Decision Rationale
Total Maximum Daily Loads
Anacostia River Watershed
For Biochemical Oxygen Demand
Executive Summary

I. Introduction

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

$$TMDL = WLAs + LAs + MOS$$

where

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

This document sets forth the United States Environmental Protection Agency's (EPA) rationale for approving the TMDLs for biochemical oxygen demand (BOD) in the tidal Anacostia River. The following TMDL Summary table is discussed in Section IV.2. of the Decision Rationale.

TMDL Summary

TOTAL ANNUAL LOADS - POUNDS			
	BOD	Nitrogen	Phosphorus
Maryland			
Existing			
Anacostia River & Lower Beaverdam Creek	2,077,133	834,836	117,880
Watts Branch - 53%	38,935	12,333	1,568
Total	2,116,068	847,169	119,448
Allocated			
Anacostia River & Lower Beaverdam Creek	1,017,201	582,257	82,185
Watts Branch - 53%	19,067	8,602	1,093
Total	1,036,268	590,859	83,278
MOS	4,508	2,180	336
Reduction Required			

TOTAL ANNUAL LOADS - POUNDS			
	BOD	Nitrogen	Phosphorus
Anacostia River - %	51	30	30
Watts Branch -%	51	30	30
District of Columbia			
Upper Anacostia			
SW - Existing including 47% Watts Branch	167,668	43,818	7,205
SW - Allocated including 47% Watts Branch	81,083	29,196	4,893
MOS	2,751	1,430	151
Reduction Required - %	52	33	32
Lower Anacostia			
DC SW - existing	106,962	22,987	3,769
DC CSO - existing	1,574,132	95,674	55,878
Total - existing	1,681,094	118,661	59,647
DC SW - allocated	51,724	15,319	2,631
DC CSO - allocated	152,906	12,171	8,047
Total - allocated	204,630	27,490	10,678
MOS	6,265	2,930	519
Reduction Required - %			
DC SW	52	33	30
DC CSO	90	87	86
TOTAL	2,798,445	738,716	147,818
MOS	13,524	6,540	1,006

MOS = Margin of Safety
SW = Storm water
CSO = Combined Sewer Outfall

II. Background

The Anacostia River watershed covers 176 square miles in the District of Columbia and Maryland. The Basin is highly urbanized, with a population of 804,500 and a population density of 4,570 per square mile in 1990[1]. Only 25% of the watershed is forested and another 3% is wetlands. The non-tidal portion of the Anacostia River is divided into two branches, the Northeast Branch and the Northwest Branch. Their confluence is 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 6 ft, while the average depth at the Anacostia's confluence with the Potomac

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[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.

River is 20 feet. The average width of the river increases from 375 feet at Bladensburg to 1,300 at the mouth. Only 17 percent of the watershed lies withing the District. Much of this drainage is controlled by storm sewers or combined (storm and sanitary) sewers. In the tidal portion of the river combined sewer overflows (CSOs) are a contributor to low dissolved oxygen in the river. CSOs drain over eight square miles of the Basin in the District of Columbia, and 17 CSO outfalls drain directly into the tidal Anacostia River.

As the Anacostia River watershed is heavily urbanized, it can be expected to have the water quality problems associated with urban streams. The District is also a signatory to the Chesapeake Bay Agreement, pledging to reduce nutrient loads to the Bay by 40 percent or more by the year 2010.

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

The TAM/WASP model simulates the physical, chemical, and biological processes in the river which are believed to have the most significant impact on dissolved oxygen levels. TAM/WASP 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, 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, including use of a BASINS[2] model for the Watts Branch sub-watershed.

The model as used for this BOD TMDL has evolved from when ICPRB turned over the modified model to the District. The DC DOH and the DC Water and Sewer Authority (WASA) collaborated on model development, and, as each has different schedules for meeting their commitments, the model was in different stages of development at the time it was used.

IV. 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 eight 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.

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[2]Hydrologic Simulation Program - Fortran

4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a margin of safety.
7. There is reasonable assurance that the proposed TMDLs can be met.
8. The TMDLs have been subject to public participation.

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I. Introduction

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

This document sets forth the United States Environmental Protection Agency's (EPA) rationale for approving the TMDLs for biochemical oxygen demand (BOD) in the tidal Anacostia River. The TMDL was established to address impairment of water quality as identified in the District of Columbia's (DC) 1998 section 303(d) list of impaired waters. The DC Department of Health, Environmental Health Administration, submitted the *Total Maximum Daily Loads, Upper Anacostia River, Lower Anacostia River, District of Columbia, Biochemical Oxygen Demand*, dated May 2001 (TMDL Report), to EPA for final review on May 21, 2001. The TMDL Report uses as its technical basis *The TAM/WASP Model: A Modeling Framework for the Total Maximum Daily Load Allocation in the Tidal Anacostia River, Final Report* (modeling report), Interstate Commission on the Potomac River Basin, October 6, 2000. Additional documents used in EPA's review are listed below:

> *Manual For the TAM/WASP Modeling Framework, DRAFT,* Ross Mandel, Interstate Commission on the Potomac River Basin, February 28, 2000,
>
> Information enclosed with the Bureau of Enviromental Quality Letter dated September 12, 2001, and
>
> The computer files, together with a brief description used in EPA's review are listed in Appendix A.

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II. Summary

Table 1 presents the 1996 and 1998 section 303(d) listing information for the water quality-limited waters of the Anacostia River.

Table 1 - Section 303(d) Listing Information

S. No.	Waterbody	Pollutants of Concern	Priority	Ranking	Action Needed
1996 Section 303(d) list					
1.	Lower Anacostia (below Pennsylvania Ave Bridge)	BOD, F. Coliform and toxics in sediment and fish	High	1	Control CSO and NPS pollution
2.	Upper Anacostia (above Pennsylvania Ave Bridge)	BOD, F. Coliform and toxics in sediment and fish	High	2	Control CSO and NPS pollution
1998 Section 303(d) list					
1.	Lower Anacostia (below Pennsylvania Ave Bridge)	BOD, bacteria, organics, metals, total suspended solids, and oil & grease	High	1	Control CSO, point and Nonpoint Source (NPS) pollution
2.	Upper Anacostia (above Pennsylvania Ave Bridge)	BOD, bacteria, organics, metals, total suspended solids, and oil & grease	High	2	Control CSO, point and Nonpoint Source (NPS) pollution

CSO - combined sewer outfall
Total Suspended Solids (TSS) is not a criterion violation of Water Quality Standards (WQS). However, TSS is the major cause of violation of turbidity in the WQS. TSS is listed in Section 303(d) list, where high turbidity and or high siltation rate have been observed.

The TMDL is an analysis of the pollutant loads necessary to ensure that a waterbody will attain and maintain water quality standards. The TMDL considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a "margin of safety" value. Conditions, available data and the understanding of the natural processes are naturally variable and can change more than anticipated by the margin of safety. The option is always available to refine the TMDL for resubmittal to EPA for approval. Therefore, the TMDL may be modified when warranted by additional data or other information in the future.

EPA has long recognized[3] that developing and implementing a TMDL may not always be a simple process and that a phased approach as more scientific certainty is gained may be more appropriate. The level of effort and scientific knowledge needed to acquire adequate data and perform meaningful predictive analyses is often a function of the pollutant source, pollutant

[3] *Guidance for Water Quality-based Decisions: The TMDL Process*, EPA 440/-91-001, April 1991.

characteristics, and the geographical scale of the pollution problem. The Anacostia River, actually a fresh-water estuary, has been used and under significant environmental stress for 200 years and presents a difficult modeling problem. Under a phased approach, the TMDL has load allocations (LAs) and waste load allocations (WLAs) calculated with margins of safety to meet water quality standards. The allocations are based on data available and information at the time, but further monitoring for collection of new data to verify or modify assumptions and estimates is required in a phased TMDL. The phased approach provides for pollution reduction targets without waiting for new data collection and analysis.

In addition to the allocations for point and nonpoint sources, a TMDL under the phased approach will establish the schedule or timetable for the installation and evaluation of point and nonpoint sources load reductions, additional data collection, the assessment for water quality standards attainment, and additional predictive modeling. The scheduling with this approach should be developed to coordinate all the various activities (permitting, monitoring, modeling, etc.) and involve all appropriate local authorities, and state and federal agencies. The schedule for the installation and implementation of control measures and their subsequent evaluations will include the time frame within which water quality standards will be met and controls re-evaluated.

The following TMDL Summary table is discussed in Section IV.2:

Table 2 - TMDL Summary

TOTAL ANNUAL LOADS - POUNDS			
	BOD	Nitrogen	Phosphorus
Maryland			
Existing			
Anacostia River & Lower Beaverdam Creek	2,077,133	834,836	117,880
Watts Branch - 53%	38,935	12,333	1,568
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Reduction Required			
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MOS = Margin of Safety
SW = Storm water
CSO = Combined Sewer Outfall

III. Background

The Anacostia River watershed covers 176 square miles in the District of Columbia and Maryland.[4] 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[5]. Only 25% of the watershed is forested and another 3% is wetlands. The non-tidal portion of the Anacostia River is divided into two branches, the Northeast Branch and the Northwest Branch. Their confluence is 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 USGS 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

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[4]Much of the background information is taken from *The TAM/WASP Model: A Modeling Framework for the Total Maximum Daily Load Allocation in the Tidal Anacostia River* (modeling report), ICPRB, 2000.

[5]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.

Bladensburg is 6 ft, 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 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% 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 3 shows, the Anacostia River watershed is heavily urbanized and can be expected to have the water quality problems associated with urban streams. The District has several programs in place to control the effects of storm water runoff and promote nonpoint source pollution prevention and control. Because nonpoint source pollution problems are best addressed on a watershed-wide basis, the District also has joined with the State of Maryland, Prince George's and Montgomery Counties, the Army Corps of Engineers, and other federal agencies to form the Anacostia Watershed Restoration Committee, whose goal is to coordinate efforts to improve water quality in the Anacostia Watershed. The District is also a signatory to the Chesapeake Bay Agreement, pledging to reduce nutrient loads to the Bay by 40% by the year 2010.

Table 3 - Land Use in the Anacostia River Basin (acres)

Watershed	Residential	Commercial	Industrial	Parks	Forest	Agriculture	Other
NW Branch	14,044	1,437	117	2,155	6,592	2,428	1,908
NE Branch	16,086	2,333	1,391	1,393	14,445	4,978	5,897
Lower Beaverdam Creek	4,374	314	314	314	2,296	429	364
Watts Branch	1,691	116	23	190	289	0	96

(ICPRB, 2000)

In the tidal portion of the river combined sewer overflows (CSOs) are a contributor to low dissolved oxygen in the river. CSOs drain over eight square miles of the Basin in the District of Columbia, and 17 CSO outfalls drain directly into the tidal Anacostia River:

The two largest are the Northeast Boundary CSO, which drains into the Anacostia near RFK Stadium (East Capital Street), and the "O" Street Pump Station, just below the Navy Yard.

The management of CSOs is the responsibility of the Washington Water and Sewer Authority (WASA), an independent agency which is responsible for the District's combined sanitary and storm sewers, sanitary sewers, and the waste water treatment plant at Blue Plains. WASA is developing a Long-Term Control Plan (LTCP) for the District's CSOs, a draft LTCP has been submitted to EPA for review and approval. As part of the LTCP, computer simulation models of the District's combined sewer and storm water system were constructed. Those models were used to simulate current conditions and alternative management plans. As part of WASA's assessment of alternative control plans, the TAM/WASP model was also used to assess the impact of CSOs on water quality in the Anacostia River.

These BOD TMDLs were completed by the District to partially meet the first-year TMDL milestone commitments under the requirements of the 2000 TMDL lawsuit settlement of *Kingman Park Civic Association et al. v. EPA*, Civil Action No. 98-758 (D.D.C.). First-year milestones include the development of TMDLs for biochemical oxygen demand (BOD) and total suspended solids (TSS) for the upper and lower Anacostia River.

History and use of the Tidal Anacostia Model (TAM/WASP)

The TAM/WASP model simulates the physical, chemical, and biological processes in the river which are believed to have the most significant impact on dissolved oxygen levels. TAM/WASP 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 new implementation by Dr. Winston Lung[6] of the sediment oxygen demand (SOD) model of DiToro[7], 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, including use of a BASINS model for the Watts Branch sub-watershed. The methods are explained in detail in *The TAM/WASP Model: A Modeling Framework for the Total Maximum Daily Load Allocation in the Tidal Anacostia River, Final Report*.

The Anacostia River is not a static system. It continues to change, both from the forces of nature and man-made effects. Likewise, the model used to compute the BOD TMDL continues to change. Model development often proceeds from the simple to the complex and may go through several iterations. As additional data is collected, the understanding of the modeled system increases, and the modeled representation of the natural system can be improved.

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

[7]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.

The model as used for this BOD TMDL has evolved from when ICPRB turned over the modified model to the District. The DC DOH and the DC Water and Sewer Authority (WASA) collaborated on model development, and, as each has different schedules for meeting their commitments, the model was in different stages of development at the time it was used.

In the modeling report, ICPRB details the models' history, structure, modification, available data, calibration, verification, and sensitivity analysis. The model was turned over to the District, and WASA began testing the model for use in developing the long-term control plan (LTCP) for the CSOs.[8] The model was modified to reflect new information available, specifically, revised cross section geometry obtained from the Corps of Engineers reflecting recent dredging. DOH then used the model to develop the BOD TMDLs. Concurrently, DOH directed some of their EPA grant money back to EPA for a dye study during summer, 2000. WASA used the results of the dye study to further refine the model. WASA also funded studies to better estimate loads from the CSOs, to the river. WASA then turned the model back over to DOH.

DOH developed a draft BOD TMDL prior to August 2000 and was not able to use all of the model refinements while developing this TMDL. However, DOH was able to use the revised cross section geometry, which required re-calibrating the model. During recalibration, DOH found that the CSO loads used by ICPRB for model calibration needed modification to more accurately represent currently existing loads. Once EPA obtained the final model and input files, EPA was able to determine the correlation between the model calibration loads and submitted TMDL Report for the existing loads for BOD, total nitrogen (TN), and total phosphorus (TP). The storm water (SW) loads in the TMDL Report are equal to the calibration loads which were obtained from various sources as described in the modeling report. The CSO loads in the TMDL Report are 1.5 times the calibration loads which were estimated from 1988-1991 data collected at selected monitoring stations in the tidal Anacostia by Metropolitan Washington Council of Governments (MWCOG) and its subcontractor. The TMDL Report indicates the total CSO flow contribution to be 1.5 billion gallons per year based on a LTCP public meeting prior to August 2000. A WASA LTCP presentation June 11, 2001 estimates the CSO discharge to the Anacostia River to be 2.1 billion gallons per year, the June 2001 draft LTCP report estimated overflows to the Anacostia River based on three scenarios. Scenario B1 predicted 2.1 billion gallons per year based on flow conditions existing 1988 to 1990, 1.5 billion gallons per year with Phase I controls in place, and 1.3 billion gallons per year with Phase I controls in place with pump station rehabilitation. Phase I controls were implemented, although presently some are not operational, since 1990 and pump station rehabilitation are currently planned capital improvements. Therefore, NPDES permit effluent controls for the CSO system need to be consistent with the allocations contained in the TMDL rather than determined as an expression of CSO volume or percent reduction.

On September 12, 2001, the Department of Health sent a letter to EPA's Water Protection Division Director to clarify the figures and tables in the TMDL Report. The letter included a table of allowable loads for the TMDL allocation run. Those allowable loads are consistent with existing CSO loads equal to two times the calibration CSO loads as opposed to the 1.5 times

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[8]The proposed Long-Term Control Plan was submitted to EPA and public noticed June 2001.

stated in the TMDL Report. It should be noted that because of the discrepancies between the September 12, 2001 letter and the TMDL Report, EPA is approving the information in the TMDL Report and *not* the letter.

Loads are equal to flow times concentration. Table 8 shows the CSO constituent concentrations used in the TAM/WASP model used to determine the TMDL loads. A model utility multiplies the pre-Phase I CSO flow times the concentration times the user specified "source multiplier factor" to create a time-series table of CSO loads. It should be noted that the TMDL model does not vary the actual CSO volume but, in effect, varies the pollutant concentration. Considering the volume of the Anacostia estuary, approximately 3.1 *billion* gallons, and that the maximum daily CSO flow is approximately 211 million gallons per day, this approximation is reasonable.

WASA's more significant modification to the model that DOH was not able to be used for the development of the TMDLs was re-segmentation of the Anacostia River. The original TAM/WASP for the Anacostia as was configured as 15 water column segments overlying 15 sediment segments as shown in Figure 1. WASA's contractor incorporated EPA's dye study by increasing the number of water column and sediment segments to 35 each. It is anticipated that DOH will use the re-segmented model in a future reevaluation of this TMDL as part of the phased TMDL approach and repropose the BOD TMDL if necessary.

The hydrodynamic portion of the TAM/WASP model requires two types of times series, hourly tidal heights at the downstream boundary with the Potomac River and the daily rate of inflow for each modeling segment. Hourly tidal heights were obtained from the NOAA[9] web site for a station that is approximately at the confluence of the Potomac and Anacostia Rivers.

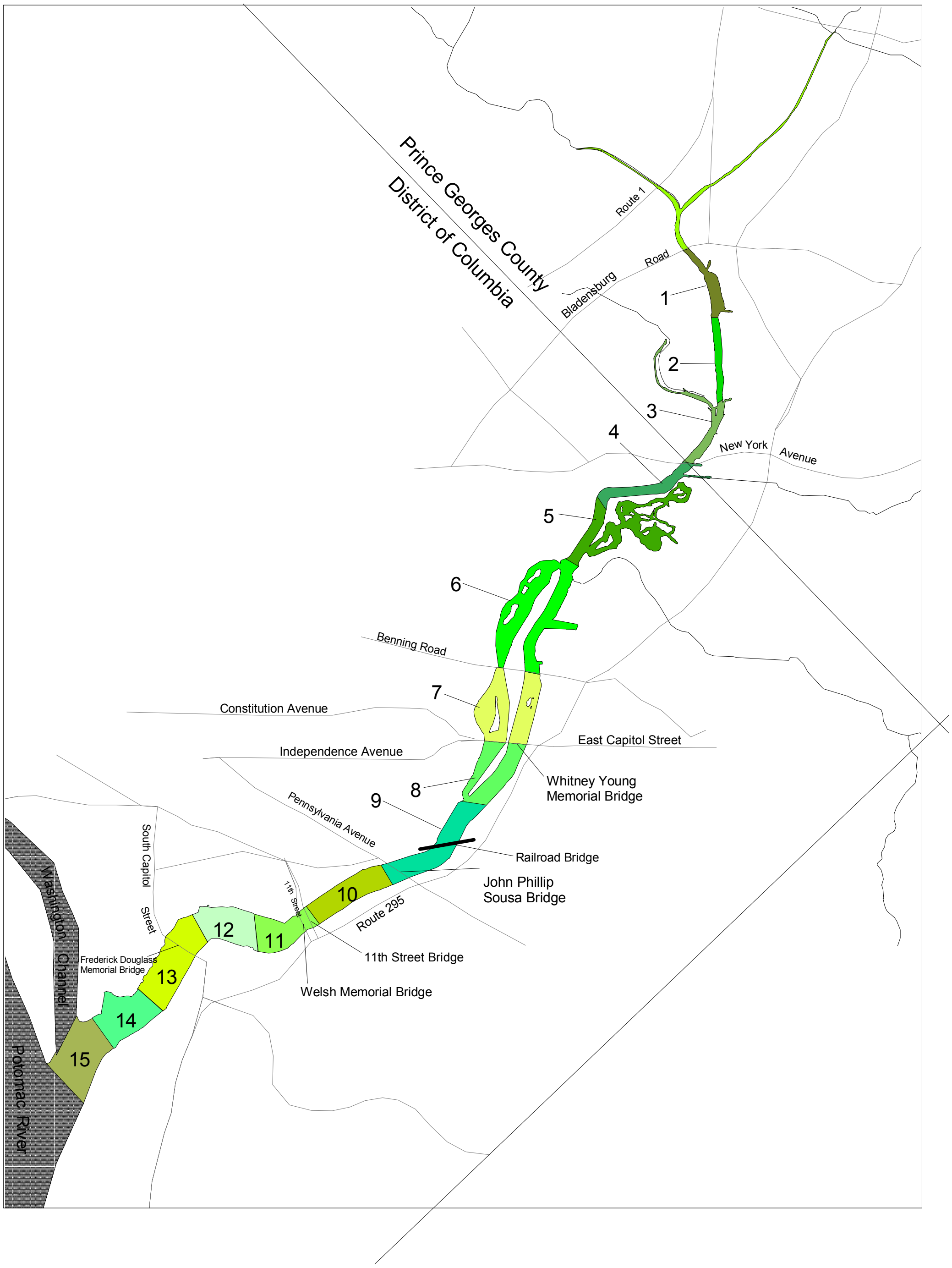
The rate at which water enters a model segment from outside the model boundary is also needed as input to the hydrodynamic model. For this TMDL, the sources of inflow include:

Non-tidal Anacostia River downstream of the Northwest and Northeast Branches
Lower Beaverdam Creek
Watts Branch
Other tributaries, storm sewers, and direct drainage to the tidal Anacostia River
Combined Sewer Overflows

The District did not attempt to include groundwater as an input flow. EPA concurs that groundwater is likely to have a minimal impact on dissolved oxygen.

The USGS maintains two surface-water gaging stations; one on the Northeast Branch and one on the Northwest Branch approximately at the head-of-tide on each branch. Daily flow from each of the stations was added and then multiplied by 1.02, as was done in the past use of TAM,

[9] National Oceanic and Atmospheric Administration



to account for the contribution from the area between the gages and the beginning of the first model segment at the Blandensburg Bridge.

Figure 1, Stream Model Segmentation

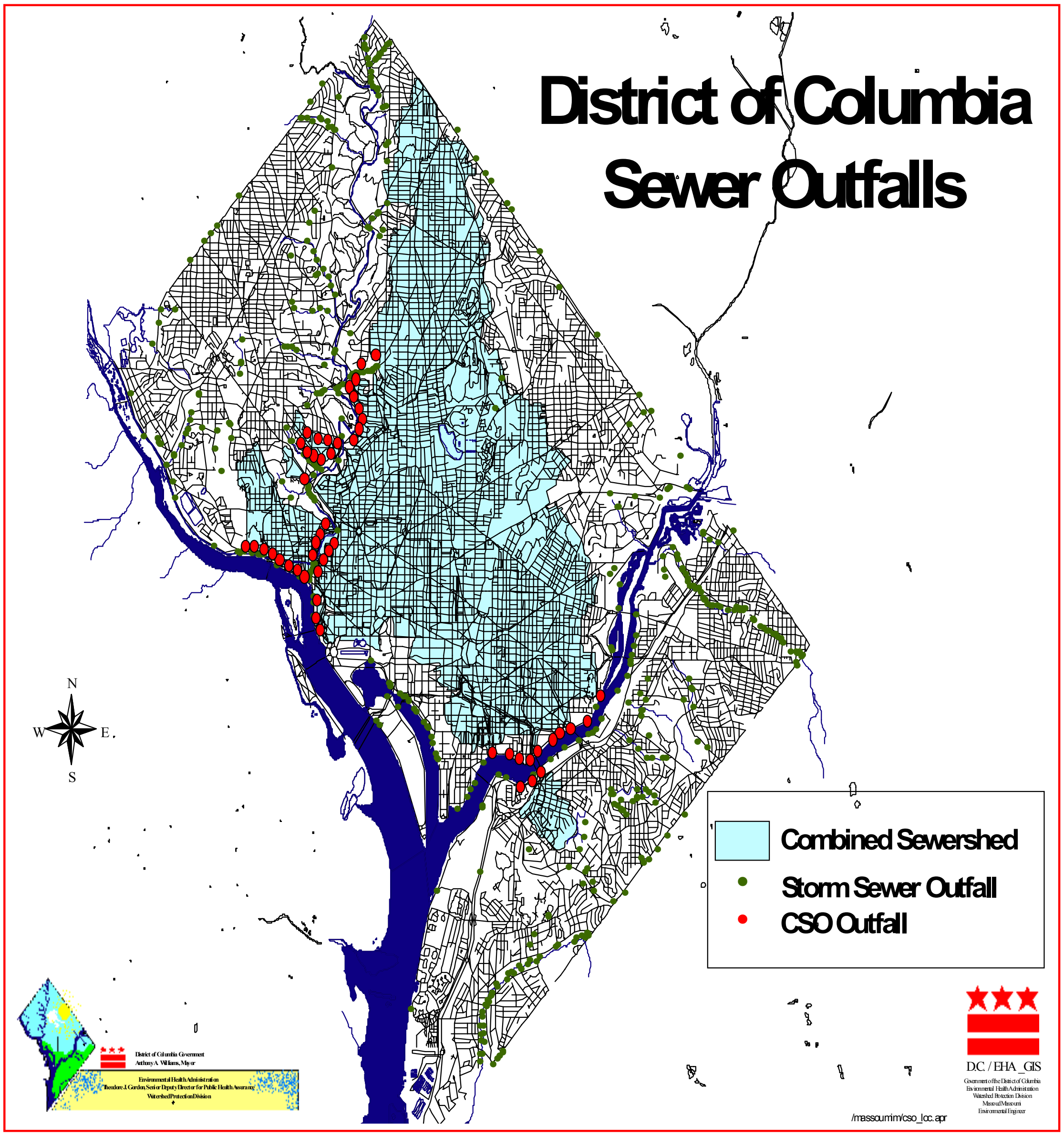


Figure 2: Combined Sewer Map

Prince George's County developed an HSPF[10] model for Lower Beaverdam Creek. This model was used to calculate the daily flow from Lower Beaverdam Creek. As most of the watershed lies within Maryland, all of the flow was counted as Maryland's storm water. The model was used without modifications to calculate the daily flow from Lower Beaverdam Creek.

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[10]Hydrologic Simulation Program - Fortran.

A BASINS model of Watts Branch was developed for this TMDL. The model was calibrated against a USGS surface water gage located one mile upstream from its mouth. Since approximately 53 percent of the watershed lies within Maryland, 53 percent of Watts Branch flow was counted as Maryland's storm water.

Flow contribution from other tributaries, storm sewers, and direct drainage to the tidal Anacostia River was estimated using the output from the Watts Branch model and land use types. Three distinct land use types were used to estimate flow to each Anacostia River model segment; impervious land, pervious forested land, and non-forested urban pervious land, *i.e.,* lawns and other areas covered with turf.

The locations of the combined sewer overflows are shown in Figure 2. The total daily flow to the tidal Anacostia River from all combined sewer overflows was estimated using a regression equation based on daily precipitation, including duration of precipitation, at Reagan National Airport, developed at the MWCOG and the WASA determination that precipitation as low as 0.27 inches can produce overflows. A model of combined sewer overflows to the tidal Anacostia River developed for MWCOG was used to apportion the total CSO flow to the TAM/WASP model segments. The total flow was apportioned as follows:

Table 4, Distribution of Total CSO Flow

WASP Segment	Percent of Flow Pre-Pase I Controls	Percent of Flow Post-Phase I Controls
9	51.3%	44.8%
10	0.2%	0.0%
11	7.4%	7.7%
12	4.8%	4.4%
13	36.3%	43.1%

(ICPRB,2000)

The above describes how flow to each WASP segment was determined. WASP also requires a daily input load for each of the eight modeled constituents for each model segment. These loads were generally calculated differently for each of the five different sources of flow. Moreover, each of the eight constituents–ammonia nitrogen, nitrate nitrogen, organic nitrogen, dissolved oxygen, chlorophyll A, BOD, inorganic phosphorus, and organic phosphorus–were often calculated using different methods even for the same source. Additional complexities were also taken into account, such as the differences introduced by Phase I CSO controls[11] or the potential difference in concentrations between storm flow and base flow.

In general, upstream loads from the non-tidal Anacostia River were calculated estimating constituent concentrations from available monitoring data and calculating the load as a product of the daily flow and the constituent concentration. Monitoring data was available from two sources. Prince George's County had a ambient monitoring program in place during the years 1985-1994 where monthly grab samples were collected at the USGS gages on the Northwest and

[11] Constructed in 1991.

Northeast Branches. Most of this data was collected under low flow conditions but some were collected on the falling limb of high flow event hydrographs. A second set of available data was provided by a study the Occoquan Watershed Monitoring Lab performed as part of the Coordinated Anacostia Regional Monitoring Program, 1989-1991, on the Northwest Branch at the USGS gaging station. However, the data sets were incomplete for purposes of developing this TMDL and a variety of methods were used to estimate loads. The results of the analyses are shown in the following tables.

Table 5. Upstream Constituent Concentrations.

Water Body	Flow Type	Constituent	Median Concentration (mg/l)
NW Branch	Base	Ammonia	0.016
NW Branch	Storm	Ammonia	0.075
NE Branch	Base	Ammonia	0.02
NE Branch	Storm	Ammonia	0.11
NW Branch	Storm	Nitrate	0.6
NE Branch	Storm	Nitrate	0.84
NW Branch	Base	Inorganic Phosphorus	0.017
NW Branch	Storm	Inorganic Phosphorus	0.24
NE Branch	Base	Inorganic Phosphorus	0.038
NE Branch	Storm	Inorganic Phosphorus	0.34
NW Branch	Base	BOD5	1.2
NW Branch	Storm	BOD5	8.0
NE Branch	Base	BOD5	1.2
NE Branch	Storm	BOD5	8.0
NW Branch	Base	Organic Nitrogen	0.34
NW Branch	Storm	Organic Nitrogen	2.14
NE Branch	Base	Organic Nitrogen	0.6
NE Branch	Storm	Organic Nitrogen	3.0
NW Branch	Base	Organic Phosphorus	0.017
NW Branch	Storm	Organic Phosphorus	0.24
NE Branch	Base	Organic Phosphorus	0.038
NE Branch	Storm	Organic Phosphorus	0.34
NW Branch	Base	Total Suspended Solids	5.0
NW Branch	Storm	Total Suspended Solids	310.
NE Branch	Base	Total Suspended Solids	77.0
NE Branch	Storm	Total Suspended Solids	527.

(ICPRB, 2000)

Nitrate concentrations show seasonality. Based on the data shown below, they are higher in the winter months than in the summer. Seasons were defined as follows, based on an examination of monthly values:

Winter: December -February
Spring: March-June
Summer: July-August
Fall: September-November

Seasonal nitrate concentrations for the Northeast and Northwest Branches are shown in Table 6.

Table 6. Seasonal Upstream Chlorophyll A and Nitrate Concentrations.

Constituent	Winter	Spring	Summer	Fall
Northwest Branch Base Flow Chlorophyll A (ug/l)	0.5	4.1	5.3	2.9
Northwest Branch Base Flow Nitrate (mg/l)	1.5	1.0	0.6	0.86
Northeast Branch Base Flow Nitrate (mg/l)	1.2	0.8	0.605	0.7

(ICPRB, 2000)

Prince George's County's HSPF model of the Lower Beaverdam Creek was used as a basis for calculating the loads of most of the constituents. The model directly calculates total nitrogen, total phosphorus, and BOD5 loads. These were adjusted for input into WASP as necessary.

The BASINS model of Watts Branch calculated daily loads of ammonia, nitrate, organic nitrogen, total phosphorus, and BOD5, five-day BOD. Ambient monitoring data was used to estimate concentrations in base flow of these constituents. The model was also calibrated for storm flow loads of BOD5, total nitrogen, and total phosphorus, using annual estimates of these loads calculated. The model includes the load table for Watts Branch.

Various procedures detailed in the modeling report were used to estimate the concentrations shown in the following table.

Table 7. Total Nitrogen, Total Phosphorus, and Total Suspended Solids Concentrations (mg/l) in Storm Water From Small tributaries, Storm Sewers, and Direct Drainage.

WASP Segment	Total Nitrogen	Total Phosphorus	BOD	Total Suspended Solids
1	3.2	0.59	11.9	165

WASP Segment	**Total Nitrogen**	**Total Phosphorus**	**BOD**	**Total Suspended Solids**
2	3.1	0.57	11.9	156
3	3.9	0.77	11.9	225
4	3.7	0.72	11.9	163
5	2.9	0.51	11.9	129
6	3.0	0.53	11.9	81
7	2.4	0.37	11.9	85
8	2.8	0.49	11.9	127
9	3.1	0.55	11.9	125
10	2.4	0.39	11.9	85
11	2.34	0.36	11.9	86
12	2.4	0.39	11.9	85

WASP Segment	Total Nitrogen	Total Phosphorus	BOD	Total Suspended Solids
13	2.4	0.37	11.9	85
14	2.4	0.37	11.9	86

(ICPRB, 2000)

Combined Sewer Overflow loads are uniformly calculated as the product of representative concentrations and CSO volume. Representative concentrations before Phase I controls were implemented are based on a 1983 study by O'Brien and Gere, as reported in Nemura and Pontikakis-Coyne (1991)[12], with the exception of dissolved oxygen, which was taken from Sullivan and Brown (1988)[13]. Table 8 shows the representative concentrations of the constituents. No chlorophyll concentration is associated with CSOs.

After Phase I controls were implemented, no adjustment was made in CSO concentrations, except for flows from Model Segment 9 where the swirl concentrator is located. Following Nemura and Pontikakis-Coyne, it was assumed that the concentrator was effective in reducing BOD5 in treated flows by 25%. This percent reduction was applied to the other constituents that are transported significantly in the solid phase: organic phosphorus, organic nitrogen, and inorganic phosphorus. It was also assumed that all of the flow in Segment 9 would receive treatment unless the total CSO volume entering the Anacostia exceeded 62.5 mgd.

Table 9 shows the estimated average annual loads by source for each of the WASP constituents for the calibration scenario. The averages are for the period 1985-1994. It should be noted that DOH selected a representative period of 1988 to 1990 to develop this TMDL and increased the CSO calibration loads by 50 percent to represent existing CSO loads.

Table 8. Constituent Concentrations in CSOs.

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[12]Nemura, A. and E. Pontikakis-Coyne, 1991, *Water Quality Benefits of Combined Sewer Overflow Abatement in the Tidal Anacostia River,* Metropolitan Washington Council of Governments, Washington, DC.

[13]Sullivan, M. P., and W. E. Brown, 1988, *The Tidal Anacostia Model*, Metropolitan Washington Council of Governments, Washington, DC.

Constituent	Concentration (mg/l)
Ammonia	2.2
Nitrate	0.72
Inorganic Phosphorus	1.4
Chlorophyll a	0.0
BOD5	77.0
Dissolved Oxygen	2.0
Organic Nitrogen	4.1
Organic Phosphorus	2.7
Total Suspended Solids	367

(ICPRB,2000)

Table 9. Average Annual Constituent Loads to Tidal Anacostia River (kg/yr and lb/yr).

Constituent	Upstream	CSOs	Lower Beaverdam Creek	Watts Branch	Tributaries	Total

	Lb/yr	Kg/yr	Lb/yr	Kg/yr	Lb/yr	Kg/yr	Lb/yr	Kg/yr	Lb/yr	Kg/yr	Lb/yr	Kg/yr
Ammonia	17,026	7,739	22,343	10,156	1,753	797	1,615	734	4,706	2,139	47,443	21,565
Nitrate	224,631	102,105	7,313	3,324	15,785	7,175	14,806	6,730	42,350	19,250	304,885	138,584
Inorganic Phosphorus	50,061	22,755	13,831	6,287	1,276	580	1,379	627	5,130	2,332	71,678	32,581
Chlorophyll A	325	148	0	0	26	12	10	5	0	0	361	164
BOD5	1,682,624	764,829	760,694	345,770	127,321	57,873	68,484	31,129	245,414	111,552	2,884,537	1,311,152
Dissolved Oxygen	2,956,413	1,343,824	20,310	9,232	224,235	101,925	70,622	32,101	176,233	80,106	3,447,814	1,567,188
Organic Nitrogen	469,295	213,316	40,504	18,411	4,385	1,993	5,040	2,291	11,763	5,347	530,988	241,358
Organic Phosphorus	50,061	22,755	26,673	12,124	1,276	580	1,379	627	5,130	2,332	84,520	38,419

(ICPRB, 2000 with Lb/yr columns added)

IV. 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.

The designated uses for the Anacostia River include:

A. Primary contact recreation,
B. Secondary contact recreation and aesthetic enjoyment,
C. Protection and propagation of fish, shellfish and wildlife,
D. Protection of human health related to consumption of fish and shellfish, and
E. Navigation.

The District's water quality standards do not have a quantifiable level for BOD or nutrients. Instead, this TMDL uses their impact on dissolved oxygen as the measure for the attainment of the water quality standards and the designated use C, protection and propagation of fish, shellfish, and wildlife.[14] The dissolved oxygen standard is a two-part standard shown in Table 10.

The BOD affects the average daily dissolved oxygen in the river. The nutrients, principally nitrogen and phosphorus, and temperature are responsible for the diurnal swing of dissolved oxygen in a waterbody.[15]

The District will evaluate whether or not the upper and lower Anacostia River needs to be separately identified on the 2002 Section 303(d) list for impairment of water quality standards from excess nutrients. If listed, EPA expects the District to develop TMDLs in association with any BOD/dissolved oxygen remodeling as part of the phased TMDL.

The majority of the Anacostia River watershed lies in Maryland. Therefore, as provided for by the Clean Water Act, the Anacostia waters crossing the DC/Maryland border must meet the District's water quality standards at the border. However, Maryland's dissolved oxygen standard

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[14]EPA does not consider that low dissolved oxygen levels, in and of themselves, affect primary and secondary recreational uses.

[15]ICPRB has estimated the maximum diurnal swing from daily average to minimum daily to be 0.7 mg/l depending on the season.

is more stringent than the District's, requiring that the dissolved oxygen level may not be less than 5 mg/l at all times.

Table 10. Water Quality Standards

Dissolved Oxygen - Protection of Aquatic Life	
District of Columbia	
Minimum Daily Average (3 samples per 24 hours, one sample per 8-hour)	5.0 mg/l
One-hour minimum	
March through June	5.0 mg/l
July through February	4.0 mg/l
Maryland	
Not less than at any time	5.0 mg/l

The following discussion is based on the TMDL scenario identifying that existing CSO loads are equal to 1.5 times the calibrated CSO loads. Initial computer scenarios concentrated on determining the storm water load reduction required in Maryland in order to meet the District's water quality standard at the Maryland/ District line. The District determined that about a 50 percent BOD load reduction and a 30 percent nitrogen and phosphorus load reduction in Maryland, consistent with the Chesapeake Bay Agreement, "would usually meet" the District's dissolved oxygen standards at the Maryland/District line. It should be noted that the model only provides the daily average dissolved oxygen value.

The District provided 13 scenarios with varying reductions in Maryland and the District storm water, BOD and nutrients, and the District's CSO loads. For scenario 13:

> Storm water loads from Maryland were reduced by 70 % to meet WQS at the Maryland/DC boundary. CSO loads were reduced by 90 %. Storm water loads were reduced by 50% BOD and nutrients by 30%. Water quality standards were met at all times.

However, the District choose scenario 11 as the TMDL scenario. Scenario 11:

> Storm water loads from Maryland were reduced by 50% for BOD and by 30% for phosphorus and nitrogen. DC loads from storm water were reduced by 50% for BOD and 30% for nitrogen and phosphorus. CSO were reduced by 90% for BOD and nutrient (*sic*). DO (dissolved oxygen) standards were met except for three storms.

The TMDL Report indicates that water quality standards are not met only during large storms at the Maryland/District line. To prevent low DO levels, the District increased Maryland's reduction by 17,224 pounds of BOD load. The "large storms" are not defined. With the additional load reductions from Maryland, EPA believes the TMDL adequately meets the requirement of attaining water quality standards for the daily average DO of 5 mg/l . EPA also believes and an estimated diurnal swing between daily average DO and minimum daily DO of 0.7 mg/l, may meet the hourly minimum DO.

Using the initially provided Access® database to generate the load input file, together with the hydro, input, and modified program as provided by the District, EPA could replicate the input loads and scenario plots.[16] The TMDL scenario 11[17] predicts that the water quality standard for average daily DO at the Maryland/District line will not be met only four times in 1989 model year, the wetter-than-average year.

Table 11. Comparison of Low Dissolved Oxygen* Rates Between Existing and TMDL Scenarios

Segment	Location	Existing CSO Loads - 1.5 x Calibrated CSO Loads	TMDL Scenario - 90% CSO, 50% BOD, 30% Nitrogen, Phosphorus Reductions**	
		No. of Low Dissolved Oxygen Days	No. of Low Dissolved Days	Dates
3	Maryland/District Line	93	4***	7/10/89, 7/24-26/89
6	Benning Road	173	25	6/20/89, 6/26-7/3/89, 7/9-14/89, 7/23-31/89, 7/19-20/90

[16]Although the District provided the scenario plots, the output files with the actual values were not provided.

[17]CSO loads equal to 1.5 times the calibration CSO loads.

9	Pennsylvania Ave.	194	26	6/26-7/2/89, 7/9-16/89, 7/24-31/89, 8/14-16/90
13	South Capital Street	93	0	

*Daily average dissolved oxygen less than 5.0 mg/l.
**Without removal of the additional 17,224 pounds of BOD by Maryland during the large storms.
***In-stream daily average dissolved oxygen for the four days are 4.99, 4.73, 4.74, and 4.99 mg/l.

Examination of the input data failed to disclose identifiable conditions, *e.g.,* precipitation, water temperature, flow, associated with the water quality standard violation at the Maryland/District line.

While EPA expects that the additional 17,224 pounds of BOD load reduction by Maryland adequately addresses the four low dissolved oxygen events at the Maryland/District line, it is less clear as to the effect of that load reduction on the low dissolved oxygen events predicted at Benning Road and Pennsylvania Ave. Certainly it is reasonable that such a reduction would significantly reduce the number of low dissolved oxygen events. EPA cannot predict that the TMDL allocation will not adequately address those downstream portions of the Anacostia River. EPA likewise cannot predict how many, or even if, low dissolved oxygen events will occur. Based on the basis of the explicit margin of safety contained in the TMDL, the above discussion, and the District's commitment to reevaluate this TMDL as part of the phased TMDL process, EPA concludes that this TMDL adequately achieves and maintains applicable water quality standards.

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

The BOD, nitrogen, and phosphorus loads to the Anacostia River are divided into storm water (SW) and combined sewer outfalls (CSOs). The permitted point source CSO loads are not entered into the model individually but are added together for each river model segment, Figures 1 and 2. The model and TMDL Report treat all point source discharges within a river model segment as one source. The required percent reduction for all CSOs loads is 90 percent.

Likewise, all storm water discharging to a river model segment are lumped together. The model does not distinguish between storm water discharging from storm sewer outfalls, overland flow adjacent to the river, and tributary (*e.g*., Watts Branch) flow. The municipal separate storm sewer system outfalls are subject to a NPDES permit, *i.e.,* the MS-4 permitted outfalls. Federal regulations at 40 CFR § 122.2 defines a point source as "any discernible, confined. and discrete conveyance, including put not limited to, any pipe, ditch, channel, tunnel, conduit, well," etc., which would include any tributary flow which happens to be piped prior to discharge to the river. As the source of all storm water loads are the same, *i.e.,* wash off from land surfaces, it is appropriate to require the same percent reduction for BOD, nitrogen, and phosphorus loads as shown in the following table.

Table 12. Allocated Loads

Segment	Source	BOD lb/yr	Nitrogen lb/yr	Phosphorus lb/yr
Maryland loads from Northwest Branch, Northeast Branch, Lower Beaverdam Creek, and 53 % of Watts Branch				
	SW	1,040,776		
Margin of Safety		4,508		
Total		1,036,268	590,859	83,278
Upper Anacostia loads from segments 4 to 8				
4	SW	12,844	5,591	1,086
5	SW	19,271	6,564	1,156
6	SW	19,583	8,464	1,116
7	SW	11,976	3,376	520
8	SW	20,160	6,631	1,160
Subtotal		83,834	30,626	5,038
Margin of Safety		2,751	1,430	151
Total		81,083	29,196	4,887
Lower Anacostia loads from segments 9-15				
9	SW	12,172	4,432	788
9	CSO	80,753	7,362	4,300
10	SW	11,153	3,146	510
10	CSO	315	29	17
11	SW	1,848	508	79
11	CSO	11,649	1,062	620
12	SW	12,145	3,425	557
12	CSO	7,556	689	402
13	SW	10,156	2,864	440
13	CSO	57,141	5,209	3,043
14	SW	6,007	1,694	441
SW		53,481	16,069	2,815
CSO		157,414	14,351	8,382
Subtotal		210,895	30,420	11,197
Margin of Safety		6,265	2,930	519

Segment	Source	BOD lb/yr	Nitrogen lb/yr	Phosphorus lb/yr
Maryland loads from Northwest Branch, Northeast Branch, Lower Beaverdam Creek, and 53 % of Watts Branch				
Total Lower Anacostia				
SW		51,724	15,319	2,631
CSO		152,906	12,171	8,047
ALL DC				
TOTAL	SW	132,807	44,515	7,518
TOTAL	CSO	152,906	12,171	8,047
TOTAL	DC	285,713	56,686	15,565

Based on the existing CSO loads equal to 1.5 times the calibrated CSO loads

Load, at any time at any point is equal to volume (or flow) times concentration. For the time period used in developing these TMDLs, January 1, 1988 to December 31, 1990, the daily CSO flow ranges from zero to approximately 211 mgd, the model reduces or increases loads by varying concentrations, not flows. The calibration BOD concentration is 77 mg/l. To represent existing conditions, the District multiplies the CSO loads by 1.5, increasing the concentration to 115.5 mg/l, and reducing the TMDL CSO load by 90 percent or decreasing the concentration to 11.55 mg/l. It is anticipated that the CSO volume will be reduced by 90 percent to meet the TMDL loads, therefore, the concentration of the reduced flow is 115.5 mg/l.[18] However, the CSO flow is not evenly spaced over the model segments, Table 4, Distribution of Total CSO Flow, and further studies have shown that the concentration varies from CSO to CSO.[19] Therefore, the District's reevaluation of the BOD TMDL may result in a different allowable CSO concentration.

Similarly, the TMDL loads resulting from nitrogen and phosphorus containing compounds are assumed to have an existing concentration with a reduced flow as shown below.

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[18]In fact, the concentration of the combined sewer flow is not constant but varies over the course of an event (storm). The event mean concentration, defined as the total mass of pollutants discharged divided by the total overflow, may not exceed the TMDL concentration.

[19]Table 2-2, CSO Event Mean Concentrations, *Study Memorandum LTCP-5-8: CSS and SSWS Event Mean Concentrations*, Draft, September 2000.

Table 13. TMDL Concentrations in CSOs.

Constituent	Concentration (mg/l)
Ammonia	3.3
Nitrate	1.08
Inorganic Phosphorus	2.1
Organic Nitrogen	6.15
Organic Phosphorus	4.05

For wet weather permitting purposes, an adequate measure of the allocated load would be to monitor individual pipes for flow and concentration to determine the event mean concentration to document conformance to this TMDL. EPA's guidance document, *Combined Sewer Overflows, Guidance for Monitoring and Modeling,* EPA 832-B-99-002, January 1999, provides further details for a monitoring program.

Storm water BOD, nitrogen, and phosphorus loads vary by season and by source as shown in Tables 5, 6, and 7. It is assumed that generally storm water volume or flows will not be significantly reduced but that the concentrations will be reduced by 30 percent.

Table 14. Total Nitrogen and Total Phosphorus TMDL Concentrations (mg/l) in Storm Water From Small tributaries, Storm Sewers, and Direct Drainage.

WASP Segment	Total Nitrogen	Total Phosphorus	BOD
1	2.2	0.41	5.95
2	2.2	0.40	5.95
3	2.7	0.54	5.95
4	2.6	0.50	5.95

WASP Segment	Total Nitrogen	Total Phosphorus	BOD
5	2.0	0.36	5.95
6	2.1	0.37	5.95
7	1.7	0.26	5.95
8	2.0	0.34	5.95
9	2.2	0.38	5.95
10	1.7	0.27	5.95
11	1.6	0.25	5.95
12	1.7	0.27	5.95
13	1.7	0.26	5.95
14	1.7	0.26	5.95

As part of the TMDL 50% reduction in BOD loading, the TMDL Report refers to storm water permitting for federal facilities. Future NPDES permits require BOD reductions consistent with the waste load allocations, based on storm water monitoring if available. The TMDL allocated Washington Navy Yard 50 percent and 30 percent nutrient reductions for the existing loading rate for BOD of 81.8 pounds per acre, for phosphorus of 2.4 pounds per year, and for nitrogen of 15.9 pounds per year. The District's response to comments table dated November 20, 2000 and revised April 23, 2001, indicated that the Pepco/Benning Road facility will also have storm water BOD reductions required in their permit.

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

All of Maryland's pollutant loads are "background" to the District's portion of the Anacostia River. Maryland's contribution to the pollutant loads has been estimated based on available information. It should be noted that Maryland Department of the Environment's (MDE) schedule for developing TMDLs for the non-tidal Anacostia River is 2004. MDE is currently having Maryland's portion of the watershed modeled using the Hydrologic System Program - Fortran (HSPF) to refine load estimates in preparation for developing their TMDLS.

4. The TMDLs consider critical environmental conditions

The TMDL Report identifies the combination of events of large rainfalls, CSO discharges, sediment (particulate BOD) accumulated during cold weather and decomposing in warm weather, leading to dissolved oxygen conditions in the estuary during the summer. The District's analysis disclosed that different combinations of events produce low dissolved levels. Therefore, even though the low dissolved oxygen events occur during the summer, seasonal allocations are not appropriate. The TMDLs are expressed as average annual loads recognizing that for these precipitation driven events, the event mean concentration is the limiting parameter.

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.

At the Ronald Reagan National Airport, the average annual rainfall for the period of record, 1949 to 1998, is 38.95 inches.[20] Yearly totals vary, from 26.94 inches in 1965 to 51.97 inches in 1972. Individual events, often hurricanes, can be significant. Hurricane Agnes in 1972 delivered approximately 10 inches of rain in the Washington, DC area. The District selected 1988 to 1990 as their representative rainfall years as shown:

Table 15, Rainfall

Year	Annual Rainfall (inches)	Representing
1988	31.74	10 percentile, dry year

[20] *Study Memorandum LTCP-3-2: Rainfall Conditions*, draft, September 1999.

1989	50.32	90 percentile, wet year
1990	40.84	median, approx. 38 percentile

(LTCP-3-2, September 1999)

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.

6. The TMDLs include a margin of safety.

The Clean Water Act and federal 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 suggest two approaches to satisfy the MOS requirement. First, it can be met implicitly by using conservative model assumptions to develop the allocations. Alternately, it can be met explicitly by allocating a portion of the allowable load to the MOS.

DC has chosen to use a one percent margin of safety taken from the total allowable load. DC has divided the MOS as shown in Table 12, Allocated Loads. Note that the TMDL requires sources over which the District of Columbia has control over are required to absorb more of the MOS reduction than the upstream Maryland sources. For example, the total margin of safety is one percent of the BOD TMDL load or 13,524 pounds of which the District is assuming responsibility for 6,265 pounds or 46 percent when only 17 percent of the Anacostia River watershed lies within the District.

With respect to CSO loads, there is an implicit margin of safety, the recognized "first flush" effect. If the CSO concentrations were constant over time, capturing 90 percent of the volume captures 90 percent of the load; however, as concentrations are generally higher for the first one-half inch of storm water runoff, capturing 90 percent of the volume captures more than 90 percent of the storm water part of the load. The relative proportion of storm water to sanitary flow determines the size of the margin of safety.

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

Based on the waste load allocation in the TMDL Report, the largest reduction in permitted loads to the Anacostia River will be to the CSOs at a 90 percent reduction based on the existing BOD loading equal to 1.5 times the calibration loads. The WASA-recommended LTCP reduces the volume of CSO flow by 95.5 percent based on a average annual volume of 2,142 million gallons per year (mgal). The proposed LTCP allows approximately 96 mgal/yr to actually enter the Anacostia River which represents a 96.5 percent reduction in volume based on TAM/WASP. The model assumes constant concentrations in CSO flow. Therefore, this TMDL requirement for a 90% reduction is reasonable.

The MS4 (municipal separate storm sewer system) permit and the NPDES storm water permits both provide regulatory authority to require storm water load reductions, providing reasonable assurance that the TMDLs will be implemented.

The re-affirmed Chesapeake Bay Agreement signed June 28, 2000, requires a 40% reduction in nutrients, nitrogen and phosphorus from the base year of 1985. With both the District and Maryland as signatories to the agreement, the 30% reduction in nutrients is reasonable. While the agreement doesn't address BOD loads specifically, it does address BOD reductions indirectly by establishing "no discharge zones" for human waste from boats. The Chesapeake Bay 2000 Agreement provides that there shall be no discharge of human waste from boats by 2003. The District intends to comply with that provision and has funded pump-out stations at every marina on the Anacostia River.

The water quality criterion against which this TMDL is evaluated is dissolved oxygen. In addition to BOD and nutrients reducing dissolved oxygen, sediment oxygen demand (SOD) also reduces the dissolved oxygen and is included as a sub-model to TAM/WASP. In the Chesapeake Bay Agreement one of the action items for the goal of achieving and maintaining the water quality necessary to support the aquatic living resources of the Bay and its tributaries is the control of sediment. In addition, Maryland has the duty to meet water quality standards at the Maryland/District line.

8. The TMDLs have been subject to public participation.

DC public noticed a August 2000 version of this TMDL from August 18 to September 18, 2000, but extended the public comment period to October 17, 2000. The TMDL was placed in the Martin Luther King Jr. Library and on the District's web site. A public hearing was held August 29, 2000.

The District and WASA held monthly technical (modeling) meetings where interested parties were briefed on the technical progress toward the District's TMDLs and WASA's LTCP.

As part of DC's TMDL submittal, a response to comments document dated November 20, 2000, and revised April 23, 2001 was submitted. The only comments received during the public comment period were from Earthjustice Legal Defense Fund and the District of Columbia water and Sewer Authority.

V. Phased TMDL Requirements

EPA's 1991 document, *Guidance for Water Quality-based Decisions: The TMDL Process,* allows the use of a phased TMDL, where a TMDL is developed using the best available information but the TMDLs need to be reevaluated when newer information is available.

> In addition to the allocations for point and nonpoint sources, a TMDL under the phased approach will establish the schedule or timetable for the installation and evaluation of point and nonpoint source control measures, data collection, a the

assessment for water quality standards attainment, and, if needed, additional predictive modeling.

The *Reasonable Assurance and Continuing Efforts, Future Activities* section of the TMDL Report identifies additional data gathering activities underway and states that with the availability of improved information, the BOD TMDL should be revised in the next year. As the TMDL Report is dated May 2001 and EPA approval is in December 2001, and that several of the activities identified have already been completed, it is anticipated that the District will accomplish a re-evaluation of the BOD TMDL by December 2002.

The current status of the ten items identified by the District is:

1. WASA has submitted a draft LTCP to EPA for review. EPA considered that the current draft LTCP represents the minimum controls that may be established.

2. The dye study is completed.

3. A sediment flux study was funded by the District. Although the project period is two years, it is believed that revised numbers may not have a significant impact on the model results.

4. The additional dissolved oxygen monitors are in place.

5. The one item that the District has no control over is Maryland's progress with modeling the non tidal Anacostia River. The new modeling should improve, or verify, the accuracy of the Maryland loads. At the monthly modeling meetings, Maryland Department of Environment has committed to expediting the project to the extent possible.

6. The sediment movement study and model development are complete.

7. & 8. The TSS and light extinction models are complete and will be incorporated into the total suspended solids (TSS) model.

9. Extending the modeling period to the present date has yet to be done.

10. The April section 303(d) list of impaired waters is now due in October 2002; however, that does not preclude the District from making the decision to include nutrients on the next section 303(d) list and developing a nutrient TMDL by December 2002.

Appendix A
Description of Required Computer Files

EPA requested application, data, and input files for the TAM/WASP model used to develop the BOD TMDLS. EPA considers it necessary to include the files is their administrative record to support the final decision to approve or disapprove the submitted TMDLs.

The TAM/WASP model is two computer models where an output file of TAM is used as an input file to WASP.

On March 8, 2000 EPA was given the following files:

TAM files:

hydro.exe	the application file for the hydrodynamic model
tam88.prj	a project file that specifies input files and the output file name
anacgeom.inp	the river geometry file
Tam88.inp	an input file
taminit.inp	a initialization file
tides.inp	the tide input file

The tam88.prj file specifies an output file named tam88.hyd which is used as an input file to WASP.

WASP files:

wasped.exe	the application file for the water quality model
tam88.nps	the load file which was created or modified by the supplied Access® file
t3z1.inp	a required input file was not provided with the above files but was provided by ICPRB September 2000.

The District continued to fine tune the computer models and river geometry. On September 15, 2000, the District provided the "final" files:

scena61.nps	which was not the final TMDL load file
scena61.inp	the WASP input file which called for a an88-A.hyd file

The above two files would not run with the wasped.exe file. In response to EPA's request for the actual files used to develop the TMDLs, the District provided a second CD which contained the same files as the original CD and the input file, t3z1.inp.

When in August 2001 ICPRB provided the updated WASP application file, tweuv1p1.exe, the scena61.nps and scena61.inp files ran.

In September 2001 the District provided the TAM output file based on revised geometry, an88-A.hyd, the WASP calibration load file, calibration.nps, and the actual TMDL scenario load file, scena46.nps.

With the final application and input files, EPA reviewed the May 2001 BOD TMDL submittal. It should be noted that the District provided output from their various scenarios as plots in MS Word® of dissolved oxygen only. The District did not provide the Excel® data for the plots.