Consolidated Total Maximum Daily Load (TMDL) Implementation Plan Report

Prepared for:
Department of Energy and Environment

Revised Draft

August 2016

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Prepared for:

District Department of Energy and Environment

August 2016

The following organization, under contract to the Department of Energy and Environment (DOEE), prepared this report:

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Executive Summary

Introduction

The District's current Municipal Separate Storm Sewer System (MS4) permit (Permit Number DC0000221, U. S. EPA 2011 and U. S. EPA 2012) requires the development of a Consolidated Total Maximum Daily Load (TMDL) Implementation Plan (Consolidated TMDL IP) for all waste load allocations (WLAs) assigned to District MS4 discharges. The permit further states that the Consolidated TMDL IP must include a schedule for attainment of the WLAs (including a final date and interim milestones as necessary); a narrative explaining schedules and controls used in the Consolidated TMDL IP, and a demonstration using modeling of how the WLAs will be attained.

The Department of Energy and Environment (DOEE; formerly known until August, 2015 as the District Department of the Environment, or DDOE) is the designated MS4 Permit Administrator for the District. This Consolidated TMDL IP document fulfills the MS4 Permit requirements and describes a plan and a timetable for how and when the District's MS4 WLAs will be attained. It also includes benchmarks and milestones and a plan for tracking progress towards achievement of the WLAs. The Consolidated TMDL IP represents a "consolidated" plan because it focuses on achieving load reductions in all of the District's TMDL watersheds simultaneously, and using a consolidated modeling approach to track and report on these load reductions in a consistent, transparent, and straightforward manner.

DOEE submitted a draft of this Consolidated TMDL IP to EPA and published the document for public comment on May 15, 2015. This version of the Consolidated TMDL IP has been updated in response to comments from EPA and stakeholders.

Background and Context

Developing a Consolidated TMDL IP for the District and implementing programs and practices to achieve MS4 WLAs represent substantial challenges. These challenges arise from both the number and nature of the District's TMDLs and the inherent difficulty of planning for so many TMDLs in a consolidated fashion. The approach for developing this Consolidated TMDL IP, as well as the IP itself, is a reflection of these challenges.

The IP development process began with an initial TMDL review which identified a number of issues with the original TMDLs and how they were developed. These include questions regarding the validity of data that supported original inclusion on the District's List of Impaired Waters (or 303(d) list, from Section 303(d) of the Clean Water Act), inconsistencies in watershed and sewershed delineations that informed TMDL modeling, Event Mean Concentrations (EMCs) selected for TMDL modeling, and how effectively TMDL modeling efforts accounted for all potential sources of pollution within the District. Further, many of the WLAs require levels of control that are beyond the capability of current BMP technologies. These issues suggest that many TMDLs may need to be revisited to develop updated and more accurate WLAs and endpoints. While acknowledging these limitations, the final WLA attainment dates projected in the Consolidated TMDL IP represent the District's best efforts to make long-term implementation projections, and are included to meet the requirements of the District's MS4 Permit.

Beyond the long-term schedule for WLA attainment, the Consolidated TMDL IP establishes a consistent framework for projecting and tracking BMP implementation, and accounting for the pollutant load reductions that will occur throughout the District's MS4 area over the next 25 years. Simultaneously, the District will be collecting new and improved data, information, and adaptively managing to inform better long-term projections, in the interest of developing a more refined, updated schedule for WLA attainment.

Development of the Consolidated TMDL IP

The Consolidated TMDL IP is organized around three different components to address the major categories of pollutants, including (1) PCBs, (2) Trash, and (3) all other pollutants including sediment, nutrients, bacteria, BOD, metals, and toxics. For PCBs, DOEE will focus on source identification and control methods, as recommended in the original TMDLs. The trash plan follows the draft Anacostia River Watershed Trash TMDL Implementation Strategy, published by DDOE in December 2013. For all other pollutants, WLA achievement will be achieved through implementation of stormwater management practices and source control methods.

The Consolidated TMDL IP addresses individual MS4 WLAs for over twenty different pollutants in over forty different tributaries and mainstem reaches of the Anacostia and Potomac rivers and Rock Creek. Development of the Consolidated TMDL IP was supported by a Stakeholder Group with representatives from government agencies, environmental organizations, and other public and private sector interests. The views and suggestions expressed by the stakeholders - individually and as a group - were important and contributed substantially to all aspects of IP development. The Consolidated TMDL IP was also developed in the context of other existing watershed and TMDL implementation plans, such as the Anacostia, Oxon Run and Rock Creek TMDL implementation plans and the Chesapeake Bay TMDL Phase II WIP. While the Consolidated TMDL IP incorporated some elements of these plans, the Consolidated TMDL IP is the controlling document for complying with MS4 WLAs in the District.

A summary of applicable MS4 WLAs to be included in the Consolidated TMDL IP was developed through a review of TMDL documents. This review initially identified 518 individual MS4 WLAs, including 406 annual, seven seasonal, two monthly, and 103 daily WLAs. A number of these WLAs were subsequently removed from the IP because they were superseded, replaced, not applicable, or not needed. As a result, only 344 WLAs were retained in the IP, including 239 annual, seven seasonal, one monthly, and 97 daily WLAs. Of these, some are not modeled because WLA achievement will be assessed through source control or management plans. This leaves 293 WLAs that are evaluated through modeling, including 206 annual, 7 seasonal, 1 monthly, and 79 daily WLAs.

Additional data collection and analysis were done to support the development of the Consolidated TMDL IP. These additional data sets consisted of:

- Information underlying the original TMDLs (pollutant sources, event mean concentrations [EMCs] used to develop original pollutant loads, original TMDL endpoints, etc.)
- Watershed and sewershed delineations
- Existing BMPs and BMP load reduction effectiveness information
- MS4 and ambient water quality data
- Existing WIPs/TMDL IPs in the District

As new and improved data is collected and becomes available, DOEE intends to revisit TMDLs where appropriate and will update the Consolidated TMDL IP to remain consistent with the latest approved TMDL WLAs.

Compliance Strategy

DOEE's approach for developing a Consolidated TMDL IP that complies with the permit requirements was to model projected BMP implementation and load reduction over time, and compare current loads at given points in time to the WLAs. The modeling of projected WLA attainment focused on the annual WLAs. It is anticipated that the load reduction practices and requirements implemented to achieve annual WLAs will result in achievement of any seasonal, monthly, or daily loads for which there are also WLAs. This approach is consistent with the precedent set by the EPA-approved Anacostia Sediment/Total Suspended Solids TMDL, in which annual modeling results were used to develop the daily WLA and the presumption was made that the daily WLA, when averaged over a year, would meet water quality standards (WQS)[1]. However, tracking progress towards WLA attainment will occur for all WLAs, including annual, seasonal, monthly, and daily expressions.

The IP Modeling Tool

An IP Modeling Tool was developed to model the stormwater runoff volumes, pollutant loads generated, and load reductions achieved through stormwater management. In order to determine how much load reduction was required to meet an individual WLA, the pollutant load "gap" between current conditions and the WLA was determined through application of the modeling tool. Methods for closing the gap and meeting WLAs were evaluated using a "scenario analysis." Load reduction is expected to be achieved through three different types of stormwater management components, including:

- Programmatic and source control efforts;
- BMP Implementation from regulated development and redevelopment activities required by the District's 2013 Stormwater Management Rule (see http://DOEE.dc.gov/swregs); and
- BMP implementation from other programs.

Benchmarks and Milestones

Annual benchmarks were developed for each pollutant/waterbody combination. These benchmarks were set based on the average annual amount of pollutant reduction that must be achieved in order to meet the WLA by the date projected by the modeling. Five-year milestones were also set for the Consolidated TMDL IP and represent enforceable targets towards implementing stormwater management practices. For the purposes of the IP, milestones were developed and set for the entire MS4 area, with estimates of expected implementation at the major basin level (i.e., for the Anacostia, Potomac, and Rock Creek basins). Different types of milestones were generated for the IP for different implementation timeframes. Milestones developed for the time period 2016-2040 were based on area controlled to a 1.2” retention standard by stormwater BMPs. However, because projections of regulated development are not available beyond 2040, milestones developed for the time period after this date were based on extrapolations of projected rates of development and load reduced by stormwater BMPs. These extrapolations lack the spatial and temporal specificity of the near-term planning data. In addition, the IP Modeling Tool projects that even after the entire MS4 area is retrofitted some combination of new technologies, improved BMP efficiencies, or BMP treatment trains will be required to achieve additional load reduction after 2127. Therefore, setting milestones based on load reduction achieved is most appropriate for the time increments after 2040. A summary of the 2020-2040 milestones is presented in Table ES-1 below.

[1] See page 5 of the 2007 “Decision Rationale; Total Maximum Daily Loads; Anacostia River Basin Watershed For Sediment/Total Suspended Solids; Montgomery and Prince George’s Counties, Maryland and the District of Columbia.”

Table ES-1. 2020-2040 Milestones in Cumulative Area (in acres) Managed					
Major Basin	**2020**	**2025**	**2030**	**2035**	**2040**
Anacostia	552	1104	1655	2207	2759
Potomac	335	670	1005	1340	1675
Rock Creek	151	302	454	605	756
TOTAL	**1,038**	**2,076**	**3,114**	**4,152**	**5,190**

WLA Achievement

The full schedule for WLA attainment can be found in Section 6.1. This schedule reflects the fact that many of the load reduction targets require over 90 percent load reduction, which is in excess of the treatment capacity of existing BMP technology. Consistent progress is made over time, but many WLAs are not achieved until some years into the future.

Modeling results and projections indicate that by 2040, 28 percent of the MS4 area will be retrofitted with BMPs capable of retaining the 1.2” storm event consistent with the District’s stormwater management regulations. However, modeling results show that even when 100 percent of the MS4 area is retrofitted to retain the 1.2” storm event (effectively eliminating runoff from 90 percent of the storms in the District), this level of control will still be insufficient to achieve many WLAs and additional measures will be required.

Programmatic Milestones

In response to comments received from EPA and stakeholders, DOEE revised and updated the Consolidated TMDL IP to include a series of programmatic milestones in addition to the numeric milestones established above. The intent of these programmatic milestones is to accelerate the implementation of stormwater management and stormwater pollutant load reductions in the near-term, while longer term adjustments are made to the District’s TMDLs and Implementation Plan modeling tool.

The programmatic milestones are discussed in detail in Section 6.7, but include:

- Committing $12.75 million to establish a Stormwater Retention Credit Purchase Agreement Program
- Developing a list of targeted watersheds and targeted implementation approaches
- Evaluating options for increasing the District’s Stormwater Fee
- Identifying priority TMDLs in need of revision, conducting intensive monitoring to support TMDL revisions, and completing priority TMDL revisions
- Conducting a cost/benefit analysis of potential changes to existing stormwater management regulations
- Updating the Consolidated TMDL IP modeling tool, the TMDL IP and its associated schedule
- Exploring the ability to convene a new Stakeholder Group to evaluate stormwater management activities and priorities

Adaptive Management

DOEE plans to use the principles of adaptive management to re-evaluate and update the IP on a regular basis. DOEE collects information on BMP implementation, MS4 discharges, and other relevant information, and it plans to use these data to determine if sufficient progress is being made towards achieving interim milestones and WLAs, and thus whether or not a course change is needed through adaptive management. This process involves evaluating modeling results on a regular basis (at least annually). If the modeling and monitoring results and evaluation of milestones and benchmarks indicates that insufficient progress is being made towards meeting WLAs, the adaptive management approach allows DOEE to change course and implement new approaches to try to get back on track to meet WLAs.

Progress towards achieving interim milestones and WLAs will be tracked using modeling, monitoring, and other programmatic tracking. The IP Modeling Tool will be the primary method used for tracking. The BMP inventory will be updated on a regular basis, and the model will be run with the updated BMP inventory to determine current loads and whether WLAs have been met. Monitoring will be used to provide supplemental water quality, habitat quality, and BMP implementation information that can help inform an understanding of what is happening in the watershed. It should be noted that since most of the watersheds which have MS4 WLAs have other pollutant sources, watershed monitoring data cannot be used to evaluate the success of MS4 WLA achievement. DOEE will also track other programmatic elements which contribute to load reduction, but which cannot currently be quantified in terms of load reduction – such as the number of outreach activities performed.

Funding the Consolidated TMDL IP

A review and compilation of funding to implement the Consolidated TMDL IP was conducted. The IP was developed based on known public resources and projected rates of regulated development and redevelopment under the District's 2013 Stormwater Management Rule. There are several available sources of public funding, including the Enterprise Fund, the Anacostia River Clean Up and Protection Fund, EPA Clean Water Act Grants, and EPA Chesapeake Bay Program Funds. These sources provide approximately $9 million annually for direct investment in BMPs that are not otherwise required by the District's stormwater regulations. The investment in BMPs by regulated projects under the District's 2013 Stormwater Management Rule is projected to be many times greater than the investment in non-regulated BMPs, and will include commitment of additional public resources for compliance with stormwater management regulations for publicly funded projects.

Public Outreach

A Public Outreach Plan is also included as part of the Consolidated TMDL IP. The goal of this public outreach plans are to inform the general public about the Consolidated TMDL IP, educate the public about stormwater management and District stormwater management programs, engage specific interest groups, and provide the most updated information on the IP on a continuing basis. Methods for implementing the Public Outreach Plan include public meetings, annual status reports, public comment periods for plan revisions and a dedicated project website (www.dcstormwaterplan.org).

Conclusion

The Consolidated TMDL IP establishes a comprehensive tool to forecast, track and report on reductions of stormwater pollution. Significant progress toward reducing pollution will be achieved with the level of effort and funding that is anticipated and described in the IP. DOEE will use an adaptive management process to incorporate new information into the IP and the IP Modeling Tool as it becomes available, and the milestones and benchmarks and projected WLA attainment dates will be updated accordingly. Thus the IP is a living document that will evolve to better forecast WLA attainment over time as TMDLs are revised and the understanding of stormwater and BMPs improves through implementation.

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1. Introduction

The District of Columbia owns and operates a Municipal Separate Storm Sewer System (MS4) that is designed to collect and drain stormwater. The District has an EPA-issued MS4 National Pollutant Discharge Elimination System (NPDES) permit that gives it the authority to operate the MS4 and discharge storm water to the Anacostia and Potomac rivers and their local tributaries within the District.

The MS4 covers an area of 19,750 acres. As shown in Figure 1-1, the MS4 area surrounds the combined sewer system (CSS) area – an area of the city where stormwater is collected and drained along with sanitary sewage. Both of these sewage systems have outfalls along water bodies where the pollutant load associated with stormwater and, in the case of the CSS, sanitary sewage is discharged. The CSS is operated by DC Water under a separate NPDES permit. Figure 1-1 shows the MS4 and CSS area, as well as the major waterbodies in the District.

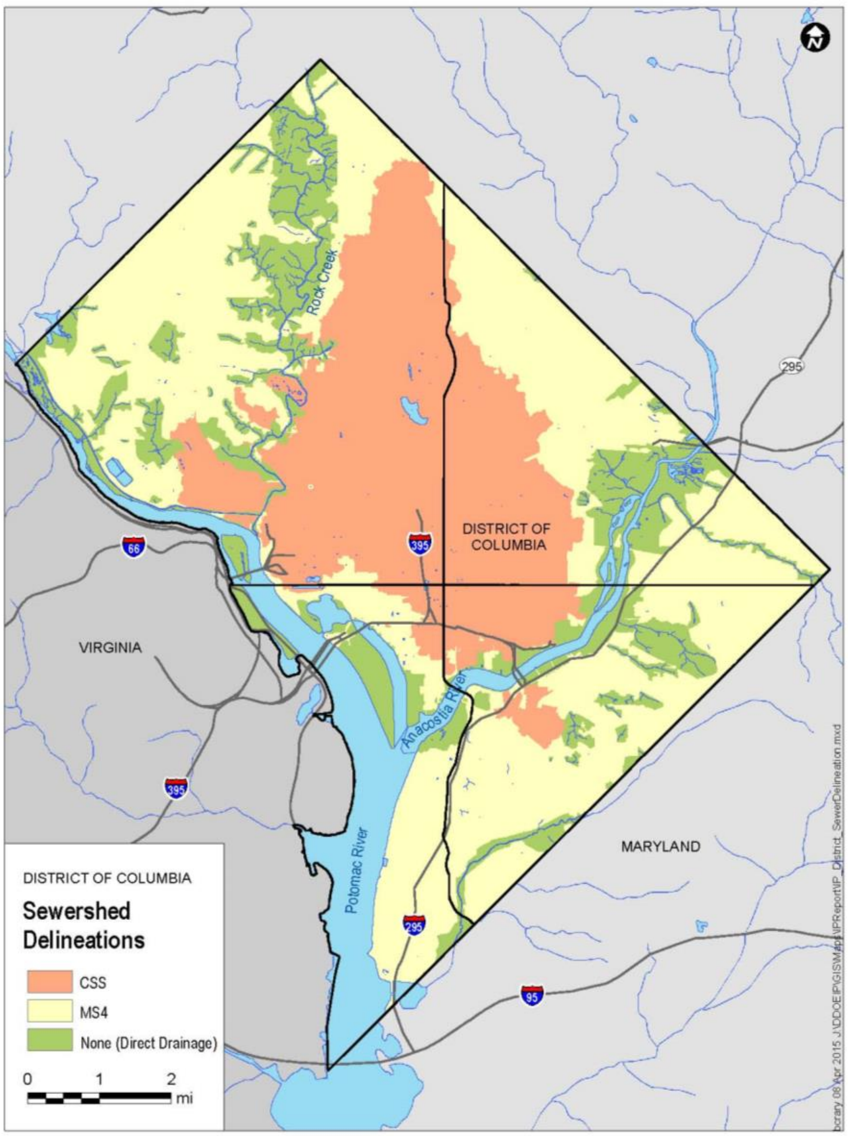

Figure 1-1- Sewershed Delineations for the District of Columbia

The District Department of the Environment (DOEE; formerly known until August, 2015 as the District Department of the Environment, or DDOE) identified impaired water bodies across the District during the late 1990s and early 2000s. The listing of these impaired water bodies led to development of 26 Total Maximum Daily Load (TMDL) studies. These TMDL studies allocate the quantity of each pollutant that can be discharged without violating WQS. The allocations assigned to the MS4 are called wasteload allocations, or WLAs.

DOEE is required to develop a Consolidated TMDL Implementation Plan as established in the District's current MS4 permit (Permit Number DC0000221, U. S. EPA 2011 and U. S. EPA 2012). One specific requirement in the MS4 permit is:

> *For all TMDL wasteload allocations assigned to District MS4 discharges, the permittee shall develop, public notice and submit to EPA for review and approval a consolidated TMDL Implementation Plan within 30 months of the effective date of this permit provision.*

The MS4 permit further states that:

> *The Plan shall include:*
>
> 1. *A specified schedule for attainment of WLAs that includes final attainment dates and, where applicable, interim milestones and numeric benchmarks.*
>   a. *Numeric benchmarks will specify annual pollutant load reductions and the extent of control actions to achieve these numeric benchmarks.*
>   b. *Interim milestones will be included where final attainment of applicable WLAs requires more than five years. Milestone intervals will be as frequent as possible but will in no case be greater than five (5) years.*
> 2. *Demonstration using modeling of how each applicable WLA will be attained using the chosen controls, by the date for ultimate attainment.*
> 3. *An associated narrative providing an explanation for the schedules and controls included in the Plan.*
> 4. *Unless and until an applicable TMDL is no longer in effect (e.g., withdrawn, reissued or the water delisted), the Plan must include the elements in 1-3 above for each TMDL as approved or established.*
> 5. *The current version of the Plan will be posted on the permittee's website.*

The Consolidated TMDL Implementation Plan (IP) described and established in this document meets these requirements. It is founded on two important documents:

- An Implementation Plan Methodology (DDOE, 2014) that organized the background material and process for developing the IP; and
- A Comprehensive Baseline Analysis (DDOE, 2015a) that documented the development of the IP Modeling Tool and quantified the baseline condition (circa 2000) and current condition (circa 2014) pollutant loads, and the pollutant loads reductions remaining that are necessary to attain MS4 WLAs.

The Consolidated TMDL IP is very detailed and complex. It addresses over 200 individual annual MS4 WLAs for over twenty different pollutants. In addition, the WLAs are assigned to over forty different tributaries and mainstem reaches of the Anacostia and Potomac rivers and Rock Creek. The Consolidated TMDL IP also builds on recent actions that the District has taken to increase stormwater management and reduce pollutant loads. These activities are described in more detail in Section 2 below.

Development of the Consolidated TMDL IP was supported by a Stakeholder Group with representatives from government agencies, environmental organizations, and other public and private sector interests. The views and suggestions expressed by the stakeholders - individually and as a group - were important and contributed substantially to all aspects of IP development.

The Consolidated TMDL IP is described in this document is organized as follows:

Executive Summary. The Executive Summary is added to provide an overview of content and to emphasize the key points of the Consolidated TMDL IP in a concise manner.

Section 1. Introduction. The Introduction provides background on the Consolidated TMDL IP and a forecast of sections and their composition.

Section 2. Permit Requirements and Regulatory Compliance. This section describes the District's stormwater management strategy and the recent actions that the District has taken to increase stormwater management and reduce pollutant loads. It then summarizes the regulatory framework underpinning the District's MS4 permit requirements to develop a Consolidated TMDL IP as well as the regulatory compliance strategy the District has implemented to meet this specific provision of the permit.

Section 3. Data Collection and Analysis. This section summarizes the data collection and analysis that were done to support the development of the Consolidated TMDL IP.

Section 4. Model Development. This section describes development and application of the IP Modeling Tool used to track and account for pollutant load generation and load reduction across the District.

Section 5. Implementation Plan: Assessment and Methods. This section describes how the amount of pollutant load reduction required to meet the TMDLs is related to the baseline load (circa 2000) and current conditions (circa 2014).

Section 6. Implementation Plan: WLA Attainment. This section describes the time table and the specific actions and programs that will lead to the required pollutant load reductions/WLAs.

Section 7. Tracking Progress in Meeting MS4 WLAs. This section describes modeling, monitoring and other tracking that will be carried out to evaluate implementation and improvement over time as the District works to reduce pollutant loads and achieve its MS4 WLAs.

Section 8. Public Outreach Plan. This section describes the outreach methods used to engage and inform the public about the IP.

S**ection 9. Integration with other Watershed Planning Efforts.** This section describes how other watershed actions and planning documents are interpreted and incorporated into the IP.

Section 10. Funding the Implementation Plan. This section describes the amount of funding and the sources of funding that will be used support the level of BMP implementation and other pollutant load reduction programs contained in the IP.

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2. Permit Requirements and Regulatory Compliance Strategy for IP

2.1 Introduction

This section summarizes the regulatory framework underpinning the District's MS4 permit requirements to develop a Consolidated TMDL IP (IP), as well as the regulatory compliance strategy the District has implemented to meet this specific provision of the permit.

The permit language indicates models shall be used to assess and demonstrate attainment of the WLAs, and that both modeling and monitoring shall be used for demonstrating progress during implementation. As described more fully in Section 4, a modeling tool has been developed and applied to assess and describe attainment of WLAs under the permit requirements. Furthermore, a revised monitoring framework has also been developed to ensure that monitoring can be used to support demonstration of progress towards meeting WLAs and that this monitoring is coordinated across all DOEE departments. Section 4.10.3 of the permit also notes that there is potential for the WLA to no longer be applicable, for instance, if there are data to demonstrate that the waterbody may be de-listed or if the TMDL is withdrawn for some reason. Updated monitoring data has led to the de-listing of several waterbodies for specific impairments, and thus some MS4 WLAs for these waterbodies are no longer applicable. In these cases, the Consolidated TMDL IP does not include further implementation plans to achieve the WLAs. Summaries of both the applicable WLAs and those that are no longer applicable are provided in Section 3. In addition, several errors have been identified in MS4 WLAs as data has been reviewed. DOEE intends to resolve these issues outside of the implementation plan framework, and the Consolidated TMDL IP includes strategies to address these MS4 WLAs as they currently exist. However, as new data and analysis become available, these strategies may be revisited and revised as appropriate.

Discussion on each of these topics is provided below, following a brief background on regulatory requirements.

2.2 TMDLs and MS4 Permits

Water quality issues and subsequent water quality-related studies such as TMDL studies serve as important drivers in developing limits and other requirements that are included in NPDES permits. For waterbodies on the 303(d) list of impaired waters, states are required to develop a TMDL that calculates the maximum pollutant load that the water body can receive and still attain WQS. The WQS set the goals to be achieved in the water body, while the assessment and TMDL programs provide information that the permit writer uses to establish effluent limits for discharges at a level necessary to achieve the goals. Specifically, for point sources, the NPDES regulations at 40 CFR 122.44(d) require the permit writer to develop permit limits based upon the assumptions included in approved TMDL WLAs. Once the appropriate permit limits for the discharge are established, the limits are written into the permit to authorize discharges into water bodies at levels that will achieve WQS.

MS4 discharges are a unique situation because the CWA requires the permit to include permit limits based upon the reduction of pollutants to the maximum extent practicable (MEP) (See 33 USC 1342(p)(3)(B)(iii)) rather than on a technology or water quality basis. Between 1996 and 2010, EPA issued multiple policy statements to clarify how permit limits in MS4 permits should be established given the unique nature of the discharge (U.S. EPA 1996; U.S. EPA 2002b; U.S. EPA 2010a; U.S. EPA 2010b). Specifically, these policy statements explain that BMPs are preferred when discharges "are highly variable in frequency and duration and are not easily characterized." The 1996 document (U.S. EPA 1996) states that "only in rare cases will it be feasible or appropriate to establish numeric limits." In summary, these memos address the fact that discharges from storm events are highly variable in both volume and pollutant loads; and acknowledge, therefore, that there is no clear way to arrive at numeric permit limits for municipal stormwater discharges. The memos conclude that, when it is determined to be infeasible to calculate a numeric permit limit, BMPs are required in the permit as the effluent limits (see 40 CFR §122.44(k)). This BMP approach is also consistent with 40 CFR §122.45(e)(1).

2.3 Specific TMDL-Related Requirements in the District's MS4 Permit

The District's MS4 permit includes several major requirements relevant to TMDLs and TMDL implementation. The requirements in the permit are set out in a number of different sections, but are summarized in the Section 1.4, Discharge Limitations. This section states that:

> The permittee must manage, implement and enforce a stormwater management program (SWMP) in accordance with the Clean Water Act and corresponding stormwater NPDES regulations, 40 CFR Part 122, to meet the following requirements:
>
> 1.4.1 Effectively prohibit pollutants . . . to comply with existing District of Columbia Water Quality Standards (DCWQS);
>
> 1.4.2 Attain applicable wasteload allocations (WLAs) for each established or approved Total Maximum Daily Load (TMDL) for each receiving waterbody, consistent with 33 USC 1342(p)(3)(B)(iii); 40 CFR Part 122.44(k)(2) and (3); and
>
> 1.4.3 Compliance with all other performance standards and provisions contained in Parts 2 through 8 of this permit shall constitute adequate progress toward compliance with DCWQS and WLAs for this permit term.

Permit Section 4.10.3, IP, provides further clarification of the requirements related to TMDLs. It states:

> For all TMDL waste load allocations assigned to District MS4 discharges, the permittee shall develop, public notice and submit to EPA for review and approval an Implementation Plan.

Together, these sections describe the requirements and methods for meeting the TMDL implementation components of the permit.

Based upon the provisions above, the permit establishes the level of control and the use of BMPs as the effluent limits. 40 CFR 122.5 defines compliance with these limits and the other permit requirements as constituting compliance with the CWA. This interpretation of CWA regulations and NPDES requirements provides the foundation for the Regulatory Compliance Strategy for the IP.

Section 4.10.3 of the permit also notes that there is potential for the WLA to no longer be applicable, for instance, if there are data to demonstrate that the waterbody may be de-listed or if the TMDL is withdrawn for some reason (for example, if water quality standards are revised.) Updated monitoring data has led to the de-listing of several waterbodies for specific impairments, and thus some MS4 WLAs for these waterbodies are no longer applicable. In these cases, the Consolidated TMDL IP does not include further implementation plans to achieve the WLAs. Summaries of both the applicable WLAs and those that are no longer applicable are provided in Section 3. In addition, several errors have been identified in MS4 WLAs as data has been reviewed. DOEE intends to resolve these issues outside of the implementation plan framework, and the Consolidated TMDL IP includes strategies to address these MS4 WLAs as they currently exist. However, as new data and analysis become available, these strategies may be revisited and revised as appropriate.

2.4 The Consolidated TMDL IP as MEP for TMDLs

DOEE has analyzed its resources and the nature of the TMDLs and has developed the Consolidated TMDL IP to reflect TMDL implementation to the MEP. The TMDL IP reflects known rates of public and private implementation, quantifiable programs and policy, and the WLAs as currently defined. This approach represents the current extent of DOEE's authority and resources to implement BMPs, and allows for an adaptive management feedback loop to ensure that the IP remains on track.

While this TMDL IP currently represents MEP, DOEE is also committed to evaluating additional actions and making programmatic steps to increase load reduction, as further described in Section 6.7. Should DOEE determine that implementation and load reductions can be increased in the future, the MEP standard will be increased, and the IP will be updated accordingly.

2.5 Regulatory Compliance Strategy

Section 4.10.3 of the permit includes instructions for the content of the Consolidated TMDL IP and provides direction on how to demonstrate compliance with the permit requirements. Specifically, the Consolidated TMDL IP must include:

1. A schedule for attainment of the WLAs (final date and interim milestones as necessary; it should also be noted that the schedule will be designed to achieve the WLAs as soon as possible)
2. Demonstration using models for how each applicable WLA will be attained
3. Narrative explaining schedules and controls used in the IP
4. Requirement to follow elements 1-3 above until the TMDL is withdrawn, reissued or waterbody is de-listed
5. Requirement to post the IP on the District website.

As noted above, the permit language states that models shall be used to assess and demonstrate attainment of the WLAs, and that modeling and monitoring during implementation shall be used for demonstrating progress. As described more fully in Section 4, a modeling tool has been developed and applied to assess and describe a plan for attainment of WLAs under the permit requirements. This model will also be applied in the future to track BMP implementation, projected load reduction, and subsequent progress towards attainment of WLAs. Furthermore, a revised monitoring framework has also been developed to ensure that monitoring required under the permit is adequate to document progress in attaining WLAs.

Because the IP has been designed to achieve compliance by reducing pollutants through the use of BMPs, the methods used to develop the original WLAs have been a key source of information for defining compliance. Generally, when WLAs are developed, the agency in charge of the process includes information related to the WQS, the assessment that led to the listing of the water, and the assumptions and calculations used to establish the WLA. Therefore, review of the documentation in the TMDLs was conducted to understand the assumptions that were part of the WLA development and to identify an appropriate compliance endpoint (e.g., source control, load reduction) for that WLA. Information regarding the listing of the waterbody was also important in cases where updated sampling indicated that impairments no longer existed and the water body could be de-listed (for example, see discussion of updated impairments listings in Section 3.2.2.f of this document). Data collected and reviewed to develop compliance points for individual MS4 WLAs included:

- MS4 discharge points and corresponding WLAs;
- Pollutants to be controlled and level of control established in the WLA for the pollutant;

- BMP information;
- Correlation of pollutants and BMPs in place, as well as an assessment of the level of additional controls needed for achieving the needed pollutant reductions.

The following bullet list summarizes the permit requirements relative to TMDL implementation and the actions necessary to meet these requirements that are critical to the Regulatory Compliance Strategy.

- The permit requires development of an IP to address TMDL WLAs.
- Data used to develop the TMDLs and the MS4 WLAs was used to inform both the modeling and strategy to achieve the WLAs. Evaluation of these data led to individual strategies for different WLAs. These strategies focus on implementation of source controls, BMPs to reduce loads, or additional data evaluation to support potential de-listing of the waterbody.
- The IP, through the modeling, identifies controls (i.e., amounts of BMP implementation) necessary to achieve required load reductions.
- Models and monitoring data will be used to determine the effect of BMPs in reducing pollutants. This applies to both development of the Consolidated TMDL Plan, which used modeling data to develop a plan that will meet WLAs; and to implementation of the Plan, which will rely on models and monitoring data to track progress.
- Information from the monitoring and application of models will provide feedback on implementation, track progress, and support adaptive management decision-making on whether changes in strategy need to be made in order to meet objectives. This information will inform the need to adjust BMPs and overall implementation of the plan, using an iterative approach as described in the EPA policies.

The information outlined in the preceding sections was used to develop specific strategies to address each MS4 WLA. The methodology by which each of these individual strategies was developed is discussed in the next section.

2.6 Specific Strategies to Address Each MS4 WLA

The IP includes specific types of strategies to address different MS4 WLAs. The individual strategies were based on a number of factors, including:

- The type of pollutant/impairment;
- The quality and applicability of the data and methods used to list the waterbody as impaired, develop the TMDL, and allocate loads to specific sources, including the MS4;
- Information on expected TMDL implementation from the original TMDL document;
- Current water quality or stream condition data;
- Current levels of BMP (structural, non-structural, and programmatic) implementation in the watershed;
- Current watershed restoration or other improvements in the watershed, as described in existing watershed restoration or IP documents; and
- Other relevant data.

Two primary strategies comprise the main approach toward meeting individual MS4 WLAs:

- Documenting source control as an adequate means of achieving the required pollutant reduction; and,
- Quantifying pollutant load reduction through modeling of BMP implementation.

As stated earlier, there may be instances where data are insufficient or no longer support an existing TMDL or WLA. Several of these cases have already been identified. In these cases, it may be appropriate to re-evaluate the applicability and/or technical basis for the TMDL itself. This has already occurred with several MS4 WLAs for which updated sampling indicated that impairments no longer existed. Should future sampling and assessment indicate that additional TMDLs and MS4 WLAs should be evaluated for possible de-listing or other action, the Consolidated TMDL IP can be updated to reflect the current inventory of MS4 WLAs. It is envisioned that the TMDL evaluation would be documented within the implementation planning process, but resolved outside of this framework, through other programs within DOEE. Therefore, although some TMDLs may be re-evaluated – either in the near term or in the future – and potentially replaced, withdrawn, or otherwise modified, the Consolidated TMDL IP addresses all MS4 WLAs as they currently exist and includes a schedule and plan for achieving each one.

In order to properly evaluate the types of source control and BMPs to be selected, the relevant information was evaluated and a specific strategy to address each MS4 WLA has been proposed. The steps involved in this evaluation included:

- Information on the impairment listing was compiled and reviewed for potential issues that could impact the validity of the TMDLs and MS4 WLAs. Note: in a parallel process being done outside of the IP, EPA and DOEE have re-evaluated many of the impairments underlying the original toxics TMDLs. See Section 3.2.1.b for a discussion of this investigation. The results of this re-evaluation have informed the IP, specifically by eliminating multiple MS4 WLAs from inclusion in the IP. See Section 3.2.2.f for a summary of the results and how the MS4 WLA inventory was updated based on this investigation.
- The strategy for addressing the MS4 WLA was based on the implementation expectations in the original TMDL document. For example the implementation approach for addressing some MS4 WLAs is focused on source control. This is the case for MS4 WLAs for certain toxic pollutants (such as PCBs) where MS4 WLAs are impractical to measure and where the TMDL has identified source control as the primary method for TMDL implementation. In these cases, the original TMDL was reviewed to identify the sources of the pollutant and the recommended implementation activities.
- Determine if BMPs implemented to date have already achieved the load reduction necessary to meet the WLA. For example, the District has already developed several TMDL and watershed implementation plans and has begun implementing BMPs in some watersheds. Therefore, MS4 WLAs may already have been achieved in some impaired water bodies. More current monitoring data may also be available to confirm this. Even if WLAs have not been achieved through the previous implementation of BMPs, the load reductions achieved by these BMPs can be credited towards the total load reduction needed to meet the WLA, thereby reducing the amount of additional BMPs needed to meet the WLA.
- The modeling framework was applied with the most updated information on load reductions by BMP type to develop the timeframe in which future BMPs implemented in each TMDL watershed will achieve MS4 WLAs. Modeled load reductions achieved through the implementation of BMPs were compared to MS4 WLAs over different time increments to evaluate projected progress in meeting WLAs over time.

- An adaptive management strategy with an iterative approach has been proposed. Use of the adaptive management approach over time leads to an optimal strategy for each MS4 WLA.

The IP describes how the implementation methods for each MS4 WLA has been determined, what data were used to make the determination as to how the MS4 WLA will be implemented, how the determination was made, and how the implementation will be tracked.

2.7 Daily and Other Expressions of WLAs

The District has several TMDLs that include a daily expression of the TMDL in addition to the more common determination of TMDLs that are expressed as an annual or seasonal load. In general, annual and seasonal expressions of a TMDL are considered to be closely tied to the achievement of WQS. This is particularly true for those pollutants that exert their effect on water quality over the longer term. Annual or seasonal expressions of WLAs take into consideration the assimilative capacity of water bodies and a variety of environmental conditions through the use of models. These models account for seasonal differences in stream flow and temperature, and the discharge of intermittent sources of pollutants like stormwater that are triggered by rainfall. In contrast, the daily expression of TMDLs tends to have less bearing on the actual load or load reduction required to achieve WQS or support a designated use.

Where they exist, the daily expression of TMDLs as maximum daily loads and their linkage to WQS were carefully examined in the development of the IP. It is anticipated that the load reduction practices and requirements implemented to achieve annual or seasonal WLAs will result in achievement of the maximum daily load. Therefore, the focus of the IP is directed toward annual or seasonal WLAs, and it is assumed that the annual or seasonal WLAs are, in most cases, better aligned with regulatory compliance.

3. Data Collection and Analysis

3.1 Introduction

This section of the IP summarizes the data collection and analysis that were done to support the development of the Consolidated TMDL IP. It includes discussions of:

- The 303(d) listing process and District TMDLs
- Watershed and sewershed delineation
- BMPs
- Water quality data – MS4 and ambient
- Existing WIPs/TMDL IPs
- QA/QC procedures

3.2 The 303(d) Listing Process and District TMDLs

This section provides a comprehensive summary and inventory of current TMDLs in the District and the history of TMDL development. The goals of this section of the IP are to:

- Review and summarize the process and supporting data used to develop impairment listings and TMDLs; and
- Summarize the TMDLs and MS4 WLAs that must be implemented and describe how the inventory was developed and QA/QC'ed.

The review and analysis that was undertaken to produce this summary and inventory also provides supporting information for the evaluation of potential methods for implementing TMDLs (e.g., quantifying pollutant load reduction, source control, etc.) to be discussed in Section 5. As additional background information supporting the IP, a summary of each of the pollutants for which there is an MS4 WLA in the District is provided in Appendix A, along with a discussion of common sources of that pollutant and potential reduction strategies to address that pollutant.

The review of the 303(d) listing process and District TMDLs summarizes the information needed to develop the IP. It includes:

- The amount and breadth of supporting data used to list waterbodies as impaired;
- The quality of this supporting data and its geographic distribution relative to the waterbodies listed as impaired (i.e., were actual data used for all impaired waterbodies, or were some waterbodies assumed to be impaired because downstream waterbodies were impaired);
- The baseline loads used for the TMDL and how they were derived;
- The development of the MS4 WLA and any stormwater or direct drainage load allocations (LAs);
- The expectations for load reduction (in terms of expected percent reduction and/or pounds of pollutant reduced); and
- Potential approaches for achieving the MS4 WLA (e.g., source control, pollutant reduction through BMPs; other).

Note that all current TMDLs are addressed by this analysis – even those currently being re-evaluated by EPA Region 3 and any TMDLs pending withdrawal.

3.2.1 Analysis of Impairment Assessment and 303(d) Listing Methodology

Section 303 of the CWA requires states (in this case, the District is considered a state) to periodically assess whether waters are attaining WQS and to provide a list (the 303(d) list) to EPA detailing the locations of nonattainment and the suspected reasons for impairments. TMDLs are then typically developed to control the pollutants causing these impairments.

As part of its compliance with 303(d) listing requirements, DOEE has developed either separate 303(d) lists or "Integrated Reports" (IRs) that combine the CWA Section 305(b) requirements to report on general water quality conditions in the District with the 303(d) requirements to identify impaired waterbodies. The District developed its first 303(d) list in 1998. An update was prepared in 2002, and revised reports have been prepared every two years since then. The most recent approved IR was prepared in 2014 and is titled *Integrated Report to EPA and US Congress regarding DC's Water Quality-2014* is (DDOE 2015). DOEE's IRs include background information on the District waters and water pollution control programs, surface water assessments, and public health related assessments. The IR also includes discussion of methods by which the data generated by these monitoring programs are used to assess the District's surface waters.

DOEE uses a variety of methods to assess its waters, including:

- Ambient water quality monitoring data;
- Biological data from stream monitoring;
- MS4 monitoring data;
- Fish tissue contamination data; and
- Previous assessments.

DOEE assesses all use classes for each waterbody, including:

- Primary and secondary contact recreation ([Classes A and B];
- Protection and propagation of fish shellfish and wildlife [Class C] – otherwise known as "aquatic life" use;
- Protection of human health related to consumption of fish and shellfish [Class D]; and
- Navigation [Class E].

In general, all waters in the District are designated for each use type. WQS are established to protect these uses. Impairments are determined based on the frequency that WQS are not met.

Use support for Class A and B designations are determined using water quality data compared to bacteria WQS.

Use support for Class C designations is determined using a combination of available biological/habitat and water quality data. When streams with both conventional pollutant data and biological data are evaluated, the biological data are the overriding factor in aquatic life use decisions.

Use support for Class D designations are based on known fish consumption advisories in effect during the assessment period.

3.2.1.a Class A and B Designations

TMDLs done for impairments of Class A and B designated uses include Oil and Grease TMDLs for the Anacostia (2003) and Kingman Lake (2003), the Anacostia Trash TMDL (2010), and all of the bacteria TMDLs (Anacostia and tributaries, 2003; Kingman Lake, 2003; Potomac and Tributaries, 2004; Tidal Basin and Ship Channel, 2004; Oxon Run, 2004; C&O Canal, 2004; and Rock Creek mainstem, 2004). At the time most bacteria TMDLs were established, the bacteria WQS for the District was expressed in fecal coliform colonies. However, in 2005, the fecal coliform WQS was changed to E. coli. Therefore, all of the bacteria TMDLs were updated to reflect the new E. coli WQS. This was done through the use of a "bacteria translator" that was developed jointly by EPA and DOEE. This translator uses the statistical relationship between paired fecal coliform and E. coli data collected in District's waters to convert the original fecal coliform TMDL allocations into E. coli values. For more information on the translation of fecal coliform allocations to E. coli allocations, see the memoranda documenting the development of the translation methodology (LimnoTech 2011 and 2012).

3.2.1.b Class C Designations

For District waters, evaluation of the aquatic life use support designated use is based on a comparison of measured stream biological conditions (including benthic macroinvertebrate, fish, and habitat conditions) to the condition of reference streams in Maryland. District waters are first divided into the appropriate ecoregion (either coastal plain or piedmont), and compared to an average score of reference streams from the same ecoregion. Comparisons are expressed as a percentage of reference stream condition. A District stream is deemed 'impaired' at 0-79 percent of reference stream condition, and 'non-impaired' at 80-100 percent of reference condition (DDOE 2012).

Data for assessment of the aquatic life designated use comes from annual water quality monitoring and periodic biological stream monitoring, which is conducted on a rotating schedule.

Data used for the 2012 Integrated Report included:

- Statistical evaluation of ambient water quality data collected between 2007 and 2011 analyzed for a wide range of pollutants (metals, pesticides, other organics, TSS, nutrients);
- Habitat assessments completed in 2010 and 2011 performed on all core and second round streams;
- Biological data collected during 2002-2003 and 2009.

In addition, many of the exceedances of the water quality criteria that support Class C designated uses of Protection and Propagation of Fish, Shellfish and Wildlife are questionable. The 2010 Rock Creek WIP identifies multiple pollutants - including arsenic, mercury, PAHs, chlordane, heptachlor epoxide, dieldrin, DDD, DDE, DDT, and PCBs – as being primarily non-detect values in the water quality sampling (note that additional sampling was completed for many of these pollutants in the Fall of 2013. See discussion in the paragraphs below regarding sampling results, and see Section 3.2.2.f for a summary of impairments removed from the draft 2014 IR as a result of this sampling). Yet when non-detect values were used in developing representative outfall concentrations, they were set at one-half of the detection limit. This practice caused these pollutants to exceed their respective water quality criteria. While setting the concentration of non-detect values at half of the detection limit is standard practice for some types of evaluations, it is inappropriate for this type of evaluation, because the water quality criteria is below the detection limit for these pollutants. Thus it is unclear whether the pollutant concentrations actually exceed water quality criteria. The correct method for making this assessment is to use a detection limit below the water quality criteria for that pollutant.

While this improper use of water quality data is identified specifically for Rock Creek, the same methodology was applied to list other waters as impaired for Class C designated uses of Protection and Propagation of Fish, Shellfish and Wildlife because of organic and metals pollutants. For example, the Anacostia tributaries, Oxon Run, Kingman Lake, Potomac tributaries, and the Tidal Basin and Ship Channel are all listed as being impaired for Class C designated uses of Protection and Propagation of Fish, Shellfish and Wildlife because of organic and metals pollutants. Thus, each of these listings is questionable.

There is an ongoing effort to investigate many of the toxics TMDLs for waters impaired for Class C designated uses, including TMDLs for PAHs, PCBs, pesticides and metals. A 2010 court order based on litigation brought by the Anacostia Riverkeeper and Friends of the Earth will vacate these TMDLs due to the lack of daily loads. However, the court has refrained from vacating the TMDLs until 2017 to allow EPA and DOEE time to revise the TMDLs to include daily loads. This will also allow time to re-examine the underlying impairments for these TMDLs. The original 303(d) toxics listings and TMDLs were based on the very limited data available at the time of TMDL development - primarily fish tissue data with some supplementary sediment and water quality data collected in the Anacostia River. Assumptions arising from this limited data set were extended to Rock Creek and its tributaries and for tributaries to the Anacostia and Potomac Rivers.

Since the original 303(d) toxics listings and establishment of the original toxics TMDLs, the District has changed the WQS for most of the toxics, with some criteria becoming less stringent and others more stringent. Because of the lack of toxics data for many of the water segments, and because the WQS have changed, EPA and DOEE decided to gather more data to support, confirm or revise the toxic impairment listings and then develop new TMDLs based on the new information collected. As part of this process, EPA and DOEE have developed and initiated a toxic monitoring program to collect updated toxics data for the main stem of the Anacostia River and the tributaries to the Anacostia River, Rock Creek and the Potomac River.

Results from three rounds of sampling between October 2013 and December 2013 have been reported. Metals were re-sampled in the Anacostia and its tributaries, Oxon Run and Foundry Branch (in the Potomac watershed), and Piney Branch (in Rock Creek.) Arsenic exceeded the 30 day human health criteria (HHC) concentration[2] at least once for most waterbodies sampled, including the Upper and Lower Anacostia and all of its tributaries except Popes Branch. Results did not exceed the HHC concentration for Piney Branch in the Rock Creek watershed or Foundry Branch or Oxon Run in the Potomac watershed. For the other metals, only zinc in the Lower Anacostia segment showed any exceedances of the HHC.

PCBs showed exceedances of the HHC in all waterbodies sampled, including all Rock Creek tributaries and Fort Stanton, Hickey Run, Nash Run, Popes Branch, the Texas Avenue Tributary, and Watts Branch in the Anacostia watershed. Exceedances of HHC for PAHs occurred in the Lower Anacostia, Fort Stanton, Hickey Run, Kingman Lake, Nash Run, Popes Branch, and Texas Avenue Tributary in the Anacostia watershed, but no exceedances occurred in Watts Branch in the Anacostia watershed or in any of the water segments sampled in the Potomac or Rock Creek watersheds.

Resampling for pesticides (chlordane, DDD, DDE, DDT, dieldrin, and heptachlor epoxide) yielded many more exceedances of both HHC and the 4-day average Criterion Continuous Concentration (CCC). The Texas Avenue Tributary showed exceedances of the CCC for chlordane, DDD, DDE, and DDT, and of the HHC for dieldrin, and heptachlor epoxide. This waterbody was the only segment to show exceedance of DDD. The Upper and Lower Anacostia and Kingman Lake also showed exceedances of the CCC for DDT

[2] Note that the exceedances discussed in these cases are assuming the single sample is representative of the 30-day average for the standard.

and of the HHC for Fenwick Branch. Popes Branch and Hickey Run showed exceedances of the CCC and HHC, respectively, for DDE.

Almost all water segments evaluated showed exceedances of the HHC for dieldrin and heptachlor epoxide, with the Upper and Lower Anacostia, Fort Stanton, Kingman Lake, Popes Branch (not sampled for dieldrin), and Watts Branch (not sampled for heptachlor epoxide) in the Anacostia watershed; Klingle Valley and Melvin Hazen in the Rock Creek watershed; and Oxon Run (dieldrin only), the Tidal Basin and Washington Ship Channel in the Potomac watershed being the only exceptions.

Chlordane was found to exceed the HHC for the Upper and Lower Anacostia, Hickey Run, Kingman Lake, Nash Run, and Watts Branch in the Anacostia watershed and Broad Branch, Dumbarton Oaks, Luzon Branch, Piney Branch, and Soapstone Creek in the Potomac watershed, and to exceed the CCC for Popes Branch and Texas Avenue Tributary in the Anacostia watershed.

Overall, these results indicate that many TMDL pollutants are still found at concentrations exceeding various criteria in District waters. However, not every pollutant for which there is a TMDL requirement in a specific waterbody segment was found to exceed criteria in that segment. Therefore, additional sampling is needed to determine if all impairments exist, and/or if some TMDLs should be revised because the impairment can no longer be confirmed.

3.2.1.c Class D Designations

According to the impairment citations in the original TMDLs, only three TMDLs were completed to address water segments listed as impaired for protection of human health related to consumption of fish and shellfish – the Upper and Lower Anacostia mainstem and the Washington Ship Channel. However, the pollutants identified as causing these impairments are very diverse, and include: metals and organics (Anacostia and Tributaries Metals and Organics, 2003; TSS (Anacostia Watershed TSS, 2007); TN, TP and BOD (Anacostia Watershed Nutrients and BOD, 2008); PCBs (Anacostia and Potomac PCBs, 2007); and pH (Washington Ship Channel pH, 2004). These same pollutants are identified as causing different impairments in other waterbodies (for example, metals and organics are listed as pollutants causing impairment of the Protection and Propagation of Fish, Shellfish and Wildlife designated use in the Anacostia tributaries, Oxon Run, Kingman Lake, Potomac tributaries, and the Tidal Basin and Ship Channel). This raises questions about whether the pollutants identified as causing impairments (and thus the pollutants for which TMDLs are conducted) are being identified correctly.

In addition, there may be no direct link between fish tissue data and impairments of the protection of human health related to the consumption of fish and shellfish designated use for the Washington Ship Channel. The 2006 IR states that "Fish tissue data used to issue advisories are collected at stations on the Anacostia and Potomac Rivers. If no barrier for fish movement exists, it is assumed that fish move freely to the smaller streams and other waterbodies." Thus, impairments of Class D designated uses can be assigned to tributaries despite the fact that there is no direct evidence of contaminated fish within the tributaries.

3.2.1.d Conclusions

Many of the impairment listings and the determination of the specific pollutants responsible for impairments appear questionable. The 2012 IR acknowledges issues with the original TMDLs and states that:

> Many of these existing District's TMDLs were established based on limited data and narrow modeling options available at the time. Most of these TMDLs need to be revised by taking into account new available data and improved understanding of the natural environmental processes. Revising these TMDL will provide an opportunity to develop more sophisticated water quality

models with enhanced prediction capabilities, and consequent upon that, an improved implementation plan for better protection of the environment.

In light of these findings, it is prudent to re-examine the scientific basis of the TMDLs and MS4 WLAs. Many of the TMDLs are based on data, analysis and modeling that was performed 10 to 15 years ago. An example of such a re-examination is currently underway with updated water quality sampling to look at a number of toxics TMDLs (see discussion of this sampling under "Class C Designations"). Revisiting the scientific basis of the TMDLs and MS4 WLAs during the early phase of implementation over the next NPDES permit cycle could be coordinated with implementation of BMPs designed to address TMDLs that are not based on questionable data. These BMPs would address all impairments, and thus this process would not impede implementation, although it would verify the level of control needed.

3.2.2 TMDL/MS4 WLA Inventory

3.2.2.a Background

The first step in developing a Consolidated TMDL IP for the District's MS4 WLAs is to develop a comprehensive inventory of the MS4 WLAs. This is a complex process because it involves reviewing and interpreting many historic TMDL-related documents, including TMDL studies, EPA Decision Rationale documents, court rulings, databases, and other data sources to determine the inventory. In some cases, TMDLs were developed and superseded by subsequent TMDLs. In other cases, TMDL studies have been conducted, but the studies have concluded that no TMDL is required. In addition, there are also other cases where TMDL studies have been completed, but the result has been a recommendation to implement management strategies to control the pollutant in question; thus, these studies have not resulted in a numeric MS4 WLA for that pollutant. All of these different situations and scenarios must be accounted for in the TMDL/MS4 WLA inventory, although only some of these TMDLs and MS4 WLAs will result in numeric WLAs that can be tracked through modeling with the IP Modeling Tool. However, all MS4 WLAs (numeric and non-numeric) will be addressed in this IP.

3.2.2.b Summary of TMDL Studies in the District

A total of 26 TMDL studies have been developed for impaired waters in the District - 15 for waterbodies in the Anacostia watershed, six (6) for waterbodies in the Potomac watershed, three (3) for waterbodies in the Rock Creek watershed, and two (2) that encompass impaired waters in both the Anacostia and the Potomac watersheds (note that two of those studies [the 2001 Anacostia BOD and nutrients TMDL and the 2002 Anacostia TSS TMDL] have been superseded by subsequent TMDLs [the 2008 Anacostia watershed BOD and nutrients TMDL and the 2007 Anacostia watershed TSS/sediments TMDL, respectively]. Because these TMDLs have been superseded, they are not included in subsequent TMDL inventories). Altogether, these TMDL studies provide allocations for 23 different pollutants[3] in 44 different waterbody segments. The TMDL studies include 518 individual MS4 WLAs, consisting of 406 annual, 103 daily, seven seasonal, and two monthly WLAs. Of these, 33 are not evaluated in the IPMT, including: two daily TSS WLAs from the 2002 TSS TMDL that was superseded; 25 fecal coliform WLAs (24 annual and one monthly) that have been replaced by E. coli WLAs; three non-numeric annual WLAs from the 1998 Hickey Run oil and grease, PCB and chlordane TMDL; and three TMDLs where it was determined that annual MS4 WLAs were not needed (these include BOD from the Fort Davis BOD TMDL and TSS and BOD from the TSS, Oil and Grease, and BOD TMDL in Kingman Lake). This leaves 485

[3] Note that there are 23 different pollutants for which TMDLs have been completed, but only 22 pollutants for which MS4 WLAs must be achieved. This is because fecal coliform WLAs have been translated to *E. coli* for the purposes of setting MS4 WLAs.

WLAs to be evaluated. Of these WLAs, 376 are annual, 101 are daily, seven are growing season, and one is monthly. A summary of these TMDL studies is provided in Table 3-1 below. The table includes the name of each TMDL study; a sum of the total numeric and non-numeric MS4 WLAs in the TMDL study; a summary of the types of WLA expressions in the study (e.g., annual, daily, or seasonal WLAs); and a summary of the types of pollutants for which there are WLAs. There are also notes for each TMDL study that describe any caveats or discrepancies in the study. Finally, the total numbers of numeric and non-numeric WLAs are provided at the bottom of the table.

The first TMDL studies in the District were completed in 1998 (District Final Hickey Run TMDL Water Quality Management Plan to Control Oil and Grease, PCB, and Chlordane) by the District Department of Health (DOH) Environmental Health Administration. This agency continued to develop TMDLs in the District through 2004; by which time the vast majority of District TMDLs had been completed (21 of 26 TMDL studies were completed by DOH between 1998 and 2004). However, in response to a suit filed by Friends of the Earth, Inc., in April 2006 the U.S. Court of Appeal for the DC Circuit vacated EPA's approval of the 2001 BOD and nutrients and the 2002 TSS TMDLs. These TMDLs had expressed loads only as average annual loads or growing season loads, but the court ruled that the specification of average annual or growing season loads was not sufficient, and that the CWA specifies that TMDLs must be expressed as daily loads. In response to the court's decision, new TMDL studies for TSS and BOD and nutrients in the Anacostia River watershed were completed jointly by DDOE and the Maryland Department of the Environment (MDE) in 2007 (TSS)and 2008 (BOD and nutrients). Thus, the 2007 and 2008 TMDLs officially replaced the earlier 2001 and 2002 TMDLs and all MS4 WLAs included in the earlier TMDLs. Also in 2007, the Interstate Commission on the Potomac River Basin (ICPRB) released the Tidal Potomac and Anacostia PCB TMDL on behalf of DDOE, MDE, and the Virginia Department of Environmental Quality. U.S. EPA Region 3 finalized the Chesapeake Bay TMDL in 2010, and DDOE and MDE released the Anacostia River Watershed Trash TMDL in the same year.

Anacostia Riverkeepers, Friends of the Earth, and Potomac Riverkeepers filed an additional lawsuit in January 2009 challenging multiple TMDLs established for District waters because they did not include daily expressions. EPA conceded that these TMDLs were deficient, but represented to the court that any actions taken to address the absence of a daily load expression for bacteria TMDLs should also address the District's revised bacteria WQS from fecal coliform to E. coli. The E. coli WQS had been promulgated in 2005 after approval of all of the District's bacteria TMDLs. As a result of this lawsuit, DOEE updated all seven (7) of its bacteria TMDL studies, including TMDLs for bacteria in the Anacostia and its tributaries (2003); Kingman Lake (2003); the Potomac and its tributaries (2004); the Washington Ship Channel and the Tidal Basin (2004), the C&O Canal (2004); Oxon Run (2004); and the Rock Creek mainstem (2004). Because the assumptions and modeling underlying the original TMDLs were not challenged in the lawsuit, EPA used a bacteria translator tool to translate fecal coliform TMDLs to E. coli. These updated TMDLs included annual average, maximum daily, and average daily expressions of the MS4 WLAs, except in the case of Kingman Lake, which included monthly average instead of annual average MS4 WLAs.

Table 3 - 1. TMDL Studies and Current MS4 WLAs

Major Basin	TMDL Name	Number of Numeric MS4 WLAs	Number of Non-numeric MS4 WLAs	WLA Express-ions	Metals	Organics	Nutrients	Sediment	Bacteria	Pesticides	PCBs	Other (Oil and Grease, BOD, Trash)	Notes
Anacostia	District Final Hickey Run TMDL Water Quality Management Plan to Control Oil and Grease, PCB, and Chlordane (1998)	0	3	Non-numeric narrative		X					X	X	3 narrative WLAs
Anacostia	TMDL Upper Anacostia River Lower Anacostia River District of Columbia BOD (2001)	0	0	Annual			X					X	No MS4 WLAs provided (stormwater allocations included direct drainage). Superseded by 2008 Anacostia Watershed Nutrients and BOD TMDL
Anacostia	Total Maximum Daily Loads: Upper Anacostia River, Lower Anacostia River, District of Columbia; Total Suspended Solids (2002)	0 (see note below)	0	Daily				X					Superseded by 2007 Anacostia Watershed TSS TMDL

Table 3 - 1. TMDL Studies and Current MS4 WLAs													
Major Basin	TMDL Name	Number of Numeric MS4 WLAs	Number of Non-numeric MS4 WLAs	WLA Express-ions	Metals	Organics	Nutrients	Sediment	Bacteria	Pesticides	PCBs	Other (Oil and Grease, BOD, Trash)	Notes
Anacostia	District Final TMDL for Fecal Coliform Bacteria in Upper Anacostia River, Lower Anacostia River, Watts Branch, Fort Dupont Creek, Fort Chaplin Tributary, Fort Davis Tributary, Fort Stanton Tributary, Hickey Run, Nash Run, Popes Branch, Texas Avenue Tributary (2003)	30	0	Annual, Daily					X				Fecal coliform WLAs replaced by E. coli WLAs July 2014. Average daily loads not include as WLAs. Anacostia and Watts Branch WLAs, which were divided into Upper and Lower in original fecal coliform TMDL, are now combined. Nash Run WLA includes Maryland loads.
Anacostia	District TMDL for Organics and Metals in the Anacostia River and Tributaries (2003)	125	0	Annual	X	X				X	X		
Anacostia	District Final TMDL for Oil and Grease in the Anacostia River (2003)	2	0	Daily								X	MS4 WLAs not provided; Decision Rationale document provides WLAs, but they include CSO and MS4 loads
Anacostia	District Draft TMDL for Biochemical Oxygen Demand in Fort Davis Tributary (2003)	0	0	N/A								X	EPA Decision Record indicates TMDL/MS4 WLA not required
Anacostia	District Final TMDL for Fecal Coliform Bacteria in Kingman Lake (2003)	3	0	Monthly, Daily					X				Fecal coliform WLAs replaced by E. coli WLAs July 2014.

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Table 3 - 1. TMDL Studies and Current MS4 WLAs

Major Basin	TMDL Name	Number of Numeric MS4 WLAs	Number of Non-numeric MS4 WLAs	WLA Express-ions	Metals	Organics	Nutrients	Sediment	Bacteria	Pesticides	PCBs	Other (Oil and Grease, BOD, Trash)	Notes
Anacostia	District Final TMDL for Organics and Metals in Kingman Lake (2003)	13	0	Annual	X	X				X			
Anacostia	District Final TMDL for TSS, Oil &Grease, BOD in Kingman Lake (2003)	1	0	Daily				X				X	EPA Decision Record indicates TMDLs/MS4 WLAs not required for TSS, BOD
Anacostia	District Final TMDL for Total Suspended Solids in Watts Branch (2003)	4	0	Annual, Growing Season				X					
Anacostia	TMDL of Sediment/Total Suspended Solids for the Anacostia River Basin, Montgomery and Prince George's Counties, MD and the District (2007)	26	0	Annual, Growing Season, Daily				X					Includes daily and growing season daily WLAs
Anacostia	TMDL of Nutrients/ BOD for the Anacostia River Basin, Montgomery and Prince George's Counties, MD and the District (2008)	39	0	Annual, Daily			X					X	
Anacostia	TMDL of Trash for the Anacostia River Watershed, Montgomery and Prince George's Counties, MD and the District (2010)	4	0	Annual, Daily								X	

Table 3 - 1. TMDL Studies and Current MS4 WLAs													
Major Basin	TMDL Name	Number of Numeric MS4 WLAs	Number of Non-numeric MS4 WLAs	WLA Express-ions	Metals	Organics	Nutrients	Sediment	Bacteria	Pesticides	PCBs	Other (Oil and Grease, BOD, Trash)	Notes
Potomac	District TMDL for Organics, Metals and Bacteria in Oxon Run (2004)	15	0	Annual, Daily	X	X			X	X	X		Fecal coliform WLAs replaced by E. coli WLAs July 2014.
Potomac	District Final TMDL for Bacteria in the Chesapeake and Ohio Canal (2004)	3	0	Annual, Daily					X				Fecal coliform WLAs replaced by E. coli WLAs July 2014.
Potomac	District Final TMDL for Fecal Coliform Bacteria in Upper Potomac River, Middle Potomac River, Lower Potomac River, Battery Kemble Creek, Foundry Branch, and Dalecarlia Tributary (2004)	18	0	Annual, Daily					X				
Potomac	District Final TMDL for Organics and Metals in Battery Kemble Creek, Foundry Branch, and the Dalecarlia Tributary (2004)	18	0	Annual	X	X				X	X		
Potomac	District Final TMDL for pH in the Washington Ship Channel (2004)	1	0	Annual			X						TMDL indicates that no reduction in phosphorus is needed to meet MS4 WLA
Potomac	District Final TMDL for Bacteria in the Tidal Basin and the Washington Ship Channel (2004)	6	0	Annual, Daily					X				Fecal coliform WLAs replaced by E. coli WLAs July 2014.

Table 3 - 1. TMDL Studies and Current MS4 WLAs

Major Basin	TMDL Name	Number of Numeric MS4 WLAs	Number of Non-numeric MS4 WLAs	WLA Express-ions	Metals	Organics	Nutrients	Sediment	Bacteria	Pesticides	PCBs	Other (Oil and Grease, BOD, Trash)	Notes
Potomac	District Final TMDL for Organics in Tidal Basin and Washington Ship Channel (2004)	20	0	Annual		X				X	X		
Potomac, Anacostia	TMDL for PCBs for Tidal Portions of the Potomac and Anacostia Rivers in District , MD, and VA (2007)	17	0	Annual. Daily							X		
Potomac, Anacostia	Chesapeake Bay TMDL for Nitrogen, Phosphorus, and Sediment (2010)	12	0	Annual	X								
Rock Creek	District Final TMDL for Fecal Coliform Bacteria in Rock Creek (2004)	6	0	Annual, Daily					X				Fecal coliform WLAs replaced by E. coli WLAs July 2014.
Rock Creek	District Final TMDL for Metals in Rock Creek (2004)	8	0	Annual	X								
Rock Creek	District Final TMDL for Organics and Metals in Broad Branch, Dumbarton Oaks, Fenwick Branch, Klingle Valley Creek, Luzon Branch, Melvin Hazen Valley Branch, Normanstone Creek, Pinehurst Branch, Piney Branch, Portal Branch, and Soapstone Creek (2004)	114	0	Annual	X	X				X	X		
Total		485	3										

Table 3 - 1. TMDL Studies and Current MS4 WLAs													
Major Basin	TMDL Name	Number of Numeric MS4 WLAs	Number of Non-numeric MS4 WLAs	WLA Express-ions	Metals	Organics	Nutrients	Sediment	Bacteria	Pesticides	PCBs	Other (Oil and Grease, BOD, Trash)	Notes
WLAs Not Required	3 WLAs not required (Fort Davis BOD; TSS, BOD for Kingman Lake)												
WLAs Super-seded	25 fecal coliform WLAs superseded by E. coli WLAs; 2 Anacostia TSS WLAs superseded by subsequent TSS WLAs.												

For additional information on the TMDL studies and where various MS4 WLAs apply on the ground, "fact sheets" for each TMDL study are provided in Appendix B, and maps of each of the waterbody segments with a MS4 WLA are provided in Appendix C.

3.2.2.c Flaws in District TMDLs that Affect the IP

TMDLs in the District typically account for the following sources: upstream flows; point source wastewater (if applicable); CSO (if applicable); MS4 stormwater; and direct drainage/non-MS4 runoff. Typically, other potential sources, such as baseflow, direct atmospheric deposition, in-stream erosion, and contaminated sediment resuspension, were not evaluated, although there were exceptions. For example, direct atmospheric deposition was considered in the Potomac and Anacostia PCB TMDL, and in-stream erosion was evaluated in the Watts Branch TMDL and for some river segments in the Chesapeake Bay TMDLs. However, with respect to developing allocations, the MS4 WLA served as a general "catch-all" for loads that could potentially be attributed to these other sources. This has implications for implementation of MS4 WLAs as described below.

First, the potential sources described above were rarely evaluated to determine their specific contributions to loadings into impaired waterbodies, and, even in some cases where these sources were evaluated, they were not assigned their own allocations. For example, the DC Small Tributaries Model, which was used for bacteria, metals, and organics TMDLs for all small tributaries in the District, included baseflow/dry weather flow in its calculations of MS4 loads. Dry weather flow sampling showed that the dry weather bacteria EMC (280 MPN/100 mL) is higher that the WQS (200 MPN/100 mL), which means there are likely dry weather sources (like leaking sewer, wildlife, cross connections, etc.) contributing to the bacteria load. Therefore, since baseflow was not given its own allocation in the TMDL, but instead was aggregated with the wet weather allocation, either dry weather flows need to be reduced (which is not typically the responsibility of the MS4 program), or load reductions from wet weather surface runoff (including MS4s) must be increased in order to meet the MS4 WLA and compensate for the lack of a baseflow allocation/load reductions from baseflow.

Second, with respect to allocations to runoff-based loads (CSO and MS4), much more information was available to characterize the CSS and the CSO loads than was available to characterize the MS4 loads. Much of the information on flows, EMCs, and the extent of the CSS area came from the Long Term Control Plan (LTCP), so CSS contributions and CSO WLAs were very well characterized in the TMDLs. In addition, the focus on CSOs and implementation of the LTCP led to CSO WLAs being based on what could be achieved for CSOs and what aligned with the LTCP. In contrast, MS4 WLAs were often developed based on what load reductions were necessary to meet the TMDL once CSO WLAs were achieved. In other words, there was typically no process or regulatory framework to determine what was feasible or achievable in terms of MS4 load reduction; instead, MS4 load reduction and MS4 WLAs were based on what was left to be done.

In summary, the District's MS4 WLAs may have inherent flaws. Some of these flaws represent issues that are known and documented (for example, the issues with the inclusion of baseflow in MS4 loads and differences in the development of CSO vs. MS4 WLAs). Others represent issues that are less well understood (such as the potential impacts of atmospheric deposition or contamination from sediment resuspension). In either case, the assignment of these loads as MS4 loads makes it more difficult to achieve MS4 WLAs, and confounds the potential technical ability to achieve those MS4 WLAs. As part of the ongoing re-evaluation of the District's TMDLs, evaluation of all sources, and correcting allocations to account for these sources, will be considered.

3.2.2.d Developing the MS4 WLA Inventory

Once the universe of TMDL studies in the District was determined, the individual TMDL studies were reviewed to identify MS4 WLAs. For the most part, MS4 WLAs were identified clearly in the TMDLs. However, this was not always the case. One issue was that most of the District's TMDLs were developed between 2003 and 2004, which was the timeframe when EPA was clarifying its regulatory requirements for establishing WLAs for stormwater discharges in TMDLs[4]. Consequently, many of the older TMDL studies did not differentiate between stormwater loads from the MS4 system and areas that drained directly to the waterbodies (direct drainage areas). As a result, many of the TMDL study documents have combined allocations for point source MS4 and nonpoint source direct drainage areas. In its review of these District TMDLs, EPA on occasion used the original modeling documentation on drainage areas to separate MS4 WLAs from direct drainage LAs. The net result is that some TMDL studies present MS4 WLAs, while other MS4 WLAs are identified only in EPA's Decision Rationale documents. Additionally, in the cases of the Anacostia Watershed TMDLs for TSS (2007) and BOD and nutrients (2008), MS4 WLAs for some waterbodies were only identified in the Point Source Technical memos. Therefore, the review of the TMDLs included review of all of these documents in order to identify MS4 WLAs. The source of each MS4 WLA (e.g., document name, page or table number) was documented for future reference, as were any explanatory notes (e.g., loads combined with Maryland loads; no numeric WLA; etc.).

The next step after identifying the MS4 WLAs was to document each expression of that WLA. This is important because different subsets of the loading time series data must be evaluated for each of the different expressions of the WLA. Each TMDL document was reviewed, and the different expressions of the MS4 WLA were recorded. MS4 WLAs were typically expressed as annual averages, although in some instances the annual expression was not defined as an average – only as an annual value. However, it was assumed that this meant an annual average. The Watts Branch and Anacostia Watershed TSS TMDLs (2003 and 2007, respectively) also expressed MS4 WLAs over the growing season from April through October. The 2003 Watts Branch TMDL did not assign an MS4 WLA, but assigned a nonpoint source load allocation to stormwater in terms of tons per growing season. The EPA Decision Rationale document then re-calculated the allocations to set MS4 WLAs and a margin of safety. The Decision Rationale document labels these WLAs as average annual growing season loads in tons/year, but the correct unit should be tons per growing season. Thus these WLAs were interpreted as tons/growing season. The 2007 Anacostia TSS TMDL expressed these seasonal loads as tons/season or tons/day during the season.

The updated Kingman Lake E. coli MS4 WLA is expressed as a monthly average, as well as a daily average and a maximum daily value. In the original TMDL, average existing loads were calculated by month for a wet year, a dry year, and an average year using an assumed stormwater concentration of fecal coliform of 17,300 # / 100 mL. The maximum monthly TMDL load was calculated by reducing the maximum monthly existing load by 50 percent and assigning 10 percent as the MOS. The Kingman Lake E. coli TMDL is the only example of a WLA being expressed as a monthly maximum value.

Many TMDLs include WLAs expressed in terms of a daily value. These include all of the newly-translated E. coli TMDLs, as well as the 2007 and 2008 Anacostia Watershed TMDLs for TSS and BOD and nutrients; the Anacostia Trash TMDL; the Potomac and Anacostia PCB TMDL, which includes average daily values for PCBs for the mainstem Anacostia and Potomac segments; and the Kingman Lake TSS, BOD and oil and grease TMDL, which includes daily MS4 WLA for oil and grease.

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[4]Memorandum *Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs*, from Robert H. Wayland, III, Director, Office of Wetlands, Oceans and Watersheds, and James A. Hanlon, Director, Office of Wastewater Management, to Water Division Directors, Regions 1 - 10, dated November 22, 2002.

3.2.2.e Collection of Additional Relevant Data

In addition to the MS4 WLA data, additional information that was relevant to TMDL implementation and/or the development of the Consolidated TMDL IP was collected during the review of the TMDL documents. These data included:

- Existing ("baseline") MS4 load.
- Existing ("baseline") stormwater load if the TMDL did not break out MS4 baseline loads.
- Percent reduction of baseline load required to meet MS4 WLA.
- Nonpoint source stormwater (aka direct drainage) baseline load.
- Nonpoint source stormwater/direct drainage LA.
- Percent reduction of nonpoint source stormwater/direct drainage baseline load required to meet stormwater/direct drainage LA.
- Potential or documented pollutant sources identified in the TMDL.
- Documentation of source of information described above (i.e., identification of document name and page numbers or table numbers for relevant information.
- Comments on the TMDL. These comments included identifications of potential problems with TMDL development (e.g., identification of potentially flawed impairment listing data), potential issues with allocations (e.g., evaluation of stormwater allocations to determine whether they included or excluded direct drainage loads), discussions of implementation expectations or strategies within the TMDLs, etc.

3.2.2.f 2014 Updates to the 303(d) List and Impacts on TMDL Inventory

The 2014 Integrated Report and 303(d) (DDOE, 2014) list includes updated impairment listings for toxics (metals and organics) for multiple waterbodies in the District. As discussed previously, concerns had been raised that previous impairment listings for metals and organics had been based on flawed or incomplete data. As part of the response to the Friends of the Earth vs. the Environmental Protection Agency, 446 F.3d 140, 144 court ruling that required the development of daily limits for TMDLs in the District, additional sampling was done for many District waterbodies to fill data gaps with current information in preparation of converting existing TMDLs for these waterbodies to daily loads. In light of the concerns regarding the data used in the original impairment listings, a complimentary goal of this work was to use the data to either verify impairment of these waterbodies, or to indicate the need for additional data to determine the impairment status. Data collection for this impairment assessment included three rounds of sampling between October 2013 and January 2014. The monitoring included *in situ* water quality monitoring during one dry and two wet weather sampling events for the Anacostia River and Anacostia River tributaries, while one dry weather sampling event was performed in the Rock Creek and Potomac River tributaries.

The results of the additional sampling were used to update the 303(d) impairment listings for organics and metals TMDLs for the Anacostia and Potomac Rivers and Rock Creek. Using the updated listings, a total of 136 MS4 WLAs were moved into Category 3 status, which includes waterbodies for which there is insufficient available data and/or information to make a use support determination. These include 31 MS4 WLAs for Anacostia tributaries; 6 MS4 WLAs for Kingman Lake; 9 MS4 WLAs for Oxon Run; 10 MS4 WLAs for Potomac tributaries; 18 MS4 WLAs for the Washington Ship Channel and the Tidal Basin; and 62 MS4 WLAs for Rock Creek tributaries. Based on discussions with EPA Region 3 regarding the original impairment listings and TMDLs and the updated sampling results, DOEE concludes that the existing MS4 WLAs for these waterbodies are no longer supported by the data. Therefore, the MS4 WLAs included in Table 3 - 2 are no longer applicable and the Consolidated TMDL IP does not include further implementation plans to achieve the WLAs.

Table 3 - 2. MS4 WLAs Moved to Category 3 in 2014 303 (d) List

TMDL Name	Waterbody segment	Pollutant
District TMDL for Organics and Metals in the Anacostia River and Tributaries (2003)	Fort Dupont	Copper
		Zinc
	Hickey Run	Dieldrin
		Heptachlor epoxide
		DDD
		DDT
	Nash Run	Copper
		Zinc
		DDD
		DDE
		DDT
	Pope Branch	Arsenic
		Copper
		Zinc
		Dieldrin
		DDD
		DDT
	Watts Branch - Lower	DDD
		DDE
		DDT
		Heptachlor epoxide
		PAH1
		PAH2
		PAH3
	Watts Branch - Upper	DDD
		DDE
		DDT
		Heptachlor epoxide
		PAH1
		PAH2
		PAH3
District Final TMDL for Organics and Metals in Kingman Lake (2003)	Kingman Lake	Copper
		Zinc
		Dieldrin
		Heptachlor epoxide
		DDD
		DDE

Table 3 - 2. MS4 WLAs Moved to Category 3 in 2014 303 (d) List		
TMDL Name	**Waterbody segment**	**Pollutant**
District TMDL for Organics, Metals and Bacteria in Oxon Run (2004)	Oxon Run	Arsenic
		Copper
		Zinc
		Chlordane
		Heptachlor epoxide
		DDT
		PAH1
		PAH2
		PAH3
Organics and Metals in Battery Kemble Creek, Foundry Branch, and the Dalecarlia Tributary (2004)	Dalecarlia Tributary	Chlordane
		DDD
		DDE
		DDT
		PAH1
		PAH2
		PAH3
	Battery Kemble Creek	Arsenic
		Copper
		Zinc
District Final TMDL for Organics in Tidal Basin and Washington Ship Channel (2004)	Tidal Basin	Chlordane
		Dieldrin
		Heptachlor epoxide
		DDD
		DDE
		DDT
		PAH1
		PAH2
		PAH3
	Washington Ship Channel	Chlordane
		Dieldrin
		Heptachlor epoxide
		DDD
		DDE
		DDT
		PAH1
		PAH2
		PAH3
	Dumbarton Oaks	DDD
		DDE

Table 3 - 2. MS4 WLAs Moved to Category 3 in 2014 303 (d) List		
TMDL Name	**Waterbody segment**	**Pollutant**
District Final TMDL for Organics and Metals in Broad Branch, Dumbarton Oaks, Fenwick Branch, Klingle Valley Creek, Luzon Branch, Melvin Hazen Valley Branch, Normanstone Creek, Pinehurst Branch, Piney Branch, Portal Branch, and Soapstone Creek (2004)		DDT
		PAH1
		PAH2
		PAH3
	Fenwick Branch	Chlordane
		DDD
		DDE
		PAH1
		PAH2
		PAH3
	Klingle Valley	Chlordane
		DDD
		DDE
		DDT
		PAH1
		PAH2
		PAH3
	Luzon Branch	DDD
		DDE
		DDT
		PAH1
		PAH2
		PAH3
	Melvin Hazen Branch	Chlordane
		Heptachlor epoxide
		DDD
		DDE
		DDT
		PAH1
		PAH2
		PAH3
	Pinehurst Branch	Chlordane
		DDD
		DDE
		DDT
		PAH1
		PAH2
		PAH3

Table 3 - 2. MS4 WLAs Moved to Category 3 in 2014 303 (d) List		
TMDL Name	**Waterbody segment**	**Pollutant**
District Final TMDL for Organics and Metals in Broad Branch, Dumbarton Oaks, Fenwick Branch, Klingle Valley Creek, Luzon Branch, Melvin Hazen Valley Branch, Normanstone Creek, Pinehurst Branch, Piney Branch, Portal Branch, and Soapstone Creek (2004)	Piney Branch	Arsenic
		Copper
		Zinc
		DDD
		DDE
		DDT
		PAH1
		PAH2
		PAH3
	Portal Branch	Chlordane
		DDD
		DDE
		DDT
		PAH1
		PAH2
		PAH3
	Soapstone Creek	DDD
		DDE
		DDT
		PAH1
		PAH2
		PAH3

The MS4 WLAs remaining for the six TMDL studies for which impairment listings were updated by the 2014 303(d) list are summarized in Table 3 - 3 below:

Table 3 - 3. MS4 WLAs Remaining for TMDL Studies for Which Impairment Listings Were Updated in 2014 303(d) List		
TMDL Name	**Waterbody segment**	**Pollutant**
District TMDL for Organics and Metals in the Anacostia River and Tributaries (2003)	Fort Dupont	Arsenic
		Lead
	Hickey Run	Chlordane
		DDE
		PAH1

Table 3 - 3. MS4 WLAs Remaining for TMDL Studies for Which Impairment Listings Were Updated in 2014 303(d) List

TMDL Name	Waterbody segment	Pollutant
District TMDL for Organics and Metals in the Anacostia River and Tributaries (2003)	Hickey Run	PAH2
		PAH3
	Nash Run	Arsenic
		Chlordane
		Dieldrin
		Heptachlor Epoxide
		Lead
		PAH1
		PAH2
		PAH3
	Pope Branch	Chlordane
		DDE
		Heptachlor Epoxide
		Lead
		PAH1
		PAH2
		PAH3
	Watts Branch - Lower	Chlordane
		Dieldrin
	Watts Branch - Upper	Chlordane
		Dieldrin
District Final TMDL for Organics and Metals in Kingman Lake (2003)	Kingman Lake	Arsenic
		Chlordane
		DDT
		Lead
		PAH1
		PAH2
		PAH3
District TMDL for Organics, Metals and Bacteria in Oxon Run (2004)	Oxon Run	Lead
		Dieldrin
Organics and Metals in Battery Kemble Creek, Foundry Branch, and the Dalecarlia Tributary (2004)	Dalecarlia Tributary	Dieldrin
		Heptachlor Epoxide
	Battery Kemble Creek	Lead

Table 3 - 3. MS4 WLAs Remaining for TMDL Studies for Which Impairment Listings Were Updated in 2014 303(d) List		
TMDL Name	**Waterbody segment**	**Pollutant**
District Final TMDL for Organics in Tidal Basin and Washington Ship Channel (2004)	Tidal Basin	None
	Washington Ship Channel	None
District Final TMDL for Organics and Metals in Broad Branch, Dumbarton Oaks, Fenwick Branch, Klingle Valley Creek, Luzon Branch, Melvin Hazen Valley Branch, Normanstone Creek, Pinehurst Branch, Piney Branch, Portal Branch, and Soapstone Creek (2004)	Dumbarton Oaks	Chlordane
		Dieldrin
		Heptachlor Epoxide
	Fenwick Branch	DDT
		Dieldrin
		Heptachlor Epoxide
	Klingle Valley	Dieldrin
		Heptachlor Epoxide
	Luzon Branch	Chlordane
		Dieldrin
		Heptachlor Epoxide
	Melvin Hazen Branch	Dieldrin
	Pinehurst Branch	Dieldrin
		Heptachlor Epoxide
	Piney Branch	Chlordane
		Dieldrin
		Heptachlor Epoxide
		Lead
	Portal Branch	Dieldrin
		Heptachlor Epoxide
	Soapstone Creek	Chlordane
		Dieldrin
		Heptachlor Epoxide

3.2.3 Development of the MS4 WLA Tracking Database

The TMDL and MS4 data described above was input into an MS Access database. The MS Access database serves as a centralized data storage and model input tool. Data from the database is utilized in all evaluations of progress compliance analysis.

3.2.3.a Mapping the MS4 WLAs

A critical aspect of tracking and implementing TMDLs and MS4 WLAs is identifying the area where each MS4 WLA applies. This is important for multiple reasons. First, loads must be calculated over a certain area that has specific land cover and land use characteristics, so these areas must be accurate in order to ensure that loads are accurate for modeling purposes. Second, BMPs and other stormwater management measures that reduce loads are implemented at specific locations, and the load reductions achieved by these BMPs must be assigned to the correct TMDLs and MS4 WLAs. Last, progress towards meeting TMDLs and MS4 WLAs must be monitored, and data from stormwater outfalls must be linked to specific watersheds for which TMDLs and MS4 WLAs exist in order to help track progress.

In order to identify the physical location to which TMDLs and MS4 WLAs apply, the TMDL watersheds were mapped in GIS. The large number of TMDL studies completed over a 12 year period by the five different agencies cited earlier, along with differences in available datasets, modeling approaches, and documentation complicates the task of tracking TMDLs and MS4 WLAs and the area they were designed to control. In addition, refinements over time in mapping the MS4 system have led to improved MS4 coverages and sewershed/watershed delineations relative to those used in earlier TMDL studies. Thus, updated mapping using the most recent data was completed to identify the locations of TMDL watersheds and where MS4 WLAs apply on the ground. In addition, better identification of impervious surfaces (streets, alleys, sidewalks, parking lots, etc.) provides better characterization of runoff from each TMDL watershed.

Mapping TMDLs and MS4 WLAs on the ground was complicated by the differences in historical TMDL development in the District. Specifically, TMDL development and modeling differed depending on the type of waterbody for which the TMDL was developed. TMDL studies have been completed for four different types of waterbodies in the District:

- Mainstem waterbodies (the Anacostia and Potomac Rivers and Rock Creek).
- Small tributaries to the mainstems (e.g., Hickey Run, Texas Avenue Tributary, and other small tributaries in the Anacostia watershed; Battery Kemble Creek, Dalecarlia Tributary, and Foundry Branch in the Potomac watershed; and Soapstone Creek, Klingle Valley, and other small tributaries in the Rock Creek watershed).
- Other waterbodies that are not small tributaries but which are hydraulically connected to the mainstems (e.g., Tidal Basin and Ship Channel; the C&O Canal; and Kingman Lake).
- Chesapeake Bay segment-sheds (a set of four segments representing Potomac and Anacostia drainage areas in the District).

Based on these water body distinctions, there were multiple drainage area delineations and varying representations of MS4 areas vs. non-MS4 areas in the District within the TMDL inventory – and sometimes even within the same waterbody, depending on the TMDL. This led to the development of overlapping GIS data layers for the different waterbody types described above. In addition, it also caused ramifications for TMDL implementation, because, in some cases, more than one TMDL was developed for the same pollutant(s) in the same waterbodies. For example, the 2003 Watts Branch TSS TMDL and the 2007 and 2008 Anacostia Watershed TMDLs for TSS and BOD and nutrients have MS4 WLAs for nitrogen, phosphorus, and TSS. In addition, the District's Phase II WIP for the Chesapeake Bay TMDL established MS4 WLAs for the same pollutants, including MS4 WLAs for segments that overlap the Anacostia River and Watts Branch. Thus, the District has multiple different sets of requirements for TSS, TN and TP within the same watersheds. These overlaps must be reconciled in order to effectively consolidate implementation planning. Accurate mapping of the different watershed boundaries allows identification of where each of these MS4 WLAs applies, and thus implementation planning can proceed. By identifying where each MS4 WLA applies, load reduction through BMPs can be applied to any MS4 WLA that applies at the location where the BMP is implemented. Thus, if a BMP is located in Watts Branch, it can provide a load reduction credit for both the Watts Branch TSS MS4 WLA and the appropriate Chesapeake Bay segment TSS MS4 WLA. Similarly, a BMP in the Anacostia mainstem can receive load reduction credit for the Anacostia TSS and nutrients MS4 WLAs, as well as the appropriate Chesapeake Bay segment TSS and nutrient MS4 WLA.

3.3 Watershed and Sewershed Delineation

It was necessary to delineate watersheds and sewersheds to identify where MS4 WLAs and nonpoint source LAs apply on the ground. In addition, by identifying the spatial extent of each TMDL watershed and sewershed, it is possible to calculate the current pollutant loads being generated, plan for the implementation of BMPs in specific locations, track the load reduction from BMP implementation, and evaluate load reduction to track progress towards meeting applicable MS4 WLAs and LAs.

A summary of the watershed and sewershed delineation process and the ramifications of these delineations with respect to modeling and the development of the Consolidated TMDL IP is provided below. A full discussion of the methods and results of the watershed and sewershed delineation process is provided in Appendix D, *Technical Memorandum: Sewershed and Watershed Delineations* to the *Final Comprehensive Baseline Analysis Report* document (DDOE, 2015).

3.3.1 Delineation of TMDL Watersheds and Sewersheds

Delineation of the watersheds and sewersheds to which the original TMDLs and MS4 WLAs were intended to apply was not well documented, nor was it consistent from TMDL to TMDL. The original TMDLs included a wide variety of documentation on the delineation of TMDL watersheds and sewersheds. In some cases, the original GIS files showing the delineations were identified, while in other cases, only maps or tables containing summaries of drainage areas were available.

Because of the lack of high quality, consistent data, and in order to ensure that the TMDL watershed and sewershed delineations reflected the most recent data the collection system, new delineations were developed for use in the IP Modeling Tool and the Consolidated TMDL IP. The delineation of drainage areas was largely based on DC Office of the Chief Technology Officer (OCTO) GIS coverages (topography and stream-lines) and a DC Water geodatabase that includes sewer pipes and outfalls. Instead of using automated Digital Elevation Model (DEM) techniques, delineation was done manually in order to account for the complexities of delineation in an urban landscape. Other GIS coverages and aerial imagery were used where needed to support delineation.

All land areas within the District were included in the delineation. The major categories of drainage area delineations needed to categorize land within the District and to match established WLAs and LAs are shown in in Figure 3-1 and include:

MS4 Areas: These areas represent land in the District that drains to the separate storm sewers.

CSS Areas: These areas represent land that drains to the combined sewer system (CSS) that borders the MS4 area. While it is important to note the existence of the CSS areas, these areas will not be included in the IP Modeling Tool since they are not included under the MS4 permit requirements.

Direct Drainage (DD) Areas: These areas represent areas that are not served by the MS4 or CSS systems. These areas are typically parks that border streams and rivers.

Additional delineations of the MS4 and DD areas were necessary in order to establish the areas that currently have an established TMDL. These areas exist at various spatial scales, including:

- Chesapeake Bay Watershed Segments: These areas represent the areas that have a WLA under the Chesapeake Bay TMDL. This represents the coarsest level of delineation for the District. A map of the Chesapeake Bay Segments is presented in Figure 3-2.

- Mainstem Watersheds: These areas represent the watersheds draining to the Anacostia, Rock Creek and Potomac River. These major watersheds at typically divided into upper and lower segments, and a middle segment for the Potomac River. This is shown in Figure 3-3.
- Tributary and Other Small Waterbody Watersheds: These areas represent the watersheds draining to the small tributaries that have TMDLs, as well as other small waterbodies (such as the Washington Ship Channel and Kingman Lake) that are not tributaries but which also have TMDLs. This is shown in Figure 3-4.

Figure 3-1. Sewershed Delineations

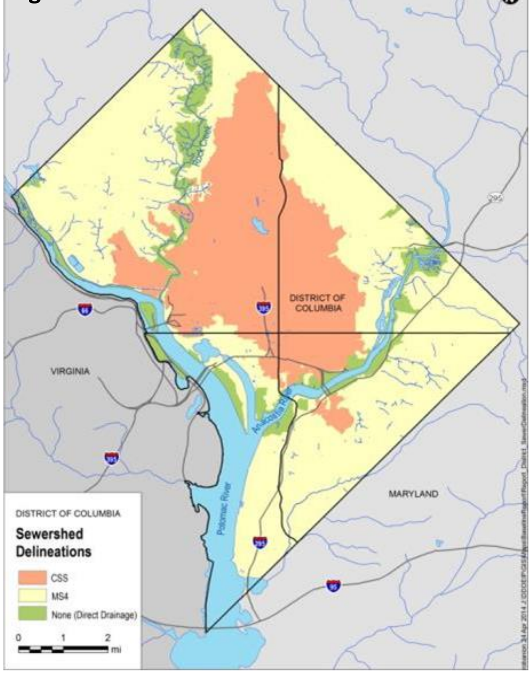


Figure 3-2. Chesapeake Bay Delineations

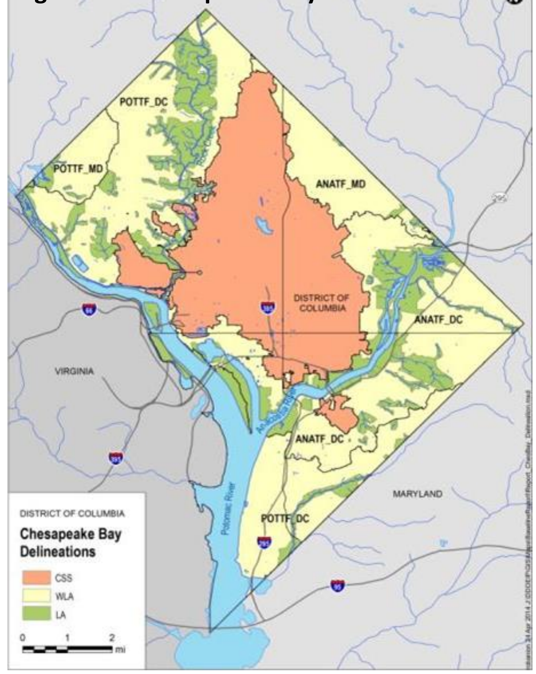


Figure 3-4. Mainstem Delineations

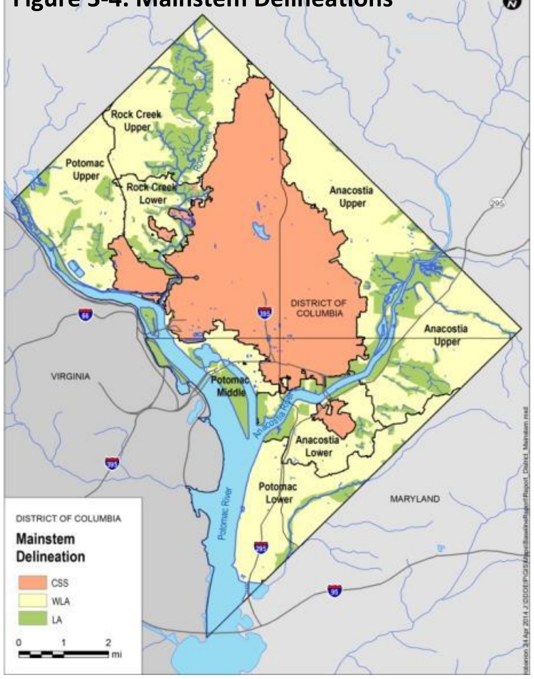
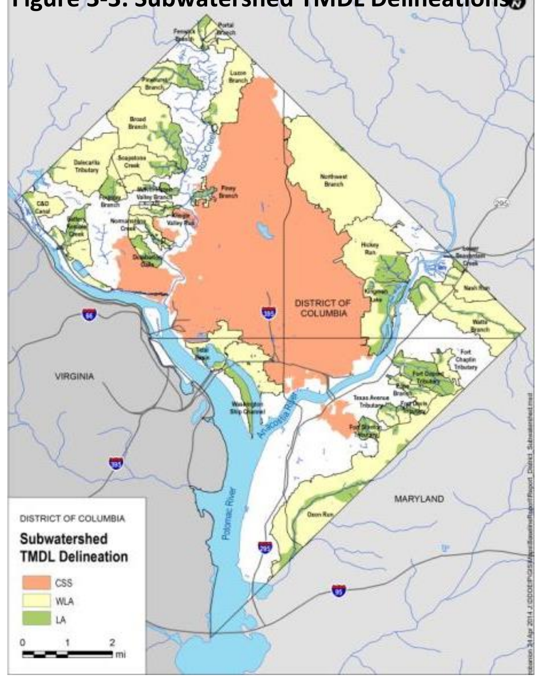


Figure 3-3. Subwatershed TMDL Delineations



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Major categories of drainage delineations/watersheds used in the Consolidated TMDL IP
After initial delineations were completed, a series of QA/QC steps were taken to ensure that the delineations were both accurate relative to current information on the extent of the MS4 system, while also reflecting the sewer and watersheds as they were originally delineated in the TMDL studies. QA/QC included tabulation of areas from the original TMDLs (either through evaluation of model input files on sewer/watershed areas or tables of these areas in TMDL-related documents) and comparison of these areas to areas of the updated delineations from the geodatabase. QA/QC also included visual comparison of the watershed and sewershed boundaries between maps from the TMDL documents, GIS files from the original TMDL modeling, and current delineations. In several cases, discrepancies were found between the sewershed and watershed delineations completed for the original TMDLs and the delineations based on updated data. These discrepancies were resolved through further research into the original TMDL data, review of topography and other outside mapping data, and engineering judgment. Corrections to delineations and/or assignments of loads were made where necessary.

Another QA/QC check involved the comparison of areas from the current geodatabase with areas in the original TMDLs. In general, areas agreed within ± 20 percent, which was deemed to be acceptable for this type of exercise with multiple delineations. However, several subsheds, including seven (7) small tributaries and the ANATF-MD Chesapeake Bay segment shed, had discrepancies of more than 20 percent. A discussion of these discrepancies, along with a discussion of how the discrepancies were resolved, is provided in Table 6 of Appendix D, *Technical Memorandum: Sewershed and Watershed Delineations* to the *Final Comprehensive Baseline Analysis Report* (DDOE, 2015).

3.3.2 Impact of Watershed and Sewershed Delineations on Modeling

One ramification of the differences between the watershed and sewershed delineations in the original TMDLs and the updated watershed and sewershed delineations is that loads calculated from these updated areas will not match the loads calculated for the original TMDLs. Because load is a function of runoff, which in turn is dependent on the contributing drainage area, changes in area inherently impact loads. However, any changes in loads due to changes in land areas delineated for the TMDLs reflect the actual current conditions in that watershed/sewershed using the most updated data. This greatly increases confidence in the IP and its ability to affect changes in the watersheds and sewersheds that will lead to meeting applicable MS4s and improving water quality in District waterbodies.

3.4 BMPs

BMPs are a critical component of the Consolidated TMDL IP because they are the means by which load reduction is achieved. BMP information is an important input into the IP Modeling Tool, which allows evaluation of the potential impact of BMPs and meets the permit requirement to use modeling to demonstrate progress of how each applicable WLA will be attained. Development of the Consolidated TMDL IP and use of the IP Modeling Tool required data for both existing and future proposed BMPs. Data on existing BMPs were used to calculate current conditions/ existing load reductions to help determine current status relative to achieving WLAs. Data on future proposed BMPs were used to develop scenarios that “close the gap” between current conditions and MS4 WLAs, thus informing the implementation plan to address those WLAs.

In order to assemble the required data, existing BMPs were catalogued, categorized and quantified. Additional information on BMP effectiveness necessary for current condition analysis and scenario modeling was compiled through research. The following subsections address the various steps conducted to compile the BMP information required to perform these modeling exercises.

3.4.1 Database of Existing BMPs

A comprehensive database of existing BMPs was developed for use in the IP Modeling Tool. The BMP database includes information on BMPs (such as BMP type, spatial locations, ownership, information on area treated and/or volume managed, and other data) that provided input data for the IP Modeling Tool and was used to calculate load reductions to evaluate current conditions.

3.4.1.a Data for Existing Structural BMPs

In order to develop a comprehensive database of existing structural BMPs in the District, existing BMP data were compiled from multiple sources, including the existing DOEE BMP Tracking Database; RiverSmart Communities and RiverSmart Homes spreadsheets; Green Roofs spreadsheet; data reported by federal agencies, including GSA, the District of Columbia Army National Guard, U.S. Army Installation Management Command, National Park Service, and National Zoological Park; data from the DC Water Clean Rivers Project (DCCR); and a dataset that includes all BMPs operated by the District Department of Transportation (DDOT).

Data from these sources existed in multiple formats, used different schema, and had variable degrees of completeness and accuracy. Therefore, rigorous QA/QC was performed on the data from these different sources to ensure that the required database fields were populated consistently. Critical data tracked in the database includes BMP identification information, BMP type, drainage area controlled, build date, and locational information. Data were reviewed to remove duplicate records and evaluate the reliability/accuracy of information for each record. Questions regarding whether individual BMPs included in the database had actually been built, as well as issues with reported drainage areas, were resolved through specific QA/QC steps. In particular, issues regarding reported drainage areas were resolved through a GIS analysis that led to recommended modifications to reported drainage areas for some BMPs (for more information on this issue and the recommendations, see Appendix F, *Technical Memorandum: BMPs and BMP Implementation* to the *Final Comprehensive Baseline Analysis Report,* DDOE, 2015). Any missing spatial location information for individual BMPs was also researched and updated through the use of several methods, including the District's Master Address Repository (MAR) geocoder, a list of previously researched locations from internal DOEE documentation, and a manual geocoding process. A full discussion of the development of the BMP database is provided in Appendix F, *Technical Memorandum: BMPs and BMP Implementation* to the *Final Comprehensive Baseline Analysis Report* (DDOE, 2015).

It should be noted that the BMP database represents the best estimate of BMPs that were currently in place at the start of the project (i.e., October, 2013). It is intended that the BMP database will be updated periodically as better information becomes available on historic/existing BMPs, as well as when new BMPs are implemented. Specific efforts are planned with the goal of verifying and improving information on existing BMPs. This should allow better characterization of the current conditions for future iterations of the BMP modeling.

3.4.1.b Data for Existing Non-Structural BMPs

Data on existing non-structural BMPs (i.e., existing stormwater management activities and other stormwater control practices) were also collected. Unlike data collected for structural BMPs, which were basically consistent for the different structural BMP types, data for non-structural BMPs were more individualized. This was necessary because the methods and calculations for quantifying the load reduction impacts, and thus the data required for input into those methods and calculations differed with each non-structural BMP type. For example, stream restoration projects required length of stream restored, whereas street sweeping required information on specific street lengths and locations that had been swept at least 26 times per year. Thus, the data required to implement the load reduction calculations for each non-structural BMP type were identified based on the research conducted to determine the BMP effectiveness for that BMP (see Section 3.4.2 below). This research informed the data collection needs for each BMP.

Note that sufficient information was not available to quantify the load reduction achieved by all existing non-structural BMPs – even for those for which load reduction methodologies were available (see Section 3.4.2 below on BMP effectiveness for a discussion of load reduction methodologies for non-structural BMPs). In some cases, even when appropriate methodologies for quantifying load reduction were identified, insufficient information was collected to allow quantification of that load reduction. For example, load reduction calculation methodologies are available for IDDE and catch basin cleaning programs, but the information required to quantify the impacts of these BMPs is not currently collected within the District. Conducting the data collection necessary to quantify the impacts of these BMPs is among the implementation actions proposed in the Consolidated TMDL IP. Should the required information be collected in the future, the impact of these BMPs will be modeled in the IP Modeling Tool and used to evaluate progress towards meeting WLAs.

3.4.2 BMP Effectiveness

In addition to the cataloging and quantification of existing BMPs, methods were needed to quantify the impacts of those BMPs. Thus, additional research was conducted to determine “BMP effectiveness” data that could be used in the IP Modeling Tool. A review of structural and non-structural BMP information was undertaken to help develop load reduction methods for the various BMPs that either exist or are planned for use in the District. For structural BMPs, standard load reduction methods include load reduction efficiency and volume reduction efficiency approaches. Identifying methods to account for load reductions from non-structural BMPs was not as straightforward because there is no standard accounting method for non-structural BMPs. Therefore, research into non-structural BMPs was done on an individual basis.

The literature review for the load reduction efficiency approach for structural BMPs began with an evaluation of the International Stormwater BMP Database (2013) to determine if it could be used to develop pollutant percent removals. Linear regression analysis of both local and national paired BMP data for inflow and outflow concentrations returned extremely poor fits, and thus this data source was deemed unusable for this purpose. An additional literature review was undertaken to identify peer reviewed journals and previously approved Watershed Implementation Plans (WIPs) that studied the pollutant removal efficiency of structural BMPs. Data were abundant for some pollutants (e.g., nutrients, TSS, fecal coliform), less abundant for other pollutants (e.g., copper, lead, zinc, BOD), and minimal to non-existent for the remaining pollutants (arsenic, mercury, organic toxics). Based on this data gap for organics, additional research was undertaken to identify literature that focused on using TSS as a surrogate for organics. This research led to the use of linear partitioning theory to determine the pollutant removal efficiency for particle bound pollutants without literature based removal rates. The end result was a look-up reference table that included load reduction efficiency numbers for every pollutant/BMP combination. The IP Modeling Tool uses this look-up table to determine the load reduction efficiency that should be applied in its calculations of load reduction associated with a specific pollutant/BMP combination.

The literature review for the volume reduction efficiency approach was primarily focused on the volume reduction efficiencies documented in “Recommendations of the Expert Panel to Define Removal Rates for New State Stormwater Performance Standards” developed by Schueler and Lane (2012) for the Chesapeake Bay Program’s Urban Stormwater Work Group (CBP Work Group). The CBP Work Group approach developed nutrient and sediment removal rates for composite categories of BMPs based on the amount of runoff treated or reduced. The removal rates are presented as BMP removal rate adjustor curves based on runoff depth managed (i.e., treated or reduced) per impervious acre. This research was used to inform BMP-specific volume reduction modeling efforts using SWMM. The end result of the research and modeling of volume reduction efficiency is a series of curves for that can be used to evaluate the load reduction of a specific pollutant (as a percentage) based on the retention depth of that BMP. The IP Modeling Tool uses these curves to determine the load reduction that should be applied in its calculations of load reduction through the application of a specific volume-retention BMP to a specific pollutant.

A literature review was also conducted to help develop load reduction methodologies for non-structural BMPs. The literature review focused on identifying non-structural BMPs for which load reduction impacts could be quantified, either directly or indirectly. The literature review consisted of research of primary and secondary literature (i.e., review of other literature reviews), and, in many cases, follow up communications with the authors of the primary literature. The literature review resulted in a series of methodologies that allowed the load reduction impacts of selected non-structural BMPs to be evaluated. These load reduction methodologies were included in the IP Modeling Tool. In combination with the data on non-structural BMPs included in the BMP database (see subsection 3.4.1.b on Data for Existing Non-Structural BMPs above), these methodologies allowed the load reduction of non-structural BMPs to be modeled.

It should be noted that quantifiable load reduction methodologies could not be developed for many non-structural BMP types – for example, for source control, public outreach and education, or pollution prevention. While the impacts of these non-structural BMPs are not quantifiable, they are still critical components of stormwater management and control, and they are an important part of the Consolidated TMDL IP strategy to reduce pollutant loading and meet MS4 WLAs. Research into quantifying the impacts of non-structural BMPs will be ongoing, and updates to non-structural BMPs can be made in the future should additional information become available.

A complete summary of the various structural and non-structural BMP load reduction methods and the BMP literature review is provided in Appendix F, *Technical Memorandum: BMPs and BMP Implementation* to the *Final Comprehensive Baseline Analysis Report* (DDOE, 2015).

3.5 Water Quality Data – MS4 and Ambient

Ambient water quality and biological monitoring data used to support impairment listings and the development of the TMDLs was also collected and compiled. These data may be useful in tracking the sources of the original impairment listings, as well as in identifying potential candidate waterbodies for de-listing. Evaluation of the District's current monitoring program (developed under a parallel effort to the IP) will also help to identify specific monitoring locations that can be used to evaluate MS4 WLA implementation. These topics are discussed in more detail in Section 7.3, *Monitoring*.

Knowledge of current and historical water quality and stream biological conditions data is helpful in assessing the current condition of a waterbody relative to a previously identified impairment. Where sufficient data are available, the current data will be reviewed alongside the historical data to assess whether the waterbody is still impaired by the pollutant for which the MS4 WLA was developed. This type of comparative analysis will help to determine the strategy for addressing the MS4 WLA in that watershed.

In addition to evaluating current conditions versus historical impairments, identifying existing monitoring locations can help to establish plans for tracking activities to address MS4 WLAs. For example, if water quality or biological monitoring stations already exist in a watershed which has a MS4 WLA, then results from the existing station can be used to track progress for addressing that MS4 WLA.

The District has been implementing wet weather monitoring programs in association with its municipal separate storm sewer (MS4) permit since 2000 when its first permit was issued. Within each watershed, DOEE has selected outfalls that are representative of the MS4. Samples from these outfalls reflect end-of pipe runoff concentrations from MS4 sources discharging to waterbodies.

The monitoring stations used since 2000 are shown in Table 3-4 and Figure 3-5 below. The District's 2004 MS4 permit established a rotating schedule for monitoring wet weather discharges to the Anacostia River, Rock Creek, and the Potomac River. Monitoring each year occurred only in one of the watersheds so that each watershed was monitored once every three years. Three wet events were sampled at all locations for the designated watershed each year. Storm events are chosen given the following criteria: at least 0.1 inch of precipitation, 72 hours since the last storm, and one month since the last collection at a specific site. From 2000 through 2011, samples were collected by grab method, except for those that could be analyzed in the field. From 2012 and on, time-composite samples were collected, except for those that could be analyzed in the field.

Table 3 - 4. Stormwater Outfall Monitoring Locations, 2000-2012 (Source: EDC 2006)
A. Anacostia River Sub Watershed Monitoring Sites
1. Stickfoot Sewer (Suitland Parkway)-2400 block of Martin Luther King, Jr. Ave., SE, near Metro bus entrance.
2. O St. Storm Water Pump Station - 125 O St., 125 O SE-just outside front gate at O St. Pump Station
3. Anacostia High School/Anacostia Recreation Center - corner of 17th St. and Minnesota Ave. SE
4. Gallatin & 14th St., NE-across from the intersection of 14th St. and Gallatin St. in a large outfall
5. Varnum and 19th Place, NE-2100 Block of Varnum St.
6. Nash Run-intersection of Anacostia Drive and Polk St., NE.
7. East Capitol St.-200 Block of Oklahoma Ave., NE.
8. Ft. Lincoln-Newtown BMP-in the brush along the side of New York Ave. West (coming into city) after the bridge.
9. Hickey run-33rd and V Streets, NE.
B. Rock Creek Subwatershed Monitoring Sites
1. Walter Reed (Fort Stevens Drive).
2. Military Road and Beach Drive.
3. Soapstone Creek (Connecticut Avenue and Albemarle Street).
4. Melvin Hazen Valley Branch (Melvin Hazen Park and Quebec Street).
5. Klingle Valley Creek (Devonshire Place and 30th Street).
6. Normanstone Creek (Normanstone Drive and Normanstone Parkway).
7. Portal Dr. and 16th St.
8. Broad Branch.
9. Oregon and Pinehurst.
C. Potomac River Subwatershed Monitoring Sites
1. Battery Kemble Creek-49th and Hawthorne Streets, NW.
2. Foundry Branch-at Van Ness and Upton Streets, NW in the park.
3. Dalecarlia Tributary-Van Ness Street and Dalecarlia Parkway.
4. Oxon Run-Mississippi Avenue and 15th Street, SE.
5. Tidal Basin-17th Street and Constitution Avenue, NW.

Table 3 - 4. Stormwater Outfall Monitoring Locations, 2000-2012 (Source: EDC 2006)
6. Washington Ship Channel-Washington Marina parking lot, SW.
7. C and O Canal-Potomac Avenue and Foxhall Road, NW.
8. Archbold Parkway.

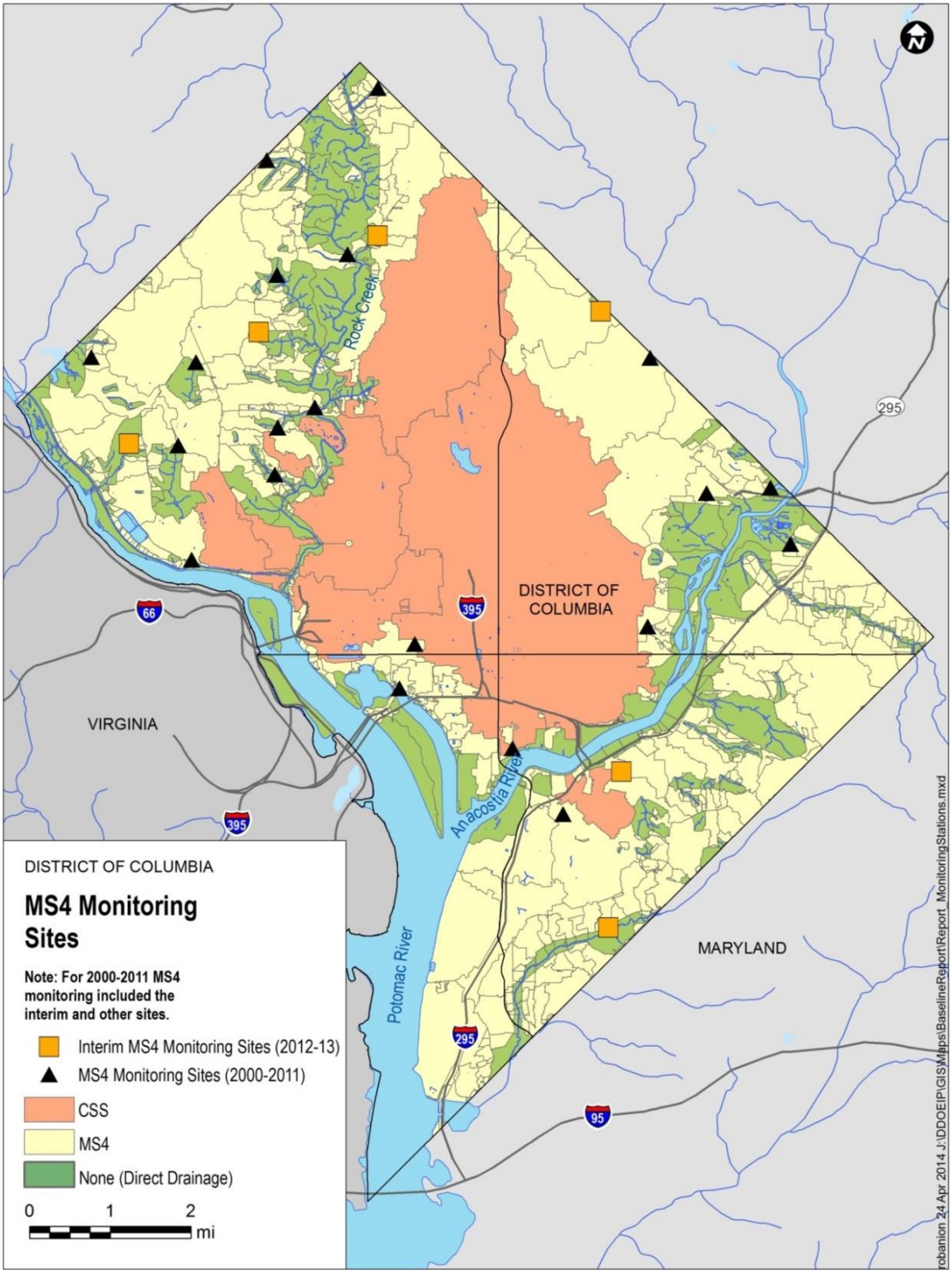

Figure 3-5. MS4 Monitoring Sites in Washington DC

Table 3 - 5 shows the list of parameters that were analyzed from 2000 through 2011.

Table 3 - 5. Parameters Analyzed Outfall Discharge Monitoring Samples, 2000-2011. (Source: Apex Companies 2012)		
Grab Samples		**Field Analysis**
• VOCs	• SVOCs	• Residual Chlorine
• Cyanide	• Pesticides and PCBs	• Dissolved Oxygen
• Total Phenols	• Metals	• pH
• Oil & Grease	• Nutrients	• Temperature
• Fecal Coliform	• BOD5, Chlorophyll a	• Flow
• Fecal Streptococcus	• TSS, TDS, Hardness, TOC	
• E-Coli	• Dioxin	

Starting in 2012, the wet weather discharge monitoring was implemented in a slightly revised format (the interim program) based on the revised MS4 permit (finalized in 2012). Interim monitoring stations are shown in Table 3 - 6. For the interim program, the sampling protocols changed to include time-composited samples for certain parameters and the number of stations monitored was reduced to two per watershed (to be monitored each year) for efficiency's sake while a new monitoring program is being developed. Pollutants included in the interim monitoring program are summarized in Table 3 - 7.

Table 3 - 6. Required Interim Monitoring Stations (Source Table 5, MS4 Permit)
A. Anacostia River Sub Watershed Monitoring Sites
1. Gallatin Street & 14th Street N.E. across from the intersection of 14th St. and Gallatin St. in an outfall (MS-2)
2. Anacostia High School/Anacostia Recreation Center – Corner of 17th St and Minnesota Ave SE
B. Rock Creek Subwatershed Monitoring Sites
1. Walter Reed -- Fort Stevens Drive -- 16th Street and Fort Stevens Road, N.W. at an outfall (MS-6)
2. Soapstone Creek -- Connecticut Avenue and Albemarle Street N.W. at an outfall (MS-5)
C. Potomac River Subwatershed Monitoring Sites
1. Battery Kemble Creek-49th and Hawthorne Streets, N.W. at an outfall (MS-4)
2. Oxon Run-Mississippi Avenue and 15th Street, S.E. into Oxon Run via an outfall (MS-1)

Table 3 - 7. Parameters Analyzed in Outfall Discharge Monitoring Samples, 2012-2013 (Source: Apex 2012)		
GRAB SAMPLES	**COMPOSITE SAMPLES**	**FIELD SAMPLES**
VOCs	SVOCs	Residual Chlorine
Cyanide	Pesticides/PCBs	Dissolved Oxygen
Coliform	Metals (As, Cu, Cr, Cd, Ni, Pb, Zn)	pH
E. Coli, Fecal Coliform, Fecal Streptococcus	Nutrients	Temperature
Oil and Grease	BOD5, Chlorophyll a, COD	Flow
Total Phenols	TSS, TDS, Hardness, TOC	
	Dioxin	

Section 5.1 of DOEE's revised MS4 permit (first issued in 2011 and modified in 2012) includes the requirement to design a revised monitoring program. At a minimum, the permit requires a minimum

small set of parameters to be monitored (Table 3 - 8). The monitoring sites and protocols are currently in development and will be completed in 2015.

Table 3 - 8. Parameters to be Monitored for Outfall Discharge as Part of Revised Program, 2015 (Source: MS4 Permit, Table 4)

E. coli	Lead	Total Suspended Solids
Total nitrogen	Zinc	Arsenic
Total phosphorus	Trash	Copper

3.6 Existing WIPs/TMDL IPs

Multiple plans that address watershed restoration or TMDL implementation have been developed for District waterbodies. These plans will be reviewed to identify relevant information, such as watershed data, historical discussions on impairments and TMDL development, implementation strategies, implementation tracking and accounting methods, and implementation quantification.

The list of plans to be reviewed included:

- Anacostia River Watershed Implementation Plan (DDOE, 2012)
- Oxon Run Watershed Implementation Plan (DDOE, 2010)
- Rock Creek Watershed Total Maximum Daily Load Waste Load Allocation Implementation Plan (DDOE, 2005)
- Rock Creek Watershed Implementation Plan (DDOE, 2010)
- Chesapeake Bay TMDL Phase I Watershed Implementation Plan for the District of Columbia (DDOE, 2010)
- Chesapeake Bay TMDL Phase II Watershed Implementation Plan for the District of Columbia (DDOE, 2012)
- Anacostia River Watershed Restoration Plan and Report (multiple authors, 2010)
- Anacostia Watershed Trash Reduction Plan (DDOE, 2008)

3.7 QA/QC Procedures

A Quality Assurance Project Plan (QAPP) (specifically, *Quality Assurance Project Plan Consolidated Total Maximum Daily Load (TMDL) Implementation Plan and Monitoring Program*, DDOE, 2014) has been prepared to document the quality assurance procedures and processes that will be undertaken to ensure the quality of the data and analytical methods used in the project. The QAPP focuses on the use of secondary data, and includes discussions and procedures for identifying metadata on the data used for the project (e.g., identifying any QA/QC procedures used in collecting the original data) and documenting the data sources, the intended use of the original data, and any caveats to the original data collection. The QAPP also focuses on procedures to document and validate pollutant loading calculations, including establishing baseline pollutant loads and pollutant load reductions, as well as BMP pollutant removal efficiencies and the effectiveness of non-structural BMPs in reducing pollutant loads. This was important in establishing load reduction strategies that meet the project objectives. The QAPP also established and assessed data quality objectives for these data prior to their use in the modeling.

4. Model Development

4.1 Introduction

A major component of the development of the Consolidated TMDL IP was the development of an Implementation Plan Modeling Tool to track and account for pollutant load generation and load reduction across the District. The IP Modeling Tool, which was based on a modified version of the Simple Method, was designed to use a single, consistent modeling approach for analysis of all of the pollutants of interest that have MS4 WLAs. The application of this consistent modeling approach made the tracking of pollutant loads:

- Consistent, despite the different pollutants, watersheds, and modeling approaches of the original TMDLs;
- Reflective of current conditions;
- Transparent; and
- Easy to understand.

The process undertaken to evaluate modeling needs for the Consolidated TMDL IP and develop the IP Modeling Tool are described below.

4.2 Modeling Requirements

In order to address all of the needs of the Consolidated TMDL IP, it was necessary for the selected modeling tool to meet the following requirements:

- Calculate and track pollutant loads and reductions spatially and temporally by watershed, catchment (a defined MS4 drainage area), pollutant, or other specification;
- Estimate a baseline of current pollutant loads as well as estimate pollutant load reductions achievable via various BMP implementation scenarios;
- Tabulate loads on an annual basis but be able to represent the daily expression of the TMDL;
- Account for site-specific characteristics of watersheds and catchments such as land use, land cover, and soil type;
- Quantify pollutant load reductions associated with various IP scenarios, including the implementation of the District stormwater management regulations over defined time periods;
- Incorporate spatial changes over time to the District's land use/land cover and BMP implementation and their effect on pollutant loads and reductions;
- Evaluate progress towards WLA compliance by comparing current and future condition pollutant loads with benchmarks and milestones;
- Utilize a GIS component to allow spatial visualization of modeling scenarios;
- Be user-friendly and not require expert knowledge of modeling concepts to run the modeling tool and understand the output;
- Be adaptive so that future information can be incorporated into the tool as knowledge and data sources improve; and

- Be linked directly with input data sources (such as the BMP database) to allow for continuous or periodic updates as sources are updated.

4.3 Model Selection

A review of many potential modeling tools was undertaken to determine the most appropriate model to use for developing the IP Modeling Tool for use in developing the Consolidated TMDL IP. The review focused on the ability of different modeling options to meet the modeling needs and requirements, and included evaluation of many of the models used to develop TMDLs in the District. The Modified Version of the Simple Method (CWP and CSN, 2008), which was developed to calculate annual or seasonal runoff volumes and loads in urbanized areas and small watersheds, was selected for the IP Modeling Tool to calculate runoff and pollutant loads from land-based sources. Because only wet-weather surface flows and loads will be modeled for the Consolidated TMDL IP, the Modified Version of the Simple Method was found to be very well suited to calculate the annual or seasonal runoff volumes and loads needed for this effort. The Modified Version of the Simple Method also accommodates the calculation of the daily load expression for TMDLs. In addition, the Modified Version of the Simple Method has been broadly applied in the greater Chesapeake Bay area to support MS4 and TMDL planning studies. Many states, including Maryland, Virginia, New York and New Hampshire, recommend use of the Simple Method or the Modified Version of the Simple Method for stormwater management purposes. Finally, the Simple Method was among the models applied to generate stormwater loads and, in particular, direct drainage loads, in several of the District TMDL studies. Therefore, use of the Modified Version of the Simple Method represented continuity with at least some of the previous TMDL modeling done in the District.

More information on model selection can be found in Appendix A, *Technical Memorandum: Model Selection and Justification* to the *Final Comprehensive Baseline Analysis Report* document (DDOE, 2015).

4.4 Description of the Modified Version of the Simple Method

The Simple Method was originally developed at the Metropolitan Washington Council of Governments by Schueler (1987) using local (metropolitan Washington area) stormwater data collected under EPA's Nationwide Urban Runoff Program, or NURP. The Modified Version of the Simple Method was developed by CWP and the Chesapeake Stormwater Network in order to specifically incorporate the runoff characteristics of turf and forest cover, as well as hydrologic soil groups, into the modeling (CWP and CSN, 2008).

The Modified Version of the Simple Method is described by the following two equations:

$$R = \frac{P\ x\ P_j\ x\ R_{vc}}{12} \times A \qquad (1)$$

$$L = R \times C \times 2.72 \qquad (2)$$

Where:

R = Runoff volume, typically expressed in acre-feet

P = Precipitation, typically expressed in inches

P_j = Precipitation correction factor, typically 0.9

R_{vc} = Composite runoff coefficient

A = Area of the catchment, typically expressed in acres

L = pollutant load, typically expressed in pounds

C = Flow-weighted mean pollutant concentration, typically expressed in mg/l

A unit conversion factor of 12 is used for inches for precipitation, and 2.72 is used for the combination of acres for area and mg/l for pollutant concentration (Note: a separate conversion factor of 1.03E-3 MPN is used for E.coli concentrations).

As described above, the four main inputs to the Modified Version of the Simple Method are rainfall (used to determine P above), runoff coefficients (used to determine R_{vc} above), drainage areas (used to determine A above), and EMCs (used to determine C above). Each of these inputs is discussed separately in the following sub-sections.

4.4.1 Rainfall

Precipitation, which is quantified through rainfall, drives the generation of runoff and pollutant loads. The calculation of runoff and pollutant loads with the Modified Version of the Simple Method is typically based on annual rainfall totals. For the purposes of the Consolidated TMDL IP, the long term record (1948-2013) annual average rainfall depth at Ronald Reagan Washington National Airport (40.0 inches) was used to calculate the average runoff and pollutant loads.

While the Consolidated TMDL IP modeling is based on the annual average rainfall depth, the IP Modeling Tool can accommodate alternative rainfall regimes to assess different planning conditions or global climate change by simply replacing the rainfall depth in the runoff equation.

More information on the methodology for developing rainfall inputs for the modeling can be found in Section 3.5.a of Appendix A, *Technical Memorandum: Model Selection and Justification* to the *Final Comprehensive Baseline Analysis Report* document (DDOE, 2015).

4.4.2 Runoff Coefficient

The runoff coefficient, R_{vc}, used in the modeling is a composite value that represents the fraction of rainfall that is converted to runoff for the area being modeled. Because the areas being modeled are comprised of different proportions of different land use types, a composite runoff coefficient is calculated to represent the combination of different land use types in the area being modeled. The reference runoff coefficients for different soil groups and land use types recommended for use in the Modified Version of the Simple Method are summarized in Table 4 - 1. As shown in the table, all impervious areas have a runoff coefficient of 0.95. This reflects the fact that most rainfall that falls on impervious surfaces becomes runoff. On the other hand, turf and forest areas tend to have much lower runoff coefficients, and generate less runoff. The under lying hydrologic soil group (HSG) for turf and forest areas has a strong influence on runoff generation, and is differentiated accordingly.

Table 4 - 1. Reference Runoff Coefficients

Soil Group	Impervious	Turf	Forest
HSG A Soils	0.95	0.15	0.02
HSG B Soils	0.95	0.20	0.03
HSG C Soils	0.95	0.22	0.04
HSG D Soils	0.95	0.25	0.05

As described above, composite runoff coefficients were developed for each TMDL segment. These composite runoff coefficients are developed based on weighting the relative occurrence of each soil and land cover type, and the appropriate runoff coefficient. In the MS4 area, the runoff coefficients for the TMDL waterbodies range from 0.43 to 0.86. In the direct drainage areas, which are predominantly parkland areas, the runoff coefficients for the TMDL waterbodies range from 0.06 to 0.47.

More information on the methodology for developing the runoff coefficient for the modeling can be found in Section 3.5.c of Appendix A, *Technical Memorandum: Model Selection and Justification* to the *Final Comprehensive Baseline Analysis Report* document (DDOE, 2015).

4.4.3 Drainage Areas

Drainage area (*A*) in the Modified Version of the Simple Method describes the physical extent of the sewershed or watershed included in the runoff and pollutant load calculation. For the Consolidated TMDL IP, the applicable areas are the MS4 and direct drainage areas that are assigned WLAs or LAs in the TMDL studies. Because of the complexity of the original TMDL modeling, different TMDL studies used different logic for determining the areas to which that TMDL's MS4 WLAs and nonpoint source LAs apply. The differences in modeling and consequent identification of MS4 and nonpoint source areas included in the TMDLs were particularly important with respect to mainstems versus small tributaries and other waterbodies. Therefore, understanding the delineation and extent of watersheds and sewersheds from the original TMDLs was of critical importance to identifying where MS4 WLAs and nonpoint source LAs apply on the ground. It was also important to understand the most updated information on the MS4 sewersheds, because current MS4 delineations did not always match up exactly with the delineations used in the original TMDLs. One potential reason for this discrepancy is that the writers of the original TMDLs did not have access to the sewers geodatabase that has subsequently been developed to help track the MS4 and CSS areas in the District. Use of this sewers geodatabase was critical in the development of updated MS4 and unsewered area delineations.

The delineation of TMDL watersheds and sewersheds through the use of the most current data on the MS4 system resulted in several changes to watersheds and sewersheds relative to those used to develop the original TMDLs. Some of these changes were due to an updated understanding of the sewer system and of where flows discharge. In other cases, errors in the original assignment of areas to watersheds and sewersheds were corrected. Finally, in several cases, the logic for assigning WLAs and LAs to specific parts of the watersheds was modified to accommodate the way that WLAs and LAs were assigned in the original TMDLs.

More information on the methodology for drainage areas for the modeling can be found in Section 3.5.d of Appendix A, *Technical Memorandum: Model Selection and Justification* to the Final *Comprehensive Baseline Analysis Report* document (DDOE, 2015).

4.4.4 Event Mean Concentrations (EMCs)

EMCs are used to develop the flow-weighted mean pollutant concentrations (*C*) used in conjunction with runoff calculations to develop pollutant load estimates. Several parallel lines of investigation were used to identify the appropriate set of EMCs to support application of the IP Modeling Tool. These included:

- A review of the EMCs used to develop TMDLs in the District.
- A review of EMCs reported in literature for various land use classes.
- An evaluation of District MS4 monitoring data to develop District-specific EMCs.

Analysis of the EMCs used in the original TMDLs showed that EMCs used in District TMDLs were typically developed from local monitoring data, although in a few cases, other data (such as data from Maryland and/or literature values) were used. Several different sets of EMCs developed at different times for different purposes were used in the TMDLs. Because EMCs used in the original TMDLs were not consistent from one TMDL to the next, and they did not reflect the most updated available data, potential options were explored to develop updated EMCs for use in the modeling. One option was to develop land use-based EMCs. If different EMCs could be related to different land use types, this would be helpful in targeting BMP implementation for the land use types with high EMCs for a given pollutant. A literature review was conducted to develop land use based EMCs. These land use based EMCs were then compared to MS4 monitoring data from the District to ensure that they were representative of pollutant concentrations from the District's MS4 system. However, it was determined that literature-derived land use-based EMCs cannot consistently predict EMCs from the monitoring data. Therefore, land use-based EMCS were not used in the modeling.

As an alternative, recent District MS4 monitoring data was reviewed to develop updated District-specific EMCs, including analysis to determine if watershed/basin-specific EMCs could be developed. Based on this analysis, it was determined that a mixture of methods would be used to develop EMCs for different pollutants. Because the average concentration of the pooled MS4 outfall monitoring data for TSS, TN, TP, bacteria, BOD, Oil & Grease, zinc, arsenic, copper, and lead compared very well with the EMCs used in District TMDL studies, District MS4 outfall monitoring data was used to develop EMCs for these pollutants. Further, for some parameters for which updated EMCs can be developed from MS4 monitoring data, the monitoring data was sufficient to develop EMCs at the watershed/basin level (i.e., Anacostia, Rock Creek, and Potomac watersheds). This was done for BOD, Oil and Grease, TSS and Zinc. For all other pollutants, insufficient monitoring data exists to develop updated EMCs. Therefore, the recommendation for organic compounds, arsenic and mercury is to use the original EMCs applied to develop TMDLs in the District.

A summary of the recommended EMCs to be applied in the IP Modeling Tool is presented in Table 4-2.

Table 4 - 2. EMCs Used in the IP Modeling Tool

Pollutant	Units	EMC Value	Source of EMC
TN	mg/l	3.32	From monitoring data
TP	mg/l	0.38	From monitoring data
TSS (Anacostia)	mg/l	73	From monitoring data
TSS (Rock Creek)	mg/l	60	From monitoring data
TSS (Potomac)	mg/l	42	From monitoring data
FC	MPN/100ml	13,639	From monitoring data
BOD (Anacostia)	mg/l	35.93	From monitoring data
BOD (Rock Creek)	mg/l	23.67	From monitoring data
BOD (Potomac)	mg/l	28.08	From monitoring data
Oil&Grease (Anacostia)	mg/l	3.65	From monitoring data
Oil&Grease (Rock Creek)	mg/l	4.15	From monitoring data
Oil&Grease (Potomac)	mg/l	3.35	From monitoring data
Arsenic	ug/l	1.54	From monitoring data
Copper	ug/l	52.88	From monitoring data
Lead	ug/l	15.94	From monitoring data
Mercury	ug/l	0.19	From TMDL
Zinc (Anacostia)	ug/l	120.92	From monitoring data
Zinc (Rock Creek)	ug/l	101.73	From monitoring data
Zinc (Potomac)	ug/l	100.90	From monitoring data
Chlordane	ug/l	0.00983	From TMDL

Table 4 - 2. EMCs Used in the IP Modeling Tool			
Pollutant	**Units**	**EMC Value**	**Source of EMC**
DDD	ug/l	0.003	From TMDL
DDE	ug/l	0.0133	From TMDL
DDT	ug/l	0.0342	From TMDL
Dieldrin	ug/l	0.00029	From TMDL
Heptachlor Epoxide	ug/l	0.000957	From TMDL
PAH1	ug/l	0.6585	From TMDL
PAH2	ug/l	4.1595	From TMDL
PAH3	ug/l	2.682	From TMDL
TPCB	ug/l	0.0806	From TMDL

More information on the methodology for developing EMCs for the modeling can be found in Section 3.5.a of Appendix D, *Technical Memorandum: Selection of Event Mean Concentrations (EMCs)* to the *Final Comprehensive Baseline Analysis Report* document (DDOE, 2015).

4.5 Additional Pollutant Load Model Components

In addition to modeling pollutant loads through runoff using the Modified Version of the Simple Method, the Consolidated TMDL IP also evaluates in-stream erosion and trash loading. These components of the modeling are described below.

4.5.1 Estimating In-stream Erosion

Stream erosion is common in urban environments. It occurs when the balance between stream flow and stream bank conditions becomes poor due to excess stormwater runoff. The net amount of sediment eroded from native bed and bank material and accumulated sediments contributes to the TSS load.

While in-stream erosion can be an important part of the TSS load, District TMDLs do not account for stream erosion in a consistent manner, and it is not accounted for at all in some TMDLs. In addition, the TSS TMDLs are not always in agreement on whether in-stream erosion should be considered a point source or a non-point source. This has implications on the accounting of loads for meeting WLAs or LAs. Therefore, it was important to incorporate a consistent method for estimating in-stream erosion into the IP Modeling Tool. A literature review was undertaken to determine potential approaches for incorporating in-stream erosion into the tool. A number of approaches were identified for estimating the rate of sediment load from in-stream erosion, and the portion of the in-stream erosion that contributes to the downstream sediment yield. In-stream erosion can be estimated using different methods. However, when results developed using these methodologies were compared to the in-stream erosion loads from the existing TMDLs, there was little agreement between the two data sets. Because of the conflicting information on in-stream erosion, several assumptions were incorporated into the IP Modeling Tool, including:

- In-stream erosion sediment load was calculated using an empirical equation developed by MDE that correlates in-stream erosion to imperviousness, but the equation was scaled to allow for an assessment of the stream degradation potential developed by CWP (see Appendix C, *Technical Memorandum: Stream Erosion Methodology* to the *Final Comprehensive Baseline Analysis Report* document (DDOE, 2015) for a full discussion of this equation).
- A sediment delivery ratio was applied to estimate the sediment yield from upland in-stream erosion sources to the mainstem rivers and the Chesapeake Bay.

- When calculating sediment loads and sediment load reductions for meeting the Chesapeake Bay TMDL, in-stream erosion was included as part of the MS4 load.
- When calculating sediment loads and sediment load reductions for meeting the local TMDLs, in-stream erosion was included as part of the direct drainage load.

As additional data on in-stream erosion is collected and more clarity on accounting for in-stream erosion is provided by the regulatory agencies, it may be possible to establish better methodologies to account for and calculate the loads from in-stream erosion. Until such time though, the accounting and calculation methods described above will be utilized in the IP Modeling Tool.

More information on the analysis of in-stream erosion and the development of the methodology for calculating the in-stream erosion sediment load incorporated into the IP Modeling Tool can be found in Appendix C, *Technical Memorandum: Stream Erosion Methodology* to the *Final Comprehensive Baseline Analysis Report* document (DDOE, 2015).

4.5.2 Accounting for Trash Loads

The Trash TMDL that was developed for the Anacostia Watershed requires a different method for accounting for trash than can be accommodated through a runoff-based model like the Modified Version of the Simple Method. The IP Modeling Tool accounts for trash generation using land use-based loading factors developed specifically for this TMDL. The calculation of the trash load in any given watershed or subwatershed requires information on land use and stream length. Both land use and stream length were obtained from DC OCTO GIS coverages, with the latter a derivative of the stream line coverage.

MS4 loadings in the District are calculated based on land use and the loading rates described in the Trash TMDL report (MDE and DDOE, 2010). Nonpoint source loadings from direct drainage in the District are calculated based on linear stream distance and the loading rates also described in the Trash TMDL report.

4.6 Development of the Modeling Tool

Once the appropriate modeling framework was selected, it was developed into an IP Modeling Tool that is used to track and account for pollutant load generation and load reduction across the District. The Tool consists of three parts:

- Runoff Module: calculates the runoff volume using the Modified Version of the Simple Method
- Pollutant Load Module: calculates the pollutant loads using EMCs, stream bank erosion calculations, and/or trash load rates in conjunction with runoff volume from the runoff module described above
- BMP Module: consists of the current BMP inventory and the BMP pollutant load reduction efficiencies in order to calculate load and runoff reductions provided by the BMPs

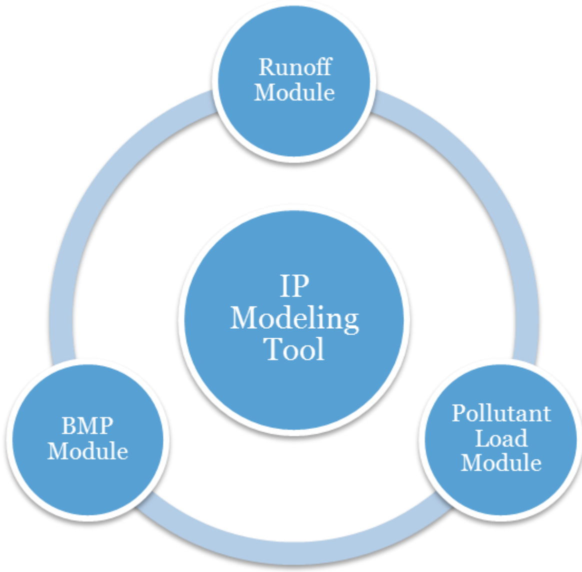

Figure 4-1. Conceptual Model of IP Modeling Tool

The Runoff and Pollutant Load modules are based on the runoff and pollutant loading calculations discussed in the *Description of the Modified Version of the Simple Method* section above. The BMP Module is discussed below.

4.7 BMP Module

The BMP Module of the IP Modeling Tool integrates the current inventory of BMPs and assigns a reduction efficiency to each BMP in order to calculate the runoff volume and pollutant load removed on an annual or seasonal basis.

4.7.1 BMP Inventory

A BMP database inventory was developed to capture all of the necessary information on existing structural and non-structural BMPs, including the type of BMP and its location. For structural BMPs, other important information captured in the database included the drainage area controlled by each BMP, while for non-structural BMPs, other information was used to indicate the extent of the BMP's impact. Modeling capabilities for 13 structural BMPs were included in the model, as were several non-structural BMPs, including stream restoration, street sweeping, catch basin cleaning, impervious surface removal, and coal tar sealant removal.

4.7.2 BMP Efficiencies

Extensive research was conducted to develop pollutant removal rates for both structural and non-structural BMPs. This involved analysis of the International Stormwater BMP database, the Chesapeake Bay Expert Panel Reports, as well as other literature, to review existing data on pollutant removal percent efficiency rates. In addition, curves that relate runoff retention to load reduction were developed. Finally, because of the paucity of research on the removal rates for toxics and some metals, partition coefficients were applied that relate the removal of particle bound pollutants such as metals and toxics to the removal of TSS. This research provides information that can be used to evaluate how individual BMPs remove pollutants. Once pollutant removal rates for each individual BMP type were developed for each pollutant type (to the extent that this was possible) – either through direct pollutant removal efficiency, through runoff retention, or through the relationship with TSS using a partition coefficient, these removal rates can be used in the IP Modeling Tool to evaluate the impact of BMPs currently being implemented in the District, as well as to evaluate future load reduction scenarios. The decision tree depicted in Figure 4-2 below is used to determine the approach for modeling load reductions from any individual structural or non-structural BMP. The first step is to determine if the BMP retention volume is known. If the retention volume is known, then the next step is to determine if the BMP is a rain barrel or a new tree (trees are considered BMPs because they help retain runoff). If the BMP is a rain barrel or a new tree, the lumped average annual reduction is used for the rain barrel or tree, respectively. The lumped average annual volume reduction was determined through an analysis of the canopy size and stormwater interception capacity of typical trees in the District, and, for rain barrels, an analysis of typical barrel size and usage (including how often rain barrels are drained).

If the BMP is not a rain barrel or a new tree, then the runoff reduction curves are applied. Runoff reduction curves were developed for the major categories of retention-based BMPs, including bioretention, permeable pavement, infiltration trenches, cisterns, and green roofs. The efficiency of these BMPs is commensurate with the amount of runoff volume that can be retained by the BMP. For example, a BMP designed to retain runoff from a 0.5-inch storm provides less annual volume reduction than a BMP designed to retain runoff from a 1-inch storm.

The BMP retention volume is not known for many of the existing BMPs because historically this was not an attribute documented during the permitting process. This is a particular problem for BMPs implemented before 2013, when the new stormwater regulations came into effect and retention volume was required to be reported as part of the permit application. Additionally, some BMPs, such as filters and wet ponds, do not provide runoff retention capacity, but provide load reductions only. If the BMP treatment volume is not known, then the next step is to determine if the BMP has a prescribed load removal, and if so, to apply this load reduction. A prescribed load removal refers to a load reduction methodology that is based on the design parameters of the BMP. This type of load removal applies to stream restoration, street sweeping, catch basin cleaning, impervious surface removal, and trash reduction strategies, which require information such as the length or area of restoration to calculate the appropriate annual load removal. If the BMP does not have a prescribed load removal, then the percent reduction efficiency values are applied for that BMP. Percent reduction efficiencies were researched for each of the 13 BMP categories and for all 22 pollutants. The result of this research is a lookup matrix with an efficiency value for each BMP and pollutant combination. The percent reduction efficiencies apply uniformly to each BMP category, regardless of how a BMP was designed. As a result, they are regarded as being the least precise in terms of annual load removal estimates.

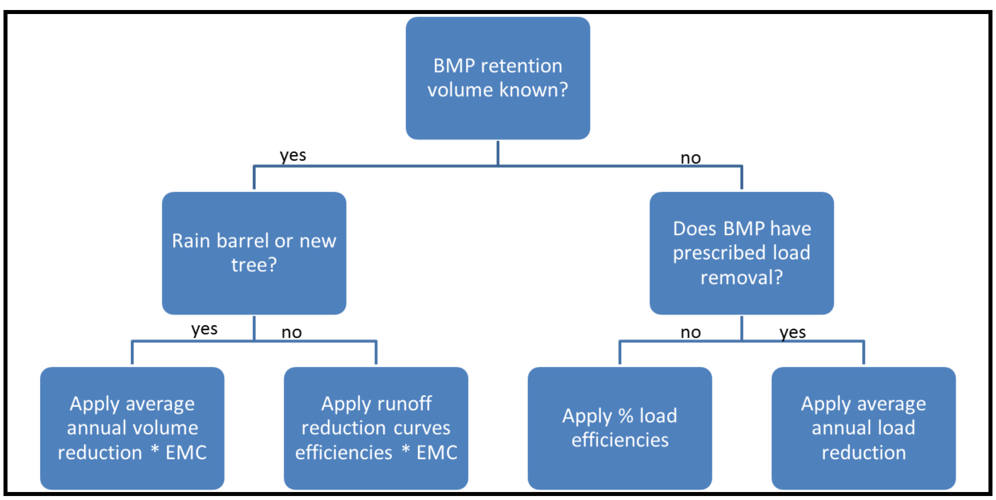

Figure 4-2. BMP Load Reduction Method Selection

The existing BMPs and the load reduction methodology described above are applied in the IP Modeling Tool to calculate the load reduction from existing BMPs. Since each BMP is spatially located within the MS4, the reductions provided by each BMP are aggregated by TMDL watershed. Individual pollutant reductions were summed by TMDL watershed and subtracted from the baseline load to determine the existing load. The existing load was then compared to the MS4 WLA to provide the basis for the "gap analysis" and shows the additional load reduction necessary to achieve each MS4 WLA.

More information on the BMP inventory and the development of BMP efficiencies can be found in Appendix F, *Technical Memorandum: BMPs and BMP Implementation* to the *Final Comprehensive Baseline Analysis Report* document (DDOE, 2015).

4.8 Development of Geodatabase

The geodatabase contains all relevant geospatial data need to run the IP Modeling Tool and to produce output maps. Examples of relevant data include:

- Land use/land cover
- Impervious areas
- Ownership parcels
- Soils
- Topography
- Watershed and catchment delineations
- Hydrography
- Rainfall

The development of several of these data sets (such as the watershed and catchment delineations) was described above. The remaining data used to populate the geodatabase was collected from a variety of local and federal agencies, including DOEE, DC OCTO, the U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS), EPA, and others. The assimilation of data into the geodatabase follows the minimum spatial data standards published by EPA and the Federal Geographic Data Committee (FGDC).

Data acquired for inclusion in the geodatabase was also verified for accuracy and validity, as described in the QAPP. Data gaps identified during this verification process were flagged and resolved to the extent possible. The geodatabase will be updated if and when newer data becomes available.

5. Implementation Plan: Assessment and Methods

5.1 Introduction

The Consolidated TMDL IP develops a strategy and a schedule to attain applicable WLAs for each established or approved TMDL. The District's MS4 permit requires modeling to demonstrate how each applicable WLA will be attained. Subtracting the load reductions from BMPs from the baseline loads allow a snapshot of progress at any given time, and this progress can be compared to the WLA to determine if more needs to be done, or if the WLA has been achieved. In order to make this comparison, particularly at a point in time where some progress has already been made, three data points are needed. These are:

- The baseline load, which represents the stormwater loads that occur prior to the addition or implementation of any BMPs;
- The current condition load, which reflects the stormwater load after implementation of BMPs. The current condition load is less than the baseline load due to the impact of BMPs in reducing loads; and
- The WLA, which is the fixed target. Once the current condition load equals the WLA, the WLA has been achieved.

This section summarizes how the baseline load, the current condition loads, and the remaining load reduction required (the gap) were developed for each MS4 WLA; how these were used to determine the amount of implementation necessary to meet each MS4 WLA; and how load reduction projections were developed to show how the gap would be closed through BMP implementation over time to meet MS4 WLAs. Full documentation of this approach is provided in previously submitted reports (DDOE, 2015).

5.2 Assessment of Baseline Loads, Current Condition Loads, and the Gap

Analyses of the baseline and current condition loads, as well as a discussion of the gap analysis, are presented in separate sub-sections below. A conceptual depiction of these components is provided in Figure 5-1.

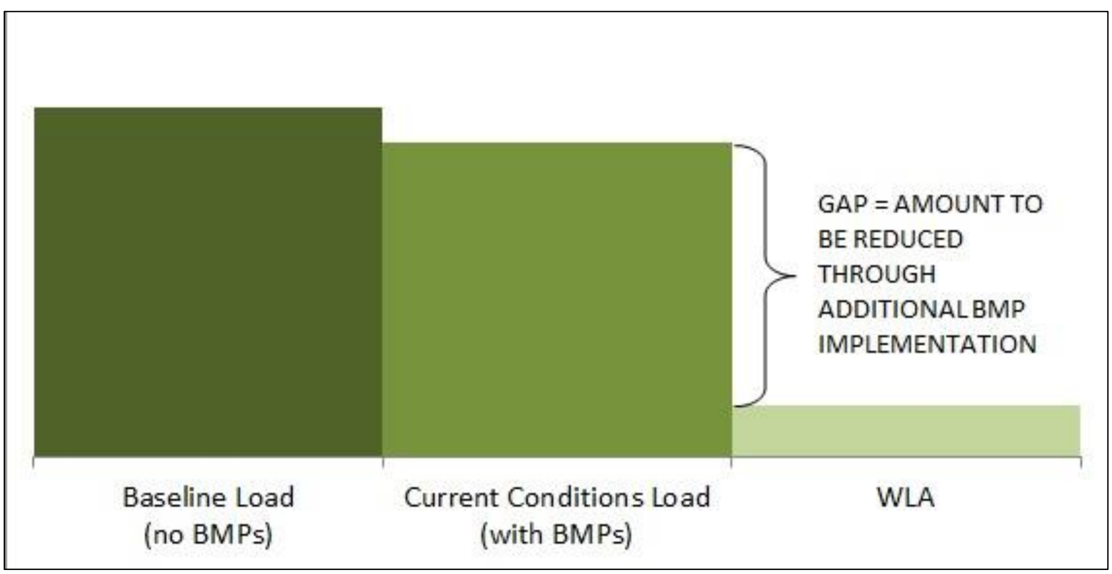

Figure 5-1. Load and Gap Analysis

5.2.1 Development of Baseline Loads

Baseline loads represent the stormwater loads in the District that are not influenced or reduced by BMPs or other storm water management practices. A full description of inputs used to develop the baseline loads can be found in Appendix A, *Technical Memorandum: Model Selection and Justification* to the *Final Comprehensive Baseline Analysis Report* document (DDOE, 2015).

The baseline condition is computed with the IP Modeling Tool using the best GIS and monitoring data available, including updated EMCs, TMDL drainage areas, and runoff, to develop loads that are appropriate for the circa 2000 pre-BMP baseline period. These updates resulted in loads that were different than baseline loads in the original TMDLs. It should be noted that the baseline condition is not an attempt to reproduce the original baseline loads from each TMDL study, nor was that deemed necessary for these evaluations.

Full discussions of the updated EMCs, TMDL drainage areas, and runoff and load calculations were discussed in Section 4. Results of the baseline condition analysis are included with the results of the current condition analysis in Section 5.3 below.

5.2.2 Development of Current Condition Loads

In contrast to the baseline loads, the current condition loads represent the stormwater loads in the District that are influenced and reduced by BMPs and other storm water management practices currently in place. This includes structural and non-structural BMPs, as well as source controls, installed and put into operation prior to 2014.

The remainder of this section defines the BMPs currently in place in the District, describes how they are incorporated into the IP Modeling Tool, and documents the runoff and pollutant load reductions that are achieved with these BMPs. Further evaluation of the current condition to address the effectiveness of existing BMPs is provided at the end of the section.

5.2.2.a Structural BMPs

DOEE's Stormwater Management Guidebook (DDOE, 2013b) identifies 13 groups of structural BMPs that can be used to meet the stormwater retention volume and/or peak flow criteria included in the 2013 revisions to the District's 1988 stormwater management regulations. The groups of BMPs described in the Stormwater Management Guidebook include green roofs, rainwater harvesting, impervious surface disconnection, permeable pavement systems, bioretention, filtering systems, infiltration, open channel systems, ponds, wetlands, storage practices, proprietary practices, and tree planting and preservation.

5.2.2.b Non-Structural BMPs

Non-structural BMPs consist of programmatic, operational, and restoration practices that help prevent or minimize pollutant loading or runoff generation. Non-structural BMPs include stream restoration, street sweeping, impervious surface removal, and source controls such as urban phosphorus legislation and coal tar pavement removal.

5.2.2.c BMPs Currently Accounted for in the IP Modeling Tool

The BMP database described in Section 3.4 (and discussed in more detail in Appendix F, *Technical Memorandum: BMPs and BMP Implementation* to the *Final Comprehensive Baseline Analysis Report* document (DDOE, 2015)) was used to identify the BMPs currently in place in the District. 3,193 BMPs, excluding "new" trees, were originally identified, of which 2,226 (approximately 70 percent) were retained after removing duplicates, correctly assigning drainage areas and physical locations, and performing other

QA/QC procedures. These remaining BMPs treat over 15 million square feet (approximately 364.6 acres) within the District's MS4 area (note: because of the way BMPs were accounted for, the 2,226 BMPs also include 58 BMPs that are in direct drainage areas. These 58 BMPs are in watersheds with TMDLs, and thus they were included in the BMP inventory because they contribute to load reduction in TMDL watersheds.)

Table 5- 1 summarizes the current set of BMPs accounted for in the IP Modeling Tool by watershed, and Table 5- 2 shows each BMP type and the amount of area it controls in each watershed – both in actual area and also as a percent of the watershed.

Table 5- 1. Current Condition: Number and Distribution of MS4 Area BMPs by Watershed

BMP	Number in District	Number in Anacostia Watershed	Number in Potomac Watershed	Number in Rock Creek Watershed
Bioretention	353	185	73	95
Filtering Systems	55	25	20	10
Green Roof	75	26	30	19
Impervious Surface Disconnect	4	1	3	0
Infiltration	208	74	86	48
Open Channel Systems	47	14	17	16
Permeable Pavement Systems	53	30	11	12
Ponds	3	2	1	0
Proprietary Practices	214	103	84	27
Rainwater Harvesting	1,186	573	245	368
Storage Practices	17	7	4	6
Tree Planting and Preservation[5]	16,773	7,900	5,281	3,592
Wetland	11	9	2	0
TOTAL (without trees)	2,226	1,049	576	601

Table 5- 2. Area Controlled by BMPs in Each Watershed

BMP	BMP Drainage Area (sq. ft.)	Percent of Watershed Controlled (%)	BMP Drainage Area (sq. ft.)	Percent of Watershed Controlled (%)	BMP Drainage Area (sq. ft.)	Percent of Watershed Controlled (%)
	Anacostia Watershed		Potomac Watershed		Rock Creek Watershed	
Bioretention	1,109,238	0.22	312,534	0.08	81,016	0.03
Filtering Systems	88,462	0.02	90,965	0.02	67,131	0.02
Green Roof	732,281	0.15	435,918	0.11	118,689	0.04
Impervious Surface Disconnect	9,852	<0.01	11,235	<0.01	0	0.00

[5] The numbers indicated in this category only show the new trees that have been planted since 2005.

Table 5- 2. Area Controlled by BMPs in Each Watershed						
BMP	BMP Drainage Area (sq. ft.)	Percent of Watershed Controlled (%)	BMP Drainage Area (sq. ft.)	Percent of Watershed Controlled (%)	BMP Drainage Area (sq. ft.)	Percent of Watershed Controlled (%)
	Anacostia Watershed		Potomac Watershed		Rock Creek Watershed	
Infiltration	325,807	0.06	453,759	0.12	309,610	0.11
Open Channel Systems	164,668	0.03	74,362	0.02	165,322	0.06
Permeable Pavement Systems	218,615	0.04	23,296	0.01	104,659	0.04
Ponds	4,236,355	0.85	8,973	<0.01	0	0.00
Proprietary Practices	1,163,410	0.23	498,183	0.13	188,202	0.07
Rainwater Harvesting	243,141	0.05	122,899	0.03	181,919	0.06
Storage Practices	181,859	0.04	20,128	0.01	19,336	0.01
Tree Planting and Preservation[6]	3,871,000	0.77	2,587,690	0.66	1,760,080	0.62
Wetland	4,116,420	0.82	5,708	<0.01	0	0.00
TOTAL (without trees)	12,590,108	2.51	2,057,960	0.53	1,235,884	0.44

5.2.3 Gap Analysis

The gap analysis evaluates the difference between the current condition load and the individual TMDL WLAs, where:

$$\text{Gap} = \text{Current Condition Load} - \text{TMDL WLA}$$

Gaps were calculated for 293 of the 485 WLAs described in Section 3.2.2.b and Table 3-1. Gaps were not calculated for the remaining 192 WLAs for the following reasons:

- 136 MS4 annual WLAs were not included in the modeling because the impairments underlying these WLAs were removed from the 2014 IR.
- 40 PCB WLAs (30 annual and 10 daily) were not included in the modeling because these WLAs are to be managed through management plans and source control activities.
- Six (two annual and four daily) E. coli WLAs were not included in the modeling because they included allocations from Maryland.
- Eight daily TSS WLAs expressed over the growing season ("daily-seasonal") were not included in the modeling because the maximum daily-seasonal expressions were equivalent to the maximum daily TSS WLAs expressed over the year ("daily-annual") from the same TMDL document. Therefore, there is no difference in the modeling approach between the daily-seasonal and daily-annual expressions for these WLAs because attainment is based on the maximum expressions.

[6] The numbers indicated in this category only show the estimated canopy areas provided by new trees that have been planted since 2005.

- Two annual copper WLAs from the Upper and Lower Anacostia were not included in the modeling because the WLAs are incorrect.

The 293 remaining gaps were broken down as follows: 206 annual, 7 seasonal, one monthly and 79 daily. The baseline loads, current condition loads, WLAs, and gaps for each of these pollutant/impaired waters segment combinations are tabulated in Appendix D.

Several methods are used to express the gap, and each is discussed below.

5.2.3.a Gap Expressed as an Absolute Load

Expressing the gap as an absolute load in this method quantifies the actual amount of pollutant load reduction needed to meet the WLA (e.g., number of lbs). The absolute load reductions of different TMDLs vary in magnitude depending on the pollutant and TMDL segment. It is difficult to provide a comparative assessment of absolute loads for different pollutants since, for example, one pound of total suspended sediment cannot be compared to one pound of arsenic. Appendix D summarizes the gap for each MS4 WLA expressed an absolute load.

5.2.3.b Gap Expressed as a Percent Load Reduction

Expressing he gap as a percent load reduction provides a simple way to convey the relative amount of additional load reduction needed to meet WLAs. Figure 5-2 below shows the percent reductions needed to meet the annual WLAs and ranks them in ascending order. The blue bars represent the percent reduction needed for the 206 annual WLAs that were evaluated with the IP Modeling Tool. This analysis depicts the number of loads that currently meet the WLAs, and also number of loads needing incrementally higher levels of load reduction in order to meet WLAs. The figure also shows 200 annual WLAs that fall into one of three additional categories: "Removed from 303(d)", "Management Action", and "No Action Needed" (note that some of these 200 WLAs were also discussed above when describing WLAs for which no numeric gap was calculated, while others were discussed in Section 3.2.2.b during discussions of WLAs that are not evaluated in the IPMT).Each of these categories is explained in more detail below.

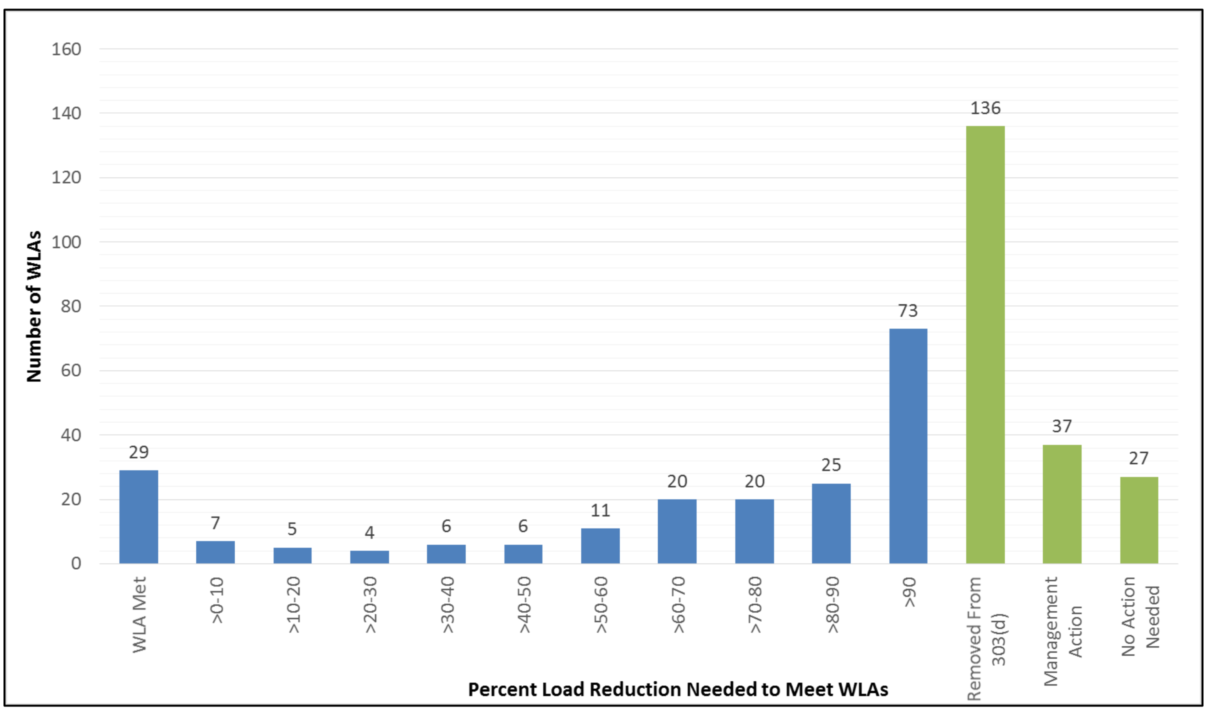

Figure 5-2. Gap Expressed as Percent Reduction Needed to Meet WLA

The current percent load reductions needed to meet the annual WLAs is summarized qualitatively by segment and pollutant in Figure 5-3. The larger and greener the bubble, the larger the percent reduction required to meet the WLA (note that the size and color of the bubbles use sliding scales). Empty squares indicate that the WLA has been achieved. If there is no square, then there is no annual WLA for that pollutant/waterbody combination.

Figure 5-3 shows that, in addition to being abundant, the WLAs for bacteria and organic pollutants require the greatest amount of load reductions. The figure also shows that the Anacostia has the greatest number of WLAs of all watersheds, and that all tributaries, regardless of their location in the MS4, have a multitude of WLAs.

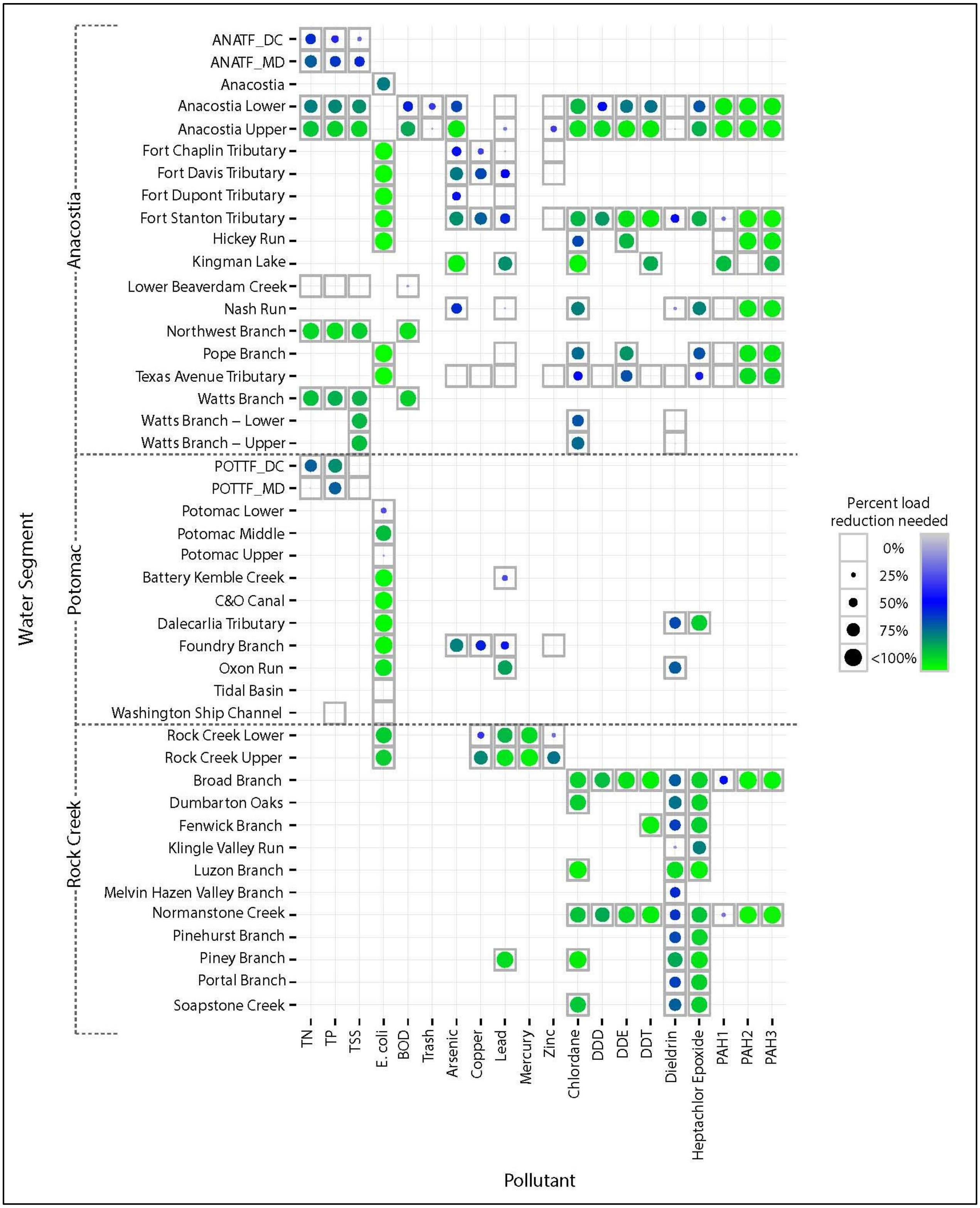

Figure 5-3. Percent Load Reduction Needed to Meet Annual WLAs

5.2.3.c Gap Expressed as a Depth of Stormwater Volume Retention Needed

Expressing the gap in terms of the depth of stormwater runoff volume that needs to be retained by BMPs to meet the WLA provides for a direct comparison to the stormwater volume retention standard required by the District's 2013 Stormwater Management Rule. It explicitly acknowledges that pollutant load is directly proportional to stormwater volume.

Specific discussions of the methodology for calculating the gap as a volume are provided in Section 5.3.5.c of the *Final Comprehensive Baseline Analysis Report* document (DDOE, 2015).

Depicting the gap in terms of retention depth provides a useful way to assess implementation needs. For example, as the hypothetical runoff retention depth is increased over the MS4 area, an increasing number of individual WLAs are expected to be met, as shown in Figure 5-4 below (note that the two trash WLAs are not included in this figure, because trash removal is not related to stormwater retention. Thus the figure depicts 204 WLAs). Multiple observations can be made from the figure.

- A total of 29 WLAs require zero retention depth. These 29 WLAs have already been met.
- No additional WLAs are achieved by increasing the retention depth from zero to 0.003 inches (the yellow bar). A 0.003 inch retention depth is provided by the aggregate of the existing retention-based BMPs in the MS4 area. Thus no additional WLAs - other than the ones that have already been met - have been achieved by the retention depth provided by the existing retention-based BMPs in the MS4 area.
- If the retention depth is increased to 1.2 inches - a scenario that reflects capture of the entire MS4 area to the 2013 Stormwater Management Rule standards - a total of 113 WLAs will be met.
- Only by increasing the retention depth to 2 inches will all WLAs be met.

Note that 2 inches of runoff retention would not be required in all subwatersheds to achieve WLAs; in some subwatersheds, less retention depth is required to meet WLAs. This is illustrated in Figure 5-5, which shows the spatial variation in the BMP retention depth required to meet MS4 WLAs over the MS4 area.

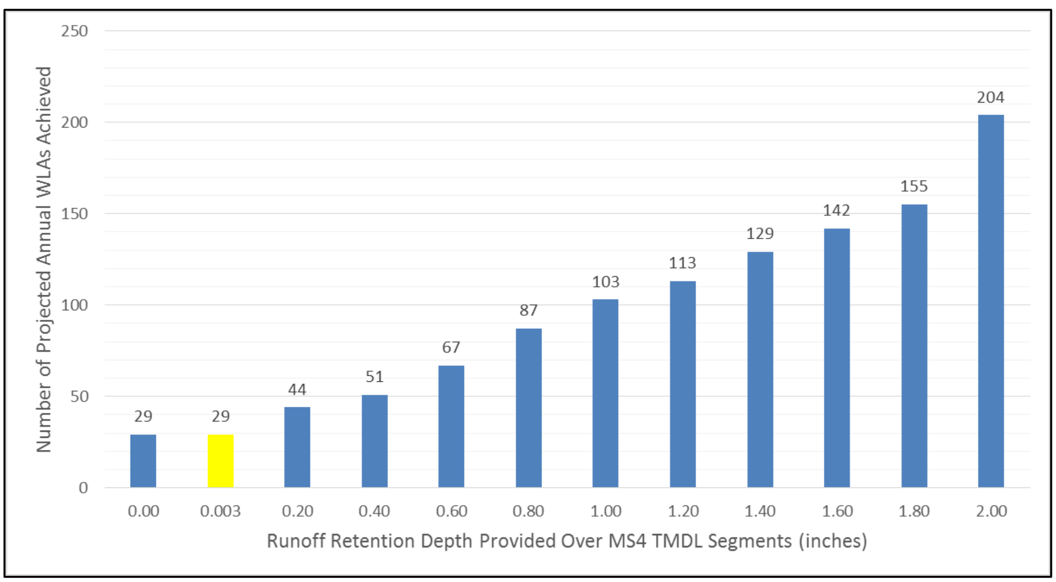

Figure 5-4. Projected WLAs Achieved with Incremental Increase in Runoff Retention Depth Provided[7]

[7] Note that this figure shows results for 204 out of the 206 total modeled annual WLAs. The 2 trash WLAs are independent of the runoff retention depth and therefore are not included in this figure.

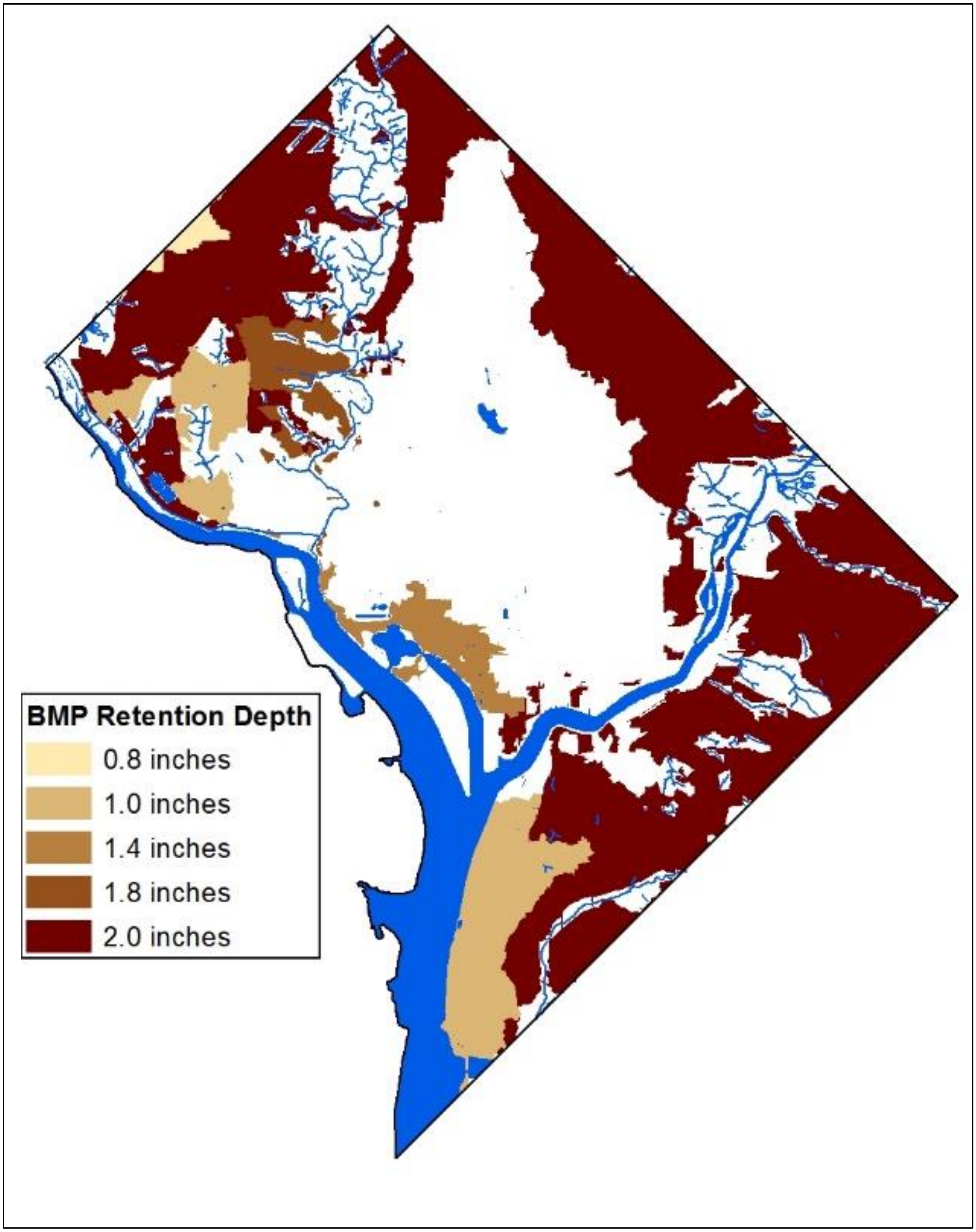

Figure 5-5. Spatial Representation of the Required BMP Retention Depth over the MS4 to Meet All Annual MS4 WLAs

5.2.4 Results and Implications for Developing an Implementation Strategy

The major findings of the evaluation of the baseline loads, current condition loads, and gaps are as follows:

- The IP Modeling Tool produced baseline pollutant loadings that differed from the baseline loads reported in the TMDL studies. This was largely attributable to a combination of the use of a different runoff calculation, re-delineation of sewershed areas, and the use of updated EMCs.
- The inventory of existing BMPs was useful in determining a current condition load that shows the load reduction achieved by these BMPs. Because of data gaps in the BMP inventory, only a portion of the overall BMP inventory was modeled. In general, the modeled BMPs have a minor impact on reducing pollutant loads across the District. Trash presents an exception, where current control programs remove roughly 60 to 80 percent of the required trash WLA.
- The pollutant load reduction gaps for individual TMDL segments vary substantially in magnitude, and no distinctive spatial patterns were found.
- The gap analysis revealed that 29 of the 206 MS4 TMDL WLAs have been attained, primarily because of the choice of model framework and inputs.
- Bacteria and organic substances are the controlling pollutants that require the greatest amount of stormwater control. These pollutants make up the majority of MS4 TMDL WLAs.
- The gap analysis showed that meeting the MS4 WLA targets for most of the remaining TMDLs will require a very large amount of stormwater volume and pollutant load reduction. A total of 149 MS4 TMDL WLAs will require more than a 50 percent reduction in current loads, and 73 of these require reduction that is 90 percent or greater.

The major implications of these finding for the Consolidated TMDL IP are as follows:

- The pollutant load reduction gaps for nearly all of the MS4 TMDL WLAs are substantial. Achieving the WLAs for the majority of the pollutants will require extremely high levels of stormwater management and control.
- The existing inventory of BMPs represents a start, but generally achieves less than 5 percent of the pollutant load reduction that is needed, except for trash, where existing BMPs achieve 60 to 80 percent of the load reduction required to meet the WLAs.
- Current BMP efficiencies will limit the ability of BMPs to achieve the pollutant load reductions necessary to meet targets. Nearly half of the annual MS4 WLAs require pollutant load reduction in excess of 80 percent, while the typical pollutant removal efficiency for many BMPs is less than 80 percent.
- The requirement to retain 1.2 inches of runoff volume, even if applied to the entire MS4 drainage area (not just to new development and redevelopment as is currently required under the District's Stormwater Regulations), would still not achieve the prescribed load reduction for nearly 45 percent of the MS4 TMDL WLAs. Moreover, implementing sufficient stormwater retention and infiltration to meet all of the MS4 WLAs may not be feasible. The stormwater retention depth needed to attain all the WLAs is estimated at approximately 2 inches, which would require a very high density of BMPs across the MS4 and a high retention or infiltration capacity.
    - As a point of comparison, the amount of MS4 stormwater volume that needs to be treated to meet all of the WLAs exceeds the treatment volume required of the combined sewer system.

5.3 Methods for Closing the Gap

Once the gaps have been identified and quantified, they must be closed by reducing pollutant loads through the implementation of BMPs and other stormwater management measures. This section identifies potential control strategies for reducing these pollutants and closing the gaps to meet MS4 WLAs, including:

- Existing programmatic and source control efforts.
- Other potential source reduction programs.
- Identification of potential sources database for industrial and commercial pollutants.
- BMP Implementation from development and redevelopment activities and the application of the District's 2013 Stormwater Management Rule.
- BMP implementation from other programs.

Each of these strategies is discussed separately below.

5.3.1 Existing Programmatic and Source Control Efforts

Source identification, tracking, and control is also an important part of developing an IP and achieving MS4 WLAs. Therefore, identifying, tracking, and controlling pollutant sources with the goal of preventing or reducing the potential for pollutants to enter stormwater is critical to achieving MS4 WLAs.

There are multiple existing programmatic and source control efforts that reduce stormwater pollutants in the District. Some of these efforts can be quantified and load reductions can be projected; other efforts are more difficult to quantify because of a lack of data collected on these efforts Methods include:

- Street sweeping.
- Coal tar ban and coal tar sealant removal.
- Fertilizer control.
- Catch basin cleaning.
- Trash control.
- Management of construction activities.
- Vehicle maintenance/materials storage/municipal operations.
- Landscape and recreation facilities management, including pesticide, herbicide and fertilizer management.
- Management of industrial facilities and commercial and institutional areas.
- Management of illicit discharge and improper disposal.
- Public education.
- Hazardous waste collection.
- Leaf collection.
- Plastic bag fee.
- Styrofoam container ban.

These control measures are discussed in Appendix F, *Technical Memorandum, BMPs and BMP Implementation* of the *Comprehensive Baseline Analysis Report* document (DDOE, 2015).

Other Existing Efforts

In addition to the programs mentioned above, DOEE tracks, operates, maintains and manages many existing District-owned BMPs. DOEE also sets design standards, inspects, and tracks BMPs installed in the District by private and federal entities. By setting standards and ensuring that BMPs are maintained in good working order, DOEE helps ensure that BMPs are designed properly and that they are functioning as designed. This in turn helps ensure that projected stormwater management and load reductions are achieved by these BMPs.

DOEE tracks all BMPs in a tracking database. Data collected in the database includes BMP type, location, owner, and total and impervious area controlled. By collecting these data, DOEE can calculate expected pollutant load reduction from each BMP. This is critical to modeling expected pollutant load reduction in each watershed, and can be used as input data into the IP Modeling Tool to evaluate whether or not watersheds are meeting MS4 WLAs.

5.3.2 Other Potential Source Reduction Programs

In addition to the existing programmatic and source control efforts that are already underway in the District, additional potential source reduction programs may be considered for reducing the impacts of individual pollutants. Three potential options are discussed below.

5.3.2.a Bacteria Source Tracking (BST)

BST analysis is a technique designed to determine if bacteria from water quality samples originate from human, domestic or wildlife animal sources. BST can be an important tool in identifying potential types of sources of bacteria in the MS4 area. Specifically, BST can be used to distinguish between human, domestic pets, and wildlife fecal sources. Once potential sources have been identified, specific management measures that address and reduce those sources can be implemented.

There are multiple potential methods for implementing BST, including library-dependent and library-independent and genotypic and phenotypic methods. Each of the methods has advantages and disadvantages in parameters such as ease of use, ability to distinguish bacteria sources, and cost. However, previous BST efforts using the Antibiotic Resistance Analysis (ARA) phenotypic method were conducted in the Anacostia, Potomac, and Rock Creek watersheds in the early 2000s. During non-baseflow conditions, it was often observed that nearly 50-60 percent of fecal contamination within a waterbody came from sources that could potentially be controlled (humans, pets, and livestock), while 40-50 percent came from sources that would be extremely difficult to control (wildlife and birds). This trend was repeated in each of the three watersheds. Additionally, two sampling locations with abnormally high livestock signatures were found to be in close proximity to horse stables. These previous findings suggest that a considerable portion of the fecal contamination could be controlled through the use of appropriate management practices.

EPA guidance on the use of BST in TMDL implementation suggests that identification of specific bacteria sources can help target BMPs to control those source types. For instance, if BST indicates human sources are predominant in a watershed, BMPs may focus on identifying and eliminating sewage overflows and illicit discharges. In contrast, if the major sources are shown to be domestic pets, then BMPs can focus on public education on pet waste and the implementation of more pet waste removal BMPs. The previous BST efforts in the District suggest that both approaches could be beneficial, as both humans and pets were considerable sources during non-baseflow conditions.

In the case of the District's TMDLs, the first step would be to reassess the major sources of bacteria in watersheds with bacteria TMDLs, and then to develop site-specific BMPs and strategies to deal with the identified sources. The landscape in the District has changed substantially since the previous study was performed, thus, verification of those findings is necessary in order to properly invest in management techniques. In some cases, depending on the major sources found, it may be appropriate to re-evaluate the feasibility of controlling specific sources, such as wildlife, to achieve WLAs.

5.3.2.b Pollutant Minimization Planning

Many municipalities develop Pollutant Minimization Plans (PMPs) as integral tools in identifying and controlling pollutants. Pollutant minimization planning combines elements of source tracking and source control to "track back" up the MS4 system to try to identify major contributions of specific pollutants – either from specific sites, specific catchments, or specific sewer pipes.

In the case of the District's MS4 WLAs for many pollutants, sources are likely to dispersed, and it is unlikely that specific locations or facilities can be identified as being "the" sources of a specific pollutant in a given watershed. However, by using MS4 monitoring data and selected additional sampling, the major contributions of various pollutants may be able to be tracked back up the MS4 system, and controls may be able to be put in place to minimize that pollutant from either entering into the MS4 system or being discharged from it.

The specific implementation of a PMP approach would involve using water quality sampling to identify major contributions of specific pollutants from specific inflows into the MS4 system – specifically catchments or sewer pipes. The first samples are taken at the most downstream end of the system – either at the outfall, or further back up into the system if contributions of the specific pollutant are expected or known from a certain catchment. If a specific sample shows high concentrations of the pollutant of interest, then samples are taken at major inputs to the pipe at which the first sample was taken. These results are then analyzed and the cycle is repeated, following back upstream based on sampling results. This may lead to identification of a specific source upstream, or it may be an indicator that the sediments in the sewers themselves are the sources of the pollutant. In either case, the information can be used to inform management decisions as to what types of controls to use (e.g., upland sediment controls, pipe clean-out) and where to place controls in order to maximize their effectiveness.

A PMP-type approach can be effective in cases where either specific sources of a pollutant in a system are unknown, or in cases where prioritization of controls within a system is warranted. PMP trackbacks can be effective in identifying specific sources or catchments with high pollutant concentrations. They may also help identify specific pipe segments that contribute to high pollutant loads. However, the sampling required to implement a PMP approach is intensive and time consuming, and interpretation of results may not be conclusive. Therefore, it is recommended that use of a PMP approach be judicious, and that it be included as part of an adaptive management approach to ensure that it is providing results in line with the resources it requires.

For the District, a PMP-type approach is most appropriate for PCBs. The 2007 Potomac and Anacostia PCB TMDL recommends this proposed implementation approach. The "TMDL Implementation and Reasonable Assurance" Section of this TMDL study states that the WLAs will be achieved by implementing non-numeric BMPs focusing on PCB source tracking and elimination at the source. DOEE has incorporated this recommendation into its TMDL implementation plan for PCBs. Specific recommendations on use of a PMP approach for assisting with meeting the District's PCB WLAs is provided in Section 6.3.

5.3.2.c Contaminated Sediment Control

Legacy pollutants accumulated in the sediments of receiving waters can be a source of impairment to waterbodies through scouring and re-suspension, and can also be a source of impairment to aquatic life through direct ingestion. The importance of bottom sediments to the health of the waterbody has been specifically recognized for the Anacostia River, where elevated concentrations of hazardous substances, including PCBs, PAHs, lead, other trace elements, and pesticides have been identified as posing a risk to aquatic organisms and to humans. DOEE is currently conducting a remedial investigation and feasibility study (RI/FS) of the Anacostia River sediments to assess the nature and extent of contamination by sampling river sediment and fish for a wide variety of chemicals.

The District's TMDLs did not investigate the impact of contaminated sediments as a potential source of water quality impairment. It is unlikely that WQS will be met without control of these contaminated sediments, even if MS4 WLAs are met. Evaluation of bottom sediments will also be important for the smaller tributaries. Therefore, the location of contaminated sediment and their impact on water quality should be evaluated in all TMDL waterbodies, in a parallel effort to the implementation of the Consolidated TMDL IP. Once the locations of contaminated sediments are established, typical controls for reducing their impact on water quality include capping and/or removal.

5.3.3 Identification of Potential Sources Database for Industrial and Commercial Pollutants

Many of the pollutants for which there are MS4 WLAs – particularly the organic chemicals, PCBs and metals - can be generated by industrial or commercial activities. In order to identify potential source locations of these types of pollutants in the various TMDL watersheds, a database of potential pollutant sources of toxics and metals in the District was developed. The database contains records for many different types of potential pollutant sources, including NPDES-permittees, known hazardous waste handling/storage locations, RCRA/CERCLA sites, pesticide applicators, and other potential pollutant sources within the District. These data were compiled from multiple sources in the District, including DOEE, DC Water, and EPA. Once records of potential sources were compiled, potential pollutants were identified for each potential source.

The primary method for identifying potential pollutants for each potential source is through the Standard Industrial Classification (SIC) code for each potential source. The SIC code is used to classify business types, and can be a useful identifier for classifying the general type of activity that occurs at a site or business. Some of the original data compiled for this exercise included SIC codes; in other cases, SIC codes were assigned based on descriptions of the activity conducted at that location. SIC codes can in turn be linked to typical pollutant types through crosswalks conducted for various EPA studies.

Together, these data sources were used to indicate whether a specific potential source had the potential to discharge specific pollutant types. This is not to conclude that any individual facility actually does discharge that specific type of pollutant, or that the discharge would consist of stormwater contaminated with that pollutant. Rather, the goal is to associate industry types with specific pollutant types, and identifying those industries as being potential sources for those pollutants. Therefore, results of queries of the database will be used as a guide as to where sources may exist. This process can help target specific locations for further investigation. Once potential sources of specific pollutants have been identified from the database, additional data gathering may be done to determine if that potential source actually contributes pollutants to the MS4.

5.3.4 BMP Implementation from Development and Redevelopment Activities and the Application of the District's 2013 Stormwater Management Rule

One of the primary methods for closing gaps and meeting WLAs is implementation of the District's 2013 Stormwater Management Rule. BMP implementation is projected to occur from the planned or forecasted development and redevelopment in the MS4 area that would trigger the District's 2013 Stormwater Management Rule (DDOE, 2013). The regulations require stormwater retention for new development and redevelopment projects (1.2 inches of retention for major land disturbing activities and 0.8 inches for substantial improvements).

The future impact of the District's 2013 Stormwater Management Rule are unknown, but can be projected based on future expected development. To project the anticipated load reduction expected to occur in the future due to implementation of the stormwater regulations on parcels that will develop/redevelop, the anticipated major land-disturbing activities that will be subject to the storm water regulations over a 25-year period were forecasted. The forecasting period for this exercise was limited to 25 years because the District's Office of Planning [OP] projections of development and redevelopment are only available for the next 25 years. This forecast in turn establishes the acreage of MS4 area that will be treated to the 1.2" standard by BMPs over time. This information was used to estimate the corresponding load and storm water volume reductions. For additional information on the methodology used to develop the load reduction forecasts owing to the implementation of the stormwater regulations, please see Section 5 and the *Scenario Analysis Report* (DDOE, 2015).

The projections of the rate and extent of development and redevelopment were determined using different approaches for two different categories of land parcels:

1. **Development/Redevelopment Projections for all Parcels except those zoned as R1-R4:** OP tracks and forecasts the expected development and redevelopment of parcels not zoned R1-R4 (basically, all parcels except non-single-family residential). Figure 5-6 shows the projected development and redevelopment on these parcels from 2016-2040.
2. **Development/Redevelopment Projections for Parcels that are zoned R1-R4**
   Since OP's forecast excludes R1-R4 parcels, different assumptions were made to forecast the development/redevelopment of these parcels. These assumptions are documented in the Scenarios Report (DDOE, 2015).

The aggregate area for the categories of land parcels described above determines the rate and extent of area that will be subject to the District's 2013 Stormwater Management Rule. Altogether, 187 acres per year are projected to be developed or redeveloped over the next 25 years. This consists of approximately 66 acres/yr. of R1 through R4 parcels and 121 acres/yr. of non R1 through R4 parcels (including roadways).

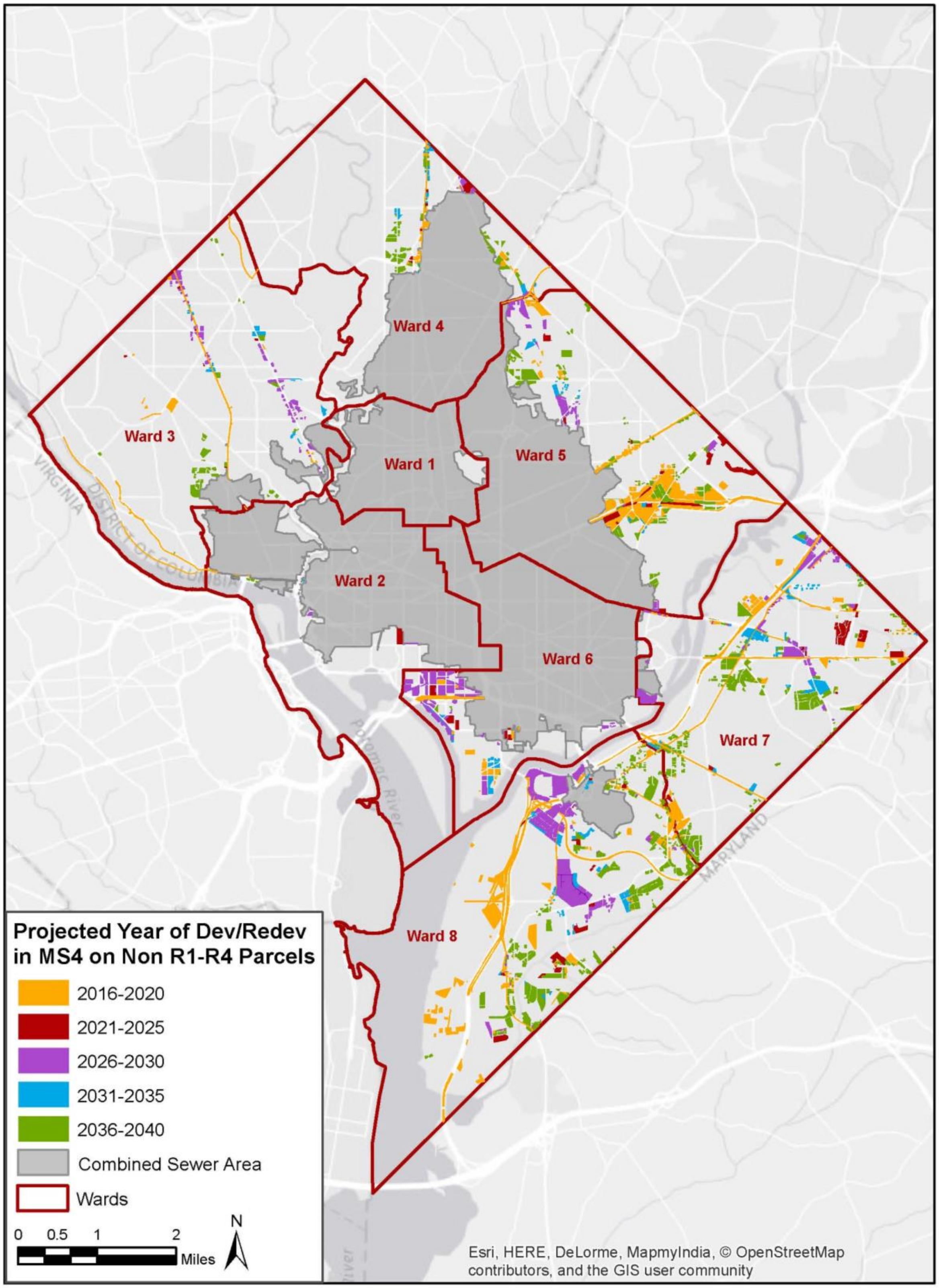

Figure 5-6. Projected Development and Redevelopment in the MS4 on Parcels Not Zoned R1 through R4

Additional observations about the projected area of development and redevelopment in the MS4 area between 2015 and 2040 include:

- Wards 5, 7, and 8 are forecasted to have the most development or redevelopment on non R1-R4 parcels.
- The forecasted development or redevelopment area is less than 25 percent of the total MS4 area.
- The majority of predicted development or redevelopment on non R1-R4 parcels is expected to occur on privately owned parcels or on District-owned parcels.
- Development or redevelopment on non R1-R4 parcels is expected to be focused along commercial properties along major transportation corridors.
- Roads and the public right of way make up a sizeable area of development or redevelopment in the forecast.

Figure 5-7 shows the total projected area of development or redevelopment in the MS4 from 2015 through 2040.

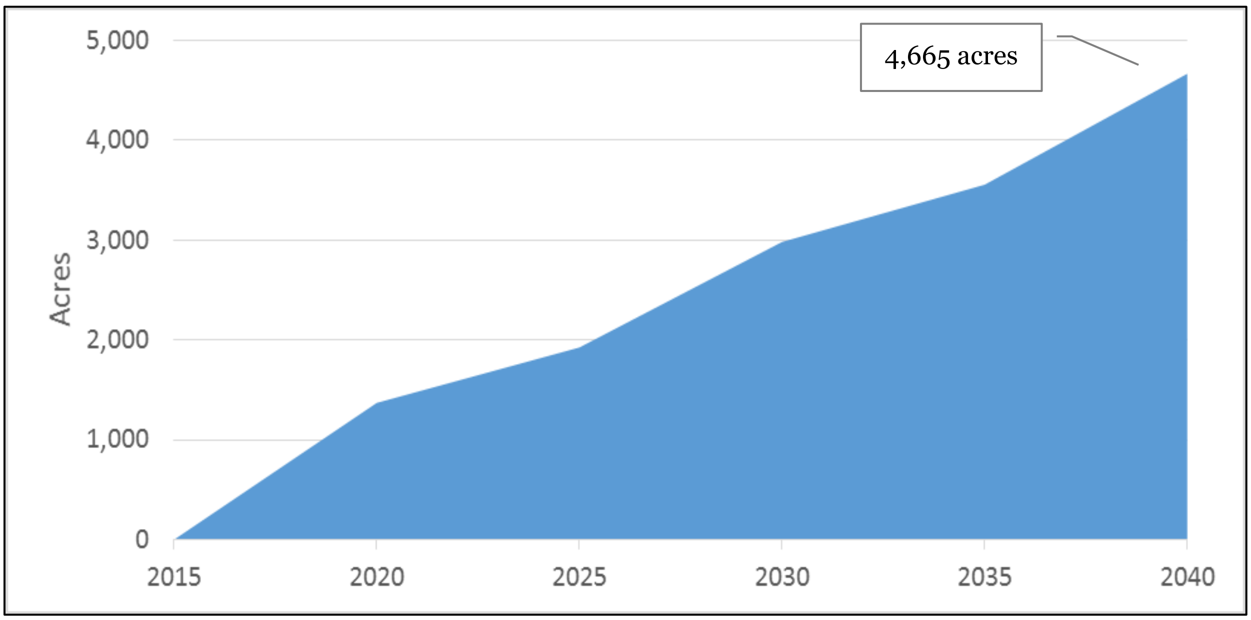

Figure 5-7. Total Projected Area of Development or Redevelopment in the MS4 from 2015 to 2040

Projections of development and redevelopment are currently available through the year 2040. It is expected that development and redevelopment, and subsequent BMP implementation and load reductions in response to the 2013 Stormwater Management rule, will continue into the future beyond 2040. Therefore, the projected annual rate of development or redevelopment was extrapolated beyond 2040 to project additional load reduction into the future. The spatial location of the development and redevelopment beyond 2040 depends on market and regulatory forces and is not predictable. Consequently, it was assumed that the annual rate of development or redevelopment of R1-R4 parcels, non R1-R4 parcels, and roadways, beyond 2040 will occur evenly and at a steady rate across the entire MS4, as shown in Figure 5-8. For additional information on the methodology used to forecast development and redevelopment, please see the *Scenario Analysis Report* (DDOE, 2015).

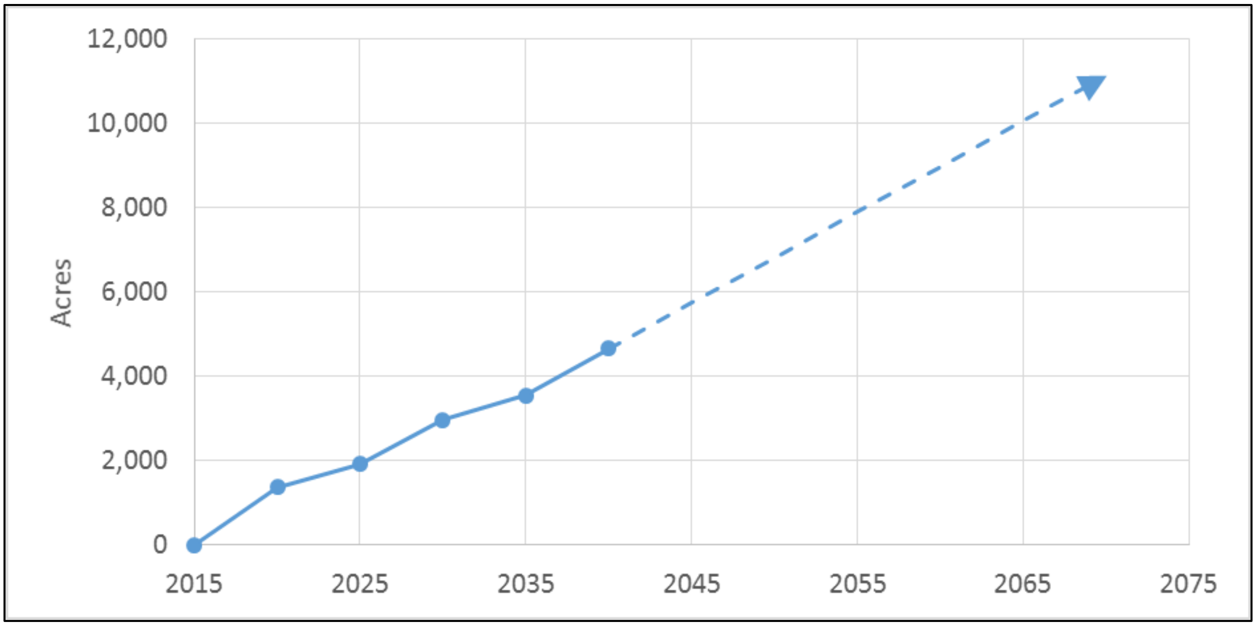

Figure 5-8. Total Projected Area of Development or Redevelopment in the MS4 over Time

5.3.5 BMP Implementation from Other Programs

BMP implementation is also expected to occur through other existing drivers and programs unrelated to implementation of the stormwater regulations, including through District agency funding, grant programs, voluntary implementation, and regulatory drivers other than those from major land disturbances that would trigger the stormwater regulations. Examples include:

- RiverSmart programs
- Other DOEE-funded programs (stream restoration and LID projects)
- University stormwater management or sustainability plans
- Federal agency stormwater management or sustainability plans
- DDOT's green alley program or sustainability plan

Overall, the BMPs implemented through other existing drivers and programs include BMPs installed by various District agencies, the federal government, and private landowners. The future impact of BMP implementation from other existing drivers and programs unrelated to implementation of the stormwater regulations was projected into the future to evaluate the future impact on load reduction and achievement of MS4 WLAS. In this case, future implementation rates were based on extrapolation of historic data on BMP implementation unrelated to the stormwater regulations. A full discussion of the methodology for developing these projections is provided in the *Scenario Analysis Report* (DDOE, 2015); a summary of this projected implementation is provided in Table 5- 3 .

Table 5- 3. Projected Annual Rate of BMP Implementation in the MS4 Area		
BMP Type	**Projected Annual Rate of Implementation**	**Units**
Permeable Pavement	2,800	Square Feet
Rain Barrel	667	Count
Standard Bioretention	31,799	Square Feet
Cistern	3,900	Square Feet
Impervious Surface Removal	10,367	Square Feet
Green Roofs	20,499	Square Feet
New Trees	4,150	Count
Undefined (DDOT)	100,108	Square Feet
Schools	3 schools/year @2,500 cubic feet treated	-
Stream Restoration	1,500	feet

As these are projected implementation rates, it was not possible to predict the exact location of future BMPs. It is therefore assumed that these BMPs will be installed uniformly across the MS4, at the same annual rate until the available area or land for each BMP type is exhausted. The total equivalent area controlled from BMP implementation through these programs is approximately 21 acres/year.

5.3.6 Results and Implications for Developing an Implementation Strategy

The analyses of the methods available to close the gap between current pollutant loads and the WLAs described above have major implications for developing an implementation strategy to meet MS4 WLAs. The major findings of the available methods to close the gap include:

- A variety of programmatic and source control efforts are currently occurring in the District but not all can be quantified in terms of load reduction provided.
- The BMP implementation expected to occur from development and redevelopment activities that will trigger the stormwater regulations will retrofit slightly less than 25 percent of the MS4 with BMPs by the year 2040.
- The BMP implementation expected to occur from other existing drivers and programs will retrofit approximately 3 percent of the MS4 with BMPs by the year 2040 (not including stream restoration projects).

5.4 Discussion

The goal of the Consolidated TMDL IP is to develop a strategy and a schedule to attain applicable WLAs for each established or approved TMDL. The District's NPDES permit also requires modeling to demonstrate how each applicable WLA will be attained. Fulfilling these requirements necessitates evaluating loads against the fixed target WLA for that pollutant, and assessing the various methods by which the current loads can be reduced.

Pollutant load reduction gaps for nearly all of the MS4 TMDL WLAs are substantial. Achieving the WLAs for the majority of the pollutants will require extremely high levels of stormwater management and control. The existing inventory of BMPs and programmatic and source control efforts represents a start for reducing stormwater pollutant loads, but much more implementation remains.

Programs and policies are already in place that can lead to additional BMP implementation in the future. These include:

1. Programmatic and Source Control Efforts
2. BMP implementation from development and redevelopment activities and the application of the District's 2013 Stormwater Management Rule
3. BMP implementation from other programs

Modeling the continued implementation of these existing policies and programs over time can project how the existing gaps can be closed and the MS4 WLAs can be achieved in the future. The development of these individual components into an integrated implementation plan to meet MS4 WLAs is described in Section 6.

6. Implementation Plan: WLA Attainment

6.1 Introduction

The District has a long history of implementing programs and practices to manage stormwater runoff, reduce pollutant loads, and improve water quality. The District has had a MS4 NPDES permit since April 2000, and prior to that, had developed and implemented a Stormwater Management Plan. The District's first MS4 permit strengthened existing stormwater management programs and added new requirements, including source identification, monitoring, control of construction site runoff, and illicit discharge detection and elimination. The first permit also required LID practices to control stormwater runoff, as well as a coordinated catch basin cleaning and street-sweeping strategy that optimized reduction of storm water pollutants. The first permit also included references to the Hickey Run Oil and Grease, PCB, and Chlordane TMDL, which was the only TMDL in existence at the time of the permit issuance. This permit included an effluent limit for oil and grease, as well as monitoring requirements for compliance. Subsequent permits also include these same basic requirements, and many of the later TMDLs include references to these programs as the methods for TMDL implementation.

The District has also developed multiple TMDL implementation and watershed management plans. These plans have evaluated the pollutants, loads, and potential BMPs that can be implemented to achieve load reduction goals. Summaries of these plans, and a discussion of how these plans have been integrated with the Consolidated TMDL IP, can be found in Section 9.

There are also over 3,000 publically- and privately-owned BMPs that manage stormwater in the District. Ongoing programs such as the RiverSmart program encourage and subsidize LID practices on private land, contributing to water quality improvements. In addition, the District has had stormwater management regulations in place since 1988. These regulations established requirements to manage both stormwater quality and quantity. These regulations were updated in 2013 to set more stringent retention standards, making them one of the most advanced and progressive stormwater management regulations nation-wide.

In order to develop and implement a plan to achieve MS4 WLAs as required by its MS4 permit, the District intends to continue to leverage existing programs and stormwater management practices and build on the solid foundation of BMPs already in place. This section presents the specific plan for achieving WLAs and the timeframes over which each individual MS4 WLA will be achieved. The plan is based on continued implementation of the programmatic and source control efforts, BMP implementation from development and redevelopment activities and the application of the District's 2013 Stormwater Management Rule, and BMP implementation from other programs described in Section 5. Because of the dispersed nature of ongoing programmatic stormwater management activities implemented throughout the MS4 area, load reduction will take place in all watersheds throughout the MS4 area.

6.1.1 Implementation Plan Strategy

The Implementation Plan Strategy is based on the ability of the existing programs to close the gap between an individual current condition load and the MS4 WLA. Because of differences in pollutant type and sources, the Consolidated TMDL IP is organized around three different approaches to address the major categories of pollutants:

- **Implementation plan for all pollutants except trash and PCBs**: additional structural and non-structural BMPs and programmatic and source control efforts need to be implemented to reduce the pollutant load of the majority of TMDL pollutants, including nutrients, metals, and toxics.

A full discussion of the evaluation of this implementation plan, along with projections on future load reductions and WLA attainment dates, is provided in Section 6.2.

- **Implementation plan for trash**: trash is considered in a separate category because this pollutant of concern is addressed through BMPs or management actions that specifically target this pollutant. The Trash Implementation Plan is discussed in detail in Section 6.3.
- **Implementation plan for PCBs**: PCBs are also considered in a separate category because the expectations for a MS4 load reduction plan for PCBs are different than for other pollutants and are not tied to achieving specific numeric WLAs.

  The PCB Implementation Plan is discussed in detail in Section 6.4.

6.1.2 Overview of Projected WLA Attainment Dates

The load reductions to be achieved (for all pollutants except PCBs) were determined using the IP Modeling Tool. The IP Modeling Tool was also used to project end dates for achieving each MS4 WLA except for PCBs, as required by the District's MS4 NPDES permit. A summary of the timeframe in which WLAs are expected to be achieved is provided in Figure 6-1. This figure shows that 29 WLAs are currently achieved, 43 WLAs will be achieved by 2040, 115 WLAs will be achieved by 2127, and all WLAs will be achieved by 2154. As described in the subsequent sections, these projections are based on several assumptions, including:

- Load reductions increase over time as BMPs are implemented. Progress towards achieving WLAs occurs as the amount of load reduction closes the gap for individual Ms4 WLAs. When the gap is zero, the WLA is achieved.
- Load reductions for 2015 through 2040 are based on projections of BMP implementation to comply with the stormwater regulations; ongoing BMP implementation not associated with the stormwater regulations; and source and programmatic controls. Data provided by OP accounts for most of the projected area of BMP implementation resulting from development and redevelopment activities that will trigger the stormwater regulations. Thus, WLA achievement for this timeframe can be projected with a relatively good degree of confidence.
- Load reductions from 2040 through 2127 are based on extrapolations of projected BMP implementation rates. Projections for this timeframe assume that the entire MS4 area will gradually be retrofitted with BMPs at the same rate as calculated for the period of 2015 through 2040. Under this assumption, the entire MS4 area will become entirely retrofitted with BMPs by 2127. Because this implementation rate is based on extrapolation of existing trends, projections of WLA achievement are made with a lower level of confidence. Note that even if the entire MS4 area is retrofitted by BMPs, not all WLAs will be attained. This future condition occurs because it is assumed that the retrofitted areas will manage 1.2 inches of runoff. However, even after all areas are retrofitted to meet this standard, additional control will be necessary to meet the most stringent WLAs.
- Load reductions after 2127 are based on extrapolations using the annual average rate of load reduction for each TMDL segment and pollutant from current conditions through 2127. Despite the fact that all of the MS4 area will already have been retrofitted to meet the 1.2 inch retention standard by 2127, it is assumed that some combination of new technologies, improved BMP efficiencies, or BMP treatment trains will allow load reduction to continue after this date. This in turn will allow achievement of all remaining WLAs by 2154. Because this implementation rate is

based on further extrapolation of existing trends and assumptions regarding future BMPs and efficiencies, these projections are made with an even lower level of confidence.

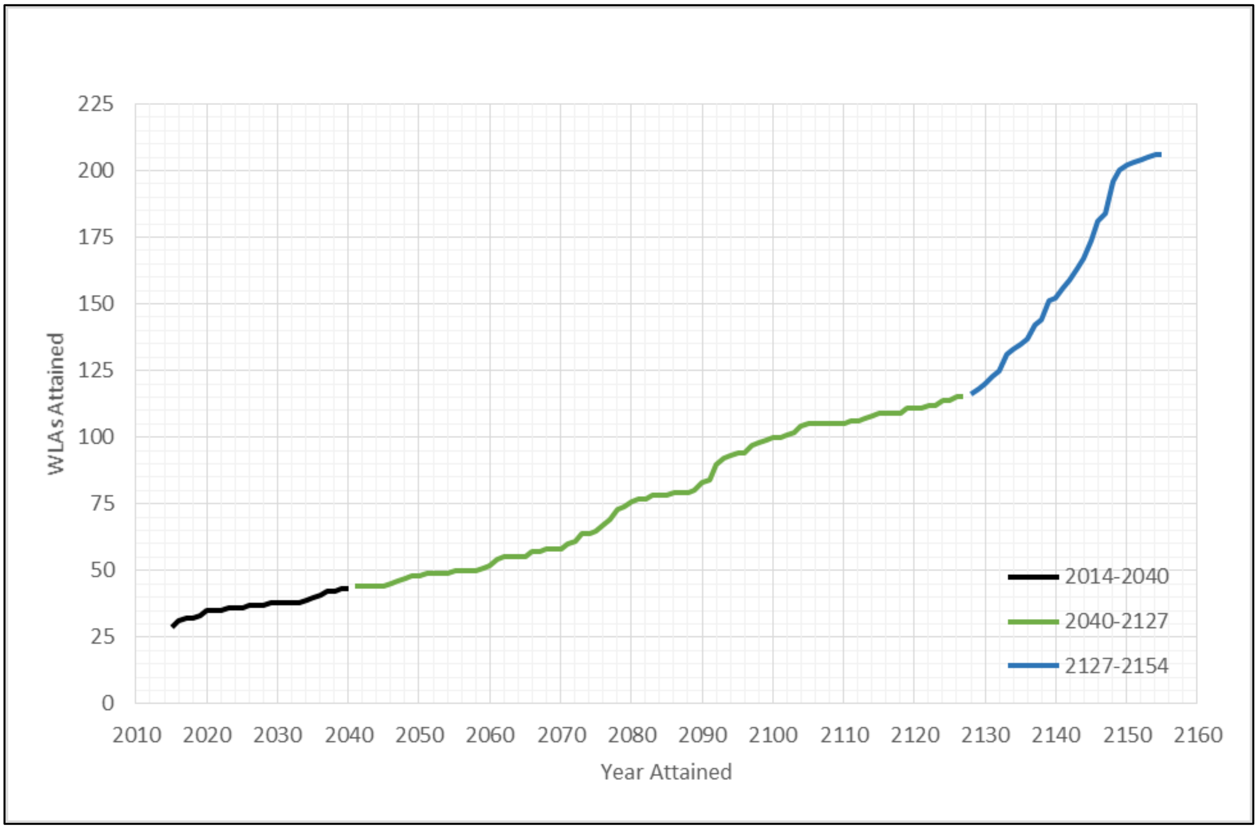

Figure 6-1. Cumulative WLA Achievement over Time after Implementation of Consolidated TMDL IP

The number and type of WLAs that are achieved in each of the major waterbodies (Anacostia, Potomac, Rock Creek) over time is summarized in the leftmost half of Table 6-1. The number of annual WLAs achieved by pollutant type over time is summarized in the rightmost half of the table as fractions, where the first number in each cell (the numerator) shows the number of WLAs achieved, while the second number (the denominator) shows the total number of WLAs of that type. Thus a cell showing (2/20) indicates that there are 20 WLAs for that pollutant type, two of which have been achieved by the year indicated.

Table 6- 1. Summary of Annual WLAs Achieved Over Time												
Year	Total # WLAs Achieved (cumulative)	# WLAs Achieved per Major Waterbody (cumulative)			# WLAs achieved by Pollutant Type (cumulative)							
		Anacostia	Potomac	Rock Creek	Bacteria	TSS	Nutrients	Metals	Toxics	BOD	Trash	
2014	29	23	5	0	2/20	3/11	3/19	11/44	10/105	0/5	0 / 2	
2020	35	29	5	0	2/20	3/11	3/19	12/44	12/105	1/5	2 / 2	
2025	36	29	6	0	2/20	3/11	4/19	12/44	12/105	1/5	2 / 2	
2030	38	31	6	0	2/20	3/11	4/19	13/44	13/105	1/5	2 / 2	
2035	40	33	6	0	2/20	4/11	4/19	14/44	13/105	1/5	2 / 2	
2040	43	35	7	0	3/20	4/11	4/19	15/44	14/105	1/5	2/2	
2045	44	35	7	1	3/20	4/11	4/19	15/44	15/105	1/5	2/2	
2050	48	36	8	3	4/20	4/11	5/19	16/44	16/105	1/5	2/2	
2055	50	38	8	3	4/20	4/11	5/19	17/44	17/105	1/5	2/2	
2060	52	38	9	4	4/20	4/11	5/19	19/44	17/105	1/5	2/2	
2065	55	40	10	4	4/20	4/11	5/19	21/44	17/105	2/5	2/2	
2070	58	43	10	4	4/20	4/11	5/19	22/44	19/105	2/5	2/2	
2075	65	48	11	5	4/20	4/11	6/19	24/44	23/105	2/5	2/2	
2080	76	58	11	6	4/20	5/11	9/19	27/44	27/105	2/5	2/2	
2085	78	60	11	6	4/20	6/11	9/19	28/44	27/105	2/5	2/2	
2090	83	61	13	8	4/20	6/11	10/19	28/44	31/105	2/5	2/2	
2095	94	67	15	11	4/20	6/11	12/19	31/44	37/105	2/5	2/2	
2100	100	69	17	13	5/20	6/11	13/19	33/44	39/105	2/5	2/2	
2105	105	72	17	15	5/20	6/11	13/19	35/44	42/105	2/5	2/2	
2110	105	72	17	15	5/20	6/11	13/19	35/44	42/105	2/5	2/2	
2115	109	75	17	16	5/20	6/11	14/19	36/44	44/105	2/5	2/2	
2120	111	76	17	17	5/20	6/11	14/19	36/44	46/105	2/5	2/2	
2125	114	78	17	18	5/20	7/11	14/19	36/44	47/105	3/5	2/2	
2130	120	83	18	18	5/20	8/11	14/19	37/44	51/105	3/5	2/2	
2135	135	92	19	23	6/20	9/11	18/19	38/44	59/105	3/5	2/2	
2140	152	97	20	34	8/20	11/11	19/19	40/44	68/105	4/5	2/2	
2145	174	112	20	41	8/20	11/11	19/19	42/44	87/105	5/5	2/2	
2150	202	127	25	49	18/20	11/11	19/19	44/44	103/105	5/5	2/2	
2154	206	129	25	51	20/20	11/11	19/19	44/44	105/105	5/5	2/2	

A detailed discussion of each implementation plan, including the specific load reductions expected to be achieved and the timeframe for achieving MS4 WLA attainment, is provided below.

6.2 Implementation Plan for all Pollutants except Trash and PCBs

The components of the proposed implementation strategy for all pollutants except trash and PCBs are:

- Continued BMP implementation through the implementation of the existing stormwater regulations, which will reduce loads as development and redevelopment occurs and new BMPs are put in place to retain runoff in compliance with the regulations.

- Ongoing BMP implementation not associated with the stormwater regulations. This includes the use of public funds to install voluntary green infrastructure, stream restoration projects and incentive programs that support voluntary retrofits in the private sector.
- Ongoing programmatic and source control efforts, such as street sweeping and the coal tar ban.

While these components represent the District's current level of effort for stormwater management, they also reflect a concerted effort to increase stormwater implementation during the current MS4 permit cycle. These increased efforts are focused in two primary areas:

- The updated 2013 stormwater regulations, which established retention requirements for land disturbances of over 5,000 ft^2, and also regulated Major Substantial Improvement projects for the first time; and
- The development of the Stormwater Retention Credit (SRC) trading program, which by allowing the trading of credits generated from voluntary green infrastructure implementation on an open market to others who use them to meet regulatory requirements for retaining stormwater. The program incentivizes the placement of GI in the MS4, promotes the use of private investment to implement GI projects, and provides enhanced environmental performance by increasing stormwater retention.

<u>The District's Updated 2013 Stormwater Regulations</u>

In 2013, the District updated its stormwater regulations to increase the requirement for projects disturbing more than 5,000 ft^2 from treatment and detention of the first 0.5 inches to retention of the first 1.2 inches of stormwater. The new regulations thus shifted in regulatory approach from "peak shaving" to on-site retention. In addition, the 2013 regulations added a new requirement for every Major Substantial Improvement project to meet retention requirements as well. The District's updated stormwater management regulations are among the most progressive and environmentally protective in the nation, and marked a major increase in both the amount of retention required by specific projects, and also in the universe of parcels impacted by the regulations. Projections of additional load reduction from the increased retention standard for projects disturbing more than 5,000 ft^2 were incorporated into the Consolidated TMDL IP. DOEE is collecting data on the increase in retention practices from Major Substantial Improvement projects and will include projections from this new regulatory trigger in future updates to the TMDL IP.

Additionally, the 2013 stormwater regulations are driving other District agencies to increase public investment and expenditures on stormwater management. As a result of the regulations, the District's investment in stormwater management through capital projects has already increased dramatically relative to prior implementation of the regulations. For example, roads reconstructed by the District Department of Transportation (DDOT) must be designed as green streets and public buildings must include green infrastructure to comply with the new regulations.

<u>Stormwater Retention Credit (SRC) Market</u>

Regulated projects that the use of the SRC market will accelerate the schedule to attain WLAs by increasing annual load reductions by installing more BMPs than would otherwise occur and by shifting the location of BMPs from the CSS to MS4. These projections have been made because development projects in the CSS area typically have high land values and limited options for installing BMPs. In contrast, BMPs typically can be built in the MS4 area for a lower cost than in the CSS area because land values are lower and more low cost opportunities exist to install GI.

Initial data from the SRC markets support these projections. As of March 2016, these data show 60 percent of the demand for off-site retention has been generated by projects in the CSS, but 71 percent of the SRCs have been generated in the MS4.

There are 204 annual WLAs for pollutants other than trash and PCBs, and the load reductions necessary to achieve these WLAs were modeled using the implementation strategies described above. The next section describes in detail the modeling approach taken to develop the implementation plan to meet these WLAs.

6.2.1 Modeling Load Reductions and WLA Attainment Dates

Each of the components described above were evaluated in the IP Modeling Tool to determine the amount of stormwater volume and pollutant load reductions achieved over time. The three components are expected to continue into the future, assuming that current level of funding for BMP implementation and stormwater management remains unchanged. Several assumptions were made from these implementation measures, including:

- For the load reductions associated with the development and redevelopment of the MS4:
    - The total projected BMP area expected to occur from the implementation of the stormwater regulations is approximately 187 acres/year but will change over time as documented in the *Scenario Analysis Report* (DDOE, 2015).
    - The area required to be retrofitted to comply with the stormwater regulations would be retrofitted by BMPs using the 1.2-inch design standard. The exact type of BMP, or combination of BMPs, that would be constructed is unknown and could be highly variable depending on the site conditions and designer. Therefore, it was not possible to be specific about BMP implementation at each site, and a representative BMP (enhanced bioretention with underdrain) was used.
    - The efficiency of an enhanced bioretention with underdrain (which, at 83.5 percent removal efficiency, is slightly less than the median efficiency of all the retention-based BMPs) was chosen as the representative efficiency to model the stormwater volume reduction. The expected pollutant load removed was determined in the model by multiplying the volume removal by the appropriate pollutant EMC.
- For the load reductions associated with BMP implementation from other programs and drivers:
    - The total equivalent area controlled from BMP implementation through these programs is projected to be approximately 21 acres/year. Note that this acreage changes over time after 2040 for the same reasons documented above for load reductions associated with the development and redevelopment of the MS4. The rate of implementation is expected to, at a minimum, remain constant over time, until the available area or land for each BMP type is exhausted. Because there was no data available to project spatial trends in BMP implementation, it is assumed that these BMPs will be installed uniformly across the MS4
    - Retention-based BMPs would be designed to the 1.2 inch standard.
    - The BMP efficiencies were selected according to the BMP type, which can range from 53 percent for a green roof to 92 percent for an infiltration trench (based on 1.2 inches of retention). Non-retention BMPs would perform at the efficiencies as shown and explained in Appendix F of the *Final Comprehensive Baseline Analysis Report* document (DDOE, 2015).

- For the load reductions associated with source control and programmatic activities:
  - Street sweeping, phosphorus fertilizer control, and coal tar sealant removal are included because they are the only activities in this category that have supporting performance data could be quantified in the model using the available data. The pollutant load removal provided by each of these activities is explained in *Appendix F, Technical Memorandum: BMPs and BMP Implementation*, of the *Final Comprehensive Baseline Analysis Report* (DDOE, 2015). Note that the reductions from this source control method are accounted for in the calculation of the current load reductions. No increases in the amount of street sweeping or coal tar sealant removal are anticipated for the future. For the phosphorus fertilizer ban, the District will be able to take an additional phosphorus load reduction after approving the District's Anacostia River Clean Up and Protection Fertilizer Amendment Act of 2012

Three different time periods were used to model the future load reductions and WLA achievement dates.

1. **Load reductions and WLA attainment between 2015 and 2040.** The load reductions and WLA attainment dates from this timeframe are based on projections of expected development or redevelopment and associated BMP implementation to comply with the stormwater regulations, as well as projections of ongoing BMP implementation, and source and programmatic controls, based on historical trends. The load reductions and WLA achievements for this timeframe can be projected with a relatively good degree of confidence because they are based in large part on the development and redevelopment forecasts prepared by the Office of Planning, and they have a high degree of spatial resolution.
2. **Load reductions and WLA attainment between 2040 and 2127.** The spatial location of the development and redevelopment beyond 2040 depends on market and regulatory forces that are not predictable. Consequently, the impact of this implementation component was distributed evenly across the MS4 for the 2040 to 2127 timeframe. Similarly, the BMP implementation from other programs and drivers is also assumed to be uniform across the MS4. Load reduction projections occurring after 2040 assume that the entire MS4 area will gradually be retrofitted with BMPs at the same rate as calculated for the period of 2015 through 2040. To better project the area that will be controlled by BMPs beyond the year 2040, a rate of BMP implementation was calculated for three different land categories including (1) Roads and the PROW, (2) R1-R4 parcels, (3) all other parcels. The reason for using three different rates of implementation is that the data shows that these three types of land categories experience different rates of development/redevelopment and/or BMP implementation. A full description of how these rates were developed can be found in the *Final Scenario Analysis Report* (DDOE, 2015).

   Table 6- 2 shows the projected rate of BMP implementation beyond 2040 for the three categories.

Table 6- 2. Projected BMP Implementation Rates Beyond 2040

	Roads and PROW	R1-R4	All Other Parcels
Target area	Road and PROW	Parcels zoned R1-R4 and excluding roads and PROW	Parcels not zoned R1-R4 and excluding roads and PROW
Retrofit rate	56 acres/year	76 acres/year	104 acres/year
Remaining available area to retrofit after 2040	4,880 acres	5,104 acres	4,565 acres
Date by which land use type is completely retrofitted	2127	2107	2084

The implementation rates in Table 6-2 were applied to the appropriate "remaining available area" in the MS4 to continue projecting stormwater volume and load reductions beyond 2040, and to determine the timeline necessary to meet each WLA. The "remaining available area" represents areas of the MS4 that have not yet been retrofitted by BMPs as of 2040. It is further assumed that these areas will be treated by enhanced bioretention with underdrains that are designed to the 1.2 inch standard. Because this implementation rate is based on extrapolation of existing trends, projections of BMP implementation, and subsequent load removal and WLA achievement, are made with a lower level of confidence. Using these implementation rates, it is expected that the entire MS4 area will be retrofitted by the year 2127.

Load reductions and WLA attainment beyond 2127. Figure 5-4 in Section 5.2.3.c shows that even if the entire MS4 area is retrofitted by BMPs designed to retain 1.2 inches of runoff, not all WLAs will be met. This level of control is insufficient to meet the more stringent WLAs. Load reductions must therefore be extrapolated beyond the date at which the entire MS4 area will be retrofitted with BMPs. It is assumed that some combination of new technologies, improved BMP efficiencies, or BMP treatment trains will allow load reduction to continue or increase until all WLAs are met. The load reductions after 2127 are based on extrapolations using the annual average rate of load reduction, for each TMDL segment and pollutant, from 2014 through 2127, as further explained in the *Final Scenario Analysis Report* (DDOE, 2015). The projections of WLA attainment date are made with very low level of confidence because the load reduction rates are based on further extrapolation of existing trends and assumptions regarding future BMPs and efficiencies. Annual load reductions are applied for each individual pollutant/waterbody combination that has an MS4 WLA until the individual WLA until the WLA is attained. Based on the load reduction projections described in this section, all of the WLAs will be achieved by 2154.

6.2.2 Load Reduction Projections and Timeframe for Achieving WLAs

6.2.2.a Projected Stormwater Volume and Load Reductions

Figure 6-2 shows the cumulative stormwater volume reduction projected to be achieved by the current rate of BMP implementation in each of the three major watersheds (Anacostia, Potomac, and Rock Creek) from 2015 through 2154. While all BMP implementation programs and drivers contribute to load reductions over time, the impact of the stormwater regulations on development and redevelopment activities is by far the largest contributor to volume reduction. Overall, stormwater volume reductions in the MS4 area from the BMP implementation expected from development and redevelopment activities (the dotted lines in Figure 6-2) make up almost 90 percent of the total stormwater volume reduction achieved through the IP.

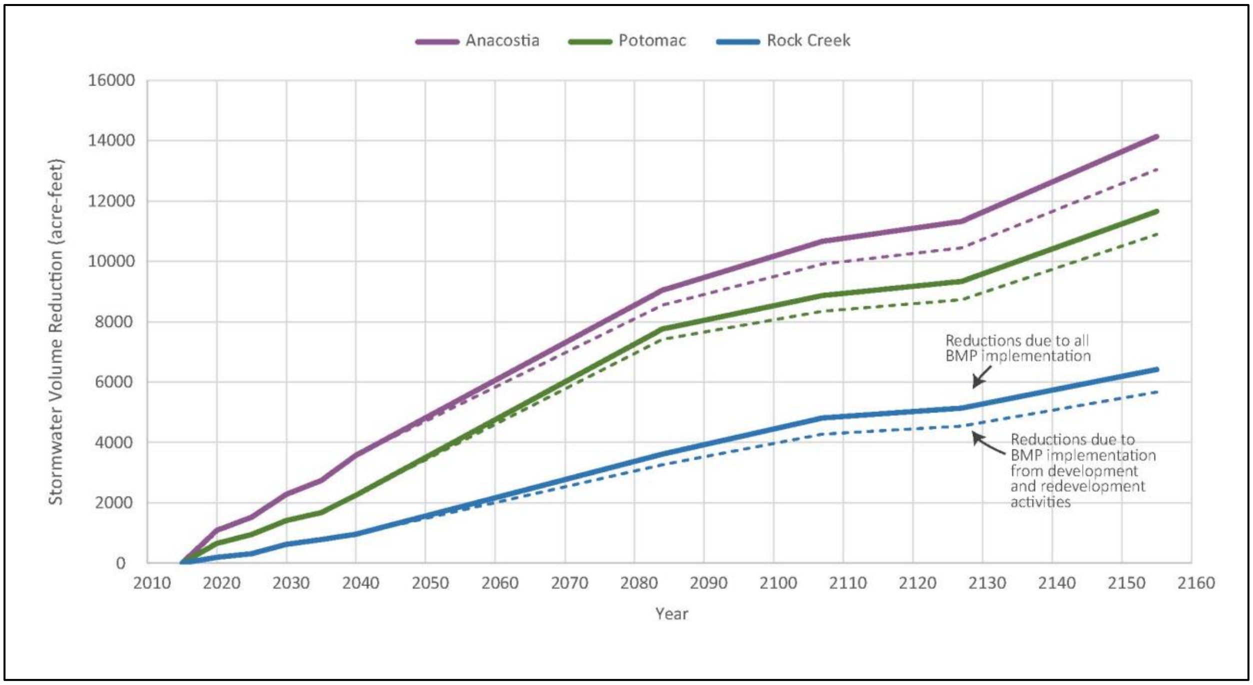

Figure 6-2. Projected Stormwater Volume Reduction in the MS4 Area over Time by Major Watershed

Load reductions achieved through implementation of the stormwater regulations are modeled by multiplying the projected stormwater volume reduction by the EMC for each pollutant type. The load reductions are different for each pollutant and TMDL water body. However, an example of the load reduction expected for TSS in the MS4 area of the three major watersheds, over time, is shown in Figure 6-3.

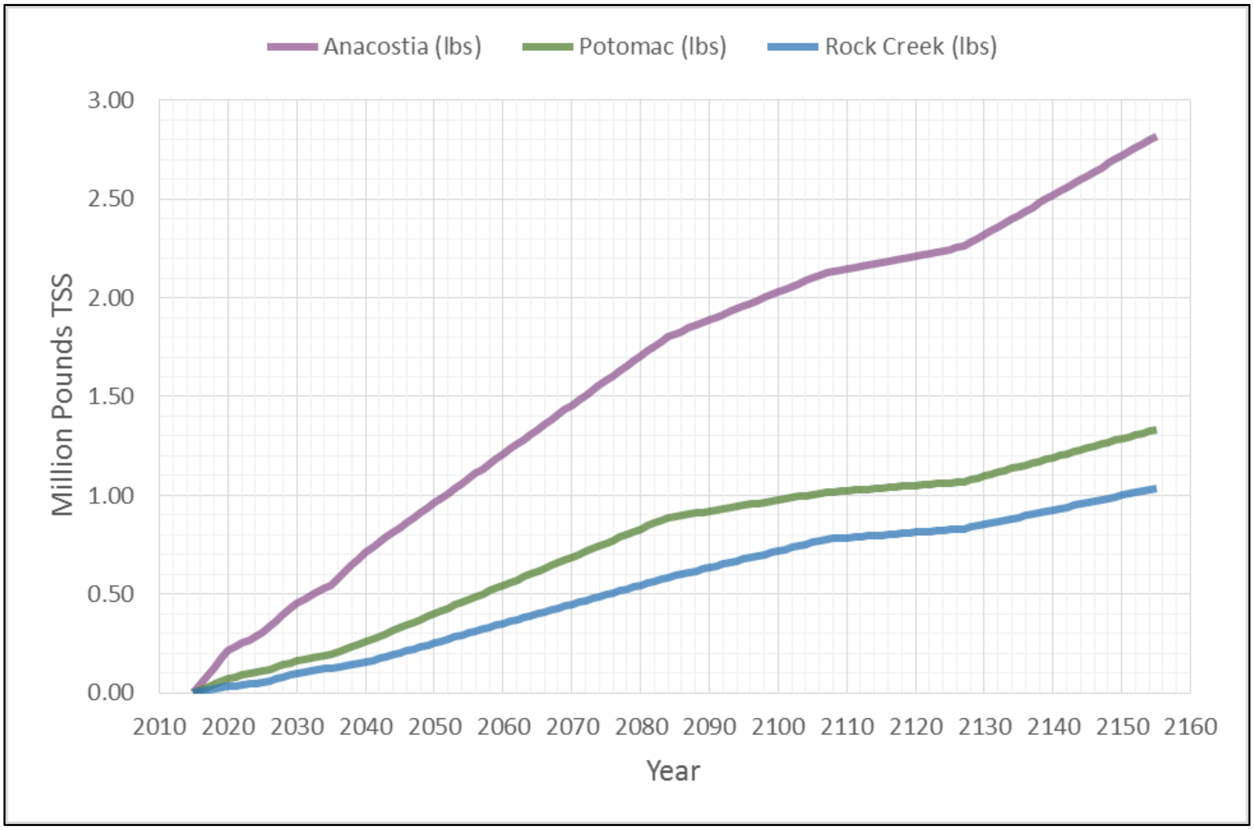

Figure 6-3. Projected TSS Load Reduction (lbs) Over Time by Major Watershed

6.2.2.b Timeframe for Achieving WLAs

A summary of the timeframe in which WLAs are expected to be achieved is provided in Figure 6-4. This figure shows that 29 WLAs are currently attained, and that additional WLAs will be achieved over time as BMP implementation is increased. The results are shown for the three different time periods that were modeled and can be summarized as follows:

- During the time period of 2015 through 2040, it is predicted that an additional 12 WLAs will be attained for a total of 41 WLAs achieved by 2040 (note that this total excludes trash WLAs, which are discussed in Section 6.3). These projections on WLA achievement are made with a relatively good degree of confidence.
- During the time period of 2040 through 2127, an additional 72 WLAs will be attained, for a total of 113 WLAs (does not include trash WLAs, as described above). These projections on WLA achievement are made with a lower level of confidence.
- During the time period of 2127 through 2154, all remaining WLAs will be achieved for a total of 204 WLAs (does not include trash WLAs, as described above). These projections are made with a very low level of confidence.

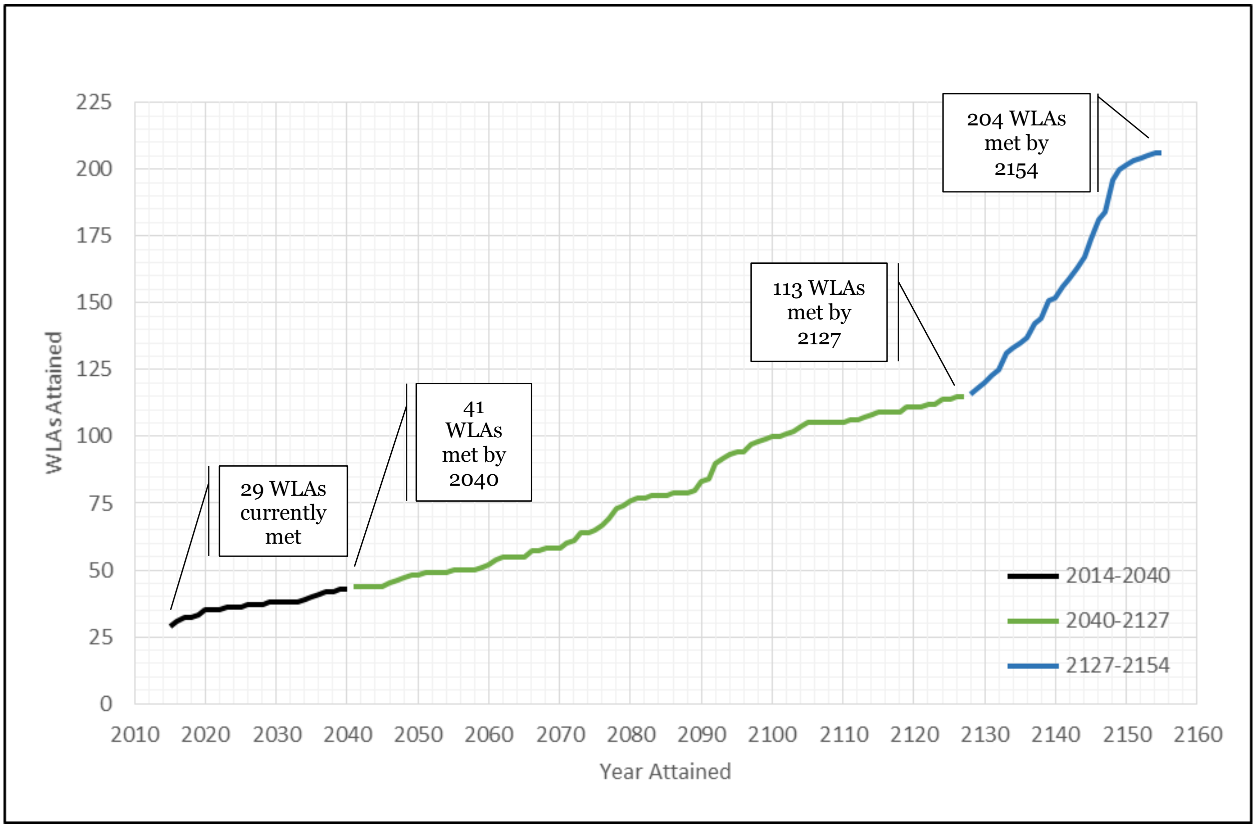

Figure 6-4. WLA Attainment Projections over Time

Figure 6-4 shows that WLA attainment will require lengthy implementation timelines. However, these forecasts are potentially subject to both conservative and non-conservative biases, and that these timelines may change as additional data on implementation and load reduction is collected in the future. On one hand, these forecasts may prove too conservative because several ongoing source control and programmatic efforts are not currently quantified through modeling. In addition, the so-called "first flush" effect is not captured in the modeling. The first flush effect theory states that pollutant loads are concentrated in the initial volume of stormwater, which means that running this initial volume through BMPs may reduce many of the pollutants. On the other hand, these forecasts may not be conservative enough relative to other factors. For example, it is assumed that when a development project triggers the stormwater regulations, the entire parcel area will be controlled by BMPs rather than a portion of the parcel. Another example is that the average BMP efficiency used to model load reductions in the forecast is 83 percent, which is higher than the average efficiency of some BMPs. It is difficult to predict the aggregate effect of these assumptions on the actual load reductions that will be achieved in the future. Section 6.8 discusses the role of adaptive management in fine-tuning the forecast in the future.

Projections of individual WLA attainment are provided in waterbody-specific tables provided in Appendix D. General discussions of WLA attainment for the three major basins are provided in Section 6.2.3.

6.2.3 Watershed-Specific Results

Additional information on the projections for WLA attainment is provided for each major watershed below.

6.2.3.a Anacostia Watershed

Over half of all the projected development and redevelopment projected to occur in the MS4 area by 2040 will occur in the Anacostia watershed, with most of it occurring in Wards 5, 7, and 8. Large areas of land are expected to be developed or redeveloped along the New York Avenue, Benning Road, and North Capitol Street corridors, on the St. Elizabeth's property, and on Barry Farm near the intersection of I-295 and Suitland Parkway. Approximately 30 percent of the expected development and redevelopment in the Anacostia MS4 Watershed is likely to occur by 2020.

Twenty-three of the 29 WLAs that have already been achieved are in the Anacostia watershed, including:

- Seven metals and toxics WLAs in the Texas Avenue Tributary.
- Lead WLAs in the Lower Anacostia, Fort Dupont, and Pope Branch.
- Zinc WLAs in the Lower Anacostia, Fort Chaplin, Fort Davis, and Fort Stanton.
- PAH WLAs for Hickey Run, Kingman Lake, Nash Run and Pope Branch.
- Dieldrin WLAs for the Lower Anacostia and Lower Watts Branch.
- WLAs for TSS, TP and TN in Lower Beaverdam Creek.

Six additional WLAs are expected to be achieved in the short term (by 2020), including:

- Two Anacostia trash WLAs.
- The Lower Beaverdam Creek BOD WLA.
- Dieldrin WLAs in the Upper Anacostia and Upper Watts Branch.
- The Arsenic WLA in the Texas Avenue Tributary.

After this, WLA achievement climbs at a slow, steady rate, until it begins increasing more rapidly after 2127. This is reflective of the fact that many WLAs require more than 90 percent load reduction, and the model projects that it will take until approximately 2127 to begin achieving this much load reduction in most of the water segments in the Anacostia watershed.

Many of the last WLAs to be achieved are for bacteria and toxics. Most individual segments in the Anacostia watershed are not projected to achieve all of their WLAs until after 2127. With the exception of Lower Beaverdam Creek, which is expected to achieve its last remaining WLA (BOD) by 2020, and the Chesapeake Bay TMDL segments, which will achieve the last of their WLAs by 2092[8], no other subwatersheds in the Anacostia watershed achieve all of their WLAs until 2137, when Watts Branch achieves the last of its WLAs. Northwest Branch achieves the last of its WLAs by 2142, the Lower Anacostia and Nash Run by 2145, Fort Davis, Kingman Lake, and the Upper Anacostia by 2148, Fort Chaplin, Pope Branch and Texas Avenue Tributary by 2149, Hickey Run by 2150, Fort Dupont by 2151, and Fort Stanton by 2152.

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[8] Projected WLA achievement dates for the Chesapeake Bay TMDL reported in the Consolidated TMDL IP differ from the projections reported to the Chesapeake Bay Program for several reasons, most having to do with the different modeling and BMP reporting used for the Consolidated TMDL IP versus the Chesapeake Bay TMDL. Major factors influencing the differences in projected end dates include the scale of the modeling (modeling of loads for the Chesapeake Bay TMDL is done on a 64,000 sq. mile watershed, while modeling for local TMDLs is done on a much finer scale), the modeling inputs (for example, EMCs for TN and TP are higher in the IP Modeling Tool than for the Chesapeake Bay TMDL Watershed Model), the modeling endpoints (local TMDLs are designed to achieve local water quality goals, while the Chesapeake Bay TMDL is designed to achieve water quality goals in the Bay itself), and the BMP inventory (the Consolidated TMDL IP is very conservative with respect to the existing BMP inventory used to evaluate current conditions; some BMPs reported to the Bay Program are not used in the Consolidated TMDL IP modeling).

6.2.3.b Potomac Watershed

Over 30 percent of the projected development and redevelopment projected to occur in the MS4 area by 2040 will occur in the Potomac watershed. Much of the predicted development or redevelopment will occur in Ward 8 along the southwest waterfront, and along Wisconsin and Massachusetts Avenues in Ward 3. Approximately 30 percent of the expected development and redevelopment in the Potomac MS4 Watershed will occur by 2020.

There are relatively few (25) WLAs to achieve in the Potomac watershed versus the Anacostia and Rock Creek watersheds. Of these 25 WLAs, five have already been achieved, including zinc in Foundry Branch, E. coli in the Tidal Basin and the Washington Ship Channel, and TSS in the POTTF_DC and POTT_MD Chesapeake Bay TMDL segments. The modeling projects that WLA achievement will increase at a slow, steady rate until all WLAs are achieved by 2148. Very few WLAs are achieved in the near-term (within the first 25 years): only E. coli in the Upper and the POTT_MD TN WLAs are projected to be achieved by 2040. The relatively low number of WLAs attained is not indicative of a lack of load reductions compared to the other watersheds, but rather the relatively low number of WLA targets.

As with the Anacostia watershed, many individual segments in the Potomac watershed are not projected to achieve all of their WLAs until after 2127. The last WLAs to be achieved in the Potomac watershed are for E. coli. The model projects that Oxon Run will achieve its E. coli WLA by 2146, while Battery Kemble Creek, the C&O Canal, the Dalecarlia Tributary, and Foundry Branch will achieve their E. coli WLAs in 2148.

6.2.3.c Rock Creek Watershed

Only 14 percent of the development and redevelopment projected to occur in the MS4 area by 2040 will occur in the Rock Creek watershed. Much of the projected development or redevelopment will occur along Connecticut Avenue or near the Walter Reed Site between 16th street NW and Georgia Ave NW. More than half of the expected development and redevelopment in the Rock Creek MS4 Watershed will occur by 2030.

There are 51 WLAs to be achieved in the Rock Creek watershed and, as of 2014, none of these have been achieved. The first WLA projected to be achieved in the Rock Creek watershed is dieldrin in Klingle Valley Run, which is projected to occur by 2041. Similarly to what was seen with the Anacostia watershed, WLA achievement climbs at a slow, steady rate, until it begins increasing more rapidly after 2127. This is reflective of the fact that many WLAs require more than 90 percent load reduction, and the model projects that it will take until approximately 2127 to begin achieving this much load reduction in most of the water segments in the Rock Creek watershed.

Unlike in the Anacostia watershed, waterbodies in the Rock Creek watershed achieve their WLAs over a wide range of time and are not all clustered towards the end of the modeling projection timeline. The modeling projects Melvin Hazen Valley Branch to achieve all of its WLAs first, by 2080, followed by:

- Klingle Valley Run by 2102.
- Soapstone Creek by 2137.
- Pinehurst Branch by 2138.
- Portal Branch by 2139.
- Lower Rock Creek by 2140.
- Piney Branch by 2143.
- Fenwick Branch by 2144.

The last WLAs to be achieved are in Upper Rock Creek, Broad Branch, Luzon Branch, and Normanstone Creek, all of which are projected to be achieved between 2146 and 2148. These last WLAs consist of toxics for Broad Branch, Luzon Branch, and Normanstone Creek (PAH2, Chlordane and Heptachlor Epoxide, and PAH3 and DDT, respectively), and mercury for Upper Rock Creek.

6.3 Implementation Plan for Trash

The Draft Anacostia River Watershed Trash TMDL Implementation Strategy was published in December 2013 (DDOE, 2013). A summary of the trash implementation plan is provided below. A full discussion of the plan can be found in the above-referenced document.

6.3.1 Modeling Load Reductions and WLA Attainment Dates

The Draft Anacostia River Watershed Trash TMDL Implementation Strategy summarizes the District's strategy for achieving the MS4 permit goal of putting the controls in place by 2017 to prevent 103,188 pounds of trash per year from reaching the District's portion of the Anacostia River. As a first step, trash-loading coefficients were developed for various land use types found in the District. Using the loading coefficients, total annual loads were developed for each of the MS4 sewersheds in the District's portion of the Anacostia watershed. The average trash load for all Anacostia MS4 sewersheds was then determined. The District then developed a multi-prong approach for removing trash, quantifying the removal, and evaluating compliance with the MS4 WLAs. DOEE intends to use a combination of end-of-pipe BMPs placed at as many MS4 hotspot outfalls (defined as sewersheds determined to have greater than average annual trash loads) as is possible, plus a variety of structural and non-structural controls where outfall retrofit is not feasible because of issues such as access and stability of the outfall.

Current trash removal strategies and the estimated amounts of trash removed by each practice are summarized in Table 6- below. Note that for some of the practices (e.g., Kenilworth Bandalong Litter Trap; James Creek Bandalong Litter Trap), the collected empirical data (i.e., the "Total Amount of Trash Actually Being Removed" column) was counted towards meeting load reductions. For other practices (e.g., Marvin Gaye Park Bandalong Litter Trap, sweeping of environmental hotspots; various clean-up activities), best professional judgment was applied to assess reductions through the use of load reduction factors. These factors, which are explained in the "Calculation Methodology" column, were used to calculate the load reductions summarized in the "Annual Load Reduction Counted" column and to evaluate against the MS4 WLA. The load reduction factors were used to help eliminate variables which could cause overestimates of efficiency. Thus the actual or estimated amount of trash removed through these BMPs is much larger than the amount of trash quantified to evaluate achievement of MS4 WLAs. This makes the estimates of trash removal conservative relative to the MS4 WLA. In addition, all trash removed from the Anacostia helps to improve the waterbody, whether or not it is "credited" as being removed from the MS4 area, the nonpoint source direct drainage area, or the CSO area. Therefore, implementation of the trash strategy and related BMPs will help to meet goals beyond MS4 WLAs.

Table 6- 3. Trash Removal Strategies for Anacostia Trash TMDL

Activity Category	Activity	Total Amount of Trash Actually Being Removed (pounds)	Annual Load Reduction Counted (pounds)	Calculation Methodology
Trash Traps	Marvin Gaye Park Bandalong Litter Trap	1,296	26	Annual average value taken from empirical data collected between Jan 2012 and November 2014. The average amount of trash collected during this time period is multiplied by 2 percent since that is the approximate proportion of the Watts Branch watershed which lies within District and drains to the trash trap.

Table 6- 3. Trash Removal Strategies for Anacostia Trash TMDL				
Activity Category	**Activity**	**Total Amount of Trash Actually Being Removed (pounds)**	**Annual Load Reduction Counted (pounds)**	**Calculation Methodology**
	River Terrace Trash Trap	256	256	Current total collected in 2014. Data was only collected during part of 2014.
	Kenilworth Bandalong Litter Trap	2,323	2,323	Annual average taken from empirical data collected between March 2011 and November 2014. No reduction factors are being applied since the entire drainage area above this trap lies within the District.
	Nash Run Trash Trap	2,126	1,595	Annual average taken from empirical data collected between 2009 and 2014. The total amount collected is then multiplied by 75% since that is the approximate proportion of the Nash Run watershed that lies within the District and drains to the trash trap.
	Hickey Run BMP	10,000	2,000	Based on assumed efficiency of 100 percent design capture of device. A reduction factor of 20 percent was applied since glass and plastic bottles may not have been emptied of water.
	James Creek Bandalong Litter Trap	184	184	Annual average taken from empirical data collected between January 2012 and November 2014. No reduction factors have been applied since the entire drainage area for this practice lies within the District.
	Earth Conservatio n Corps Trash Booms	1,475	124	Amount collected from trap in 2014. Annual average not taken for 2013 and 2014 data since only four months of data was collected in 2013. Reduction factors are applied since a portion of the trash collected is coming from the mainstem of the river. A reduction factor of 16.5% is applied since this the proportion of the Anacostia watershed which lies within the District. A second reduction factor of 50.8 % is applied to account for the District's portion of the Anacostia served by the MS4.
Roadway and Block Cleanups	Adopt-A-Block Program	425	85	All cleanup events accounted for are within the MS4 area of the Anacostia watershed. An assumed weight of 25 pounds per bag is applied to calculate the total weight of bags collected. Total weight of trash was multiplied by 20% to account for bottles and other containers not being emptied of water.
Sweeping Environme ntal Hotspots	Sweeping Environment al Hotspots	144,768	72,384	The total area of roadways within the environmental hotspots (e.g. blocks found to contain high trash amounts)[3] was calculated. That area was then multiplied by 50 percent because roughly half of the roadway (the middle of the road) is swept in these areas because they are unsigned. That area is then multiplied by the trash loading coefficient of 31.12 lbs/acre developed for the TMDL. That total mass in pounds is then multiplied by 16 since the DC Department of Public Works (DPW) is supposed to sweep environmental hotspots (i.e. blocks with high amounts of trash) twice per month, 8 months out of the year. That result is then multiplied by 50 percent because not all hotspots may always be swept.

Table 6- 3. Trash Removal Strategies for Anacostia Trash TMDL				
Activity Category	**Activity**	**Total Amount of Trash Actually Being Removed (pounds)**	**Annual Load Reduction Counted (pounds)**	**Calculation Methodology**
Clean-Up Activities	Clean-Up Events	33,507	2,868	Based on empirical data collected during cleanup events within the District's portion of the Anacostia watershed. If a site is located along the mainstem of the river, a reduction factor of 16.5 percent is applied since this the proportion of the Anacostia watershed which lies within the District. A second reduction factor of 50.8 percent is applied to account for the District's portion of the Anacostia served by the MS4. A third reduction factor of 20 percent is applied to account for the fact that not all plastic and glass bottles collected may have been emptied of water before bagged.
	Skimmer Boats	1,116,000	9,354	Based on the annual average of material collected by DC Water skimmer boats between 2003 and 2014. The average amount is first multiplied by 16.5 %, which represents the proportion of the watershed that lies within the District. A second reduction factor of 50.8 % was applied to account for the area of the District's portion of the watershed served by the MS4. A third reduction factor of 50 percent was applied since not all material collected by the skimmer boats may have been trash. Finally, a fourth reduction factor of 20 percent was applied since not all plastic and glass bottles collected were emptied of water.
Education and Outreach	Watershed Wide Anacostia Campaign	NA	NA	Efficiency of education and outreach is being assessed. DOEE is awaiting results from a grant funded project being undertaken by the Alice Ferguson Foundation. Results should be finalized some time in 2015.
Regulatory Approaches	Bag Law	1,072	272	DOEE currently estimates (based on data collected for the development of the Anacostia Watershed Trash Reduction Plan) that there are 82,431 bags in the river and tributaries. This amount is first multiplied by 50.8 percent, since this is the proportion of the Anacostia River served by the MS4. The amount is then reduced by 50 percent because according to a recent survey report, 50 percent of businesses in the District report a 50% reduction in bag purchases. Finally, the total number of bags is then multiplied by 0.013 lbs., which is the standard weight for a plastic bag.
Total currently removed per year (pounds)		**1,313,432**	**91,471**	

3 - The environmental hotspots which are swept differ from the "hotspot" sewersheds mentioned earlier. The environmental hotspots swept represent a series of blocks found to contain very high amounts of trash.

In addition to the BMPs described and quantified in the table, there are a number of BMPs that will be implemented, however the impact of which cannot be easily quantified. These include education and outreach efforts such as the Watershed Wide Anacostia Campaign and trash Meaningful Watershed Education Experiences (MWEEs). While the impact of these BMPs cannot be measured directly in terms of the amount of trash reduction they achieve, they serve as an important component of the strategy and will continue to play a role in changing people's behavior and reducing trash in the Anacostia watershed.

6.3.2 Load Reduction Projections and Timeframe for Achieving WLAs

As required by the permit, the District intends to achieve the MS4 WLAs for trash in the Anacostia River by 2017 through implementation of the BMPs discussed above and quantifying the expected load reduction through the methodologies described in the table. These BMPs are expected to achieve the MS4 WLAs of 83,868 lbs/yr removed from the Upper Anacostia and 24,480 lbs/yr from the Lower Anacostia, as well as the combined MS4 WLA of 108,347 total lbs/yr of trash from the entire watershed, according to the TMDL. The current trash removal strategies remove 75,820 lbs/year in the Upper Anacostia and 15,651 lbs/year in the Lower Anacostia, for a sum of 91,471 lbs/year. The difference between current conditions and the WLAs is 16,876 lbs for the entire Anacostia, which will be achieved through implementation of additional trash reduction strategies, including a combination of additional trash traps, quantifying the benefit of outreach and education, and implementation of additional litter cans throughout the MS4. A summary of the additional trash reduction strategies to be implemented to reach these goals is provided in Table 6- 4.

Table 6- 4. Projected Additional Trash Removal Strategies

Activity Category	Activity	Total Amount of Trash Projected To Be Removed (pounds)	Annual Load Reduction Counted (pounds)	Calculation Methodology
Trash Traps	Gallatin trash trap	4,263	4,263	Calculated using the landuse loading coefficients developed for the trash TMDL discounted by 40 percent.
Other Activities			12,613	
Total projected to be removed per year (pounds)			16,876	

A map of the existing and proposed trash trap BMPs is provided in Figure 6-5.

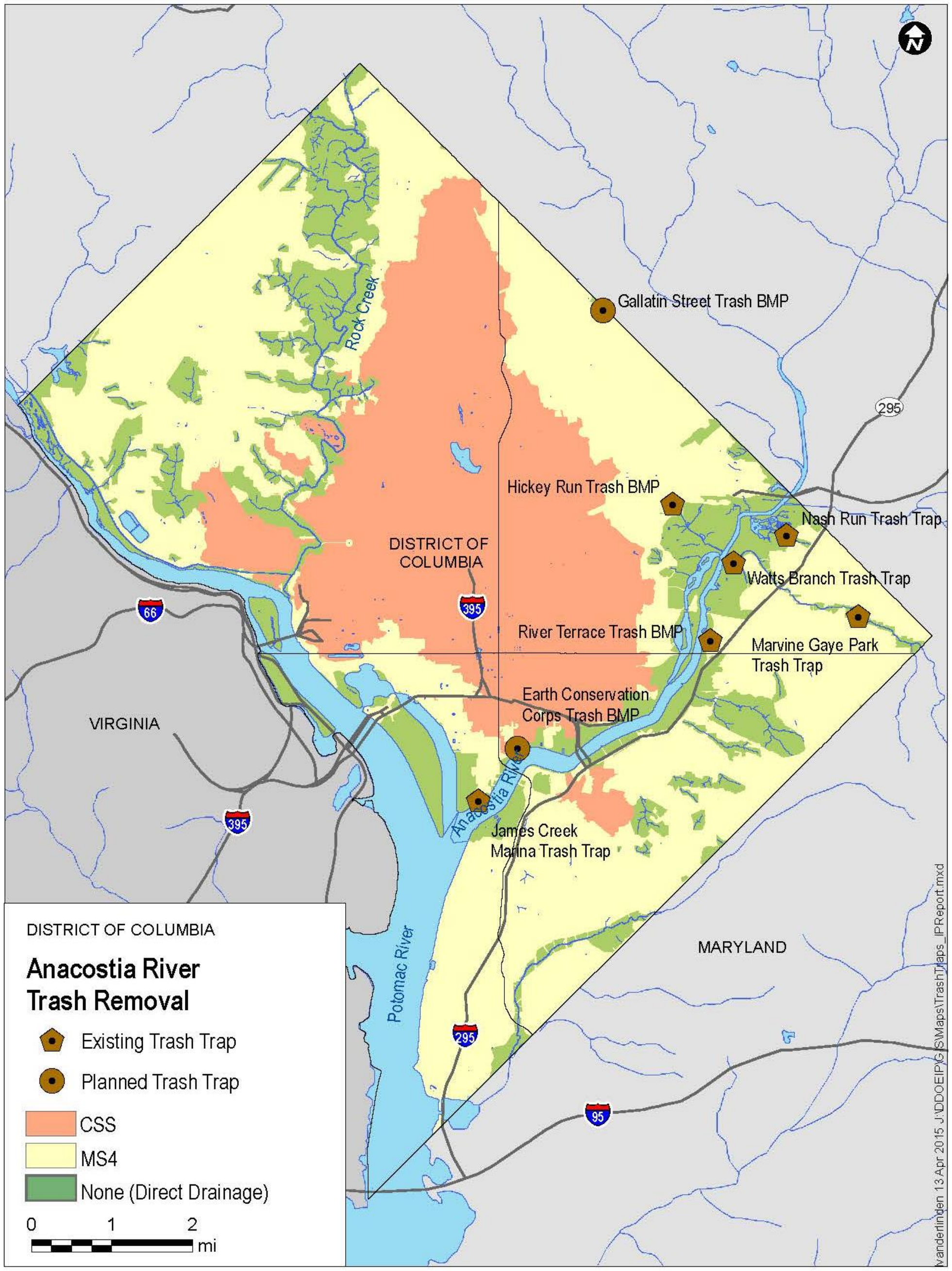

Figure 6-5. Location of Existing and Proposed Trash Trap BMPs

The District will track and report implementation annually, and DOEE will report on new practices along with their respective load reduction calculation methodologies as they are implemented. DOEE will continue to collect empirical data on all end-of-pipe BMPS and adjust efficiencies for future TMDL tracking purposes as necessary and appropriate.

6.4 Implementation Plan for PCBs

The expectations for a MS4 load reductions for PCBs are different than for other pollutants because the implementation of the MS4 WLAs focuses on BMP implementation rather than achieving specific numeric WLAs. For example, p. 21 of the Potomac and Anacostia PCB TMDL (2007) states that "Upon approval of the TMDL "NPDES-regulated municipal stormwater and small construction storm water discharges effluent limits should be expressed as Best Management Practices (BMPs) or other similar requirements, rather than as numeric effluent limits" (US EPA 2002)."" Further, on p. 41, under the sub-section entitled Implementation of Waste Load Allocations, the document states:

> Following the approval of the TMDL for the tidal Anacostia and Potomac River estuary, the water quality-based effluent limitations (WQBELs) in NPDES permits that are issued, reissued or modified after the TMDL approval date must be consistent with the WLAs (CFR 2007b). EPA's NPDES regulations at 40 CFR 122.44(k) allow permits to use non-numeric, BMP-based WQBELs under certain conditions. The regulation, in subsections 3 and 4, states that BMP based WQBELs can be used where "Numeric effluent limitations are infeasible; or [t]he practices are reasonably necessary to achieve effluent limitations and standards or to carry out the purposes and intent of the CWA."
>
> The jurisdictions intend to use non-numeric WQBELs to comply with the WLA provisions of the TMDL because BMPs are appropriate and reasonably necessary to achieve water quality standards and to carry out the goals of the CWA for the tidal Potomac PCB TMDL. This approach will first entail additional data collection from selected NPDES permitted facilities to better characterize PCB discharges. Where warranted, non-numeric, BMPs will be implemented. These BMPs are intended to focus on PCB source tracking and elimination at the source, rather than end-of-pipe controls.

The focus on the use of use non-numeric WQBELs and BMPs rather than numeric limits is based on an explicit recognition of the challenges of achieving meaningful numeric goals for PCBs. One of these challenges is that, even if numeric MS4 WLAs are achieved, water quality standards may not be met in the receiving waters because of other ongoing sources of contamination to the water bodies. For example, Section 5.4.7 of the Anacostia and Tributaries Metals and Organics TMDLs, which describes use of the TAM/WASP modeling for evaluating PCBs in the mainstem Anacostia, notes that:

> The critical criterion is based on Class-D Standard with a concentration value of 4.5x10-5 ug/l. Such level of criteria could not be achieved even with 100 percent load reduction. The 100 percent load reduction scenario has been run continuously for seven consecutive runs (21 years) by taking the outputs of the previous run as starting values for the new run. However, even at the end of this period considerable occurrences of WQS violations were observed. An evaluation of the contaminant source determined that the primary source impairing compliance is the contaminated sediment.

In a subsequent section on PCB allocations to the mainstem, the document states

> …Only 5 percent of a tributaries PCB load is transported to the Potomac, the remaining 95 percent are trapped because the "dilution by downstream transport is not an effective cleansing mechanism for tributaries." The TAM/WASP Toxics Screening Model estimated that the load to the Potomac may be as high as 33 percent. In both cases, the flux and resuspension of the contaminated sediment load creates a continuous source to the water column, inhibiting attainment of the water quality standards. To effectively achieve attainment of the water quality standards, a sediment management plan must be developed and implemented. Without implementing a sediment management plan, the sediment contamination will remain a continuous source of PCBs impairing the ability to attain the water quality standards. Because DOH believes that a sediment management plan will allow water quality standards to be met, no further reductions to the remaining Maryland and District loads will be imposed at this time.

Stormwater sources are also recognized as a relatively small part of the PCB loading, whereas atmospheric deposition, which contributes to MS4 loading, is a major source. The Anacostia and Tributaries Metals and Organics TMDLs states that:

> The Anacostia River is located in a watershed in which the PCB impairment is predominately due to atmospheric deposition 70 percent and historic spills, landfill releases, land applications, e.g., dust suppression, and sediment contamination. Consequently, 70.34 percent of the PCB loads have been allocated to Atmospheric Deposition…The releases from unidentified land sources are accounted for in the model by the CSO and storm water loads from the MS4 storm sewers.

Controlling atmospheric deposition is outside of the jurisdiction of the Consolidated TMDL IP. However, atmospheric deposition is expected to decrease over time since the production and use of PCBs was banned in the 1970's. This reduction in atmospheric deposition over time will have a positive effect on PCB concentrations in the District and may even be sufficient to meet some MS4 WLAs. For example, the Potomac and Anacostia PCB document notes that

> For some of the…jurisdictions and watersheds, the WLA is a 5 percent reduction from the baseline, which is entirely due to the Margin of Safety (MOS). In other words, in these watersheds, absent the MOS, no additional reduction in PCB load is necessary. While the exact relationship between atmospheric deposition to the land surface and nonpoint source runoff of PCBs is unclear at this time, it is expected that the proposed 93 percent reduction in atmospheric deposition of PCBs will yield the 5 percent reduction in stormwater loads represented by the MOS.

The Consolidated TMDL IP will follow the implementation expectations established in the Potomac and Anacostia PCB TMDL (2007). Under the discussion of *District of Columbia Water Quality Impairments* on p. 5 of the TMDL, this document states that "A PCB TMDL was established for the tidal Anacostia River in 2003. The PCB TMDL developed for the Potomac and Anacostia tidal waters in this report, when approved, will replace the 2003 Anacostia PCB TMDL." Therefore, for TMDL and MS4 WLA planning purposes, only the MS4 WLAs established under the Potomac and Anacostia PCB TMDL will be considered. While other PCB MS4 WLAs exist under other TMDLs (Oxon Run, Washington Ship Channel and Tidal Basin; Potomac tributaries; and Rock Creek tributaries), it is assumed that these WLAs and the underlying PCB impairments in these waterbodies will be addressed through the same focus on implementing the Potomac and Anacostia PCB TMDL. This is realistic because these TMDLs also recognize BMP implementation is an appropriate strategy to address PCBs. For example, the Rock Creek Tributaries Metals and Organics and the Ship Channel and Tidal Basin Metals and Organics TMDLs both have sections stating that:

> In terms of legacy compounds such as PCBs, many of these compounds are banned from widespread use and/or strictly regulated under the Toxics Substances Control Act (TSCA). As toxics and other pollutants are associated with particles and washes to streams during wet weather conditions, different storm water management initiatives, including BMPs that reduce suspended solids loads to the receiving water bodies will, in turn, reduce toxics pollution.

These TMDLs have implementation plans focused on source controls that reduce pollutant runoff are construction site management, sediment and erosion control, and street sweeping.

The Anacostia Metals and Organics TMDL is explicit in stating that "implementation of this TMDL may require identification of potential PCB sources, e.g., rail yards."

Based on these expectations, the load reduction plan for PCBs will focus on leveraging the BMP planning and implementation developed to address other pollutants to also simultaneously address PCBs. Because the focus for the PCB TMDLs is on BMP implementation instead of numeric WLAs, this plan maximizes effectiveness and efficiency of BMP implementation in the District. Structural and non-structural controls and BMPs that remove TSS, such as most structural BMPs, street sweeping, erosion and sediment control, and other practices, will be effective in reducing PCB loads as well.

In addition to using BMPs to reduce sediment and associated PCBs, source tracking may be used to identify potential sources of PCBs. The development of the Potential Sources Database was discussed in Section 5.3.3. As described in that section, the Potential Sources Database can be used to identify possible specific sources of PCBs in the District. If these sources are identified, they could be targeted for specific controls. In addition, potential source tracking could be implemented through "tracking back" high concentrations of PCBs through the MS4 system. However, it is not envisioned that either of these steps will be necessary to address PCBs, for several reasons. First, PCBs have not been detected in recent MS4 outfall monitoring data. This indicates that PCB concentrations may be decreasing over time and that PCBs in stormwater may be becoming less of a problem. Second, it is unlikely that there are discrete sources of PCBs in the District; rather, it is likely that PCB "sources" actually consist of legacy concentrations in soils and sediments. Therefore, tracking PCBs to specific sources that can be removed to reduce the problem is also unlikely.

Based on the specific case of PCBs in the District, it is recommended that PCB concentrations continue to be tracked through MS4 outfall monitoring. PCB concentrations and loads should continue to decrease as additional BMPs are implemented and atmospheric contributions continue to decline. However, should monitoring show that PCB loads are still an issue, adaptive management principles can be used to change course and develop different tactics to address PCBs.

6.5 Additional Ongoing Programmatic Stormwater Management and Source Control Activities

In addition to the components of the TMDL implementation plan described above, DOEE conducts a large number of ongoing programmatic stormwater management activities that reduce loads in the District. These programmatic activities, many of which were summarized in Section 5.3.1., are mandated by the District's NPDES permit. The focus of these activities is on identification, tracking, and management of potential sources of stormwater pollution; education and outreach on stormwater issues; and tracking, operation, maintenance and management of existing BMPs. As described in Section 5.3.1, while it is difficult to quantify the specific impact of many of these activities on load reduction, they are nonetheless critical components of a successful program to control stormwater.

6.6 Numeric Milestones and Benchmarks for Tracking and Assessing Progress to Meet WLAs

6.6.1 Definitions and Purpose of Numeric Milestones and Benchmarks

Milestones and benchmarks are developed and incorporated into the IP to help track the progress in meeting WLAs. The MS4 permit defines milestones as "an interim step toward attainment of a WLA that upon incorporation into the permit will become an enforceable limit to be achieved by a stated date." The permit further states that "interim milestones will be included where final attainment of applicable WLAs requires more than five years. Milestone intervals will be as frequent as possible but will in no case be more than five (5) years." The permit defines benchmarks as "quantifiable goals or targets to be used to assess progress towards milestones…Benchmarks are intended as an adaptive management aid and generally are not considered to be enforceable." The permit goes on to state "numeric benchmarks will specify annual pollutant load reductions and the extent of control actions to achieve these numeric benchmarks."

Based on the definitions and requirements in the permit, numeric milestones that represent targets for cumulative progress over time are developed and incorporated in the IP. These are set at five year time increments, and are designed to help DOEE ensure that adequate progress is being made over time to stay on schedule to meet WLAs within the timeframe projected by the modeling and documented in the IP. Establishing and tracking progress in meeting numeric milestones over relatively short timeframes is critical for the IP, which has been developed to meet multiple WLA targets over a period of many years. Assessment of the achievement of numeric milestones over time allows DOEE to assess whether it is on track to meet WLAs within the proposed schedule, or if it needs to increase implementation rates, alter implementation strategies, or take some other action to ensure that it meets its requirements.

In contrast to numeric milestones, which are intended to assess physical progress towards meeting requirements over a multiple-year period, benchmarks are the annual targets that must be met, on average, to meet the WLAs. Because benchmarks are set as average annual targets, they allow assessment as to whether the progress made in a given year is above or below what is needed to stay on track to meet WLAs. If annual progress is at or above the benchmark, then the IP is on track to meet or exceed the projected timeframe for meeting WLAs. But if annual progress is below the benchmark, then the IP is not on track to meet the projected timeframe for meeting WLAs. However, because benchmarks are intended to give a "snapshot in time" as to whether or not sufficient short-term progress is being made to stay on track to meet WLAs, course corrections are not necessarily warranted based on failing to meet any individual annual benchmark. For example, if load reduction in previous years had exceeded the annual benchmark, then the IP would still be on track to meet WLAs by the projected attainment date. But if annual progress is consistently below the benchmark, then further actions can be taken through adaptive management to make up the additional load reduction needed to stay on track. As noted above in the discussion of milestones, these further actions could include increasing implementation rates, altering implementation strategies, or taking some other action to ensure that adequate progress is made to meeting milestones. In summary, because benchmarks are evaluated on such a frequent basis, they provide timely feedback on progress that can be acted upon before problems occur in meeting enforceable milestones.

6.6.2 Development of Numeric Milestones and Benchmarks

Numeric Milestones and benchmarks were developed using the projections of future BMP implementation and modeled future load reductions and WLA attainment dates. More specifically, the numeric milestones and benchmarks were developed using:

1. Projections of MS4 area controlled by BMPs over time based on implementation of the various stormwater management and control programs as described in Section 5.3;
2. Modeled projections of future load reductions of the various pollutants in each TMDL watershed over time, and;
3. Modeled projections of the timeframe over which WLAs would be achieved.

Together, these three pieces provide the information necessary to set the milestones and benchmarks that need to be met in order to meet individual WLAs by their projected achievement dates. The breadth of data generated by the BMP implementation projections and by the IP Modeling Tool (e.g., area controlled by BMPs, load reductions, and WLA achievement dates) allows the establishment of appropriate numeric milestones and benchmarks that accommodate the uncertainties inherent in the modeling projections, while ensuring that progress towards meeting WLAs can be tracked in an adequate and meaningful way.

Note that milestones or benchmarks are not required for pollutants for which no MS4 WLA exists in a specific waterbody segment, for WLAs that are non-numeric, or where modeling indicates that the WLA has already been achieved.

6.6.2.a Development of Numeric Milestones

As described above, the purpose of developing milestones is to set enforceable targets to assess physical progress towards meeting requirements over a multiple-year period. For the purposes of the IP, numeric milestones were developed and set for the entire MS4 area, with estimates of expected implementation at the major basin level (i.e., for the Anacostia, Potomac, and Rock Creek basins). Setting numeric milestones for the entire MS4 meets several goals of the IP. First, setting milestones for the entire MS4 is consistent with the consolidated nature of the IP. The Consolidated TMDL IP consists of a plan to meet 518 individual MS4 WLAs (annual, seasonal, monthly, daily) for 22 different pollutants[9] in 44 different waterbody segments, but setting and reporting on enforceable milestones for each of these WLAs is impractical. Instead, developing and evaluating milestones that show consolidated progress in meeting all WLAs is easier to track, present, and understand. In addition, the inherent uncertainties in the spatial and temporal projections of development and re-development (which are the main drivers of BMP implementation) limit the ability to set meaningful milestones at the watershed or subwatershed level. Setting milestones at these smaller levels, with the inherent uncertainty of when and where BMP implementation will occur, would require such a degree of conservatism that any milestones set at these levels would not be reflective of what was needed to meet WLAs by the dates projected by the modeling. Estimates have been developed for each of the major basins to illustrate where DOEE anticipates implementation to occur while still providing flexibility to account for the temporal and spatial uncertainty involved in these forecasts.

Different types of milestones were generated for the IP for different implementation timeframes. Numeric milestones developed for the time period 2016-2040 were based on area controlled by stormwater BMPs; in contrast, milestones developed for the time period 2041-2154 were based on load reduced by stormwater BMPs. The methodology used for setting these milestones, and the reasoning behind the methodology, is described below.

<u>2016-2040 Numeric Milestones</u>

For the time period from 2016-2040, numeric milestones were set based on projections of area controlled by stormwater BMPs. The area controlled for each 5-year increment from 2016-2040 was calculated for each major basin using the IP Modeling Tool, and these results were averaged to create the long-term average from 2016-2040. Using the long-term average rate over the time period of 2016-2040 (instead of the specific projections from the modeling for each 5-year time period) helps to smooth out the expected year-to-year differences projected in the modeling. Thus, differences in what actually occurs year-to-year versus what was predicted by the modeling should not impact the ability to achieve milestones, so long as the actual implementation does not deviate significantly from the long-term projected average over a given 5-year timeframe. Milestones are established cumulatively; thus, the 2025 numeric milestone is reflective of the amount of area projected to be controlled from 2016 to 2020, plus the amount of area projected to be controlled from 2021 to 2025.

Setting the 2016-2040 numeric milestones based on the amount of area controlled is appropriate since it is the metric by which the main driver of BMP implementation in the IP (implementation of the 2013 Stormwater Management Rule) is implemented, measured, and reported. In addition, one of the primary sources of input data for the IP Modeling Tool was OP projections of area to be developed in the timeframe from 2016 to 2040. Thus using modeling projections on the amount of area controlled to set numeric milestones for this timeframe aligns with the input data into the model.

[9] As described in footnote 2 in Section 3.2.2.b, there are 23 different pollutants for which TMDLs have been completed, but only 22 pollutants for which MS4 WLAs must be achieved. This is because fecal coliform WLAs have been translated to E. coli for the purposes of setting MS4 WLAs.

2041-2154 Numeric Milestones

For the time period 2041-2154, numeric milestones were set for the major basin level based on modeled projections of load reductions. These milestones were set based on the modeled annual load reduction for each pollutant from 2041 to 2154 by calculating the total amount of load reduction for each pollutant that is expected to be achieved at each 5-year interval from 2016-2154 in each major basin. In order to avoid double-counting load reductions of the same pollutant needed at the different segment levels (i.e. mainstem, submainstem, tributary, subtributary, and appropriate proportions of the Chesapeake Bay delineations) within a major basin, the amount of projected load reduction was summed for each segment level, and the largest projected load reduction at any segment level was used for the milestone. For example, the sum of the projected arsenic reductions in the Anacostia tributaries from 2041-2045 is 0.3 lbs, while the sum of projected reductions in the Anacostia mainstem (which includes the tributary area) from 2041-2045 is 2.6 lbs. Thus the projected mainstem reductions would be used to set the milestone. Like the numeric milestones from 2016-2040, these milestones are established cumulatively; thus, the 2050 numeric milestone is reflective of the amount of load reduction projected to be achieved prior to 2045, plus the amount of load reduction projected to be achieved from 2046 to 2050.

This approach for setting numeric milestones for the 2041 – 2154 period was selected because there are several issues with model projections of area controlled after 2040. These issues do not occur with model projections of load reduction.

As previously described above in Section 6.1.2, projections of area controlled beyond 2040 are no longer based on planning data from OP, but rather on extrapolations of the 2016-2040 data. Extrapolations of these data lack the spatial and temporal specificity of the OP data, and thus provide a lower confidence level in the projections. In addition, the IP Modeling Tool projects that the entire MS4 area will become entirely retrofitted with BMPs by 2127, and that some combination of new technologies, improved BMP efficiencies, or BMP treatment trains will allow load reduction to continue after 2127 despite the lack of additional available non-retrofitted MS4 area. Therefore, it would be inappropriate and inconsistent with modeling assumptions to continue using area controlled as a milestone after 2127. Based on these considerations, setting milestones based on load reduction achieved is most appropriate for the time increments after 2040, because load reduction continues until all WLAs are achieved.

6.6.2.b Development of Benchmarks

Benchmarks were developed for all MS4 WLAs in each TMDL waterbody segment. Developing benchmarks in this way provides a way to gauge individual progress towards meeting each MS4 WLA.

Benchmarks were set based on the average annual amount of pollutant reduction that must be achieved in order to meet the WLA by the date projected by the modeling. Thus if the model projected that a WLA for pollutant X in waterbody Y was to be achieved in 2025 (i.e., 10 years from now), and that 100 lbs of pollutant X needed to be reduced by 2025 to meet that WLA, then the benchmark for pollutant X in waterbody Y would be calculated as (100 lbs/10 yrs) = 10 lbs/yr.

Deriving benchmarks in this way allows a simple and straightforward annual assessment of progress towards meeting any individual WLA. If the amount of progress in any given year is at or above the benchmark, then sufficient progress has been made in that year to keep the waterbody on target to meet the WLA for that pollutant. If the amount of progress is below the benchmark, insufficient progress has been made in that year to keep the waterbody on target to meet the WLA for that pollutant. This may not be an issue if progress in previous years has exceeded the benchmark, because then overall progress may still be on target to meet the WLA for that pollutant. But if annual progress is consistently below the benchmark, then more must be done in subsequent years. Note that this is an annual benchmark, but adding the incremental annual progress over time into a cumulative quantification of the annual benchmarks gives a snapshot at any given time of whether the waterbody segment is on track to meet its WLA in the timeframe projected by the modeling. Using the benchmarks in this way is a key component of adaptive management, because it allows DOEE to evaluate progress over a short timeframe, and to act on the information about whether sufficient progress is being made towards meeting individual WLAs.

6.6.2.c Summary of Numeric Milestones and Benchmarks

A summary of the 2020-2040 numeric milestones is presented in Table 6-5 below.

Table 6- 5. 2020-2040 Milestones (cumulative area managed, in acres)

Major Basin	2020	2025	2030	2035	2040
Anacostia	552	1104	1655	2207	2759
Potomac	335	670	1005	1340	1675
Rock Creek	151	302	454	605	756
Total	**1,038**	**2,076**	**3,114**	**4,152**	**5,190**

Tables for all numeric milestones set for 2020 through 2154, by which time all MS4 WLAs are projected to be achieved, are presented in Appendix E.

An example of the annual benchmarks for one watershed is provided in the Table 6- 6 below. Tables providing the benchmarks for all watersheds are provided in Appendix F.

Table 6- 6. Annual Benchmarks for Fort Stanton Tributary

Pollutant	Annual Benchmark (lbs/yr; billion MPN/yr reduced for E. coli)
TN	N/A*
TP	N/A*
TSS	N/A*
E. coli	27.5
BOD	N/A
Trash	N/A
Arsenic	1.80E-03
Copper	7.10E-02
Lead	2.20E-02
Mercury	N/A*
Zinc	Projected as met in 2014
Chlordane	1.10E-05
DDD	3.50E-06
DDE	1.50E-05
DDT	3.80E-05
Dieldrin	4.10E-07
Heptachlor epoxide	1.10E-06
PAH1	9.00E-04
PAH2	4.60E-03
PAH3	3.00E-03

Table 6- 6. Annual Benchmarks for Fort Stanton Tributary	
Pollutant	Annual Benchmark (lbs/yr; billion MPN/yr reduced for E. coli)
Oil and Grease	N/A*
PCBs	No annual benchmarks are established for PCBs
*There is no MS4 WLA for this pollutant for this waterbody, and therefore no benchmark has been established.	

6.7 Programmatic Milestones for Evaluating and Implementing New Initiatives to Accelerate the Attainment of WLAs

Even with the District's innovative programs and regulations underway, the District acknowledges that more work is needed to increase the pace of efforts to address stormwater pollution and reduce pollutant loads. The following sections detail initiatives that DOEE is implementing to accelerate the attainment of WLAs.

6.7.1 SRC Purchase Program

In 2016, DOEE is establishing a Stormwater Retention Credit Purchase Agreement Program, to help jumpstart the nascent SRC market and incentivize the installation of GI in priority areas DOEE. Under the SRC Purchase Agreement Program, DOEE will commit $12.75 million of District funding for the purchase of SRCs, and technical support for property owners who are interested in generating SRCs. Any SRCs purchased by DOEE will be retired to achieve additional benefit to District waterbodies, beyond that achieved by the District's stormwater management regulations.

DOEE views the SRC market as a major opportunity to fund stormwater retrofits for the long term, in the most cost efficient manner, by using the market to leverage stormwater fee revenue. In addition, DOEE may be able to further leverage the District's stormwater fee by bonding stormwater fee revenue to increase purchases of SRCs if the program proves to be a cost effective method of incentivizing GI retrofits.

Programmatic Milestones:

- Establish SRC Purchase Program (2016)
- Report on the impact and effectiveness of the SRC Purchase Agreement (2019)

6.7.2 Prioritize Watersheds

Under the SRC Purchase Agreement program, DOEE will only purchase SRCs generated in MS4. DOEE will also continue to prioritize watersheds with recent or planned stream restoration projects for additional implementation, through targeted outreach and increased incentive offerings from RiverSmart Homes, RiverSmart Communities, and DOEE's Green Roof Subsidy program. In addition, DOEE will identify additional watersheds for such targeted approaches, and evaluate opportunities to provide additional incentives in these targeted watersheds.

Programmatic Milestones:

- Develop list of targeted watersheds and targeted implementation approaches (2017)

6.7.3 Stormwater Fee increases

The cost of full implementation to address the District's TMDL WLAs will far exceed the public resources currently available to the District's stormwater management program. DOEE has evaluated the impact of increasing the stormwater fee by 25, 50, and 100 percent on the timeline for achieving WLAs. The assumptions underlying these projections were the same as those used to develop the projections for "BMP implementation from other programs" as described in Section 5.3.5. The results of this analysis are shown in Figure 6-6.

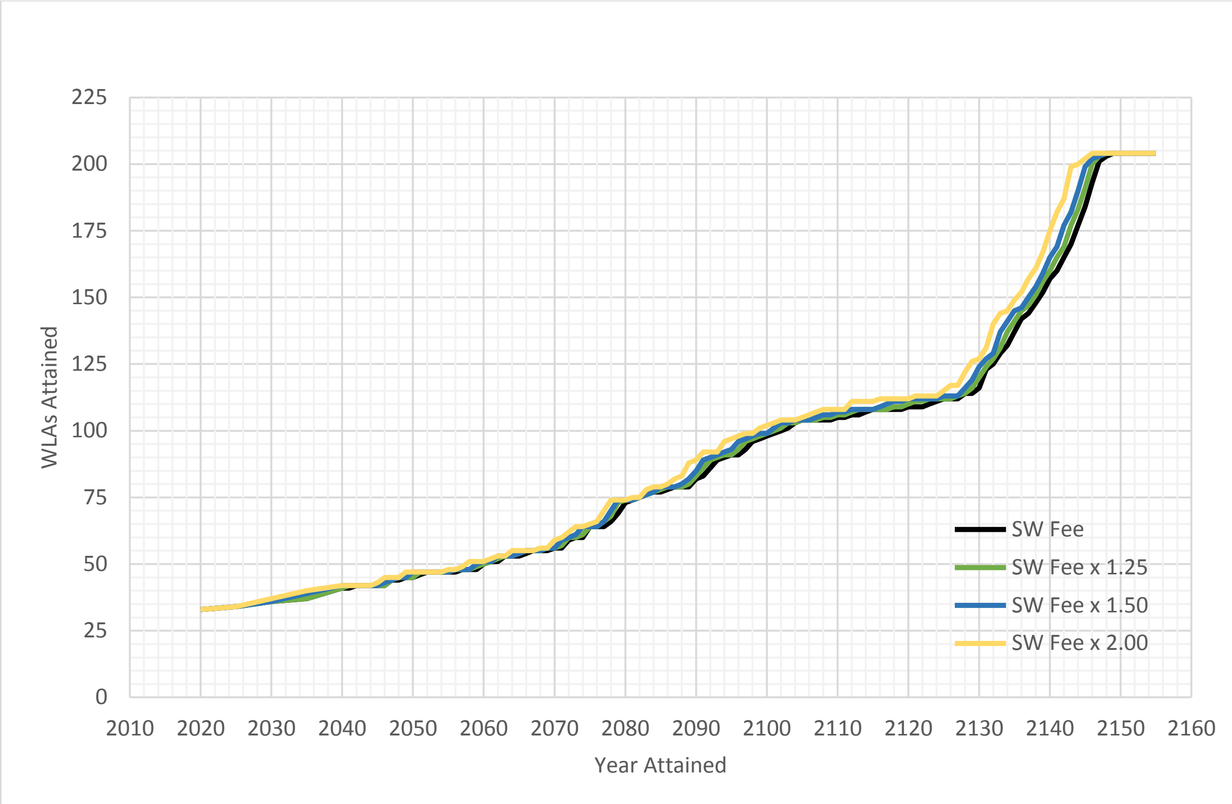

Figure 6-6. Results of Increasing Stormwater Fee on Achievement of WLAs over Time

As shown in the figure, even a doubling of the current stormwater fee has only minimal impact on the timeline for achieving WLAs. This result highlights the fact that, because meeting the WLA targets requires such large load reductions, even by significantly increasing current funding levels it will still take a long time to achieve WLAs. Thus DOEE's strategy of leveraging public resources through incentive programs, implementing protective regulations, and evaluating WLA targets to ensure they are accurate becomes even more important. These results also support that the IP represents MEP for TMDL implementation, because increasing public resources does not provide measurable benefit.

Although increasing public resources does not substantially reduce the schedule for WLA attainment, DOEE is committed to exploring numerous options to accelerate the pace of implementation. As a result, during the next permit cycle DOEE will evaluate options for increasing the District's Stormwater Fee. It is also important to note that the outcome of any proposed fee increase will be governed by a number of factors beyond DOEE's control, including a public ratemaking process and overall affordability constraints that are discussed in more detail in Section 10.4.

Programmatic Milestones:

- Evaluate options for increasing the District's Stormwater Fee, and if feasible, formally propose an increase (2018)

6.7.4 TMDL Revisions

Beyond a need for greater resources for implementation, the District's planning process has identified a number of TMDLs in need of updates and revision. These TMDLs may need to be updated due to a variety of factors, including a lack of quality data underlying the original TMDL development, the availability of improved data to characterize runoff and stormwater discharges in the District, the ability to use new and improved modeling approaches for TMDL development, or a need to correct technical errors contained in the original TMDL. Updates of TMDLs to address these issues would be expected to produce more realistic WLAs, which would correspondingly be expected to result in a shorter timeline for achieving WLA attainment. DOEE proposes to identify TMDLs in need of these revisions, perform additional monitoring to collect data necessary to support these revisions, and commit to a schedule for revising priority TMDLs.

Programmatic Milestones:

- Identify priority TMDLs in need of revision (2017)
- Develop a monitoring workplan to support TMDL revisions (2018)
- Conduct intensive monitoring to support TMDL revisions (2019-2020)
- Complete first round of priority TMDL revisions (2025)

6.7.5 Evaluate changes to District Stormwater Management Regulations

Another possible approach for increasing the pace of stormwater management improvements would be to alter the existing stormwater management regulations. The intent of any potential regulatory changes would be to either increase the performance of regulated projects, or have the regulations apply to projects that are not currently regulated. For example, DOEE could consider increasing the retention standards currently applied to major land disturbing activities and/or substantial improvement projects. Another possibility would be to reduce the threshold that triggers the regulations; for example, by requiring major land disturbing activities on areas less than 5,000 square feet in area to comply with the regulations. Yet another possibility would be to create new triggers for project types that are not currently regulated, such as for single family residences that are undergoing major rehabilitation and/or being "flipped." As discussed above for potential increases to the District's stormwater fee, any regulatory changes would require a thorough cost/benefit analysis and be subject to public input. As a result, DOEE's ability to implement any such changes may be constrained by factors beyond its control.

Programmatic Milestones:

- Conduct cost/benefit analysis of potential changes to existing stormwater management regulations (2018)

6.7.6 Quantify additional programmatic activities

While the Consolidated TMDL IP represents the best of the District's ability to project increased load reduction from its stormwater management efforts, projections could not be made for every individual stormwater management activity, program, or BMP. Therefore, there is a need to use an adaptive management approach and collect data to evaluate the full impact of the efforts included in the Consolidated TMDL IP, even as the District is contemplating additional efforts, to provide for the most accurate projections possible. These additional practices that will be evaluated for quantifiable load reductions include:

- Impact of Major Substantial Improvement projects

- Education and outreach
- Impact of SRC Trading program
- Impact of coal tar pavement product ban
- Catch basin cleaning

DOEE will also evaluate appropriate control methods for various pollutants. While structural BMPs are appropriate for traditional pollutants such as TSS and nutrients, non-structural BMPs may be more effective for pollutants such as bacteria. For example, dog waste pickup, illicit discharge detection and elimination (IDDE), and wildlife control may be the most appropriate BMPs for bacteria control. DOEE will focus on quantifying the impact of non-structural BMPs so better load reduction projections can be made.

A number of TMDL pollutants also present unique challenges. For example, many of the District's WLAs are for legacy pollutants – pollutants that are no longer manufactured or used. Examples include PCBs, chlordane, heptachlor epoxide, dieldrin, DDD, DDE, and DDT. While the implementation expectations for PCB TMDLs typically focus on source control and implementation of BMPs rather than achieving a numeric target, implementation expectations for the other pollutants described above have not been well established. However, due to the similar ubiquity of these legacy pollutants in the environment, it may be appropriate to apply similar strategies to achieving TMDL targets for these pollutants as for PCBs. For example, in-stream sediment remediation may be a key strategy for these types of pollutants. While in-stream sediment remediation may not directly address MS4 "sources," it is not apparent that there are discrete, singular "sources" of these pollutants to the MS4. Therefore, DOEE may explore these types of solutions for addressing these pollutants. Based on these strategies, it may more appropriate to track the amount of remediation as a surrogate for load reduction for these pollutants.

From these analyses, DOEE may confirm it is feasible to do more to reduce pollutant loads in the future. In addition, improvements in technology may occur over time, also increasing load reductions. DOEE will continue to evaluate its capabilities and capacity through an adaptive management approach. DOEE will incorporate methods for estimating the impact of these and other programmatic approaches into the Consolidated TMDL IP modeling tool, for use in a future update of the TMDL IP and its projections.

Programmatic Milestones:

- Update the modeling tool and the TMDL IP (2020)

6.7.7 On-going Stakeholder Groups to evaluate policy changes

As DOEE contemplates these and other policy changes to increase the pace of stormwater management, stakeholder input will be critical in identifying options and priorities for implementation. A new stakeholder group that convenes members with the ability to effect significant policy changes (including elected leaders, policy makers, business leaders, community members, environmental stakeholders, and District agency staff) could focus on developing the legislative, regulatory, programmatic, and political strategies necessary to increase stormwater management and load reduction in the District. DOEE will explore stakeholder interest and options for establishing such a group.

Programmatic Milestones:

- Explore ability to convene new Stakeholder Group to evaluate stormwater management activities and priorities (2017)

6.8 Assessing Progress in Meeting Milestones and Benchmarks

DOEE will regularly assess progress in meeting milestones and benchmarks, and report on this progress in annually in its MS4 Annual Reports. As described above, progress in meeting benchmarks will be assessed on an annual basis. Assessing progress in meeting annual benchmarks will also help evaluate progress in staying on track to meet five year milestones. Thus, while the regulatory and legal assessment of meeting milestones will only be assessed at five year intervals, DOEE will have information allowing the assessment of progress towards meeting milestones on a much more regular, shorter-term basis.

Additional information on how the assessment of milestones and benchmarks fits into tracking progress in meeting WLAs is provided in Section 7, Tracking Progress in Meeting MS4 WLAs.

6.9 Adaptive Management

The Consolidated TMDL IP lays out a plan under which BMP implementation occurs over time, pollutant loads are reduced, and continual progress is made towards achieving individual MS4 WLAs until their final attainment dates. DOEE has set milestones as a way to track and assess progress towards meeting the WLAs. However, the overall IP, and the milestones in particular, are set based on the current understanding of MS4 hydrology, pollutant loads, BMP effectiveness, and various other types of data on the TMDLs and the MS4 area. Ongoing data collection efforts will continually provide new information that will be used to better understand current conditions and inform the direction of the IP. These data include information on stormwater flows and quality, pollutant sources and concentrations, BMP effectiveness, receiving water quality and impairments, and other information. Therefore, the principles of adaptive management will be used to re-evaluate and update the IP on a regular basis. The U.S. Department of the Interior defines adaptive management as "[a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood" (DOI, 2009). In their Watershed Academy training modules, EPA states that adaptive management as applied to watersheds is "the process by which new information about the health of the watershed is incorporated into the watershed management plan. Adaptive management…provides the opportunity to "learn by doing"" (EPA, 2005b.) Adaptive management will be applied to management of the IP. Thus, DOEE will focus its adaptive management efforts on gaining a better understanding of MS4 discharges, changes to those discharges over time as better information becomes available, and the impacts of MS4 discharges relative to achieving WLAs.

Adaptive management is an appropriate technique to apply to plans such as the IP because of the "inherent uncertainty about how ecosystems function and how management affects ecosystems" (EPA, 2005a). EPA has also specifically linked adaptive management to addressing MS4s in the context of TMDLs. Its 2002 memo "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs" recognizes the need for an iterative approach to control pollutants in storm water discharges. Specifically, the Interim Permitting Approach Policy (U.S. EPA, 1996) anticipates that a suite of BMPs will be used in the initial rounds of permits and that these BMPs will be tailored in subsequent rounds. In its November 26, 2014 revisions to this 2002 memo, EPA continues to support use of an iterative approach. Thus, the use of adaptive management principles to periodically re-evaluate and update the IP ensures that the IP continuously utilizes the best, most current understanding of pollutants and BMPs to establish a continuing path forward for achieving MS4 WLAs.

For the IP, adaptive management will be applied towards attaining MS4 WLAs by ensuring that the monitoring focuses on MS4 impacts. The steps in this process are:

1. Develop a monitoring plan to inform adaptive management of the IP
2. Conduct monitoring

3. Evaluate monitoring results
4. Adjust IP as necessary

DOEE developed a revised monitoring program, which meets the permit requirement to "include any additional necessary monitoring for purposes of…wasteload allocation tracking." The revised monitoring framework serves as the basis for the monitoring plan described in step 1 above. In this case, the primary monitoring data necessary to evaluate progress in achieving WLAs are BMP implementation data. BMP implementation data are submitted to DOEE through its plan review process. DOEE reviews plans to comply with the 2013 Stormwater Regulations. DOEE also receives additional BMP information from voluntary BMP implementation or from BMPs that are implemented in response to other (non-Stormwater Regulation) requirements. All of this BMP information is compiled into the IP Modeling Tool to determine progress towards meeting milestones and benchmarks, as well as individual WLAs. The process of using BMP implementation data in the modeling meets the NPDES permit requirement to demonstrate "using modeling… how each applicable WLA will be attained using the chosen controls, by the date for ultimate attainment." DOEE intends to update and run the IP Modeling Tool on a regular basis (at least annually), and to report on progress annually.

Other data to be used in the adaptive management process includes MS4 outfall monitoring. One of the goals of the MS4 outfall monitoring proposed in the revised monitoring program is to collect additional information that will allow better characterization of stormwater flows and TMDL pollutant EMCs in the future. The revised monitoring program also includes "special studies" to evaluate BMP effectiveness and the impact of BMP implementation on loads and the achievement of WLAs over time. These data will be used to update and improve model inputs over time. These model inputs are the basis of characterizing MS4 loads and load reductions, and thus updating inputs with better data as they become available is critical for understanding progress over time in meeting MS4 WLAs. Another goal of stormwater monitoring is to conduct trend analysis to try to determine if stormwater loads of specific pollutants are changing over time. This information will be used to "ground-truth" the modeling results and confirm progress towards meeting WLAs. However, it should be noted that it could take multiple years to see trends in stormwater loads (see Section 3.13of the Revised Monitoring Plan for a discussion of the power of the Revised Monitoring Plan to evaluate trends in MS4 outfall monitoring data), and thus results of trend analysis will typically lag results predicted by the modeling.

Finally, updated ambient water quality and physical and biological monitoring proposed in the Revised Monitoring Plan lay the groundwork for better understanding of the impacts of stormwater flows and loads on receiving waterbody health. These data will be used in conjunction with other watershed monitoring activities conducted by DOEE's Water Quality Division, including benthic, fish, and habitat assessments, to better characterize the impacts of various discharges – including MS4s - on the District's watersheds and to inform designated use evaluations and impairment listings.

In addition to water quality and watershed studies conducted by DOEE, re-evaluation of the assumptions of the original TMDLs used to generate the MS4 WLAs that are the subject of this IP is very important. Section 3.2.2.c of this document has already summarized some of the flaws that impact the District's TMDLs and, in particular, the MS4 WLAs. As part of the adaptive management plan, DOEE plans to continue to work with EPA Region 3 and other partners to re-evaluate, update, and correct flaws, errors, or outdated data or assumptions used to generate the original TMDLs and MS4 WLAs. This ensures that the resources expended to implement the IP are targeted to address verified impairments and meet MS4 WLAs based on the best and most recent data and science. Section 3.2.2.b described the recent re-sampling that was conducted to investigate questionable impairment listings, and Section 3.2.2.f summarized the major impact that this re-sampling and re-assessment of impairment listings had on the inventory of MS4 WLAs included in this IP. Yet additional issues remain to be investigated which will continue to be evaluated as the IP is implemented.

DOEE will use the data it collects to determine if sufficient progress is being made towards achieving WLAs, and thus whether or not a course change is needed through the adaptive management process to stay on track to meet WLAs by the end dates projected by the modeling. This process involves evaluating modeling results on a regular basis (at least annually), as described above. Water quality and watershed data, and other programmatic measures also provide information that helps to determine whether progress is being made towards meeting MS4 WLAs. Collectively, this information will be used to determine the need for course corrections to stay on track to meet MS4 WLAs by the ultimate attainment date projected by the modeling.

If the modeling and monitoring results and evaluation of milestones and benchmarks indicate that insufficient progress is being made towards meeting WLAs, the adaptive management approach allows DOEE to change course and implement new approaches to try to get back on track to meet WLAs by the timeframes projected by the modeling. These “new approaches” may include attempting to increase implementation rates, altering implementation strategies, or taking some other action to help ensure that targets are met in the proposed timeframe. If necessary, these updated implementation strategies will be adopted into a revised IP that will serve as the implementation framework moving forward. The process will repeat itself iteratively, continually evolving and improving as new information, new assessments, and new implementation methods are integrated into each iteration of the IP.

More detail on how progress towards achieving MS4 WLAs is to be tracked is provided in Section 7, Tracking Progress in Meeting MS4 WLAs.

6.10 Summary and Discussion

This section presents the details of the District’s Consolidated TMDL IP to address MS4 WLAs. Because of the diverse nature of the pollutants for which TMDLs exist, the IP is divided into three separate sub-plans. The plan for all MS4 WLAs except trash and PCBs focuses on continued implementation of the programmatic and source control efforts, BMP implementation from development and redevelopment activities, and BMP implementation from other District programs and requirements. The plan to address the Anacostia Trash TMDL mirrors the draft Anacostia River Watershed Trash TMDL Implementation Strategy (DDOE, 2013), which is designed to meet the Anacostia Trash TMDL MS4 WLAs by 2017. The plan to address PCBs focuses on identifying and implementing source control activities, which follows the recommended implementation strategies included in the PCB TMDLs. Continued implementation will result in ongoing load reduction in all watersheds throughout the MS4 area. Model projections have been used to set projected end dates for each WLA.

The IP also includes milestones that serve as interim targets prior to ultimate attainment of WLAs, and annual benchmarks, which help evaluate progress on an annual basis. By comparing progress to milestones and benchmarks, DOEE can assess whether or not it is on track to meet WLAs by the date projected by the modeling. DOEE will also implement an adaptive management process, which will allow DOEE to change course if tracking information indicates that it is falling behind interim targets.

It is important to note that the IP is based on the most current understanding of the impairments, MS4 WLA targets, stormwater pollutant loads, and BMP effectiveness. Current stormwater pollutant loads, projected BMP implementation rates, BMP load reductions, milestones and benchmarks, and projected WLA attainment dates have all been set based on the current modeling. However, as more information is collected on these parameters over time, DOEE will use the process of adaptive management to incorporate new information into the IP and the IP Modeling Tool, and update the milestones and benchmarks and projected WLA attainment dates to reflect updated information. Thus the IP will be a living document that will evolve to better define WLA attainment as information is refined. As part of the adaptive management process built into the IP, DOEE will take a number of actions that will shape the IP in the future, including:

TMDL Refinement

As has been discussed several times in the IP (e.g., Section 3.2.2.c), many of the District's TMDLs and MS4 WLAs are based on questionable impairment data, potentially outdated or inaccurate EMCs, and incomplete partitioning of loads to other potential sources. These issues have been recognized, and DOEE and EPA have already investigated several impairments and updated the 2014 303(d) list to eliminate some existing MS4 WLAs (see Section 3.2.2.f). However, identified problems still exist in some remaining TMDLs. Therefore, the process of re-evaluating TMDLs will continue into the future, and the IP will be refined as better information becomes available to revise the list of applicable WLAs, or to modify existing WLAs to more accurately reflect the contribution of MS4 discharges to existing impairments.

Identification and Quantification of Additional BMPs

The IP does not include a number of existing BMPs because data was lacking to quantify the performance of those BMPs. These include many source control BMPs but also structural BMPs that are in the current BMP inventory. Additional BMP types can be added to the model as data on those BMPs are collected and methodologies to quantify load reductions from those BMPs are determined. These can include source control BMPs, non-structural BMPs, BMP treatment trains, or BMPs not currently included in DOEE's 2013 Stormwater Regulations. Moreover, better characterization of the existing BMP inventory will also aid in better quantification of the current load reductions occurring in the MS4.

Additional Source Identification and Control

The development of the potential pollutant source database was described in Section 5.3.3. Source identification and control is a critical component of pollutant reduction for most of the pollutant types for which there are MS4 WLAs in the District. As described in Section 6.4, source control is the primary method for achieving WLAs for PCBs, but source control is also important for other pollutants. This is particularly true in light of the fact that load reduction efficiency for most BMPs is in the 70 -80 percent range, but many pollutants must be reduced by more than 90 percent to meet WLAs. Source identification and reduction may be necessary to help close that gap.

Model Refinements

Through the adaptive management process, DOEE will continue to collect additional MS4 and BMP data that will be used to update and improve the IP Modeling Tool. For example, one of the goals of the MS4 outfall monitoring proposed in the Revised Monitoring Program is to collect additional data that will allow better characterization of pollutant sources, stormwater flows, EMCs, and BMP effectiveness. This improved characterization can then be used to improve the modeling.

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7. Tracking Progress in Meeting MS4 WLAs

7.1 Introduction

The success of the Consolidated TMDL IP depends on the implementation of many individual pollution control activities that are spread out over a long time line. Tracking progress in a consistent manner over time is critical to the success of the IP. Tracking progress enables program managers and others to assess the pace of implementation and achievement of the planned pollution load reduction goals that are set out in the Consolidated TMDL IP. This breaks up long-term commitments into smaller, more manageable pieces, such as benchmarks and other programmatic measures that are assessed on an annual basis, and milestones that are assessed on a once every five-year basis. In short, tracking progress provides evidence indicating whether TMDL Implementation is on track to meet projected timeframes for achieving WLAs.

This section of the IP describes the tracking that will be carried out to evaluate implementation and improvement over time as the District works to reduce pollutant loads and achieve its MS4 WLAs. Progress towards meeting the IP and achieving WLAs will be tracked using three different methods, including:

- **Modeling:** The MS4 permit anticipates that models will be used to demonstrate how each of the individual MS4 WLAs will be met. The IP Modeling Tool is extremely well-suited for this use and it is the key component of tracking progress on TMDL implementation over time.
- **Monitoring**: Monitoring provides data on the loads from the MS4 system. Monitoring data will be used to help confirm achievement of WLAs projected by the modeling. Specific monitoring to be used to help track progress includes monitoring of the volume and concentration of stormwater at MS4 outfalls and monitoring for BMP effectiveness, trends in ambient water quality, and other monitoring at special study sites.
- **Other Programmatic Tracking**: Other programmatic tracking includes accounting for a wide variety of measures that contribute to achievement of the planned pollution load reduction goals. This includes tracking BMP-specific information like the number of BMPs implemented, the number of BMPs inspected, etc. It also includes the tracking of iterative actions that result in pollutant load reduction, but which may not be quantifiable in terms of actual loads reduced - activities such as site inspections, public education, and or hazardous waste collection.

Taken together, the information from these tracking methods will enable the District to evaluate progress on a regular basis. Each tracking element is described in more detail in the following sub-sections.

7.2 Modeling

The IP Modeling Tool will be the primary method used to track milestones, benchmarks and attainment of individual WLAs. Previous applications of the IP Modeling Tool defined the pre-BMP Baseline Condition (circa 2000) and the Current Condition (circa 2014) that includes the existing BMPs that are in place. In addition, the IP Modeling Tool was applied to quantify the WLA-specific load reductions that need to be achieved for all pollutants except PCBs. The implementation plan strategy described in Section 6 establishes the BMP implementation programs and the timeframe required to close the gap between individual current condition loads and the WLAs. Modeling therefore provides a consistent and straightforward way to track results over time as this gap is closed.

The IP Modeling Tool uses specific information on BMPs to calculate load reduction. This includes:

- Type of BMP
- Location of BMP
- Implementation date
- Area controlled by the BMP
- Design stormwater volume retained by the BMP

The District's Stormwater Database is the primary database for recordation of stormwater management plans, soil erosion and sediment control plans, green area ratio plans and other detailed information on green infrastructure and BMPs associated with development and redevelopment activities. BMP information is updated and tabulated in this database as the facilities are planned, inspected and become operable. BMPs that are not captured by the District's Stormwater Database, such as RiverSmart, source control, and certain non-structural BMPs, are currently tracked in a variety of other databases, but a process is underway to standardize the tracking and record keeping of those BMPs into a single consolidated database.

Data from the BMP databases will be input into the IP Modeling Tool to allow modeling of progress in achieving the goals of the IP. The IP Modeling Tool will be applied at a minimum on an annual basis across the entire MS4 area to quantify the load reduction accomplished each year with the new BMPs that have been put in place and become operational. For tracking purposes, this annual quantification of load reduction is compared directly against the benchmarks established for each of the MS4 WLAs. As described in Section 6.6, benchmarks have been set as the average annual amount of pollutant reduction that must be achieved in order to meet the WLA by the date projected by the modeling. Thus, comparing the load reduced in a given year against the annual benchmark indicates if sufficient progress has been achieved in that year to stay on track to meet that specific WLA by the projected final attainment date. These numbers can also be evaluated cumulatively over time to determine the longer-term trends in progress.

An example of applying the IP Modeling Tool for tracking progress in this manner is presented Table 7- 1.

Table 7- 1. Example of Using the IP Modeling Tool to Track Progress for Benchmarks

	2016	2017	2018	2019	2020	Cumulative
Benchmark: Annual Pollutant Load Reduction Required to meet WLA (lbs.)	35	35	35	35	35	175
IP Modeling Tool Annual Update of Pollutant Load Reduction Achieved (lbs.)	36	32	33	38	37	176

As shown in this example, the benchmark load reduction is constant but there is year-to-year variability in the modeled pollutant reduction achieved. This is likely to occur due to year-to-year differences in the rate of development and re-development and other factors. In this case, however, the model results show that progress is being made at an acceptable rate. The cumulative load reduction of 176 lbs. realized at the five-year mark (2020) slightly exceeds the cumulative five-year benchmark target of 175 lbs. This would be viewed as acceptable progress.

The IP Modeling Tool will be applied in a similar manner to track progress towards meeting milestones. As described in Section 6.6, milestones represent physical progress quantified for the entire MS4 area. Milestones have been set as model-based projections of five-year area-controlled and pollutant load reduction metrics. For tracking purposes, the annual quantification of area controlled and load reduction based on actual BMP implementation is summed for five year intervals (e.g., 2016-2020), and directly compared with the appropriate milestones. Progress will be assessed based on the level of area controlled or pollutant load reduction achieved as compared to the milestone targets.

7.3 Monitoring

The District's MS4 permit states that the Revised Monitoring Program will include "any additional necessary monitoring for purposes of…wasteload allocation tracking" (NPDES permit Section 5.1.1). For the purposes of the IP, the primary monitoring data used to track the achievement of WLAs is the monitoring and tracking of BMP implementation data. Monitoring and tracking BMP implementation is necessary to provide the IP Modeling Tool with the required input data to evaluate achievement of WLAs. As described in Section 7.2, monitoring data for BMP implementation is compiled into DOEE's Stormwater Database and other databases, which will then be used as inputs into the IP Modeling Tool. Monitoring and tracking data on BMP implementation is received by DOEE on a continuous basis as plans are submitted to comply with the stormwater retention requirements under the 2013 Stormwater Regulations, or as other BMP information is reported under other programmatic requirements (e.g., RiverSmart or DDOT BMPs). Comprehensive BMP monitoring plans will be developed to ensure that all BMP information is tracked and captured on a regular basis so that it can be incorporated into the IP Modeling Tool.

Other monitoring data will be used to supplement BMP monitoring information and provide additional information on achieving the goals of the IP. This includes MS4 outfall monitoring data and other types of data. MS4 outfall monitoring data provides direct evidence of pollutant loads from individual MS4 outfalls. However since not every pollutant for which there is a MS4 WLA is monitored at every MS4 outfall, the value of MS4 outfall monitoring data is somewhat limited. The sections below describe how MS4 outfall monitoring data will be used to help track progress towards meeting the IP.

In general, MS4 outfall monitoring data will be used to confirm that individual WLAs have been achieved. Specifically, MS4 outfall monitoring data will be evaluated after projections from the IP Modeling Tool show that a specific WLA has been achieved. This will be done in one of several ways. First, if the pollutant in question is already monitored in MS4 outfalls to the waterbody segment for which the modeling indicates that a WLA has been achieved, then that MS4 outfall data will be used to calculate updated EMCs to use in estimating current loads to compare against the WLA. However, if that pollutant is not currently monitored in the watershed, "special studies" may be conducted in that segment to collect MS4 data to make this type of comparison. Other "special studies" may also be conducted to evaluate the effectiveness of BMPs, detect long term trends in MS4 outfall loads, or develop updated EMCs to use in the IP Modeling Tool.

In addition to the direct monitoring of MS4 outfalls, there is other monitoring data that can be used to help assess progress towards meeting the IP. This includes receiving water quality monitoring, Aquatic Life Use Support assessment, fish tissue analysis, geomorphological assessment, physical habitat assessment, and trash monitoring. However, it should be noted that all of these monitoring data are watershed-based (as opposed to MS4-specific) and reflect the impacts from numerous types of discharges into the watershed, not just MS4 discharges. Therefore, these data will be used only to provide supplemental information, and will not be used directly to evaluate progress in meeting the IP or achieving MS4 WLAs. A summary of these monitoring program elements is presented in Table 7- 2. Wet weather monitoring (MS4 outfall monitoring) has been included for completeness, although this monitoring was previously discussed above.

Table 7- 2. Summary of Monitoring Program Elements and Methods			
Monitoring Program Element	**Location**	**Parameter**	**Method**
Wet weather monitoring	Stormwater Outfalls, Special Studies	Flow rate and wet weather concentration	Standard Methods
Receiving water quality monitoring	Tributary and mainstem locations	Ambient water quality concentrations	Standard Methods
Aquatic Life Use Support Assessment	Mostly tributary locations (2 sites in Rock Creek)	Benthic macro-invertebrates; fish population and biomass	Maryland Biological Stream Survey (MBSS)
Fish Tissue Analysis	Selected mainstem locations	Fish tissue contamination data	Standard Methods
Geomorphological Assessment	Tributary locations	Stream type , based on slope, amount of entrenchment, ration of width to depth, and sinuosity	Rosgen Level I
Physical Habitat Assessment	Tributary Riparian Corridors	Various metrics related to streambed, bank condition, and riparian cover	MBSS Physical Habitat Inventory
Trash Monitoring	Stormwater outfalls and tributary and mainstem locations	Trash (weight)	Trash traps, skimmers and other methods

Wet weather monitoring is used in a number of ways to track progress. Trend analysis of rainfall induced flow volume and pollutant concentration at stormwater outfalls over time as additional BMP implementation occurs provides direct evidence of the ability of BMPs and other source control practices to capture volume and modify pollutant concentration. This monitoring can inform program managers on the overall effectiveness of implementation within individual monitored sewersheds. With representative monitoring in place across the MS4 area, as planned, wet weather monitoring also provides some indication of the overall effectiveness of implementation across the District.

Wet weather monitoring in special studies aimed at individual sub-sewersheds or individual pollutant control practices provides data for the evaluation of concentrated BMP implementation and new and innovative control technologies. It also provides a check on the performance of practices with regard to pollutant removal. Another important use of wet weather monitoring data is that it allows for examination of pollutant EMCs used in the IP Modeling Tool. EMCs can be verified or modified based on the trends in concentration that are monitored over time.

Wet weather monitoring is an integral part of adaptive management. The analysis of wet weather data for the purposes described above can be instrumental in modification of the IP, particularly with respect to assumptions about pollutant control and the priority given to individual BMPs and source control practices. In addition, changes to some of the basic assumptions within the IP Modeling Tool may be justified based on the wet weather monitoring data. Potential examples include modifications to the modeling methods for BMPs, the addition of innovative BMPs currently not modeled, and changes to the EMCs for individual pollutants.

Receiving water quality monitoring provides the data upon which the assessment of designated use support in the water bodies within the District is based. It will also help evaluate the effectiveness of the stormwater program in reducing pollutant loads to receiving waterbodies. Trend analysis will indicate either improving trends or lack of improvement. Trend analysis can help to inform the IP as to whether or not the pace of watershed-wide implementation is on track.

Over time, trend analysis of receiving water quality monitoring data in the tributaries is expected to provide evidence that designated use support is improving due to the IP and, eventually, that the designated uses are supported. Designated use support in individual tributaries can indicate that the MS4 WLA and other LAs have been successfully achieved or that use support is realized for other reasons. In either case, the attainment of designated use support demonstrated by receiving water monitoring data is important to the IP because it suggests that MS4 WLAs may no longer be needed in tributaries where this occurs. It is important to note that this type of conclusion is only valid for tributaries whose drainage area lies completely within the District MS4 system. For tributaries with drainage areas that are partially located in Maryland, such as Watts Branch, Nash Run, Oxon Run, Lower Beaverdam Creek, Portal Branch, Pinehurst Branch, and Fenwick Branch, the ultimate success of attainment in these water bodies is dependent on implementation of pollutant reduction programs in Maryland, as well as in the District.

Receiving water quality monitoring data for the three mainstem water bodies in the District (the Anacostia and Potomac rivers and Rock Creek) is also expected to provide useful evidence on designated use support and water quality trends. However, unlike the tributaries, the mainstem waterbodies receive a substantial amount of pollutant loads from upstream sources in Maryland and, in the case of the Potomac River, Virginia. Trend analysis of receiving water quality monitoring data in the mainstem water bodies will inform program managers about progress in the attainment of designated use support. However, the ultimate success of attainment in these water bodies is dependent on implementation of WLA and LA pollutant reduction programs in Maryland and Virginia in addition to the Consolidated TMDL IP for the District.

Aquatic Life Use Support Assessment provides information on the quantity and characteristics of the macroinvertebrate and fish communities found in receiving waterbodies. It is used as a surrogate indicator for stream health and it is well-correlated to the presence of urban stormwater impacts like accelerated streambank erosion and stormwater pollutant loads. Consequently, tracking improvements in the make-up of macroinvertebrate and fish communities in tributaries can be associated with the IP and MS4 pollutant load reduction.

Aquatic Life Use Support Assessment also plays another important role in the IP. Benthic macroinvertebrate and fish population data are used extensively in the assessment of designated use support and impairment in tributaries. In particular, benthic macroinvertebrate bioassessments are listed as a cause category of impairment that affects the protection and propagation of fish, shellfish and wildlife. Tracking change and improvement in the macroinvertebrate communities in tributaries may lead to attainment of designated use support for aquatic life use that would influence the continued need for additional pollutant load reduction from MS4 sources.

Fish Tissue Analysis provides information on bioaccumulation of pollutants in fish residing in District waters. Fish tissue contamination data is the basis for establishing fish consumption advisories. There is currently a public health advisory in the District that:

> ... *urges limited consumption of Anacostia and Potomac river fish. PCBs and other chemical contaminants have continued to be found in certain fish species caught in the Potomac and Anacostia rivers and their tributaries, including Rock Creek, within the District's boundaries.*

District water bodies do not support the fish consumption designated use when fish/shellfish advisories or bans like this are in effect. Consequently, fish tissue contamination data is responsible for widespread non-attainment of the fish consumption use and the need for many of the MS4 WLAs for PCBs, PAHs and other chemical contaminants found in fish tissue.

Fish tissue analysis needs to be tracked but it is not necessarily well linked as an indicator of the success of the MS4 program and the planned pollution load reductions in the IP. Instead, it is more closely tied to watershed pollutant loads in the Anacostia and Potomac rivers and Rock Creek. In addition, the chemical concentration of organic pollutants found in fish tissue is well correlated with the chemical concentration in bottom sediments. This correlation suggests that the legacy pollutants found in bottom sediments of the major waterbodies may be as or more important than, surface pollutant loads from MS4 discharges and nonpoint sources in contributing to bioaccumulation of pollutants in fish tissue. Fish tissue analysis is not as reliable a source of data compared to the other monitoring programs because it is conducted on an irregular basis when funding is available. It also has limited use for evaluating the MS4 program and BMP implementation because it is only conducted in a limited number of locations due to equipment and access restrictions.

Geomorphological Assessments will be conducted as part of the rapid assessment stream walks, which will also assess habitat and infrastructure. Geomorphological assessments will help determine whether a stream is connected to its floodplain, whether channel alteration has occurred, and whether the stream is capable of conveying flow and sediment efficiently and safely. The geomorphological assessment will use a Rosgen Level I classification system that groups streams by class based on slope, amount of entrenchment, ration of width to depth, and sinuosity.

Physical Habitat Assessment is primarily focused on evaluation of the physical and ecological conditions within streams and riparian corridors. The assessments provide an inventory of resources and identify biodiversity within stream reaches. This information can be used by program managers to target degraded areas in need of restoration as well as vulnerable areas that need to be protected. Trend analysis is used to determine whether or not improvement has been made over time.

The tributaries in the District are severely impacted by stormwater volume and this is manifested by accelerated stream bank erosion and widespread threats to the structural integrity of sewer pipes and outfall structures. Physical habitat assessment is an element of monitoring that provides a link between volume-based stormwater management and the condition of tributaries.

Trash Monitoring is an integral element in the Consolidated TMDL IP. The MS4 permit contains specific requirements for the Anacostia River Watershed Trash TMDL Implementation that include quantitative goals for trash reduction. This includes implementing measures such as:

1. Direct removal from waterbodies, e.g., stream clean-ups, skimmers
2. Direct removal from the MS4, e.g., catch basin clean-out, trash traps
3. Direct removal prior to entry to the MS4, e.g., street sweeping
4. Prevention through additional disposal alternatives, e.g., public trash/recycling collection
5. Prevention through waste reduction practices, regulations and/or incentives, e.g., bag fees

Monitoring and annual quantification of each of these elements will be used directly to track progress on the achievement of Trash TMDLs.

In summary, there is a large amount of monitoring data available to assist with evaluating the implementation the IP and the achievement of MS4 WLAs. However, of these potential data sources, only a very few provide direct information on MS4 loads and their impacts. The primary monitoring element used to track progress is BMP implementation. BMP implementation is tracked and used in the IP Modeling Tool to project WLA attainment. In addition, wet weather MS4 outfall monitoring data can also provide direct evidence used to calculate MS4 loads and EMCs. However, because not all TMDL pollutants are monitored in every MS4 outfall, these data cannot be used to assess achievement of every individual MS4 WLA. Special studies will be used to supplement the wet weather MS4 outfall monitoring data. These special studies can provide additional information on BMP effectiveness, water quality trends, and EMCs, that can inform evaluations of progress in meeting the IP. Other sources of monitoring data, including receiving water quality monitoring, benthic macroinvertebrate and fish population surveys, fish tissue analysis, physical habitat assessment, and trash monitoring, can provide supplemental information to help evaluate the IP – primarily by providing information as to whether or not underlying designated uses are being met, and thus whether MS4 WLAs are still needed. However, because these monitoring data are watershed-based, they reflect the impacts from numerous types of discharges into the watershed – not just MS4 discharges. Therefore, these data will be used only to provide supplemental information, and will not be used directly to evaluate progress in meeting the IP or achieving MS4 WLAs.

7.4 Other Programmatic Tracking

The District implements a variety of stormwater control programs under its MS4 permit and reports on these programs annually in the MS4 Annual Report. The District also plans to evaluate a number of these programmatic activities and metrics to help assess progress in meeting the IP. The types of programmatic activities tracked will include activities that contribute to stormwater management and pollutant load reduction, such as site inspections, training sessions, outreach activities, etc. The types of programmatic metrics that will be tracked include quantification of implementation measures, such as the number of BMPs installed, the number of BMPs inspected, the number of site inspections conducted, the number of training sessions held, etc. Tracking and reporting on these components as they relate to helping to achieve the IP is important because they provide supplemental, quantifiable information on stormwater control activities in the District. Thus, they are a good complement to the modeling results because they provide a "ground-truthing" of the levels of stormwater management and control activity that are producing the load reductions projected by the modeling.

Examples of these programmatic tracking measures are summarized in Table 7- 3. Each of these measures will be tracked across the MS4 area at the major watershed scale (Anacostia, Potomac, and Rock Creek) and on the city-wide MS4 level. It should be noted that these programmatic tracking measures include both activities where the actual pollutant control achieved by that activity is quantifiable (e.g., BMP implementation; stream miles restored; trees planted), and activities where the pollutant control achieved by that activity is not currently quantifiable[10] (e.g., IDDE inspections, public education and outreach). It is important to track and report on both types of activities, because even activities where the actual pollutant load reduction achieved by that activity is not be quantifiable do contribute to load reduction, and so their contribution to meeting the goals of the IP will be acknowledged.

Table 7- 3. Summary of Other Programmatic Measures and Tracking Methods

Other Programmatic Measure	Units	Data Source/Tracking Method
BMP installations	# and type/year	Stormwater Database
BMP inspections	#/year	Program Database
Catch basin cleaning	#/year	Program Database
Street sweeping	Miles/year	Program Database
Stream restoration	Feet/year	Program Database
Trees planted	#/year	Program Database
Stormwater Pollution Prevention Plans implemented	#/year	Program Database
IDDE Inspections	#/year	Program Database

[10] In some cases, pollutant reduction achieved by specific activities that cannot currently be quantified can be quantified in the future if the appropriate data is collected. For example, IDDE and catch basin cleaning may be able to be quantified in the future if the appropriate data is collected. See Section 3.2 of *Appendix F, Technical Memorandum: BMPs and BMP Implementation*, to the *Comprehensive Baseline Analysis* document (DDOE, 2014).

Table 7- 3. Summary of Other Programmatic Measures and Tracking Methods		
Other Programmatic Measure	**Units**	**Data Source/Tracking Method**
Staff training	#/year	Program Database
Inspections and maintenance of municipal facilities	#/year	Program Database
Coal tar inspections	#/year	Program Database
Public education and outreach activities	#/year	Program Database
Program funding	$/year	Program Database

8. Public Outreach Plan

8.1 Background and Purpose

Throughout the development of the Consolidated TMDL Implementation Plan, DOEE met on a regular basis with a group of stakeholders representing environmental non-governmental organizations, development organizations, other District agencies, and federal government representatives, including personnel from EPA Region 3 and EPA Headquarters Water Permits Division. This group of stakeholders met semi-monthly, reviewed draft project documents, attended project update sessions, and provided input and feedback during the development of the IP. Upon completion of the IP, DOEE will expand this engagement to inform various public sectors how the implementation plan yields a systematic approach to meeting the District's MS4 permit obligations to achieve WLAs. Ultimately, implementation of the IP will help to improve the quality of the District's waters. This section of the IP describes DOEE's plan to engage inform the public about the plan.

8.2 Goals

DOEE has set specific goals for public outreach, including informing the general public, engaging specific interest groups, and providing the most updated information on the IP on a continuing basis. This will help DOEE continue to meet its ultimate goals of implementing the IP and improving water quality in the District. DOEE also plans to evaluate the effectiveness of its outreach efforts to ensure public awareness of the IP and its scope. Summaries of the outreach goals and measures for determining their effectiveness are provided in Table 8- 1 below.

Table 8- 1. Outreach Goals and Measures of Effectiveness

GOAL	HOW ACCOMPLISHED	MEASURES OF EFFECTIVENESS
To inform District residents from diverse backgrounds about the Consolidated TMDL Implementation Plan	Host public meetings using communication and outreach strategies that attract residents from diverse populations	Document demographic data by reviewing meeting sign in sheets and Title VI forms
To engage special interest groups and jurisdictional partners	Attend select environmental organization meetings and present at MWCOG meetings	Track meeting presentations and idea exchanges with other jurisdictions
To provide updated information on the implementation plan and status	Post information online following meeting	Information posted within timeframe, keep analytics on site visits and downloads

8.3 Outreach Methods

8.3.1 Public Meetings

Public meetings will be used as a tool to inform residents about the Consolidated TMDL Implementation Plan and how it will impact the restoration of the Anacostia and Potomac Rivers and Rock Creek, and to educate residents about stormwater management and District stormwater management programs. DOEE will host four public meetings, in different parts of the District, and use a variety of communication tools, including community listservs, social media, and community liaisons, to encourage attendance at the meetings. Attendees will have the opportunity to review a summary of the plan's findings and gain clarity on how its implementation will impact the District's waters.

8.3.2 Roadshows

In addition to public meetings, which are open to everyone, DOEE will join established meetings to present a summary of the Consolidated TMDL Implementation Plan. These stakeholders include but are not limited to environmental organizations and regional partners like the DC Environmental Network (DCEN) and MWCOG. The DCEN hosts monthly meetings where this information can be presented. In addition, MWCOG hosts meetings on stormwater management and the Anacostia River either of which would be appropriate to share this presentation. Presenting to these stakeholder groups, who have familiarity with the subject matter, will allow the agency to focus the presentation more on the technical depth and schedule for the plan.

Roadshows will be conducted for the following types of organizations:

8.3.2.a Environmental Organizations

The District has active groups of citizens who are passionate about the District's environment. DOEE will present the summary and results of the TMDL IP to select environmental organizations. The advantage of these smaller group presentations is they create an opportunity for DOEE to understand concerns about specific TMDL pollutants and interact with people with special interest in restoration of the watershed. Furthermore, through these focused presentations, DOEE can gain support in implementing the plan.

8.3.2.b Regional Partners

The impact of activities within the region ultimately affects the Anacostia and Potomac River as well as Rock Creek; therefore, restoring the watershed will take a multijurisdictional approach. DOEE will present a summary of the District's TMDL IP to the Metropolitan Washington Council of Governments (MWCOG). This presentation and discussion will allow agency partners to exchange technical information, identify mutual interests, resolve conflicts, and develop ideas to create mutually beneficial solutions.

8.4 Website

The project website, which was created during the development of the Consolidated TMDL Implementation Plan will continue to be used upon the plan's completion. DOEE will maintain the site keeping it updated with information on public meetings, relevant policy, and the implementation schedule.

Table 8- 2 summarizes the outreach methods that will be deployed for the Consolidated TMDL Implementation Plan and covers additional topics such as information dissemination, timing and distribution.

Table 8- 2. Summary of Outreach Methods					
Tools	**Purpose**	**Information Disseminated**	**Frequency or Timing**	**Distribution**	**Stakeholders Targeted**
Online Tools					
Project Website	Serves as project landing page and materials repository	Meeting Notifications, Project Documents, Timelines, Public Meeting Materials	Updated as often as needed. Information from public meetings uploaded within 24 hours	General public, Agency social media, fact sheets	General Public, ANCs, Environmental interested populations
Meetings					
Public Meetings	Present Information, Develop Project Contact List	Fact sheets, project information	Four hosted during the TMDL IP public comment period	Four geographically distinct locations within the District	General public, ANCs, environmental interested populations, Title VI populations
Roadshows	To present information to stakeholders with a specific interest in the TMDL IP	Technical summary	Develop schedule for presenting at selected environmental organizations and MWCOG	Join existing meetings of organizations in the District and region	Environmental groups, local jurisdiction representatives

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9. Integration with other Watershed Planning Efforts

A number of other watershed plans and implementation plans for many of the District's watershed predate the Consolidated TMDL IP. The Consolidated TMDL IP is built upon and integrates implementation work already planned and/or underway in these watersheds, including those for watersheds entirely within the District (e.g., the Hickey Run Watershed Implementation Plan, the Anacostia River Watershed WIP), as well as for regional or larger watersheds (e.g., Anacostia River Watershed Plan, the District's Phase I and Phase II Chesapeake Bay TMDL WIPs).

Because the Consolidated TMDL IP was developed to meet an NPDES permit requirement, it is a legally binding document. Therefore, while the Consolidated TMDL IP builds upon and/or incorporates other watershed planning efforts, the IP takes precedence over all other watershed planning documents as the principal plan to manage MS4 WLAs in the District. Other existing watershed planning documents will continue to be valuable in managing and coordinating overall watershed improvement and stream health for individual watersheds. However, the MS4 component of watershed planning, and specifically addressing MS4 WLAs, is coordinated through the Consolidated TMDL IP in order to ensure that regulatory requirements are met. The integration and coordination of the Consolidated TMDL IP and other watershed planning efforts is accomplished in two ways: first, all existing WIPs and IPs have been reviewed and relevant planning efforts have been incorporated into the Consolidated TMDL IP; and second, the ongoing implementation of other watershed planning efforts will continue to be coordinated with this Consolidated TMDL IP such that all relevant activities conducted as part of these ongoing efforts support the goals of the Consolidated TMDL IP.

As part of the effort to integrate and coordinate relevant planning information from existing WIPs and IPs and other planning efforts into this Consolidated TMDL IP, existing watershed planning documents were reviewed to assess and evaluate the following issues with respect to each existing plan. The following questions were considered:

- Are the objectives of other watershed plans relevant to TMDL implementation or to aspects of the Consolidated TMDL IP? Conversely, are aspects of the Consolidated TMDL IP relevant to the implementation of these other plans?
- Are planned or proposed BMPs, stormwater management controls, or other activities from existing watershed planning efforts relevant to controlling TMDL pollutants and meeting MS4 WLAs? Is sufficient data available on these planned or proposed BMPs to incorporate them into the IP Modeling Tool to evaluate how implementation of these BMPs would impact the load reduction necessary to achieve MS4 WLAs?
- Can implementation of source controls or load reduction through the implementation of BMPs done to meet MS4 WLAs in individual watersheds as part of the IP also help to achieve goals of the other watershed plans in the same watershed?
- Can specific types of BMPs be identified and/or proposed that will achieve load reduction to meet MS4 WLAs in individual watersheds as part of the Consolidated TMDL IP and also enhance habitat or promote the health of biological communities to meet goals of other existing watershed plans (e.g., stream restoration, buffer planting, etc.)?
- Can data collection, sampling, modeling, BMP evaluation, implementation, or tracking be coordinated between the Consolidated TMDL IP and other existing watershed plans?

- Can financial and technical resources be shared and optimized between the Consolidated TMDL IP and these other watershed planning efforts?

The following watershed plans were reviewed as part of this effort:

- Anacostia Watershed Total Maximum Daily Load Waste Load Allocation Implementation Plan (DC Stormwater Administration, 2005);
- Anacostia River Watershed Restoration Plan and Report (multiple authors, 2010);
- Anacostia River Watershed Implementation Plan (DDOE, 2012);
- Anacostia Watershed Trash Reduction Plan (DDOE, 2008);
- Hickey Run Watershed Implementation Plan (DDOE, 2005);
- Hickey Run Watershed and Stream Assessment (USFWS, 2005);
- Rock Creek Watershed Total Maximum Daily Load Waste Load Allocation Implementation Plan (DC Stormwater Administration, 2005);
- Rock Creek Watershed Implementation Plan (DDOE, 2010);
- Oxon Run Watershed Implementation Plan (DDOE, 2010);
- Chesapeake Bay TMDL Phase I Watershed Implementation Plan for the District (DDOE, 2010);
- Chesapeake Bay TMDL Phase II Watershed Implementation Plan for the District (DDOE, 2012).

Full summaries of these planning documents and a discussion of any information from the documents that is relevant to the development or implementation of the Consolidated TMDIP is provided in Appendix G.

In general, the existing plans provide background on the watershed characteristics, land uses, impairment issues and other watershed problems, and they identify potential BMPs that could be implemented to reduce pollutant loads. The WIPs and IPs also include methods for calculating pollutant loads and estimating load reductions. These methods are generally consistent with the pollutant load and load reduction calculations used in the IP Modeling Tool. For example, all of the District's WIPs utilized the Simple Method to estimate the existing annual pollutant loads and used BMP efficiency data to track load reductions. The existing WIPs and IPs also provide historical context for the TMDLs, and identify potential issues with the impairment listings and the data underlying the TMDLs that is important to consider when developing an implementation plan for the TMDLs and MS4 WLAs.

Discussions of specific relevant aspects of the plans are provided below:

9.1 Background on Impairments, Impairment Listings, and TMDLs

The WIPs and IPs typically include discussions of the designated uses of the waterbodies and the impairments of those designated uses that necessitated the development of TMDLs. This useful information sets the historical context for the TMDL and allows analysis of the impairments to determine if the TMDLs still need to be met. For example, the Consolidated TMDL IP recommends continued monitoring of water quality and biological data to ensure that identified impairments still exist. If future data show that the impairments for which TMDLs have been developed no longer exist, then the goals of the TMDLs have been achieved and there is no longer a need for additional implementation.

The WIPs and IPs also provide analysis of the validity of the TMDLs and MS4 WLAs. In the case of the 2005 Rock Creek TMDL IP, the need for several MS4 WLAs was questioned. For example, the IP points out a number of concerns with the pollutant listings and the need for MS4 WLAs. The IP notes that for a number of pollutants, most of the monitoring samples were non-detect for that pollutant. However, for the purposes of EMC calculations for that pollutant, all non-detect values were assumed to be one half of the detection limit. This assumption, which is not supported by any available data, was used to develop an EMC, which was then used to develop a load for that pollutant. This load was then used in the TMDL. However, it is unknown whether that pollutant even existed in that waterbody because it was never detected above the method detection limit used to evaluate it. This raises questions about the validity of the impairment and these TMDLs. This IP also includes discussions of several other issues with specific pollutants. For example, the document states that CSOs, and not MS4 stormwater, are the most likely source of arsenic, copper, and lead in Piney Branch.

These initial evaluations of impairments and impairment listings and their impacts on the validity/ necessity of individual TMDLs and MS4 WLAs are important to the development of the Consolidated TMDL IP because they establish the precedent for ongoing evaluation of the TMDLs and MS4 WLAs. The Consolidated TMDL IP includes an adaptive management focus, and impairments and the need to meet MS4 WLAs will continue to be evaluated as additional information becomes available in the future.

9.2 BMP Effectiveness

Determining a way to track the effectiveness of individual BMPs in reducing loads was a critical part of each WIPs and IPs. For the most part, the WIPs and IPs identified the percent load reduction of an individual pollutant that specific BMP types could achieve. This required literature reviews of the available pollutant removal information, and compilation of the available sources to ensure that all of the pollutants and BMP types of interest were included. These compendiums of BMP effectiveness were important for the development of the Consolidated TMDL IP in several respects. First, the IP Modeling Tool also uses percent load reduction calculations as one of the ways it tracks BMP effectiveness and load reduction, and thus the methodology for the calculation of loads and load reductions is consistent between the Consolidated TMDL IP and the original WIPs and IPs. Second, the specific information on BMP effectiveness in the WIPs and IPs helped inform the IP Modeling Tool calculations.

9.3 Loading and Load Reduction Calculations and Tracking

As required by the MS4 permit, all of the District's WIPs and IPs utilized the Simple Method to estimate the existing annual pollutant loads and load reductions. The Simple Method uses the drainage area, a runoff coefficient (which in turn is a function of land cover and soil type), and precipitation to determine runoff from a particular area (watershed or sewershed). It then uses runoff in conjunction with a pollutant EMC to calculate pollutant load. The Consolidated TMDL IP generally uses the same methodology to calculate loads and load reductions. The IP Modeling Tool actually uses a modified version of the Simple Method to account for the differential impact of turf and forest cover in generating runoff from a site. See Section 4.4 for a full discussion of the modeling calculations. The decision to use the Simple Method to track loads and load reductions for the Consolidated TMDL IP was determined independently from the decisions to use this method for the development of the previous WIPs and IPs. This provides additional confidence in the methodology and its ability to represent TMDL loads and load reductions from BMPs.

9.4 Strategy to Reduce Loads and Meet MS4 WLAs

The WIPs and IPs provide a good accounting of the District's general strategy for managing stormwater and reducing pollutants. This strategy consists of continuing implementation of non-structural "General Management Measures" that are ongoing throughout the watershed, as well as specific structural BMP and LID projects to be implemented in the future. DOEE's ongoing General Management Measures include legal regulation, construction plan review and regulation, regulation of pollutant sources, public education, illicit discharge detection and enforcement, and the management of the District's solid waste through street sweeping, trash collection, catch basin cleaning, and floatable reduction as primary means to control pollutants. General management measures also include programs such as RiverSmart Homes and Green Roof Retrofit programs that encourage the installation of structural BMPs through voluntary measures on private lands. The WIPs and IPs also identify specific potential structural BMPs and LID projects that could help to control pollutants. These BMP and LID projects are discussed further below.

Like the previous WIPs and IPs, the Consolidated TMDL IP recommends the continued implementation of the District's stormwater management program as an important part of the load the reduction strategies to meet MS4 WLAs. Many of these general management practices attempt to control pollutants before they can run off and enter the MS4 system, and thus are a critical component of a multi-layered strategy to manage pollutants. Methodologies exist to quantify the load reduction impacts of some of these practices (e.g., street sweeping, trash collection, catch basin cleaning, IDDE). However, the District does not currently collect the data necessary to quantify all of them, and part of the IP is to perform pilot projects to collect additional information to allow quantification of the load reductions attributable to these practices. In other cases (such as with public education, pollution prevention, hazardous waste management, etc.), it is not possible to quantify the load reduction achieved through implementation of these practices. However, they are still an important part of the Consolidated TMDL IP, and identification of potential pollutant sources and implementation of recommended source control measures should result in waterway improvements, even if the specific impacts of these BMPs cannot be modeled effectively.

9.5 Specific Structural BMPs and LID Projects

Many of the WIPs and IPs include specific lists of potential structural BMPs and LID projects that, if implemented, would reduce pollutant loads and help meet MS4 WLAs. Information on these projects was collected from the WIPs and IPs and analyzed to determine the potential load reduction that could be achieved by implementing these projects. In addition to scenario analysis, the WIP projects continue to serve as an important part of the Consolidated TMDL IP. The most important aspect of the WIP projects is that they were identified for specific TMDLs and MS4 WLAs. Development of the project lists involved significant expenditure of resources including fieldwork to identify potential project locations and GIS/data processing to provide initial evaluations of potential project size and type. These initial insights into what types of projects may be feasible and where they may be able to be implemented was valuable in developing the Consolidated TMDL IP.

Finally, the Anacostia River Watershed Trash TMDL Implementation Strategy (draft, December 2013) documents the specific plan to meet the Anacostia Trash TMDL. Since this plan already includes a specific strategy that will meet the MS4 WLAs, it has been incorporated directly into the Consolidated TMDL IP.

9.6 Other Important Watershed Planning Elements

While the Consolidated TMDL IP can draw on the existing WIPs and IPs directly for methodologies and proposed strategies for calculating, tracking, and reducing loads, other watershed planning documents provide other valuable information that supports the development of the Consolidated TMDL IP. For example, DC Water's Clean Rivers Project for CSO control provides context and an example of the programmatic structure required to manage loads on a city-wide scale. Implementation of the Clean Rivers Project is a multi-billion dollar effort that has required defining the regulatory endpoint and developing an acceptable technical strategy to reach that endpoint; integrating management efforts along with gray and green infrastructure planning to reduce loads and flows; and engaging disparate stakeholders and the public to support the strategy and fund its implementation. Implementation of the Consolidated TMDL IP will likely require detailed planning on a similar scale.

Other watershed planning documents provide other important context for implementation of the Consolidated TMDL IP. The Chesapeake Bay TMDL Phase I and Phase II WIPs document the District's commitment to address the Chesapeake Bay TMDL. While DOEE is the lead agency for implementation of the Chesapeake Bay TMDL WIPs, the WIPs involve more than reducing pollutants in the MS4 system. They require coordination with DC Water, federal partners, and private landowners to reduce loads in both the separate (MS4) and combined sewer areas as well as unregulated areas. The Chesapeake Bay TMDL and its supporting documentation also informed many of the technical decisions on how to model load reduction through BMPs.

Some watershed plans had a different focus than the Consolidated TMDL IP, and these plans provide a different perspective on watershed restoration. For example, the Hickey Run Watershed and Stream Assessment (2005) focused on the geomorphic condition of the stream itself, the landside conditions of the banks and watershed, and the health of the biological communities in the stream. The Hickey Run restoration strategy focuses heavily on restoring degraded stream banks and habitat. While some of the projects recommended to restore Hickey Run would reduce pollutant loading from a TMDL perspective (e.g., stream bank restoration), others would not (e.g., habitat restoration) – yet both would improve the condition of Hickey Run and meet project goals. Similarly, the Anacostia Watershed Restoration Plan (AWRP) includes specific projects to protect and restore the watershed's ecological integrity, support wildlife habitat and improve fish passage – none of which would achieve TMDL load reduction goals. Therefore, it is important to remember that while the ultimate goal of the Consolidated TMDL IP is to meet MS4 WLAs and help to address impairments to the designated uses of impaired waterbodies, other parallel planning efforts that do not focus on achieving MS4 WLAs can also contribute to the health of these waterbodies.

9.7 Additional Planning Documents

It should be noted that planning documents from other District agencies, such as the DC Water's Clean Rivers Program and various DDOT plans, were also reviewed during preparation of the Consolidated TMDL IP. The Clean Rivers Program provided context for the planning to control large runoff volumes, as is required to meet MS4 WLAs. DDOT will play an important role in the implementation of the Consolidated TMDL IP because much of the land potentially available for BMP implementation is in public right-of-way and roads. Specific DDOT documents reviewed for this effort include DDOT's Green Infrastructure Standards (2014), which contains lists of planned or proposed GI projects that were incorporated into the planned implementation to meet MS4 WLAs.

9.8 Conclusions

Many different watershed planning documents have been written for the District's waterbodies over the years by many different agencies and for many different purposes. In general, these planning efforts are useful for informing the development of the Consolidated TMDL IP. Some of the plans – particularly the previously developed WIPs and IPs for TMDL watersheds – provide direct information, like proposed projects. In addition, they also provide corroborating support to the methodologies used for the development of the Consolidated TMDL IP – such as methods for calculating pollutant loads and load reductions. Other plans - such DC Water's Clean Rivers Program - provide more contextual information that can help put the "big picture" requirements of the Consolidated TMDL IP into a better perspective. Overall, the integration and coordination of the Consolidated TMDL IP with these other watershed plans will help to achieve overall watershed goals and improve the health and usability of the District's waterways.

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10. Funding the Implementation Plan

10.1 Introduction

This Implementation Plan has been developed based on currently allocated public resources and projected rates of development and redevelopment under the District's revised Stormwater Management regulations. Available sources of public funding include:

- The Enterprise Fund (funds generated from the stormwater fee).
- The Anacostia River Clean Up and Protection Fund (funds generated from the "Bag Law").
- EPA Clean Water Act Grants (Clean Water State Revolving Fund and Section 319 grants).
- EPA Chesapeake Bay Program Funds (Chesapeake Bay Implementation and Regulatory and Accountability Program grants).

Further reductions are also anticipated outside of this funding from the District's 2013 Stormwater Management Rule governing development and development and ongoing BMP implementation projected to occur from other existing drivers and programs. This additional substantial investment is projected to be many times greater than the investment in non-regulated BMPs, and will include commitment of additional public resources for compliance with stormwater management regulations for publicly funded projects.

This section of the IP presents the District's approach to funding the IP. The subsections contained in this section summarize:

- Public Sources and Levels of Funding
- District Agency Financial Responsibilities
- Financial Affordability
- Funding the Consolidated TMDL IP

10.2 Public Sources and Levels of Funding

The District MS4 program operates with a mix of funding sources. The Annual Operating Budget and Capital Plan for the District includes general funds that allow individual agencies to conduct business and provide the services they are responsible for. Part of this general funding is used to address core agency functions that pre-date any federal requirement for stormwater management, but that still contribute to the goals of the MS4 program (for example, DPW's street sweeping program, DDOT road reconstruction projects, etc.). The District also receives funding from stormwater fees and environmental grants that are used by District agencies to administer specific programs required under the MS4 permit and to implement stormwater BMPs, stream restoration, and source control activities. It should be noted that costs for the stormwater program also include addressing programmatic responsibilities such as monitoring, reporting, plan review, and inspection and enforcement. These efforts are a critical component of the District's efforts to reduce and control pollution from stormwater runoff. The cost for these programmatic responsibilities must also be covered through the funding discussed below.

This description of current sources and levels of funding highlights the local revenues and grants available to the District's MS4 program and distinguishes between total funding and funding available for direct investment in pollution controls that implement the IP. The level of total funding has been fairly stable in recent years and is summarized in the following sub-sections by funding source.

10.2.1 Enterprise Fund

The Enterprise Fund and the District's stormwater fee were established in 2000, and the stormwater fee was subsequently updated to be based on impervious surface in 2009 (DC, 2000). The Enterprise Fund receives revenue from the District's stormwater fee. The revenue from this fee is intended to address costs of implementing MS4 Permit, including costs to manage and treat pollutants in stormwater runoff. Explanation of how the DC Stormwater Fee is calculated is provided in Table 10- 1 (DC 2014).

Table 10- 1. Calculation of the DC Stormwater Fee

The stormwater fee is based on the concept of an Equivalent Residential Unit (ERU), which is based on the average amount (1,000 square feet) of impervious surface on residential properties.

Single family residences are assessed a number of ERUs based on the amount of impervious surface. The following is the tiered rate structure:

Square Feet of Impervious Surface	Number of ERUs
100 to 600	0.6
700 to 2,000	1.0
2,100 to 3,000	2.4
3,100 to 7,000	3.8
7,100 to 11,000	8.6
11,000 and above	13.5

Each ERU is charged $2.67 per month.

For all other properties, such as businesses and large multi-family properties, the stormwater fee is charged at a rate of $2.67 per month for each 1,000 square feet of impervious area on their lot, reduced to the nearest 100 square feet.

The stormwater fee is collected for DOEE by DC Water on its monthly water bill. A similar ERU-based fee, the Clean Rivers Impervious Area Charge (CRIAC), is also included on the monthly DC Water bills. Each ERU is charged $16.75 per month under the CRIAC (DC Water, 2014). Revenue from the CRIAC is used by DC Water to finance DC Water's investment in large tunnels to capture combined sewage during rainfall events and other controls implemented under the DC Water's Clean Rivers (DCCR) project.

The stormwater fee generates approximately $13 million in revenue per year. DOEE uses most of this revenue to address MS4 programmatic requirements. Sizeable portions are also distributed directly to DDOT, DPW and DC Water for stormwater-related maintenance, inspection and other source control activities under interagency MOUs. The amount that is available for direct investment in BMPs and other pollution controls is approximately $3.65 million per year.

10.2.2 The Anacostia River Clean Up and Protection Fund

This fund was established by the Anacostia River Clean Up and Protection Act (DC 2009), the "Bag Law." Explanation of how the Bag Law funding is collected is provided in Figure 10-1.

"Bag Law Funding"

The Anacostia River Clean Up and Protection Act ('Bag Law') requires all District businesses that sell food or alcohol to charge five cents for each disposable paper or plastic carryout bag — whether or not food or alcohol products are purchased in the store.

The business retains one cent (or two cents if it offers a rebate when customers bring their own bag), and the remaining three or four cents go to The Anacostia River Clean Up and Protection Fund. The law also requires that reusable paper and plastic bags meet specific material and labeling requirements.

Figure 10-1. Bag Law Funding

The Bag Law generates approximately $2.1 million in revenue per year. This revenue is used by the District to fund a variety of activities including installing and maintaining trash retention projects, stream restoration projects, and watershed educational programs. The amount that is available for direct investment in new practices to keep trash and other pollutants out of District waterways is approximately $915,000 per year.

10.2.3 Clean Water State Revolving Fund

The Clean Water State Revolving Fund (CWSRF) is a congressionally authorized loan program administered by EPA that provides low interest loans to municipalities, water agencies and other entities to help communities achieve the goals of the Clean Water Act. The level of funding at the national level in recent years has been on the order of $5 billion per year. Funding is typically used to improve and expand wastewater treatment, stormwater management and nonpoint source control programs.

The District receives approximately $6 million in CWSRF funds each year, with approximately $3.1 million typically dedicated for green infrastructure projects. The remaining funds are utilized by DC Water for grey infrastructure improvements. In the case of the District, the CWSRF funds are treated as a grant, not a loan, and repayment is not required. $3.1 million is available for direct investment in BMPs and other pollution controls.

10.2.4 Section 319 Grants

EPA awards Section 319 grants to states under the Clean Water Act for the implementation of nonpoint source management programs. The District receives approximately $1.2 million in Section 319 grant funds each year. Approximately one-half of this funding, or $600,000 per year, is available for direct investment in watershed and water quality oriented projects.

Section 319 funds are restricted for use in nonpoint source control – not MS4 stormwater management. Consequently, much of this funding is directed toward stream restoration projects. However, while stream restoration may not directly reduce MS4 loading, it has the benefit of improving stream health, which is one of the ultimate goals of meeting MS4 WLAs.

The amount of funding in 319 grants in the federal budget has decreased over time. For example, the level of Section 319 funding of $238 million in 2003 decreased to $165 million in 2012.

10.2.5 Chesapeake Bay Implementation Grants

The Chesapeake Bay Implementation Grants (CBIGs) are authorized under the Chesapeake Bay Agreement and administered by the EPA Chesapeake Bay Program. This federal funding source is given to states and the District for the purpose of implementing pollution management and control programs that primarily address nutrients (nitrogen and phosphorus) and sediment, the major pollutants affecting the quality of the Chesapeake Bay.

The District receives approximately $750,000 in CBIG funds granted to DOEE each year. Nearly half of this amount is directed toward supporting the RiverSmart Communities Program. This program provides financial and technical assistance and incentives to condominiums, co-ops, apartments, locally-owned businesses and houses of worship interested in installing green infrastructure on their properties.

10.2.6 Chesapeake Bay Regulatory and Accountability Program Grants

The Chesapeake Bay Regulatory and Accountability Program (CBRAP) provides grants to support regulatory and accountability programs aimed at improving water quality in the Chesapeake Bay. CBRAP funds are authorized by Congress and administered by EPA. The funds are intended to be used for a variety of purposes to include development and implementation of:

- Regulatory monitoring, tracking, reporting and verification activities.
- Trading and offset programs.
- Technical and compliance assistance and guidance for Watershed Implementation Programs.

The District receives approximately $1 million in CBRAP funds each year. While this funding is used to support implementation, none of the funding is available for direct investment in BMPs and other pollution control measures.

10.2.7 National Fish and Wildlife Foundation Grants

The National Fish and Wildlife Foundation (NFWF) is a congressionally supported conservation organization. NFWF pursues partnership among federal agencies, private corporations and other non-federal partners in order to leverage funds for priority projects. EPA's Chesapeake Bay Program is an active partner. The NFWF Chesapeake Bay Stewardship Fund provides financial and technical assistance to local communities and organizations to protect and restore polluted water bodies in the Chesapeake Bay Watershed.

The District receives approximately $500,000 in NFWF funds each year. All of this funding is used for stream restoration projects and the retrofitting of stormwater BMPs in urban settings.

10.2.8 Other District Programs

Although not tracked directly, the District does utilize other sources of funds to invest in BMPs and pollution control including green infrastructure. General funds are used for capital projects and improvements by a number of District agencies, including DDOT road reconstruction projects, public facilities construction by DGS, DC Housing Authority projects, etc. All public projects must comply with the District's stormwater management regulations, and projections.

10.2.9 Summary of Current Sources and Levels of Funding

The District currently pays for its investment in stormwater management and pollution control under the MS4 program with funds from seven separate sources. In addition, there are several other District programs that provide and invest funds in stormwater management and pollution control activities where the specific amount of funding for these purposes is not tracked. The seven current sources of funding are summarized in Table 10- 2. As shown, slightly more than $9 million is available annually for direct investment in BMPs and other pollution control measures. This investment in BMPs is for stormwater management retrofits that are not otherwise required by the District's stormwater management regulations.

Table 10- 2. Current Sources and Levels of MS4 Funding

Funding Source	Funding ($) Available for Direct Investment in Pollution Controls
Enterprise Fund	3,650,000
Bag Law	915,000
CWSRF	3,100,000
Section 319 Funds	600,000
CBIG	325,000
NFWF	500,000
Total:	**9,090,000**

In addition to these funds, the investment in BMPs by regulated projects under the District's 2013 Stormwater Management Rule (including public projects) is projected to be many times greater than the investment in non-regulated BMPs, and will include commitment of additional public resources for compliance with stormwater management regulations for publicly funded projects.

10.3 Funding the Consolidated TMDL IP

The major component of implementation - contributing approximately 80 percent of the projected total stormwater volume reduction achieved through the IP - is the construction and operation of BMPs projected to occur due to development and redevelopment in the MS4 area as a result of the District's 2013 Stormwater Management Rule. This rule affects public as well as privately–owned land, and includes portions of the PROW. The cost of implementing these BMPs will be absorbed by those doing the development and redevelopment.

Remaining implementation – the approximately 20 percent of the projected total stormwater volume reduction achieved through the IP that consists of ongoing BMP implementation from drivers and programs other than the stormwater regulations - will be backed and financed by a variety of funding sources. The annual level of funding is currently expected to remain constant over time, or to grow at a slow rate due to inflation. As discussed above, this funding is derived from many sources and it is used to administer, manage and advance the MS4 program. A major element of this is the requirement to reduce pollutant loads and achieve the MS4 WLAs. This challenge will be met in two major ways. One is direct investment in BMPs and other pollution control measures. The available funding for this is approximately $9 million per year. Use of these funds will be for stormwater retrofits that are not otherwise required by the District's stormwater management regulations, through:

- RiverSmart Programs
- DOEE-funded Stream Restoration
- DOEE-funded LID Projects
- DDOT BMP Projects

The second is the continuation of investment in existing programmatic activities and stormwater infrastructure to include:

- Catch basin cleaning
- Street sweeping

- Ongoing source control efforts
- IDDE
- Coal tar ban
- Household hazardous waste collection
- Fertilizer control
- Leaf collection
- Education and outreach on stormwater issues
- Operation and maintenance of District-owned BMPs

Other implementation activities on federal land within the MS4 area will also occur. For example, federal guidance on the implementation of Section 438 of the Energy Independence and Security Act of 2007 (EPA, 2009) calls on federal agencies to utilize a variety of stormwater management practices and green infrastructure to reduce the impact that federal facilities have on watersheds and urban water quality. In addition, the movement toward implementing sustainable solutions to stormwater management at private institutions like universities will occur.

DOEE's ability to expend funds for the purpose of the TMDL IP are subject to the provisions of the federal Anti-Deficiency Act, and DOEE may not expend in any one fiscal year any sum in excess of appropriations made available for the purpose of the TMDL IP for any particular fiscal year. Nothing in this TMDL IP shall be construed as obligating DOEE to expend any sum, or enter into any contract or other obligation for the expenditure of money, in any fiscal year in excess of such appropriations.

10.4 Financial Affordability

The Consolidated TMDL IP has to be planned, managed and funded within the financial means available. This involves balancing the rate of implementation with the financial capabilities of the District in a manner that is affordable to and can be sustained by the District's residents and sewer rate payers.

The Baseline Assessment that accompanies this Consolidated TMDL IP documents that achievement of the MS4 WLA pollutant load reductions is a major undertaking. In particular,

- The pollutant load reduction gaps for nearly all of the MS4 TMDL WLAs are substantial. Achieving the WLAs for the majority of the pollutants will require extremely high levels of stormwater management and control.
- The existing inventory of BMPs represents a start, but generally achieves less than 5 percent of the pollutant load reduction that is needed to meet MS4 WLAs.
- Retaining 1.2 inches of runoff volume, even if theoretically applied to the entire MS4 drainage area (not just to new development and redevelopment), would still not achieve the load reduction necessary to meet nearly 45 percent of the MS4 TMDL WLAs.
- The MS4 area is largely residential (approximately 40 percent) and, beyond the RiverSmart programs, there is little incentive for home owners in residential neighborhoods to retrofit stormwater BMPs on properties where development and/or redevelopment is not planned.

The District and sewer rate payers are faced with the challenge of implementing large amounts of pollution control over broad areas with BMPs and other forms of stormwater management that are very expensive. This challenge is in addition to other very expensive programs that the District and its residents and sewer rate payers are committed to, including advanced water and wastewater treatment and CSO control.

The next sections discuss these implementation challenges in the context of financial affordability from both a local and national perspective.

10.4.1 Local Perspective

The District is investing heavily in water infrastructure projects, including treatment system upgrades at the Blue Plains Waste Water Treatment plan, and the over $2 billion cost of the DC Clean Rivers (CSO control) Project. A listing of significant changes that have impacted District rate payers since establishment of the Long Term Control Plan Consent Decree in 2005 includes:

- Nitrogen removal at Blue Plains
- A new Biosolids Program
- The increased cost of the DC Clean Rivers (CSO control) Project to $2.6 billion.
- Acceleration of the Anacostia River Tunnel schedule to alleviate flood problems.
- Additional renewal and rehabilitation of sewer system infrastructure.

In the District, DC Water recently reevaluated the affordability of implementing its Long Term Control Plan for CSOs (DC Water, 2014). Drawing on EPA's acknowledgement in its 2013 Memorandum on *Assessing Financial Capability for Municipal Clean Water Act Requirements,* DC Water determined that the best financial indicators for the assessment of affordability in the District are:

- Unadjusted MHI
- Cost of Living Adjusted (COLA) MHI
- Unadjusted Upper Limit of the Second Quintile for Household Income
- COLA adjusted Upper Limit of the Second Quintile for Household Income

DC Water undertook this assessment in order to explore an option to modify its Long Term Control Plan in order to place more emphasis on green infrastructure and less on gray infrastructure (tunnels). The cost of implementing MS4 stormwater controls to meet TMDL requirements beyond the existing stormwater fee in the sewer bill (discussed earlier) was not included in the assessment of affordability for sewer rate payers in the District. Nevertheless, the major conclusions of this assessment are:

- Using a sewer bill threshold of 2 percent of MHI is a poor indicator for assessing affordability.
- With the COLA factor taken into account, forecasted sewer bills become unaffordable to 40 percent of District households as soon as 2018.
- Extension of both the Consent Decree Schedule and deferment of other sewer and wastewater projects is necessary to maintain affordable rates.

These findings for District sewer rate payers suggest that incurring additional costs for stormwater management beyond current expenditures would be significantly constrained. Therefore, the projected implementation of the IP is based on the current levels of public resources.

10.4.2 National Perspective

Affordability and the amount of investment required by local governments and utilities to meet Clean Water Act requirements is an issue of great interest across the nation. The initial focus on this topic during the late 1990s was centered on CSO communities (including the District) that had requirements to develop Long Term Control Plans to address water quality issues caused by CSO discharges. More recently, TMDL requirements have been incorporated into MS4 permits. As enforceable mechanisms, strict compliance with TMDL requirements might obligate MS4 permittees to implement extremely costly and in some instances infeasible levels of stormwater management and pollution control in order to meet water quality standards. The potential strain that strict compliance places on local governments and water agencies is a concern recognized by EPA, states, and the regulated community.

EPA's 2011 Memorandum on *Achieving Water Quality through Integrated Municipal Stormwater and Wastewater Plans* recognized the difficult financial conditions that state and local governments face (EPA, 2011). The emphasis in this approach is placed on concurrent consideration of all Clean Water Act requirements (permits and consent decrees) in a balanced and integrated manner. This enables permittees to prioritize and act on the most important water quality problems that are present in their communities with cost-effective solutions for these problems. The memorandum states that

> … *In doing so, we must be diligent in ensuring that a municipality be positioned to address its most pressing public health and welfare issues first.*

Positioning in this manner requires prioritization of problems, understanding of financial capability and the need for realistic implementation schedules.

The US Conference of Mayors in conjunction with the American Water Works Association and the Water Environment Federation issued an Issue Brief on *Assessing the Affordability of Federal Water Mandates* (Stratus, 2012). This paper took a critical look at the limited resources that local governments and water agencies have to address the many requirements that have to be implemented under the Clean Water Act and the Safe Drinking Water Act. In addition, the Issue Brief expressed the need for EPA to consider alternative methods for assessing a community's financial capability beyond the current approach and its emphasis on Median Household Income (MHI).

Assessing the Affordability of Federal Water Mandates

Investment to meet federal water and wastewater requirements can impose significant financial hardships on households, businesses, and the broader communities in which they are located. When communities face large— and sometimes multiple—federal water mandates, the combined impact of the required expenditures can be extremely expensive for everyone in that community who pays a water or wastewater bill (most consumers get one combined bill for water and wastewater services). For the utility, the cumulative suite of required investments not only strains fiscal capacity but may also displace other important investments, including critical but non-mandatory capital improvement and infrastructure renewal projects. For the greater community, mandatory investments may also squeeze out other important priorities, such as social safety net programs and economic development efforts. For the residents and businesses in affected cities, the capital and operating expenses associated with federal mandates are often reflected in water and wastewater bills that must grow faster than household incomes and the general rate of inflation. Very significant affordability challenges are often created, particularly for lower-income households.

Stratus Consulting, 2012.

After hearing from these organizations and others, EPA clarified its position with regard to the economic challenges faced by local governments in its 2013 Memorandum on *Assessing Financial Capability for Municipal Clean Water Act Requirements* (EPA, 2013). EPA acknowledged in this Memorandum that:

> *"Many local governments face complex water quality issues that are heightened by the need to address population growth, increases in impervious surfaces, source water supply needs, and aging infrastructure."*

EPA's 2013 Memorandum also stated:

> *"The flexibilities under the Clean Water Act, regulations, and EPA policies allow local government to continue to maintain existing wastewater and stormwater systems while making progress on clean water goals in a manner that is sustainable and within a community's financial capability."*

EPA affirmed that MHI is one indicator of financial capability that is used to establish an appropriate implementation schedule. It strongly encouraged communities to use a broader range of other financial indicators and municipal-specific information in the assessment of rate structure and a sustainable timeframe for the implementation of projects.

To put funding into context, the Comprehensive Baseline Assessment (DDOE, 2015) that accompanies this IP document shows that achievement of the MS4 WLA pollutant load reductions is a major undertaking. The District is faced with the challenge of implementing large amounts of stormwater control over broad areas with BMPs and other forms of stormwater management that are very expensive. This challenge comes on top of other very expensive programs that the District and its residents and sewer rate payers are committed to, including advanced water and wastewater treatment and CSO control.

10.5 Summary

In summary, regulated development will be the largest driver of BMP implementation to address stormwater runoff and pollution. Public funding and policies for the IP will be used in a targeted manner to address gaps and implementation in priority watersheds as the District tracks progress under the IP. This level of investment allows for continued progress toward reaching MS4 WLAs and makes the IP sustainable and affordable to District residents. However, affordability for potential additional controls remains an issue in the District.

While the total cost of the IP is not quantified, it is expected to exceed the $2.6 billion cost of DC Water's CSO control program. The water bill paid by District rate payers currently includes charges to address drinking water, wastewater and stormwater requirements under the Safe Drinking Water Act and the Clean Water Act. It includes the ERU-based stormwater fee and the substantially larger CRIAC that goes to CSO control. There is evidence that incurring additional costs for stormwater management beyond current expenditures for water and wastewater would be unaffordable. The level of funding described herein for the Consolidated TMDL IP represents a substantial investment that is balanced with the investment in CSO control and other programmatic requirements and priorities, in a manner that is consistent with EPA's recognition of the need for Integrated Municipal Stormwater and Wastewater planning.

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Appendices

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