The Town of Leesburg
INTEROFFICE MEMORANDUM
DEPARTMENT OF PUBLIC WORKS

TO: John Wells, Town Manager

FROM: Charles A. Mumaw, P.E., Deputy Director of Public Works
William R. Ackman, Jr. P.E., Director of Plan Review

DATE: November 20, 2012

RE: Status Update of Federal and State mandates for the Chesapeake Bay Total Maximum Daily Loads (TMDLs)

RECOMMENDATION: For Information Only.

ISSUE: In January 2012, staff reported that we would be working on scenarios and strategies to meet the mandated Chesapeake Bay TMDL. Since then, the Virginia Department of Conservation and Recreation (DCR) has provided the EPA with the Phase II Watershed Implementation Plan (WIP) which states that the Commonwealth will utilize MS4 permits to ensure BMP implementation on existing developed lands to achieve nutrient and sediment reductions.

UPDATE: Staff has engaged AMEC, an Environmental and Infrastructure consulting firm, to perform a more detailed planning-level exercise to estimate the general level of effort required for the Town to implement the Chesapeake Bay TMDL (Total Maximum Daily Load) Action Plan to meet the nitrogen (N), phosphorus (P) and sediment (S) reduction requirements that will be included in the next MS4 permit.

AMEC has provided the Town a report titled; "Chesapeake Bay TMDL Compliance Analysis and Options, dated November 19, 2012" (attached). The report confirms that the Town will need to construct stormwater facilities to remove N, P, and S for existing stormwater flows. Included in the report is a list of potential projects that

will be needed to meet the required reduction amounts. New projects will need to be added to the CIP for the new program to meet the required minimum TMDL nutrient reductions.

Staff has prepared the attached preliminary drafts of potential new CIP projects that may need to be added to the 2014-2019 CIP in order to comply with DCR's TMDL mandates.

This program is based upon the best available information at this time but may be subject to change if the State makes changes to the requirements for the Chesapeake Bay TMDL nutrient reductions. Staff will continue to provide updates to you and the Council in the coming months.

cc: Ms. Jeanette Irby
Mr. Kaj Dentler
Mr. Thomas Mason, P.E.
Mrs. Renee LaFollette, P.E.
Mr. Irish Grandfield
Mr. Nathaniel Ogedegbe

Attachments: Chesapeake Bay TMDL Compliance Analysis and Options, AMEC
Preliminary Draft CIP's for the Chesapeake Bay TMDL program

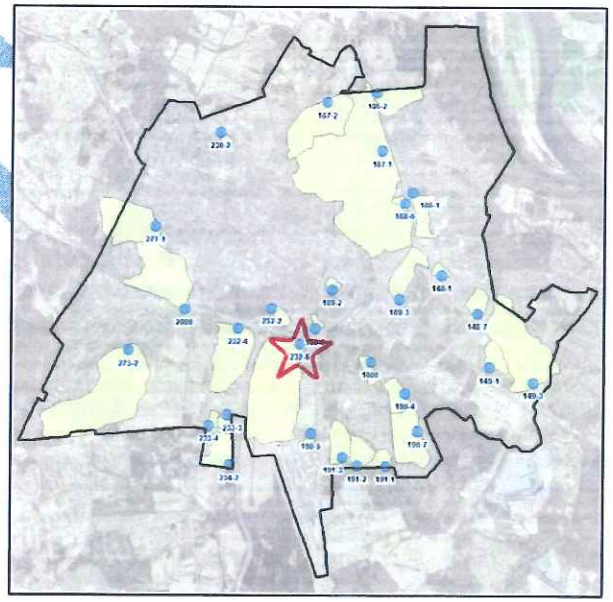
J:/TMDL Info/Ches Bay TMDL Council memos/ November 20, 2012 update cam-wra.doc

CAPITAL PROJECTS FUND PROJECTS (continued)

TITLE: CHESAPEAKE BAY TMDL PROJECT NUMBER 1 (STRATFORD STORMWATER POND RETROFIT)

STATUS: NEW

PROGRAM DESCRIPTION: The Town is required to implement a Chesapeake Bay TMDL (Total Maximum Daily Load) Action Plan to meet the nitrogen (N), phosphorus (P), and sediment (S) reduction requirements that will be included in the Town's next Municipal Separate Storm Sewer System (MS4) permit. Based on the most recent information from the Virginia Department of Conservation and Recreation (DCR), the new permit will be effective July 1, 2013. The MS4 permit requires construction of facilities to reduce N, P, S from existing developed land. The first project must be completed by July 1, 2018. Multiple additional projects are required through 2028.



PLANNED FINANCING

Sources:	Total Required Project Funding	Funded through 6/30/13	2014	2015	2016	2017	2018	2019	TOTAL for 6-Yr CIP	Future Funds Required
General Fund										
GO Bonds										
TOTAL										

PLANNED EXPENDITURES

Uses:	Total Project Cost	Exp through 6/30/13	2014	2015	2016	2017	2018	2019	TOTAL for 6-Yr CIP	Future Funds Required
Land										
Design/Eng.					50,000				$50,000	
Construction						150,000			$150,000	
TOTAL					$50,000	$150,000			$200,000	

OPERATING IMPACT

Operating/Maintenance:	2014	2105	2016	2017	2018	2019	TOTAL for 6-Yr CIP
					$16,000	$32,000	$48,000

CONSTRUCTION START DATE: Summer 2017

ESTIMATED COMPLETION DATE: Ongoing

OPERATING IMPACT: Ongoing additional maintenance of best management practices for the Chesapeake Bay TMDL.

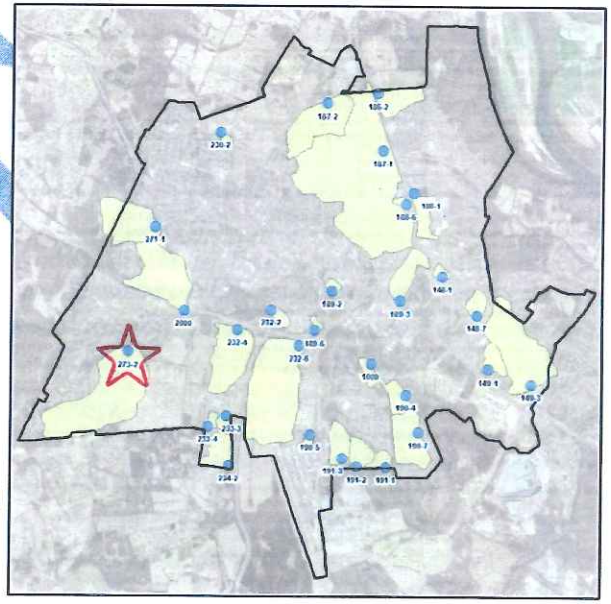
GOAL ADDRESSED:

Meet the requirements of the federally-mandated Chesapeake Bay TMDL (Total Maximum Daily Load) waste load allocation (WLA) Action Plan for the Town's municipal wastewater system.

CAPITAL PROJECTS FUND PROJECTS (continued)

TITLE: CHESAPEAKE BAY TMDL PROJECT NUMBER 2
(GREENWAY FARM STORMWATER POND RETROFIT)

STATUS: NEW



PROGRAM DESCRIPTION: The Town is required to implement a Chesapeake Bay TMDL (Total Maximum Daily Load) Action Plan to meet the nitrogen (N), phosphorus (P), and sediment (S) reduction requirements that will be included in the Town's next Municipal Separate Storm Sewer System (MS4) permit. Based on the most recent information from the Virginia Department of Conservation and Recreation (DCR), the new permit will be effective July 1, 2013. The MS4 permit requires construction of facilities to reduce N, P, S from existing developed land. The first project must be completed by July 1, 2018. Multiple additional projects are required through 2028.

PLANNED FINANCING

Sources:	Total Required Project Funding	Funded through 6/30/13	2014	2015	2016	2017	2018	2019	TOTAL for 6-Yr CIP	Future Funds Required
General Fund										
GO Bonds										
TOTAL										

PLANNED EXPENDITURES

Uses:	Total Project Cost	Exp through 6/30/13	2014	2015	2016	2017	2018	2019	TOTAL for 6-Yr CIP	Future Funds Required
Land										
Design/Eng							50,000		$50,000	
Construction								150,000	$150,000	
TOTAL							$50,000	$150,000	$200,000	

OPERATING IMPACT

Operating/Maintenance:	2014	2105	2016	2017	2018	2019	TOTAL for 6-Yr CIP
						$16,000	$16,000

CONSTRUCTION START DATE: Summer 2018

ESTIMATED COMPLETION DATE: Ongoing

OPERATING IMPACT: Ongoing additional maintenance of best management practices for the Chesapeake Bay TMDL.

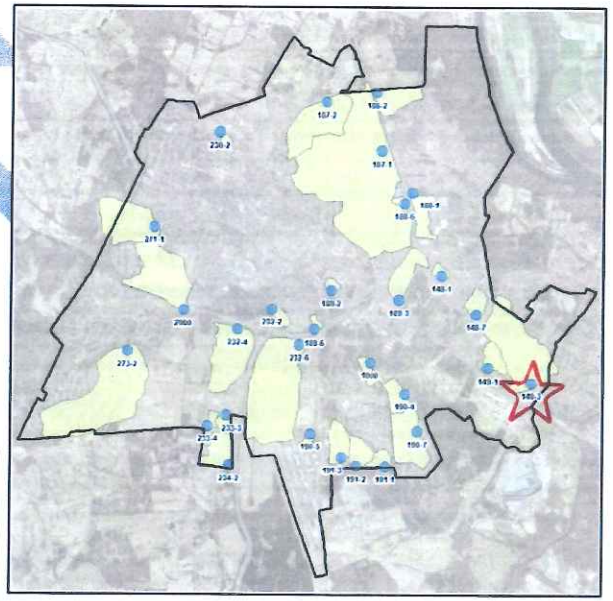
GOAL ADDRESSED:

Meet the requirements of the federally-mandated Chesapeake Bay TMDL (Total Maximum Daily Load) waste load allocation (WLA) Action Plan for the Town's municipal wastewater system.

CAPITAL PROJECTS FUND PROJECTS (continued)

TITLE: CHESAPEAKE BAY TMDL PROJECT NUMBER 3
(POTOMAC STATION POND #3 STORMWATER POND RETROFIT)

STATUS: NEW



PROGRAM DESCRIPTION: The Town is required to implement a Chesapeake Bay TMDL (Total Maximum Daily Load) Action Plan to meet the nitrogen (N), phosphorus (P), and sediment (S) reduction requirements that will be included in the Town's next Municipal Separate Storm Sewer System (MS4) permit. Based on the most recent information from the Virginia Department of Conservation and Recreation (DCR), the new permit will be effective July 1, 2013. The MS4 permit requires construction of facilities to reduce N, P, S from existing developed land. The first project must be completed by July 1, 2018. Multiple additional projects are required through 2028.

PLANNED FINANCING

Sources:	Total Required Project Funding	Funded through 6/30/13	2014	2015	2016	2017	2018	2019	TOTAL for 6-Yr CIP	Future Funds Required
General Fund										
GO Bonds										
TOTAL										

PLANNED EXPENDITURES

Uses:	Total Project Cost	Exp through 6/30/13	2014	2015	2016	2017	2018	2019	TOTAL for 6-Yr CIP	Future Funds Required
Land										
Design/Eng.								50,000	$50,000	
Construction										
TOTAL								$50,000	$50,000	

OPERATING IMPACT

Operating/Maintenance:	2014	2105	2016	2017	2018	2019	TOTAL for 6-Yr CIP

CONSTRUCTION START DATE: TBD

ESTIMATED COMPLETION DATE: Ongoing

OPERATING IMPACT: Ongoing additional maintenance of best management practices for the Chesapeake Bay TMDL.

GOAL ADDRESSED:

Meet the requirements of the federally-mandated Chesapeake Bay TMDL (Total Maximum Daily Load) waste load allocation (WLA) Action Plan for the Town's municipal wastewater system.

Town of Leesburg, Virginia

Chesapeake Bay TMDL Compliance Analysis and Options

Final Draft – November 19, 2012

Prepared for:

Town of Leesburg, Virginia
Department of Public Works

Prepared by:

AMEC Environment & Infrastructure
14424 Albemarle Point Place
Suite 115
Chantilly, Virginia 20151
(703) 488-3700

Town of Leesburg, Virginia

Chesapeake Bay TMDL Compliance Analysis and Options

Final Draft – November 19, 2012

Executive Summary

The purpose of this planning-level exercise is to estimate the general level of effort that will be needed for the Town of Leesburg (Town) to implement a Chesapeake Bay TMDL (Total Maximum Daily Load) Action Plan to meet the nitrogen, phosphorus, and sediment reduction requirements that will be included in the Town's next Municipal Separate Storm Sewer System (MS4) permit. Based on the most recent information from the Virginia Department of Conservation and Recreation (DCR), the Town must prepare and submit its MS4 permit application no later than April 1, 2013. Once approved by DCR, the permit will be effective July 1, 2013. The Chesapeake Bay TMDL Action Plan is then due within 24 months of the effective permit date.[1]

DCR's draft MS4 permit regulations incorporate the required nutrient and sediment reduction levels published in the Virginia Watershed Implementation Plan (WIP), which is the state's primary planning tool to establish strategies, targets, and expectations for meeting the Chesapeake Bay TMDL. While the draft Phase II WIP contains a range of strategies applicable to urban land uses, the Town can only be *required* to implement strategies that are enforceable through the MS4 permit. The following excerpt from the draft Phase II WIP summarizes the expected requirements for the Town.

> The Commonwealth will utilize MS4 permits to ensure BMP implementation on existing developed lands achieves nutrient and sediment reductions equivalent to Level 2 (L2) scoping run reductions by 2025. Level 2 implementation equates to an average reduction of 9 percent of nitrogen loads, 16 percent of phosphorus loads, and 20 percent of sediment loads from impervious regulated acres and 6 percent of nitrogen loads, 7.25 percent of phosphorus loads and 8.75 percent sediment loads beyond 2009 progress loads for pervious regulated acreage. These reductions are beyond urban nutrient management reductions for pervious regulated acreage.

According to the draft Phase II WIP, the Town will have three full MS4 permit cycles to implement the required reductions (2013-2018; 2018-2023; and 2023-2028). During the first cycle, the Town will need to implement practices sufficient to achieve 5% of the reduction target. During the second cycle, the

[1] Notice of Intended Regulatory Action, September 28, 2012, Virginia Soil and Water Conservation Board – Amend and Reissue the General Permit for Discharges of Stormwater from Small MS4s.

Town will need to implement additional practices sufficient to achieve 35% of the reduction target, for a total of 40%. Finally, the Town will need to achieve the remaining reductions by 2028.

The Town will be assigned baseline and reduction target loads by DCR for phosphorus, nitrogen, and sediment in pounds per acre per year. The *actual* amount in pounds of these pollutants that the Town will need to reduce will depend on several factors. These include, but are not limited to, the area of the Town draining to the regulated MS4 and the amount of pervious versus impervious land cover. The Town's regulated MS4 includes those areas draining to a regulated storm drain outfall. Areas of the Town that sheet flow to waters of the state or otherwise drain to waters of the state through means other than a regulated outfall are not considered part of the Town's MS4.

The technical and fiscal challenges of meeting the Chesapeake Bay TMDL will be significant. The Town engaged AMEC Environment & Infrastructure, Inc. (AMEC) to assist in a preliminary analysis of the requirements and to develop a better understanding of the potential cost and feasibility of different mixes of stormwater best management practices (BMPs). While DCR has developed a macro-level planning tool called the Virginia Assessment and Scenario Tool (VAST), it is not of sufficient detail or accuracy to conduct meaningful "what-if" scenarios at the Town -level.

AMEC developed customized Geographical Information System (GIS) and Excel-based spreadsheet tools (see Appendix A and Appendix B) to calculate baseline and target phosphorus, nitrogen, and sediment loads. AMEC used the rates provided by DCR in the September 28, 2012 version of the draft MS4 permit. Impervious cover and storm sewer data were provided by the Town. The baseline condition is the July 2009 condition established by the Chesapeake Bay Model and represents the starting point for meeting TMDL reductions. All BMPs constructed before July 2009 are considered part of the baseline load and are not eligible for credit unless modified or upgraded.

Based on the above analysis, the difference between the baseline load and the target load in pounds per year for phosphorus, nitrogen, and sediment was determined. It is this "gap" that needs to be filled to achieve compliance with the Chesapeake Bay TMDL. Staff from the Town and AMEC identified a range of potential projects that are further detailed in this report. The following factors and overall strategies were considered during the assessment process:

- ***BMPs Implemented Post-2009.*** New impervious surfaces added after July 2009 contribute to nutrient and sediment loadings. However, stormwater BMPs implemented under the Town's stormwater ordinance partially offsets this increase. The net increase has been factored into the Town's reduction requirements.
- ***Potential Large Scale Projects – Pond Retrofits.*** This strategy involves the retrofit of existing water quantity-only facilities (detention pond retrofits), or outdated water quality facilities such as dry ponds, in order to provide enhanced pollutant removal or a greater area of treatment.
- ***Retrofits of Town Rights-of-Way.*** This strategy includes the retrofit of Town rights-of-way, including but not limited to Town streets, with stormwater quality BMPs.
- ***Potential Retrofits on Town Property.*** This strategy involves retrofitting Town properties that are not currently treated by stormwater quality BMPs.

The Town also considered the potential for redevelopment to result in pollutant reductions since the Town's existing Stormwater Management Ordinance requires a 10% reduction over baseline conditions and the new Virginia Stormwater Management Regulations will require a 20% reduction for properties over one acre after July 1, 2014. However, Town staff did not identify significant redevelopment projects likely to occur in the Town within the next three MS4 permit cycles.

Although this is still a planning-level exercise, it is estimated that the projects included in this report will exceed all of the nitrogen, phosphorus, and sediment reductions needed to meet the Chesapeake Bay TMDL. The Town would need to appropriate approximately $350,000 (in capital and maintenance) to satisfy the first permit cycle (2013-2018). There may also be a need for additional appropriations during this first cycle to begin planning and designing projects for the second permit cycle. This amount is estimated by Town staff at approximately $200,000. Costs will increase during the second and third permit cycles as the reduction requirements accelerate.

Several unknowns could impact the results of this analysis. This is especially true concerning potential large scale pond retrofit projects since implementation often relies on the cooperation of private property owners or HOAs. In addition, the pollutant removal efficiencies for these facilities are still being debated. As a result, this report includes a "worst case" scenario where these larger retrofit projects would need to be replaced with other strategies.

Introduction

As noted in the Executive Summary, the draft Phase II Virginia Watershed Implementation Plan (WIP)[2] states the Town of Leesburg (Town) will need to make significant reductions in existing nitrogen, phosphorus, and sediment loads to meet the requirements of the Chesapeake Bay TMDL. These will begin to be imposed through the Town's next Municipal Separate Storm Sewer System (MS4) permit issued in July 2013. The Town will then have until 2028 (three full MS4 permit cycles) to fully implement the required reductions.

AMEC conducted an analysis of the requirements to develop a better understanding of the potential feasibility and cost of different mixes of stormwater best management practices (BMPs) that would be sufficient to meet the Chesapeake Bay TMDL. The analysis included the following steps:

- The extent of the Town's regulated MS4 was estimated using an analysis of the storm sewer layer in the Town's GIS. Before this analysis began, Town staff developed a draft estimate of the regulated MS4 area. AMEC reviewed and modified the MS4 layer for accuracy. At present, the Town is only required to meet reductions assigned by permit, which in this case is the Town's regulated MS4.

- The Town's baseline and target loads for nitrogen, phosphorus, and sediment were established based on the extent of the regulated MS4 along with impervious cover and storm sewer data provided by the Town. AMEC used the rates provided in the September 28, 2012 version of DCR's draft MS4 permit regulations. An estimate of the compliance "gap," the difference between baseline and target loads, was then established.

- Potential strategies and projects were identified by the Town to address the compliance gap. Strategies investigated included the following:
  - Potential Large Scale Projects – Pond Retrofits
  - Retrofits of Town Rights-of-Way
  - Potential Retrofits on Town Property

- The order of magnitude cost for complying with the Phase II WIP and MS4 permit requirements was then estimated based on best engineering practices, local assumptions, discussions with regional partners, and recent research on the costs of various BMPs.

- Once the technical portion of the TMDL's have been finalized, the Town will have to make decisions regarding how to fund the operation and maintenance as well as the capital **expenses** required to meet the state mandated TMDL programs.

[2] Virginia adopted the Phase I WIP on November 29, 2010. The draft Phase II WIP was submitted to the U.S. EPA and released on March 30, 2012 for public comment. The public comment period ended May 31, 2012.

The Town also considered the potential for redevelopment to result in pollutant reductions since the Town's existing Stormwater Management Ordinance requires a 10% reduction over existing conditions and the new Virginia Stormwater Management Regulations will require a 20% reduction for properties over one acre after July 1, 2014. However, Town staff does not anticipate significant redevelopment to occur in the Town within the next three MS4 permit cycles.

Table 1 summarizes the extent to which each of the reduction strategies meets the total TMDL reduction requirements. AMEC then ranked the projects based on cost per pounds of pollutant removed to determine the optimal mix for MS4 compliance. The estimated cost of compliance and the estimated cost to implement all projects identified in this report are summarized in Table 2.

Table 1 – Percent of Total TMDL Requirements Met by Specific Reduction Strategies

Reduction Strategy	N (lbs)	% Goal	P (lbs)	% Goal	S (lbs)	% Goal
Potential Large Scale Projects – Pond Retrofits	6,812	150%	631	115%	492,998	110%
Retrofits of Town Rights-of-Way	211	4%	24	4%	20,372	4%
Potential Retrofits on Town Property	87	2%	9	2%	7,352	2%
Total All Projects	**7,110**	**150%**	**665**	**118%**	**520,722**	**114%**

Table 2 – Chesapeake Bay TMDL Implementation Order of Magnitude Cost

Permit Cycle	Initial Capital Cost	Annual Maintenance	Lifetime (20-yr) Total	Project Ranks (From Appx B)
2013-2018 (5%)	$200,000	$32,206	$844,120	1
2018-2023 (35%)	$1,600,000	$245,215	$6,504,305	2-5
2023-2028	$2,090,000	$275,738	$7,604,756	6-22
Total for MS4 Compliance	**$3,890,000**	**$553,159**	**$14,953,182**	
Additional Projects	$4,440,000	$654,811	$6,473,029	23-46

It is important to note that several factors necessary to assess compliance have not yet been finalized. These are further discussed under Unknowns and Additional Considerations.

Estimating Leesburg's Regulated MS4 Land Area

The Town's MS4 permit will be the regulatory mechanism used to require implementation of structural stormwater quality BMPs necessary to meet the Chesapeake Bay TMDL. As a result, the first step in the Town's analysis involved distinguishing between regulated and unregulated land areas. To perform this analysis, the Town utilized local GIS data and tools, a review of other state stormwater permits under the Virginia Stormwater Management Program (VSMP) and Virginia Pollutant Discharge Elimination

System (VPDES) programs, and discussions with regulating agencies. Storm sewer pipes (represented as lines), outfall locations, and elevation data were used to delineate the watershed boundaries of the Town's storm sewer system.

The above approach, along with the Town's impervious surface data, rendered a delineation of impervious versus pervious areas within the regulated (Leesburg MS4) and unregulated (non-Leesburg MS4) areas. Unregulated impervious and pervious areas include land with direct drainage to surface waters and no connection to the MS4, stream corridors, and areas covered under separate MS4 or VPDES industrial stormwater permits. For example, excluded areas include those that sheet flow directly to natural channels of major drainage sheds such as streams or creeks without the benefit of an engineered system. The exclusion of these categories from the MS4 regulated area was confirmed by DCR.

Lands associated with separate MS4 or VPDES industrial stormwater permits that were removed from the Leesburg MS4 area totals include those listed in Table 3. It is noted that separate nutrient and sediment reduction requirements may be incorporated into the VPDES industrial permits for Town-owned properties such as the Leesburg Executive Airport and the Water Pollution Control Division.

Table 3 – Permit Holders Excluded from the Town's MS4 Area

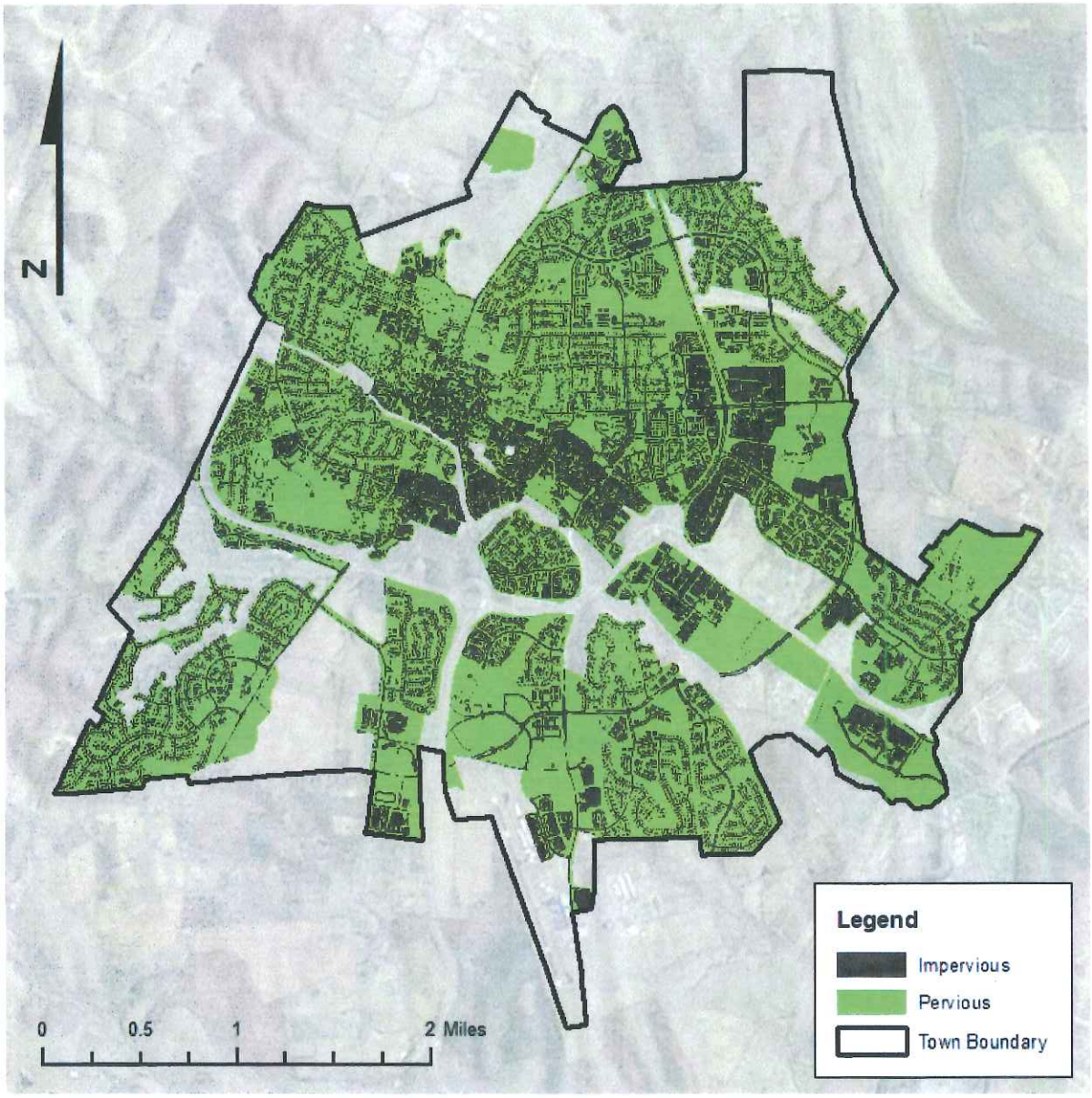
Permit Holder	Permit
VDOT	MS4
Leesburg Iron and Metal Incorporated	VPDES
Leesburg Municipal Airport	VPDES
Town of Leesburg – Water Pollution Control Division	VPDES
Southern States – Leesburg Petroleum Service	VPDES

Based on the above analysis, the estimated land areas draining to the Leesburg MS4 and non-Leesburg MS4 by impervious versus pervious acres is presented in Table 4. Figure 1 shows these areas with pervious and impervious land uses delineated. Light gray areas are those outside of the regulated Leesburg MS4.

Table 4 – Leesburg MS4 and Non-Leesburg MS4

	Impervious (ac)	Pervious (ac)	Totals (ac)
Leesburg MS4 (regulated)	1,936.7	3,804.2	5,740.9
Non-Leesburg MS4 (unregulated)	120.8	2,121.6	2,242.4
Total	2,057.50	5,925.80	7,983.30

Figure 1 – Regulated Town of Leesburg MS4 (2009 Conditions)



Developing Baseline Loads

Baseline loads for nitrogen, phosphorus, and sediment were established using impervious surface polygons provided by the Town and loading rate data provided by DCR in the September 28, 2012 version of the draft MS4 permit regulations.[3] Using GIS, the impervious surface cover was clipped to the previously established MS4 area, and all non-impervious areas within the MS4 area were assumed to be

[3] Public comment on the draft permit regulations closes on January 4, 2013 after which time the Virginia Soil and Water Conservation Board will consider final amendments and adoption.

pervious. Loading rates (lbs/ac/yr) for these areas are presented in Table 5. Figure 2 presents loading rates for nitrogen in a graphic format. Rates for phosphorus and sediment will generally show similar intensity differentials.

It is important to note that impervious cover calculations required by DCR will be based on July 1, 2009 conditions. The Town must account for new impervious surface area added after this date. Development under the new Virginia Stormwater Management Regulations, which must be adopted by the Town no later than July 1, 2014, is considered by DCR to be pollution-neutral, and does not affect the Town's TMDL burden. However, any new development under the current stormwater regulations is considered to *add* to the Town's TMDL burden, since the regulations are less strict. This issue is further discussed under the next section – BMPs Implemented Post-2009.

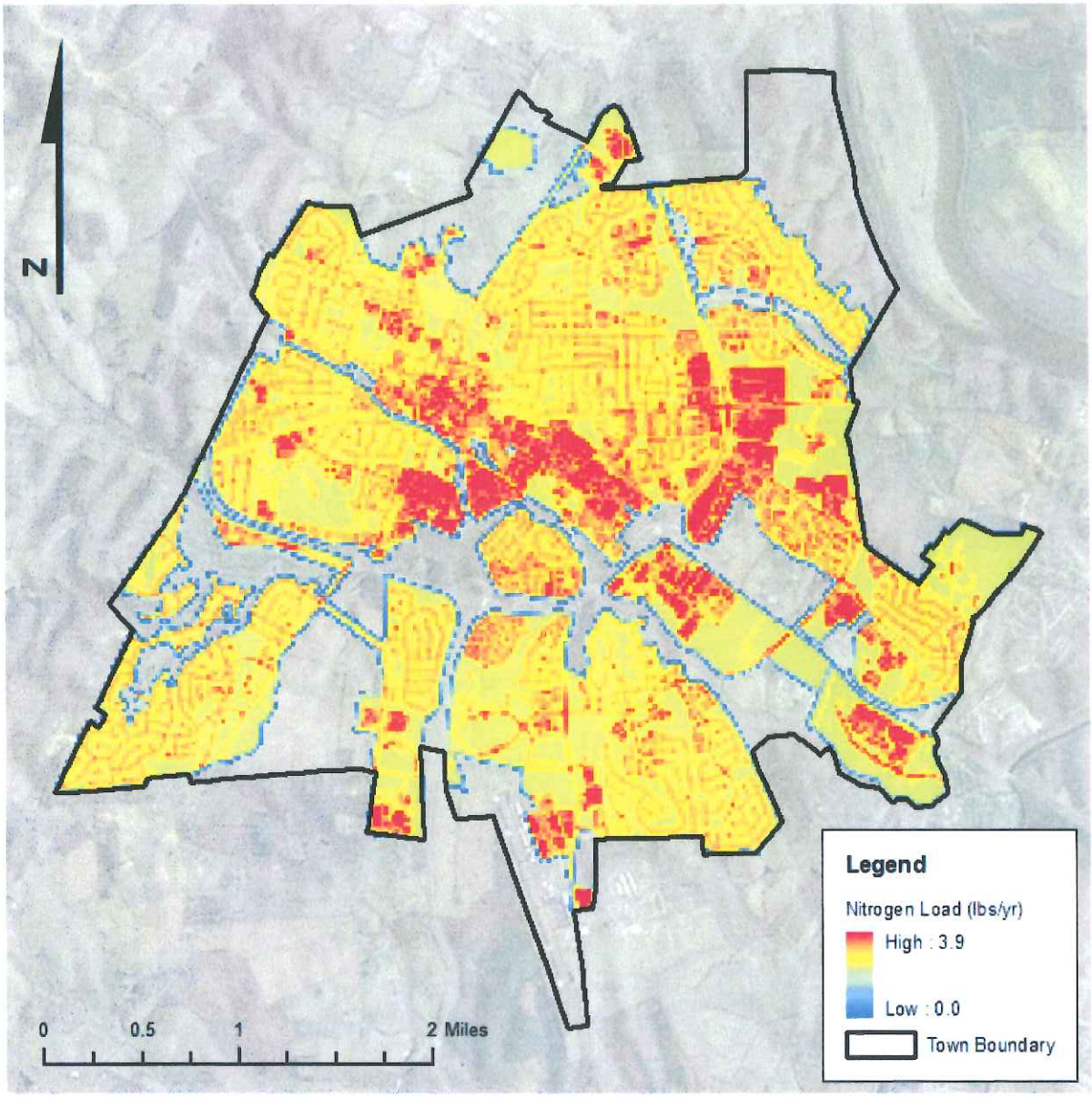
Table 5 – Baseline Loading Rates for Nitrogen, Phosphorus, and Sediment

Basin	Land Cover	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)	2009 Area within Town MS4 (ac)	Current (2012) Area within Town MS4 (ac)
POTOMAC RIVER	**Impervious**	16.86	1.62	1171.32	1878.3	1936.7
	Pervious	10.07	0.41	175.8	3862.6	3804.2
				Total	5740.9	5740.9

Software developed by AMEC was used to calculate the total loads from the MS4 area and to generate spatial data to help visualize areas of higher and lower loading rates. Based on this analysis, the 2009 and 2012 baseline loads for the Town of Leesburg are:

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
2009 Baseline Loads	70,565	4,627	2,879,162
2012 Baseline Loads	70,961	4,697	2,937,232
Difference	396	70	58,070

Figure 2 – Graphic Representation of Town Loading Rates for Nitrogen (2009 Conditions, 100-ft cells)



Virginia's draft Phase II WIP and draft MS4 permit language state that MS4 areas will need to meet Level 2 (L2) reduction requirements. During the first MS4 permit cycle (2013-2018), the Town will need to implement practices sufficient to achieve 5% of the L2 reduction target. During the second cycle (2018-2023), the Town will need to implement additional practices sufficient to achieve 35% of the L2 reduction target, for a total of 40%. Finally, the Town will need to achieve the total reduction targets by 2028. The Level 2 reductions that will be applied to the regulated MS4 area of the Town are presented in Table 6.

Table 6 – Level 2 Reduction Requirements for MS4 Localities

	Required Reduction		
	N	**P**	**S**
Impervious	9.00%	16.00%	20.00%
Pervious	6.00%	7.25%	8.75%

Table 7 presents the total required reductions calculated by AMEC for the Town based on DCR's draft Potomac River basin loading rates applied to impervious and pervious areas within the Town's regulated MS4 and using the L2 reduction scenarios.

Table 7– Pollutant Reductions Based on L2 Reduction Scenarios

Land Use	Pollutant	Loading Rate (lbs/ac)	2009 Acres	2012 Acres	2009 Load (lbs/yr)	2012 Load (lbs/yr)	L2 Reduction from 2009 Load	Target Reduction from 2009 Load (lbs/yr)	Target Reduction from 2012 Load (lbs/yr)
Impervious	N	16.86	1878.3	1936.7	31,669	32,652	9.00%	2,850	3,834
Impervious	P	1.62	1878.3	1936.7	3,043	3,137	16.00%	487	581
Impervious	S	1171.32	1878.3	1936.7	2,200,123	2,268,449	20.00%	440,025	508,350
Pervious	N	10.7	3862.6	3804.2	38,896	38,309	6.00%	2,334	1,746
Pervious	P	0.41	3862.6	3804.2	1,584	1,560	7.25%	115	91
Pervious	S	175.8	3862.6	3804.2	679,039	668,783	8.75%	59,416	49,161
							Total Nitrogen Reductions (lbs/yr)	5,184	5,580
							Total Phosphorus Reductions (lbs/yr)	602	672
							Total Sediment Reductions (lbs/yr)	499,440	557,551

BMPs Implemented Post-2009

As noted previously, new development after July 1, 2014 will be considered pollutant neutral if it complies with the standards of the new Virginia Stormwater Management Regulations. Until that time, any increase in impervious cover in the Town is partially offset by BMPs implemented under the Town's current ordinance depending on the specific site. Eventually, the "net" increase in pollutant loads will need to be made up through additional retrofits over the next three MS4 cycles.

The Town maintains a current digital inventory of constructed stormwater BMPs. This database was used to identify and gather data on BMPs constructed after July 2009. BMPs installed prior to July 2009 are not given credit towards treatment. An analysis was conducted to estimate the total load reductions achieved by post-July 2009 BMPs within the regulated MS4 area. A more detailed analysis of post-2009 BMPs will be required when the Town develops its Chesapeake Bay TMDL Action Plan for submittal to DCR in 2015.

The Town's BMP database is currently stored in an Excel spreadsheet. It contains a number of fields with specific information about each BMP, including location, type, and treated acreage. BMPs constructed after July 2009 were extracted from the database, and the data was reorganized and reformatted to better allow for reduction calculations. To calculate a load reduction for each BMP, analogous BMPs accepted by the Chesapeake Bay Model and their corresponding removal efficiencies were selected. Accepted BMP types and efficiencies are listed in Section 6 of the Phase 5.3 Chesapeake Bay Model documentation.[4] For example, BaySeperator™ systems were categorized as "Dry Detention Ponds and Hydrodynamic Structures" and were assigned reduction efficiencies of 5%, 10%, and 10% for nitrogen, phosphorus, and sediment, respectively.

For BMPs designed to treat a catchment area, the following equation was used to determine reductions (R) in pounds:

$$R = \{(A - A_i) * L_p + A_i * L_i\} * e$$

where:

A = total treated area (ac)
A_i = impervious treated area (ac)
L_p = pervious loading rate (lbs/ac/yr)
L_i = impervious loading rate (lbs/ac/yr)
e = reduction efficiency

[4] There is currently discussion between Virginia DCR and the Chesapeake Bay Program on whether to use the efficiencies from the Chesapeake Bay Model (which is the basis for reductions and progress) or the efficiencies used in the Virginia BMP Clearinghouse (which is used to demonstrate compliance with state regulations for development). Switching to the Virginia BMP Clearinghouse could have a modest impact on the overall analysis of compliance options.

Since the impervious area treated by each BMP is not currently available in the database, a planning-level impervious ratio was assumed based on BMP type. Smaller BMPs, such as Filterra™ and bioretention systems, were assumed to treat a ratio of 85% impervious and 15% pervious. Larger BMPs, such as extended detention ponds, were assumed to treat 33% impervious – the average impervious ratio throughout the Town's MS4 area.

The resulting reductions in nitrogen, phosphorus, and sediment are presented in Table 8.

Table 8 – Estimated Reductions Achieved Through Post-July 2009 BMPs

Treated Impervious Acres	Treated Pervious Acres	TN (lbs)	TP (lbs)	TSS (lbs)
102.7	124.5	714	98	87,079

These BMPs were installed to offset recent development. Table 9 details the Town's estimated burden through the three phases of compliance, factoring in these BMPs.

Table 9- Estimated Pollutant Reduction Burden, Including Reductions from Post-July 2009 BMPs

3	N (lbs/yr)	P (lbs/yr)	S (lbs/yr)
Required Reductions from 2012 Loads	5,580	672	557,511
Estimated Reductions from Existing Post-2009 BMPs	714	98	87,079
Total Required Reductions	**4,866**	**574**	**470,432**
- *Phase I (5%)*	*243*	*29*	*23,522*
- *Phase II (40%)*	*1,947*	*230*	*188,173*
- *Phase III (100%)*	*4,866*	*574*	*470,432*

Further investigation to determine the true impact of these BMPs will be necessary as part of the Town's Chesapeake Bay TMDL Action Plan. In addition, the Town will need to account for new development that occurs between the present and implementation of new stormwater requirements in July 2014.

Potential Large-Scale Projects

AMEC and the Town reviewed a number of existing stormwater pond sites to evaluate planning-level retrofit potential for new or enhanced water quality benefits. The Town has a large number of ponds with strong retrofit potential. As indicated by Department of Public Works staff, many ponds throughout Leesburg were designed as "peak-shaving" facilities, built for flood control purposes to prevent new development from increasing peak flows by detaining runoff. Over 25 potential large-scale projects were identified, including retrofits of Exeter Pond, Stowers Pond, the Greenway Farm Pond, and a large-scale bioretention project adjacent to Clubhouse Drive (see Figure 3 for potential project locations and Appendix A for a detailed list of projects). Custom GIS tools developed by AMEC were used to

determine the reductions provided by these large-scale projects. The following is a summary of some of the major projects identified.

- Exeter Pond, a flood retention facility draining over 530 acres, currently provides very little (if any) water quality treatment. The parcel (PIN# 187185796000) is owned by the Exeter Homeowners Association. Like many of the ponds throughout the Town, there is room for a dedicated water quality treatment volume. A proposed retrofit would modify the riser structure for water quality storage and add forebays for biological nutrient uptake.

- Stowers Pond is a dry detention facility draining over 100 acres. It was designed for flood control, and is owned by the Evergreen Meadows Homeowners Association (PIN# 232278512000). A proposed retrofit would modify the riser structure to allow for water quality treatment.

- The Greenway Farm Pond, originally designed for flood control, drains nearly 260 acres. The pond straddles two adjacent parcels – one owned by the Greenway Farm Homeowners Association (PIN# 273491085000) and another owned by the Town (PIN# 272186110000). With significant free space water quality storage, a retrofit would modify the riser structure for water quality treatment.

- A VDOT-owned site adjacent to Clubhouse Drive, near the Leesburg Bypass-King Street interchange, was noted by Town staff as a potential bioretention project location. The site drains nearly 130 acres and appears to contain A and B soils.

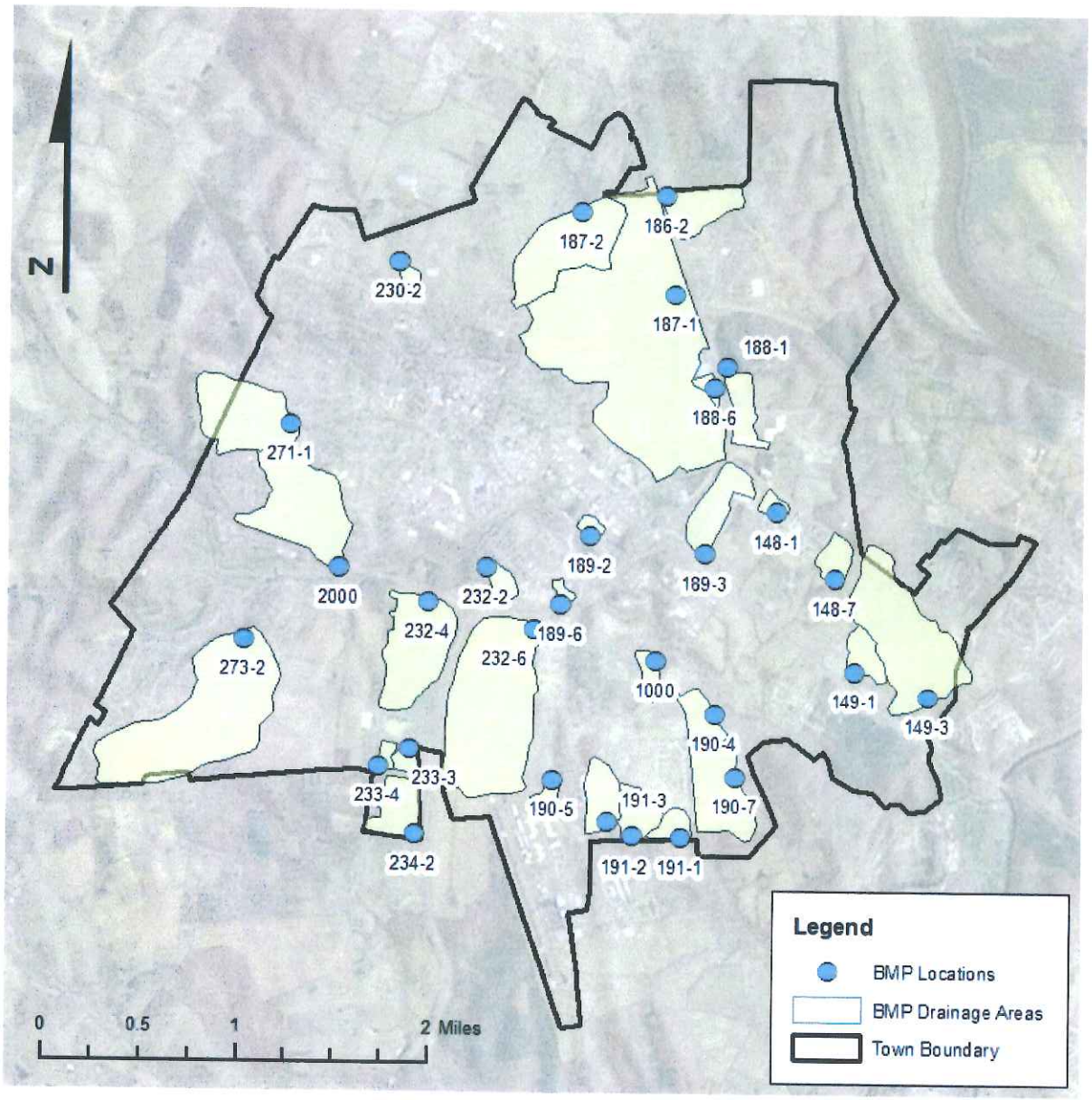
Table 10 presents the potential reductions that could be achieved if these projects and others identified can be fully implemented, and if the Town can take full water quality credit for the conversion of the facilities. Pollutant removal efficiencies are based on the report "Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Projects" dated October 9, 2012. This panel was assembled by the Urban Stormwater Work Group of the Chesapeake Bay Partnership. While the report has been finalized, these efficiencies may change based on further discussions. In particular, there is discussion about how much credit an existing facility that was not designed to provide water quality benefits should be given since they were likely providing "incidental" benefits that were captured in the 2009 baseline Bay Model run. It is further noted that the Bay Model does not currently allow for "treatment trains." That is, where there are overlapping BMPs, credit can only be taken for the one with the highest efficiency as opposed to the cumulative impacts of the BMPs working in tandem. However, based on discussions with DCR, this is likely to change. As a result, AMEC's analysis allows treatment trains. If this position is not reversed by the Chesapeake Bay Program, it will require the Town to identify additional, albeit small, reductions to make up for the difference.

Table 10 – Reductions Achieved from Potential Large-Scale Projects

	Reduction (lbs/yr)			Treatment Area
	N	P	S	Acres
Total Potential Large-Scale Projects (Appendix A)	6,812	631	492,998	2,155

Efficiencies for wet pond retrofits were selected from Figures 3, 4, and 5 from the Expert Panel report. It was assumed that these retrofits would treat 0.5 inches of runoff per impervious acre, and therefore removal efficiencies of 26%, 41%, and 51.5% respectively for nitrogen, phosphorus, and sediment were assigned. The Expert Panel report lists efficiencies for extended dry detention retrofits in Table A-4. This table lists efficiencies of 24% for nitrogen and 31% for phosphorus. A 43% sediment removal efficiency was assumed for dry ponds based on a comparison of the dry pond N and P efficiencies to the previously listed wet pond efficiencies. For the proposed Clubhouse Drive bioretention project, the Chesapeake Bay Model BMP category of "Bioretention (A/B soils, underdrain)" was selected, with efficiencies of 70% for nitrogen, 75% for phosphorus, and 80% for sediment.

Figure 3 – Location of Potential Large-Scale Projects



See Appendix A for full list of large-scale projects.

Retrofits of Town Rights-of-Way

Retrofits of Town rights-of-way, including public streets, is a potential strategy for treating large areas of impervious surface cover. This approach has the benefit of using public property, which avoids the cost of land acquisition. Retrofits include bioretention located between the road and sidewalk, tree box filters, and various hydrodynamic structures. However, these types of retrofits tend to treat relatively small areas. As a result, it will take a large number of these facilities to achieve meaningful reductions and could potentially be maintenance intensive. While all rights-of-way may be appropriate for retrofit, for this analysis AMEC investigated the following high potential corridors as identified by Town staff:

- Battlefield Parkway :
  - Between Fort Evans Road and Route 7
  - Between Edwards Ferry Road and Leesburg Bypass
  - Between Greenway and Kincaid Boulevard
- Fort Evans Road:
  - Between Route 15 and River Creek Parkway
- South King Street:
  - From Evergreen Mill Road to the Town Boundary
- Smaller downtown areas:
  - Church Street
  - King Street
  - Loudoun Street
  - East Market Street

Figure 4 – Example of Filterra™ Bioretention System

With the exception of South King Street, these projects were assumed to be retrofitted with Filterra™ bioretention cells – a common urban retrofit practice. See Figure 4 for an example (photo credit, Virginia Tech, Hampton Roads Research and Extension Center). Although Virginia DCR currently credits Filterra tree box filter systems with 74% phosphorus removal, the removal efficiencies granted to Filterra systems are currently under review by the state and are likely to change. To be conservative in this analysis, a phosphorus removal efficiency of 50% was selected for Filterra tree box filters, consistent with Fairfax County's July 16, 2007 Letter to Industry regarding low impact development practices. Appropriate corresponding nitrogen (32%) and sediment (64%) removal efficiencies were selected from the stormwater treatment adjustor curves included in the October 2012 report "Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Projects." South King Street was assumed to be retrofitted with a traditional bioretention system, with removal efficiencies of 70%, 75%, and 80% for nitrogen, phosphorus, and sediment, respectively.

Table 11 – Reductions Achieved from Select Rights-of-Way Improvement Projects

	Reduction (lbs/yr)			Treatment Area
ROW Project	**N**	**P**	**S**	**Acres**
Battlefield Pkwy – Fort Evans Rd. to Rt. 7	65.6	7.8	6,619.0	15.9
Battlefield Pkwy – Edwards Ferry Rd. to Leesburg Bypass	23.8	2.9	2,502.1	5.8
Battlefield Pkwy – Evergreen Mill Rd. to Town Boundary	43.4	5.0	4,173.4	10.3
Fort Evans Rd – Rt. 15 to River Creek Pkwy	46.4	5.7	4,816.4	12.9
South King St. – Evergreen Mill Rd. to Town Boundary	23.3	1.9	1,335.4	3.3
Church Street	1.1	0.1	127.2	0.3
King Street	1.6	0.2	193.2	0.3
Loudoun Street	2.9	0.4	330.6	0.6
East Market Street	2.5	0.3	275.2	0.6

Potential Retrofits on Public Property

In addition to public rights-of-way, the Town also owns a number of properties within the MS4 area that are currently untreated for stormwater runoff and could potentially be retrofitted. Not all of these properties are appropriate for retrofit, but a small number were evaluated as part of this analysis. It was assumed that bioretention practices could be used to treat these areas, with removal efficiencies of 70% for nitrogen, 75% for phosphorus, and 80% for sediment. Based on these assumptions, the potential reductions from the retrofit of select public properties are presented in Table 12.

Table 12 – Reductions Achieved from Potential Retrofit of Public Property

	Reduction (lbs/yr)			Treatment Area
Retrofit on Public Property	**N**	**P**	**S**	**Acres**
Edwards Landing Park	2.3	0.2	101.4	0.3
Ida Lee Park (3 small sites)	17.6	2.1	1,819.1	4.0
Leesburg Police Department (Plaza St.)	26.6	3.0	2,530.4	6.3
Simpson Middle School	12.2	1.6	1,423.3	2.6
Catoctin Skate Park	3.0	0.3	201.6	0.3
Tuscarora Park	25.8	1.9	1,276.1	3.1

Other Projects – Stream Restoration

Although the reduction credits available from all best management practices are subject to change, the credit available for stream restoration is perhaps the most likely to vary and therefore is only included for

information purposes and not as a compliance measure. Currently, MS4 permit holders will not be able to take credit for stream restoration projects, since restored areas typically fall outside of MS4 boundaries. However, it is possible that DCR will grant credits for stream restoration projects in the future through some type of trading program. The most recent reduction rates available from the Chesapeake Stormwater Network's Expert Panel on Urban Stream Restoration are 0.2, 0.068, and 310 pounds of nitrogen, phosphorus, and sediment (respectively) per linear foot of stream restored.

The restoration of Tuscarora Creek in the Town of Leesburg is currently in the design stages. The project will restore approximately 1,500 linear feet. According to the most recent reduction rates from the Expert Panel, the Tuscarora Creek restoration will reduce 300 pounds of nitrogen, 102 pounds of phosphorus, and 465,000 pounds of sediment.

Summary of Calculations

The projects evaluated in this study represent a starting point for assessing options available to the Town for compliance with the Chesapeake Bay TMDL as it is likely to be integrated into the Town's MS4 permit. It is noted that these strategies are for discussion purposes and are not exhaustive. Further, many of the assumptions made in calculating pollutant reduction targets and BMP efficiencies are subject to change and may significantly alter this analysis. With those limitations in mind, the projects and strategies outlined in this study are estimated to potentially exceed all of the required nutrient and sediment reductions. This means that the Town would meet its targets set out in the Phase II WIP for all three MS4 permit cycles.

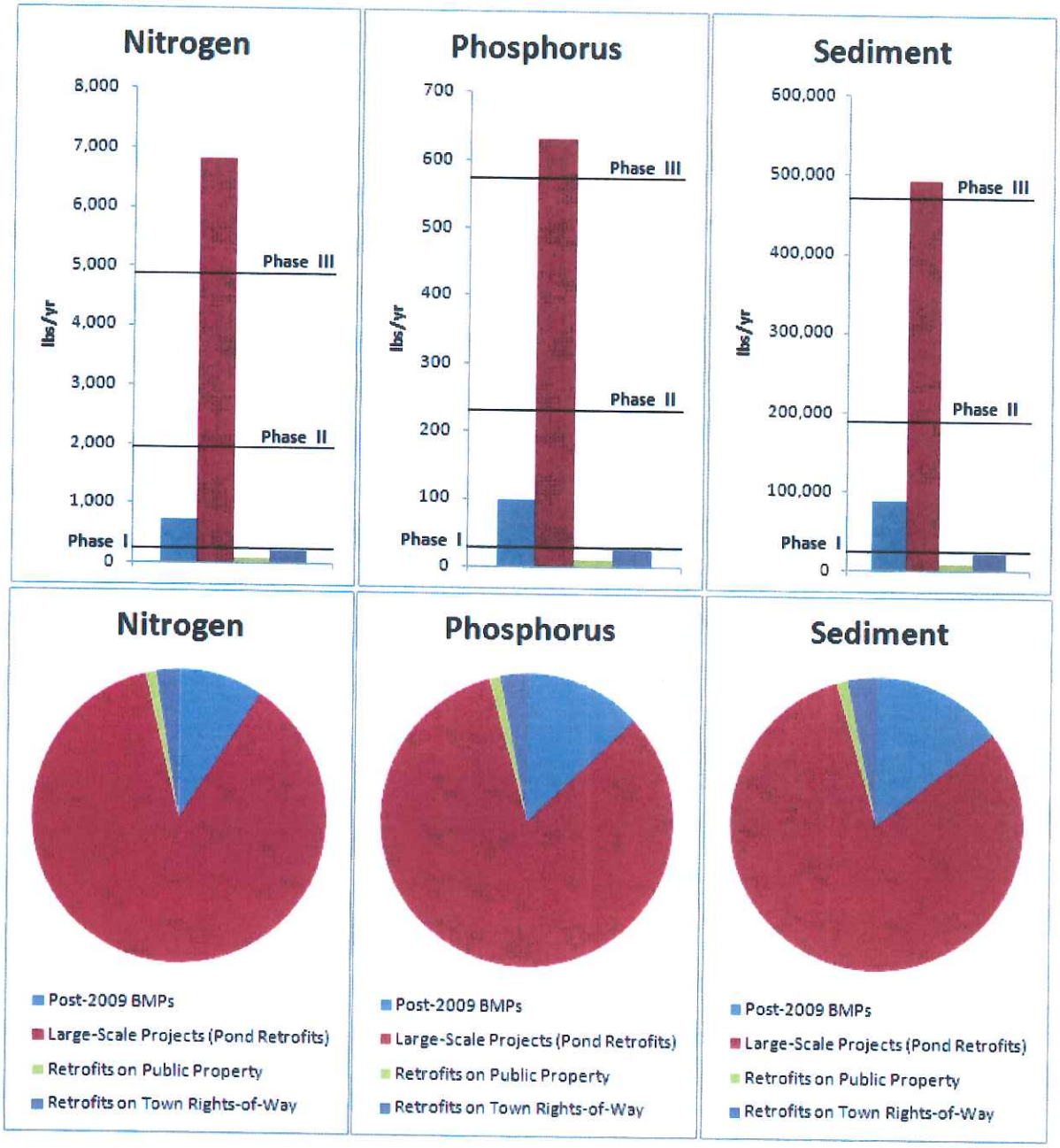
Table 13 – Summary of Reduction Strategies and Reduction Values by MS4 Permit Phase

Project Category	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment (lbs/yr)	Treated Area	
BMPs Implemented Post-2009	714	98	87,079	227.2	acres
Large-Scale Projects (Pond Retrofits)	6,812	631	492,998	2,155.1	acres
Retrofits of Town Rights-of-Way	211	24	20,372	50.0	acres
Retrofits on Public Property	87	9	7,352	16.7	acres
Other Projects - Stream Restoration*	300	102	465,000	1,500.0	linear feet

**Reduction credits available for stream restoration are not currently applicable to MS4 reduction requirements.*

Figure 5 below presents the information from Table 12 in graphical format.

Figure 5 – Summary of Reductions by Pollutant and Strategy



Note: Reductions from Post-2009 BMP projects installed to offset new development are already factored into Phase I, II, and III requirements, and may not be double-counted.

Estimated Costs

The cost to implement the strategies outlined in this study will largely fall to the Town of Leesburg. While small amounts of grant funding may be available from state and federal agencies, Virginia has acknowledged that the planning, implementation, operation, and maintenance of BMPs "will be costly and likely borne by local government." (Virginia Senate Finance Committee, November 2011)

To provide the Town Council with a planning tool for future budgeting, AMEC and Town staff worked together to develop an order of magnitude cost to comply with the Chesapeake Bay TMDL requirements under the MS4 permit. Individual project capital costs were initially estimated by AMEC and then adjusted by Town staff based on local knowledge and experience. It was assumed for this exercise that the specific retrofit strategies outlined in this report would be sited on public property. This assumption may or may not hold true.

Total initial capital costs for all projects examined in this report (excluding the Tuscarora Creek stream restoration) are estimated to be $8.33 million. Average annual maintenance costs were estimated by AMEC using rates developed for a draft report researching the costs of various BMPs (King and Hagen, 2011) prepared for the Maryland Department of Environment. These rates are given in dollars per impervious acre treated per year. Total average annual maintenance costs for all projects listed in this report (excluding the Tuscarora Creek stream restoration) are estimated to be approximately $650,000, or roughly 8% of estimated capital costs.

However, based on AMEC's analysis, the projects identified in this report will exceed the required nutrient and sediment reductions. To help prioritize projects, AMEC ranked each project based on its relative cost-efficiency in cost per pounds of pollutant removed. As a result, the initial capital cost for projects needed to meet the TMDL is estimated to be $3.89 million, with average annual maintenance costs for these projects estimated to be approximately $550,000. A summary of estimated costs is compiled in Table 14. A more detailed list is provided in Appendix B.

Table 14 – Summary of Estimated Costs

Permit Cycle	Initial Capital Cost	Annual Maintenance	Lifetime (20-yr) Total	Project Ranks (From Appx B)
2013-2018 (5%)	$200,000	$32,206	$844,120	1
2018-2023 (35%)	$1,600,000	$245,215	$6,504,305	2-5
2023-2028	$2,090,000	$275,738	$7,604,756	6-22
Total for MS4 Compliance	**$3,890,000**	**$553,159**	**$14,953,182**	
Additional Projects	$4,440,000	$654,811	$6,473,029	23-46

Estimated Costs – "Worst-Case" Scenario

In addition to the above, AMEC developed a cost estimate for a "worst-case" scenario. In particular, while the large-scale pond retrofits identified in this report are cost-efficient, many of these projects will rely on the concurrence of private property owners or the local HOA. Because of their high visibility,

they may also be more prone to objections from local neighbors. Finally, there may be unanticipated physical constraints or changes in approved removal efficiencies that would make these facilities less cost effective. For the worst case scenario, AMEC assumed that none of the large-scale pond retrofits were feasible. The Town would still construct identified right-of-way and public property projects. The "gap" would be filled through the use of a BMP mix of 50% bioretention and 50% filtration practices. These types of facilities are typically installed on the parcel-level, requiring the Town to implement a very large number of small projects.

Bioretention efficiencies were set to 75% for nitrogen, 80% for phosphorus, and 85% for sediment, corresponding to the Chesapeake Bay Model BMP category "Bioretention – A/B soils, underdrain." Filtration efficiencies were set to 40% for nitrogen, 60% for phosphorus, and 80% for sediment, which matches the "Filtering Practices" BMP category in the Chesapeake Bay Model. It was assumed that these practices would each treat an average impervious ratio of 85%.

The cost to implement these BMPs was derived from the report developed by King and Hagen. Average bioretention implementation costs were set to $115,313 per impervious acre treated – an average of the "Suburban" and "Highly Urban" bioretention categories – with average annual maintenance costs of $1,531 per impervious acre treated. Average filtration implementation costs were assumed to be $56,000 per impervious acre treated, with average annual maintenance costs of $1,631 per impervious acre treated.

This analysis found that the previously identified right-of-way and public property projects would achieve the first phase of compliance, but a very large gap would remain for the second and third phases. It is estimated that the initial capital cost of compliance would increase from $3.89 million to $37.28 million. This emphasizes the potential cost savings of larger-scale BMPs, as well as the importance of continued preparation for the Chesapeake Bay TMDL.

Table 15 – Summary of Estimated Costs for the "Worst Case" Scenario

Permit Cycle	Analysis Category	Initial Capital Cost	Annual Maintenance	Lifetime (20-yr) Total
2013-2018 (5%)	Previously Identified Public Property and ROW Projects	$2,630,000	58,548	$3,802,950
	Gap	$0	$0	$0
2018-2023 (35%)	Previously Identified Public Property and ROW Projects	$870,000	$6,226	$994,520
	Gap	$13,780,000	$250,000	$18,780,000
2023-2028	Previously Identified Public Property and ROW Projects	$0	$0	$0
	Gap	$20,000,000	$370,000	$27,400,000
Total for MS4 Compliance		**$37,280,000**	**$684,774**	**$50,977,470**

Unknowns and Additional Considerations

The following unknowns and additional considerations are presented for further consideration and possible analysis as the WIP and MS4 planning processes continue to move forward.

MS4 Area Delineation. MS4 boundaries were delineated manually, using topographic data and the Town's GIS layers as a guide. Regulated outfalls and their drainage areas may need to be further validated to ensure accuracy depending on any guidance provided by DCR with the next permit.

Impervious Cover. The impervious cover used in this analysis is based on aerial photography obtained in 2009 and 2012. DCR stated at the July 25th MS4 General Permit Regulatory Advisory Panel meeting that localities will likely need to estimate impervious cover as of July 1, 2009 for compliance and tracking purposes. As the Town continues to develop, an accurate impervious cover spatial dataset will need to be maintained.

Post-2009 BMPs. Post-2009 BMPs receive credit toward TMDL targets if they control existing impervious cover. Because the Town is largely built-out, all BMPs constructed after July 2009 were assumed to control existing impervious surface areas. A more detailed analysis will be required to distinguish between BMPs controlling new development versus redevelopment when the Town develops its Chesapeake Bay TMDL Action Plan.

VSMP Construction Permits. DCR is currently determining how to deal with active VSMP construction permits since they are technically in a similar position as VPDES industrial permits, which are considered separate from the MS4 permit for calculating loading rates. The impact of this is likely to be very small; however, it may affect total loadings.

Loading Rates. Phosphorus, nitrogen, and sediment loading rates used in this study were provided by DCR and presented in the draft MS4 permit regulations dated September 28, 2012. The rates are specific to the Potomac River basin. DCR stated that these are likely the final rates. However, changes could be made or DCR could adopt a single set of state-wide rates.

BMP Efficiencies – General. BMP efficiencies used in this report are from the Chesapeake Bay Model and recent Expert Panel reports available from the Chesapeake Stormwater Network. However, these efficiencies may change and DCR is still working with the Chesapeake Bay Program on when efficiencies from the Virginia Stormwater Management Regulations may be used in lieu of the model efficiencies.

BMP Efficiencies – Retrofits by Upgrading Ponds. BMP efficiencies for pond retrofits are based on the report "Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Projects" dated October 9, 2012. This panel was assembled by the Urban Stormwater Work Group of the Chesapeake Bay Partnership. Although the report has been finalized, AMEC believes these efficiencies may change based on further discussions. There is considerable discussion about how much credit an existing facility that was not designed to provide water quality benefits should be given since they were likely providing "incidental" benefits that were captured in the 2009 baseline Bay Model run.

BMP Efficiencies – Treatment Trains. At present time, the Bay Model does not allow for "treatment trains." One can only take credit for the BMP with the greatest efficiency. However, this is being revisited, and according to DCR, has a high likelihood of changing. As a result, treatment trains are given credit in this study.

Street Sweeping. According to DCR, the Town may be able to take credit for the number of annual acres swept and receive the associated nitrogen, phosphorus, and sediment reductions. However, there are a number of outstanding policy and modeling issues surrounding credit for street sweeping. Street sweeping is not currently considered in this report but may be revisited at a later date.

State Trading Programs. Legislation passed during the 2012 General Assembly (HB176) directs the Virginia Soil and Water Conservation Board to adopt regulations governing the certification of nutrient credits. These regulations will establish an online registry of certified credits and provide a means of purchasing credits for application against MS4 nutrient reduction targets. The purpose is to create a market for nutrient credits that could be generated cheaper than implementing retrofits within the Town. The Town will need to consider this approach in lieu of, or in combination with, the strategies outlined in this report. For instance, the Town may choose to purchase nutrient credits from a credit bank if it determines that it is more cost-efficient than installing stormwater BMPs within the Town.

Stream Restoration. Credit for stream restoration projects is currently the subject of a Chesapeake Bay Partnership expert panel. The two issues involved are the amount of nutrient and sediment credit for stream restoration and how to provide credit for stream restoration projects since they are technically outside of the regulated MS4 area. It may be possible for the Town to trade reductions achieved outside of the MS4 for credit inside the MS4, but this mechanism is yet to be developed.

Appendix A – Potential Large Scale Project Details

			Efficiency			Lbs/Ac/Year			
Pond #	**Project Name**	**BMP Type**	**N**	**P**	**S**	**N**	**P**	**S**	**Acres**
190-5	Airport Commerce Park	Dry Extended Detention Ponds	0.24	0.31	0.43	25	2	1,320	9
189-6	Bellemeade Farms	Wet Ponds and Wetlands	0.26	0.41	0.52	20	2	2,047	6
232-2	Brookmeade Condo	Wet Ponds and Wetlands	0.26	0.41	0.52	44	5	4,487	13
2000	Clubhouse Drive Bioretention	Bioretention - A/B soils, underdrain	0.70	0.75	0.80	862	49	28,300	128
148-1	Evans Ridge	Dry Extended Detention Ponds	0.24	0.31	0.43	26	3	2,337	8
187-1	Exeter	Wet Ponds and Wetlands	0.26	0.41	0.52	1,696	177	138,694	534
187-2	Exeter - Dry Pond	Dry Extended Detention Ponds	0.24	0.31	0.43	329	27	23,549	113
189-2	Fox Chapel Pond	Wet Ponds and Wetlands	0.26	0.41	0.52	26	3	2,684	7
271-1	Foxridge Park	Wet Ponds and Wetlands	0.26	0.41	0.52	203	21	16,697	102
233-3	Freedom Park #1	Wet Ponds and Wetlands	0.26	0.41	0.52	25	2	1,450	9
233-4	Freedom Park #2	Wet Ponds and Wetlands	0.26	0.41	0.52	20	2	1,143	7
273-2	Greenway Farm	Wet Ponds and Wetlands	0.26	0.41	0.52	761	72	53,131	259
149-1	Harper Park	Dry Extended Detention Ponds	0.24	0.31	0.43	64	5	4,713	25
234-2	Heritage High School	Dry Extended Detention Ponds	0.24	0.31	0.43	117	10	8,493	41
230-2	Ida Lee	Wet Ponds and Wetlands	0.26	0.41	0.52	20	2	1,913	7
188-1	Khol's	Dry Extended Detention Ponds	0.24	0.31	0.43	119	13	13,098	33
190-4	Kincaid Forest #1	Dry Extended Detention Ponds	0.24	0.31	0.43	108	10	8,852	35
190-7	Kincaid Forest #2	Dry Extended Detention Ponds	0.24	0.31	0.43	226	19	15,787	78
189-3	Leesburg Corner	Dry Extended Detention Ponds	0.24	0.31	0.43	172	19	18,899	49
1000	Near Tuscarora Park, behind houses	Wet Ponds and Wetlands	0.26	0.41	0.52	33	3	2,504	11
186-2	Potomac Crossing	Wet Ponds and Wetlands	0.26	0.41	0.52	121	13	9,871	46
149-3	Potomac Station Pond #3	Wet Ponds and Wetlands	0.26	0.41	0.52	502	52	41,104	171
148-7	Potomac Station Pond 1 (Potomac Station /Battlefield Parkway)	Dry Extended Detention Ponds	0.24	0.31	0.43	70	7	5,913	22
232-4	Stowers	Wet Ponds and Wetlands	0.26	0.41	0.52	336	34	25,903	108

			Efficiency			Lbs/Ac/Year			
Pond #	**Project Name**	**BMP Type**	**N**	**P**	**S**	**N**	**P**	**S**	**Acres**
232-6	Stratford #1	Wet Ponds and Wetlands	0.26	0.41	0.52	619	56	40,372	245
191-1	Tavistock Farms #1	Dry Extended Detention Ponds	0.24	0.31	0.43	45	4	2,924	16
191-2	Tavistock Farms #2	Dry Extended Detention Ponds	0.24	0.31	0.43	83	7	5,408	29
191-3	Tavistock Farms #3	Dry Extended Detention Ponds	0.24	0.31	0.43	109	9	8,124	37
188-6	Walmart	Wet Ponds and Wetlands	0.26	0.41	0.52	27	4	3,282	7

Appendix B – Detailed Cost Breakdown of Projects

Category	Name	BMP Type	Treated Area (ac)	Impervious Area (ac)	Estimated Initial Costs	Maintenance Unit Cost ($/imp.ac/yr)	Estimated Avg. Annual Maintenance ($/yr)	Estimated 20 yr Cost	N Cost ($/lb/yr)	P Cost ($/lb/yr)	S Cost ($/lb/yr)	Average Pollutant Reduction Cost ($/lb/yr)	Rank	Phase
Pond Retrofits	Stratford #1	Wet Ponds and Wetlands	245.1	42.2	$200,000	$763	$32,206	$844,120	$68	$756	$1	$275	1	Phase I
Pond Retrofits	Greenway Farm	Wet Ponds and Wetlands	258.8	59.6	$200,000	$763	$45,477	$1,109,530	$73	$775	$1	$283	2	Phase II
Pond Retrofits	Clubhouse Drive Bioretention	Bioretention - A/B soils, underdrain	128.1	15.8	$400,000	$1,531	$24,266	$885,315	$51	$909	$2	$321	3	Phase II
Pond Retrofits	Potomac Station Pond #3	Wet Ponds and Wetlands	171.1	52.7	$200,000	$763	$40,217	$1,004,349	$100	$959	$1	$353	4	Phase II
Pond Retrofits	Exeter	Wet Ponds and Wetlands	534.5	177.3	$800,000	$763	$135,256	$3,505,111	$103	$992	$1	$365	5	Phase II
Pond Retrofits	Stowers	Wet Ponds and Wetlands	107.6	31.6	$200,000	$763	$24,090	$681,802	$101	$1,012	$1	$372	6	Phase III
Pond Retrofits	Foxridge Park	Wet Ponds and Wetlands	102.2	21.4	$250,000	$763	$16,336	$576,714	$142	$1,357	$2	$500	7	Phase III
Pond Retrofits	Exeter - Dry Pond	Dry Extended Detention Ponds	113.0	35.3	$100,000	$1,231	$43,439	$968,772	$147	$1,762	$2	$637	8	Phase III
Pond Retrofits	Kincaid Forest #2	Dry Extended Detention Ponds	78.2	23.5	$100,000	$1,231	$28,872	$677,439	$150	$1,822	$2	$658	9	Phase III
Pond Retrofits	Brookmeade Condo	Wet Ponds and Wetlands	12.9	6.9	$100,000	$763	$5,251	$205,010	$232	$1,918	$2	$718	10	Phase III
Pond Retrofits	Potomac Crossing	Wet Ponds and Wetlands	46.0	12.6	$300,000	$763	$9,610	$492,208	$204	$1,956	$2	$721	11	Phase III
Pond Retrofits	Tavistock Farms #2	Dry Extended Detention Ponds	29.5	7.6	$100,000	$1,231	$9,337	$286,743	$172	$2,195	$3	$790	12	Phase III
Pond Retrofits	Tavistock Farms #3	Dry Extended Detention Ponds	36.9	12.6	$100,000	$1,231	$15,534	$410,684	$188	$2,193	$3	$794	13	Phase III
Pond Retrofits	Near Tuscarora Park, behind houses	Wet Ponds and Wetlands	10.8	3.3	$100,000	$763	$2,547	$150,948	$229	$2,308	$3	$847	14	Phase III
Pond Retrofits	Kincaid Forest #1	Dry Extended Detention Ponds	34.9	15.2	$100,000	$1,231	$18,661	$473,227	$219	$2,395	$3	$872	15	Phase III
Pond Retrofits	Khol's	Dry Extended Detention Ponds	32.7	25.5	$40,000	$1,231	$31,431	$668,629	$280	$2,483	$3	$922	16	Phase III
Pond Retrofits	Walmart	Wet Ponds and Wetlands	7.0	5.5	$100,000	$763	$4,201	$184,022	$336	$2,455	$3	$931	17	Phase III
Pond Retrofits	Fox Chapel Pond	Wet Ponds and Wetlands	7.5	3.9	$100,000	$763	$2,966	$159,326	$301	$2,490	$3	$931	18	Phase III
Pond Retrofits	Leesburg Corner	Dry Extended Detention Ponds	48.6	36.5	$100,000	$1,231	$44,930	$998,595	$290	$2,569	$3	$954	19	Phase III
Pond Retrofits	Potomac Station Pond 1 (Potomac Station /Battlefield Parkway)	Dry Extended Detention Ponds	22.3	10.0	$100,000	$1,231	$12,367	$347,346	$248	$2,655	$3	$969	20	Phase III
Pond Retrofits	Tavistock Farms #1	Dry Extended Detention Ponds	15.9	4.1	$100,000	$1,231	$5,076	$201,526	$225	$2,861	$3	$1,030	21	Phase III
Pond Retrofits	Freedom Park #1	Wet Ponds and Wetlands	8.9	1.4	$100,000	$763	$1,088	$121,764	$241	$2,885	$4	$1,043	22	Phase III
Pond Retrofits	Heritage High School	Dry Extended Detention Ponds	40.7	12.9	$270,000	$1,231	$15,819	$586,375	$250	$2,970	$3	$1,074	23	Additional
Pond Retrofits	Bellemeade Farms	Wet Ponds and Wetlands	5.8	3.2	$100,000	$763	$2,419	$148,382	$366	$3,037	$4	$1,135	24	Additional
Pond Retrofits	Ida Lee	Wet Ponds and Wetlands	6.5	2.9	$100,000	$763	$2,182	$143,632	$362	$3,102	$4	$1,156	25	Additional
Pond Retrofits	Harper Park	Dry Extended Detention Ponds	25.3	7.2	$170,000	$1,231	$8,921	$348,418	$271	$3,193	$4	$1,156	26	Additional
Pond Retrofits	Freedom Park #2	Wet Ponds and Wetlands	6.8	1.0	$100,000	$763	$755	$115,106	$294	$3,486	$5	$1,262	27	Additional

Category	Name	BMP Type	Treated Area (ac)	Impervious Area (ac)	Estimated Initial Costs	Maintenance Unit Cost ($/imp.ac/yr)	Estimated Avg. Annual Maintenance ($/yr)	Estimated 20 yr Cost	N Cost ($/lb/yr)	P Cost ($/lb/yr)	S Cost ($/lb/yr)	Average Pollutant Reduction Cost ($/lb/yr)	Rank	Phase
Rights-of-Way	Battlefield Pkwy between Fort Evans Rd and Rte 7	Tree Box Filter (Filterra)	15.9	10.9	$250,000	$1,531	$16,737	$584,748	$446	$3,761	$4	$1,404	28	Additional
Pond Retrofits	Airport Commerce Park	Dry Extended Detention Ponds	9.3	1.4	$100,000	$1,231	$1,769	$135,373	$274	$3,936	$5	$1,405	29	Additional
Pond Retrofits	Evans Ridge	Dry Extended Detention Ponds	8.3	4.0	$100,000	$1,231	$4,914	$198,273	$374	$3,886	$4	$1,421	30	Additional
Rights-of-Way	Battlefield Pkwy between Greenway and Kincaid Blvd	Tree Box Filter (Filterra)	10.3	6.2	$250,000	$1,531	$9,427	$438,531	$505	$4,406	$5	$1,639	31	Additional
Public Property	Police Dept.	Tree Box Filter (Filterra)	6.3	2.7	$250,000	$1,531	$4,183	$333,652	$628	$5,519	$7	$2,051	32	Additional
Rights-of-Way	Battlefield Pkwy between Edwards Ferry Rd and Leesburg Bypass	Tree Box Filter (Filterra)	5.8	3.6	$250,000	$1,531	$5,479	$359,579	$756	$6,188	$7	$2,317	33	Additional
Rights-of-Way	Fort Evans Rd between Rte 15 and River Creek Pkwy	Tree Box Filter (Filterra)	12.9	8.9	$500,000	$1,531	$13,701	$774,024	$834	$6,840	$8	$2,561	34	Additional
Public Property	Simpson Middle School	Tree Box Filter (Filterra)	2.6	1.9	$200,000	$1,531	$2,937	$258,747	$1,059	$8,055	$9	$3,041	35	Additional
Rights-of-Way	Loudoun St	Tree Box Filter (Filterra)	0.6	0.5	$50,000	$1,531	$826	$66,511	$1,157	$8,885	$10	$3,351	36	Additional
Rights-of-Way	E Market St	Tree Box Filter (Filterra)	0.6	0.4	$50,000	$1,531	$633	$62,658	$1,251	$9,917	$11	$3,727	37	Additional
Public Property	IMP Tuscarora Park	Bioretention - A/B soils, underdrain	3.1	1.2	$400,000	$1,531	$1,812	$436,240	$846	$11,546	$17	$4,136	38	Additional
Rights-of-Way	South King St from Evergreen Mill Rd to Town Boundary	Bioretention - A/B soils, underdrain	3.3	1.9	$430,000	$1,531	$2,913	$488,262	$1,046	$12,938	$18	$4,667	39	Additional
Rights-of-Way	King St	Tree Box Filter (Filterra)	0.3	0.3	$50,000	$1,531	$397	$57,943	$1,861	$13,504	$15	$5,127	40	Additional
Public Property	Ida Lee Park (1)	Tree Box Filter (Filterra)	2.4	1.8	$310,000	$1,531	$2,761	$365,213	$1,722	$14,180	$16	$5,306	41	Additional
Public Property	Ida Lee Park (3)	Tree Box Filter (Filterra)	1.2	1.0	$160,000	$1,531	$1,544	$190,883	$1,775	$14,723	$17	$5,505	42	Additional
Public Property	Skate Park	Bioretention - A/B soils, underdrain	0.3	0.2	$100,000	$1,531	$379	$107,585	$1,794	$19,753	$27	$7,191	43	Additional
Rights-of-Way	Church St	Tree Box Filter (Filterra)	0.3	0.2	$50,000	$1,531	$296	$55,929	$2,445	$19,242	$22	$7,236	44	Additional
Public Property	Ida Lee Park (2)	Tree Box Filter (Filterra)	0.4	0.3	$100,000	$1,531	$522	$110,432	$3,461	$29,904	$35	$11,133	45	Additional
Public Property	Edward's Landing Park	Bioretention - A/B soils, underdrain	0.3	0.2	$100,000	$1,531	$327	$106,535	$2,308	$34,163	$53	$12,175	46	Additional
					$8,330,000		**$654,811**	**$21,426,210**						