.6
Other MD SW-Tidal		9.0	6.4
Total MD PS Loads		**6442.1**	**3067.8**

***SW = NPDES Regulated Stormwater**

DC Point Source Name	*Permit Number*	*TMDL – Annual* (tons/year)	*TMDL – Growing Season* (tons/growing season)
Aggregate Super Concrete Industries	DC0000175	**0.8**	**0.5**
CTIDC	DC0000191	**0.5**	**0.3**
PEPCO*	DC0000094	*	*
Total DC Industrial PS Loads		**1.3**	**0.7**
DC MS4 - NWB	DC0000221	26.2	20.7
DC MS4 - LBC	DC0000221	0.6	0.4
DC MS4 - Watts Br	DC0000221	24.2	15.5
Total DC Non-tidal MS4 Loads		**51.0**	**36.6**
DC MS4 – Tidal Upper	DC0000221	84.6	60.4
DC MS4 – Tidal Lower	DC000221	46.4	33.6
Total DC MS4 Loads		**182.0**	**130.6**
DC CSO Loads – Tidal Upper	DC0021199	**83.9**	**61.7**
DC CSO Loads – Tidal Lower	DC0021199	**90.8**	**74.6**
Total CSO Loads		**174.7**	**136.3**
Total DC PS Loads		**356.7**	**266.9**

NWB = Northwest Branch; NEB = Northeast Branch; LBC = Lower Beaverdam Creek; Watts Br = Watts Branch

* Included in stormwater (MS4) loads.

Based on the information provided in the point source technical memorandum, the maximum daily loads for the permitted facilities in Maryland are provided in Table 11. these loads were determined using the procedures as described in Appendix D of the TMDL report.

Table 11: Maximum Daily Loads for Point Sources in Maryland

MD Point Source Name	**Permit Number**	**Maximum Daily Load – Annual (Tons/Day)**	**Maximum Daily Load – Seasonal (Tons/Day)**
BARC East Side WWTP	MD0020842	0.1886	0.1545
Beltsville USDA West WWTP	MD0020851	0.0625	0.0527
Laurel Sand & Gravel	MD0001953	0.5004	0.5004
UM Fire & Rescue	MD0059161	18.765	18.765
MD State Military Facility	MD0065625, MD0067717	22.518	22.518
National Archives at UMCP	MD0065871	3.753	3.753
NASA Goddard Center	MD0067482	30.024	30.024
Percountee, Inc	MDG499863	121.1	121.1

Table 12: Maximum Daily Loads for MS4 Areas in Maryland

Flow Quintile	Montgomery County – Max Daily Load – Seasonal (Tons/Day)	Montgomery County – Max Daily Load – Annual (Tons/Day)	Prince George's County – Max Daily Load – Seasonal (Tons/Day)	Prince George's County – Max Daily Load – Seasonal (Tons/Day)
< 0.89	0.109	0.118	0.396	0.392
0.89 – 2.34	0.559	0.611	2.022	2.022
2.34 – 3.48	4.517	4.942	16.353	16.353
3.48 – 10.75	9.657	10.567	34.960	34.963
> 10.75	828.624	329.943	2999.886	1091.694

Table 13: Maximum Daily Loads for Point Sources in DC

DC Point Source Name	Permit Number	Maximum Daily Load – Annual (Tons/Day)	Maximum Daily Load – Seasonal (Tons/Day)
Aggregate Super Concrete	DC0000175	6.014	6.014
CTDIC	DC0000191	2.7522	2.7522

Table 14: Maximum Daily Loads for MS4 Areas in DC

MS4 Area	Maximum Daily Load – Annual (Tons/Day)	Maximum Daily Load – Seasonal (Tons/Day)
Lower Beaverdam Branch	0.0954	0.093
Watts Branch	3.425	3.425
Upper Anacostia Tidal	18.35	18.35
Lower Anacostia Tidal	10.24	10.24

The "Technical Memorandum – Significant Sediment/TSS Nonpoint Sources in the Anacostia Watershed" provided allocations to the significant nonpoint sources. TMDLs are being established in the Anacostia watershed for both average annual and growing season[1] (April 1 to October 31) conditions. The NPS loads that were used in the model account for all sources, including both natural and human-induced components. The ESTIMATOR model was used to compute total daily sediment loads for the Northwest Branch and the Northeast Branch. HSPF was used as well to provide a breakdown of the sediment loads by source, i.e., from the various land uses (agriculture, forest, or urban) or from streambank erosion. Urban land and streambank erosion contributions are included in the point sources technical memorandum as municipal separate storm sewer system (MS4) loads.

The Memorandum provided one possible scenario for the distribution of the annual NPS loads between different land use categories in the non-tidal Anacostia watershed and one possible scenario for the distribution of growing season NPS loads between different land use categories. The contributions of NPS loads in the tidal Anacostia watershed are all from urban land use, with the exception of some loads from direct drainage in the District's tidal Anacostia. These are shown below in Tables 15 and 16.

Figure 15: Annual NPS Loading Allocations

Annual NPS Loads Attributed to Significant Land Uses for Non-tidal Anacostia Sediment/TSS TMDLs (tons/year)

Landuse Category	NWB	NEB	LBC	Watts Br	Total	% of Non-tidal NPS Loads
Mixed Agricultural	16	178	0	0	194	79%
Forest and Other Herbaceous	7	41	5	1	53	21%
Total	**23**	**218**	**5**	**1**	**247**	**100%**

NWB = Northwest Branch; NEB = Northeast Branch; LBC = Lower Beaverdam Creek; Watts Br = Watts Branch

Figure 16: Growing Season NPS Loading Allocations

Growing season (April 1 – October 31) NPS Loads Attributed to Significant Land Uses for Non-tidal Anacostia Sediment/TSS TMDLs (tons/season)

Landuse Category	NWB	NEB	LBC	Watts Br	Total	% of Non-tidal NPS Loads
Mixed Agricultural	2	20	0	0	22	92%
Forest and Other Herbaceous	1	2	0	0	3	8%
Total	**3**	**22**	**0**	**0**	**25**	**100%**

NWB = Northwest Branch; NEB = Northeast Branch; LBC = Lower Beaverdam Creek; Watts Br = Watts Branch

Additionally, the NPS loads of sediment/TSS attributed to direct drainage in the District of Columbia tidal Anacostia are given potential allocations of 29.8 tons/year annually and 20.9 tons/season for the growing season in the Upper Anacostia, and 20.7 tons/year annually and 14.9 tons/season for the growing season in the Lower Anacostia.

As required, total loads were developed for TSS/sediment. These were based on an annual load, a load for the growing season and a daily load. In addition, the total loads were allocated to the various significant sources of the pollutant.

EPA believes the proposed TMDLs meet the requirement to include total loads as well as wasteload allocations and load allocations.

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

All loads of sediment/TSS outside of the modeling domain were considered as background loads to the model. These loads were identified in the allocation tables as allocations to upstream.

EPA believes the proposed TMDLs appropriately considered impacts of background pollutant contributions.

4. The TMDLs consider critical environmental conditions.

The TMDL Report considers critical environmental conditions by modeling the watershed using daily simulations for three years. The three years represent average flow in the Anacostia River, a wetter than average year, and a drier than average year based on precipitation data and accounts for various hydrological conditions. The simulation period was from 1995 to 1997.

EPA believes the proposed TMDLs meet the requirement to consider the critical environmental conditions.

5. The TMDLs consider seasonal environmental variations.

The TMDL Report considers seasonal variations by modeling the watershed using daily simulations for three years with seasonal data as appropriate. The critical condition and seasonality was accounted for in the TMDL analysis by the choice of simulation period, 1995-1997. This three-year time period represents a relatively dry year, wet year, and average year, based on precipitation data and accounts for various hydrological conditions.

EPA believes the proposed TMDLs meet the requirement to consider seasonal environmental variations.

6. The TMDLs include a margin of safety.

The CWA and EPA's TMDL regulations require TMDLs to include a margin of safety (MOS) to take into account any lack of knowledge concerning the relationship between effluent limitations and water quality. EPA guidance suggests two approaches to satisfy the MOS requirement. First, it can be met implicitly by using conservative model assumptions to develop the TMDL and its allocations. Alternately, it can be met explicitly by allocating a portion of the allowable load to the MOS.

The MOS in these TMDLs is implicit and identified as a separate allocation. This is legally permissible appropriate here because the computer simulations used to compute this TMDL, contained several implicit conservative assumptions used in the modeling framework. EPA has confidence in the calibrated/validated modeling foundation serving as the basis for the TMDL calculations.

1. The 1995-1997 simulation of growing season secchi depth medians under existing conditions underestimates the minimum secchi depth. This implies that secchi depths computed for load reduction scenarios are also underestimated.

2. The TAM/WASP sediment transport model does not simulate the process of "sediment aging." Sediment recently deposited on the riverbed is more subject to tidal re-suspension than older sediment, which has had time to become compacted. The simulation of sediment aging is difficult and requires data not currently available in the Anacostia, so it was not included in the TAM/WASP sediment transport model. Because

a greater fraction of the surficial sediment bed is "older" in simulations of load reduction scenarios, the inclusion of sediment aging in the model would have led to greater improvements in water clarity.

3. SAV beds lead to improvements in water clarity by slowing and trapping suspended material, and this phenomenon was not accounted for in the water clarity simulations. Accordingly, the model under-predicted water clarity that will result from these allocations because it did not account for the gradual improvement in clarity that will result from the SAV growth.

4. Municipal waste water treatment plants and industrial point sources (PS) were simulated using their weekly maximum and daily maximum permitted concentrations, respectively, but were given annual WLAs based on their monthly permitted concentrations.

With respect to CSO loads, there is an implicit margin of safety due to the "first flush" effect. If the CSO concentrations of TSS/sediment were assumed to be constant over time, accounting for 95 percent of the discharge volume would presumably account for 95 percent of the load. However, as TSS/sediment concentrations are generally higher for the first one-half inch of storm water runoff, accounting for 95 percent of the volume captures more than 95 percent of the storm water part of the load. This tends to under-predict resultant water clarity.

EPA believes the proposed TMDLs meet the requirement to include a margin of safety.

7. The TMDLs have been subject to public participation.

A 30-day public comment period for the draft document took place from April 6, 2007 to May 7, 2007. Copies of the draft document were made available to the public at various locations including the Silver Spring Branch of the Montgomery County Public Library, the Greenbelt Branch of the Prince George's County Memorial Library System (PGCMLS) and the Hyattsville Branch of the PGCMLS. The draft document and a modeling report developed in support of this TMDL was also made available on MD's and the District's Internet at web sites. Copies could also be obtained directly from Maryland and the District.

EPA hosted a public meeting about the Anacostia River sediment/TSS TMDL for all interested parties from both Maryland and the District on Wednesday, April 25, 2007, at the Metropolitan Washington Council of Governments offices.

A response to comments document was submitted as part of the TMDL submittal. Comments were received from Anacostia Watershed Citizens Advisory Committee, Anacostia Watershed Society, Earthjustice Legal Defense Fund, Audubon Naturalist Society of the Central Atlantic Sates, Anacostia Waterfront Corporation, Anacostia Community Boathouse Association and the District of Columbia Water and Sewer Authority. EPA considered those comments and the District's response to them in its evaluation of the TMDL submission.

EPA believes the proposed TMDL meets the requirement to provide adequate opportunity for public participation.

VII. There is reasonable assurance that the proposed LAs can be met.

The TMDL report provides an adequate discussion of practicable implementation measures and strategies for achieving the TMDLs' nonpoint source allocations. The TMDL report notes that the nonpoint source reductions can be achieved by application of best management practices (BMPs). Forested and/or agricultural areas can be improved by riparian buffer systems. A riparian buffer reduces the effects of upland sediment sources through trapping and filtering. In agricultural areas (5% in the Anacostia watershed) comprehensive soil conservation plans can be developed that meet criteria of the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Field Office Technical Guide. Such Soil conservation plans help control erosion by modifying cultural and structural practices. The regulatory agencies in Maryland and the District of Columbia will continue to work with an active coalition of local, state and federal agencies, environmental organizations and citizens groups in the watershed to restore the river and its tributaries. Maryland and the District of Columbia intend for the required reduction to be implemented in an iterative process that first addresses those sources with the largest impact to water quality, with consideration given to ease and cost of implementation.

In the District of Columbia , in conjunction with voluntary activities to control nonpoint source pollution through the Nonpoint Source Management and Chesapeake Bay Implementation programs, various activities are regulated; land disturbing activities, stormwater management, and flood plain management. The District, under authority of various laws, implements a number of action plans that involve reviewing and approving construction plans for stormwater runoff control measures, flood plain intrusion, unstable soils, topography compatibility, erosion and sediment control measures, and landscaping; conducting routine and programmed inspections at construction sites; and providing technical assistance to developers and the District of Columbia residents; and conducting investigations of citizen complaints related to drainage and erosion and sediment control. EPA reasonably assumes that the District will approve and implement these plans in a away that will minimize runoff of sediment and other turbidity causing pollutants.

EPA anticipates that the funding will continue to be provided under Section 319 of the CWA for nonpoint source control. Additional funding sources for implementation include Maryland's Agricultural Cost Share Program (MACS) which provides grants to farmers to help protect natural resources, and the Environmental Quality and Incentives Program, which focuses on implementing conservation practices and BMPs on land involved with livestock and production.

VIII. Implementation

Neither the Clean Water Act nor the EPA implementing regulations, guidance or policy requires a TMDL to include an implementation plan. However, several activities are taking place or are planned that will begin the implementation process. These activities were described in the TMDL report and are summarized here. Further, the District and Maryland understand the importance of coordinating the implementation activities for the watershed. In a series of e-mails between the District and Maryland, there was agreement that the two jurisdictions would meet subsequent to the approval of the TMDL to discuss implementation issues. These discussions would include state staff responsible for the NPDES permitting as well as counties and most likely the soil conservation districts.

EPA regulations require that effluent limits in National Pollutant Discharge Elimination System (NPDES) permit that is issued, reissued or modified be consistent with the assumptions and requirements of any available wasteload allocation for that discharge in an approved TMDL. This TMDL provides wasteload allocations for all permitted sources discharging to the Anacostia River including the Municipal Separate Storm Sewer System (MS4) areas. Therefore, it is expected that the TMDL will be implemented under the NPDES program for all permitted discharges. The District of Columbia Water and Sewer Authority (WASA) has established a Long Term Control Plan (LTCP) for the reduction of CSOs and the sediment loads associated with them. Under its MS4 NPDES permit, the District is implementing a stormwater management plan to control the discharge of pollutants from separate storm sewer outfalls. The MS4 permit requires the implementation of available waste load allocations. It is expected that the Maryland MS4 permits will also include requirements to fully consider the wasteload allocation requirements of this TMDL.

For the sources that are not permitted, Maryland and the District of Columbia will work with an active coalition of local, state and federal agencies, environmental organizations and citizens groups in the watershed to restore the river and its tributaries. Maryland and the District intend for the required reductions to be implemented in an iterative process that first addresses those sources with the largest impact to water quality, with consideration given to ease and cost of implementation. The District of Columbia is also implementing a nonpoint source management plan through its Nonpoint Source management and Chesapeake Bay Implementation programs

Maryland and the District have several well-established programs to draw upon including, 1) the Water Quality Improvement Act of 1998 (WQIA) in MD, 2) the Erosion and Sedimentation Control Amendment Act of 1994 and the District of Columbia Law 5-188 (Storm Water Management Regulations – 1988) of the District of Columbia Water Pollution Control Act of 1984 in the District of Columbia, and 3) the Federal Nonpoint Source Management Program (Section 319 of the Clean Water Act). Pursuant to the 2000 Maryland Stormwater Design Manual, MDE requires an 80% reduction of sediments for new development. Additionally, for existing development, MDE's NPDES stormwater permits require watershed assessments and restoration based on impervious surface area. Currently, Prince George's and Montgomery Counties are required to restore 10% of their impervious areas.

In Maryland, Sediment and Erosion Control Programs are operated at the local level, where local governments have shown the ability to enforce the provisions of their ordinances relating to soil erosion and sediment control. MDE conducts periodic reviews of local programs to ensure that implementation is acceptable and has the authority to suspend delegation and take over any program that does not meet State standards.

There is also an active coalition of local, state, and federal agencies, environmental organizations and citizens groups working together to restore the river and its tributaries; this coalition can help to ensure the implementation of the sediment TMDLs. In 1987, the Anacostia Watershed Restoration Agreement was signed by Maryland, the District of Columbia, and Montgomery and Prince George's Counties, resulting in the formation of the Anacostia Watershed Restoration Committee (AWRC). Several sediment reduction strategies have been implemented and are ongoing under this agreement. For example, regular stream assessment monitoring and MS4 monitoring for constituents including TSS have been conducted in Prince George's and Montgomery Counties and in the District of Columbia. Various sediment reduction/controlling strategies are also ongoing in the watershed, including: street sweeping, storm drain-inlet cleaning, storm pipe cleaning in urban areas, stormwater ponds, and Environmental Site Design (ESD)/Low Impact Development (LID) projects.

Maryland and the District of Columbia intend for the required reductions to be implemented in an iterative process, which includes the existing stormwater management program and cooperation with AWRC. The iterative implementation of best management practices (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.