Appendix D
Technical Approach Used to Generate Maximum Daily Loads

Summary

This appendix documents the technical approach used to define maximum daily loads for BOD and nutrients (i.e., total phosphorus and total nitrogen) consistent with the average annual TMDLs which, when met, are protective of water quality standards in the Anacostia River over the entire year. The approach builds upon the modeling analysis that was conducted to determine the loadings of BOD and nutrients that comply with 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 loading targets will result in compliance with the applicable water quality standards during all regulatory seasons. These average annual 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 is consistent with the approach used for expressing daily loads in the U.S. EPA-approved Anacostia River TSS TMDL (MDE and DDOE 2007).
- 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.

Introduction

The Anacostia River is listed on the District of Columbia Section 303(d) list as impaired by total suspended solids (TSS) and biochemical oxygen demand (BOD), and on the Maryland Section 303(d) list as impaired by nutrients. BOD, total nitrogen (TN) and total phosphorus (TP) loadings are being addressed within the TMDL. A TMDL for both the non-tidal and tidal portions of the Anacostia River that are designated as impaired for sediment and TSS on the Maryland and DC 303(d) lists was previously established and approved by U.S. EPA in 2007 (MDE and DDOE 2007). The purpose of the discussion in this Appendix is to document the technical approach used to develop and represent the average annual TMDLs for BOD, TP and TN in “daily” terms, similarly to the daily load expressions presented in the 2007 TSS TMDL.

This appendix documents the development and application of the approach used to define total maximum daily loads on a daily basis. It is divided into sections discussing:

- Basis for Approach
- Options Considered
- Selected Approach
- Application of Approach

Basis for Approach

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

- **Anacostia River TSS TMDL:** The 2007 TSS TMDL approved by U.S. EPA protected the aquatic life use, SAV, through interpretation of the narrative standard expressed as annual/seasonal loads. Daily load expressions for TSS sources were developed and presented in that TMDL.
- **Daily time-series loadings developed for this nutrient and BOD TMDL:** This nutrient and BOD TMDL employed continuous simulation modeling to determine compliance 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 U.S. EPA guidance on "Options for Expressing Daily Loads in TMDLs"**: The draft U.S. EPA guidance on presenting daily loads in TMDLs (U.S. EPA 2007) provides options for defining maximum daily loads when using TMDL approaches that generate daily output.

The rationale for developing TMDLs with *daily* load expressions was to accept the existing TMDL development methodology, but to then develop a method for converting the resulting daily time series of loadings into maximum *daily* values – in a manner consistent with EPA guidance. This same approach was utilized for the 2007 Anacostia River TSS TMDL.

Options Considered

The available guidance for developing daily loads does not specify a single allowable approach; it contains a range of options. Selection of a specific method for translating a time-series of allowable loads into expression of a TMDL requires decisions regarding both the level of resolution (e.g., single daily load for all conditions vs. loads that vary with environmental conditions) and level of probability associated with the TMDL.

This section describes the range of candidate options that were considered for use in developing maximum daily loads for the Anacostia River. It is divided into discussions corresponding to the two primary decisions required in selecting an approach: 1) Level of Resolution, and 2) Probability Level. It concludes with a discussion of how various options were applied via the calculation of example maximum daily loads for the 2007 TSS TMDL.

Level of Resolution

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 are potentially applicable for the Anacostia River:

1. **Representative daily load:** In this option, a single daily load (or multiple representative daily loads) is specified that covers all time periods and environmental conditions.
2. **Flow-variable daily load:** This option allows the maximum daily load to vary based upon the observed flow condition.
3. **Temporally-variable daily load:** This option allows the maximum daily load to vary based upon seasons or times of varying source or waterbody behavior.

Probability Level

Essentially all TMDLs have some probability of being exceeded, with the specific probability being either explicitly specified or implicitly assumed. This level of probability reflects, directly or indirectly, two separate phenomena:

1. Water quality criteria consist of components describing acceptable magnitude, duration, and frequency. The frequency component addresses how often conditions can allowably surpass the combined magnitude and duration components.

2. Pollutant loads, especially from wet weather sources, typically exhibit a large degree of variability over time. It is rarely practical to specify a "never to be exceeded value" for a daily load, as essentially any loading value has some finite probability of being exceeded.

The draft daily load guidance states 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. This statistical measure represents how often the maximum daily load is expected, or allowed, to be exceeded. The primary options for selecting this level of protection would be:

1. **The maximum daily load reflects some central tendency:** In this option, the maximum daily load is based upon the mean or median value of the range of loads expected to occur. The variability in the actual loads is not addressed.
2. **The maximum daily load reflects a level of protection implicitly provided by the selection of some "critical" period**: In this option, the maximum daily load is based upon the allowable load that is predicted to occur during some critical period examined during the analysis. The developer does not explicitly specify the probability of occurrence.
3. **The maximum daily load is a value that will be exceeded with a pre-defined probability:** In this option, a "reasonable" upper bound percentile is selected for the maximum daily load based upon a characterization of the variability of daily loads. For example, selection of the 95^{th} percentile value would result in a maximum daily load that would be exceeded 5% of the time.

Sample Daily Load Calculations

The process for selecting a specific approach to develop maximum daily loads for the Anacostia River was guided by an advisory group led by EPA Region 3, and including participation from EPA Headquarters, the Maryland Department of the Environment and the District of Columbia Department of the Environment.

During the TSS TMDL study, the advisory group requested that "sample" calculations be conducted to determine maximum daily loads generated using four candidate approaches in order to evaluate the viability of each of these alternatives prior to selecting a single specific approach. The candidate approaches consisted of two options each for level of resolution and probability level; namely: 1) Representative load/central tendency, 2) Representative load/critical period, 3) Flow-variable load/central tendency, and 4) Flow-variable load/ critical period.

Calculation of the sample flow-variable TSS daily loads highlighted the difficulties of applying these approaches in tidally-influenced areas. The flow used in a flow-variable daily load generally represents the available dilution flow, and is typically represented by gauged stream flow. This approach is applicable for free-flowing streams, where stream flow can be directly measured and is a direct measurement of available dilution. The flow-variable approach is not readily applicable in tidally-influenced areas because stream flow cannot be directly gauged nor is it necessarily an accurate indicator of available dilution. For this reason, the flow-variable expression of the maximum daily load was conducted only for the non-tidal portions of the Anacostia River. For this nutrient and BOD TMDL, the advisory group decided to utilize the same approach that was selected for the TSS TMDL, since the factors which influenced that selection are still applicable.

Selected Approach

The selected approach for defining a daily maximum load for the Anacostia River was based upon the consensus decision of the EPA Region 3/EPA Headquarters/Maryland Department of the Environment/District of Columbia Department of the Environment advisory group. The approach consists of unique methods for each of the following categories of sources:

- Approach for MS4 and Nonpoint Sources
- Approach for CSOs
- Approach for Other Point Sources

Maryland and the District of Columbia chose different options regarding probability level for certain sources. The details of the respective approaches for Maryland and the District of Columbia sources are provided below.

Maryland Approach:

Approach for MS4 and Nonpoint Sources

The level of resolution selected for defining a daily maximum load for the Anacostia River is for a flow-variable 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. This approach was selected to provide the maximum detail possible, given the nature of the system.

The probability level is based upon the use of a critical condition. This approach was selected because it is directly analogous to the approach used in setting the original TMDL and will maintain the policy decisions made during development of that TMDL. The probability level for the annual TMDL determination was based on the use of a critical period approach. For the annual TMDL, the period 1995-1997 was selected as representing a range of wet, average and dry rainfall conditions and the TMDL was based upon the most critical loading from that three-year period. The most direct analogy for developing maximum daily loads is to use the same critical period approach, with the critical period being defined as the highest single daily loading predicted during the same three-year simulation period used in this TMDL. The maximum "daily" load for each contributing source is therefore defined as the highest observed (or predicted) daily load for each loading source over the course of the critical period. These maximum daily loads are calculated for each of the flow strata considered.

Approach for Other Point Sources

The TMDL also considers contributions from other point sources (i.e., not MS4) in the watershed that have NPDES permits with BOD and nutrient limits. These sources are generally minor contributors to the overall load. The calculation approach for point sources in Maryland is as follows:

Annual TMDL Loads

- Municipal – BOD loads were calculated based on the permitted flow and monthly average concentrations. The permits contain values for two seasons for BOD, which were incorporated into the calculations based on the permit-defined seasons. TN and TP loads were calculated based on permitted flow and concentrations. There are no permit-defined seasons for TN and TP.
- Industrial – BOD loads were calculated from the maximum reported flow, 2005 through 2007, and the monthly average permitted BOD values. There are no permit limits on nutrients.

Maximum Daily Loads

- Municipal – Loads were calculated based on the U.S. EPA (1991) guidance. The annual TMDL value was converted to a daily load and then multiplied by a conversion factor. The conversion factor was based on USEPA guidance (1991). A default coefficient of variation of 0.6 was used based on USEPA (1991) recommendations and the 99^{th} percentile was selected based on input from the MDE Water Management Administration (Stone, 2007, personal communication). This resulted in a long-term average load to maximum daily load conversion factor of 3.11.
- Industrial – BOD loads were calculated from the maximum reported flow and the daily maximum permitted BOD values. There are no permit limits on nutrients.

District of Columbia Approach:

Approach for MS4 and Nonpoint Sources

The level of resolution selected for defining a daily maximum load for the Anacostia River is for a flow-variable daily load for each loading source in the non-tidal Anacostia River, and representative maximum and daily average loads for each loading source in the tidal portions of the Anacostia River. This approach was selected to provide the maximum detail possible, given the nature of the system.

The probability level is based upon both the representative load/central tendency and representative load/critical period options. This approach was selected because it is directly analogous to the approach used in setting the original 2002 TSS TMDL (U.S. EPA, 2002) and will maintain the policy decisions made during development of that TMDL. The probability level for the annual/seasonal TMDL determination was based on the use of a critical period approach. For the annual/seasonal TMDL, the period 1995-1997 was selected as representing a range of wet, average and dry rainfall conditions, and the TMDL was based upon the most critical loading from that three year period. The most direct analogy for developing maximum daily loads is to use the same critical period approach, with the critical period being defined as the highest single daily loading predicted during the same three-year simulation period originally used in the TMDL. The maximum "daily" load for each contributing source is therefore defined as the highest observed (or predicted) daily load for each loading source over the course of the critical period. These maximum and daily average loads are calculated for each of the flow strata considered.

Approach for CSOs

Similar to the method used for MS4 and nonpoint sources, 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

The TMDL also considers contributions from other point sources (i.e., not MS4 or CSO) in the watershed that have NPDES permits with BOD limits. These sources are generally minor contributors to the overall BOD loads. The DC point sources do not have nutrient limits, so the TMDL does not allocate TP and TN loads to these sources.

Upper Tidal Anacostia:

Annual and Maximum Daily Loads

BOD loads were calculated based on the permitted flow and the monthly average concentrations for the one contributing point source, identified as PEPCO-Benning Road. Due to the infrequent nature of the discharge from this facility, both the maximum and daily average loads were assumed to be the same. There are no permit limits for nutrients.

Lower Tidal Anacostia:

In the Lower Tidal Anacostia, the BOD TMDL analysis that defined maximum allowable average loads held each of the point 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 Technical Support Document (TSD) for Water Quality-based Toxics Control (USEPA 1991), per the instructions of the advisory group. 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 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 99^{th} percentile probability. This results in a multiplication factor of 3.11.

Application of Approach

This section documents the application of the selected approach to define maximum daily loads for the Anacostia River. It is divided into sub-sections for Maryland and the District of Columbia sources discussing:

- Data Used for Analysis
- Calculation Approach for Non-Tidal Anacostia River MS4 and Nonpoint Sources
- Calculation Approach for Tidal Anacostia River MS4 and Nonpoint Sources
- Calculation Approach for Combined Sewer Overflows *(applicable to DC only)*
- Calculation Approach Other Point Sources

The final results for the daily loads are then presented together for both Maryland and the District of Columbia reaches of the Anacostia River.

Application for Maryland Sources

Data Used for Analysis

Predicted daily BOD, TP and TN loads that comply with the applicable TMDL water quality targets, and that were generated for the determination of the annual TMDL loads, were provided for the period 1995-1997 for the following sources:

- Non-Tidal Anacostia River
  - Non-Tidal Upstream Sources
  - MD Non-Tidal MS4
  - MD Non-Tidal Other Point Sources
  - MD Non-Tidal Nonpoint Sources
- Tidal Anacostia River
  - MD Tidal MS4
  - MD Tidal Nonpoint Sources

In addition to the above daily loads for Maryland sources, time-series of information provided from the TMDL modeling effort also contained corresponding District of Columbia loads (as applicable) and observed flow data for the Anacostia River for each day. These data consisted of the sum of the observed daily flows at the USGS gages on the Northeast Branch and Northwest Branch of the Anacostia River. Note that the daily loading time series incorporate the 5% explicit margin of safety (MOS), where appropriate, that was designated for the TP and TN TMDLs. The BOD TMDL was designated to have an implicit MOS, so an explicit numeric representation of this load cannot be established.

Calculation Approach for Non-Tidal Anacostia River MS4 and Nonpoint Sources

The specific approach used for application to the non-tidal Anacostia River TMDL was implemented as follows:

1. Obtained the predicted daily loading time series over the simulation period 1995-1997 from each contributing source for the recommended TMDL scenario that demonstrates compliance with the TMDL targets.
2. Conducted a flow duration analysis for the Anacostia River flow, dividing flows into five strata corresponding to the commonly used flow duration intervals (U.S. EPA 2006 and 2007). These common flow ranges represent high flows (0–10 percent), moist conditions (10–40 percent), mid-range flows (40–60 percent), dry conditions (60–90 percent), and low flows (90–100 percent).
3. Determined the maximum daily load over the period of simulation for each source and for each flow duration interval.
4. Used the maximum daily load obtained in Step 3 as the basis of the maximum daily load for each source.

Calculation Approach for Tidal Anacostia River MS4 and Nonpoint Sources

The specific approach used for application to the tidal Anacostia River TMDL was implemented as follows:

1. Obtained the predicted daily loading time series over the simulation period 1995-1997 from each contributing source for the recommended TMDL scenario that demonstrates compliance with the TMDL targets.
2. Determined the maximum and average daily load over the period of simulation for each source.
3. Use the maximum daily load obtained in Step 2 as the basis of the maximum daily load for each source.
4. Defined the maximum and average daily upstream load as the sum of their respective loads in the upstream sections.

Calculation Approach for Other Point Sources

1. Obtained the predicted daily loading time series over the simulation period 1995-1997 for the other point source discharges for the recommended TMDL scenario that demonstrates compliance with the TMDL targets.
2. Converted these values, where necessary, from long-term averages to maximum daily loads by multiplying them by a factor of 3.11 (from TSD Table 5-2). Note that for the WLA to be met, compliance with the long-term average loads would also be necessary.
3. Developed the loads in accordance with the description of the Selected Approach section of this document for Maryland's Other Point Sources.

Application for District of Columbia Sources

Data Used for Analysis

Predicted daily BOD, TP and TN loads that comply with the applicable TMDL water quality targets, and that were generated for the determination of the annual TMDL loads, were provided for the period 1995-1997 for the following sources:

- Tidal Anacostia River
    - Lower Beaverdam Creek Upstream Sources
    - Lower Beaverdam Creek MS4
    - Lower Beaverdam Creek Nonpoint Sources
    - Watts Branch Upstream Sources
    - Watts Branch MS4
    - Watts Branch Nonpoint Sources
    - DC Upper Anacostia Other Point Sources
    - DC Upper Anacostia River MS4
    - DC Upper Anacostia River CSO
    - DC Upper Anacostia River Nonpoint Sources

- DC Lower Anacostia River MS4
- DC Lower Anacostia River Other Point Sources
- DC Lower Anacostia River CSO
- DC Lower Anacostia River Nonpoint Sources

In addition to the above daily loads, the time-series of information provided from the TMDL modeling effort also contained corresponding Maryland loads (as applicable) and observed flow data for the Anacostia River for each day. These data consisted of the sum of the observed daily flows at the USGS gages on the Northeast Branch and Northwest Branch of the Anacostia River.

Calculation Approach for Tidal Anacostia River MS4 and Nonpoint Sources

The specific approach used for application to the tidal Anacostia River TMDL was implemented as follows:

1. Obtained the predicted daily loading time series over the simulation period 1995-1997 from each contributing source for the recommended TMDL scenario that demonstrates compliance with the TMDL targets.
2. Determined the maximum daily and average daily loads over the period of simulation for each source. Note that there were non-zero loads from these sources during every day of the simulation period.
3. Used the maximum and average daily load obtained in Step 2 as the basis of the maximum and average daily load for each source.
4. Defined the upstream load as the sum of loads from the maximum and average daily loads in the upstream sections.

Calculation Approach for Combined Sewer Overflows (CSOs)

1. Obtained the predicted daily loading time series over the simulation period 1995-1997 from each of the contributing CSO discharges for the recommended TMDL scenario that demonstrates compliance with water quality standards.
2. Separated the contributing CSO discharges into two categories: DC Tidal Upper Anacostia River and DC Tidal Lower Anacostia River.
3. Summed the contributing CSO daily loading time series within these two categories - DC Tidal Upper Anacostia River and DC Tidal Lower Anacostia River.
4. Determined the maximum and average daily loads over the period of simulation for the DC Tidal Upper Anacostia River and DC Tidal Lower Anacostia River (for non-zero loading days).
5. Used the maximum and average daily load obtained in Step 4 as the basis for the maximum and average daily load for CSOs.

Calculation Approach for Other Point Sources

Upper Tidal Anacostia:

A single permitted point source in the Upper Tidal Anacostia, the PEPCO-Benning Road facility, discharges infrequently, if at all, throughout the year. The facility was assigned a TMDL allocation for BOD of 125.18 lbs/day based on the assumption that it will discharge at its maximum permitted rate for four days out of each year. Both the maximum and daily average loads were assumed to be the same (i.e., 125.18 lbs/day) because of the infrequent nature of this discharge.

Lower Tidal Anacostia:

The predicted daily loading time series over the simulation period 1995-1997 for the other point source discharges for the recommended TMDL scenario that demonstrates compliance with the TMDL targets was provided for the daily load development in the Lower Tidal Anacostia.

1. These values were converted from long-term averages to maximum daily loads by multiplying them by a factor of 3.11 (from TSD Table 5-2). Note that for the WLA to be met, compliance with the long-term average loads would also be necessary.

Final Results

Tables 1-3 contain the final maximum daily load results generated using the approaches described above for BOD, TN and TP, respectively. The margin of safety (MOS) for these maximum daily loads is identical to that specified for the annual average TMDLs, with the MOS being implicit for BOD and explicit at 5% for the TN and TP.

Note: In Tables 1-3, the MS4-WLA in Maryland includes both county MS4s and other NPDES-regulated stormwater discharges outside the counties' jurisdictions. The MS4-WLA in DC includes District MS4s and industrial stormwater discharges.

References

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Table 1. Summary of Annually-Based Maximum Daily Loads of BOD for the Anacostia River Watershed (lbs/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	4.37 : 3.419	303	209	0.652	Implicit	517 : 239
0.89 - 2.34	14.2 : 6.22	1,629	225	12.6	Implicit	1,881 : 394
2.34 - 3.48	29.0 : 12.0	6,931	225	24.8	Implicit	7,210 : 712
3.48 - 10.75	189 : 31.8	12,525	225	121	Implicit	13,060 : 1,812
> 10.75	1,216 : 304	77,499	225	2,832	Implicit	81,772 : 16,455

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	81,772 : 2,438	6,797	34.0	Implicit	88,603 : 2,648

Table 1 (cont'd). Summary of Annually-Based Maximum Daily Loads of BOD for the Anacostia River Watershed (lbs/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	10,163 : 355	32.3 : 1.10	- : -	Implicit	10,195 : 356
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	1,213 : 38.5	1125 : 39.0	- : -	Implicit	2,338 : 77.5

DC Tidal Upper Anacostia							
Flow Range (m^3/s)	Upstream (max : avg)	DC Upper Anacostia MS4-WLA (max : avg)	DC Upper Anacostia Other PS-WLA	DC Upper Anacostia CSO-WLA (max : avg)	DC Upper Anacostia LA (max : avg)	MOS	TMDL to Upper / Lower Boundary (max : avg)
All	88,603 : 2,648	18,330 : 564	125	49,674 : 14,311	6,212 : 182	Implicit	162,944 : 17,830

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	162,944 : 17,830	9,588 : 312	8.56	34,334 : 15,491	2,644 : 81.3	Implicit	209,519 : 33,717

Table 2. Summary of Annually-Based Maximum Daily Loads of Total Nitrogen for the Anacostia River Watershed (lbs/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	0.775 : 0.331	41.9	27.4	5.74	3.99	79.8 : 51.7
0.89 - 2.34	3.34 : 1.32	182	27.4	29.0	12.7	254 : 109
2.34 - 3.48	5.64 : 2.39	703	27.4	50.4	41.4	828 : 187
3.48 - 10.75	25.1 : 4.80	1,367	27.4	142	82.2	1,644 : 375
> 10.75	215 : 30.8	13,919	27.4	3,604	935	18,700 : 2,331

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	17,765 : 401	397	9.96	956	19,128 : 438

Table 2 (cont'd). Summary of Annually-Based Maximum Daily Loads of Total Nitrogen for the Anacostia River Watershed (lbs/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	1,082 : 37.1	3.57 : 0.124	- : -	57.1	1,143 : 39.2
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	145 : 4.46	138 : 4.74	- : -	14.9	298 : 9.68

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	18,172 : 416	964 : 34.7	4,791 : 1,380	334 : 11.3	1,277	25,538 : 1,939

DC Tidal Lower Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	DC Lower Anacostia MS4-WLA (max, avg)	DC Lower Anacostia CSO-WLA (max : avg)	DC Lower Anacostia LA (max : avg)	MOS	TOTAL TMDL (max : avg)
All	24,261 : 1,842	433 : 16.1	3,312 : 1,494	141 : 5.11	1,481	29,628 : 3,534

Table 2. Summary of Annually-Based Maximum Daily Loads of Total Phosphorus for the Anacostia River Watershed (lbs/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	0.0309 : 0.00900	3.57	2.05	0.0698	0.301	6.02 : 2.83
0.89 - 2.34	0.192 : 0.0421	18.6	2.05	0.401	1.12	22.4 : 5.01
2.34 - 3.48	0.403 : 0.0857	85.0	2.05	0.853	4.65	93 : 9.2
3.48 - 10.75	2.26 : 0.238	162	2.05	5.47	9.04	181 : 22.8
> 10.75	30.2 : 3.51	3,119	2.05	375	186	3,712 : 316

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	3,526 : 40.0	43.4	0.515	187.9	3,758 : 43.6

Table 3 (cont'd). Summary of Annually-Based Maximum Daily Loads of Total Phosphorus for the Anacostia River Watershed (lbs/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	152.2 : 4.50	0.470 : 0.0160	- : -	8.04	160.7 : 4.75
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	18.8 : 0.576	20.1 : 0.678	- : -	2.047	40.9 : 1.32
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	3,570 : 41.4	104.2 : 3.46	991 : 286	31.6 : 0.989	247	4,944 : 349

DC Tidal Lower Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	DC Lower Anacostia MS4-WLA (max, avg)	DC Lower Anacostia CSO-WLA (max : avg)	DC Lower Anacostia LA (max : avg)	MOS	TOTAL TMDL (max : avg)
All	4,697 : 332	47.6 : 1.61	685 : 309	13.7 : 0.443	286	5,730 : 677