Charles County Phase II Watershed Implementation Plan Strategy






Prepared for:

Charles County Department of Planning and Growth Management

February 2013

Prepared By:
LimnoTech
Mid-Atlantic Regional Office

LimnoTech
Water | Scientists
Environment | Engineers

This page is blank to facilitate double sided printing.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

THIS PAGE IS BLANK TO FACILITATE DOUBLE SIDED PRINTING.

EXECUTIVE SUMMARY

In December, 2010, the U.S. Environmental Protection Agency (EPA) published the Chesapeake Bay Total Maximum Daily Load (i.e., the Bay TMDL). The Bay TMDL set limits on the number of pounds of nitrogen, phosphorus and sediment to be discharged within the various Chesapeake Bay "basins" while still allowing the Bay to meet water quality standards. EPA apportioned the TMDL among the Bay states and the District of Columbia (called the Bay "jurisdictions"), giving them allocations, or "target loads," (targets) which represented the portion of the nitrogen, phosphorus and sediment that jurisdiction could discharge. These targets included 2017 "Interim" and 2025 "Final" targets, with the goals of having sufficient pollution control measures in place by 2017 to meet the Interim target of 60 percent of the pollutant load reductions, and to have additional measures in place by 2025 to meet the Final target of 100 percent of the reductions. EPA expected each jurisdiction to develop Watershed Implementation Plans (WIPs), which described in detail the jurisdiction's strategy to meet their targets.

Maryland published its Phase I WIP in December 2010 and submitted the first draft of its Phase II WIP in December 2011. As part of the Phase II WIP process, the Maryland state agencies developing the WIP had further subdivided the target loads received from EPA and had assigned them in a number of ways, including by major basin, and also by responsible entity (local, state, or federal government) and "source sector" (wastewater, urban stormwater, septic, agriculture, forest, air). The Phase II WIP development process also engaged local partners, including county governments, to develop local strategies to meet these targets. County governments provided narrative strategies and Two-Year Milestones that were intended to document progress towards meeting targets. Some counties also submitted a detailed accounting of their strategies through a tool called the Maryland Assessment and Scenario Tool, or MAST. If a county chose not to submit a BMP scenario through MAST (as was the case for Charles County), a scenario was developed for that county based on generalized assumptions, and that scenario was included in the Phase II WIP.

This document represents Charles County's Phase II WIP strategy. It includes analysis of the County's baseline and target loads for the various source sectors for which the County government is responsible (wastewater, urban stormwater, septic systems, forest; the County is not responsible for agricultural or air deposition loads, nor for loads from federal or state lands), and potential scenarios to reduce loads from these source sectors. It also includes analysis of the potential costs of these various scenarios. The strategy discusses integration of the Bay TMDL requirements with those of other County programs and requirements such as the reissuance of the County's pending NPDES municipal stormwater permit and other County planning efforts. Finally, the strategy summarizes the results of the load analyses and recommends a set of Two-Year Milestones that can guide the County towards implementing a successful strategy over the next two years.

Much of this strategy document is focuses on analyzing the County's baseline loads and developing scenarios to reduce loads reflecting the actual conditions in the

County. This means using local data, such as the County's inventory of its septic systems and local information on land use, impervious surfaces, and current Best Management Practices (BMPs) in place in the County. The use of local data has resulted in identifying several discrepancies between the loading numbers provided by Maryland Department of the Environment (MDE) and the loading numbers calculated as part of this strategy. This is not surprising, as the data sets used to develop the Bay TMDL targets are known not to have the necessary resolution to be scaled down to the local level. This process of scaling the Bay TMDL targets depended on the assumptions in the overall TMDL, and then more assumptions and re-working of the data by MDE. Therefore, many of the loads for the County presented in Maryland's Phase II WIP are inaccurate when compared to calculations using available local data.

The strategy developed in this document was based on using local data to calculate baseline loads, but then using targets based on the same percent load reduction that was shown in the Phase II WIP. For example, using the baseline load and target numbers in the Phase II WIP shows that the County should achieve a 15.5 percent reduction in nitrogen from the urban stormwater sector. Therefore, this strategy was designed to achieve a 15.5 percent load reduction from the actual urban stormwater loads that were calculated using local data.

The strategy presents a number of potential options, or scenarios, for achieving the load reduction targets. These include scenarios for both the septic system and urban stormwater sectors. For the septic system sector, proposed strategies include developing an ordinance to require regular pump-outs, and greatly increasing the number of septic systems that are connected to wastewater treatment plants (WWTPs) and/or upgraded to Best Available Technology (BAT). These strategies are based on identifying the septic systems that contribute the most to the problem, and prioritizing them for load reduction practices. For urban stormwater, the proposed strategies include stream restoration, retrofitting existing stormwater ponds with more efficient BMPs, restoring stream buffers, and retrofitting developed properties with no stormwater management to Environmental Site Design (ESD) to reduce loads. Many of these strategies involve the need to work on private land, and it will be critically important to find and develop incentives for private landowners to participate in the process of reducing loads from private land.

The strategy discusses several options for funding the BMPs needed to meet targets, including using the Bay Restoration Fund (BRF) and potentially other grant opportunities. While the Maryland Phase II WIP analysis suggests that the BRF will be a large source of the funds necessary to achieving the septic system targets at the local level, the new requirements to implement stormwater utility fees are expected to fund the majority of the BMPs for stormwater. Even with the new utility fee, it is likely that the County will need to incentivize BMPs on private land in return for reductions in the stormwater fee. This is also particularly important because the County will be hard pressed to achieve the load reduction targets by only working on County-owned land.

Because the load reduction targets are difficult to reach, the scenarios also envision "offsetting" some of the required load reductions by taking credit for excess load capacity available at the County's WWTPs, particularly the Mattawoman plant. Even accounting for projected growth in the County based on scenarios in the County's Water Resource Element document, the Mattawoman should be well below the targets set by MDE. Therefore, a portion of this excess load capacity can be used to offset load reductions in other sectors; in other words, some sectors can do less because other sectors are doing more. The scenarios propose using excess load capacity from the Mattawoman plant to decrease the amount of load reduction that the septic system sector must make to meet targets.

While the costs for the various scenarios have a very large range depending on the BMPs that are implemented (for example, the scenarios for urban stormwater range from $125 million to $2.5 billion), some scenarios are relatively low cost. The least costly option developed for this strategy is $216 million, as shown in Table ES-1.

Table ES-1
Total Costs for Load Reduction Strategies, Urban Stormwater Sector Scenario 3 and Septic System Sector Scenario 3

Scenario Name	Total Cost	Cost to County
Stormwater Sector Scenario 3 - Focus on Stream Restoration	$125,662,791	$97,817,080
Septic System Sector Scenario 3 – Focus on Priority Project Areas	$90,807,690	$74,642,840
Totals	**$216,470,481**	**$172,459,920**

While this is the least costly option, cost may not be the only factor in choosing a strategy. For example, it may be not be feasible to implement strategies that require extensive work on private land, even if they are less costly. It may be difficult to get the cooperation of private property owners, and there may be legal, political, or other issues that must be resolved in order to do this type of work. All of these factors must be considered before adopting a specific strategy to reduce loads.

Nonetheless, the analysis included in this document should give the County the tools to move forward with choosing an appropriate scenario to reduce loads. The County intends to use this strategy to work towards meeting the TMDL/WIP goals established by the EPA and MDE. However, the only specific commitments that can be made at the current time are to meet the two year milestones proposed in this document. Once the GIS data updates, demonstration projects, and studies are completed, the County will reassess its position. Ultimately, the County will require time beyond 2025 to meet the TMDL/WIP goals, and its strategies and progress will be based on the County Commissioners' goals and what is found to be an acceptable level of funding and burden for the county taxpayers.

This page is blank to facilitate double sided printing.

1. INTRODUCTION

In December, 2010, the U.S. Environmental Protection Agency (EPA) published the Chesapeake Bay Total Maximum Daily Load (i.e., the Bay TMDL), which has resulted in the need for local governments, agriculture, and federal and state governments to reduce pollutant loads.

The Charles County Phase II Watershed Implementation Plan (WIP) Strategy document (WIP Strategy) summarizes the proposed strategy for the Charles County Government (Charles County or County) to achieve load reductions and demonstrate progress in meeting the goals of the TMDL. The first section of the WIP Strategy document describes the TMDL and discusses some of the challenges inherent in development of the TMDL and the targets. Section 2 discusses the County's targets. Section 3 presents several potential load reduction scenarios, and Section 4 documents the costs of these scenarios. Section 5 discusses integration of the load reduction strategy with other County programs. Section 6 summarizes the findings in Sections 3 and 4 and outlines Two-Year Milestones that can be implemented to move the County forward in implementing a strategy to meet the targets.

One major finding of the analysis conducted for the WIP Strategy is that there are significant challenges in applying the Bay TMDL at the local (county) scale. Successful resolution of these challenges required the re-calculation of baseline loads and target loads for the septic system and urban stormwater sectors relative to what was provided by MDE. As a result, the re-calculated baseline loads and targets are not identical to those provided by MDE. However, the load reduction strategy presented herein is consistent with achieving the same percent reductions for each source sector (wastewater, urban stormwater, and septic systems) as was provided by MDE.

1.1 THE BAY TMDL

The Bay TMDL actually consists of 276 individual TMDLs, one for each of three pollutants (nitrogen [TN], phosphorus [TP], and sediment) for each of the 92 impaired segments in the watershed. Because the Bay TMDL extended over multiple jurisdictions, EPA divided the pollutant targets by jurisdiction and major river basin. EPA relied on a combination of monitoring data, modeling results, and discussions with jurisdiction partners to ensure that the baseline and target loads were distributed "equitably" among the various jurisdictions and basins such that the tributary basins that contributed the most to the Bay water quality problems were required to make the most load reductions. This process ensured that each jurisdiction and basin had a load cap or target that, once achieved, would ensure that the overall TMDL was met.

Jurisdictions are responsible for developing "Watershed Implementation Plans" or WIPs, to describe the process by which they will achieve the pollution targets. The State of Maryland published its Phase I WIP in December 2010. One of its main purposes was to identify final target pollutant loads to be achieved by various sources and geographic areas in the state. The Phase I WIP also provided a basic strategy for meeting these targets.

Maryland's Phase II WIP was published in October 2012 and contained more detailed plans for meeting the TMDL, including target loads for each county and Baltimore City for the pollutant "source sectors" for which these local governments were responsible. These included municipal point source wastewater, urban stormwater, and septic system loads. Baseline loads and reduction targets were also identified and assigned for systems owned by other entities (e.g., federal and state governments, private owners). Finally, targets were also provided for agriculture and air deposition.

The County received target loads for the agriculture, urban stormwater, septic system, forest, and wastewater sectors. As a local government with jurisdiction over various aspects of land use, as owner and operator of multiple municipal wastewater treatment plants (WWTPs), and as permit holder for a National Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) discharge permit, the County is responsible for load reductions in the urban stormwater, septic system, and wastewater sectors. The County is not responsible for loads or load reductions from federally-owned or state-owned land or facilities, or private industrial point sources, nor is it responsible for loads from the Towns of Indian Head and La Plata, both of which are separate municipalities with jurisdiction over their own land area. The County is also not responsible for loads or load reductions from the agriculture or air deposition sectors, which are managed by State agencies. No load reduction is required from the forest sector, and because forest has the lowest pollutant loading rate of all land uses, increasing forest is preferred.

1.2 ACCOUNTABILITY FRAMEWORK

As the restoration of the Chesapeake Bay has transitioned from a voluntary regional compact under the Chesapeake Bay Agreement to include a regulatory process under the federal Clean Water Act, the federal government has established an accountability framework to ensure the restoration of the Bay. The federal accountability framework includes the following elements:

- Bay TMDLs
- Watershed Implementation Plans
- 2-Year Implementation Milestones
- Tracking and Evaluating Progress
- EPA "Consequences Letter"

EPA has established the Bay TMDLs and has worked with the Bay jurisdictions to develop WIPs and Two Year Milestones. Local jurisdictions have also become involved in developing local WIPs and Two Year Milestones at the request of the Bay jurisdictions. The WIPs and Two Year Milestones will help EPA and the Bay jurisdictions, including Maryland, track and evaluate progress in meeting the TMDLs. EPA has also issued its "Consequences Letter" to describe actions it may take if it believes insufficient progress is being made towards meeting the TMDLs.

For a local government, the accountability for the TMDLs resides in the enforceability of any TMDL-related NPDES permit provisions. While the County has been assigned target loads as part of the Bay TMDL, these target loads are not directly enforceable. Instead, the only enforceable aspects of the TMDL are requirements incorporated into NPDES permits. For example, WWTPs have loading limits in their NPDES permits that either are currently consistent with the Bay TMDL Wasteload Allocations (WLAs) for these WWTPs, or will be consistent in the future when the permits are re-issued. For Phase I NPDES MS4 permittees like Charles County, the new generation of MS4 permits are expected to require permittees to "coordinate with" the Phase II WIP. More recently drafted MS4 permit text, such as that for Prince George's County, states:

> This permit is requiring compliance with the Chesapeake Bay TMDL through the use of a strategy that calls for the restoration of 20% of previously developed impervious land with little or no controls within this five year permit term as described in Maryland's Watershed Implementation Plan.

Thus the enforceable aspects of the Bay TMDL in MS4 permits are requirements to develop TMDL restoration plans and restore certain percentages of impervious surface. These requirements, however, are not directly parallel with the load targets assigned to the urban stormwater sector by the Bay TMDL.

Further complicating matters, EPA's expectations are that the Bay TMDL targets will be met at the basin level as opposed to the county level. Thus it is unclear if a specific county government or permittee would be held responsible for doing more if the larger basin did not meet targets.

While there do not appear to be direct methods for EPA to enforce targets for the Bay TMDL, EPA issued a "Consequences" letter in December 2009 which identifies actions that EPA may take against a Bay jurisdiction if that jurisdiction does not demonstrate satisfactory progress toward meeting the TMDL goals. Among the specific "actions" that the letter indicated that EPA would consider were to:

- Expand NPDES permit coverage to currently unregulated sources;
- Object to NPDES permits and increase program oversight;
- Require net improvement offsets;
- Establish finer scale WLAs and Load Allocations (LAs) in the Bay TMDL;
- Increase and target federal enforcement and compliance assurance in the watershed;
- Condition or redirect EPA grants; and
- Initiate Federal promulgation of local nutrient water quality standards.

It is worth noting that while EPA's "consequences" would be applied to the Bay jurisdiction, they could ultimately directly impact NPDES permit holders.

Because of this, the best compliance approach appears to be pursuing compliance with all NPDES permit requirements, including load limits and MS4 permit language requiring coordination with the Bay TMDL, TMDL restoration plans and restoration of impervious surface.

Non-compliance with the County's NPDES permit can result in MDE taking certain actions against the County. These could include:

- Fines
- Re-issuance of the permit with more stringent permit requirements
- Rejection of requests for increased loads or permits for new source loads.

The last point could ultimately restrict the potential for growth in the County if no new loads are allowed.

1.3 THE BAY MODELING PROCESS AND RESULTING LOADS AND TARGETS

The Bay TMDL is among the most complex TMDLs ever developed based on its scale and the amount of data used in its development. It is also unique with respect to the level of implementation planning through the WIPs. Based on this complexity and scale, it is important to understand how the TMDL was developed, what data were used to develop loads, how the loads were developed and allocated, and how these complexities and scales can lead to difficulties in reconciling allocations with local data.

1.3.1 Scale of Chesapeake Bay Modeling Efforts

As part of the modeling efforts for the Bay TMDL, EPA's Chesapeake Bay Program (CBP), subdivided the Chesapeake Bay watershed into 92 separate "segment-sheds" according to watershed and political boundaries and the similarities of the watersheds within each segment-shed. Generally, segment-sheds reflect certain unique physical, chemical or biological characteristics of a portion of a waterbody (e.g., salinity, influence of pollutant sources, etc.). As stated above, TMDLs for nitrogen, phosphorus, and sediment were developed for each of the 92 segment-sheds. Consequently, the data for use in the TMDL was also compiled and modeled on a segment-shed basis. This has ramifications for the reconciliation of local data with Chesapeake Bay modeling results (see discussion under Section 1.5 below).

1.3.2 Chesapeake Bay Modeling Tools

EPA used multiple modeling tools to calculate the TMDL. These modeling tools, the data used to run them, and the scale at which they are run, have major impacts on the TMDL and resulting pollution limits. For example, the Bay Watershed Model simulates nutrient inputs from manure, fertilizers, and atmospheric deposition based on an annual time series using a mass balance of U.S. Census of Agriculture animal populations and crops, records of fertilizer sales, and other data sources. It also considers the contributions from municipal and industrial wastewater treatment facilities and onsite wastewater treatment systems. The Chesapeake Bay Land Change Model uses modeling tools to project future urban developed area for more than 2,000 Bay Watershed Model segments. After the Bay Watershed Model segment scale forecasts of housing demand are adjusted to match the county scale totals, they are converted to an estimate of future urban developed area using segment-specific ratios of urban developed land cover area to total housing units and applied within the modeling framework.

After these models have estimated inventories of land uses and loads from various pollutant source types, they are run through EPA's Chesapeake Bay Scenario Builder tool. Scenario Builder generates information used to simulate loads related to animal production areas, manure storage, application of manure and fertilizers, septic inputs, plant growth/uptake, and BMP implementation. Scenario Builder estimates the amount of nitrogen and phosphorus load that will be generated by a given set of land uses and activities and estimates the available area of erodible soil. Loads are input to the Bay Watershed Model to generate modeled estimates of loads delivered to the Bay.

1.3.3 Modeling Individual Pollutant Source Sector Loads

For modeling for the TMDL, EPA collected information on multiple sources of pollutants in the Bay watershed, including pollutant loadings and estimates from WWTPs, urban stormwater, septic systems, agriculture, air deposition, and forested lands. These sources are designated as pollutant "source sectors" or simply "sectors." In some cases, such as with the wastewater sector, EPA had actual measured data on loads through databases that track discharges of wastewater treatment plants per NPDES discharge permits. In other cases, such as for urban stormwater, septic systems, agriculture, air deposition, and forest lands, EPA used available data (e.g., data from state databases, agricultural surveys, Geographical Information System (GIS) databases, etc.) to model the estimated load from these sectors.

A short summary of some of the major pollutant sources to the Bay watershed and how EPA modeled them for the Bay TMDL is provided below. This summary focuses on pollutant sources that are the responsibility of the County, and therefore does not include discussions of sources such as agricultural or atmospheric loads.

1.3.3.a WWTPs

EPA set load caps for municipal and industrial WWTPs using flow and discharge concentrations. The baseline loads and load caps were based on current WWTP flows and current discharge characteristics (baseline loads) and their design flows and permit limits (load caps). For major (>500,000 GPD) WWTPs identified as "significant" point sources, information on flows and permit limits was available from the facility permits and annual reporting. This information was also available for some minor, "nonsignificant" WWTPs, but not for all. Therefore, loading information for some "nonsignificant" facilities was based on default assumptions regarding flow and concentrations if no information was available on current pollutant loads. "Significant" point sources were given individual WLAs – equivalent to individual load caps – in the TMDL. The loads and load caps for "nonsignificant" facilities were grouped together in an aggregate WLA for the purposes of the TMDL.

1.3.3.b Urban Stormwater

Modeling various urban stormwater loads, including both regulated (e.g., Phase I and Phase II MS4s, construction and industrial stormwater) and non-regulated stormwater, is a complex process. Urban stormwater loads are generated through modeling runoff from different urban land use types. The Chesapeake Bay Model Version 5.3 uses four different developed urban land use types (high density impervious, high density pervious, low density impervious, low density pervious), plus extractive and construction land uses, to generate urban loads. EPA used satellite imagery, road, and housing data to define and quantify the developed urban land uses. As a next step, EPA developed imperviousness coefficients for each developed urban land classification that represented the percent imperviousness for that land class.

Quantities of each land use type were determined, and then land use-based loading rates, soil-based water, sediment, nitrogen, and phosphorus sub-models, and hydrologic simulations are applied to generate loads from the different land use types. Other factors, such as implementation of stormwater BMPs, fertilizer application, atmospheric deposition, and information on other pollutant sources (point sources, septic loads) are also applied in the model. The final modeling result provides average annual flow-adjusted loads, including developed urban land loads.

Further compounding the development of urban stormwater loads was that EPA used a Land Change model to forecast future land use changes. The Land Change model forecasts increased urbanization (and as such increased urban stormwater loads). These forecasted future loads were also incorporated into the TMDL.

It is important to note that the original dataset used by EPA to develop the urban land cover acreage may show higher or lower amounts of developed urban land than does the developed land use dataset that was used to set baseline pollutant loads and targets to meet the TMDL. This is because the developed land use dataset that was reported by EPA as part of the TMDL was modified to account for agricultural land as reported by the agricultural statistics survey data. The ramifications of this discrepancy include:

- The land cover data used to develop urban stormwater loads are not necessarily an accurate representation of the actual land cover in the Bay watershed, either in total land acreage or in the distribution of different land cover types relative to each other. Because of the large scale of the Bay modeling, this discrepancy is especially true at smaller scales, such as at the county level.
- It is not possible to reconstruct the urban stormwater loads used in the TMDL at a local scale using data that are available through planning tools such as the Maryland Assessment and Scenario Tool (MAST).
- Because the data available from MDE through MAST does not provide an accurate representation of stormwater loads at a local level, this tool and its data are not valuable for evaluating potential stormwater load reduction strategies. Therefore, other methods for evaluating potential stormwater load reduction strategies must be indentified and implemented.

The CBP has acknowledged the potential discrepancies in land use data and has convened a Land Use Workgroup as part of an attempt to address this issue. The Land Use Workgroup's website (http://www.chesapeakebay.net/groups/group/land_use_workgroup) contains the following statement "During the WIP process, differences have come to light between the land use data set used by the CBP that covers the entire watershed over a multi-decadal period and local-scale information. These differences have caused difficulties in implementation planning and reporting in support of the WIPs."

The website lists the Workgroup's goals as:

1. To create a temporally, spatially, and categorically consistent and accurate land use dataset from 1982 to 2012 for all jurisdictions in the Chesapeake Bay watershed using the best available data at all scales.
2. To approve methods for projecting future land use conditions for all jurisdictions in the Chesapeake Bay watershed.

This document will not address the ramifications of the reconciliation of urban versus agricultural land quantities for the overall Bay TMDL modeling effort, but it does provide an overall strategy that uses local data to re-calculate baseline loads and targets for the septic system and urban stormwater sectors relative to what was provided by MDE for these sectors. The use of local data resolves the problem of the inaccuracy of the baseline loads and load reduction targets provided by MDE, although it also causes other problems with respect to achieving the load reduction targets to meet the TMDL. This issue is addressed further in the following sections on "Using Local Data to Generate Loads" and **"**General Strategy to Address TMDL Allocations and Load Reduction Targets Using Local Data."

1.3.3.c Septic Systems (also known as onsite wastewater treatment systems)

In order to determine baseline loads from septic systems, EPA estimated the number of septic systems in each modeling segment by calculating the number of households outside areas served by public sewer. One septic system was assumed to exist for each household. EPA used digital data provided by the Maryland Department of Planning as well as digital maps of 2009 sewer service areas of some major WWTPs in the basin to determine the locations and numbers of septic systems in each jurisdiction. EPA then used standard assumptions of an average water flow of 75 gallons/person-day for a septic tank, a mean value of 3,940 grams of nitrogen/person-year for groundwater septic flow, 4,240 grams/person-year for surface flow of septic effluent, and typical surface/subsurface splits to calculate an average total nitrogen concentration of about 39 mg/L at the edge of the septic field for every septic system in the Bay watershed. EPA then applied delivery factors of 0.8, 0.5, and 0.3, respectively, to calculate the loads reaching the Bay from systems located within the critical area (defined as areas within 1,000 feet of the shoreline); not within the critical area but within 1,000 feet of a perennial stream; and not within the critical area and not within 1,000 feet of a perennial stream, respectively.

1.3.3.d Forest

As discussed in the Bay TMDL document, forested lands represent a significant portion of the Chesapeake Bay watershed, with forested and open wooded areas comprising approximately 70 percent of the watershed. Although forest lands contribute the lowest loading rate per acre of all the land uses in the Chesapeake Bay watershed, they still contributed an estimated 20 percent of total nitrogen, 15 percent of total phosphorus, and 18 percent of sediment of the total delivered loads to the Bay from the watershed.

Because forested lands do contribute loads to the Bay, forests were given their own baseline loads and targets in the Phase II WIP. The Phase II WIP assigned forests their current loading, with no expected load reductions. Because the TMDL modeling did not project forest loss due to growth and conversion of forest lands to other land uses, the amount of forest land was expected to remain constant, or actually increase (see below) over the timeframe of TMDL implementation.

In contrast to many other sectors, where loads are expected to decrease to meet the TMDL, the targets actually show a slight increase in forest loads because of the expected implementation of forested buffers or forestation BMPs. These BMPs convert the current land cover to forest land, increasing forest acres. These BMPs function to reduce load by converting higher-load land uses to lower-load forest land uses.

Despite their low loading rates, forest loads can be reduced through implementation of BMPs. The Bay Watershed Model differentiates between harvested and un-harvested forest lands as distinct land uses, with harvested forest lands contributing significantly higher pollutant loads than un-harvested forest lands. Harvested forest loads can be reduced by using forest harvesting BMPs.

Specifically, Maryland's Phase II WIP assigned Charles County 313,237 lbs TN and 10,629 lbs of TP load for un-harvested forest land for both current load and 2025 target. The 2025 targets for TN and TP loads for harvested forest are actually higher than the current loads (baseline of 12,431 lbs vs. 17,203 lbs for 2025 target for TN; baseline of 380 lbs vs. 551 for 2025 target for TP). As discussed above, these baseline loads and targets indicate that the County is not expected to decrease loads in this sector. Because the County is not expected to decrease loads in the forest sector, this strategy document does not contain further discussion of the sector as a whole. However, individual BMPs that convert high-loading land uses to forest land uses were evaluated as potential strategies to reduce loads in the urban stormwater sector, and these land conversion BMPs are discussed further in the urban stormwater section of this document.

1.4 ESTABLISHING BASELINE AND TARGET LOADS AT THE LOCAL LEVEL

As described above, when each Bay jurisdiction received its baseline and target loads, it was responsible for subdividing these baseline loads among source sectors and developing a WIP to describe how target loads would be met. In Maryland, MDE set targets at the county level, and various entities became responsible for developing strategies to meet targets at the county level. These include county governments, state entities owning land in a county, such as the Maryland State Highway Administration (SHA); or industrial or municipal dischargers. Agricultural loads and targets were managed by the Maryland Department of Agriculture. Federal loads were handled separately through dialogue between the state and the federal agencies.

MDE determined baseline and target loads for most source sectors in a very straightforward way. For example, point source wastewater baseline and target loads were based on NPDES permit information on flows and effluent limits, and much of the information on allocations for major point sources had been included in the TMDL itself. Baseline loads for the septic system sector were based on MDE's data on the number and location of septic systems in each county. However, MDE's determination of urban stormwater baseline loads was somewhat complicated, as discussed further below.

In general, MDE used the methodology already in place for developing stormwater WLAs for TMDLs. MDE used the same high and low density impervious and pervious loading rates used by the EPA in its allocations, but in a more refined land use classification scheme than what EPA used to generate the loads. In this process, MDE used 2007 Maryland Department of Planning (MDP) Land Use data to break the developed urban land loads into components that could be assigned to different landowners or responsible entities. Thus, MDE was able to identify forested land (assigned to the non-regulated stormwater sector), industrial and institutional lands (assigned to either the industrial sector or to individual state and federal Phase II MS4 institutions), SHA lands (assigned to SHA), and low density residential pervious land (assigned to the non-regulated stormwater sector). All of the remaining acreage and loads that weren't assigned elsewhere were assigned to the regulated MS4 sector. Of these developed urban land loads, the counties are responsible for:

- Regulated urban stormwater, which consists of the county's MS4 NPDES permit area.
- Non-regulated stormwater runoff, which consists of low density residential pervious and forested land uses.

1.5 TOOLS AVAILABLE TO DEVELOP LOAD REDUCTION STRATEGIES

MDE provided assistance in several ways to local governments for developing load reduction strategies, including the facilitation of Phase II WIP teams and the development of technical materials and presentations describing the TMDL development and allocation process. The Phase II WIP team in Charles County met regularly from March 2011 to November 2011, at which time the County submitted its initial two-year milestones to the State. MDE also developed and released MAST in 2011 to assist local governments and other affected parties in developing load reduction scenarios to meet their load targets. MAST is an online scenario development and load estimator tool that estimates nitrogen, phosphorus and sediment loads within a county based on the input of specific BMP and load reduction strategies. MAST's internal calculations and output files are consistent with the Chesapeake Bay modeling and allow direct upload of load reduction scenarios created by the counties into the Bay Model to evaluate whether these strategies will meet the Bay TMDL.

MAST includes baseline data on the amount of different land cover types, the number of BMP practices, the number of septic systems, and other baseline data organized by county. The tool works by allowing users to input certain implementation levels of different BMPs, typically by specifying either the percent of a pollutant source that will be controlled by a BMP, or the actual number of pollutant sources that will be controlled by that BMP. For example, for septic systems, MAST allows the user to specify the percentage or the number of septic systems in a county that will be connected to a WWTP or upgraded to Best Available Technology (BAT). For the urban stormwater sector, MAST allows the user to specify the percentage or the number of acres that will be controlled by specific BMPs, such as wet ponds. MAST then uses the CBP BMP efficiencies to calculate the appropriate load reduction from baseline that implementation of this level of these practices will achieve. The user can then compare the load reduction achieved by this scenario with the target loads for that county or sector to determine if the scenario is meeting targets. By mixing and matching the implementation level of different BMPs, the user can develop different scenarios that will achieve the required load reductions.

While MAST allows high level planning for evaluating load reduction strategies and facilitating upload of scenario data into the Bay Model, it has several weaknesses rendering it less useful for local planning. First, MAST has no spatial component and is not capable of evaluating where a certain practice would be located within a county. Therefore, MAST does not allow for assessing the feasibility of actually achieving that level of implementation of a certain BMP type because it does not allow consideration of local conditions “on the ground.” As an example, a user may set up a scenario wherein they choose to manage five percent of the MS4 impervious area using urban filtering practices, and MAST would show how much load reduction this level of implementation of this BMP would achieve. But this will not help a county assess whether it is feasible to actually manage the MS4 impervious area using urban filtering practices. In order to do this, the county must evaluate its local data to determine specifically where it can implement urban filtering practices, and, consequently, how much of this practice it can actually implement. Without the ability to conduct this type of “reality check,” MAST’s usefulness is limited.

A second issue with MAST is that its baseline data are based on CBP modeling at the entire Bay watershed scale. As discussed above, the CBP modeling used only four land use types to represent urban land and generate urban loads, whereas MDE used a larger number of land uses to allocate those loads. EPA’s modeling also incorporated future land use projections which show more urbanized land in the future. Finally, EPA’s urban land use inventory was modified to account for the quantity of agricultural land as reported by the agricultural statistics survey data. Taken together, all of these factors make it difficult, if not impossible, to reconcile land inventories (including total quantity of land and the proportion of land of different land use types) on a county scale between local data and data inputs to and outputs from the Bay model that were used in the TMDL and are represented within MAST.

Because of this, it is evident there is not value in using MAST or MAST data in evaluating urban stormwater load reduction strategies for the County. On the contrary, this analysis confirms it is more valuable and accurate to evaluate the County’s loads (specifically the urban stormwater and septic system sector loads) on a local scale using local data, and then to proceed with developing a load reduction strategy that used these more accurate evaluations of loads from the County.

1.6 USING LOCAL DATA TO GENERATE LOADS

Because tools such as MAST and its associated data are not reliable for accurate information about County pollutant sources and loads, alternative methods were developed for calculating loads and load reductions for the County. This was most important for the septic system and urban stormwater sectors, where there were major discrepancies in the data used to generate the original loads in the TMDL and/or to allocate the loads to the County. For example, for the septic system sector, the County's records show a substantially lower number of septic systems than do MDE's records and the MAST data, which should translate to a lower septic system sector load for the County relative to MDE's allocations. For the urban stormwater sector, review of MDP data actually shows more urban land in the County than is shown in MAST.

Based on these parameters, loads for the septic system and urban stormwater sectors were calculated based on local data. For the septic system sector, loads were calculated using local data on the inventory of septic systems and their locations relative to the critical area, plus standard assumptions regarding the loads from typical septic systems. For the urban stormwater sector, loads were calculated using local data on the quantities of different land use types, applying land use-based loading rates derived from local research results, and running standard runoff equations. More specific detail on the calculation of loads for these sectors is provided in the document section on that sector.

These methods, while based on the same principles as the TMDL modeling and load allocations, did not produce the same results as the TMDL and the MDE baseline loads or required load reductions, nor were they expected to. However, using these local data did provide greater confidence that the loads were better representative of what was actually occurring in the County.

1.7 GENERAL STRATEGY TO ADDRESS TMDL ALLOCATIONS AND LOAD REDUCTION TARGETS USING LOCAL DATA

Discussions presented above describe the problems and inconsistencies inherent in the loads and load reduction targets allocated to the County by MDE. Because the baseline loads for the septic system and urban stormwater sectors are potentially inaccurate, it makes little sense to develop strategies to reduce loads to the specific targets in Maryland's Phase II WIP. Instead, the load reduction strategies presented herein focus on load reductions from these sectors by the same percentages identified in the Phase II WIP.

The specific methods for re-calculating baseline loads and load reduction targets using local data are discussed in the section for each pollutant source sector, as are the strategies to achieve load reduction targets.

This page is blank to facilitate double sided printing.

2. CHARLES COUNTY'S BASELINE AND TARGET LOADS

As discussed previously, EPA developed the Bay TMDL and then set targets for each jurisdiction. Each Bay jurisdiction then further subdivided the targets and assigned them to the various entities responsible for those loads, including the agriculture sector and federal, state, and local (county) governments. As a whole, entities in the County received baseline loading information and targets for the agriculture, urban stormwater, septic, forest, and wastewater sectors. Baseline loads were provided as of 2009 data, and two sets of targets were provided: the 2017 "Interim" target and the 2020 (later revised to 2025) "Final" target. Strategies in the Maryland Phase II WIP therefore focus on having sufficient pollution control measures in place by 2017 to meet 60 percent of the pollutant load reductions, and to have additional measures in place by 2025 to meet 100 percent of the reductions.

Figures 2-1 and 2-2 show the 2009 loads and targets for both TN and TP, as provided to the County from the Maryland Phase II WIP (Note that MDE did not provide target sediment loads). Separate discussions of the County's responsibilities for each sector are provided below:

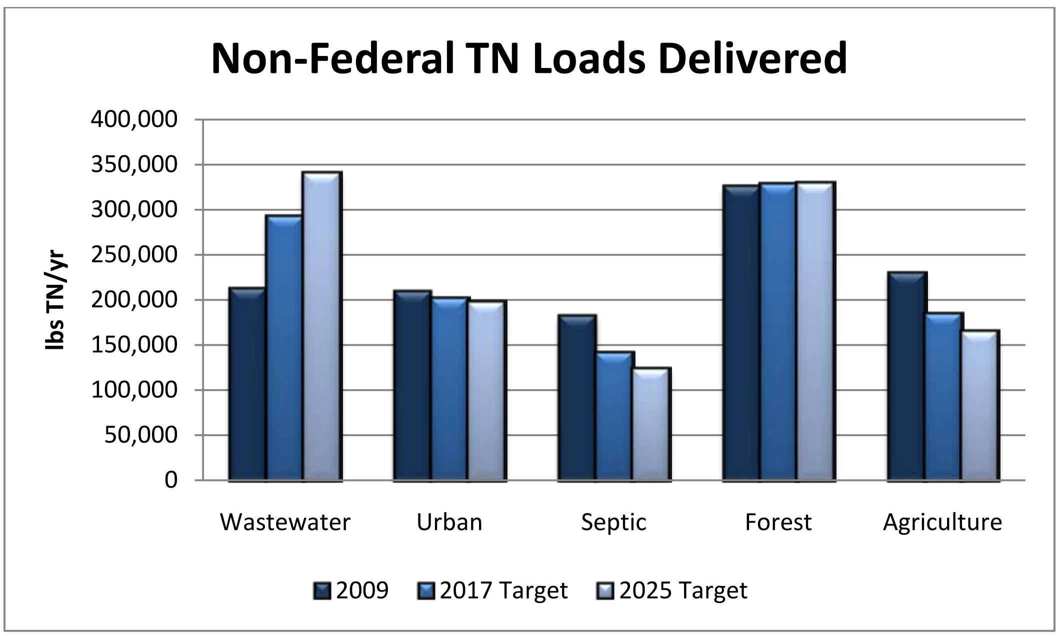


Figure 2-1 Baseline and Target TN Loads for Pollutant Source Sectors from the Maryland Phase II WIP

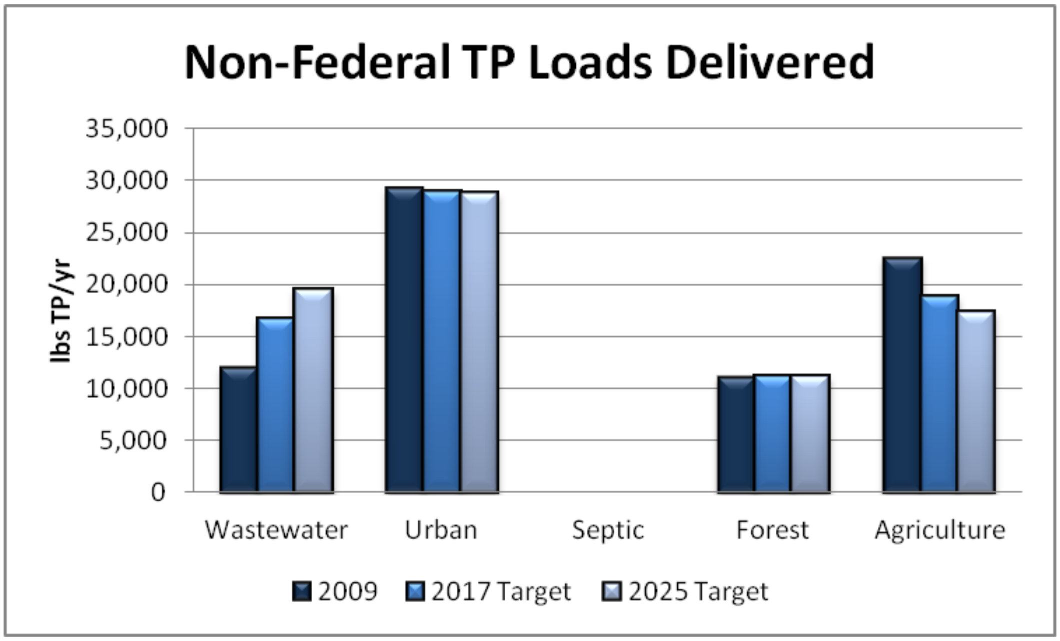


Figure 2-2 Baseline and Target TP Loads for Pollutant Source Sectors from the Maryland Phase II WIP

2.1 SOURCE SECTOR BASELINE AND TARGET LOADS

The following sections discuss the individual source sector loads and targets that were assigned to the County in the Maryland Phase II WIP.

2.1.1 Wastewater

Figures 2-3 and 2-4 show the respective baseline and targets for TN and TP, for the wastewater sector. As shown below, the wastewater sector includes major and minor municipal WWTPs; major and minor industrial WWTPs; major and minor federal WWTPs; and combined sewer overflows (CSOs). Of these, the County is responsible for a portion of the major municipal WWTPs and all of the minor municipal WWTPs. The loads for major municipal WWTPs include loads for the Mattawoman and Swan Point WWTPs for which the County is responsible, as well as the Indian Head and La Plata WWTPs, for which the County is not responsible.

Figures 2-3 and 2-4 show that the County does not have to reduce loads in the wastewater sector to meet targets. On the contrary, the figures show that the load from the wastewater sector is allowed to increase over time. This has ramifications for the overall management of pollutant loads by the County, and the availability of excess load capacity in the wastewater sector is discussed in more detail in Section 3.1.

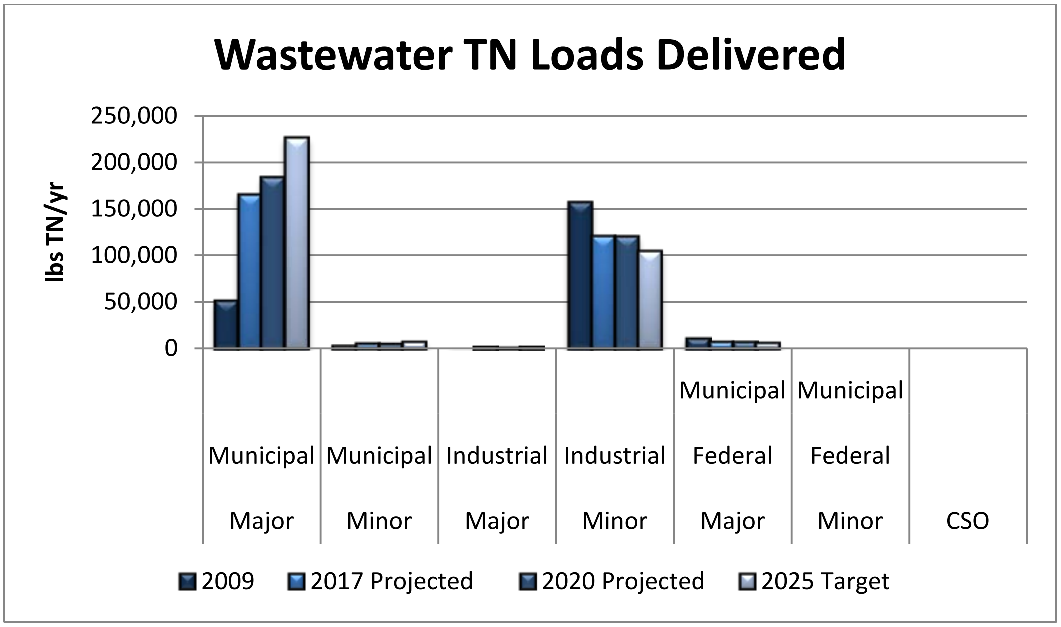


Figure 2-3 Baseline and Target TN Loads for the Wastewater Sector from the Maryland Phase II WIP

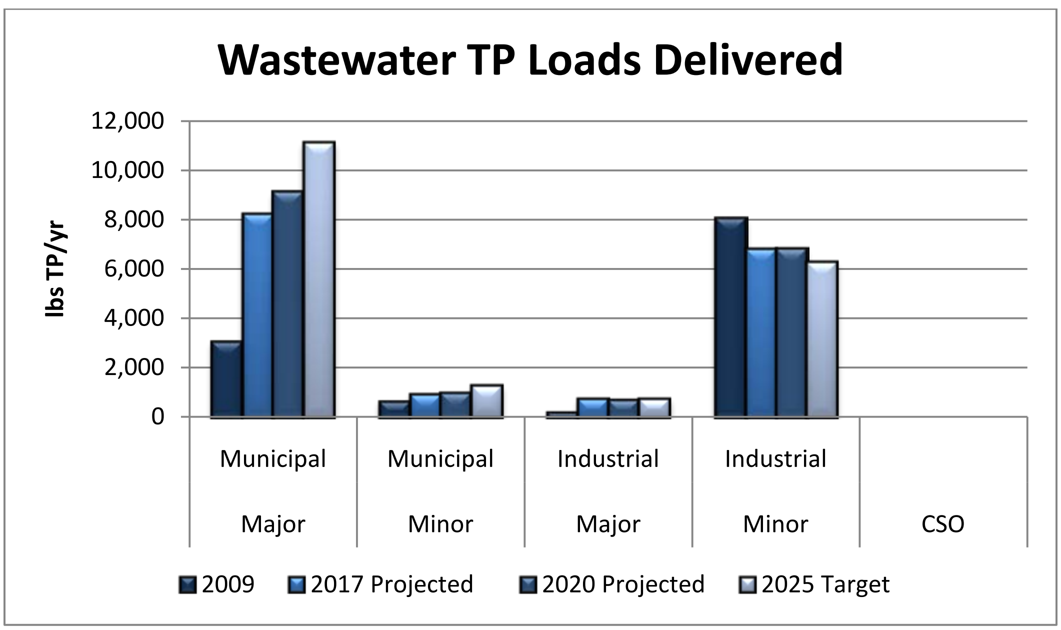


Figure 2-4 Baseline and Target TP Loads for the Wastewater Sector from the Maryland Phase II WIP

2.1.2 Urban Stormwater

The urban loads for TN and TP are shown in Figures 2-5 and 2-6. As shown in the figures, these loads consist of multiple components, including:

- County Phase I MS4 loads. These are stormwater loads from the County's Phase I MS4 area. The County is responsible for these loads.
- Municipal Phase II MS4 loads. These are stormwater loads from incorporated towns within the County that have Phase II MS4 permits. There are no municipal Phase II MS4 communities in the county, nor would the county be responsible for these loads if there were.
- State Phase II MS4 loads. These are storm water loads for state-owned facilities with Phase II MS4 permits, such as Maryland Army National Guard, Maryland Transit Administration, Maryland Department of Transportation Motor Vehicle Administration, and Maryland State Highway Administration (SHA) Phase II properties. The County is not responsible for these loads.
- SHA Phase I MS4 loads. These are stormwater loads generated from SHA Phase I MS4 lands in the County. The County is not responsible for these loads.
- Regulated industrial facilities. These are stormwater loads generated by facilities covered under the General Discharge permit for Stormwater Associated with Industrial Activities. The County is responsible for these loads, which are generated at County owned facilities, but is not responsible for these loads generated at privately owned facilities. These loads are expected to be addressed through permit conditions, thus are not discussed further in this document.
- Construction. These are stormwater loads generated from active construction sites. These loads are expected to be controlled according to current, applicable Construction General Permit Practices, and thus they are not discussed further in this document.
- Extractive. These are stormwater loads from active and abandoned mines. The County is not responsible for these loads.
- Non-regulated. These are areas that are not served by stormwater systems owned and operated by an MS4 jurisdiction. The County is responsible for these loads, within its jurisdictional boundaries.
- Federal developed. These are stormwater loads generated from Federal MS4s, such as the Naval District Washington, Indian Head. The County is not responsible for these loads.

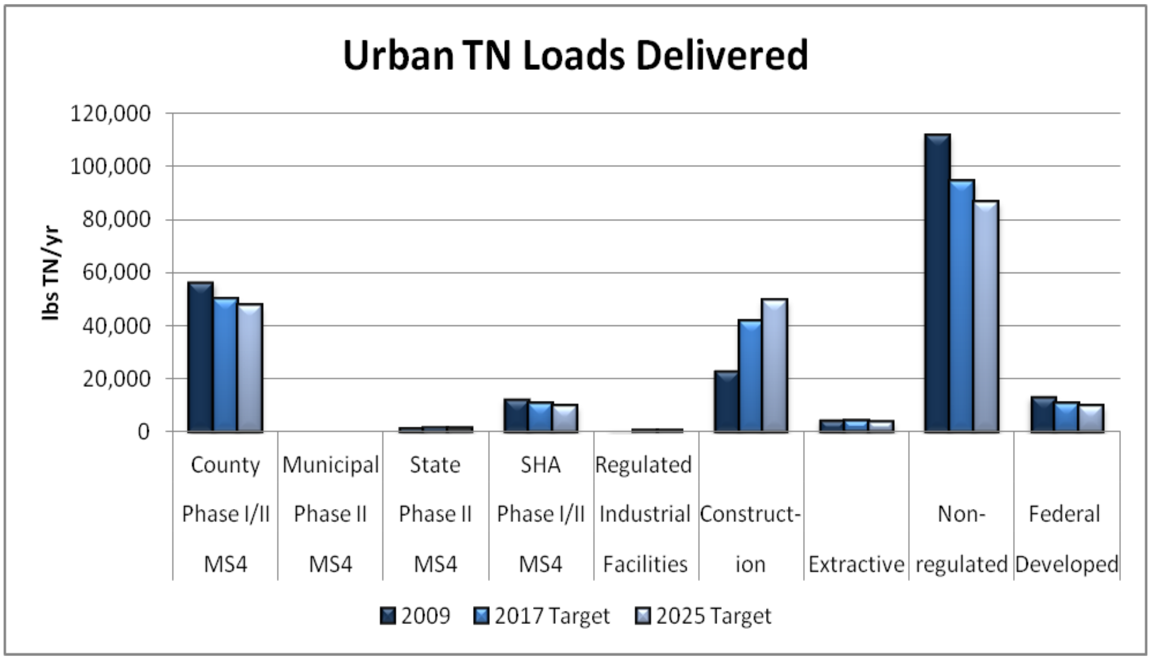


Figure 2-5 Baseline and Target Urban Stormwater Sector Loads for TN from the Maryland Phase II WIP

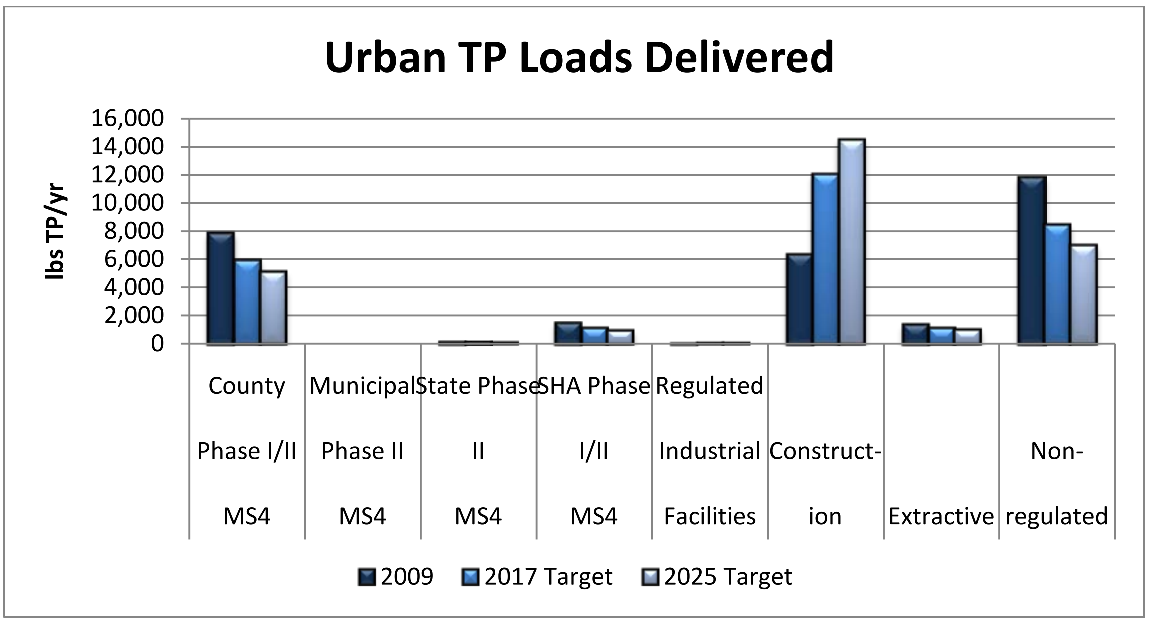


Figure 2-6 Baseline and Target Urban Stormwater Sector Loads for TP from the Maryland Phase II WIP

The summary above indicates that the County is only responsible for the County Phase I MS4 and the non-regulated stormwater loads. However, the municipalities of Indian Head and La Plata were included in the loads for the non-regulated area, and the County is not responsible for these municipalities. This issue is discussed in Section 2.2.

This document has already discussed the problems with the methods by which the urban sector loads were derived, including issues with the use of different land use types between EPA and MDE, and the problem of scaling loads and land use quantities from the Bay watershed scale to the local (county) scale. Evaluations of the data on total land and the distribution of different land use types in tools provided by MDE, such as MAST, reveal significant discrepancies between these data and local data, related to both the quantities and the distributions of different land use types. These discrepancies raise concerns for the validity and accuracy of the underlying data used by MDE to generate baseline loads and targets for the County's urban stormwater sector. Because of this, MDE's data on targets were not used in this strategy. Rather, the percent reductions used in the Maryland Phase II WIP were applied, but were using local (not state) data. This same percent reduction from baseline (only using local data) then became the target for this strategy. Also, load reductions expected from the Phase I MS4 sector and the non-regulated sector were not distinguished, as both are the County's responsibility, and because the MS4 area will likely expand into areas not currently regulated. Finally, the expectation is that targets will be met at the basin scale, so there is no real need to develop separate strategies or track separate targets for the regulated MS4 and non-regulated areas.

Based on the data shown in Figures 2-5 and 2-6, meeting the urban TN and TP targets will require load reductions of 20.3 percent and 38.2 percent, respectively. This information is summarized in Tables 2-1 and 2-2.

Table 2-1
Load Reduction Targets for TN for Urban Stormwater Sector from the Maryland Phase II WIP

Load Type	2009 Baseline (lbs)	2025 Target (lbs)	Load Reduction Required to Meet Target (lbs)	Percent Load Reduction Required to Meet Target (%)
County Phase I MS4	56,290	47,400	8,890	15.8
Non-regulated	111,896	86,696	25,200	22.5
Total	**168,186**	**134,096**	**34,090**	**20.3**

Table 2-2
Load Reduction Targets for TP for Urban Stormwater Sector from the Maryland Phase II WIP

Load Type	2009 Baseline (lbs)	2025 Target (lbs)	Load Reduction Required to Meet Target (lbs)	Percent Load Reduction Required to Meet Target (%)
County Phase I MS4	7,872	5,161	2,711	34.4
Non-regulated	11,830	7,005	4,825	40.8
Total	**19,702**	**12,166**	**7,536**	**38.2**

The strategies for urban stormwater were developed to achieve these 20.3 percent and 38.2 percent load reductions. The urban stormwater load reduction scenarios are discussed in detail in Section 3.2.

2.1.3 Septic Systems

The septic system sector loads are shown in Figure 2-7. Please note that septic systems are not considered to be significant contributors to phosphorus loads, and so septic systems did not receive baseline loads or targets for phosphorus.

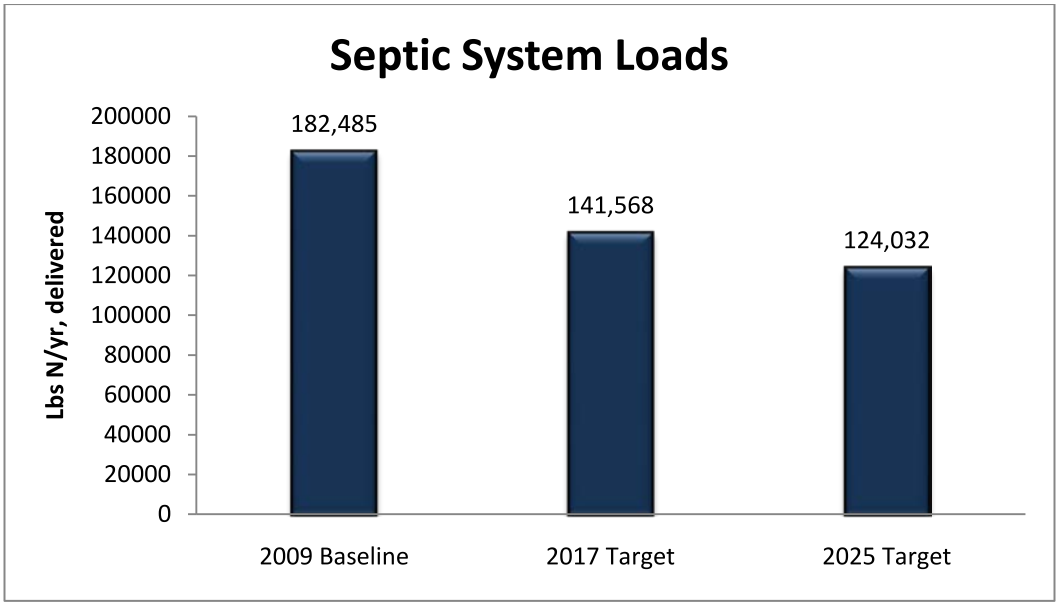


Figure 2-7 Baseline and Targets for TN for the Septic System Sector from the Maryland Phase II WIP

For septic systems, the County's inventory shows a significantly lower number of septic systems than does MDE's inventory. This is discussed in more detail in Section 3.3.

Because the number of septic systems in the County is a primary determinant of load for this sector, the septic loads in the WIP appear to be inaccurate. Therefore, the same percent reduction approach to that was used for the urban stormwater sector was applied to the septic system sector. The percent reduction from baseline necessary to achieve the targets is shown in Table 2-3.

Table 2-3
Load Reduction Targets for TN for the Septic System Sector From the Maryland Phase II WIP

Load Type	2009 Baseline (lbs)	2025 Target (lbs)	Load Reduction Required to Meet Target (lbs)	Percent Load Reduction Required to Meet Target (%)
Septic System	182,485	124,032	58,453	32

Based on these results, the septic system load reduction scenarios summarized in Section 3.3 of this document will be based on meeting a load reduction target of 32 percent of the TN load calculated for this sector.

2.1.4 Forest

As described in Section 1, the Phase II WIP assigned forests their current loading, with no expected load reductions. Forests have the lowest loading rates of any land use type in the Chesapeake Bay watershed, and local governments can actually reduce loads from other sectors by converting different land use types to forest (e.g., through implementing the forest buffer BMP type). Harvested forest land has a much higher loading rate than does unharvested forest land, and these loads can be reduced by using forest harvesting BMPs. The 2009 baseline loads and 2017 interim and 2025 final targets for TN and TP are shown in Figures 2-8 and 2-9.

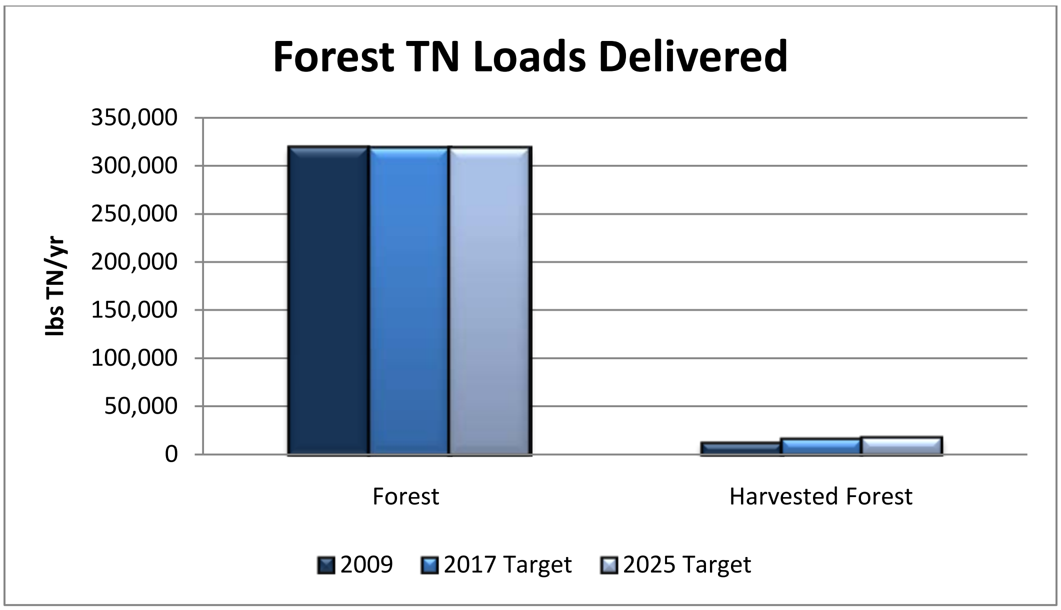


Figure 2-8 Baseline and Target TN Loads for the Forest Sector from the Maryland Phase II WIP

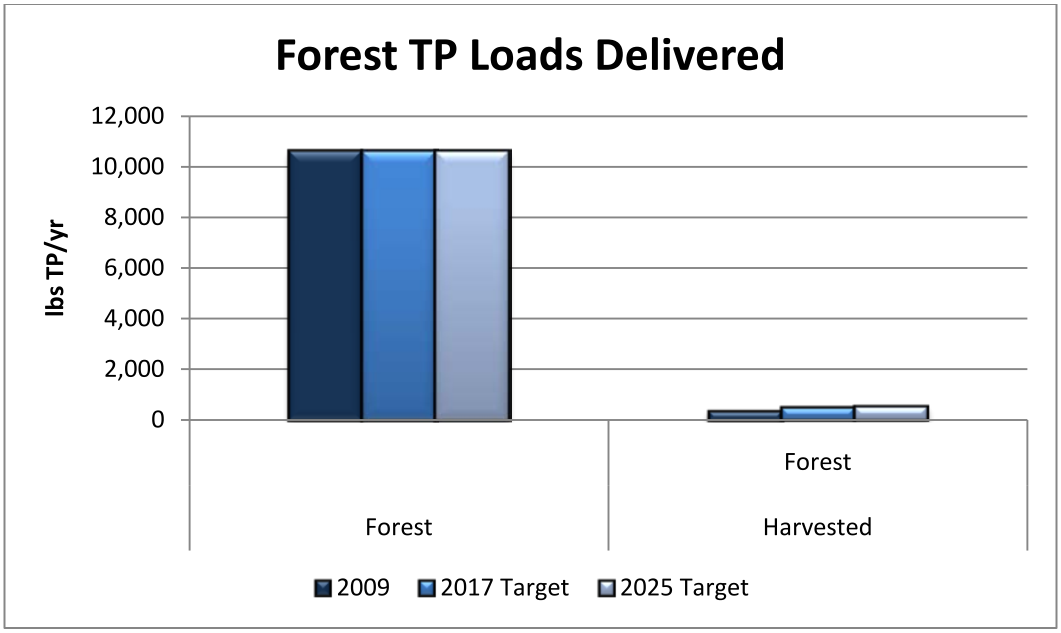


Figure 2-9 Baseline and Target TP Loads for the Forest Sector from the Maryland Phase II WIP

Because no load reduction is required from this sector, forest loads are not discussed in further detail in this document.

2.1.5 Agriculture

The County is not responsible for loads from the agriculture sector, and so these loads are not discussed further in this document.

2.2 INDIAN HEAD AND LA PLATA LOADS

The Towns of Indian Head and La Plata are two incorporated communities located in Charles County. Because they are incorporated, they have their own town governments, and the County is not responsible for the lands within the towns' boundaries. However, neither Indian Head nor La Plata have a Phase II NPDES MS4 permit for stormwater, and their loads were included in the urban stormwater sector baseline and target loads for the County, despite the fact that the County has no jurisdiction over land within Indian Head and La Plata. Similarly, loads for septic systems in Indian Head and La Plata were included in the loads and targets for the septic system sector. To rectify this, when loads and targets were re-calculated for the County using local data, Indian Head and La Plata were excluded. The subsections below describe the process for excluding Indian Head and La Plata loads.

2.2.1 Non-regulated Stormwater

Because land ownership could be determined for all land in the County, land from Indian Head and La Plata was simply excluded from the re-calculations of baseline load for the non-regulated area. And because load reductions were calculated using the same expected percentage reduction from background that was reported in the Maryland Phase II WIP, this percent reduction could be applied to just the calculated non-regulated area that excluded Indian Head and La Plata. Thus the target calculation remained valid.

2.2.2 Septic Systems

The County provided GIS datasets that included the locations of all septic systems, as well as the municipal boundaries of Indian Head and La Plata. These data were used to identify and then exclude septic systems within the municipal boundaries of Indian Head and La Plata. The calculation of septic system loads and targets after the removal of septic system located in Indian Head and La Plata is discussed in more detail in Section 3.

3. DEVELOPMENT OF A LOAD REDUCTION STRATEGY

3.1 WASTEWATER SECTOR

3.1.1 Wastewater Capacity

The County's 2009 baseline loads and 2025 targets for TN and TP are shown in Figures 3-1 and 3-2, respectively. Maryland's Phase II WIP strategy includes a higher target for wastewater than what is currently being discharged by WWTPs in the County. There are several reasons why the target loads are higher than current loads in this sector. First, the County's largest WWTP, Mattawoman, is operating at 57 percent of its maximum flow capacity in 2012 and is very efficient at removing nitrogen. Second, water re-use and water conservation projects reduce the overall flow or volume of wastewater going to the County's WWTPs. Thus the opportunity to leverage nutrient credits from the wastewater sector to be used in offsetting other sectors, such as the septic system sector and stormwater sector, presents itself.

According to Maryland's Phase II WIP, there were 175,121 lbs of annual average available load for Total Nitrogen (TN) (delivered) from the major municipal WWTPs in the County as of the 2009 baseline. This available load is calculated by subtracting the 2009 annual average baseline from the 2025 cap. This available load reflects the load that was available as of 2009. It should be adjusted by the expected 2025 growth projections and any planned plant upgrades to determine the expected available load by 2025.

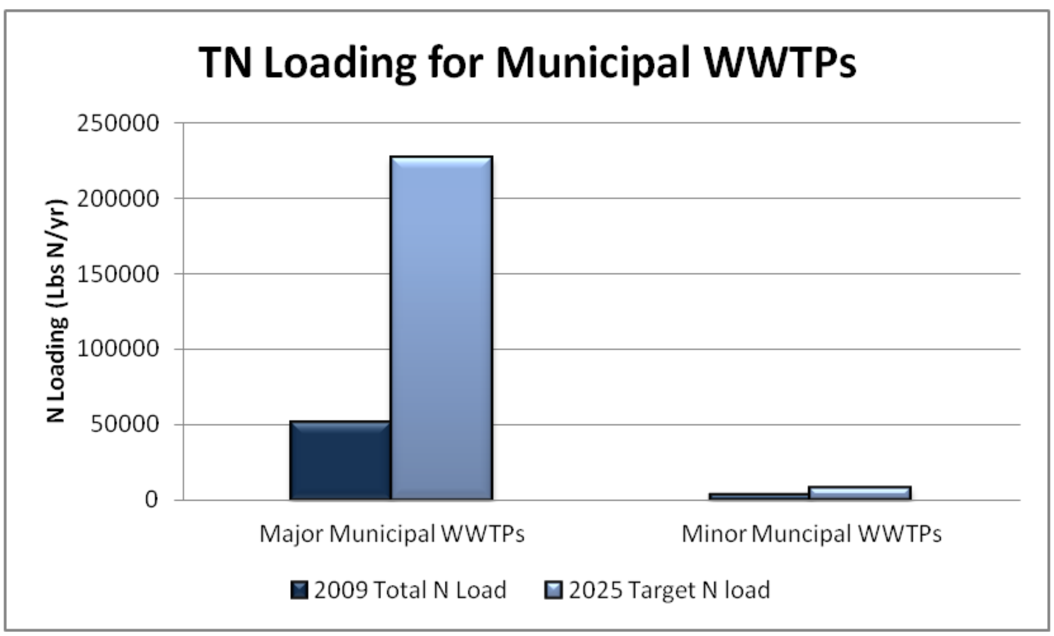


Figure 3-1 Total Nitrogen Loading for Municipal WWTPs in Charles County from the Maryland Phase II WIP

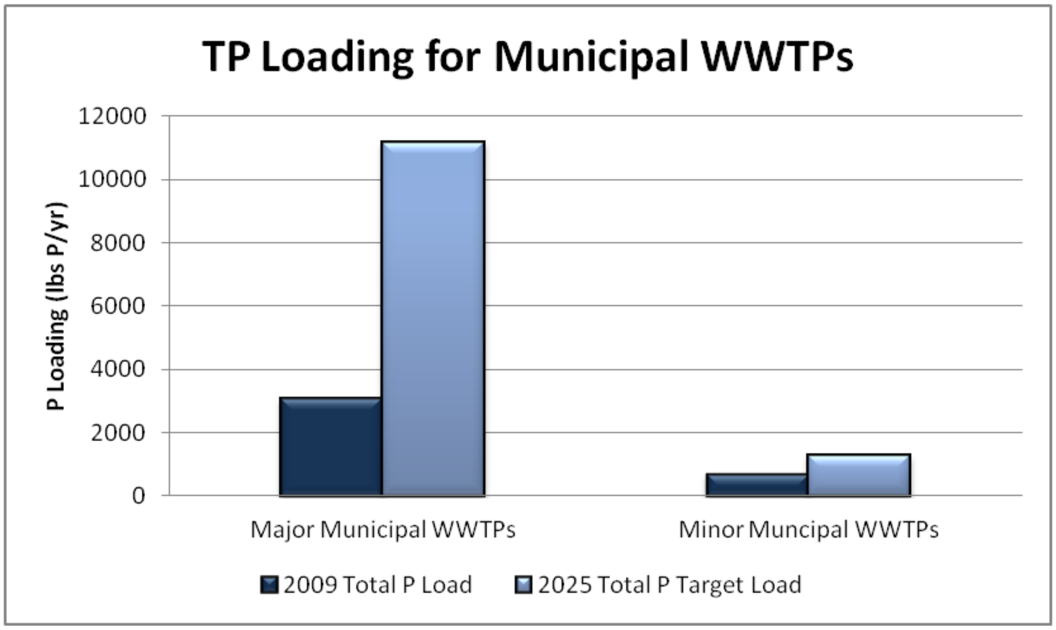


Figure 3-2 Total Phosphorus Loading for Municipal WWTPs in Charles County from the Maryland Phase II WIP

MDE calculated the 2009 baseline loads using the 2009 reported flow rates and annual average nutrient concentrations. To calculate the 2025 loading caps, MDE used maximum flow rates and pollutant concentration limits allowed by the permit. The calculations for the major municipal WWTPs in the County are presented in the Tables 3-1 and 3-2 below. WWTPs shown to be operating above permit limits in 2009, have since been upgraded to meet permit limits. Note that the major WWTPs in the County include the Indian Head and La Plata WWTPs, which are not owned and operated by the County. Therefore, the nutrient load available to the County is primarily from the Mattawoman WWTP.

Table 3-1
Total Nitrogen Loads from Major Municipal WWTPs in Charles County

Facility Name	2009 Flow (MGD)	2009 TN concentration (mg/L)	2009 TN Load (lbs/yr)	2025 Design Flow (MGD)	2025 Permit Limit for TN concentration (mg/L)	2025 Permit Cap on TN Load (lbs/yr)	Available TN Load (lbs/year)
Mattawoman WWTP	8.2	2.0[1]	49,712	20.0	4.0	194,916	145,204
Swan Point WWTP[2]	0.1	10.0	3,264	0.6	4.0	7,309	4,045
La Plata WWTP	1.1	3.26	11,397	1.5	4.0	18,273	6,877
Indian Head WWTP	0.3	4.63	4,547	0.5	4.0	5,540	1,544

[1]Conservative estimate of current TN effluent concentration.
[2] When the Swan Point WWTP is expanded to 0.6 MGD the permit limit for TN concentration will be reduced from the current 10 mg/L to 5.0 mg/L

Table 3-2 Total Phosphorus Loads from Major Municipal WWTPs in Charles County							
Facility Name	**2009 Flow (MGD)**	**2009 TP concen-tration (mg/L)**	**2009 TP Load (lbs/yr)**	**2025 Design Flow (MGD)**	**2025 Permit Limit for TP concen-tration (mg/L)**	**2025 Permit Cap on TP Load (lbs/yr)**	**Available TP Load (lbs/year)**
Mattawoman WWTP	8.2	0.08[1]	1,989	20.0	0.18	8,771	6,782
Swan Point WWTP	0.1	0.5	71	0.6	0.3	548	477
La Plata WWTP	1.1	0.24	834	1.5	0.3	1,371	536
Indian Head WWTP	0.3	0.47	459	0.5	0.3	457	-2
[1]Conservative estimate of current TP effluent concentration.							

Based on this analysis, the County appears to have significant future load capacity at the Mattawoman WWTP. Further analysis of future loads at the Mattawoman WWTP is warranted to try to determine how much capacity the County will have at the Mattawoman WWTP in the 2025 timeframe.

3.1.2 Estimated Loads at the Mattawoman WWTP in 2025

Future estimated flows at the Mattawoman WWTP were calculated using data from the Water Resources chapter of the November 2012 draft of the Charles County Comprehensive Plan – specifically, Table 4-6, which projects growth of flows to the Mattawoman WWTP through 2040. The County's contractual agreements with the Washington Suburban Sanitary Commission to discharge up to 3 MGD, and for build out of the St. Charles community are accounted for in this table. To determine projected capacity available by 2025, the year that TMDL targets are expected to be met, a straight linear growth estimate was used by subtracting the current 2012 average daily flows (11,495 MGD) from the 2040 future capacity (20 MGD), and then dividing this difference by the 28 years between 2012 and 2040 to get an annual flow increase. This calculation is shown below:

[20MGD (2040 capacity) – 11.495 MGD (2012 average daily flow)]/28 (years between 2012 and 2040) = 0.315 MGD/yr

Thus the average growth at the Mattawoman WWTP is projected to be 0.315 MGD annually. Multiplying this by the 13 years between 2012 and 2025 and adding it to the current average daily flow of 11.495 MGD yields a projected 2025 flow of 15.589 MGD. Assuming that the Mattawoman maintains its current effluent quality, the load capacities available for TN and TP in 2025 based on the 2025 loads are summarized in Tables 3-3 and 3-4.

Table 3-3 Total Nitrogen Load Available at the Mattawoman WWTP in 2025 Based on Projected 2025 Flows				
2025 Projected Flow (MGD)	**2025 TN concentration (mg/L)**	**2025 Projected TN Load (lbs/yr)**	**2025 Permit Cap on TN Load (lbs/yr)**	**Available TN Load (lbs/year)**
15.589	2.0	94,970	194,916	99,946

Table 3-4 Total Phosphorus Load Available at the Mattawoman WWTP in 2025 Based on Projected 2025 Flows				
2025 Projected Flow (MGD)	**2025 TP concentration (mg/L)**	**2025 Projected TP Load (lbs/yr)**	**2025 Permit Cap on TP Load (lbs/yr)**	**Available TP Load (lbs/year)**
15,589	0.08	3,799	8,771	4,972

To counter-act increasing flows (and resulting loads) to the Mattawoman WWTP due to growth, water re-use projects could be implemented to reduce WWTP nutrient loads. The County has existing water re-use projects for the Mattawoman WWTP and is also considering future water re-use projects. Water re-use (and the subsequent reduction of plant discharges into receiving waters) "frees-up" potential nutrient load capacity. For example, when the County diverts wastewater to the PANDA Brandywine and Competitive Power Ventures (CPV) power plants for turbine cooling purposes or for steam in the power generation process, or to other users, then loads can be reduced. In 2016, when CPV is anticipated to be on-line, it is estimated that 3 MGD will be diverted for re-use, of which approximately 30 percent will return to the WWTP, resulting in a reduction of 6,732 lbs TN (delivered) and 362 lbs TP (delivered) annually. As their needs increase, the PANDA and CPV power plants could divert as much as 8.4 MGD of treated effluent that would otherwise be discharged to the Potomac River[1]. Should this re-use volume be reached in the future, even more load capacity would be freed up at the Mattawoman WWTP.

The County may wish to consider other types of water re-use projects to "free-up" additional loading capacity. Other options for wastewater re-use include urban irrigation, agricultural, and potable water. In addition to re-use of water from a WWTP, re-use of water internally within a commercial or industrial building using 'purple lines' reduces the amount of wastewater volume sent to the WWTP. Water conservation also reduces the volume of wastewater sent to the WWTP, thus conserving volume at the WWTP for future growth. The County's continued work with MDE to investigate these and other water re-use options will advance progress towards the nutrient loading targets.

[1] Information from *Charles County Water Resources Element*, adopted May 24, 2011.

The County's 2011 Water Resources Element estimates that water conservation efforts could reduce water use by as much as 1.7 MGD by 2030. Reducing water use also reduces flows to the WWTP. By doing straight-line projections of water savings for the 22 years from 2008 (the baseline year from water use in the WRE) to 2030, the average annual water savings from water conservation would be 0.08 MGD per year if these efforts were implemented. By subtracting this yearly average from the total potential water savings for the years between 2030 and 2025 (five years), all but 0.4 MGD of this savings (5 * 0.08) could be achieved by 2025. Therefore, the total potential water savings through water conservation by 2025 could be 1.7 MGD – 0.4 MGD = 1.3 MGD. If implemented as a strategy, this would save 5,138 lbs TN (delivered) and 277 lbs TP (delivered) of load capacity annually by 2025.

Incorporating the capacity needed to accommodate future growth through 2025, and water re-use the Mattawoman WWTP will have "excess loading capacity" of as shown on Table 3-5.

Table 3-5
Project 2025 Excess Loading at the Mattawoman WWTP

	TN lbs (delivered)/year	TP lbs (delivered)/year
a). 2025 Permit Loading Cap	194,916	8,771
b). 2012 Loads	70,029	2,801
c). 2012-2025 Loads for Growth	24,492	998
d). Projected 2025 Loads (b + c)	94,971	3,799
e). Wastewater Re-use (Industrial)	6,732	362
f). Wastewater Re-use (Other types)	Future projects to be included here	Future projects to be included here
g). Water Conservation (reduction in volume to WWTP)	5,138	277
h). Total Savings from Projected 2025 Baseline Loads (e + f + g)	11,870	639
i). Total Loads Projected in 2025 (d - h)	83,101	3,160
2025 Excess Loading Capacity (a – i)	111,860	5,611

*The Mattawoman WWTP has the most excess loading capacity, however this could also be calculated for other WWTPs.

Other types of projects could also help the County in reducing loads. For example, the connection of the College of Southern Maryland wastewater treatment system to the Mattawoman WWTP eliminates a WWTP that is currently discharging higher effluent concentrations and divert these flows to an advanced WWTP that discharges at lower effluent concentrations. While the flows from the College of Southern Maryland (CSM) wastewater treatment system are very low, this connection would reduce the current TN loading of 240 lbs annually by approximately half – to 120 lbs annually – because the effluent TN concentration at the Mattawoman WWTP is approximately half of the effluent TN concentration at the CSM WWTP (approximately 2.0 mg/L at the Mattawoman WWTP versus approximately 4.0 mg/L at CSM). Likewise, the connection would reduce the TP loading by approximately 80 percent to around 4.9 lbs TP annually because the effluent TP concentration at the Mattawoman WWTP is approximately 20 percent of the effluent TP concentration at the CSM WWTP (0.08 mg/L TP at the Mattawoman WWTP versus approximately 0.32 mg/L at the CSM WWTP).

3.1.3 Potential Uses of Wastewater Capacity

The above planning data shows that the Mattawoman WWTP could have up to 111,860 lbs per year of TN and 5,611 lbs per year of TP in excess loading capacity in 2025. This "capacity" may be able to be used to offset the need to reduce load in other sectors. For example, the excess nitrogen and phosphorus capacity at the Mattawoman WWTP may be able to offset the need to reduce loading from the stormwater and/or septic system sectors, thereby reducing the number of costly and maintenance intensive BMPs needed in those sectors.

The credit from the WWTP load could be used to supplement goals in the stormwater and/or septic system sectors. For example, 51,759 lbs N (delivered)/yr is the amount of pounds of delivered TN that must be reduced in Charles County to meet the TMDL goals for the septic system sector. Meeting this required load reduction through the Mattawoman WWTP's load capacity would require crediting 35 percent of the WWTP's currently available TN load (51,759/111,860 = 46 percent). Because projected growth is already figured into this load cap analysis, it is safe to assume that crediting this amount of load capacity from the Mattawoman WWTP would not impact the potential growth in the Mattawoman service area.

Crediting the entire excess loading capacity for offsetting the stormwater or the septic system sector would equate to estimated cost savings as shown in Table 3-6. Note that these cost savings estimates are based on the least costly scenarios identified in Section 3. These options will be incorporated into the strategies to achieve the most cost effective means.

Table 3-6
Potential Cost Savings by Crediting Mattawoman WWTP Excess Nutrient Loading Capacity

Load	Target Load Reduction (lbs/yr)	Excess Loading Capacity (lbs/yr)	Percent of Excess Loading Capacity Required to Offset Target Load Reduction	Cost of Scenario	Cost of Scenario per lb of Pollutant Removed
Urban Stormwater					
Nitrogen	32,119	111,860	28.71	$132,690,750	$413.22
Phosphorus	7,866	5,611	140.02	$132,690,750	$16868.90
Septic Systems					
Nitrogen	51,759	111,860	46.27	$90,807,690	$1,754.43

It should be noted that offsets of this nature between the wastewater sector and the stormwater and/or septic system sectors would need to be monitored on a regular basis to ensure the credits from the wastewater sector remain available for use in other sectors.

In the future when innovative and more cost effective BMPs become available in the stormwater and septic system sectors, the credits could be reduced or removed as the BMPs are implemented.

If the County chooses not to use the WWTP NPDES permit to formalize these trade-offs, then the accounting for loads would have to be reconciled during required reporting. It remains to be seen how the State will require accounting for loads from the various sectors, so the County should track discussions on this topic to ensure that the loads and load reduction targets are reported such that the County demonstrates that it meets its overall targets.

3.2 URBAN STORMWATER SECTOR

3.2.1 Calculation of Urban Stormwater Loads

The County's urban stormwater loads were calculated with a modeling approach that generated pollutant loads from land surfaces and considered their potential control by BMPs. The model calculates annual TN, TP, and sediment loading for existing conditions and annual load reductions or credits that can be achieved through applying additional BMPs in the future. One advantage of this modeling method is that it uses local data on land use and pollutant generation to calculate loads. Using local data to calculate loads provides a more accurate picture of stormwater loads in the County compared to the loads provided by MDE. The problems inherent in MDE's urban stormwater loads were discussed previously in Section 1.2.3, and the use of local data on the amount of different land use types eliminates the most egregious problems with MDE's loads.

The modeling approach utilized EPA's Simple Method and the BASINS PLOAD model. The Simple Method calculates annual runoff as a product of annual rainfall, the fraction of annual rainfall events that produce runoff, and a runoff coefficient based on the impervious fraction in the drainage area. In a modification to the Simple Method, the model uses actual impervious cover data to explicitly represent impervious surface runoff instead of the standard impervious rating approach. PLOAD is then used to calculate the annual loads from each land use type. PLOAD can also be used to estimate reductions in loads due to BMPs by using pollutant removal efficiencies for BMPs provided by the CBP. The specific formulas used for these calculations are described in more detail later in this section.

The basic data required for the modeling effort included:

- Land use: inventory of land use types and the areal extent of each type.
- Impervious Cover: the amount of impervious cover associated with each land use type.

- Event Mean Concentrations (EMCs): EMCs for the pollutants of interest for each land use type. The pollutants of interest for the Bay TMDL are nitrogen, phosphorus, and sediment.

An EMC is defined as the total constituent mass of a specific pollutant in a given sample divided by the total runoff volume of the sample. Typically, EMCs for specific pollutants are established by developing a flow-proportioned composite sample of concentrations of that pollutant taken at various points in time during a runoff event. Once EMCs have been established for specific pollutants, they can be used in conjunction with flow data to estimate the pollutant loading from a given storm. The concept of EMCs was developed by the EPA's Nationwide Urban Runoff Program (NURP) in the early 1980s to help define and quantify pollutant loading and the impact of urban runoff. Many jurisdictions use EMC data to help calculate loads.

As part of its NPDES MS4 permit requirements for discharge characterization, the County is already calculating and using EMCs from some land use types. In the past, the County has calculated EMCs to characterize runoff from commercial land use. In 2006, the County's monitoring station was moved from commercial apartments to 1/8 acre residential lots. Since that time, EMCs for high-density residential areas have been calculated. While these data are valuable, additional EMCs are needed to calculate loads from the other types of land in the County.

Locally, Anne Arundel County has been using EMCs for various land use types defined in its General Plan to characterize loading and to perform watershed planning, including planning for the Bay TMDL. In addition, Anne Arundel County has developed a database of pollutant concentration and storm data and has performed rigorous QA/QC on the development and use of its EMCs. Anne Arundel County's EMCs should be valid for use in Charles County because the two counties generally have similar land use and rainfall patterns. Therefore, Anne Arundel County's EMCs were used to develop Charles County's loads.

The basic set-up of the model and the specific data requirements for the modeling are discussed in the following sections.

3.2.1.a Model Setup

The model's basic elements are polygons determined in GIS by the intersection of MDP's 2007 land use dataset and an impervious layer developed specifically for this model. It was necessary to develop a new impervious layer specifically for this modeling effort because the County' 2007 impervious was found to be missing impervious area detail in areas of the county. The impervious layer used in the model was created by combing the County's 2007 impervious cover dataset and the roads and buildings planimetric data that was received from the County contractor responsible for updating the County's impervious and BMP datasets . The GIS attribute information from each polygon generated from this step is imported into a spreadsheet model to perform the loading calculations. Calculations are then performed for each distinct polygon generated from this process. Because the County is only responsible for the urban stormwater load, the specific land use types that qualify as "urban" land uses were also identified.

The first step in developing the model inputs was to do a “cross-walk” between the MDP land use data and the land use types for which Anne Arundel County had developed its EMCs. Table 3-7 shows MDP’s land use classifications, the equivalent land use type used by Anne Arundel County, the area and percentage of Charles County covered by each one of the MDP land use types, and the percent imperviousness of that land use type. The land use cross-walk was performed by relating the MDP land use types to the Anne Arundel County land use types. For MDP land uses with common classifications (e.g., commercial, residential) the translation was a simple exercise. For MDP land uses without an obvious analogous classification in the Anne Arundel dataset (e.g., brush, feeding operations, etc.), the translation was assisted by examining the County’s planimetric land cover data and aerial imagery. The classification of each MDP land use type as “urban” or “non-urban” was based on best professional judgment of the types of land uses typically found in urban and non-urban settings. The percent of imperviousness for each land use was determined by performing an intersection between the Charles County impervious dataset and the MDP land use dataset.

Table 3-7
Charles County Lands Used to Calculate Loads

MDP Land Use Classifications	Anne Arundel County Land Use Classification	Urban or Non-Urban	Area (acres)	% of County Land	% Impervious
Ag. Building breeding	Pasture	Non-Urban	111	0.04%	5.7
Bare ground	Residential	Urban	1,375	0.47%	9.4
Brush	Woods	Non-Urban	5,705	1.94%	0.7
Commercial	Commercial	Urban	3,199	1.09%	43.1
Cropland	Crops	Non-Urban	43,377	14.73%	2.0
Deciduous forest	Woods	Non-Urban	108,979	37.01%	0.7
Evergreen forest	Woods	Non-Urban	13,049	4.43%	0.7
Extractive	Industrial	Non-Urban	1,040	0.35%	14.4
Feeding Operations	Pasture	Non-Urban	393	0.13%	4.9
High-density residential	Residential Lots 1/8 acre	Urban	1,804	0.61%	36.8
Industrial	Industrial	Urban	1,234	0.42%	32.0
Institutional	Commercial	Urban	4,061	1.38%	23.6
Large lot subdivision (ag)	Residential lots 2 acre	Urban	4,411	1.50%	4.8
Large lot subdivision (forest)	Woods	Non-Urban	14,309	4.86%	2.9
Low-density residential	Residential lots 1/2a	Urban	33,244	11.29%	9.5
Medium-density residential	Residential lots 1/4 acre	Urban	8,692	2.95%	26.0

Table 3-7 cont. Charles County Lands Used to Calculate Loads					
MDP Land Use Classifications	**Anne Arundel County Land Use Classification**	**Urban or Non-Urban**	**Area (acres)**	**% of County Land**	**% Impervious**
Mixed forest	Woods	Non-Urban	36,692	12.46%	0.7
Open urban land	Residential Lots 1 acre	Urban	915	0.31%	9.5
Orchards/ vineyards/ horticulture	Open Space	Non-Urban	73	0.02%	1.2
Pasture	Pasture	Non-Urban	4,023	1.37%	2.4
Row and garden crops	Crops	Non-Urban	391	0.13%	2.0
Transportation	Transport-Highways	N/A	595	0.20%	71.0
Wetlands	Water	Non-Urban	6,780	2.30%	0.3

3.2.1.b Event Mean Concentrations

Once the cross-walk described above was completed, EMCs could be assigned to the different land uses in the County. Table 3-8 shows the MDP land use classifications for land in Charles County, and relevant EMCs based on Anne Arundel County's data.

Table 3-8 EMCs for Charles County Land Uses				
MDP Land Use Classifications	**Urban or Non-Urban**	**EMC, Nitrogen, mg/L**	**EMC, Phosphorus, mg/L**	**EMC, Sediment, mg/L**
Ag. building breeding and training facilities	Non-Urban	7.83	2.09	341
Brush	Non-Urban	1	0.11	34
Cropland	Non-Urban	16.06	2.63	1,046
Deciduous forest	Non-Urban	1	0.11	34
Evergreen forest	Non-Urban	1	0.11	34
Feeding operations	Non-Urban	7.83	2.09	341
Large lot subdivision (forest)	Non-Urban	1	0.11	34
Mixed forest	Non-Urban	1	0.11	34
Orchards/vineyards/ horticulture	Non-Urban	1.15	0.15	34
Pasture	Non-Urban	7.83	2.09	341

Table 3-8 cont. EMCs for Charles County Land Uses				
MDP Land Use Classifications	**Urban or Non-Urban**	**EMC, Nitrogen, mg/L**	**EMC, Phosphorus, mg/L**	**EMC, Sediment, mg/L**
Row and garden crops	Non-Urban	16.06	2.63	1,046
Wetlands	Non-Urban	1	0.11	34
Extractive	Non-Urban	2.22	0.19	77
Transportation	Urban	2.59	0.43	99
Bare ground	Urban	7.83	2.09	341
Commercial	Urban	2.24	0.3	43
High-density residential	Urban	2.74	0.32	43
Industrial	Urban	2.22	0.19	77
Institutional	Urban	2.24	0.3	43
Large lot subdivision (agriculture)	Urban	2.74	0.32	43
Low-density residential	Urban	2.74	0.32	43
Medium-density residential	Urban	2.74	0.32	43
Open urban land	Urban	2.00	0.19	51

3.2.1.c Model Calculations

Once data inputs were defined, the model could be applied. The following formulas describe the Simple Method runoff calculations.

First, the runoff coefficient for each land use type is calculated:

$$R_{vu} = 0.05 + (0.009 * I)$$

Where:

R_{vu} = Runoff coefficient for land use type u, $inches_{run}/inches_{rain}$

I = Percent imperviousness of the land use polygon

Once the runoff coefficient is calculated for each polygon, the annual runoff volume can be determined from the following equation:

$$V = P * P_j * R_{vu} * A_u * 3,630$$

Where:

V = Annual runoff volume, cubic feet

P = Precipitation, inches/year, (average for Charles County = 44.7 inches/year)

P_j = Ratio of storms producing runoff (default = 0.9)

R_{vu} = Runoff coefficient for land use type u, $inches_{run}/inches_{rain}$

A_u = Drainage area of land use type u, acres

The pollutant loads are the product of the annual runoff volume calculated above and the EMCs for each land use category. Pollutant loads calculated for each polygon are aggregated to obtain the total load County-wide. The aggregated pollutant load is calculated as follows:

$$L = \Sigma (V * C_u * 6.23x10^{-5})$$

Where:

L = Pollutant load, lbs/year

V = Annual runoff volume, cubic feet

C_u = Event Mean Concentration for land use type u, mg/L

The existing condition delivered loads by individual land use type, the total urban and non-urban loads, and the total aggregated stormwater loads in the County are presented in Table 3-9.

Table 3-9
Delivered Loads for Charles County Land Uses

MDP Land Use Classifications	Urban or Non-Urban	TN Load (Delivered) lbs/yr	TP Load (Delivered) lbs/yr	Sediment Load (Delivered) lbs/yr
Water	Non-Urban	561	15	26,421
Ag. building breeding and training facilities	Non-Urban	723	213	49,826
Brush	Non-Urban	2,756	313	106,712
Cropland	Non-Urban	389,824	68,813	35,807,938
Deciduous forest	Non-Urban	48,299	5,730	2,189,450
Evergreen forest	Non-Urban	6,260	719	248,745
Feeding operations	Non-Urban	2,389	701	139,939
Large lot subdivision (forest)	Non-Urban	9,190	1,082	414,823
Mixed forest	Non-Urban	17,442	2,007	735,224
Orchards/vineyards/ horticulture	Non-Urban	49	7	1,672
Pasture	Non-Urban	17,907	5,261	1,133,647
Row and garden crops	Non-Urban	3,601	650	369,626
Wetlands	Non-Urban	2,998	331	103,371
Extractive	Non-Urban	2,836	276	171,981

Table 3-9 cont. Delivered Loads for Charles County Land Uses				
MDP Land Use Classifications	**Urban or Non-Urban**	**TN Load (Delivered) lbs/yr**	**TP Load (Delivered) lbs/yr**	**Sediment Load (Delivered) lbs/yr**
Transportation	Urban	7,772	1,444	397,409
Bare ground	Urban	3,558	501	94,220
Commercial	Urban	19,856	3,419	593,128
High-density residential	Urban	12,281	1,773	302,719
Industrial	Urban	6,969	656	375,270
Institutional	Urban	19,244	2,812	470,198
Large lot subdivision (agriculture)	Urban	9,200	1,182	216,061
Low-density residential	Urban	99,775	12,843	2,205,878
Medium-density residential	Urban	42,813	6,378	1,080,112
Open urban land	Urban	1,792	191	68,797
Subtotal	Urban	226,095	31,473	5,975,772
Totals	**Non-Urban + Urban**	**728,095**	**117,315**	**47,303,166**

The total urban load in Charles County, which is shown in Table 3-9, includes loads from other landowners for which the county is not responsible. These other landowners include the Towns of Indian Head and La Plata, and federal, state, and Maryland State Highway Association (SHA) lands, and these lands need to be removed from the County load. In order to do this, the Charles County Tax Parcel database was used to identify parcel areas owned by state, federal, and municipal landowners. The loads for these parcels were determined in the same method identified above. However, land owned by SHA could not be indentified from the Charles County Tax Parcel database. The County tax database has an identification of road right-of-ways (ROW), but there is no ownership designation of these right-of-ways (ie state, federal, and county). Therefore, in order to determine the ROWs owned by SHA, the SHA road polylines were buffered by 80 feet (40 feet on both sides of the polyline), which was the typical road ROW measured from aerial imagery. These buffers were then intersected with the tax database ROWs. Any ROWs that were within the buffer were assumed to be owned by SHA. After SHA ownership was established, loads were determined using the methodology described above.

After the loads were calculated for all of the lands for which Charles County was not responsible, they were subtracted from the load calculated for the entire County to determine the load for which the County was responsible. This is shown in Table 3-10.

Table 3-10
Calculation of Urban Loads for which Charles County is Responsible

Sector Urban Loads	TN Load (Delivered) lbs/yr	TP Load (Delivered) lbs/yr	Sediment Load (Delivered) lbs/yr	Description
Charles County	226,095	31,473	5,975,772	Charles County
La Plata-Indian Head	15,487	2,085	363,973	La Plata-Indian Head
Federal	7,017	935	137,541	Federal
State	919	125	24,403	State
Maryland SHA	22,102	3,869	853,432	Maryland SHA
Total Baseline Delivered Load	**180,210**	**24,459**	**4,596,223**	**County's Responsibility**

These loads are representative of stormwater without existing BMPs. This is called the "baseline" load. Because the County has stormwater BMPs already in place, the impact of these BMPs needs to be quantified prior to evaluating the need to implement additional BMPs to reach the target. The load with existing BMPs in place is termed the "current progress load." The method for calculating the County's current progress load is outlined below.

3.2.1.d Determining the Current Progress Load

Once the baseline loads have been determined using the process outlined above, the "current progress" load must be determined. The current progress load is the baseline less the load reduced by the BMPs that the County already has in place. EPA uses estimates of current progress in its modeling to determine the starting place from which to measure TMDL load reductions. MDE includes progress loads in its MAST reporting and modeling tool. Progress loads are calculated by determining the amount of land controlled by BMPs, and then reducing the pollutant loads generated from the BMP-controlled land by using the load reduction efficiencies for each BMP. The resulting loads are then added to the loads from lands not controlled by BMPs to determine the current progress load.

MDE uses BMP data reported through the MS4 Annual Reports to estimate progress loads, which are provided in the MAST tool. However, as described in Section 1, the current progress loads cannot be used directly from MAST because the data on overall land area and the amount of different land use types is inaccurate. In addition, because baseline loads were calculated using different land use types, existing BMP load reductions cannot be taken directly from the County's data. Furthermore, because the County's current data do not include the delineation of drainage areas for individual BMPs, direct calculation of existing BMP load reductions using MDP land use data is also not possible. Given these issues, an alternate approach was applied. In this approach, the equivalent percent reduction achieved between the baseline and the most recent progress data in MAST was applied to the baseline loads calculated using the methodology described above.

The first step was to obtain the baseline and progress loads from MAST. The most recent progress data available from MAST was from 2010. This data was processed to identify the percent reduction from baseline for 2010 progress for each pollutant for each land use type. These percent load reductions are shown in Tables 3-11, 3-12, and 3-13 for TN, TP, and sediment, respectively. Sediment data are shown for completeness; however, MDE did not provide targets for sediment for the counties in the Maryland Phase II WIP.

Because the areal extents of different land uses in MAST were not the same as those calculated from local data, the individual percent reductions were not used. Instead, the average percent reduction for all urban land uses was calculated for each pollutant, and the calculated baseline loads were reduced by these amounts to determine the current progress. As shown in the tables, the average load reduced by current BMP implementation for urban land from MAST was 12.2 percent for TN, 15.8 percent for TP, and 15.5 percent for sediment. Thus, these percentages were applied to the calculated baseline loads to determine current progress from implementation of existing BMPs. As discussed above, no calculations were done for sediment because the Phase II WIP had no targets for sediment.

Table 3-11
Percent Load Reductions for TN from 2010 Current Progress in MAST

Land Use Type	Acres	Pre- BMP Lbs TN- (Delivered) (Baseline)	Post BMP Lbs TN- (Delivered) (2010 Progress)	% Delivered N Load Reduced by BMPs
County Phase I MS4 Impervious	4,331	20,045	18,611	7.2
County Phase I MS4 Pervious	12,673	42,442	36,919	13.0
Non-regulated Impervious Developed	4,802	32,956	30,598	7.2
Non-regulated Pervious Developed	18,216	91,076	77,648	14.7
Totals	**40,022**	**186,519**	**163,776**	**12.2**

Table 3-12 Percent Load Reductions for TP from 2010 Current Progress in MAST				
Land Use Type	**Acres**	**Pre- BMP Lbs TP-(Delivered) (Baseline)**	**Post BMP Lbs TP-(Delivered) (2010 Progress)**	**% Delivered P Load Reduced by BMPs**
County Phase I MS4 Impervious	4,331	4,849	4,273	11.9
County Phase I MS4 Pervious	12,673	4,288	3,499	18.4
Non-regulated Impervious Developed	4,802	6,386	5,627	11.9
Non-regulated Pervious Developed	18,216	7,292	5,814	20.3
Totals	**40,022**	**22,814**	**19,212**	**15.8**

Table 3-13 Percent Load Reductions for Sediment from 2010 Current Progress in MAST				
Land Use Type	**Acres**	**Pre- BMP Lbs Sediment (Delivered) (Baseline)**	**Post BMP Lbs Sediment (Delivered) (2010 Progress)**	**% Delivered Sediment Load Reduced by BMPs**
County Phase I MS4 Impervious	4,331	2,007,272	1,655,942	17.5
County Phase I MS4 Pervious	12,673	862,893	693,219	19.7
Non-regulated Impervious Developed	4,802	2,918,821	2,407,802	17.5
Non-regulated Pervious Developed	18,216	1,338,424	1,262,519	5.7
Totals	**40,022**	**7,127,409**	**6,019,481**	**15.5**

The current progress loads for urban stormwater are provided in Table 3-14.

Table 3-14 Current Progress Loads for Urban Stormwater in Charles County			
Pollutant	**Calculated Delivered Load (lbs/year)**	**Percent Reduction from Calculated Delivered Load Due to Existing BMPs**	**Current Progress Load (lbs/yr)**
Total Nitrogen	180,210	12.2	158,224
Total Phosphorus	24,459	15.8	20,594
Sediment	4,596,223	15.5	3,883,808

3.2.1.e Current Targets

Targets for 2025 are calculated by reducing the current progress loads for each pollutant by the same percent reductions shown in the 2025 targets provided in the Maryland Phase II WIP. This parallels MDE's TMDL and WIP methodology whereby load reduction targets are determined as the additional load reductions necessary to meet the targets based on current progress. Tables 2-1 and 2-2 summarize the data provided in the Maryland Phase II WIP, which show load reductions of 20.3 percent TN and 38.2 percent TP for urban stormwater (County Phase I MS4 pervious and impervious plus non-regulated pervious and impervious loads). Table 3-15 applies the same load reduction targets to the current progress loads from Table 3-14. Note that there is no sediment target, so sediment was not included in Table 3-15.

Table 3-15
Target Urban Stormwater Loads for Charles County

Pollutant	Current Progress Load (lbs/yr)	Reduction from Current Progress Load to Meet Targets		2025 Target (lbs/yr)
		Percent (%)	Load (lbs/yr)	
Total Nitrogen	158,224	20.3	32,119	126,105
Total Phosphorus	20,594	38.2	7,866	12,727

3.2.2 Load Reduction Practices

A number of potential restoration activities and BMP-retrofits are available to meet TMDL nutrient load reduction targets. Key considerations in choosing amongst these options are cost effectiveness relative to the quantity of pollutant removed, implementability, ease of maintenance, life expectancy, and public acceptance. The following general restoration activities and retrofits were chosen based on their ability to meet these criteria:

- Programmatic/non-structural practices
  - Urban nutrient management
  - Street sweeping
  - Inlet cleaning
- Structural practices
  - Stream restoration
  - Pond retrofits
  - Environmental Site Design (ESD) retrofits
  - Shoreline stabilization

- o Buffer restoration

These activities have been implemented successfully by other entities in the Chesapeake Bay watershed and it is expected that they will translate well to conditions encountered in the County. A more detailed description of these strategies is presented in the subsections that follow.

3.2.2.a Urban Nutrient Management

According to research completed by the Chesapeake Stormwater Network (CSN), turf covers nearly 4 million acres in the Chesapeake Bay, or just under ten percent of total watershed area (CSN, 2009). Surveys have indicated that perhaps as much 50 percent of the turf cover is regularly fertilized (CSN, 2009). Runoff of fertilizer from turf in urban areas is thought to play an important role in causing nutrient pollution to the Chesapeake Bay. The Maryland Phase II WIP relies heavily on urban nutrient management as a planned BMP to help reduce loads from urban stormwater. According to the WIP, Maryland plans on having 100 percent of urban pervious land under "urban nutrient management" as part of its load reduction strategy. Urban nutrient management is the general term for a set of strategies designed to reduce nutrient loading to Maryland's waters. These strategies include restricting the types of nutrients allowed in fertilizer (i.e., elimination of phosphorus, reducing the allowable nitrogen content), regulating the timing of nutrient application, requiring certification of lawn care professionals, and requiring regulated parties to implement BMPs and follow recommendations developed by the University of Maryland when applying fertilizer.

The Maryland Phase II WIP indicates the state will attempt to achieve load reductions from urban nutrient management through regulatory compliance with existing urban nutrient management laws and development of additional nutrient management laws. Existing laws already regulate some types of urban nutrient application/use. For example, under the authority of the Water Quality Improvement Act of 1998, the Maryland Department of Agriculture (MDA) regulates 275,000 acres of managed turf and landscape. Regulations were expanded by the Fertilizer Use Act of 2011, which was enacted in May of 2011. It expands the scope of regulatory authority for fertilizer use on non-agricultural land. Under the Fertilizer Act, MDA now regulates individuals and companies that apply fertilizer to 10 or more acres of non-agricultural land, including private lawns and landscapes managed by commercial service companies, highway rights-of-ways, golf courses, athletic fields, school campuses and recreational areas. The Phase II WIP estimates that this law will also result in an additional 220,000 acres under regulatory authority. The law will be phased in and fully implemented by October 1, 2013. Elements under the law include eliminating phosphorus in fertilizers used on lawns and use only slow release nitrogen fertilizers on lawns and managed turf and creating economic disincentives for the use of fertilizers used by homeowners.

As part of Maryland's Phase II WIP, MDE included county-by-county strategies for achieving load reduction targets. Because the County chose not to provide specific BMP input decks to MDE through MAST, MDE included its own County-scale estimate of the BMPs that would achieve Charles County's targets (see Table 3-23 in

Section 3.2.3). This strategy included a final target of 16,277 acres under urban nutrient management. MDE estimated that 6,733 acres in the County were under urban nutrient management as of the 2011 baseline, leaving approximately 9,544 acres to be put under urban nutrient management in the County by 2025. As part of the County's load reduction scenarios, this strategy was retained at the same level of implementation as modeled by MDE.

In order to calculate the load reduction that would be achieved by putting an additional 9,544 acres under urban nutrient management, the "baseline" nitrogen and phosphorus loads from these acres were calculated by applying land use-based loading rates for nitrogen and phosphorus (in lbs/acre/year) to the total number of additional acres that were to be put under nutrient management (9,544 acres). Land use based loading rates for residential land uses were used to estimate the loads from these acres. While it is not clear how many acres of residential land versus other land (commercial, etc.) were modeled under MDE's scenarios, the vast majority of acres managed under this scenario are anticipated to be residential.

After the loads were calculated, the load reduction efficiencies for the urban nutrient management BMP were applied to the loads to determine the amount of load reduced through these BMPs (Table 3-15). Urban nutrient management is assigned load reduction efficiencies of 17 and 22 percent, respectively, for nitrogen and phosphorus. Urban nutrient management is not assigned any removal efficiency for sediment, so sediment was not included in the analysis.

The results are shown in Table 3-16. The results show that urban nutrient management is expected to achieve load reductions of approximately 6,570 lbs of nitrogen and 252 lbs of phosphorus annually. These load reduction represent approximately 20 percent of the nitrogen load reduction and 3.5 percent of the phosphorus load reduction required to meet the County's 2025 targets for urban load.

Table 3-16
Nitrogen and Phosphorus Load Reduction Estimated from Implementation of Urban Nutrient Management

	Number of Additional Acres Under Nutrient Management by 2025[1] (Based on MD's Phase II WIP Scenario)	Loading Rate, Residential[2] Land Uses (lbs/acre/yr)	Load Prior to Urban Nutrient Management, (lbs/yr)	Load Reduction Efficiency (%)	Load After Urban Nutrient Management, (lbs/yr)	Load Reduction from Urban Nutrient Management (lbs/yr)
Nitrogen	9,544	4.05	38,653.2	17	32,082.2	6,571
Phosphorus		0.12	1,145.3	22	893.3	252

[1] The number of acres of additional urban nutrient management required by 2025 was calculated by subtracting the 2012 progress for County Phase I/Phase II MS4 lands from the 2025 Target for County Phase I/Phase II MS4 lands

[2] Loading rates determined by adding loads (as calculated by LimnoTech) from all residential land uses and dividing by the total number of acres of residential land use

3.2.2.b Street Sweeping

Street sweeping is a standard activity in many municipalities, with the primary goal of reducing litter and debris. While street sweeping is often viewed by the general public as an effort to improve "quality of life" or to "beautify" an area, street sweeping can also play an important role in removing pollutants from streets – particularly debris, trash, and sediment. In addition, street sweeping can be used to meet the pollution prevention and good housekeeping requirements in NPDES MS4 permits. Street sweeping is often an important part of controlling trash, and can be a major BMP implemented as part of a response to trash TMDLs. Street sweeping is not particularly effective with respect to reducing nutrient loads because of the nature of the pollutants it is designed to remove (e.g., trash). However, in removing sediment, street sweeping does remove some nutrients that are sorbed to the sediment. The CBP provides credit for street sweeping in several different ways. In the first method, based on weight of street sweeping debris collected, the total particulate dry mass of the street sweeping collection is multiplied by 0.3 to get the sediment load reduction, and then the sediment weight is multiplied by 0.0025 and 0.001, respectively, to obtain the TN and TP load reductions. However, the documentation for the MAST tool states that this level of control only applies if the streets are swept on a twice monthly basis. The MAST documentation states that "the regularity of the street sweeping and reduces nitrogen, phosphorus, and sediment whereas less regular street sweeping reduces only sediment. The same street must be swept 25 times a year. The lbs submitted are for the lbs of material picked up by the sweeper. These lbs of material are the lbs of TSS removed. The TN reduction is 0.00175 of the TSS. The TP reduction is 0.0007 of the TSS."

MDE's "Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated" guidance document (June, 2011, hereafter called the Stormwater Guidance) has different requirements to receive credit for street sweeping (it does not specify that the same street must be swept 25 times per year to get any street sweeping credit) and uses 30 percent of the total particulate dry mass of the debris collected as the sediment value, and 0.0025 and 0.001 of the sediment load for the TN and TP loads, respectively. However, p. 12 of the Stormwater Guidance states that "reductions only apply to an enhanced street sweeping program where the streets are located in commercial, industrial, central business district, or high density residential neighborhoods and they are swept on a regular basis, e.g., twice per month."

Thus, it appears that the County's current street sweeping does not qualify for load reduction credit for nitrogen or phosphorus. Furthermore, based on the small amount of credit received versus the large number of times that the streets must be swept to receive this credit, increasing the amount of street sweeping to meet the criteria to receive credit does not appear cost effective.

As a way of evaluating the cost effectiveness of street sweeping, in 2012 the County's street sweeping contractor collected 159.35 tons of debris. Converting this to pounds and multiplying by 0.3 to get the sediment load, and then multiplying the sediment load by 0.0025 and 0.001, respectively, to get the TN and TP loads gives loads of 23.9 lbs TN and 9.6 lbs TP. At a cost of $50,000 for annual street sweeping, this comes to over $2,000/lb for TN and over $5,000/lb for TP. These costs are approximately in the middle range of cost effectiveness for urban BMPs. But it should be noted that according to the Bay Program, this credit should only be awarded if roads are swept twice monthly. Therefore, the County may want to consider changing its street sweeping program to concentrate on industrial or commercial areas where it can achieve more load reduction credit. However, this potential change may cause other problems with the general public, which may not be in favor of shifting street sweeping away from their neighborhoods.

3.2.2.c Storm Inlet Cleaning

Storm inlet cleaning is evaluated in a similar manner to street sweeping. MDE's Stormwater Guidance states that load reductions for catch basin cleaning and storm drain vacuuming would be calculated the same way as for street sweeping. However, the CBP does not specifically recognize inlet cleaning or storm drain vacuuming as BMPs that receive load reduction credit. In the MAST documentation, catch basin cleanouts are discussed in the same part of Appendix 4 as is street sweeping. In commenting on the lack of data with which to calculate load reduction for street sweeping, the MAST documentation notes that "fewer studies are available to evaluate the pollutant reduction capabilities due to storm drain inlet or catch basin cleanouts" relative to street sweeping, and thus MAST does not provide credit for this BMP.

3.2.2.d Stream Restoration

Stream channel stability is often described as a long- term state of "dynamic equilibrium." In such a state, a stream will generally maintain its form and function and will undergo lateral adjustments over long periods of time in response to the range of hydrologic conditions to which it is exposed. Development within a watershed can alter the natural hydrology of the system, upsetting this dynamic equilibrium and setting into motion a series of major, sometimes rapid, channel adjustments that can be very detrimental to the stream and the surrounding ecosystem. These adjustments create conditions that greatly increase erosion and sediment pollution, decrease downstream water quality, and negatively impact human developments and infrastructure.

Stream restoration is an increasingly common approach in the Chesapeake Bay watershed and elsewhere to restore stream systems that have been degraded by urban development. Stream restoration techniques include a number of different approaches that attempt to re-establish the dynamic equilibrium between a stream and its watershed. These techniques are bounded by site conditions and local constraints, but generally include: physical grading to re-establish a stable channel pattern and reconnect the stream with the floodplain, introducing habitat features such as step-pools and woody debris, and establishing or enhancing riparian vegetation. The CBP recognizes stream restoration for its ability to improve ecosystem functions and provide environmental benefits, including pollutant removal.

To identify stream restoration candidates, the U.S. Geological Survey's (USGS) high resolution National Hydrography Dataset (NHD) was used to represent perennial streams in the County. Two primary criteria were considered for this planning level exercise. First, the stream reach needed to be in a sufficiently degraded state to warrant restoration. Second, due to the disruptive nature of stream restoration projects, the stream reach to be restored needed to be located on a parcel or contiguous parcels owned by the County or other potential partners. These potential partners were assumed to be large land owners with whom the County could reasonably expect to be granted site access and permission to conduct restoration activities. Potential partners included the State of Maryland, conservation organizations, and home owners associations (HOAs). The Charles County Tax Parcel dataset was used to identify land owners. To facilitate analysis, stream reaches were segmented at property boundaries and at confluences with other streams.

The lack of a comprehensive data source of degraded streams in the County necessitated that a number of datasets be employed in combination to identify streams that could be candidates for stream restoration. The first such dataset is from the Maryland Biological Stream Survey (MBSS). Since 1995, the MBSS has conducted random sampling of over 3,400 streams around the state of Maryland to evaluate stream health. The assessed streams are rated "Good", "Fair," or "Poor" based on the relative health of the stream. Of these assessed streams in the County, 12 miles were considered to be in unhealthy or "Poor" condition and as such, to be good candidates for stream restoration.

Due to the random nature of the MBSS sampling, an additional analysis was employed to identify other sufficiently degraded streams for restoration. Streams assessed during the MBSS random sampling were omitted from this analysis, which looked at impervious cover in close proximity to streams. A relationship has been well established between the level of impervious cover within a drainage area and the overall health of downgradient water bodies. A study by the Center for Watershed Protection (CWP) suggested that streams with greater than 25 percent tributary impervious cover are typically considered impaired or non-supporting; streams with 10 to 25 percent impervious cover are typically considered stressed or impacted, and streams with less than 10 percent imperviousness can support sensitive habitat and are typically relatively unimpaired (Schueler, 1992). To facilitate this analysis, a 1,000 foot buffer was drawn around each stream reach owned by the County or potential partner and intersected with the County's impervious cover dataset to calculate the percent of impervious area within the buffer. Approximately 14 miles of stream have greater than 10 percent impervious cover, while approximately 9 of these miles have greater than 25 percent. If the impervious percentage within the buffer was greater than 10 percent, it was assumed that the stream was a candidate for restoration.

Unlike other BMPs, the pollutant removal for stream restoration is determined on the basis of linear foot of stream restored. Thus, the length of restored stream in linear feet is multiplied by the removal rate per linear foot of stream (lbs/linear feet). The removal rate per linear foot of stream was taken from the CSN Technical Bulletin No. 9, Nutrient Accounting Methods to Document Local Stormwater Load Reductions (CSN 2011) and is summarized below:

- Total nitrogen – 0.2 lb per linear foot per year
- Total phosphorus – 0.068 lb per linear foot per year

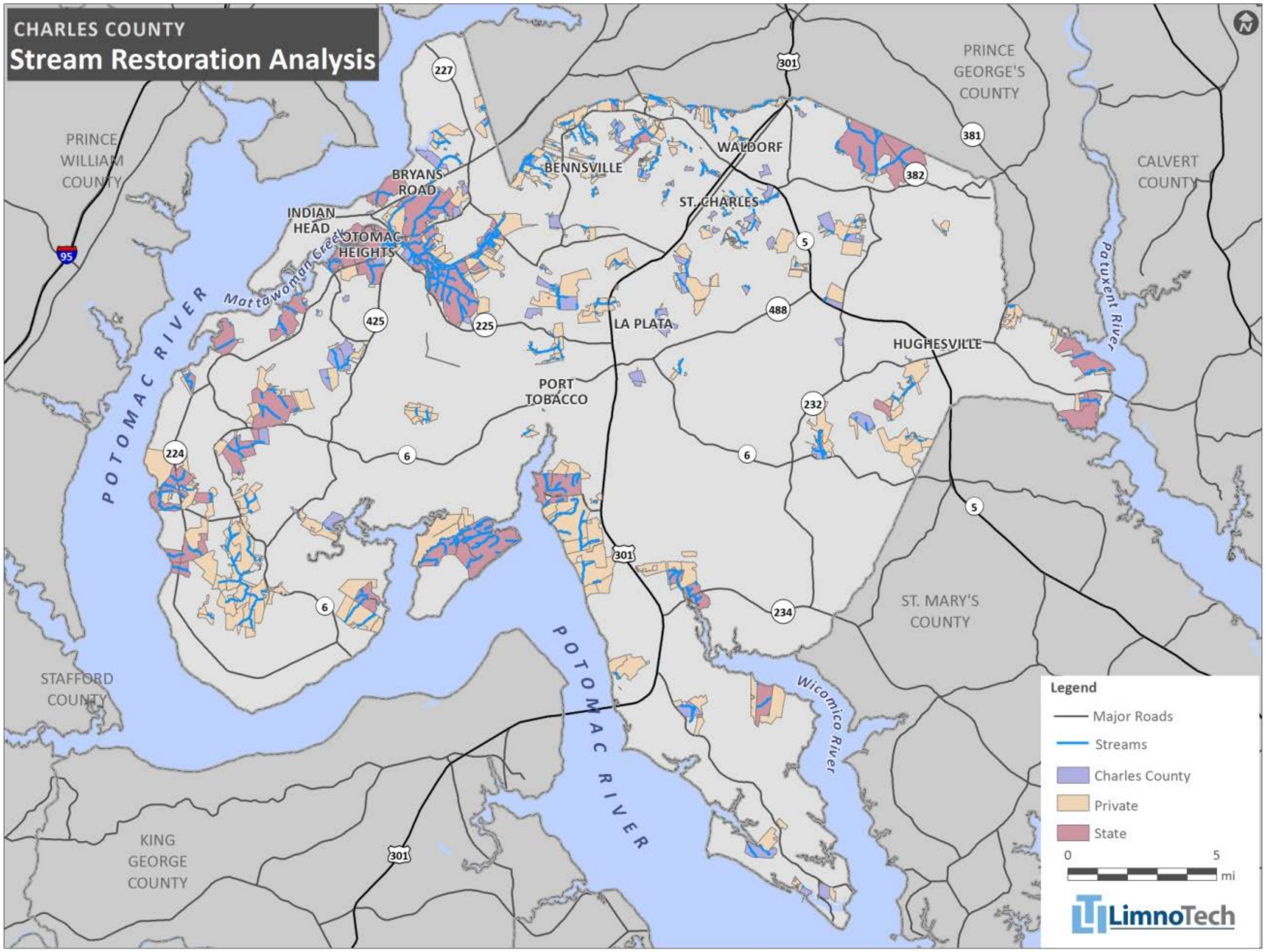
- Total suspended solids – 310 lb per linear foot per year

The delivery efficiencies were then applied to the pollutant load reductions for each stream segment to determine the total load reduced from stream restoration. The results of this analysis are summarized in Table 3-17. See Figure 3-3 for a depiction of the streams identified during this analysis.

Table 3-17
Nitrogen and Phosphorus Load Reduction Estimated from Stream Restoration

Owner	Length of Stream Identified for Restoration (ft)	Nitrogen Load Reduction (lbs/yr)	Phosphorus Load Reduction (lbs/yr)
County Land	14,782	2,222	902
State Land	39,761	6,531	2,394
Select Private Land (conservation organizations, HOAs)	82,985	10,546	4,585

Figure 3-3 Location of Potential Stream Restoration Sites



3.2.2.e Pond Retrofits

Many dry ponds, dry extended detention ponds, and some wet ponds are typically designed for water quantity management, and have low pollutant removal efficiencies. This is especially true of ponds built before 2002, when Maryland's 2000 Maryland Stormwater Design Manual (MDE, 2009) was widely adopted. The 2000 manual improved BMP water quality performance and specifically stipulated volumetric criteria for groundwater recharge, water quality treatment, and channel protection.

This strategy focuses on retrofitting both wet and dry stormwater ponds to more efficient BMPs designed for water quality management, like submerged gravel wetlands or regenerative step-pool storm conveyance (SPSC) systems. Submerged gravel wetlands are constructed wetland systems that provide water quality enhancements by directing flow through a surface marsh, which then discharges to a permanently ponded subsurface gravel bed. SPSC retrofits, which were pioneered in Anne Arundel County, entail replacing the existing BMP, the stormwater outfall, and portions of the adjacent pipe with a series of shallow pools, riffle grade controls, native vegetation, and an underlying sand and compost media filter to treat, detain, and safely convey drainage area runoff.

Similar to the stream restoration projects discussed above, for a BMP to be considered for retrofit it needed to be owned by the County or other potential private partners, which for this strategy were limited to HOAs. All low-efficiency BMPs that met these ownership requirements regardless of age were considered for retrofits. As retrofit implementation occurs, it will be important to focus first on the BMPs designed before 2002.

The Charles County Urban BMP Database and the Charles County Tax Parcel dataset were used to identify BMPs owned by the County and HOAs. An analysis of this dataset revealed that 572 BMPs are classified as wet ponds (WP), dry ponds (DP), or extended detention ponds (EDSD). Of these, 102 BMPs are owned by the County and 156 BMPs are owned by HOAs. For most of these BMPs, a design drainage area in acres is reported in the database, but specific delineated drainage areas are not available. Because the delineated drainage areas are not available, the catchment area land use for each individual BMP cannot be specifically determined. This information is needed to determine the specific pollutant load being delivered to the BMP. Drainage areas could not be delineated from existing GIS data, because the spatial locations of many BMP points in the database were not always accurate. For the purposes of calculating pollutant loading for this planning analysis, representative land characteristics (i.e., land use and impervious cover) were generated for each BMP owner from the County's GIS datasets. BMPs were then assumed to manage all or a portion of the pollutants generated from the representative land use for that BMP owner. For HOAs, the land use and impervious cover breakdown is determined for all subdivision parcels including the HOA-owned space and the parcels for individual homes which are contributing to the urban runoff load. For example, a dry pond with a reported drainage area of 5 acres is owned by the HOA of a 10-acre residential subdivision. In such a case, the BMP is assumed to be managing 50 percent of the pollutant load generated from that subdivision[2].

Pollutant load reduction calculations were performed as described in Section 3.2 with one exception. This analysis accounts for the fact that the existing BMP was already receiving some pollutant load reduction credit in the County's progress load. As such, the calculated load reduction due to a retrofit is the difference between the old and the new load reduction. The load reductions were then multiplied by the land river segment delivery efficiency to determine the total delivered pollutant load achieved by the BMP retrofits. The pollutant reduction efficiencies utilized in the analysis are presented in Table 3-18. The results of this analysis are summarized in Table 3-19 and a depiction of the parcels with proposed BMP retrofits is presented on Figure 3-4.

Table 3-18
BMP Pollutant Removal Efficiencies

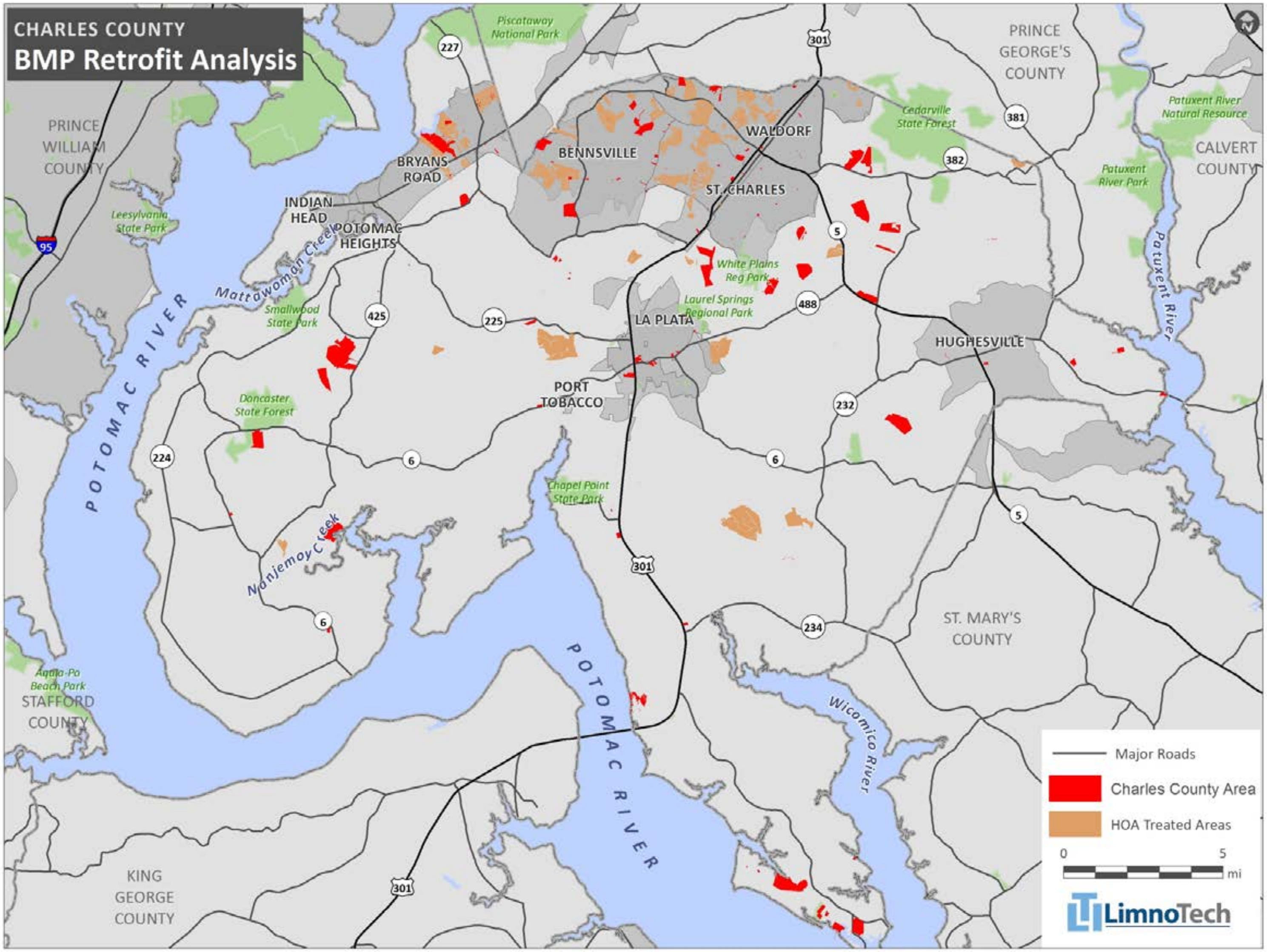
BMPs	Percent Removal, Nitrogen	Percent Removal, Phosphorus	Percent Removal, TSS
Pre-retrofit BMP Types			
Dry Detention Ponds	5%	10%	10%
Dry Extended Detention Ponds	20%	20%	60%
Wet Ponds and Wetlands	20%	45%	60%
Post-retrofit BMP Types			
Submerged Gravel Wetlands	50%	60%	90%
Step Pool Stormwater Conveyance	50%	60%	90%

Table 3-19
Nitrogen and Phosphorus Load Reduction Estimated from Pond Retrofits

Owner	Number of Ponds	Nitrogen Load Reduction (lbs/yr)	Phosphorus Load Reduction (lbs/yr)
County Ponds	102	2,376	234
Select Private Ponds (HOAs)	156	3,477	437
BMP Pond Retrofits (TOTAL)	258	5,853	671

[2] Note that these analyses are based on existing data, and when updated GIS data for BMPs are available, these analyses should be re-run to identify more specific locations for retrofits.

Figure 3-4 Location of Potential Pond Retrofits



3.2.2.f ESD Retrofits

Maryland's 2007 Stormwater Management Act requires that ESD be implemented to the maximum extent practicable on new development and redevelopment sites through the use of nonstructural BMPs and other better site design techniques. ESD encompasses a combination of site planning techniques, alternative cover, and small-scale treatment practices to address impacts associated with development. When applied as a retrofit technique, the emphasis of ESD is on installation of treatment practices. These practices include but are not limited to permeable pavement, bioretention, green roofs, vegetated swales, or other landscape infiltration to capture and treat runoff from impervious surfaces.

This strategy focuses on retrofitting entire parcels that have little or no existing stormwater management with ESD practices. For this planning level exercise, it was assumed that all of the design runoff (water quality volume) generated from the site can be effectively managed with the ESD retrofits, but there is no assumption about the specific practice being employed. This analysis is performed separately for both County-owned parcels and private parcels. All parcels, except those covered by the County's 2011 BMP Treated Area GIS dataset, are considered for this analysis. For County-owned parcels, this amounts to approximately 1,314 acres of property that could be retrofitted. For private parcels, there is no specific assumption about the level of retrofit implementation that can be achieved. BMP pollutant removal efficiencies for ESD (50 percent nitrogen, 60 percent phosphorus, 90 percent sediment) from the CBP were applied to estimate the amount of pollutants removed. The results of this analysis for County owned properties are summarized in Table 3-20.

As discussed in Section 4.4.1, the State of Maryland recently passed legislation that calls for Phase I counties and municipalities to establish a stormwater utility, among other requirements. The stormwater utility must include a stormwater remediation fee to be collected annually from property owners within each county. Under this Act, each county may also consider a concomitant fee discount program. It is expected that a stormwater fee and potential discount program could be a driver for a subset of private property owners to retrofit their properties with ESD practices outside of the normal course of development and redevelopment. Although the specific elements of such a program have not yet been developed in the County, it is possible that the private retrofits that are undertaken as a result of this program could be counted as a TMDL pollution reduction credit.

Table 3-20
Nitrogen and Phosphorus Load Reduction Estimated from ESD Retrofits

Owner	Number of Impervious Drainage Acres	Nitrogen Load Reduction (lbs/yr)	Phosphorus Load Reduction (lbs/yr)
County Parcels	276	2,491	437

3.2.2.g Shoreline Stabilization

CBP defines the shoreline erosion control BMP as protection of shoreline from excessive wave action by creating a marsh or an offshore structure such as a sill, breakwater or sand containment structure. Shoreline erosion control has been included as a BMP in the Chesapeake Bay Model and Maryland's Phase I and Phase II WIPs include targets for shoreline erosion control for both agricultural and developed lands. MDE also recognizes shoreline stabilization/erosion control as a method to provide alternative restoration credits in its Stormwater Guidance document. The Stormwater Guidance states that "MDE and Maryland's Chesapeake and Coastal Bays Critical Area Protection Program encourage the use of nonstructural practices or living shorelines. These include tidal marsh creation and beach nourishment. Structural practices include stone revetments, breakwaters, or groins." Several other counties in Maryland, including Wicomico and Kent Counties, have included shoreline erosion control as part of their Phase II WIP strategies, and Kent County has included several recently completed "living shoreline" projects in Chestertown and Rock Hall as part of its 2012-2013 Milestones.

The County has been receiving information on shoreline erosion control projects on private land since at least 2004 and approximately 45 projects encompassing over 13,000 linear feet have been completed in the County since that time. Using these data, the County estimates that approximately 1,962 feet of shoreline erosion control projects have been completed per year from 2006 to 2012. Projecting a similar rate of shoreline erosion control project completion rate out to 2025, and applying the current load reduction credit of 0.02 and 0.0025 lbs of TN and TP, respectively, reduced per foot of shoreline erosion control, the County can expect to achieve approximately 510 lbs/year of TN (delivered) and 63.77 lbs TP/yr (delivered) by 2025. These load reductions are summarized in Table 3-21.

Table 3-21
Anticipated Load Reduction Achieved Through Shoreline Stabilization Projects

Implement-ation Rate, ft/yr	Years of Implement-ation, 2013-2025	Total # Ft. Estimated for Comple-tion 2013-2025	Nitrogen Load Reduction Rate (lbs TN reduced/ft of shoreline erosion control)	Nitrogen Load Reductio n (lbs TN reduced)	Phosphorus Load Reduction Rate (lbs TP reduced/ft of shoreline erosion control)	Phosphorus Load Reduction (lbs TP reduced)
1,962	13	25,506	0.02	510.1	0.0025	63.77

Currently, shoreline erosion control projects are developed and proposed by private landowners, and the County does not promote these types of projects or provide incentives. However, the Maryland Phase I WIP identifies the establishment of non-structural shoreline erosion controls on residential and other waterfront properties as a BMP that could be incentivized through tax breaks, and the County may consider some incentive in the future, such as establishing a grant fund under which private homeowners could apply to get grant funding to complete shoreline erosion control projects. The County could finance such a program through a fee on landowners who own shoreline. The County could also use other tools, such as its database of previous projects or maps produced by Maryland Department of Natural Resources (MDNR) that identify shoreline areas with high erosion potential (http://dnr.maryland.gov/coastsmart/pdfs/Charles.pdf). These tools could be used to help identify which projects should be funded to achieve the most load reduction benefit for the dollars spent.

3.2.2.h Urban Forest Buffer Restoration

Intact natural vegetated stream buffers provide important terrestrial habitat and shading and also serve to dampen runoff velocities and filter runoff pollutants before they enter a stream. These functions are lost or significantly diminished when stream buffers are removed or compromised by land management decisions. This strategy considers restoring deficient stream buffers via reforestation.

The analysis utilizes the County's Resource Protection Zone (RPZ) dataset, which identifies required stream buffers defined by the County's Zoning Ordinance, and the MDNR Forest Service's Plantable Area dataset, which identifies bare earth areas. These datasets were intersected with the urban land use dataset to determine areas in the stream buffer that could be restored to a forested buffer. The Charles County Impervious dataset was then overlain to remove any impervious areas that were inadvertently captured within the designated plantable areas. There was a total of 3,005 acres of plantable area within the RPZ buffer zone that could be restored to urban forest buffer. BMP pollutant removal efficiencies for Forest Buffers (25 percent nitrogen, 50 percent phosphorus, 50 percent sediment) from the Bay TMDL program were applied to estimate the amount of pollutants removed (Table 3-22).

Table 3-22
Nitrogen and Phosphorus Load Reductions Estimated from Urban Stream Buffer Restoration

Owner	Number of Acres	Nitrogen Load Reduction (lbs/yr)	Phosphorus Load Reduction (lbs/yr)
County Parcels	16	4	1
Private Parcels	270	65	16
Total Parcels	**286**	**69**	**17**

Table 3-22 shows that there is a relatively small amount of load reduction that can be achieved from urban forest buffer restoration, particularly if work is conducted only on County-owned land. In addition, it may be difficult to restore urban forest buffer on privately owned land depending on the property. For example, if a property owner has landscaped a property to the stream edge, it may be unlikely that the owner will be willing to remove his landscaping and have a tree buffer planted instead. It was also difficult to identify specific parcels for potential forest buffer restoration based on the County's current GIS dataset. Urban forest buffer is also a relatively expensive BMP (see Section 4). Based on all of these factors, urban forest buffer restoration was not used in load reduction scenarios. However, if the County chooses to use urban forest buffer restoration as a BMP, it may be a valuable supplement to other BMPs for load reduction.

3.2.3 Load Reduction Scenarios

If fully implemented, there are a multitude of combinations of restoration activities and retrofits that will meet the Bay TMDL targets. A true accounting of the strategies must consider costs (described further in Section 4) and the County's implementation planning. To help understand the level of implementation required to meet the TMDL targets, three load reduction scenarios are summarized below.

Scenario 1 - Maryland Phase II WIP Scenario

As part of its planning efforts for the Phase I and Phase II WIPs, MDE provided input decks of modeling data to demonstrate how the State would meet its targets. Absent a local strategy from the County, these input decks represent the State's scenario for the County to meet its urban stormwater targets in the Maryland Phase II WIP. This scenario is summarized in Table 3-23 below. As shown in the table, the WIP strategy includes a number of ESD practices such as bioretention, rain gardens, bioswales, and urban filtration. Many of the BMPs included in the Maryland Phase II WIP strategy are the same as those envisioned as part of the ESD retrofits within the urban load reduction scenarios included in this document. However, whereas the urban load reduction scenarios included in this document envision focusing on the individual site level and designing specific BMPs that fit the specific site, the Maryland Phase II WIP does not specify expectations regarding how these BMPs would be implemented. Therefore, it is unclear whether the Maryland Phase II WIP strategies are based on ESD or load reduction from larger scale projects.

Table 3-23
Maryland Phase II WIP Scenario for Urban Stormwater

BMP Name	Unit	2025 Strategy[1]	Units Remaining to Meet 2025 Strategy
Bioretention/Rain Gardens	Acres	3	3
Bioswales	Acres	46	46
Dry Detention Structures and Hydrodynamic Separators (Retrofit)	Acres	2,462	79
Dry Extended Detention Ponds (Retrofit)	Acres	296	84
Impervious Urban Surface Reduction	Acres	1,608	1,608
MS4 Retrofit	Acres	583	108
Urban Filtering Practices	Acres	11,036	10,866
Urban Forest Buffers	Acres	1,122	1,095
Urban Infiltration Practices	Acres	497	18
Urban Tree Planting - Urban Tree Canopy	Acres	251	251
Vegetated Open Channel – Urban	Acres	259	259

Table 3-23 cont.
Maryland Phase II WIP Scenario for Urban Stormwater

BMP Name	Unit	2025 Strategy[1]	Units Remaining to Meet 2025 Strategy
Urban Nutrient Management	Acres/Yr	18,004	9,544
Urban Stream Restoration/ Shoreline Erosion Control	Feet	2,279	2,279

[1]Note that the Maryland Phase II WIP aggregates BMPs required for the entire County, including BMPs for SHA, federal facilities, State lands, industrial facilities, Phase I and II MS4, and non-regulated stormwater. However, most of the burden for implementing BMPs will fall on the County.

As shown in the table, MDE's scenario includes many different BMP types, including impervious surface restoration, urban filtering practices, urban forest buffers, and urban nutrient management. The scenario is expressed by showing the total number of units (acres, acres per year, or linear feet) of a BMP type that must be implemented by 2025 to meet the targets.

Scenario 2 – Focus on ESD Implementation

The second scenario is heavily oriented towards significant load reduction from ESD on land with little or no stormwater management, and maximizes stream restoration, pond retrofits, and stream buffer on public land. No stream restoration is proposed on private land. Table 3-24 below provides a summary of the level of implementation and pollutant reduction for the various activities and retrofits to meet the targets. As noted in the footnote in Section 3.2.2.e, when GIS datasets are updated, these analyses should be updated to help identify the specific projects that can be undertaken on County land.

Scenario 3 - Focus on Stream Restoration

The third scenario maximizes use of stream restoration projects, in conjunction with other BMPs, to achieve the load reduction necessary to meet targets. Similarly to Scenario 2, this Scenario includes a high level of BMP implementation on private property, but in this scenario, the ESD projects on private land are replaced with stream restoration projects on private land. Table 3-25 below provides a summary of the level of implementation and pollutant reduction for the various activities and retrofits to meet the targets. As noted in the footnote in Section 3.2.2.e, when GIS datasets are updated, these analyses should be updated to help identify the specific projects that can be undertaken on County land.

Both Scenarios 2 and 3 meet the load targets for nitrogen and phosphorus. Table 3-26 indicates Scenario 2 exceeds the nitrogen target by 10.942 lbs. Table 3-27 indicates Scenario 3 exceeds the phosphorus target by 306 lbs.

Table 3-24
Urban Stormwater Scenario 2

Strategy	Quantity	Units	Description	Treatment Drainage Acres	Treatment Impervious Acres	Pollutant Reduction	
						TN (lbs/ year)	TP (lbs/ year)
Stream Restoration (TOTAL)	54,543	Feet	Stream restoration of degraded or potentially degraded stream channels. Potential restoration streams identified from "Poor" rated streams from MBSS and analysis of impervious cover within 1,000 feet of stream.	NA	NA	8,753	3,296
Streams on County Land	14,782	Feet		NA	NA	2,222	902
Streams on State Land	39,761	Feet		NA	NA	6,531	2,394
Streams on Select Private Land	0	Feet		NA	NA	0	0
BMP Pond Retrofits (TOTAL)	102	# of Ponds	Retrofit low-efficiency SWM ponds with submerged gravel wetlands, SPSCs, or similar approach.	1,023	242	2,376	234
County Wet Ponds	79	# of Ponds		443	104	618	43
County Dry Ponds	23	# of Ponds		580	137	1,758	191
Select Private Wet Ponds	0	# of Ponds		0	0	0	0
Select Private Dry Ponds	0	# of Ponds		0	0	0	0
ESD Retrofits (TOTAL)	18,738	Acres	Retrofit areas without SWM with ESD practices (100% of County parcels, 44% of private parcels)	18,738	2,154	24,851	4,021
County Parcels	1,314	Acres		1,314	276	2,491	437
Private Parcels	17,424	Acres		17,424	1,878	22,360	3,584
Shoreline Stabilization	25,506	Feet	Shoreline stabilization based on projections of future implementation levels identified by Charles County	NA	NA	510	64
Urban Nutrient Management	9,544	Acres	Implementation of existing urban nutrient management laws and regulations at level implemented by MDE in WIP	9,544	NA	6,571	252
					TOTALS	**43,061**	**7,867**

Table 3-25
Urban Stormwater Scenario 3

Strategy	Quantity	Units	Description	Treatment Drainage Acres	Treatment Impervious Acres	Pollutant Reduction	
						TN (lbs/ year)	TP (lbs/ year)
Stream Restoration (TOTAL)	117,037	Feet	Stream restoration of degraded or potentially degraded stream channels. Potential restoration streams identified from "Poor" rated streams from MBSS and analysis of impervious cover within 1,000 feet of stream.	NA	NA	16,695	6,749
Streams on County Land	14,782	Feet		NA	NA	2,222	902
Streams on State Land	39,761	Feet		NA	NA	6,531	2,394
Streams on Select Private Land	62,494	Feet		NA	NA	7,942	3,453
BMP Pond Retrofits (TOTAL)	258	# of Ponds	Retrofit low-efficiency SWM ponds with submerged gravel wetlands, SPSCs, or similar approach.	3,498	774	5,853	671
County Wet Ponds	79	# of Ponds		443	104	618	43
County Dry Ponds	23	# of Ponds		580	137	1,758	191
Select Private Wet Ponds	82	# of Ponds		1,481	309	1,327	117
Select Private Dry Ponds	74	# of Ponds		994	223	2,150	320
ESD Retrofits (TOTAL)	1,314	Acres	Retrofit areas without SWM with ESD practices (100% of County parcels, 0% of private parcels)	1,314	276	2,491	437
County Parcels	1,314	Acres		1,314	276	2,491	437
Private Parcels	0	Acres		0	0	0	0
Shoreline Stabilization	25,506	Feet	Shoreline stabilization based on projections of future implementation levels identified by Charles County	NA	NA	510	64
Urban Nutrient Management	9,544	Acres	Implementation of existing urban nutrient management laws and regulations at level implemented by MDE in WIP	9,544	NA	6,571	252
					TOTALS	**32,120**	**8,173**

Table 3-26 Summary of Urban Stormwater Scenario 2 Performance		
Scenario	**TN (lbs/ year)**	**TP (lbs/ year)**
Baseline Load without Existing BMPs	180,201	24,459
BMP Load Reduction	21,986	3,865
Baseline Load with Existing BMPs	158,224	20,594
WIP Strategy Load Reduction	43,061	7,867
Load with WIP Strategy Implemented	115,163	12,727
Target Percent Load Reduction	20.3	38.2
2025 Target	126,105	12,727
Difference Between Target and Implementation	**10,942**	**0**

Table 3-27 Summary of Urban Stormwater Scenario 3 Performance		
Scenario	**TN (lbs/ year)**	**TP (lbs/ year)**
Baseline Load without Existing BMPs	180,201	24,459
BMP Load Reduction	21,986	3,865
Baseline Load with Existing BMPs	158,224	20,594
WIP Strategy Load Reduction	32,120	8,173
Load with WIP Strategy Implemented	126,104	12,422
Target Percent Load Reduction	20.3	38.2
2025 Target	126,105	12,727
Difference Between Target and Implementation	**0**	**306**

3.3 SEPTIC SYSTEM SECTOR

3.3.1 2009 Nitrogen Load and 2025 Target Nitrogen Load

Maryland's Phase II WIP includes a baseline loading of 182,485 lbs TN/ year (delivered) for non-federal septic system loads in the County, and a 2025 target of 124,032 lbs TN/year (delivered). This represents a 32 percent reduction in septic system loading for the County. The septic system sector 2009 nitrogen load and 2025 target nitrogen load are shown below in Figure 3-5. Because septic systems do not remove phosphorus or sediment, no targets have been established for these constituents.

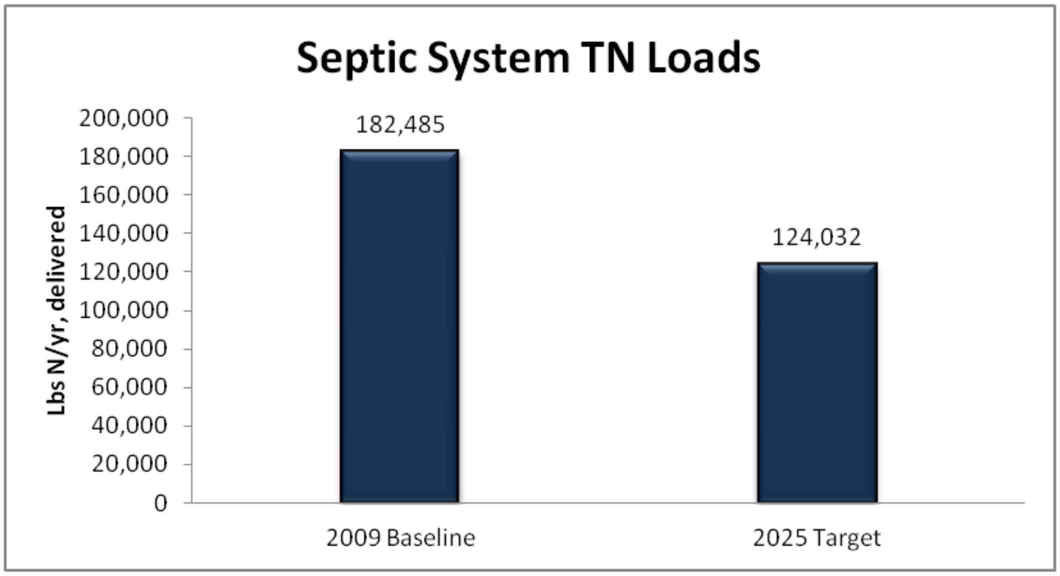


Figure 3-5 Septic System Sector Baseline and 2025 Targets

3.3.2 Septic System Load Calculations

Septic system loads were calculated based on two different methods in order to differentiate between residential and non-residential septic systems. This provides an extra level of accuracy relative to septic system loading calculations used in the Bay TMDL and in MDE's target, which are based on averages that do not differentiate between residential and non-residential systems.

The first step was to classify the properties with septic systems into either residential or non-residential systems. This was done using the "DESCLU" field from the County's "OSDS_Septic_Locations2009" GIS data layer. Properties with "Agricultural," "Exempt," "Residential," and "Town House" in the DESCLU filed were classified as residential septic systems. Properties with "Apartments," "Commercial," "Country Club," "Exempt Commercial," "Industrial," and "Commercial Residential" in the DESCLU filed were classified as non-residential septic systems.

For residential septic systems, the MDE methodology for calculating septic systems was used. This method is as follows:

Septic load per system = number of persons/septic * average annual load/person

MDE uses an average of 2.6 persons per septic system and 8.6 lbs of total nitrogen per person per year, so that an average septic system load is:

Average septic system load = 2.6 persons/system * 8.6 lbs TN/year/person = 22.4 lbs TN/system/year

For non-residential septic systems, data from a septic system study done by Anne Arundel County (http://www.aacounty.org/DPW/Utilities/OSDS.cfm) was used. Anne Arundel County used a flow rate of 1,300 gpd for non-residential septic systems, which was the flow factor per acre for most their non-residential zoning types. Using this flow rate, plus a total nitrogen concentration of 40 mg/L from a conventional septic system, yields the following loading equation:

1,300 gpd * 40 mg/L TN * 0.00305 (conversion factor) = 158.4 lbs TN/system/year

The load discharged from the septic system is referred to as the "edge-of-stream" or EOS load. However, because of various interactions within the soil and distances to major Bay tributaries, not all of the EOS load reaches the Chesapeake Bay. The CBP includes "delivery factors" to adjust for the amount of the load that reaches the Bay based on the location of an individual septic system. The CBP uses three tiers of locations to determine delivery factors, including:

- Septics located within the critical area, which is defined as "all land within 1,000 feet of the Mean High Water Line of tidal waters or the landward edge of tidal wetlands and all waters of and lands under the Chesapeake Bay and its tributaries;"
- Septics not within critical area but within 1,000 feet of a perennial stream (locations of perennial streams were determined using a high resolution National Hydrography Dataset [NHD] dataset from USGS); and
- Septics not within critical area and not within 1,000 feet of a perennial stream.

The delivery factors for each of these tiers are summarized in Table 3-28 below:

Table 3-28
Delivery Factors for Septic System Loads

Septic System Location	Delivery Factor
In critical area	0.8
Not within critical area but within 1,000 ft. of a perennial stream	0.5
Not within critical area and not within 1,000 ft. of a perennial stream	0.3

Therefore, a septic system located in the critical area would deliver 80 percent of its load to the Bay, while a septic system located in an area that is not in the critical area and is not within 1,000 feet of a perennial stream would only deliver 30 percent of its load to the Bay.

Using these delivery factors, the average loads into the Chesapeake Bay for the three tiers of septic system locations can be calculated. These are summarized in Table 3-29 below. Note that these numbers show the load for residential systems.

Table 3-29
Average Delivered Loads for Residential Septic Systems in Different Locations Relative to the Critical Area

Septic System Location	EOS Load per System (lbs N/year)	Delivery Factor	Delivered Load (lbs N/year)
In critical area	22.4	0.8	17.9
Not within critical area but within 1,000 ft. of a perennial stream	22.4	0.5	11.2
Not within critical area and not within 1,000 ft. of a perennial stream	22.4	0.3	6.7

3.3.3 Comparison of Septic System Inventories

According to data from MAST, MDE reports 26,857 septic systems in the County, which is substantially higher than the 17,067 septic systems in the County's inventory[3]. Table 3-30 provides a comparison of MDE's numbers to the County's numbers, including a breakdown by the number of systems relative to the critical area, within 1,000 feet of a perennial stream, and not in the critical area or within 1,000 feet of a perennial stream. Figure 3-6 summarizes these numbers graphically.

Table 3-30
Comparison of MDE and Charles County Septic System Inventories

Septic System Location	Number of Septic Systems		Difference
	MDE/MAST	Charles County	
In critical area	1,232	1,178	54
Not within critical area but within 1,000 ft. of a perennial stream	9,441	7,623	1,818
Not within critical area and not within 1,000 ft. of a perennial stream	16,184	8,266	7,918
Totals	**26,857**	**17,067**	**9,790**

[3] The County inventory includes all properties not paying a sewer/water bill, and with assessed improvements greater than $10,000.

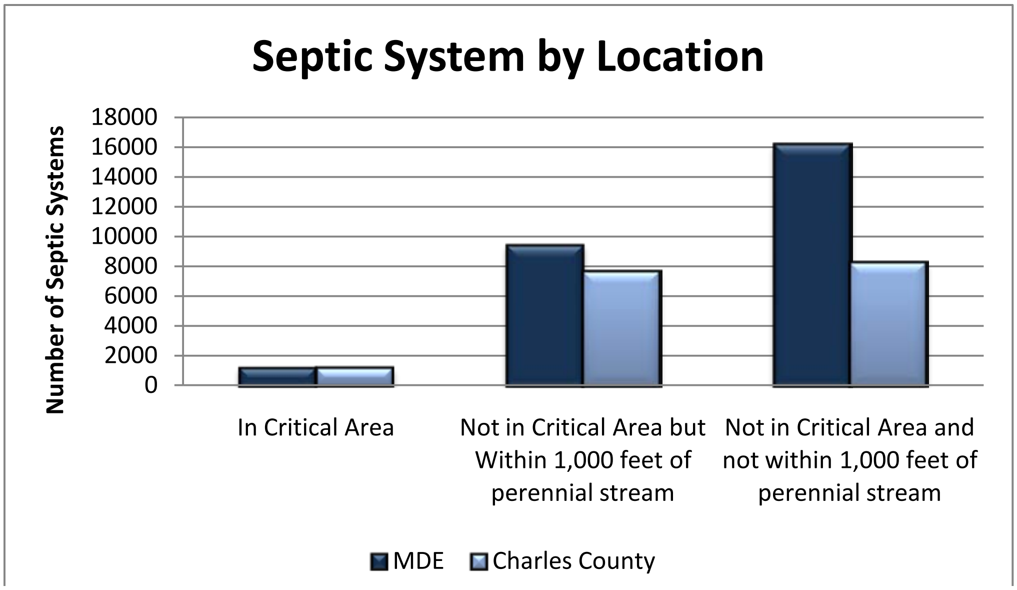


Figure 3-6 Septic System Sector Inventories by Location

Note that this inventory includes septic systems in Indian Head and La Plata, as well as any other non-federally-owned septic systems located within the County. The number of septic systems in Indian Head and La Plata are summarized in Table 3-31 below.

Table 3-31
Septic Systems in Indian Head and La Plata

Septic System Location	Indian Head	La Plata
In critical area	2	0
Not within critical area but within 1,000 ft. of a perennial stream	0	35
Not within critical area and not within 1,000 ft. of a perennial stream	1	26
Totals	**3**	**61**

The number of other non-federal septic systems in the County is unknown but is expected to be very low. Thus, the estimated total number of septic systems for which the County is responsible for load reduction is provided in Table 3-32 below.

Table 3-32
Number of Septic Systems in Charles County for which the County is Responsible for Load Reduction

Septic System Location	Number of Septic Systems
In critical area	1,176
Not within critical area but within 1,000 ft. of a perennial stream	7,588
Not within critical area and not within 1,000 ft. of a perennial stream	8,239
Total	**17,003**

Using the factors summarized above, the baseline loading from the County's existing septic system can be calculated. These numbers are summarized in Table 3-33. Again, note that these loads are based only on residential systems. However, this is appropriate for comparison to MDE's load calculations because these are based on a similar type of load calculation.

Table 3-33
Total Nitrogen Load (Delivered) from Charles County Septic Systems

Septic System Location	Number of Septic Systems	Septic System Load lbs TN (delivered)/year)
In critical area	1,178	21,072
Not within critical area but within 1,000 ft. of a perennial stream	7,623	85,225
Not within critical area and not within 1,000 ft. of a perennial stream	8,266	55,448
Totals	**17,067**	**161,746**

3.3.4 Target

As discussed above, there are significant differences in the inventory of septic systems provided by MDE versus the County's inventory. Therefore, the strategy used in this document is to achieve the same percent reduction in septic system sector load that was required to reach targets (as provided in Maryland's Phase II WIP), but using the County's numbers for septic system inventory. In other words, Maryland's Phase II WIP showed that the County had to reduce its septic system sector loading by 32 percent. That percent reduction target was applied using County data for the septic system sector. This also eliminates the problem of including septic systems over which the County has no jurisdiction (e.g., septic systems in Indian Head and La Plata) in the original targets. Table 3-34 shows the annual loading that must be reduced to meet a 32 percent reduction.

Table 3-34
Septic System Sector Load Reduction Required for Charles County

Septic Sector Loads	Septic Sector Load lbs TN (delivered)/year)
Total 2009 Baseline Load, Septic System Sector	161,746
Total Reduction Required to meet 32% Reduction Target	51,759

3.3.5 Septic System Best Management Practices (BMPs)

Three different BMPs can be implemented to reduce load from septic systems. These are:

- Septic system pump-out

- Septic system upgrade to Best Available Technology (BAT)
- Septic system connection to a Waste Water Treatment Plant (WWTP)

The load reductions that can be received for each BMP type are different and are summarized in Table 3-35 below:

Table 3-35
Load Reduction Credit from Septic System BMPs

BMP Type	Load Reduction Credit
Septic pump-out	5% load reduction per pump-out
Septic upgrade to BAT	50% load reduction per upgrade
Septic system connection to a WWTP	90% load reduction per connection (See text below.)

Load reduction credit for connecting a septic system to a WWTP is handled several different ways depending on the source of the information. In MAST, this BMP reduces number of septic systems, thereby eliminating the septic system load from that system (in effect, this is a 100 percent credit for the septic system load)[4]. In contrast, MDE recommends using a 50 percent load reduction credit for connection to a WWTP. This is intended to reflect a reduction in load from the average septic system TN effluent concentration to the average advanced WWTP TN effluent concentration. However, MDE's use of a 50 percent load reduction credit may be too conservative, considering that most conventional septic systems have a TN effluent concentration of approximately 40 mg/L TN and advanced WWTPs typically have TN effluent concentrations of approximately 4 mg/L TN. Using a load reduction effectiveness of 90 percent will apply a credit that is more reflective of the load reduction that would actually be achieved through septic connection projects, while still tracking the BMP and load in the septic sector.

3.3.6 Strategy for Meeting Septic System Target

There are several different approaches that can be taken to address septic system loads in the County with respect to the expectations of the Bay TMDL. The first step in this process will be to reconcile the septic system inventories tracked by the County versus the inventory used by MDE. As described above, MDE has used a higher number of septic systems in its calculations. MDE acknowledged this issue in the Phase II WIP. Specifically, Section IV (Future Steps), p. 81 of Maryland's Phase II WIP discusses "concerns" raised by local governments regarding the number of septic systems identified by MDE and states that "those concerns will provide a basis for discussions with EPA on data and model revisions. Addressing these concerns is an ongoing process, but will likely be most active from 2013 to 2015." However,

[4] Note that any loads from septics connected to WWTPs will be shifted to the WWTP, and so must be accounted for as growth in the WWTP load. To account for the difference between loads from septics and loads from WWTPs, MDE assumes a load reduction of approximately 50% delivered N when connecting a septic system to a WWTP, irrespective of the increased flow at the WWTP.

even if MDE accepts the County's lower number, it is unlikely that they would also accept that the County had met its septic system load reduction target. This is because a TMDL is a hard number, whereby lowering load reduction requirements in one sector will require increasing them for another sector so that the same overall target is met from a jurisdiction. Therefore, it is likely that the County will still need to reduce loads from the septic system sector, even if the number of septic systems is reconciled. Using a percent reduction from baseline, such as is included in this strategy, is consistent with MDE's modeling and its recommendations for an equitable percent reduction of the nonpoint sectors, including the septic system sector.

The County has reported that EPA's Bay TMDL contractor has collected information on the number of septic systems in the County. Therefore, it will be important for the County to follow any developments in reconciling septic system numbers and any resulting changes in expectations for load reduction in the septic system sector. At this point, this strategy still recommends reducing the County's septic system sector load by a similar percentage to that indicated for the County in the Maryland Phase II WIP.

A second approach to the septic system sector load would be to consider "offsetting" the septic system load reduction requirements with load capacity available through the Mattawoman WWTP. As described in Section 3.1, the Mattawoman WWTP should have approximately 150,213 lbs of TN capacity/year available based on 2025 projected flows and the current effluent quality of 1.3 mg/L TN. Thus, the entire 51,759 lbs TN of septic system load reduction could be offset by reserving this amount of the load capacity at the Mattawoman WWTP. Even reserving this capacity for septic system loads would leave 98,454 lbs TN of load capacity at the WWTP at 2025 projected flow rates, which is 50 percent of the WWTP's 194,916 lbs TN/year load cap.

The third approach would be to use BMPs to reduce the septic system loads. The following sections summarize the potential for the County to use various types of BMPs to reduce its septic system sector loads. The subsequent section discusses potential load reduction scenarios using various combinations of these BMPs.

3.3.6.a Septic Pump-outs

While an individual septic pump-out receives a relatively low load reduction credit (5 percent of the load per pump-out), the County has the potential to get credit for a large number of pump-outs, particularly if it passes an ordinance requiring pump-outs. For example, Virginia passed the Chesapeake Bay Preservation Act in 1988 to establish a cooperative program between the State and local governments with the purpose of reducing nonpoint source pollution. The Chesapeake Bay Preservation Act, which was primarily targeted to communities in the Tidewater region, required the identification of Chesapeake Bay Preservation Areas where land and waters required regulation to help protect the health of the Bay. This was followed by the Chesapeake Bay Preservation Area Designation and Management Regulations in 1989 (amended 1991), which included 11 performance criteria for management of the Preservation Areas. Criterion 7 states that local governments (through their applicable land use ordinances) require that any use, development, or redevelopment of land in Chesapeake Bay Preservation Areas using an on-site sewage treatment system shall be pumped-out at least once every five years. Local governments have since adopted ordinances requiring these pump-outs. For example, the Department of Planning and Zoning in Isle of Wight County sends material to homeowners with on-site septic tanks that include an introductory letter, the Septic Pump-Out Registration and Compliance form, and supporting information designed to help homeowners understand the need for routine septic tank pump-outs. According to the County website (http://www.co.isle-of-wight.va.us/planning-and-zoning/environmental-planning/septic-pump-out-program/), once notified by the county, homeowners generally have two years to have a septic tank pump-out done. If there has been a pump-out within the past five years then the date of the next septic tank pump-out tracks from the date of that most recent pump-out.

If the same schedule were to be used, the County would get about 20 percent of its septic systems pumped every year. Applying the 5 percent load reduction credit on 20 percent of the County's total septic load of 161,746 lbs TN (delivered) annually would achieve a load reduction of 1,617 lbs TN (delivered) annually, or approximately three percent of the 51,759 lbs TN (delivered) load reduction target.

Because the septic systems in the Development District and septics located in the critical area will be targeted for other strategies, it is appropriate to exclude these systems from consideration for a septic pump-out program. This also ensures that load reduction credit will not be applied to the same septic systems for two different BMPs. Therefore, BMP credit for septic pump-outs were calculated using only systems outside of the Development District that were either not within the critical area but within 1,000 feet of a perennial stream or not within the critical area and not within 1,000 feet of a perennial stream. As described above, if the systems are pumped out once every five years, then the County can receive an annual credit for 20 percent of the systems (i.e., every year, 20 percent of systems are pumped, so every year the County can claim credit for load reduction from 20 percent of the systems). Table 3-36 below shows the number of systems that fall into these categories, the total load from these systems, the number of systems that would be pumped on an annual basis, and the credit that could be achieved from this level of pump-out.

Table 3-36
Load Reduction Credit from 5-Year Pump-out Program for Selected Septic Systems Outside the Development District

Location	Number of Systems	Total Load (Assuming Residential Loads) lbs TN (delivered)/ Year	# Systems Pumped/Year (Assuming 20%/Year)	Load Reduction (5% Credit) lbs TN (delivered) /Year
Not within critical area but within 1,000 ft. of a perennial stream	6,915	77,310	1,383	773
Not within critical area and not within 1,000 ft. of a perennial stream	6,339	42,522	1,268	425
Totals	**13,254**	**119,832**	**2,651**	**1,198**

Table 3-36 shows that 1,198 lbs TN (delivered)/year could be achieved through this targeted septic pump-out program.

An advantage of a pump-out strategy is that whether it is implemented by incentives, made mandatory through local ordinances, or a combination of both, it is still one of the least expensive ways to achieve nitrogen reductions in the septic sector. Typically, most of the cost of pump-out programs is borne by private landowners instead of by the County; however other funding options may be desired. Local estimates show that it costs approximately $200/system for a septic system pump-out. The County's primary responsibility would be to track the pump-out program to ensure compliance, and to claim load reduction credit from the program.

Regular pumping of septics not only reduces nitrogen discharge but also increases the life of the septic system. Because of benefits associated with the program, this strategy should be pursued for implementation.

3.3.7 Septic System Upgrade to BAT

The County does not envision septic system upgrades to BAT to be a large part of its septic system load reduction strategy, primarily due to the difficulty in promoting and achieving upgrades to BAT among private landowners, and because of the significant annual operation and maintenance costs. However, this may be a good strategy to target for specific areas or neighborhoods, particularly for areas where there are septic systems in the critical area but there are no existing sewer systems in close proximity to enable septic system connection to a WWTP.

Since the Bay Restoration Fund began awarding grants to counties in 2007, the County has received over $1.2 million for the purpose of installing BAT. The County has achieved an average of 30 septic upgrades to BAT annually. The County should consider developing a more robust outreach campaign and perhaps developing ordinances to require upgrades to BAT under certain circumstances, such as sale of the property or major improvements. These types of requirements may make it easier for the County to increase the number of systems upgraded to BAT, and thus to meet load reduction targets.

3.3.7.a Septic System Connection to WWTP

As described above, the County could receive a large amount of load reduction credit from connecting septic systems to WWTPs. For example, the Mattawoman WWTP has a large amount of unused TN capacity, even considering projected growth rates. In addition, a WWTP such as the Mattawoman, which achieves very high effluent quality for TN, would have a very high load reduction for every septic system connected. Using a load reduction credit of 90 percent gives a conservative estimate of the load reduction that could be achieved by connecting septic systems to WWTPs.

The County has explored several projects to connect parcels on septic systems to the sewer system, including several projects in the Development District. While connecting systems in the Development District could be very helpful in reducing load, most of the septic systems that contribute highest loads – those located in the critical area – are not located in the Development District. Therefore, the County may wish to consider community systems or other sewer projects that target septic systems in locations with high loads, such as the critical area.

3.3.8 Septic System Load Reduction Scenarios

This section presents several alternative scenarios for achieving the target of 51,759 lbs TN/year. As discussed above, this target was calculated based on a 32 percent reduction in current septic system load.

Scenario 1: Maryland Phase II WIP Scenario

Maryland Phase II WIP presented a scenario for the County to meet its septic system sector targets. This scenario focuses solely on upgrading septic systems to BAT as shown in Table 3-37. It should be noted that the State's inventory of the total number of septic systems in the County is higher than what the County itself reports (see Table 3-30 above). However, it is instructive to look at the percentage of recommended septic system upgrades.

Table 3-37
Maryland Phase II WIP Scenario for Septic Systems

Septic System Location	Number of Septic Systems to be Upgraded to BAT to meet 2025 Strategy	Load Reduction Achieved, lbs TN (delivered)/year
In critical area	1,233	11,028
Not within critical area but within 1,000 ft. of a perennial stream	3,722	20,806
Not within critical area and not within 1,000 ft. of a perennial stream	9,441	31,665
Totals	**14,396**	**63,499**

Note that the State's numbers actually include more septic systems that are not within critical area and not within 1,000 feet of a perennial stream than does the County's inventory. Therefore, this scenario represents upgrading 100 percent of the septic systems in the critical area, approximately 50 percent of the septic systems not in the critical area but within 1,000 feet of a perennial stream, and more than 100 percent of the septic systems not within critical area and not within 1,000 feet of a perennial stream.

Scenario 2 – Focus on connecting septic systems in the Development District

This scenario focuses on connecting all systems in the Development District to the Mattawoman WWTP (Figure 3-7). This scenario has the advantage of focusing efforts in a small area of the County where the County has the majority of its sewers and its largest WWTP. Table 3-38 shows the load reduction that could be achieved by connecting all of the septic systems in the Development District to the Mattawoman WWTP.

Table 3-38
Load Reduction from Septic Connections to WWTP in the Development District

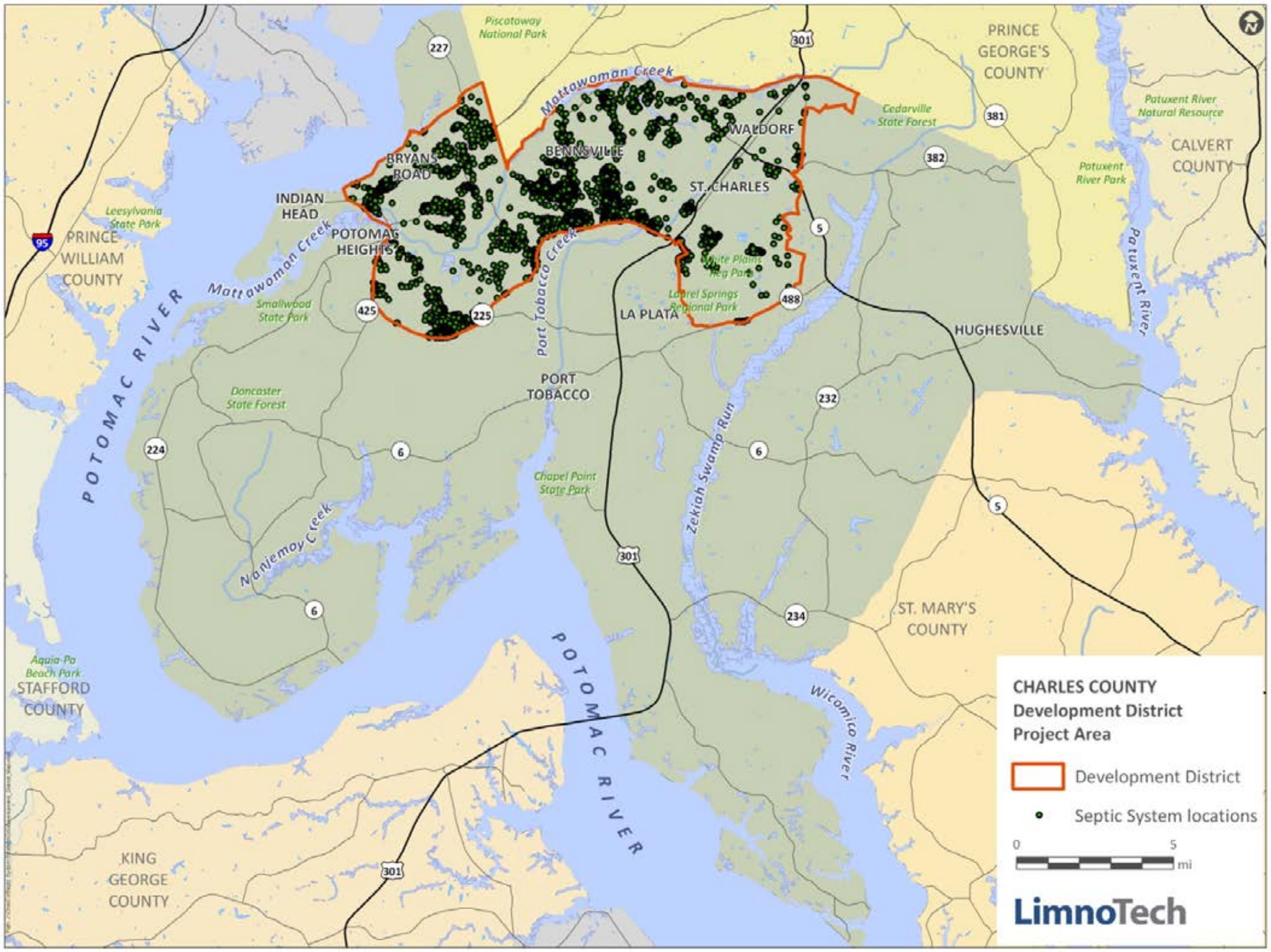
Location	Number of Systems	Baseline Load	Load Reduction
In critical area	28	1,045	941
Not within critical area but within 1,000 ft. of a perennial stream	708	8,460	7,614
Not within critical area and not within 1,000 ft. of a perennial stream	1,927	15,457	13,911
Totals	**2,663**	**24,962**	**22,465**

Assuming the same level of implementation of septic system pump-outs as described above (septic system pump-outs required once every five years for all areas outside of the Development District, achieving 1,198 lbs TN (delivered)/year load reduction, this scenario still falls short of the load reduction target of 51,759 lbs TN (delivered)/year. Table 3-39 shows how this shortfall could be made up by allocating some of the reserve capacity to make up the difference from the septic system sector.

Table 3-39
Load Reduction Scenario 2

Project Type	Load Reduction Achieved, lbs TN (delivered)/year
Septic Pump-out Program	1,198
Septic Connections in Development District	22,465
WWTP Credit (25% of remaining TN capacity)	28,096
Totals	**51,759**

Figure 3-7 Septic Systems within the Development District



3.3.8.a Scenario 3 – Focus on Priority Project Areas

Another scenario is to expand the consideration of projects outside of the Development District. The County has identified a number of potential projects to connect septic systems to WWTPs both inside and outside the Development District. In order to determine the potential impact on load reduction of these potential projects, GIS was used to identify the specific parcels that were included in the County's plans for each project. As described above, the parcels were identified as either residential or non-residential so that the appropriate septic system loading rates could be applied. Next, the location of these parcels relative to the three septic system loading categories (within critical area; not within critical area but within 1,000 feet of a perennial stream; or not within critical area and not within 1,000 feet of a perennial stream) were evaluated to determine the septic load that would be generated from each parcel. As a final step, a load reduction factor of 90 percent was applied to the septic system load from each parcel to reflect the load reduction that would be achieved by connecting the parcels to a WWTP. The spreadsheets showing how the septic loads were calculated for each project are provided in Appendix A. The total loads and load reduced by each project is summarized in Table 3-40.

Table 3-40
Potential Load Reduction from Septic System Connection Projects Identified by Charles County

Project Name	Total Number of Septic Systems	Septic Load, Lbs TN (delivered)/year	BMP Type	Septic Load Reduction, Lbs TN (delivered)/year
Old Woman's Interceptor Drainage	741	6,466	Connection	5,819
Mt. Carmel Woods	75	718	Connection	646
Benedict	130	3,958	Connection	3,562
White Plains	32	318	Connection	286
White Plains 2	147	1353	Connection	1,218
White Plains 3	52	398	Connection	358
Hughesville	91	1802	Connection	1622
Old Chapel Point	56	613	Connection	551
Port Tobacco	163	2431	Connection	2188
Settle Woods	34	228	Connection	205
Eutaw Forest	0	0	Connection	0
Mill Hill Road	35	235	Connection	211
Davis Road	19	132	Connection	119
Totals	**1,575**	**18,650**		**16,785**

Evaluating results from the table indicates that completing these projects would not achieve the required load reduction of 51,759 lbs of TN (delivered)/year. Therefore, additional load reduction projects must be completed. An analysis was undertaken to identify areas of the County with high septic loading, as described in Scenario 2. In addition to the identifying locations with high concentrations of septic systems in the critical area, the analysis also included evaluation of the date that properties were built. Using the County's recommendation of identifying properties built before 1990 as having a higher potential for failing septic systems, a map of prioritized potential project areas was developed (Figure 3-6). The map identifies locations with high concentrations of septic systems in critical areas where a large number of properties were built before 1990. These locations were further divided into locations that are close to existing sewers (within 500 feet of an existing sewer line) and locations that are not close to existing sewers (within 500 feet of an existing sewer line). Figure 3-8 also includes the locations of the potential septic connection projects identified by the County.

The potential load reductions that could be achieved by these projects are summarized in Table 3-41.

Table 3-41
Potential Load Reduction from Septic System BMPs Identified by Prioritization Analysis

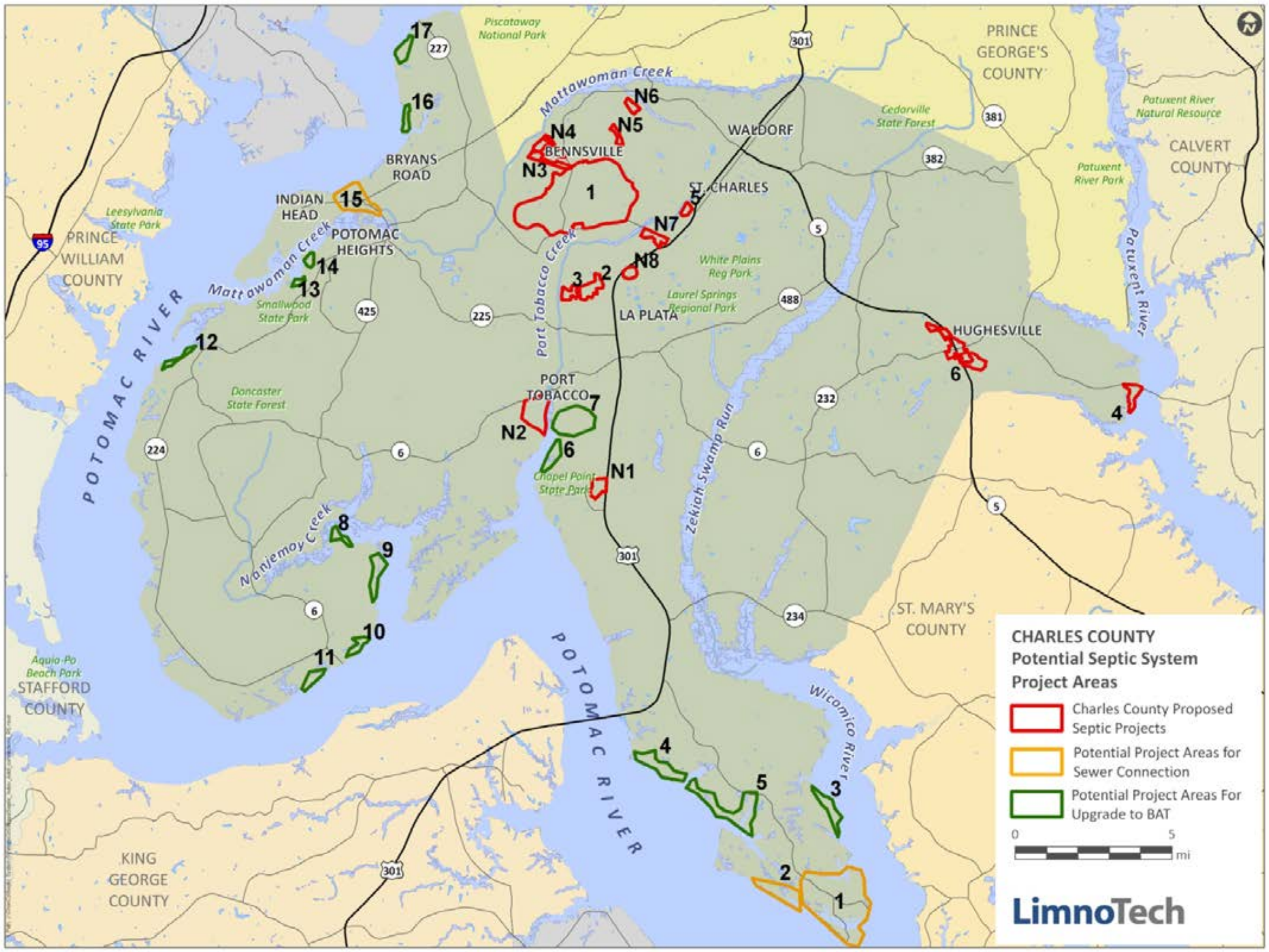
Project Area Number	Total Number of Septic Systems	Septic Load, lbs TN (delivered)/year	BMP Type	Load Reduction Achieved, lbs TN (delivered)/year
1	115	2,445	Connection	2,200
2	13	251	Connection	226
3	40	704	Upgrade to BAT	352
4	119	2,046	Upgrade to BAT	1,023
5	92	1,617	Upgrade to BAT	808
6	35	588	Upgrade to BAT	294
7	129	1,290	Upgrade to BAT	645
8	21	376	Upgrade to BAT	188
9	22	380	Upgrade to BAT	190
10	30	537	Upgrade to BAT	268
11	25	440	Upgrade to BAT	220
12	16	286	Upgrade to BAT	143
13	15	268	Upgrade to BAT	134
14	31	499	Upgrade to BAT	249
15	45	1273	Connection	1,146
16	36	521	Upgrade to BAT	260
17	39	642	Upgrade to BAT	321
Totals	**823**	**16,567**	**N/A**	**8,669**

This analysis shows that 8,669 pounds of TN can be reduced through targeted projects. Adding in the 16,785 lbs TN reduced through the County's potential sewer projects and the 1,198 lbs TN reduced by the septic pump-out program still leaves a shortfall of 25,107 lbs TN (51,759 – 16,785 – 8,669 – 1,198 = 25,107). As in Scenario 2, this difference can be made up using some of the reserve capacity at the Mattawoman WWTP. This scenario is summarized in Table 3-42.

Table 3-42
Load Reduction Scenario 3

Project Type	Load Reduction Achieved, lbs TN (delivered)/year
Septic Pump-out Program	1,998
Septic Connections for County identified projects	16,785
Septic BMPS from Prioritization Analysis	8,669
WWTP Credit (22% of remaining TN capacity)	25,107
Totals	**51,759**

Figure 3-8 Potential Project Locations for Septic System BMPs



This page is blank to facilitate double sided printing.

4. COSTS INTRODUCTION

This section summarizes the overall costs of the various load reduction strategies presented in this document. It includes discussions of:

- The background on funding load reduction strategies, including the potential cost-share and balance between costs incurred by the County government versus the private sector;
- The various sources of cost documentation;
- The total costs of the strategies and information about how these costs were developed; and
- Potential funding sources and funding strategies to pay for the various load reduction strategies.

4.1 THE ROLE OF COST IN DEVELOPING A LOAD REDUCTION STRATEGY FOR THE BAY TMDL

The overall costs of the load reduction strategies are critical elements in determining an appropriate overall strategy to meet the TMDL. Local governments, including the Charles County government, are faced with funding the capital costs of BMP construction, costs for maintaining those BMPs, and the programmatic and administrative costs of planning, tracking, and reporting on both structural and non-structural BMPs and other load management strategies. These activities often compete with other programs for funding. This competition for County funding may not always be direct – the County does have an Environmental Service Fee, part of which is dedicated to paying for the NPDES program, and the County is establishing a stormwater utility as an alternative way to fund the NPDES program; and user fees in the form of sewer bills pay for the operation, maintenance, and upgrades of County-owned wastewater treatment plants – but obtaining full funding for these programs can nonetheless remain a challenge.

This document does not focus on determining the capacity of the County taxpayers to support the costs of the strategies in this document. However, EPA has developed a Financial Capability Assessment protocol that may be useful in helping the County determine the burden of the load reduction strategy costs relative to various financial indicators. EPA has published this protocol in a document specifically designed for the CSO program (*Combined Sewer Overflows - Guidance for Financial Capability Assessment and Schedule Development*, available at http://www.epa.gov/npdes/pubs/csofc.pdf), but this protocol is applicable to more than just combined sewer overflow communities.

In addition to the general financial burden of a load reduction strategy, it is incumbent upon the County government to be good stewards of the taxpayers' money by being as cost efficient as possible in implementing a load reduction strategy to meet the TMDL. This means that the County must evaluate not only the total costs of various BMPs and load reduction management strategies (including capital costs, O&M costs, and administrative/programmatic costs), but also the cost efficiency of these strategies, which is measured in the amount load reduced or load reduction credit per dollar spent. Much of the documentation that has been released regarding the costs of the Bay TMDL has focused only on the specific costs of individual strategies or the overall costs of the load reduction strategies, but it is critical to also examine the "bang for the buck" that each strategy provides and ensure that the County is maximizing the efficiency of the dollars spent.

In addition to the overall costs for implementing the strategy, there are different ways of paying for the strategy. The County could choose to pay for the strategy itself through centralizing BMPs and management strategies that are "owned" (in the case of structural BMPs on County-owned land) and/or administered by the County (e.g., street sweeping or other types of programs that the County implements that reduce loads). This method of managing the load reduction strategy relies on the County to implement and pay for load reduction strategies, but it also spreads the costs among all County taxpayers, and allows a good deal of control over the implementation of the strategy. Conversely, the County could in effect "outsource" the implementation of the strategy by passing ordinances that effectively require or incentivize private citizens and landowners to manage loads from their property. For example, local governments in the Tidewater area of Virginia have passed local ordinances requiring private homeowners to pump out their septic systems on a regular basis, which achieves load reduction credit towards meeting the TMDL for these governments. Other potential ways to incentivize septic system load reductions are to require upgrades to BAT upon transfer of a property or substantial improvement to that property. With respect to urban stormwater, many local governments are instituting stormwater utility fees that provide credits to individual landowners for managing stormwater onsite. This reduces both the cost and the amount of control necessary to meet stormwater management requirements. Even in cases where private property owners bear the costs of implementing BMPs or load reduction practices, the local government must manage, track, and report on these practices in order to receive load reduction credit.

In reality, most programs, including the County's current pollution management programs are a combination of public and private efforts. It is likely that this combination will continue and may increase in order to meet the load reduction strategies. This public/private partnership is appropriate in many ways because it moves the balance of funding for pollution management away from costs shared by everyone (regardless of contribution to the load) towards having more equitable funding (i.e., those contributing most to the load pay more). If the County incentivizes private landowners to take actions to control pollution from their properties (e.g., upgrade septic systems to BAT, manage stormwater runoff and pollutant loads), achieving both targets and an equitable distribution of the costs is more likely. More information is provided in the memorandum on *Stormwater Funding – Stormwater Funding and Incentive Programs* (LimnoTech, August 2012), previously presented to the County.

4.2 SOURCES OF COST INFORMATION

Several recently-published studies and documents focus on or include costs for developing load reduction strategies for the Bay TMDL (including several with specific costs for Maryland). Because these documents are recent, focused on the TMDL, and contain cost information specifically relevant to Maryland, they have been the primary sources of cost information used in developing costs for implementation of the load reduction strategy. Specific summaries of these documents are provided below. In addition, the County has some information on costs for specific projects and programs that has informed these cost estimates. Any other sources of cost information used in this section will be documented, although not necessarily discussed in detail.

4.2.1 Maryland Phase II WIP

The primary source of cost information for implementation of the Bay TMDL in Maryland is the Maryland Phase II WIP. Section 1.10.2 of the Phase II WIP summarizes Maryland's costs for implementing the load reduction strategies described in the WIP, and Section 1.10.3 describes potential ways to fund the WIP strategies, primarily through the Bay Restoration Fund (BRF). The costs documented in this Section of the WIP are aggregated across the entire state (i.e., they are not broken out by County), although the document does provide separate estimates for the major source sectors (agriculture, wastewater, septic systems). Appendix C of the WIP, entitled "Cost Analyses and Funding Studies," provides information in some additional detail, such as the estimated costs of upgrades at major WWTPs (no WWTPs in the County are included in this list) and a table summarizing the cost estimates for the interim (2017) and final (2025) target strategies for urban stormwater and septic systems, organized by BMP type. This table summarizes the anticipated implementation level for each BMP type that is required to achieve the TMDL in Maryland. While the implementation levels for the BMPs are aggregated over the entire state, this table provides insight into Maryland's estimates of the level and distribution of the different BMP types that will be required to meet the TMDL load reductions at the state level.

Appendix C of the WIP also includes the full text of the following documents/presentations:

- *Final Report of the Task Force on Sustainable Growth and Wastewater Disposal (*released on December 20, 2011)
- *Costs of Stormwater Management Practices in Maryland Counties* (King and Hagan, draft final Report, October 11, 2011)
- A summary of a presentation on *Sustainable Financing for Stormwater Management*, prepared by the University of Maryland Environmental Finance Center (October 2011)

The King/Hagan report *Costs of Stormwater Management Practices in Maryland Counties* is discussed separately below.

Appendix C of the WIP provides some useful information for developing specific estimates for the County's costs for implementing a load reduction strategy. For example, the Appendix includes proposed unit costs for septic system BMPs (p.2 of Appendix C). These unit costs are summarized below:

- Septic system pump-out $250 per pump-out (information actually provided in Appendix C is a cost of $500 per two pump-outs which equated to $250 for one pump out). The source of this cost information is cited as MDE.
- Septic system upgrade to BAT - $13,000/system for upgrades to nitrogen removal technology. The source of this cost information is cited as MDE.
- Septic system connection to a WWTP - $30,000 system for connection to an advanced treatment plant. The source of this cost information is cited as MDE.

Table C-1 summarizes the projected TMDL implementation costs for the septic system sector by BMP type. The table shows the current number of systems that are managed by each of the three septic system BMP types (this is the "current progress"), as well as the number of systems that must be managed by 2017 and 2025 to meet the TMDL. By multiplying the difference between the 2017 and 2025 target number for each BMP type and the 2010 current progress number for each BMP type by the appropriate unit cost for that BMP, the total cost for implementation can be calculated. For example, the table shows that 42,978 septic systems must be connected to WWTPs by 2025. The 2010 current progress is 536 systems connected, so the number of systems that need to be connected by 2025 is 42,978 – 536 = 42,442. Multiplying the 42,442 by the $30,000 per connection yields a cost of $1,263,260,000 by 2025.

Appendix C also provides Maryland's estimates for stormwater BMPs. As described in the Appendix C text, Maryland has chosen to use a generic unit cost of $12,500 per acre for most stormwater BMPs. This unit cost was provided by MDE and based on data on stormwater retrofit implementation rates and costs reported through the MS4 Annual Reports. As stated in the document,

> Costs for urban stormwater were estimated, for most BMPs[5], by applying an average cost-per acre of $12,500. This cost was derived by MDE based on three years of implementation and cost records reported by Phase I MS4 jurisdictions (2009-2011). The MS4 annual report data reveals that the 11 jurisdictions expended a total of $245,502,000 to operate and maintain their local stormwater programs and another $172,302,000 for capital improvements over the last three years. During that time, 33,424 acres of developed land was retrofitted. The unit capital cost was $5,155 per acre and the combined operating and capital unit cost was $12,500 per acre.

Table C-1 in this Appendix also summarizes the TMDL implementation costs for the urban stormwater sector by BMP type. The notes to this table identify several stormwater BMPs where the $12,500 per acre unit cost was not appropriate, including:

[5] MDE provided a footnote in the original document that referenced several caveats and exceptions to this generalized unit cost estimate.

- Note 5 indicates that the Phase II WIP used costs of $285 per foot for urban stream restoration and $310 per foot for shoreline erosion control. References for the development of each of these unit costs are also provided in the note. It should be noted that the Phase II WIP reports costs for urban stream restoration and shoreline erosion control in terms of linear feet, whereas other sources, such as the King and Hagan report cited below, report unit costs for urban stream restoration and shoreline erosion control in terms of acres. Because most urban stream restoration and shoreline erosion control projects (including Charles County's urban stream restoration and shoreline erosion control projects) are reported in terms of linear feet, the Maryland Phase II WIP cost estimates were used were used for developing costs for these types of projects.
- Note 8c indicates that a flat cost of $3.50 per acre per year was used for urban nutrient management. The note cites the Maryland Department of Agriculture as the source of the cost estimate and that the estimate is based on a $1,500,000 annual cost to manage 40,000 acres annually. It is worth highlighting that this unit cost estimate is three orders of magnitude lower than the other source of unit cost information for this BMP – the King and Hagan report – which estimates average annual costs of approximately $3,000 per acre. However, the King and Hagan report assumes that a direct mail campaign will be used to elicit the public to participate in urban nutrient management. The King and Hagan report also assumes that this will be a costly effort relative to its success in encouraging public participation in urban nutrient management. However, given that much of the load reduction from urban nutrient management will be achieved through regulating large users, including landscapers, it seems more realistic to use the lower unit costs from the Maryland Phase II WIP to estimate costs for implementing this BMP.

Because other, more specific data was available regarding unit costs for most of the BMPs described in Appendix C of the WIP, only the unit costs for urban nutrient management, stream restoration, and shoreline erosion control from the Phase II WIP were to develop specific cost estimates for the County. However, the method described in the Phase II WIP for calculating the total implementation costs by determining the difference between current progress and targets for a certain BMP, and then multiplying this difference by the unit cost of that BMP, was used to determine the costs for the scenarios contained in this document.

4.2.2 King and Hagan, Costs of Stormwater Management Practices in Maryland Counties

The *Costs of Stormwater Management Practices in Maryland Counties* report prepared by Dennis King and Patrick Hagan of the University of Maryland Center for Environmental Science (October, 2011) is most valuable for the specific unit costs it provides for stormwater BMPs. This report was specifically commissioned by MDE's Science Services Administration to develop "planning level" unit cost estimates of stormwater BMPs. The goal of the report was to develop cost estimates that represent the average cost of stormwater BMPs across the state, and to present them in a way that makes them useful for assessing stormwater BMPs at the county scale. Data used to develop cost estimates included in this document were collected from:

- National literature review of published articles and reports from government and non-government organizations (with special emphasis on projects as close as possible to or in Maryland);
- Previously developed stormwater BMP cost databases and related quantitative models;
- Reviews of Maryland jurisdiction MS4 reports and supporting materials submitted to MDE;
- Interviews with Maryland local jurisdiction staff who manage stormwater and stormwater BMPs;
- Interviews with representatives of local non-profits who work on stormwater issues and private engineering and construction contractors who work on stormwater projects in Maryland;
- Applications of the Water Environmental Research Foundation (WERF) stormwater unit cost model using cost adjustment indicators developed for Maryland counties with MEANS 2011 Regional Construction Cost Indicators.

The report includes tables of planning level preconstruction, construction, and post-construction cost estimates for each of the stormwater BMPs included in MAST. A short summary of each of the costs categories and what they include is provided below:

- Pre-construction costs, which include cost of site discovery, surveying, design, planning, permitting, etc. Pre-construction costs tend to range from 10 to 40 percent of BMP construction costs.
- Construction costs, which include capital, labor, material and overhead costs (but not land costs), and associated implementation.
- Land costs (note: these costs apply only to stormwater BMPs that require land). The report used the following assumptions regarding land: 1) the opportunity cost of developable land is $100,000 per acre (the "opportunity cost of developable land" is basically a measure of the dollar value of land that is lost by setting that land aside for development of BMPs versus using it for development, which would bring in additional revenue; thus this opportunity cost measures not only the value of the land, but its future economic potential); and 2) 50 percent of projects that require land take place on developable land with the rest taking place on land that is not developable. This resulted in an opportunity cost of land for stormwater BMPs that require land of $50,000 per acre.
- Post construction costs, which consist of combined annual operating, implementation, and maintenance costs.

In order to make it easier to use and compare costs of different BMPs, the costs for each BMP are expressed as costs per acre of impervious area treated. For each BMP, the document presents planning level estimates of pre-construction, construction, and post-construction costs, plus life cycle and annualized life cycle costs. Table 4-1 summarizes these costs for the stormwater BMPs in MAST.

Table 4-1
Summary Unit Planning Level Stormwater Cost Estimates Per Impervious Acre Treated

SW BMP Type	Pre-Construct-ion Costs	Construct-ion Costs	Land Costs[1]	Total Initial Costs	Total Post Construct-ion Costs	Total Costs Over 20 Years	Average Annual Costs Over 20 Years
Impervious Surface Reduction	$8,750	$87,500	$50,000	$146,250	$885	$163,957	$8,198
Urban Forest Buffers	$3,000	$30,000	$0	$33,000	$1,210	$57,207	$2,860
Urban Grass Buffers	$2,150	$21,500	$0	$23,650	$870	$41,057	$2,053
Urban Tree Planting	$3,000	$30,000	$150,000	$183,000	$1,210	$207,207	$10,360
Wet Ponds and Wetlands (New)	$5,565	$18,550	$2,000	$26,115	$763	$41,368	$2,068
Wet Ponds and Wetlands (Retrofit)	$21,333	$42,665	$2,000	$65,998	$763	$81,251	$4,063
Dry Detention Ponds (New)	$9,000	$30,000	$5,000	$44,000	$1,231	$68,620	$3,431
Hydrodyna-mic Structures (New)	$7,000	$35,000	$0	$42,000	$3,531	$112,620	$5,631
Dry Extended Detention Ponds (New)	$9,000	$30,000	$5,000	$44,000	$1,231	$68,620	$3,431
Dry Extended Detention Ponds (Retrofit)	$22,500	$45,000	$5,000	$72,500	$1,231	$97,120	$4,856
Infiltration practices w/o Sand, Vegetated (New)	$16,700	$41,750	$5,000	$63,450	$866	$80,770	$4,039

Table 4-1 cont.
Summary Unit Planning Level Stormwater Cost Estimates Per Impervious Acre Treated

SW BMP Type	Pre-Construct-ion Costs	Construct-ion Costs	Land Costs[1]	Total Initial Costs	Total Post Construct-ion Costs	Total Costs Over 20 Years	Average Annual Costs Over 20 Years
Infiltration practices w/ Sand, Vegetated (New)	$17,500	$43,750	$5,000	$66,250	$906	$84,370	$4,219
Filtering Practices, (Sand, below ground)	$16,000	$40,000	$0	$56,000	$1,631	$88,620	$4,431
Erosion and Sediment Control	$6,000	$20,000	$0	$26,000	$10	$26,207	$1,310
Urban Nutrient Manage-ment[2]	$0	$61,000	$0	$61,000	$31	$61,620	$3,081
Street Sweeping[3]	$0	$6,049	$0	$6,049	$451	$15,079	$754
Urban Stream Restoration	$21,500	$43,000	N/A	$64,500	$891	$82,320	$4,116
Bioretention (Retrofit, highly urban)	$52,500	$131,250	$3,000	$186,750	$1,531	$217,370	$10,869
Vegetated Open Channels	$4,000	$20,000	$2,000	$26,000	$610	$38,207	$1,910
Bioswale (New)	$12,000	$30,000	$2,000	$44,000	$931	$62,620	$3,131
Permeable Pavement w/o Sand, Vegetated (New)	$21,780	$217,800	$0	$239,580	$2,188	$283,347	$14,167
Permeable Pavement w/ Sand, Vegetated (New)	$30,492	$304,920	$0	$335,412	$3,060	$396,603	$19,830

Table 4-1 cont. **Summary Unit Planning Level Stormwater Cost Estimates Per Impervious Acre Treated**
[1] Land costs reflect the amount of land required to install that particular BMP. As described on p. 10 of the King and Hagan report, because costs are provided per impervious acreage treated, and for most stormwater BMPs the acres of impervious area treated is larger than the acres of land required to implement a BMP project, the contribution of land costs to unit cost per impervious acre treated is usually lower than land value per acre. However, in some cases (e.g., urban tree planting) the cost per impervious acre treated is higher than land value per acre.
[2] Best available data indicate that "retail" (i.e., direct mail) public outreach campaigns cost about $15 per household contacted. For an illustrative county, the authors assumed that each household has 5,941 sq ft of turf and 2,406 sq ft of impervious cover (medium density development). This means that 7.33 households need to adopt this BMP to potentially result in an acre of turf being treated, at a cost $109.98 per turf acre. Based on a review of direct mail response rates, the authors assumed that 2 percent of households contacted will respond positively to this outreach effort, bringing the cost per turf acre treated to $5,497.50/acre. The equivalent on a per-impervious-acre was based on the MDE June 2011 stormwater guidance document, which provides an equivalent for this practice of .09 acres impervious area per one acre of this practice. This estimate does not include any additional costs for soil tests by the homeowner to determine the appropriate amount of fertilizer required.
[3] This represents the capital equipment cost for the street sweeper per impervious acre treated.

4.2.3 Charles County Cost Information

The County also has its own information on the costs of many BMPs and pollutant management strategies, and County-specific costs were used as much as possible during the development of the TMDL strategy and the costs. Specific cost information provided by County included:

- Costs for septic system connections to wastewater treatment plants. The County had cost information for planned septic connection projects in the Hughesville, Benedict, and White Plains areas. Based on the projected project costs and the number of septic systems to be connected in these projects, a unit cost of $42,330 per septic system was calculated for connection to a wastewater treatment plant. This is higher than the Maryland Phase II WIP estimate of $30,000 per septic connection. The higher estimated unit cost in the County may be due to the fact that individual septic units are, on average, more difficult to connect than in a typical community. Reasons for this may include that many of the locations would require pumps; homes are somewhat dispersed; and additional main collector lines would need to be installed. Based on this information, the higher unit cost of $42,330 was used in estimating the costs of this BMP in the various scenarios developed for this document.

- Costs for septic pumping in the County are estimated to average approximately $200 per pump out, in contrast to the Phase II WIP estimate of $250 per pump out.

- Costs for upgrade of a septic system to BAT are estimated to be $13,650 per system. This cost includes approximately $11,600 in capital costs for the unit, and approximately $2,050 for 5 years of O&M.

- Costs for street sweeping in Charles County are estimated to be $246 per one sweep of a mile 12 feet wide, or $4,233 per acre swept 25 times per year, which would equate to $33,357 annually per pound of TN removed or $146,980 annually per pound of TP removed.
- Costs in Charles County for completed MS4 retrofits to date average $36,200 per impervious acre treated, in contrast to Maryland's Phase II WIP estimate of $12,500 per impervious acre treated.

4.2.4 ESD Costs

Because ESD consists of a suite of many different types of individual practices, it is difficult to develop a specific unit cost per acre of ESD implementation. In order to determine a unit cost, research on the costs of different ESD projects was compiled. Based on this research, an average cost of $60,000 per acre of ESD was used for this document.

4.2.5 Summary of Costs

While these data provide an excellent way to compare the cost of different BMPs, they provide no information on the cost efficiency of different BMPs. Put another way, the unit cost data needs to be combined with pollutant removal efficiency data to determine which BMP types are most cost efficient per pound of pollutant removed. Understanding which BMP types provide the most "bang for the buck" in terms of pounds of pollutants removed per dollar spent is important for selecting BMPs as part of the overall pollutant removal strategy.

In order to perform this analysis, tables were created to show the mass of pollutants removed from one acre of land using different BMP types. A generic land use-based loading rate was applied to generate the load, and then the load was reduced according to the CBP efficiency for that pollutant for that BMP. The mass of pollutant removed was quantified, and divided by the annual BMP cost, resulting in the annual cost of the BMP per pound of pollutant removed. These results allow a comparison between BMPs to determine which BMPs have higher pollutant removal per dollar of cost. It should be noted that these comparisons are relative to each other, and the actual costs per pound of pollutant removed depend on the land use based loading rate used in the analysis. Therefore, this example is used as an exercise to determine the most cost efficient BMPs for removal of specific pollutants.

Tables 4-2 and 4-3 below illustrate how this comparison was made. The first table shows uses nitrogen removal rates and the second uses phosphorus removal rates. In both cases, the loading rate is generic. Table 4-4 shows a similar exercise for stream restoration and shoreline erosion control. However, because these BMP types account for load reduction based on linear feet of implementation, and not acreage of implementation like the practices in Tables 4-2 and 4-3, the cost efficiency of these two BMPs is not directly comparable to the BMPs in Tables 4-2 and 4-3.

Table 4-2
Summary Unit Planning Level Stormwater Cost Estimates Per Pound of TN Removed Per Year

Stormwater BMP Type	Nitrogen Removal Efficiency	N load/ Acre	# of Acres	TN load (pounds)	Lbs TN Removed/ acre	Average Annual Costs Over 20 Years	Average Annual Costs per Pound of TN Removed
Wet Ponds and Wetlands (New)	0.2	4.23	1	4.23	0.846	$2,068	$2,444.94
Wet Ponds and Wetlands (Retrofit)	0.2	4.23	1	4.23	0.846	$4,063	$4,802.06
Dry Detention Ponds (New)	0.05	4.23	1	4.23	0.2115	$3,431	$16,222.25
Hydro-dynamic Structures (New)	0.05	4.23	1	4.23	0.2115	$5,631	$26,624.14
Dry Extended Detention Ponds (New)	0.2	4.23	1	4.23	0.846	$3,431	$4,055.56
Dry Extended Detention Ponds (Retrofit)	0.2	4.23	1	4.23	0.846	$4,856	$5,739.96
Infiltration practices w/o Sand, Vegetated (New)	0.8	4.23	1	4.23	3.384	$4,039	$1,193.41
Infiltration practices w/ Sand, Vegetated (New)	0.85	4.23	1	4.23	3.5955	$4,219	$1,173.27
Filtering Practices, (Sand, above ground)	0.4	4.23	1	4.23	1.692	$4,131	$2,441.49
Filtering Practices, (Sand, below ground)	0.4	4.23	1	4.23	1.692	$4,431	$2,618.80
Urban Nutrient Management	0.17	4.23	1	4.23	0.7191	$3,081	$4,284.53
Street Sweeping	0.03	4.23	1	4.23	0.1269	$754	$5,941.28
Bioretention (New, suburban)	0.8	4.23	1	4.23	3.384	$4,025	$1,189.35

Table 4-2 cont.
Summary Unit Planning Level Stormwater Cost Estimates Per Pound of TN Removed Per Year

Stormwater BMP Type	Nitrogen Removal Efficiency	N load/ Acre	# of Acres	TN load (pounds)	Lbs TN Removed/ acre	Average Annual Costs Over 20 Years	Average Annual Costs per Pound of TN Removed
Vegetated Open Channels	0.45	4.23	1	4.23	1.9035	$1,910	$1,003.59
Bioswale (New)	0.7	4.23	1	4.23	2.961	$3,131	$1,057.41
Permeable Pavement w/o Sand, Vegetated (New)	0.75	4.23	1	4.23	3.1725	$14,167	$4,465.67
Permeable Pavement w/ Sand, Vegetated (New)	0.8	4.23	1	4.23	3.384	$19,830	$5,859.97

Table 4-3
Summary Unit Planning Level Stormwater Cost Estimates Per Estimates Per Pound of TP Removed Per Year

Stormwater BMP Type	Phosphorus Removal Efficiency	TP load/ Acre	# of Acres	TP load (pounds)	Lbs TP Removed/ acre	Average Annual Costs Over 20 Years	Average Annual Costs per Pound of TP Removed
Wet Ponds and Wetlands (New)	0.45	0.96	1	0.96	0.432	$2,068	$4,788.01
Wet Ponds and Wetlands (Retrofit)	0.45	0.96	1	0.96	0.432	$4,063	$9,404.04
Dry Detention Ponds (New)	0.1	0.96	1	0.96	0.096	$3,431	$35,739.64
Hydrodynamic Structures (New)	0.1	0.96	1	0.96	0.096	$5,631	$58,656.30
Dry Extended Detention Ponds (New)	0.2	0.96	1	0.96	0.192	$3,431	$17,869.82

Table 4-3 cont. Summary Unit Planning Level Stormwater Cost Estimates Per Estimates Per Pound of TP Removed Per Year							
Stormwater BMP Type	**Phosphorus Removal Efficiency**	**TP load/ Acre**	**# of Acres**	**TP load (pounds)**	**Lbs TP Removed/ acre**	**Average Annual Costs Over 20 Years**	**Average Annual Costs per Pound of TP Removed**
Dry Extended Detention Ponds (Retrofit)	0.2		1	0.96	0.192	$4,856	$25,291.69
Infiltration practices w/o Sand, Vegetated (New)	0.85	0.96	1	0.96	0.816	$4,039	$4,949.15
Infiltration practices w/ Sand, Vegetated (New)	0.85	0.96	1	0.96	0.816	$4,219	$5,169.74
Filtering Practices, (Sand, above ground)	0.6	0.96	1	0.96	0.576	$4,131	$7,171.88
Filtering Practices, (Sand, below ground)	0.6	0.96	1	0.96	0.576	$4,431	$7,692.72
Urban Nutrient Management	0.22	0.96	1	0.96	0.2112	$3,081	$14,588.09
Street Sweeping	0.03	0.96	1	0.96	0.0288	$754	$26,178.75
Bioretention (New, suburban)	0.85	0.96	1	0.96	0.816	$4,025	$4,932.30
Bioretention (Retrofit, highly urban)	0.85	0.96	1	0.96	0.816	$10,869	$13,319.25
Vegetated Open Channels	0.45	0.96	1	0.96	0.432	$1,910	$4,422.07
Bioswale (New)	0.75	0.96	1	0.96	0.72	$3,131	$4,348.62
Permeable Pavement w/o Sand, Vegetated (New)	0.8	0.96	1	0.96	0.768	$14,167	$18,447.05
Permeable Pavement w/ Sand, Vegetated (New)	0.8	0.96	1	0.96	0.768	$19,830	$25,820.49

Table 4-4
Cost Efficiency of Stream Restoration and Shoreline Erosion Control BMPs

BMP Type	Feet of Practice Implemented	Capital Cost/ft	Annual O&M Cost	Total Cost over 20 years	Lbs Pollutant Removed/Ft.	Cost/lb Removed
Total Nitrogen						
Stream Restoration	1	$285	$8.91	$463.20	0.2	$2,316
Shoreline Erosion Control	1	$310	$0	$310	0.2	$1,550
Total Phosphorus						
Stream Restoration	1	$285	$8.91		0.068	$6,812
Shoreline Erosion Control	1	$310	$0		0.068	$4,559

These tables show that different BMP types are more cost efficient for removal of different pollutants. However, in general, ESD practices including infiltration-type BMPs and BMPs that use vegetation, such as bioswales, are far more cost efficient than are non-ESD BMPs such as dry ponds and even wet ponds. This type of information was useful in planning cost efficient load reduction scenarios, and these analyses were taken into consideration when load reduction scenarios were developed.

It should also be noted that some BMP types, such as impervious surface reduction, urban forest buffers, urban grass buffers, and urban tree planting do not lend themselves to this type of cost efficiency analysis because they do not use a “pollutant removal efficiency” mechanism (i.e., they do not quantify load reduction through a percent reduction from baseline) to determine load reductions. Instead, these practices are based on changing the land use of the affected land. In other words, if a forest buffer is implemented, the land use of the area where the BMP is to be installed would be changed from “urban” land use to “forest” land use, and then new load for forest land would be substituted for the old load for urban land. So the cost efficiency is based on the actual loads from the original land use and the forest land use. Similarly, for impervious surface reduction, the land use changes from impervious to pervious, and the load reduction achieved is the difference between the actual loading rates for impervious and pervious lands of that land use type. Therefore, these types of BMPs were not included in the tables above. In addition, the erosion and sediment control BMP can only be applied to construction or extractive land, and so this BMP was not included in the tables above.

4.3 WIP SCENARIO COSTS

The various cost information was used to estimate the costs of the load reduction scenarios described in this document. This strategy document presents multiple load reduction scenarios for septic systems and urban stormwater, some of which include use of some of the reserve capacity in the wastewater sector. For wastewater, the County is projected to be under its load cap by 2025, so no load reduction scenarios were developed for this sector.

Determining the cost of these load reduction scenarios is important for choosing an appropriate scenario or balance of strategies to reduce loads. The following subsections summarize the projected costs of the specific load reduction scenarios developed earlier. These are planning level costs, and the actual costs of implementing any of these scenarios could be quite different, depending on site-specific conditions, the participation rate of private landowners, and the actual costs relative to the published costs. However, even planning level costs are useful for comparing scenarios, and integrating cost considerations into an overall load reduction strategy.

Multiple cost components were included as appropriate for a given scenario, including capital costs, O&M costs, and programmatic costs. Capital costs represent the up-front costs for construction or implementation of a BMP or management strategy. For constructed BMPs, capital costs would include planning, design, and construction of the BMP. For non-structural BMPs, capital costs could include the cost for purchasing equipment (e.g., purchasing a street sweeper) or to set up a management activity (e.g., an urban nutrient management program). O&M costs would include any ongoing costs to operate or maintain a BMP once it is constructed or put into place – activities such as mowing grass or repairing parts at BMPs. O&M costs are typically presented as average annual costs. In order to assess the total costs for O&M up until the TMDL goal date of 2025, annual O&M costs were multiplied by 6.5 to account for annual maintenance from 2012 to 2025 (assuming a constant rate of BMP implementation from 2013 to 2025, the average BMP will be in place for 6.5 years by 2025, so multiplying the O&M unit cost by the total number of units to be implemented and then by 6.5 will yield the total O&M cost by 2025).

Another factor which must be considered when evaluating the cost of BMPs is who is incurring that cost. For example, when the County constructs a stormwater management BMP on County land, it incurs the capital cost of that BMP, and it is also responsible for O&M costs for that facility. However, a private landowner may also construct stormwater management BMPs (perhaps to control flooding or in response to stormwater utility fee incentives), and these capital costs would be borne by the property owner. In other cases, a private developer may install a stormwater management system which becomes the responsibility of an HOA. The County has indicated that it has agreements with several HOAs whereby the HOA is responsible for O&M of the facility, and so in this case the County did not incur the capital cost of the BMP or the O&M costs.

There are also different entities responsible for paying for septic system BMPs. For connection of septic systems to WWTPs, the County typically would pay for the sewer mains to be constructed to the septic area, but the individual property owners would pay for connection of their property to the sewer system. County-administered grants (such as BRF grants) may be available to offset these costs to private homeowners and the County. For upgrade of septic systems to BAT, the homeowner is responsible for paying for the upgrade, but grants such as monies from the BRF may be available to the homeowners for this purpose. Costs for septic system pump-outs are currently the responsibility of property owners.

Even when costs are paid for through grants, there may be a cost to the County for administering a program to track these BMPs so that the County can receive credit for the load reduction achieved by the BMPs. For example, the County would incur costs for tracking things like septic pump-outs so that it could claim load reduction credit. The County would also be responsible for paying programmatic costs for tracking and inspecting stormwater BMPs. Recent work under the auspices of the Bay TMDL the Water Quality Goals Implementation Team appears to suggest that increased tracking, inspection and reporting of BMPs may be required to retain load reduction credit for existing BMPs in future years.

Estimated costs to implement each of the load reduction scenarios are presented below. Each cost estimate includes capital costs, O&M costs, and programmatic costs for the various BMP components, as discussed above, and as available.

Potential options for funding the load reduction strategies are discussed in a separate subsection of this Chapter.

4.3.1 Urban Stormwater Scenario Costs

This section describes the costs of the stormwater load reduction scenarios that were presented in Section 3.2.3.

Scenario 1 – Maryland Phase II WIP Scenario

This scenario for Charles County was developed by MDE and is included in the Phase II WIP. The total costs for the scenario are summarized in Table 4-5.

Table 4-5
Costs of Maryland Phase II WIP Scenario for Urban Stormwater

BMP Name	Unit	Units to Meet 2025 Strategy[1]	Unit Capital Cost[2]	Total Capital Cost for BMP	Total O&M Cost by 2025[3]	Total Cost (Capital and O&M) by 2025
Bioretention/ Rain Gardens	Acres	3	$49,875	$149,625	$388,109	$537,734
Bioswales	Acres	46	$44,000	$2,024,000	$3,618,797	$5,642,797
Dry Detention Structures and Hydro-dynamic Separators (Retrofit)[4]	Acres	79	$72,500	$5,727,500	$8,217,541	$13,945,041
Dry Extended Detention Ponds (Retrofit)	Acres	84	$72,500	$3,480,000	$4,992,936	$8,472,936

Table 4-5 cont.
Costs of Maryland Phase II WIP Scenario for Urban Stormwater

BMP Name	Unit	Units to Meet 2025 Strategy[1]	Unit Capital Cost[2]	Total Capital Cost for BMP	Total O&M Cost by 2025[3]	Total Cost (Capital and O&M) by 2025
Impervious Urban Surface Reduction	Acres	1,608	$146,250	$235,170,000	$120,250,260	$355,420,260
MS4 Retrofit	Acres	108	$12,500[6]	$1,350,000	$0	$1,350,000
Urban Filtering Practices[5]	Acres	10,866	$54,000	$586,764,000	$1,313,911,287	$1,900,675,287
Urban Forest Buffers	Acres	1,095	$33,000	$36,135,000	$111,958,275	$148,093,275
Urban Infiltration Practices	Acres	18	$63,450	$1,142,100	$1,317,186	$2,459,286
Urban Tree Planting - Urban Tree Canopy	Acres	251	$183,000	$45,933,000	$25,663,495	$71,596,495
Vegetated Open Channel Urban	Acres	259	$26,000	$6,734,000	$13,350,155	$20,084,155
Urban Nutrient Management	Acres/ Yr	9,544	$3.50[5]	$29,586	$0	$29,586
Urban Stream Restoration/ Shoreline Erosion Control	Feet	2,279	$298[6]	$678,003	$0	$678,003
Totals						**$2,528,984,854**

[1]Note that the Maryland Phase II WIP aggregates BMPs required for the entire County, including BMPs for lands in se strategies are for the entire County, including BMPs for SHA, federal facilities, State lands, industrial facilities, Phase I and II MS4, and non-regulated stormwater. However, most of the burden for implementing BMPs will fall on the County.

[2]All unit costs are from King and Hagan unless otherwise noted.

[3]Assuming a constant rate of implementation of BMPs over the 13 year period from 2013 to 2025, the average BMP will be in place for 6.5 years. Therefore, the annual O&M costs should be multiplied by 6.5 to calculate the total O&M cost until 2025.

[4]Used costs for "dry extended detention ponds (retrofit)" from King and Hagan.

[5]Used costs for "filtering practices, (sand, aboveground)" from King and Hagan.

[5]Unit cost from the Maryland Phase II WIP and includes O&M costs.

[6]Unit cost is an average of the cost per foot for urban stream restoration and shoreline erosion control from the Maryland Phase II WIP. O&M is included in the cost.

This is an expensive scenario, and it includes implementation of two very costly BMPs (impervious surface reduction and urban filtering practices) at high implementation levels. This scenario is not cost effective relative to the other scenarios evaluated.

Scenario 2 - Focus on ESD Implementation

This scenario focuses on achieving significant load reduction from ESD on land with no stormwater management and maximizes stream restoration, pond retrofits, and stream buffer restoration on public land. No stream restoration is proposed on private land. Table 4-6 summarizes the costs of this scenario.

Table 4-6
Total Costs For Urban Stormwater Scenario 2

BMP Type	Amt	Unit	Unit Capital Cost[1]	Total Capital Cost	Annual O&M Costs	Total O&M Costs[2]	Total Costs
Stream Restoration (County Land)	14,782	Feet	$285[3]	$4,212,870	$8.91[4]	$856,100	$5,068,970
Stream Restoration (State Land)	39,761	Feet	$285[3]	$11,331,885	$8.91[4]	$2,302,758	$13,634,643
Stream Restoration (Private Land)	0	Feet	$285[3]	$0	$8.91[4]	$0	$0
BMP Wet Pond Retrofits (County Land)	104	Acres	$65,998	$6,863,792	$763	$515,788	$7,379,580
BMP Wet Pond Retrofits (Private Land)	0	Acres	0	0	0	0	0
BMP Dry Pond Retrofits (County Land)	137	Acres	$72,500	$9,932,500	$1,231	$1,096,206	$11,028,706
BMP Dry Pond Retrofits (Private Land)	0	Acres	0	0	0	0	0
ESD Retrofits (County Land)	276	Acres	$60,000[5]	$16,560,000	$1,531	$2,746,614	$19,306,614
ESD Retrofits (Private Land)	1,878	Acres	$60,000[5]	$112,680,000	$1,531	$22,370,970	131,368,917

Table 4-6 cont. Total Costs For Urban Stormwater Scenario 2							
BMP Type	**Amt**	**Unit**	**Unit Capital Cost[1]**	**Total Capital Cost**	**Annual O&M Costs**	**Total O&M Costs[2]**	**Total Costs**
Shoreline Stabilization (Private Land)	25,506	Feet	$310[3]	$7,906,860	$0	$0	$7,906,860
Urban Nutrient Management	9,544	Acres	$3.10[3]	$29,586	$0	$0	$29,586
Totals							**$195,732,876**

[1]Unit capital costs are from King and Hagan unless otherwise noted.

[2]Assuming a constant rate of implementation of BMPs over the 13 year period from 2013 to 2025, the average BMP will be in place for 6.5 years. Therefore, the annual O&M costs should be multiplied by 6.5 to calculate the total O&M cost until 2025.

[3]Unit costs from Maryland Phase II WIP.

[4]Unit cost for O&M from King and Hagan. Assuming a conversion of 100 feet = 1 acre.

[5]Estimated based on average costs of ESD installations from literature review.

Because this scenario focuses on maximizing ESD on private property, it is anticipated implementation can be incentivized through stormwater utility fee credits, therefore much of this cost will not be born directly by the County. Instead, much of the cost will be paid by private landowners. Subtracting all costs for BMPs on private land, the cost for this scenario is $122,132,557. These costs are summarized in Table 4-7.

Table 4-7 County Costs For Urban Stormwater Scenario 2							
BMP Type	**Amount**	**Unit**	**Unit Capital Cost[1]**	**Total Capital Cost**	**Annual O&M Costs**	**Total O&M Costs[2]**	**Total Costs**
Stream Restoration (County Land)	14,782	Feet	$285[3]	$4,212,870	$8.91[4]	$856,100	$5,068,970
Stream Restoration (State Land)	39,761	Feet	$285[3]	$11,331,885	$8.91[4]	$2,302,758	$13,634,643
BMP Wet Pond Retrofits (County Land)	104	Acres	$65,998	$6,863,792	$763	$515,788	$7,379,580
BMP Dry Pond Retrofits (County Land)	137	Acres	$72,500	$9,932,500	$1,231	$1,096,206	$11,028,706
ESD Retrofits (County Land)	276	Acres	$60,000[5]	$16,560,000	$1,531	$2,746,614	$19,306,614

Table 4-7 cont. County Costs For Urban Stormwater Scenario 2							
BMP Type	Amount	Unit	Unit Capital Cost[1]	Total Capital Cost	Annual O&M Costs	Total O&M Costs[2]	Total Costs
ESD Retrofits (Private Land)[6]	939	Acres	$60,000[5]	$56,340,000	$1,531	$9,344,459	$65,684,459
Shoreline Stabilization[7]	25,506	Feet	N/A	N/A	N/A	N/A	N/A
Urban Nutrient Management	9,544	Acres	$3.10[3]	$29,586	$0	$0	$29,586
Totals							**$122,132,557**

[1]Unit capital costs are from King and Hagan unless otherwise noted

[2]Assuming a constant rate of implementation of BMPs over the 13 year period from 2013 to 2025, the average BMP will be in place for 6.5 years. Therefore, the annual O&M costs should be multiplied by 6.5 to calculate the total O&M cost until 2025.

[3]Unit costs from Maryland Phase II WIP.

[4]Unit cost for O&M from King and Hagan. Assuming a conversion of 100 feet = 1 acre.

[5]Estimated based on average costs of ESD installations from literature review.

[6]It is estimated that the County would pay half of the total cost of this BMP, because it is unlikely that 100 percent of this BMP would be funded by private landowners.

[7]Thiswork is done by private landowners, so there is no cost to the County for this BMP.

Achieving this level of BMP control on private land will be challenging. In some cases, such as with shoreline erosion control, private landowners are already installing and paying for BMPs that can gain the County load reduction credit. In other cases, such as with privately-owned stormwater maintenance ponds where there are maintenance or other agreements with the County, it may be possible to work out some sort of cost share agreement to retrofit the ponds. In still other cases, such as with ESD retrofits on private land, these BMPs may need to be incentivized through stormwater utility fee reductions or other financial incentives. In these types of situations, while the County may not be bearing the direct cost of the BMP implementation, it bears at least part of the costs indirectly through providing financial incentives to the property owners and/or losing revenue due to fee reductions.

Scenario 3 - Focus on Stream Restoration

This scenario maximizes use of highly cost-efficient stream restoration projects, in conjunction with other BMPs, to achieve the load reduction necessary to meet targets. Similarly to Scenario 2, this Scenario includes a high level of BMP implementation on private property, but in this scenario, the ESD projects on private land are replaced with stream restoration projects. Table 4-8 summarizes the costs of this scenario.

Table 4-8
Total Costs For Urban Stormwater Scenario 3

BMP Type	Amt	Unit	Unit Capital Cost[1]	Total Capital Cost	Annual O&M Costs	Total O&M Costs[2]	Total Costs
Stream Restoration (County Land)	14,782	Feet	$285[3]	$4,212,870	$8.91[4]	$856,100	$5,068,970
Stream Restoration (State Land)	39,761	Feet	$285[3]	$11,331,885	$8.91[4]	$2,302,758	$13,634,643
Stream Restoration (Private Land)	62,494	Feet	$285[3]	$17,810,790	$8.91[4]	$3,619,340	$21,430,130
BMP Wet Pond Retrofits (County Land)	104	Acres	$65,998	$6,863,792	$763	$515,788	$7,379,580
BMP Wet Pond Retrofits (Private Land)	309	Acres	$65,998	$20,393,382	$763	$1,532,486	$21,925,868
BMP Dry Pond Retrofits (County Land)	137	Acres	$72,500	$9,932,500	$1,231	$1,096,206	$11,028,706
BMP Dry Pond Retrofits (Private Land)	223	Acres	$72,500	$16,167,500	$1,231	$1,784,335	$17,951,835
ESD Retrofits (County Land)	276	Acres	$60,000[5]	$16,560,000	$1,531	$2,746,614	$19,306,614
ESD Retrofits (Private Land)	0	Acres	$60,000[5]	$0	$1,531	$0	$0
Shoreline Stabilization (Private Land)	25,506	Feet	$310[3]	$7,906,860	$0	$0	$7,906,860
Urban Nutrient Management	9,544	Acres	$3.10	$29,586	$0	$0	$29,586
Totals							**$125,662,791**

[1]Unit capital costs are from King and Hagan unless otherwise noted.

[2]Assuming a constant rate of implementation of BMPs over the 13 year period from 2013 to 2025, the average BMP will be in place for 6.5 years. Therefore, the annual O&M costs should be multiplied by 6.5 to calculate the total O&M cost until 2025.

[3]Unit costs from Maryland Phase II WIP.

[4]Unit cost for O&M from King and Hagan. Assuming a conversion of 100 feet = 1 acre.

[5]Estimated based on average costs of ESD installations from literature review.

The cost of Scenario 3 is significantly lower than the cost of Scenario 2, with the difference driven primarily by the fact that stream restoration is a much more cost efficient BMP than is retrofitting properties to ESD. As with Scenario 2, some of this cost will be borne by private landowners, and so the County will not be directly responsible for these costs. Subtracting the costs for all BMPs on private land (except for stream restoration – see below), and the projected costs to the County $97,817,080. These costs are summarized in Table 4-9.

Table 4-9
County Costs For Urban Stormwater Scenario 3

BMP Type	Amt	Unit	Unit Capital Cost[1]	Total Capital Cost	Annual O&M Costs	Total O&M Costs[2]	Total Costs
Stream Restoration (County Land)	14,782	Feet	$285[3]	$4,212,870	$8.91[4]	$856,100	$5,068,970
Stream Restoration (State Land)	39,761	Feet	$285[3]	$11,331,885	$8.91[4]	$2,302,758	$13,634,643
Stream Restoration (Private Land)	62,494	Feet	$285[3]	$17,810,790	$8.91[4]	$3,619,340	$21,430,130
BMP Wet Pond Retrofits (County Land)	104	Acres	$65,998	$6,863,792	$763	$515,788	$7,379,580
BMP Wet Pond Retrofits (Private Land)	154.5	Acres	$65,998	$10,196,691	$763	$766,243	$10,962,934
BMP Dry Pond Retrofits (County Land)	137	Acres	$72,500	$9,932,500	$1,231	$1,096,206	$11,208,706
BMP Dry Pond Retrofits (Private Land)	111.5	Acres	$72,500	$8,083,750	$1,231	$892,167	$8,975,917
ESD Retrofits (County Land)	276	Acres	$60,000[5]	$16,560,000	$1,531	$2,746,614	$19,306,614
Urban Nutrient Management	9,544	Acres	$3.10[3]	$29,586	$0	$0	$29,586
Totals							**$97,817,080**

[1]Unit capital costs are from King and Hagan unless otherwise noted.

[2]Assuming a constant rate of implementation of BMPs over the 13 year period from 2013 to 2025, the average BMP will be in place for 6.5 years. Therefore, the annual O&M costs should be multiplied by 6.5 to calculate the total O&M cost until 2025.

[3]Unit costs from Maryland Phase II WIP.

[4]Unit cost for O&M from King and Hagan. Assuming a conversion of 100 feet = 1 acre.

[5]Estimated based on average costs of ESD installations from literature review.

[6]It is estimated that the County would pay half of the total cost of this BMP, because it is unlikely that 100 percent of this BMP would be funded by private landowners.

[7]Thiswork is done by private landowners, so there is no cost to the County for this BMP.

While this scenario is significantly less expense than is Scenario 2, it may be more difficult to achieve this scenario than to achieve Scenario 2 because it involves needed access to private property, particularly for stream restoration projects.

Other local jurisdictions have conducted successful stream restoration projects on private property. For example, Baltimore County conducted a 6,600 foot stream restoration project on Jennifer Run in the Lower Gunpowder Falls watershed (http://gv.typepad.com/files/jennifer0904.pdf). The project area had 116 adjacent homes, and the stream was located on the private property of 40 of those homes. In order to complete the project, the project team had to get Right of Entry Agreements from all 40 property owners. These Right of Entry Agreements allowed Baltimore County's contractor access for construction. They also included a provision allowing Baltimore County to obtain an easement that included the stream restoration area. This easement allows Baltimore County to maintain the restoration project, but the easement will still be owned by the property owner. The County planned a Stream Restoration Workshop to inform the property owners regarding the plan, and then had individual discussions with each property owner to explain the plan and its potential impacts.

4.3.2 Septic System Scenario Costs

This section describes the costs of the Septic System load reduction scenarios that were presented in Section 3.3.8.

Scenario 1 – Maryland Phase II WIP Scenario

Table 4-10 shows the cost of Maryland's Phase II WIP scenario for Charles County. The County's unit cost data for upgrading septics to BAT were used to calculate this cost. BAT septic systems also require annual O&M and regular pumping. The County's most recent data show that 5 years of O&M on a BAT system costs approximately $2,050 for five years, or $410 annually. County data show the cost of septic pump-outs to be approximately $200. Assuming that the upgrades to BAT occur at a constant rate over the timeframe for implementation of the TMDL (13 years from 2012 to 2025), this means that septic systems will require an average of 6.5 years of maintenance and pump-outs between 2012 and 2025. Because O&M costs are annual, these costs can be calculated directly. But septic pump-outs will be required approximately once every 5 years, or 1.3 times over the average 6.5 year period that an upgraded septic system will need to be maintained from 2013 to 2025. So the average cost for pump-outs is 1.3 * $200 = $260 per system between 2013 and 2025. This is added to the capital and O&M costs to determine the full cost.

Table 4-10
Costs for Maryland Phase II WIP Septic System Scenario

Septic Location	Number of Septics	Unit Cost per Upgrade to BAT	O&M Costs[1]	Pump-Out Costs[2]	Total Cost
In critical area	1,230	$11,600	$3,277,950	$319,800	$17,865,750
Not within critical area but within 1,000 ft. of a perennial stream	3,678	$11,600	$9,801,870	$956,280	$53,422,950
Not within critical area and not within 1,000 ft. of a perennial stream	9,415	$11,600	$25,090,975	2,447,900	$136,752,875
Totals	**14,323**	**$11,600**	**$38,170,795**	**$3,723,980**	**$208,041,575**

[1]Based on an average O&M cost of $410/year and an average of 6.5 years of O&M required per system by 2025. See Scenario 3 and Table 4-016 for further details.

[2]Septic pump-outs cost approximately $200 per pump-out and will be required approximately once every 5 years, or 1.3 times over the average 6.5 year period that an upgraded septic system will need to be maintained from 2013 to 2025.

It is expected that the cost to upgrade septic systems to BAT would be paid by the Bay Restoration Fund if enough money was available. However, there are additional implications to achieving the level of implementation as discussed in 3.3.7 and 3.3.8.

Scenario 2 - Focus on connecting septic systems in the Development District

As described in Section 3.3.8, this scenario focuses on connecting septic systems within the Development District. It also includes reductions from annual septic system pump-outs, and using 19 percent of the excess nutrient loading capacity at the Mattawoman WWTP to reach the target. The costs of the annual septic pump-outs are summarized in Table 4-11. Note that the estimated cost per pump-out is based on information on pump-out costs in the County.

Table 4-11
Costs for Septic System Pump-Out

Number of Systems Pumped Annually	Cost Per Pump-Out	Annual Cost for Pump-Outs	Total Costs for Pump-Outs Between 2012 and 2025
2,651*	$200	$530,200	$6,892,600

***Assuming that all septic systems outside the Development District are pumped once every five years. This means that, on average, 20% of the total systems, or 2651 systems, are pumped annually.

The County estimates that it would require one staff person at an annual salary of $50,000 to track the septic pump-out program. The costs for this staffing requirement over the time period of TMDL implementation are shown in Table 4-12.

Table 4-12
Programmatic Costs, Septic System Pump-Out Program

Requirement	Annual Cost	Total Costs for Staff Person Between 2012 and 2025
Staff person to track septic pump-out program	$50,000	$650,000

The costs for the septic system connections in the Development District are shown in Table 4-13.

Table 4-13
Septic Connection Cost for Septic System Scenario 2

Location	Number of Systems	Unit cost for connection	Total Cost
In critical area	28	$42,330	$1,185,240
Not within critical area but within 1,000 ft. of a perennial stream	708	$42,330	$29,969,640
Not within critical area and not within 1,000 ft. of a perennial stream	1,927	$42,330	$81,569,910
Totals	**2,663**	**$42,330**	**$112,724,790**

The total costs for Scenario 2 are shown in Table 4-14.

Table 4-14
Total Costs for Septic System Scenario 2

Project Type	Total Cost
Septic Pump-Out Program	$6,892,600
County Staff Costs for Pump-Out Program Administration	$650,000
Septic Connections in Development District	$112,724,790
WWTP Credit (25% of remaining TN capacity)	$0
Totals	**$120,267,390**
County's costs for Scenario 2	**$113,374,790**

It should be noted that the County is not responsible for the actual costs of the septic pump-outs, and thus the County's costs for Scenario 2 are $113,374,790.

Scenario 3 – Focus on Priority Project Areas

This scenario focuses on reducing loads through potential septic connection projects previously identified by the County, as well as potential septic connection projects and potential septic upgrades to BAT that were identified in a separate prioritization analysis. This scenario also includes load reductions through the septic pumping program (costs shown above in Tables 4-11 and 4-12) and use of 17 percent of the excess nutrient loading capacity at the Mattawoman WWTP. The costs of the septic system connection projects are summarized in Table 4-15 below. Note that the unit cost per connection is based on information from the County.

Table 4-15
Septic Connection Costs for Septic System Scenario 3

Project Name	Number of Septics	Unit Cost of BMP	Total Cost
Septic Connections for County Identified Projects	1,575	$42,330	$66,669,750
Septic Connections from Prioritization Analysis	173	$42,330	$7,323,090
Totals	**1,748**	**$42,330**	**$73,992,840**

Scenario 3 also calls for the upgrade of septic systems in specific areas to BAT. The costs for these upgrades to BAT are summarized in Table 4-16 below.

Table 4-16
Septic Upgrade to BAT Costs for Septic System Scenario 3

Project Name	Number of Septics	Unit Capital Cost of BMP	Total Cost
Septic Upgrades to BAT from Prioritization Analysis	650	$11,600	$7,540,000
Totals	**650**	**$11,600**	**$7,540,000**

BAT septic systems require annual O&M and regular pumping. The County's most recent data show that 5 years of O&M on a BAT system costs approximately $2,050 for five years, or $410 annually. As discussed above, County data show the cost of septic pump-outs to be approximately $200. Thus the annual costs for maintaining a BAT system are $610. Assuming that the upgrades to BAT occur at a constant rate over the timeframe for implementation of the TMDL (13 years from 2012 to 2025), this means that septic systems will require an average of 6.5 years of maintenance and pump-outs between 2012 and 2025. The total expected maintenance cost for BAT systems is shown in Table 4-17 below.

Table 4-17 Septic Upgrade to BAT O&M Costs for Septic System Scenario 3				
Number of Septics	**Annual O&M Cost**	**Average Number of Years Septic System will Require O&M between 2012 and 2025**	**Average O&M Cost Per System between 2012 and 2025**	**Total Cost for O&M Between 2012 and 2025**
650	$410	6.5	$2,665	$1,732,250

The total costs for Scenario 3 are shown in Table 4-18.

Table 4-18 Total Costs for Septic System Scenario 3	
Project Type	**Total Cost**
Septic Pump-Out Program	$6,892,600
County Staff Costs for Pump-Out Program Administration	$650,000
Septic Connections	$73,992,840
Septic Upgrade to BAT	$7,540,000
Septic BAT O&M	$1,732,250
WWTP Credit (22% of remaining TN capacity)	$0
Totals	**$90,807,690**
County's costs for Scenario 3	**$74,642,840**

It should be noted that the County is not responsible for the actual costs of the septic pump-outs, the septic upgrades to BAT, or the septic BAT operation and maintenance, and thus the County's costs for Scenario 3 are $74,642,840.

4.3.3 Scenario Cost Efficiency

Based on the analyses in Sections 4.3.1 and 4.3.2, urban stormwater scenario 3 and septic system scenario 3 are the least costly scenarios. The cost efficiency (the cost per pound of pollutant removed) of each BMP is summarized in Table 4-19. As shown in the table, the cost efficiency of the BMPs used in each scenario vary widely, and if more of the more cost efficient BMPs can be done (e.g., stream restoration), the County may be able to reduce costs. However, cost may not be the only consideration when choosing a specific BMP strategy. Other factors, such as the feasibility of working on private land, or a strategy to retrofit specific properties, may also influence the suite of BMPs that are chosen for the strategy. But analyses such as the one presented below will help to guide the selection of specific BMPs as part of the overall strategy.

Table 4-19
Cost Efficiency of Least Costly Load Reduction Scenarios

BMP Name	Lbs TN Removed	Lbs TP Removed	Total Cost	Cost per lb of TN Removed	Cost per lb of TP Removed	Source of Cost Data
Stream Restoration on County Land	2,222	902	$5,068,970	$2,281	$5,620	MD Phase II WIP
Stream Restoration on State Land	6531	2394	$13,634,643	$2,088	$5,695	MD Phase II WIP
Stream Restoration on Private Land	7942	3453	$21,430,130	$2,698	$6,026	MD Phase II WIP
BMP Retrofits, County Wet Ponds	618	43	$7,379,580	$11,941	$171,618	King and Hagan
BMP Retrofits, County Dry Ponds	1758	191	$21,925,868	$12,472	$114,795	King and Hagan
BMP Retrofits, Private Wet Ponds	1327	117	$11,028,706	$8,311	$94,262	King and Hagan
BMP Retrofits, Private Dry Ponds	2,150	320	$17,951,835	$8,350	$56,099	King and Hagan
ESD Retrofits, County Parcels	2,491	437	$19,630,614	$7,751	$44,180	Literature Review
Shoreline Stabilization	510	64	$7,906,860	$15,504	$123,545	MD Phase II WIP
Urban Nutrient Management	6,571	252	$29,856	$5	$118	MD Phase II WIP
Septic Pump-out Program	1,998	N/A	$7,542,600	$3,775	N/A	Charles County

Table 4-19 cont. Cost Efficiency of Least Costly Load Reduction Scenarios						
BMP Name	**Lbs TN Removed**	**Lbs TP Removed**	**Total Cost**	**Cost per lb of TN Removed**	**Cost per lb of TP Removed**	**Source of Cost Data**
Septic Connections for County Identified Projects	16,785	N/A	$73,992,840	$4,408	N/A	Charles County
Septic BMPs from Prioritization Analysis	8,669	N/A	$9,272,250	$1,070	N/A	Charles County
WWTP Credit (22% of remaining TN capacity)	25,107					Charles County

4.4 POTENTIAL FUNDING SOURCES

4.4.1 Stormwater Utility Fee

Maryland Governor Martin O'Malley signed House Bill (HB) 987 (Stormwater Management - Watershed Protection and Restoration Program) into law in May 2012. The purpose of the Bill is to "provide financial assistance for the implementation of local stormwater management plans through stormwater management practices and stream and wetland restoration activities." The Bill requires a county or municipality covered under a Phase I MS4 NPDES permit to adopt and implement laws or ordinances to establish a Watershed Protection and Restoration Program and a stormwater remediation fee – otherwise known as a stormwater utility. The money accumulated through the fee will create the equivalent of an enterprise fund for stormwater, and funds accumulated through the utility are to be used to finance stormwater management practices and stream and wetland restoration activities. More specifically, the fund can be used for:

- Capital improvements;
- Operation and maintenance;
- Public education and outreach;
- Stormwater management planning, including related:
    - Mapping and assessment of impervious surfaces
    - Monitoring, inspection, and enforcement activities

- Review of stormwater management plans and permit applications for new development to the extent development review fees are deposited into the fund; and,
- Grants to nonprofit organizations for watershed restoration and rehabilitation projects related to:
  - Planning, design, and construction of stormwater management practices
  - Stream and wetland restoration
  - Public education and outreach
  - “Reasonable” costs to administer the local watershed protection and restoration fund. Reporting on the fee and its administration is required every two years.

The Bill requires these Watershed Protection and Restoration Programs and the stormwater remediation fees/stormwater utility to be adopted and implemented by July 1, 2013. The County is evaluating the implementation of a stormwater utility that would replace the funding for the County’s NPDES MS4 program that is currently provided by a portion of the Environmental Service Fee dedicated to the County’s stormwater management program.

The stormwater utility fee can be set up in many different ways, but the law is prescriptive in that the fee must be based on the “share of stormwater management services related to the property and provided by the county…” Therefore, a stormwater utility fee is typically set up based on some measure of impervious surface relative to the size of the parcel, although there are many variations of how this can be done. But using some measure of impervious surface meets the goal of the fee being based on the share of stormwater management services related to the property because impervious surface is a large determinant of stormwater runoff volume and pollutant loading.

Once a fee rate is set, the utility collects funds from property owners and uses these monies to manage stormwater through one of the methods described in the bullets above. One of the other components of the law requires that the utility must “establish policies and procedures… to reduce… [the] fee to account for on-site and off-site systems, facilities, services, or activities that reduce the quantity or improve the quality of stormwater discharged from the property.” In other words, the stormwater utility fee can be reduced for an individual property if that property owner implements activities to manage their own stormwater. This requirement can be further modified to actually create an incentive for private property owners to manage their own stormwater, which can reduce the burden on the utility operator for managing all of the stormwater in the utility area. Thus a stormwater utility can be used in many ways to fund stormwater management, either through the monies it collects directly, or through the incentives it provides for the reduction of the amount of stormwater that the utility must manage.

Many local governments are using stormwater utilities as an important source of funding to fund their Phase II WIP strategies, through both direct spending on stormwater management activities and through the incentivizing of stormwater management on private land. It should be noted that some municipalities see stormwater utilities as just one of the funding sources that will be needed to fund BMPs to meet the Bay TMDL targets. For example, Prince George's County is instituting a Stormwater Management Enterprise Fund to pay for stormwater management operations and activities. Prince George's County has developed a Capital Improvement Program under the Enterprise Fund, which is primarily funded through the sale of Stormwater Bonds, an Ad Valorem tax, and State and Federal grants.

4.4.2 Bay Restoration Fund

Maryland Senate Bill 320 (Bay Restoration Fund) was signed into law in 2004. The BRF, also known as the "Flush Tax" create a dedicated fund. A portion of the fund is financed by wastewater treatment plant users, to upgrade Maryland's wastewater treatment plants with enhanced nutrient removal technology for nitrogen and phosphorus. Sixty-seven major WWTPs in Maryland have priority for this funding source. In Charles County, the Mattawoman and Swan Point WWTPs, as well as the Indian Head and La Plata WWTPs, were all eligible for ENR funding from the BRF and all have been upgraded using this funding source. In addition to the fee paid by wastewater treatment plant users, a similar fee paid by septic system users is used to fund the upgrade of onsite systems, connection of onsite systems to ENR WWTPs, and the implementation of cover crops to reduce nitrogen loading to the Bay. Forty percent of the fee goes towards cover crops and 60 percent towards septic system upgrades. Specifically, septic system upgrade funding can go towards upgrades of existing systems to best available technology for nitrogen removal or for the marginal cost of using best available technology instead of conventional technology on new systems. Funding priority is given to failing septic systems in critical areas.

House Bill 446, which was passed during the 2012 legislative session, doubled the BRF fee for most users served by WWTPs to $5.00 per month per household/Equivalent Residential Unit. Fees for septic system users were doubled to $60/month. This should allow for increased funding of WWTP ENR upgrades and septic system upgrades in the future.

In Charles County, the Septic BAT Program is implemented by County Health Department. The Health Department administers the County's portion of the BRF funding, and processes applications from individual property owners for grants to either fund upgrades to BAT or connections to an ENR WWTP. Award of a grant is dependent on the availability of funding, and also on household income, with the percentage of the septic upgrade or connection fee that is funded by the grant decreasing as household income increases.

Municipalities may also apply for BRF funding to construct sewer mains, if only existing homes will be connected to the mains. In order to use BRF funding for construction of sewer mains, several criteria must be met, including:

- Funds must be available and the septic systems to be connected must meet the priority criteria for BRF funding; and

- The WWTP to which septic systems are to be connected must be an enhanced nutrient removal WWTP; and
- The sewer connection must be more cost effective than upgrading to BAT OR upgrading homes to BAT is not feasible; and
- The proposed sewer connection consistent with the County Comprehensive Plan and the Water/Sewer Plan; and
- All of the septic systems proposed for sewer connection were in existence as of October 1, 2008; and
- The septic systems proposed for sewer connection are located in the Priority Funding Areas; and
- The local government has adopted a policy or procedure guaranteeing that no household or business constructed after October 1, 2008, will be permitted to connect to portion of the sewerage system funded using BRF septic funds.

Maryland's Phase II WIP focuses on the BRF as the main source of funding BMPs necessary to achieve the load reduction targets. This was the recommendation made by the Task Force on Sustainable Growth and Wastewater Disposal, which was created by Executive Order to "recommend regulatory, statutory, or other actions to address the impacts of major developments on septic systems and their effects on nutrient pollution, land preservation, agri-business, and smart growth." One of the recommendations of the Task Force was to "increase BRF revenue … in order to cover existing shortfall in major WWTP ENR upgrades and essentially close the funding gap for implementing other WIP requirements from developed lands." Specific recommendations included:

- Increase average annual residential fee rate in SFY13 and again in SFY15.
- Allow up to 10 percent of total BRF revenue to go to ENR WWTP operations and maintenance.
- Use expanded BRF funding to include the state's 50 percent share of BNR upgrade costs for 10 major-minor plants
- Revise authorized uses of BRF funding to better meet needs of developed lands.
- Amend BRF enabling statute to permit funding of stormwater retrofits as an authorized use of the BRF funds. State should provide up to 50 percent cost share for stormwater retrofit projects.
- In addition to competitive grants, local governments would be guaranteed grants from the increased BRF to implement stormwater BMPs.

By making recommended changes in the funding levels, making additional types of projects eligible for BRF funding (e.g., stormwater), and adding guaranteed grants to the competitive grant program, the BRF should provide additional funding capacity to assist with implementation of BMPs to meet the TMDL.

4.4.3 Sewer Enterprise Fund

The County has an Enterprise Fund for its sewer system. Enterprise funds are established for operations that have a defined customer base and are primarily funded by a service fee associated directly with the operation. Operating revenue budgets within this fund are estimated based on the expected level of activity within the enterprise so as to maintain a self-supporting status. The Fund utilizes a Capital Improvement Program (CIP) that includes projects for the County's WWTPs. Among the projects included in the County's FY13-FY17 CIP were the Mt. Carmel Woods/College of Southern Maryland pump station and force mains; the Cobb Island/Swan Point interconnection; Clifton Pump Station #4; White Plains Failing Septic Sewer Improvements; the Benedict Central Sewer System; and the Hughesville Package Treatment Plant. All of these projects will help to reduce load from the wastewater sector.

4.4.4 Other Funding Sources

Other funding sources that may be utilized to pay for BMPs or other actions necessary to meet the Bay TMDL include:

- 319 Grants backed by funding from the Federal Clean Water Act Section 319(h). These grants are administered by MDE and are for nonpoint source control by State and local projects that help eliminate water quality impairments caused by nonpoint sources.
- The Chesapeake Bay Trust Fund, which is made up of monies generated through motor fuel tax and rental car tax in Maryland. The fund supports projects designed to reduce non-point source pollution that reaches the Chesapeake Bay. Some example projects include Prince George's County's $2,880,000 grant to construct a large-scale urban stream restoration in the Northwest Branch of the Anacostia River; $640,000 to Baltimore County and Herring Run Watershed Association for stormwater retrofits and forest buffer restoration in Back River; and $500,000 to Harford County to construct four stormwater management projects in Wheel Creek.
- National Fish and Wildlife Foundation Chesapeake Bay Small Watershed Grants and the Chesapeake Bay Innovative Nutrient and Sediment Reduction grants.
    - The Chesapeake Bay Small Watershed Grants Program provides grants of $20,000 to $200,000 to organizations and local governments working on a local level to implement projects that improve small watersheds in the Chesapeake Bay basin, while building citizen-based resource stewardship. In 2011, the Stewardship Fund awarded 36 Small Watershed Grants totaling nearly $2,800,000. Recipients included 10 local governments and 26 non-profit groups representing every state in the watershed.
    - Chesapeake Bay Innovative Nutrient and Sediment Reduction grants, which range from $200,000 to $750,000, support the demonstration of

innovative approaches to expand the collective knowledge about the most cost effective and sustainable approaches to dramatically reduce or eliminate nutrient and sediment pollution to the Chesapeake Bay and its tributaries. In 2011, the Stewardship Fund awarded 19 Innovative Nutrient and Sediment Reduction Grants totaling nearly $8,200,000. Recipients included six local governments, three universities, and eight non-profit groups.

Each of these grant programs is competitive, and applications would be required. However, these sources should be considered, particularly if the County is planning on doing pilot or demonstration projects that would showcase innovative or novel techniques for managing pollution. If such a strategy were implemented, the County could use these types of grants to develop pilot projects to determine if various BMP strategies or types are viable in the County, and could then ramp up the implementation level of those BMPs using stormwater utility fee funds or other monies if the BMPs were proven to be successful through the pilot projects.

5. INTEGRATION OF WIP STRATEGY WITH OTHER PROGRAMS

Meeting the pollutant reduction goals associated with the Bay TMDL will require the implementation of a wide range of pollutant reduction measures and the integration of load control efforts from multiple pollutant sectors. EPA has approved a list of activities and measures that can be used to reduce loads, ranging from construction of traditional stormwater BMPs to implementing outreach to promote urban nutrient management to conserving forest or planting trees. Other measures, such as conserving or re-using water, also ultimately reduce pollutant loads. In many cases, activities that ultimately reduce pollutant loads are already being conducted as parts of other programs or initiatives that are unrelated to the Bay TMDL or strategies implemented in response to the TMDL. For instance, the County already implements a number of programs, such as its NPDES MS4 program, and planning efforts, such as the Comprehensive Plan, that include activities that can be used to meet both the goals of the original program and Bay TMDL-related goals. Several of these programs and planning efforts are discussed below. The discussion for each program/planning effort focuses on potential ways to integrate activities from these programs and planning efforts into the County's WIP strategy, such that the County can get additional load reduction credit for the Bay TMDL.

5.1 NPDES MS4 PERMIT

There are a number of overlaps between the expected requirements in the County's pending new generation MS4 permit and the load reductions needed to meet load reduction targets for the Bay TMDL. The County will be issued its next Phase I NPDES MS4 permit in the coming months. The draft version of this permit includes several new requirements, as well as the continuation of several existing requirements, that involve assessments and analysis similar to, or overlapping, what is needed for the Bay TMDL. Complying with these permit requirements will assist the County in developing strategies and achieving the load reductions necessary for the Bay TMDL. A summary of the draft MS4 requirements is provided below.

Part III.E (*Restoration Plans and Total Maximum Daily Loads*) of the County's draft MS4 permit includes a section addressing *Restoration Plans* (Part III.E.2), which includes the following requirements:

1. *Impervious Surface Area Assessment* – this impervious surface area assessment shall serve as the baseline for the restoration efforts required in this permit.
2. *Impervious Surface Restoration* – requires twenty percent of the County's impervious surface not already treated to the MEP must be restored (this is in addition to the 10% required in the previous permit)
3. *Restoration Plan* – requires a plan to be developed for each TMDL WLA that includes :

    a. A detailed schedule for implementing pollutant reduction measures;

b. Detailed cost estimates for these measures; and

c. Evaluation and tracking of the implementation of these restoration plan efforts.

The draft permit (Part III. E) also includes requirements to:

- Complete watershed assessments;
- Provide opportunities for public participation in developing the watershed assessments and restoration plans; and
- Evaluate compliance with meeting applicable TMDL stormwater wasteload allocations.

In addition, the draft permit requires

> …coordination with MDE's Watershed Implementation Plan [WIP]…which will …be used as the regulatory backbone for controlling urban pollutants toward meeting the Chesapeake Bay TMDL by 2025.

As the term "coordination" is fairly vague, understanding expectations is important. Maryland counties had the option of submitting strategies for inclusion into the WIP to demonstrate how they would meet pollutant reduction goals. For those counties (including Charles County) that did not submit specific pollution reduction strategies, the state included its own proposed set of practices. MDE's general strategy (provided in Appendix A of the WIP) was to increase watershed restoration requirements for MS4s, so the urban stormwater strategies provided for Phase I MS4 jurisdictions that did not submit specific strategies were equivalent to retrofits of 20 percent of untreated developed land. Other more recent draft permit language (Prince George's County) clarifies that:

> This permit is requiring compliance with the Chesapeake Bay TMDL through the use of a strategy that calls for the restoration of 20% of previously developed impervious land with little or no controls within this five year permit term as described in Maryland's Watershed Implementation Plan.

This new language clarifies MDE's expectation that meeting the 20 percent impervious surface restoration requirement equates to meeting the expectations of the Bay TMDL for regulated urban stormwater. Several other proposed MS4 permit requirements, including watershed assessments and TMDL restoration plans, are also useful in providing data and planning for load reductions in specific watersheds. In summary, MDE is interpreting the County's compliance with its MS4 permit as meeting the expected load reduction associated with the urban stormwater sector for the Bay TMDL.

In addition to the MS4 permit requirements, the Water Quality Goals Implementation Team (WQGIT) has convened several working groups that have been considering updated requirements for tracking, reporting and verifying BMPs. While there have been no final decisions regarding these requirements, it is likely that any such requirements would be linked to the MS4 permit. It will be important for the County to continue tracking developments with respect to any decisions made by these working groups to ensure that the County complies with any updated requirements.

5.2 WWTP NPDES PERMITS

The Phase II WIP utilized NPDES permit information from WWTPs in the Bay watershed when developing the Bay TMDL. Individual load caps were set for each major (>500,000 GPD) WWTP, and aggregated load caps were set for minor (≤500,000 GPD) WWTPs. These load caps were based on the maximum flow rates and pollutant concentration limits allowed by the WWTP's permit. Where these data were not available (particularly for some minor WWTPs), they were estimated.

Because the Bay TMDL allocated loads to WWTPs based on their NPDES permits, compliance with the permit (specifically, compliance with any load limits in the permit) will equate to meeting the expectations of the TMDL. Under Section 7 "Reasonable Assurance and Accountability Framework") of the Bay TMDL document, EPA states that

> …the existence of the National Pollutant Discharge Elimination System (NPDES) regulatory program and the issuance of an NPDES permit provide the reasonable assurance that the WLAs in the TMDL will be achieved. That is because federal regulations implementing the CWA require that effluent limits in permits be consistent with "the assumptions and requirements of any available [WLA]" in an approved TMDL [40 CFR 122.44(d)(1)(vii)(B)].

Maryland's Phase II WIP discusses the specific implementation of targets through technology based controls at WWTPs that are required and enforceable through NPDES permits. The WIP states that:

> given the statewide target load provided by EPA, a portion of the load was assigned to traditional point sources (e.g., WWTPs) based primarily on Maryland's point source cap policy that was adopted as part of the 2004 Tributary Strategy. This policy requires what is generally considered the "limit of technology," and achieves very significant reductions from major sources, enforced through NPDES permits.

Therefore, as with the regulated urban stormwater sector, compliance with WWTP NPDES permits meets the expectations of the Bay TMDL for the wastewater sector.

5.3 INDUSTRIAL STORMWATER PERMITS

The County operates facilities subject to NPDES industrial stormwater permits. These permits will soon be renewed and will include a 20 percent impervious surface restoration requirement. This permit requirement is consistent with Maryland's Phase II WIP and compliance meets the expectations of the Bay TMDL for industrial stormwater.

5.4 EXISTING SEPTIC SYSTEM PROGRAM

Existing septic systems contribute a significant portion of the TN load in the County, but there are few actual requirements regarding existing septic systems. Instead, management of existing septic systems is a "best practice" that is encouraged for multiple reasons, including public health and environmental benefit. Septic systems must be installed by licensed individuals, but after installation, it is up to the property owner to maintain the system. This can include regular pumping and maintenance. There are no requirements for implementing BMPs that would reduce loads from septic systems, such as upgrading to BAT, or connecting to a WWTP. Competitive grant funding is available through the BRF should a homeowner choose to upgrade to BAT or connect to a WWTP, but these are voluntary efforts.

Various legislation has been proposed in Maryland that would require new construction to use BAT systems where septic systems are to be installed. Still other legislation has proposed restricting the locations where new septic systems can be installed. None of this legislation will impact existing septic systems. House Bill 446 however, recently passed in 2012, has doubled the BRF, thereby increasing the dollars available for BRF grants.

Based on the current status of existing septic systems in Maryland, additional outreach to encourage the use of BRF monies to implement septic system BMPs may be warranted.

5.5 COMPREHENSIVE PLAN

Bay TMDL efforts also include significant overlap with other County planning efforts. For instance, the Charles County Comprehensive Plan reflects a long-range planning effort that guides policy, investment, program, and land use decisions within the County that drives efforts such as preserving open space and enhancing transportation within the County. The Comprehensive Plan is currently under review and being updated as required every six years by state law. The draft “2012 Comprehensive Plan” will be the framework for land use, growth management, rural/agricultural policies, economic development, water resources, natural environmental resources, community facilities, and energy efficiency decisions through approximately 2040.

The framework for the Comprehensive Plan addresses elements such as water resources and natural resource protection, and recommends policies and actions to continue to protect and enhance these natural resources. The Plan includes evaluation of data also used in association with the Bay TMDL, such as land use and land cover, as a basis for developing these policies and associated actions. This results in overlap between these planning efforts and those required to meet the goals of the Bay TMDL. For example, the following policies influence County actions that can result in pollutant reduction that can receive credit towards the Bay TMDL goals:

- Placing special emphasis on watershed management to balance the protection of the Mattawoman Creek’s natural resources and water quality with the County’s development plans.
- Continuing to coordinate and implement the goals and objectives of adopted policy plans including the Patuxent River Policy Plan, the Wicomico Scenic River Study and Management Plan, the Zekiah Swamp Rural Legacy Area Plan, the Port Tobacco River Watershed Restoration Action Strategy, Lower Potomac River Coordinated Management Plan (Nanjemoy Peninsula), and other watershed restoration and management plans (Note: these are not the same as the watershed implementation plans expected to be required as part of the pending new generation NPDES MS4 permit).

- Guiding development away from areas vulnerable to natural hazards, especially areas subject to flooding, storm surge, and shore erosion.
- Encouraging best management practices including low-impact development techniques to minimize the impacts of development on the natural environment.
- Purchasing or otherwise acquiring conservation easements to preserve environmentally sensitive resources. Developing parks, recreation and open space plans in conjunction with stream valley protection objectives.
- Conserving remaining wooded areas in the County, pursuing grant opportunities or other programs to increase, enhance and protect forests, and require new plantings to support other natural resource objectives including enhancing riparian buffers, reducing erosion and sedimentation, improving air quality, and mitigating the effects of stormwater runoff.
- Retaining as much of the forest and tree cover as possible within urban areas.

While these are not practices that will receive specific pollution reduction credit in association with the Bay TMDL, these policies are important for establishing a framework for specific County actions that can serve the dual purposes of meeting the goals of the Plan, and assisting with TMDL-related benchmarks and goals.

The draft 2012 Comprehensive Plan includes a number of actions that can be translated into efforts that provide these pollution reduction credits. Examples include:

- *Stream Valley Protection*. Using state grant funds and County funds as available to target stream valley protection through land acquisition or conservation easements.
- *Urban forests.* Evaluating the existing urban forest and consider the adoption of an urban forest canopy coverage goal.
- *Forest fragmentation*. Considering the adoption of regulations protecting forest hubs (greater than 100 acres) and forest corridors for the survival of the remaining biodiversity of the County. Under the Forest Conservation Ordinance, add a requirement that priority forests to be maintained on development sites, unless a variance is granted by the Board of Appeals.
- *Shorelines.* Considering the adoption of buffers and development setbacks from areas vulnerable to over three feet of sea level rise in the next 100 years to protect private and public investments, and accommodate inland wetland migration.

The Comprehensive Plan also addresses a number of County programs that have data needs and goals that are similar to the data needs and goals of the Bay TMDL. These include efforts such as focusing growth areas within the County, which minimizes pollution from new development; and protecting habitat by maintaining forest cover or conducting forest restoration, which also minimizes impact from stormwater runoff. Specific programs include:

- *Natural Heritage Areas (NHAs).* An NHA is defined as plant or animal communities that are considered to be among the best statewide examples of their kind and contain at least one species designated or proposed as endangered, threatened, or in need of conservation (there are four NHAs in the County). Development activities or other disturbances in these areas are not allowed unless it can be shown that the proposed activity will have no adverse impacts on habitats. Specifically, it must be shown that the structure and overall species composition of the plant and animal communities will be retained.

- *Chesapeake Bay Critical Area Law.* Requires the County to adopt and implement a Critical Area management program and ordinance to protect the water quality and wildlife habitats of the Bay and its tributaries. The State Critical Area Commission reviews the program and ordinance every six years. All development activity within the Critical Area must comply with criteria affecting development density, water dependent uses, buffers from waterways, and protections for natural shorelines and wildlife habitats.

- *Stronghold Watersheds.* Defined as areas with the highest biodiversity of stream insects and greatest occurrence of rare aquatic species. Several of these watersheds are locate within the county and, as detailed in the Comprehensive Plan, they provide opportunities to apply less expensive protection efforts in lieu of allowing the resources to degrade to the point of costly restoration or an irrecoverable condition.

  For instance, the Plan states that land preservation is one of the most cost effective and community acceptable protection practices, and is an integral watershed management tool. Using various programs, the County, state agencies, and private conservancies work with property owners and citizens' groups to promote the preservation of sensitive environmental areas and natural resource areas, including such areas where they exist on agricultural land.

- *Charles County Land Preservation, Parks, and Recreation Plan (LPPRP*). This plan inventories programs for natural resource land conservation, along with recreation land, and agricultural land conservation. The LPPRP also discusses the County's goal to protect 50 percent of the County as open space.

- *Forest conservation/restoration efforts.* The Plan details the County's goal to conserve large tracts of contiguous forestland and forest interior dwelling bird habitat determined to be of significance due to their value for wildlife habitat, water quality and air quality. In 2009 the MD DNR Forest Service completed a Strategic Forest Assessment for the County. This assessment identified priority conservation and reforestation areas for regulatory mitigation purposes, water quality treatment, and habitat. The County's forest conservation ordinance applies to all lands outside the Critical Area and requires development proposals to include forest stand delineations and forest conservation plans. The forest conservation plan can require afforestation or reforestation. Afforestation is planting trees where forest cover has been absent, such as farm fields. Reforestation is replacing existing trees. The majority of forest outside of the County's Development District is eligible for the federal Forest Legacy Program through USDA Forest Service. This program offers incentives for protection.

5.6 WATER RESOURCES ELEMENT (WRE)

The Water Resources Element (WRE) is a component of the Charles County Comprehensive Plan. The WRE (adopted in May 2011) creates a policy framework for sustaining public drinking water supplies and protecting the County's waterways and riparian ecosystems by effectively managing point and nonpoint source water pollution. The current WRE is an amendment to the 2006 Comprehensive Plan and identifies ongoing and future strategies to manage existing water supplies, wastewater effluent, and stormwater runoff for existing and future residents and businesses (including the growth projected for the county's municipalities). It also identifies the County's policies and initiatives for – as well as the opportunities and challenges related to – achieving water quality goals and ensuring adequate drinking water for future generations of residents.

The WRE takes a watershed-based approach in analyzing the impact of future growth on the County's water resources – particularly in relation to nutrient discharges to the County's water bodies. This approach is consistent with watershed planning needs associated with the Bay TMDL. In fact the draft WRE states that the information contained in the Phase II WIP should inform the WRE in the 2012 Charles County Comprehensive Plan.

A major goal of the WRE is to more closely link land use and development policies with water quality goals. Three future land use scenarios are detailed in the WRE, which are used to gauge the impacts of alternative land use and water resources policies. The WRE describes those linkages through these three scenarios and makes land use recommendations to be considered in the next update of the 2012 Comprehensive Plan. The WRE details the fact that the preferred scenario did not achieve the water quality goals in the Mattawoman Creek or the Port Tobacco River (those waters with existing TMDLs). Consequently, the 2012 Comprehensive Plan is evaluating a wider range of land use options and will incorporate more holistic water quality and water supply concerns into decisions about the location and intensity of future development. Water quality concerns and future growth will also be an important element of the Bay TMDL as required through the associated growth and offset strategy to address new or increased pollutant loads.

In summary, many of the County's ongoing regulatory compliance and planning efforts can be leveraged to assist in meeting the goals of the Bay TMDL. In some cases, such as with compliance with NPDES permits (e.g., MS4 and WWTP discharge permits, and industrial stormwater permits for County facilities), compliance with the NPDES permit equates to meeting the goals of the Bay TMDL for that sector. In the cases of County planning efforts, such as the Comprehensive Plan and Water Resources Element, these documents summarize County policies and goals for land use and natural resource management that can be leveraged into actions that can result in load reduction credit towards the TMDL.

This page is blank to facilitate double sided printing.

6. SUMMARY AND TWO YEAR MILESTONES

6.1 SUMMARY

Sections 3 and 4 of this Strategy document develop and present detailed analysis of the County's loads and targets for the wastewater, urban stormwater, and septic sectors. These Sections also evaluate potential BMP scenarios to control those loads to meet the County's targets. While Maryland's Phase II WIP included separate targets for each of these sectors, the ultimate accounting for load reduction will be at the major basin level, and so it may not be practical to meet the targets individually, but rather to meet them at the County level. This is especially true because load reductions in the urban stormwater and septic system sectors may be difficult to achieve due to the magnitude and scale of BMPs required, and the challenges of working with private landowners to implement at least some percentage of these BMPs. The County's excess load capacity at WWTPs (particularly at the Mattawoman WWTP) - even when accounting for projected growth – suggests promotion of an integrated strategy of combining load reductions from the urban stormwater and septic system sectors with offsets from reserving excess WWTP capacity will be the most cost effective strategy.

Large load reductions are required in both the urban stormwater and septic sectors and extensive implementation of new BMPs will be required to meet targets. All BMPs to reduce load from septic systems require some amount of cooperation from private landowners because the vast majority of septic systems are privately owned. For the most part, septic BMPs require private landowners to voluntarily implement the BMP, whether to connect their septic system to a WWTP or upgrade their system to BAT. While there certainly are exceptions to this (such as mandatory a septic system pump-out programs or required upgrades to BAT due to planned construction), for the most part, these BMPs will have to be implemented using financial incentives to private property owners, and even then the rate of implementation may be low. Based on these factors, it is not likely to be feasible to do more in the septic system sector to be able to do less in the urban stormwater sector.

In contrast, the County has more control over the urban stormwater sector because it can implement stormwater BMPs on its own land. Stormwater BMPs also receive TP load reduction credit, which will be necessary if the urban stormwater targets are to be met. There is also a larger suite of BMPs types to choose from, and these BMPs are typically scalable to the size of the land area that needs to be controlled. For example, stormwater BMPs can be designed on a large scale, such as regional wet ponds or wetlands, or they can be designed on a micro-scale, such as bioretention for a single parking lot or street. Programmatic BMPs, such as outreach to encourage urban nutrient management, can also be effective.

While septic system sector BMPs are relatively inexpensive on a per-unit basis, stormwater BMPs tend to be more expensive. This is evident in the magnitude of the cost estimates for the septic system versus urban stormwater sectors discussed in Section 4.3, where the septic system sector scenario costs range from approximately

$91 million to $198 million, the stormwater sector costs range from $394 million to $2.5 billion. The scenarios for the urban stormwater sector also include BMPs on private land. However, it may become easier to incentivize BMPs on private land with the County's collection of a stormwater utility fee from private landowners (i.e., some landowners may be willing to implement BMPs on their property in exchange for reduced fees).

Based on the load reduction potential of each sector scenario, the evaluations performed with available data, and the costs of used for each of the practices discussed, the most cost-efficient approach would be to adopt a combination of scenarios similar to urban stormwater scenario 3 and septic system scenario 3. The total costs for this strategy (using the scenarios as developed herein) are shown in Table 6-1.

Table 6-1
Total Costs for Load Reduction Strategies, Urban Stormwater Sector Scenario 3 and Septic System Sector Scenario 3

Scenario Name	Cost
Urban Stormwater Sector Scenario 3, Focus on Stream Restoration	$125,662,791
Septic System Sector Scenario 3 – Focus on Priority Project Areas	$90,807,690
Totals	**$216,470,481**

While this strategy is the most cost-effective of the scenarios developed for this document, pure cost is rarely the sole factor influencing the decision on choosing a specific strategy. BMP feasibility, private land considerations and many other factors will also influence the final mix of a strategy program between all sectors. This document presents other scenarios that would also result in the load reductions necessary to meet the targets, and it is likely that "mix and match" is the best approach to selecting BMPs, implementation levels, the level of implementation on private land, and other factors. To keep moving forward, however, the County should use the next two years to implement projects that have been vetted and planned (e.g., the White Plains, Benedict, and Hughesville sewer connection projects) while also evaluating the feasibility of implementing more novel types of projects, such as ESD on County lands and stream restoration on private land). The County can also use the next two years to finalize other aspects of its strategy, such as completing its GIS data layers to assist with identification of potential, project areas. Finally, the County can continue moving forward with integrating its new MS4 permit requirements (which include restoration requirements) and other County planning efforts, such as the Comprehensive Plan and the Water Resource Element, into an overall load reduction strategy.

In order to assist to assist the County with taking the next steps to implement its load reduction strategy, the following Two-Year Milestones are proposed.

6.2 TWO-YEAR MILESTONES

As part of the "Reasonable Assurance" component of the Bay TMDL, EPA developed an "Accountability Framework" that guides water quality restoration of the Chesapeake Bay. Among the elements of the Accountability Framework are expectations that each Bay jurisdiction will develop WIPs, and that they will then develop Two-Year Milestones. The Milestones outline the steps that the Bay jurisdictions will take in the next two years to reduce nitrogen, phosphorus and sediment pollution to the Chesapeake Bay, and what reductions those measures will achieve. The Milestones are used to track progress toward reaching the TMDL's goals. In addition, the Milestones are used to demonstrate the effectiveness of the jurisdictions' Watershed Implementation Plans by identifying specific near-term pollutant reduction controls and a schedule for implementation.

In developing its Phase I and Phase II WIPs, Maryland engaged local jurisdictions with the expectation that these local WIP Teams would develop County-level WIPs that would include Two-Year Milestones. The County submitted its Watershed Implementation Plan, including a narrative and 2-Year Milestones, in July 2011 to cover July 2011 through June 2013. The County had used this time period as a "planning period," during which the County was to conduct a detailed analysis of the BMPs and projects to be developed and the associated nutrient load reductions. This Phase II WIP Strategy document represents the culmination of that planning process, as it presents the analysis of the County's loads and specific strategies for achieving the load reductions to meet targets.

The next set of milestones will cover July 2013 through June 2015. Under this set of milestones, the County will need to finalize planning for all of its load reduction strategies and then accelerate BMP implementation levels compared with the past. The County will also need to integrate and leverage other programs and efforts, such as compliance with its next generation NPDES MS4 permit, efforts to conserve water, and outreach efforts to engage the general public in assisting with load reductions, in order to maximize load reduction. The County will also need to continue to track developments within EPA and its implementation of the Bay TMDL, including any changes in the types of BMPs that can receive credit or the credit that those BMPs can receive, as well as any requirements or guidance related to tracking, verifying, or reporting BMPs to receive credit.

The following Two-Year Milestones for July 2013 through June 2015 have been organized by source sector area to better assist the County in identifying specific needs by program.

6.2.1 Wastewater

- Determine method for coordinating crediting excess nutrient capacity from the wastewater sector to other sectors (e.g., update NPDEs permit language to discuss use of this capacity for other sectors, or use another method to get this trade-off recognized by MDE).
- Prepare a sewer system capacity analysis of the County WWTPs by identifying current capacity levels and quantifying: flow saving measures such re-use or

conservation; projects approved to be connected to the WWTPs which haven't yet been built; and proposed connections of existing septic systems to WWTPs per Septic System Scenarios 2 and 3.

- Develop program to promote and actively pursue water conservation, including outreach program.
- Explore and promote additional opportunities for water re-use.

6.2.2 Urban Stormwater

- Complete review/update of GIS datasets, including impervious surface and stormwater management infrastructure, such as stormwater pipes, outfalls, and individual BMPs with delineated drainage areas.
- Resolve any discrepancies between County and MDE pollutant loading data.
- Develop GIS layer to identify deficient buffers. Use information such as "Plantable" GIS dataset as starting point. Develop program to incentivize buffer restoration on private parcels.
- Conduct pilot project to control stormwater through ESD on three to five County properties.
- Develop demonstration project for ESD on private land. Use watershed groups and other interest groups to identify landowners willing to participate and to promote this BMP.
- Perform watershed assessments and prioritize, fund, and conduct impervious surface restoration, to meet expected requirements in new NPDES MS4 permit.
- Use information generated from watershed assessments or other sources to identify potential stream restoration projects. Select three to five stream reaches for restoration and develop stream restoration projects. Coordinate this work with NPDES MS4 permit work on watershed assessment and planning.
- Develop demonstration project for stream restoration on private land. Use watershed groups and other interest groups to help identify landowners willing to participate and to promote this BMP.
- Identify three to five County-owned dry pond or wet pond BMPs and retrofit with submerged gravel wetlands, regenerative stormwater conveyance, infiltration device, or similar.
- Finalize stormwater utility and evaluation of stormwater incentive program for residential and commercial properties, including a grant program to be administered with the assistance of a third party, such as the Chesapeake Bay Trust.
- Evaluate development of a program to collect fees from shoreline property owners that can be used to fund shoreline erosion control projects.

- Develop program requirements and outreach program for incentivizing management of stormwater on private land. Develop method to account for stormwater management on private land (e.g., maintenance agreements, inspection requirements, reporting, tracking, etc.).

6.2.3 Septic Systems

- Reconcile number of septic systems in the County with MDE.
- Study feasibility of septic pump-out ordinance.
- Complete White Plains, Benedict, and Hughesville sewer connection projects.
- Conduct feasibility study to determine if priority areas identified in Phase II WIP strategy can be connected to WWTPs.
- Develop enhanced outreach program to target septic systems in critical areas for upgrade to BAT.

This page is blank to facilitate double sided printing.

7. REFERENCES

1. Anne Arundel County Department of Public Works. 2002. *Severn River Watershed Management Master Plan Current Conditions Report*. Prepared by KCI Technologies, Inc. and CH2M HILL for Anne Arundel County Department of Public Works Watershed Management Program. December 2002.

2. Anne Arundel County. 2006. *Severn River Watershed Management Master Plan, Final Report*. Prepared by KCI Technologies, Inc. and CH2M HILL for Anne Arundel County Department of Public Works Watershed Management Program. 2006.

3. Anne Arundel County Department of Public Works. 2008. *OSDS Evaluation Study and Strategic Final Report*. March 2008. Available at http://www.aacounty.org/DPW/Utilities/OSDS.cfm.

4. Anne Arundel County. 2012. *Patapsco Tidal and Bodkin Creek Watershed Assessment Comprehensive Summary Report*. Prepared by LimnoTech for Anne Arundel County Department of Public Works Watershed Management Program. 2012.

5. Baltimore County. Undated. Presentation on Jennifer Run stream restoration project at http://gv.typepad.com/files/jennifer0904.pdf, accessed January 2012.

6. Charles County. 2006. *Charles County Comprehensive Plan*. 2006.

7. Charles County. 2006. *Comprehensive Water and Sewer Plan*. October 2006.

8. Charles County. 2011. *Water Resources Element*. Adopted May 2011.

9. Chesapeake Bay Trust. Undated. Website at http://www.cbtrust.org/site/c.miJPKXPCJnH/b.5457271/k.C58E/Grants.htm, accessed January 2013.

10. Chesapeake Stormwater Network. 2009. *The Grass Crop of the Chesapeake Bay Watershed*. On CSN website at http://chesapeakestormwater.net/2009/06/the-grass-crop-of-the-chesapeake-bay-watershed/, accessed December 2012.

11. Chesapeake Stormwater Network. 2011. *Technical Bulletin No. 9, Nutrient Accounting Methods to Document Local Stormwater Load Reductions in the Chesapeake Bay Watershed, Version 1.0*. August 15, 2011.

12. Isle of Wight County, Virginia. Undated. Septic Pump-out Program website at http://www.co.isle-of-wight.va.us/planning-and-zoning/environmental-planning/septic-pump-out-program/, accessed December 2012.

13. King, D., and P. Hagan. 2011. *Costs of Stormwater Management Practices in Maryland Counties*. UMCES CBL 11-043. Draft Final Report prepared for Maryland Department of the Environment Science Services Administration. October 10, 2011.

14. LimnoTech. 2012. Memorandum: *Stormwater Funding – Stormwater Funding and Incentive Programs.* August 2012.

15. State of Maryland. 2012. Maryland House Bill 987, Stormwater Management – Watershed Protection and Restoration Program. Accessed at http://legiscan.com/MD/text/HB987/2012, January 2013.

16. Maryland Department of Agriculture. Undated. Nutrient Management website at http://mda2.maryland.gov/resource_conservation/Pages/nutrient_management.aspx accessed December 2012.

17. Maryland Department of the Environment. 2011. *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated: Guidance for National Pollutant Discharge elimination System Stormwater Permits*. Draft. June 2011.

18. Maryland Department of the Environment. Undated. Bay Restoration Fund website at http://www.mde.state.md.us/programs/Water/BayRestorationFund/Pages/index.aspx, accessed January 2013.

19. Maryland Department of the Environment, 2009. *2000 Maryland Stormwater Design Manual*. Revised May 2009.

20. Maryland Department of the Environment, Maryland Department of Planning, Maryland Department of Agriculture, and Maryland Department of Natural Resources. 2011. *Final Report of the Task Force on Sustainable Growth and Wastewater Disposal*. December 2011.

21. Maryland Department of the Environment, Maryland Department of Planning, Maryland Department of Agriculture, University of Maryland, and Maryland Department of Natural Resources. 2010. *Maryland's Phase I Watershed Implementation Plan for the Chesapeake Bay Total Maximum Daily Load*. December 3, 2010. http://www.mde.state.md.us/programs/Water/TMDL/Documents/www.mde.state.md.us/assets/document/MD_Phase_I_Plan_12_03_2010_Submitted_Final.pdf.

22. Maryland Department of the Environment, Maryland Department of Planning, Maryland Department of Agriculture, University of Maryland, and Maryland Department of Natural Resources. 2012. *Maryland's Phase II Watershed Implementation Plan for the Chesapeake Bay Total Maximum Daily Load*. October, 2012.

http://www.mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Documents/FINAL_PhaseII_Report_Docs/Final_Documents_PhaseII/Final_Phase_II_WIP_MAIN_REPORT_102612.pdf.

23. Maryland Department of the Environment, Maryland Department of Planning, Maryland Department of Agriculture, University of Maryland, and Maryland Department of Natural Resources. Undated. Maryland Assessment and Scenario Tool (MAST) website and documentation. Website at http://www.mastonline.org/default.aspx?AcceptsCookies=yes accessed December 2012.

24. National Fish and Wildlife Foundation. Undated. Website at http://www.nfwf.org/Pages/grants/home.aspx accessed January 2013.

25. Schueler, T. 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*. Metropolitan Washington Council of Governments. Washington, DC. 1987.

26. Schueler, T.R. 1992. *Mitigating the Adverse Impacts of Urbanization on Streams: A Comprehensive Strategy for Local Government*. In Watershed Restoration Sourcebook. Publication #92701 of the Metropolitan Washington Council of Governments. P. Kimble and T. Schueler, editors. 1992.

27. U.S. EPA Chesapeake Bay Program. Undated. Phase 5.3 Watershed Model documentation. Website at http://www.chesapeakebay.net/about/programs/modeling/53/ accessed December 2012.

28. U.S. EPA Chesapeake Bay Program. Undated. Land Use Workgroup website. Website at http://www.chesapeakebay.net/groups/group/land_use_workgroup accessed December 2012.

29. U.S. EPA Region 3. 2009. Letter from Shawn Garvin, Regional Administrator, to Preston Bryant, Virginia Secretary of Natural Resources, December 29, 2009. http://www.epa.gov/region3/chesapeake/bay_letter_1209.pdf.

30. U.S. EPA. Undated. Section 319 website at http://water.epa.gov/polwaste/nps/cwact.cfm#apply. Accessed January 2013.

31. U.S. EPA. 1997. *Combined Sewer Overflows - Guidance for Financial Capability Assessment and Schedule Development.* EPA 832-B-97-004, February 1997. Website at *http://www.epa.gov/npdes/pubs/csofc.pdf.*

32. U.S. EPA, 2001. PLOAD Version 3.0, An ArcView GIS Tool to Calculate Nonpoint Sources of Pollution in Watershed and Stormwater Projects. Developed by CH2M HILL. January 2001.

33. U.S. EPA. 2010. *Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus and Sediment*. December 29, 2010. http://www.epa.gov/reg3wapd/tmdl/ChesapeakeBay/tmdlexec.html.

34. Virginia Department of Conservation and Recreation. Undated. The Bay Act website at http://www.dcr.virginia.gov/stormwater_management/theact.shtml. Accessed December 2012.

APPENDIX A