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Stormwater Financing Report to Anne Arundel, Maryland

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*T*his project was managed and directed by the ***Environmental Finance Center (EFC)*** at the University of Maryland in College Park. For twenty years EFC has served the Mid-Atlantic region and is one of ten regional centers located throughout the country that comprise the Environmental Finance Center Network. These centers were established to assist communities in addressing the how-to-pay issues associated with resource protection. One of the EFC's core strengths is its ability to bring together a diverse array of individuals, agencies, and organizations to develop coordinated, comprehensive solutions for a wide variety of resource protection problems. The EFC has provided assistance on issues related to energy efficiency, stormwater management, source water protection, land preservation, green infrastructure planning, low impact development, septic system management, waste management, community outreach and training. Working to facilitate this process is at the core of the EFC's mission and skill set. www.efc.umd.edu.

Main Street Economics is a small business located in Trappe, Maryland offering professional and technical services in the emerging market for environmental economics applications. They provide these services to government agencies, private business and non-governmental organizations. Main Streets' core capability is in the application of economic analysis to environmental and natural resources management and markets. www.mainstreeteconomics.com

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Section 1: Introduction

The following document provides a final project report of the Environmental Finance Center (EFC) at the University of Maryland. The goal of the project was to expand the ability and capacity of local governments and communities to achieve water quality restoration goals and priorities through more efficient stormwater financing. This project was piloted in three key urban watershed communities throughout the Chesapeake Basin—Lynchburg, VA; Baltimore, MD; and, Anne Arundel County, MD. The project goals were threefold:

1) Establish a greater understanding of the economic and social benefits associated with implementing local Watershed Implementation Plans (WIPs);

2) Establish processes for effectively assessing local capacity "gaps" in stormwater financing and revenue generation; and,

3) Provide the pilot communities with options for taking advantage of opportunities to expand local institutional capacity necessary to achieve desired environmental outcomes.

In addition, by demonstrating how these three pilot communities can expand their financing and investment capacity, this project was designed to serve as a model for other local financing efforts across the Chesapeake Basin.

Background. Perhaps no issue better demonstrates the complexity, scale, and contentiousness of the Chesapeake Bay restoration effort better than financing urban stormwater management. As stormwater regulations at all levels of government have become more restrictive, local communities are facing significant financing obligations. The challenge is especially acute for those communities struggling to retrofit existing urban environments and development.

Urbanized areas contain large expanses of impervious surfaces such as roads, rooftops and parking lots. These areas prevent runoff from soaking into the ground and channel stormwater directly into local streams, rivers, and other water bodies. Improperly managed stormwater runoff can damage streams, cause significant erosion, and carry excessive nutrients, sediment, toxic metals, volatile organic compounds, and other pollutants downstream.[1] In the United States, stormwater runoff is responsible for 45 percent of impaired estuaries and 21 percent of impaired lakes.[2] In the Mid-Atlantic region, stormwater is responsible for over 4,000 miles of impaired streams, including many in the Chesapeake Bay watershed.

The adverse effects of stormwater are not limited to the water quality impact of the pollutants carried in the runoff; the quantity of water moving during peak flows can be just as concerning. Unnaturally high volumes of runoff during storm events can erode soil and redeposit sediment in streams, clouding water and degrading aquatic habitats.[3] These volumes also scour stream banks and alter river channels, potentially damaging public infrastructure like roads and

[1]Green Environment News: EPA, DC Showcase Recovery Act Funded Green Roof. http://www.greenenvironmentnews.com/Environment/Water/EPA%2C+DC+Showcase+Recovery+Act+Funded+Green+Roof. Last accessed on January 30, 2013.

[2]Ibid.

[3]Ibid.

bridges, as well as private property.

Though the need to better manage stormwater is clear and well established, the costs associated with achieving aspirational stormwater management goals are significant. This is especially true throughout the Chesapeake Bay region where urban communities are facing especially difficult and costly financial obligations related to Chesapeake Bay restoration efforts. Though Chesapeake Bay restoration obligations will require significant financial investment from all levels of government, the burden on local communities struggling to address stormwater management will be particularly significant. And, the complexity and costs associated with water quality restoration and protection—primarily as a result of stormwater management—is in direct contrast to the economic and financial capacity limitations within many of these communities.

Anne Arundel County offers an interesting case study on the challenges facing local governments. By the County's own estimates, achieving stipulated Chesapeake Bay pollution reductions would cost the County in excess of $1 billion, a commitment well beyond what many community leaders would consider practicable. As a result, there is a clear and pressing need to reduce costs through innovation, flexibility, and a focus on performance. To that end, this project and final report is focused on identify specific strategies and options to Anne Arundel County to achieve stormwater management and water quality goals.

This report provides an assessment of the financing challenges Anne Arundel County is facing, the financing opportunities available to the County for meeting those challenges, and the potential impact that investments in stormwater management will have on job development within the County. We begin by providing a summary of key findings and observations.

Key Findings:

- ***There are significant costs savings to be gained.*** Though the costs associated with achieving the Watershed Implementation Plans (WIP) are significant, our analysis indicates that there are opportunities to dramatically reduce implementation costs through effective and efficient implementation of best management practices. Specifically, our analysis indicates that the County could reduce WIP related costs by more than 40% through adoption of a more flexible, performance-based financing system.
- ***The financing focus should be on complying with permit obligations.*** Though the WIP process has dominated much of the discussion and debate associated with urban wet weather management, it is the NPDES permitting process and the County's MS4 permit that is, or should be driving decision-making in regards to stormwater financing. In fact, the WIPs are not a regulatory requirement. Therefore, the County's revenue and financing programs should be focused exclusively on complying with the MS4 permit obligations, including requirements to treat impervious surfaces within the County.
- ***Revenues do not match existing cost estimates.*** Current estimates for achieving permitting obligations are significant and will require fiscal resources that are beyond the existing revenues supporting the County's stormwater program.

This report provides an assessment of the financing challenges Anne Arundel County is facing, the opportunities available for meeting those challenges, and the potential impact that investments in stormwater management will have on job development within the County. In the final section of the report, we offer recommendations that we feel will enable the County to advance its stormwater program into the future, including:

- Developing and implementing a stormwater financing system that is focused on performance and measurable, verifiable benefits to the environment and local water quality.
- Substantively engaging the private sector in a way that reduces program costs in the long-term and creates efficient environmental outcomes.
- Partnering with the many existing nonprofit and environmental organizations across the County by establishing innovative public/private partnerships.

Anne Arundel County has a very unique opportunity to transform its stormwater financing efforts and to make clean water part of the County's foundation and infrastructure into the future. In fact, the County has been doing just that for several years. Our goal with this project is to assist the community in achieving its water quality goals in the future and to provide a process and opportunity for other communities to model the transformational efforts that will take place all across the County.

Finally, a comment related to the political debate surrounding stormwater financing, Chesapeake Bay restoration, and the role of dedicated revenue and funding in the process. The implementation of this project coincided with the passage of House Bill 987 in Maryland. As a result, none of our work focused on how the three communities would generate revenue to support their stormwater programs; that decision had been reached as the project started. Though each of the three pilot communities was unique, and the skill sets and capacities of each reflective of the culture and history of those communities, what was common to all three communities was the need for financing paradigm shifts. All three communities have had to address increasingly-restrictive stormwater laws and regulations, as well as more aggressive ideas within the community about the role of the environment and water quality management in the fabric of everyday life.

The passage of HB 987 resulted in a debate that was always contentious, often visceral, and at times completely misinformed. While there are certainly legitimate normative arguments associated with the State's roll in requiring specific local stormwater financing systems, there is no questioning that Maryland has been well behind the rest of the nation in implementing dedicated, sustainable fee-based financing systems, which has put stormwater management efforts behind where they should be. Regardless of what has compelled each community to implement fee systems, it is clear based on our work over the last two years that there is little evidence to suggest that any of the three communities we worked in over the past 2 years, in addition to the many others that EFC has assisted over the past 20 years, would have the capacity to implement existing and anticipated permit requirements without dedicated and sufficient revenue sources. Revenue matters, and without these fees it is hard to imagine how programs would be financed in the future.

We understand that not everyone supports the use of fees as a way of financing stormwater

programs. We are sure that everyone can agree, however, that regardless of how the revenue is generated, it is essential that each community have the capacity to address the stormwater issue effectively and that each ensure that every dollar is invested in a manner that maximizes return on investment, keeping costs low, efficiencies high, and local water clean. It was with that in mind that we implemented this project and created the following report.

Section 2: Setting the Stage—Regulatory Drivers, Anticipated Implementation Costs, and Existing Implementation Capacity

As with any financing effort, establishing efficiencies related to Anne Arundel County's stormwater program begins with developing an accurate planning level estimate of the costs associated with achieving implementation requirements. Effective financial management requires an accurate understanding of the necessary level of service and associated revenue needs. In other words, it is necessary to know costs before revenue can be allocated.

Local estimates of water quality management costs, especially those associated with Chesapeake Bay restoration requirements, have varied widely from community to community across the region; this has created confusion among local decision makers and leaders. Our aim was to provide some clarity and consistency to the cost evaluation process.

Our cost analysis focuses on the two policy and regulatory programs influencing local stormwater financing programs most directly: the Watershed Implementation Planning process, required as part of the Chesapeake Bay Total Maximum Daily Load (TMDL); and, the National Pollutant Discharge Elimination System (NPDES)[4] permit requirements as described in Anne Arundel County's MS4 permit.[5]

Section 2.1: Watershed Implementation Plans. Though communities all across the country are required to reduce stormwater emissions, regulations within the Chesapeake Bay Basin are becoming particularly stringent. These new restrictions are based on water quality requirements stipulated in the Clean Water Act.

The Clean Water Act (CWA) sets an overarching environmental goal that all waters of the United States be "fishable" and "swimmable." More specifically it requires Bay states and the District of Columbia to establish appropriate uses for their waters and adapt water quality standards that are protective of those uses. The CWA also requires that jurisdictions develop a list of waterways that are impaired by pollutants and do not meet water quality standards. For those waterways identified as impaired, a TMDL, or total maximum daily load, must be developed. A TMDL is essentially a pollution diet that identifies the maximum amount of a pollutant that a waterway can receive and still meet water quality standards.

The U.S. Environmental Protection Agency's (EPA) Chesapeake Bay TMDL uses "caps" to limit the amount of nitrogen, phosphorus and sediment that can be discharged into the Bay by the jurisdictions whose tributaries drain to it. The goal of the TMDL is to accelerate the restoration efforts that have been underway for three decades with the ultimate goal of restoring water quality and aquatic habitats throughout the Bay. As part of this process, action plans that

[4] As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

[5] Polluted stormwater runoff is commonly transported through Municipal Separate Storm Sewer Systems (MS4s), from which it is often discharged untreated into local waterbodies. To prevent harmful pollutants from being washed or dumped into an MS4, operators must obtain a NPDES permit and develop a stormwater management program.

define how each state, in conjunction with local and federal partners, will achieve and maintain the required nutrient reductions over time. These action plans are referred to as Watershed Implementation Plans (WIPs). WIP development has been a two-phase process. Phase I WIPs identified statewide strategies for reducing nutrients and sediments. In 2011, the Bay states worked with their local jurisdictions to develop plans for achieving statewide goals. These Phase II WIPs are designed to guide local-level nutrient reduction activities, with at least 60 percent of the necessary nitrogen, phosphorus and sediment reductions attained by 2017.[6]

Anne Arundel County's WIP. As described above, Anne Arundel County's Phase II WIP describes how the County intends to achieve stipulated pollution reductions. A primary component of Anne Arundel County's Watershed Implementation Plan and stormwater pollution reduction strategy involves the restoration of perennial and ephemeral stream channels through re-establishment of hydrology, connection to floodplains, and recovery of wetland functions as appropriate. Obtaining federal and state regulatory acceptance of these chosen techniques has proven to be a difficult and lengthy process, often resulting in delay of permit issuance.

The next step was to develop the WIP pollutant reduction strategy to meet the stormwater waste load allocation assigned to the Anne Arundel County MS4 Phase I urban jurisdictional area. The Anne Arundel County Urban Stormwater WIP Strategy is divided into three major categories: Core Strategy Tier I, Core Strategy Tier II, and Potential Load Reductions Outside the Tier I and Tier II Core Strategy.[7]

Core Urban Stormwater Strategy – Tier I: This category includes the restoration of ephemeral and perennial streams with a MBSS[8] Maryland Physical Habitat Index (MPHI) score of severely degraded or degraded, implementing stormwater management treatment at currently untreated major pipe outfalls, and retrofitting stormwater management ponds built prior to 2002 to optimize the pollutant reduction and ecosystem functions for the facilities. In addition, the core strategy includes other already programmed water quality improvement projects with approved budget for FY12 and FY13. Additional information about the individual strategies is shown below.[9]

Core Urban Stormwater Strategy – Tier II: The Tier II Core Urban Stormwater Strategy includes additional pollutant reduction activities that must be implemented to meet the 2025 allocations. These activities include monthly vacuum-assisted street sweeping and associated inlet cleaning for all closed section roads, a reforestation plan for available public open space land, and stormwater management to the maximum extent practical for County-owned properties including recreation areas.[10]

Potential Load Reductions Outside the Tier I and Tier II Core Urban Stormwater Strategy: This strategy focuses on the work of private citizens and Watershed Master Stewards in implementing stormwater controls to the Maximum Extent Practicable for residential rooftops,

[6] When compared to 2009 levels.

[7] WIP Page 34

[8] Maryland Biological Stream Survey

[9] WIP Page 34

[10] WIP Page 35

in high-density areas, and for private commercial and industrial properties. These areas have been selected from outside the area treated by the WIP core strategy. The strategy for load reductions outside the Tier I and Tier II strategies would supplement the treatment provided by the core strategy and potentially increase the treatment efficiency of an area to up to one hundred percent pollutant removal.[11]

Table 1: Total Delivered Nitrogen Load by Source Sector

Source Sector	2009 Progress	Interim Target Load 2017 (60 percent of final target)	Final Target Load 2025
Urban	884,663	717,203	605,563
Agriculture	176,336	135,187	107,755
Septic	518,458	376,382	281,664
Forest	214,444	213,080	212,170
Wastewater	1,278,983	1,073,965	937,287
Total	**3,072,884**	**2,515,817**	**2,144,439**

Table 1 provides a summary of the total expected load reductions by sector. The WIPs focus on multiple pollution sources, including agriculture, wastewater, and stormwater.[12] That said, Anne Arundel County's pollution reductions are dominated by two sources: wastewater management and stormwater management. As discussed in the introduction to this report, our project focused exclusively on stormwater management financing. It should be noted, however, that Anne Arundel County faces uniquely difficult challenges in addressing load reductions from septic systems, with cost estimates in the billions of dollars.

Section 2.2: The MS4 Permitting Program. Stormwater by its very nature is a diffuse or nonpoint source of water pollution. However, amendments made to the Clean Water Act in 1987 expanded the federal permitting program to include emission from stormwater. Polluted stormwater runoff is commonly transported through Municipal Separate Storm Sewer Systems (MS4s). An MS4 is a system of conveyances that include, but are not limited to, catch basins, curbs, gutters ditches, manmade channels, pipes, tunnels, and/or storm drains that discharge into water bodies. For these conveyances, or system of conveyances to be recognized as an MS4, a state, city, town, village, or other public entity must own them. These conveyances must also not be part of a Publically Owned Treatment Works and may not operate as a combined sewer. Operators of large, medium, and regulated small MS4 systems are required

[11] WIP Page 40-41

[12] Local Watershed Implementation Plans in Maryland do not include agricultural reduction goals; these are addressed by the state.

to obtain NPDES permit coverage in order to discharge pollutants.[13] These designations (large, medium, and small) are based on urbanized areas as determined by census counts.

In most cases, the NPDES permitting process is managed at the state level. Permits are applied to jurisdictions (and in some case agencies and facilities) based on a community's size:

- Phase I, issued in 1990, requires *medium* and *large* cities or certain counties with populations of 100,000 or more to obtain NPDES permit coverage for their stormwater discharges. Baltimore City and Anne Arundel County in Maryland are both Phase I communities.
- Phase II, issued in 1999, requires regulated small MS4s in urbanized areas, as well as small MS4s outside the urbanized areas that are designated by the permitting authority, to obtain NPDES permit coverage for their stormwater discharges. Lynchburg, Virginia is a Phase II community.

Generally, Phase I MS4s are covered under an individual permit and Phase II MS4s are covered by a general permit. Each regulated MS4 is required to develop and implement a stormwater management program (SWMP) to reduce the contamination of stormwater runoff and prohibit illicit discharges.[14]

Maryland Phase I Permits. Phase I jurisdictions in Maryland are entering—or have entered—the third five-year permit cycle. To that end, the Maryland Department of the Environment (MDE) has reached a tentative determination to issue an NPDES MS4 permit to Anne Arundel County. Under the conditions of the permit, Anne Arundel County, as with the other permitted communities, is required to possess the legal authority to control storm drain system pollutants, continue mapping its storm sewer system, monitor stormwater discharges, and develop and implement comprehensive management programs. The permit requires the implementation of trash reduction strategies and environmental site design for new and redevelopment projects to the maximum extent practicable. The County is also required to develop and implement plans to address waste load allocations established under EPA approved total maximum daily loads.[15]

Perhaps the most significant change in this third permit cycle is the requirement to treat impervious surfaces. The permit requires the County to treat 20 percent of the impervious surfaces that are not currently treated to the maximum extent practicable. As we discuss below, this will have a significant impact on the County's stormwater financing efforts.

Section 2.3: Anticipated Costs Associated with Implementing the WIP. Both the WIP and the MS4 processes require detailed and complex implementation strategies. Though these detailed plans will presumably allow communities to accurately assess the costs of implementation, the

[13] NPDES Permit- National Pollutant Discharge Elimination System; a national program under Section 402 of the Clean Water Act for regulation of discharges of pollutants from point sources to waters of the United States. Discharges are illegal unless authorized by an NPDES permit.

[14] http://cfpub.epa.gov/npdes/stormwater/munic.cfm

[15] http://www.mde.maryland.gov/programs/water/stormwatermanagementprogram/pages/programs/waterprograms/sedimentandstormwater/storm_gen_permit.aspx

necessary complexity of implementing successful stormwater management systems will make cost estimates equally complex. Stormwater programs are made up of the multiple components including administration and financial management, engineering and planning, operations and maintenance, capital investment, water quality compliance, regulation and enforcement, public involvement and education, technology, and other miscellaneous activities. Our focus here is on the implementation costs of water control structures and practices.

Section 2.3: Assessment of WIP Costs. Stormwater costs fall into three broad categories: administration, capital investment, and operations and maintenance. Our focus with this project was on capital costs, and to a lesser extent operations and maintenance. This is not to imply that administration and operations and maintenance are not important; they are obviously essential for achieving stormwater goals. However, Anne Arundel County has been operating a sophisticated stormwater management program since the early 1990s and has had years to establish the internal infrastructure and resources necessary for managing and administrating the program.

In addition, the County recently established a stormwater enterprise program. As part of that process, it was necessary for County leaders to assess program needs and anticipated costs as a way of establishing budgetary authority and the appropriate fee level. Therefore, an assessment of anticipated administration and operations and maintenance expenses was by necessity completed by the city, and we are presuming the corresponding estimates to be accurate and sufficient. To that end, our focus was related to the costs associated with making necessary capital investments necessary for achieving water quality goals, as well as future operations and maintenance requirements.

Best Management Practice Costs. The first step in the cost analysis was aimed at establishing a practical means to estimate the costs of achieving nutrient and sediment pollution load allocations under both the WIP and MS4 permit programs. More ambitiously, we sought to provide a means to associate costs with nutrient and sediment pollution reductions on a known acre, given the application of a specific management practice.

As a result of the passage of House Bill 987, Anne Arundel County leaders convened an advisory committee charged with providing structure to the County's new stormwater enterprise financing program. Specifically, the committee made recommendations on key provisions of a fee-based financing system, such as the necessary level of equivalent residential units, the use of fee-credit systems, and the total fee to be charged to residential and commercial customers. Obviously, it was the elected officials within the County that adopted the final stormwater financing legislation, presumably using the committee's recommendations as a guide. As part of that committee process, the EFC worked directly with Anne Arundel County Department of Public Works staff to estimate total cost associated with implementing both the WIP and MS4 permit obligations.

Table 2 provides a summary of the County's estimated WIP costs as developed during the advisory committee process. The total estimate costs to achieve the 2025 TMDL load

reductions is just over $1.1 billion, with an annual estimated cost of $70,747,000.[16]

Using these cost estimates as a starting point, our aim was to develop a planning-level estimate of stormwater management costs as a starting point for reducing those costs in the future. Specifically, we estimated planning-level annualized costs for achieving Anne Arundel County's TMDL pollution load allocations using MAST[17] as the performance standard for various combinations of pollution reduction practices in the county. MAST provides a convenient, if opaque, means for evaluating the pollution reduction impact of various mixes of pollution reduction practices. Without a standard model such as MAST, it is difficult to know the additional effect of any pollution reduction practice that is layered upon up-gradient pollution reduction practices. This is because up-gradient practices diminish the pollution available to be reduced by down-gradient practices so that, even if the pollution reduction effectiveness of a practice is known, measuring the load reduction that will occur is not straightforward.[18]

Table 2: Total cost of meeting WIP requirements

Stream Restoration:	$ 334,954,000
Stormwater Pond Retrofits:	$ 82,614,000
Stormwater Outfall Rehabilitation:	$ 386,533,000
Other Related Projects:	$ 39,360,000
Total Capital Investment:	$ 843,461,000
Estimated total operations and maintenance costs:	$285,607,000.
Total Costs:	$1,129,068,000
Estimated Annual Costs:	$70,747,400

After using MAST as the performance measure for pollution reduction effects of various combinations of pollution reduction practices, we used its record of practice implementation along with annualized estimates of implementation costs to sum costs. When summed across an entire scenario, this provides planning level estimates of the direct costs of the scenario. We can then compare total costs across scenarios, along with total pollution reduction. The 2012 scenario is taken to be a reporting scenario that identifies what has been undertaken to reduce pollution loads to date. The cost-attentive (CA) scenario has been developed to lower Anne Arundel County's expected costs of TMDL compliance, as estimated by the County.

[16] The annual cost estimate assumes a 30-year note at 4% interest.

[17] MAST is an acronym for Maryland's Assessment and Scenario Tool.

[18] It should be noted that the County utilizes a sophisticated watershed modeling system that is able to generate much more accurate load reduction estimates than the MAST tool. However, MAST is the state's codified reporting tool, and will therefore remain an important resource for local governments in regards to TMDL compliance.

There are many caveats to our approach to evaluating pollution reduction scenarios and their costs. Much depends on the starting conditions. In each scenario, we started with 2010 land use, septic, and animal data. Beyond starting conditions, there is the assumption that MAST accurately reflects the impact of reduction practices on pollution loads exported from Anne Arundel County. There are known examples wherein this is not the case. There are likely other ways in which MAST impact accounting diverges from what actually happens. Therefore, the results reported here are more useful as a compliance estimate, and not as a fully accurate prediction of downstream pollution loading impacts.

Along with uncertain accuracy of MAST's pollution impact accounting, there is considerable uncertainty regarding the accuracy of implementation cost estimates. These estimates were developed with factor costs that were relevant over a period roughly stretching from 2008 to 2012 and factor costs change over time.[19] Moreover, the way in which factor costs are used to develop implementation cost estimates depend on a range of variable factors ranging from site conditions to land ownership. Hence, the variance of our cost estimates is unknown.

Perhaps the strongest caveat to our effort is that the development of a cost-attentive scenario focuses on lowering costs and is largely blind to the question of practicality. That is, we have sought to use cost-effective practices to the broadest extent possible, independent of whether or not those practices could actually be implemented in the amount proposed. Given this caveat, our report is merely indicative of possibilities, and not a recommendation for how to revise the County's WIP.

The average annual cost-attentive scenario started with 2012 progress and then added and subtracted from the various urban BMPs. Our efforts focused on urban and, except for concrete pads in heavy use areas for livestock, did not change agricultural BMPs. In refinements, agricultural BMPs could be adjusted; but, since Anne Arundel's loads are predominantly urban, this study focused on urban BMPs as a way to achieve the load allocations.

In Table 3 below, we report the nitrogen load by land use as reported by MAST under its "compare scenarios" function. For convenience we simply show edge of stream results. As the table indicates, the cost-attentive scenario achieves urban nitrogen loads below the allocation. The schedule of BMPs by which it does this is included in Appendix 1. To the extent that our BMP specifications in the cost-attentive scenario are at all practical, we then compared costs as measured by the cost calculator across the scenarios.

Table 4, also below, reports scenario costs by land use load sector. When agriculture and forest loads are not included, the estimated costs for achieving the County's stormwater component of the WIP is $48,932,458. Compared to the County's annual estimate of $70,747,400, this represents more than a 44 percent reduction in estimated costs.[20] It is important to note that

[19] Factor cost is defined as the cost of an item or a service in terms of the various factors that have played a part in its production.

[20] Please note that the annualized capital costs used by the Chesapeake Bay Program Office are based on the assigned life of the practice in the watershed model, rather than the 30-year term used by EFC and the County in their estimate. Therefore, it is likely that the CA Scenario estimate would be even lower.

our evaluation process was agnostic in regards to the types of BMPs used to achieve the necessary load reductions. Rather, our goal was to minimize estimated costs. Part of the high costs associated with the County's estimate is due to the fact that they have identified and committed to a specific suite of BMPs, and are therefore unable to take advantage or cost reductions associated with less expensive practices.

Table 3: Comparison of Land Use Loads across County Scenarios

Sector	Land-Use Group	Anne Arundel 2012 Load - Edge of Stream	CA Scenario Load - Edge of Stream	Allocation - Edge of Stream
Agriculture	Crop	128,706	130,213	87,731
Agriculture	AFO	8,260	3,481	4,941
Agriculture	Nursery	12,914	12,914	11,778
Agriculture	Pasture	19,754	19,762	15,968
Agriculture	CAFO	0	0	0
Sum Ag		**169,634**	**166,369**	**120,418**
Urban	Municipal Phase II MS4	32,409	24,025	21,688
Urban	Construction	9,565	9,565	10,256
Urban	Regulated Industrial Facilities	9,254	6,765	6,336
Urban	Federal Developed	61,817	42,540	53,465
Urban	Extractive	6,783	6,783	5,924
Urban	Non-regulated	0	0	36,122
Urban	County Phase I/II MS4	748,646	477,608	480,687
Urban	SHA Phase I/II MS4	64,612	45,935	44,549
Urban	State Phase II MS4	72,422	50,883	45,330
Urban	Combined Sewer Systems Land	0	0	0
Sum Urban		**1,005,508**	**664,104**	**704,357**
Forest	Forest	243,119	317,461	243,030
Forest	Harvested Forest	11,528	11,528	12,769
Sum Forest		**254,648**	**328,989**	**255,799**
Water	Air	20,122	20,122	20,122
Sum		**1,449,911**	**1,179,584**	**1,100,696**

Table 4: Comparison of Estimated Annual Cost by Scenario

Sector	Anne Arundel 2012 Costs	CA Scenario Costs
Agriculture	$371,442	$418,285
Forest	$64,939	$64,939
Urban	$36,721,932	$48,932,458
Sum Land-Use BMP	$37,158,313	$49,415,682

Of course, what really matters is not the estimated costs of implementation, but rather the actual costs. As previously stated, our intent with this analysis was not to dissect the various cost-estimating processes being employed by policymakers across the region, but rather to demonstrate that when cost, efficiency, and flexibility are identified as the fundamental constraints in the implementation process, there are opportunities for reducing implementation costs significantly. We address these opportunities specifically in Section 4 of this report. First, however, we begin with an assessment of the costs associated with achieving the County's NPDES permit requirements.

Section 2.4: Estimated Cost of Meeting NPDES Permit Requirements. It is clear that successfully implementing the WIPs will require a significant financial commitment on the part of the County, though that commitment is perhaps not as extensive as originally thought. What is equally clear is that the County's primary financing obligation is associated with complying with the NPDES MS4 permit requirements, specifically as they relate to mitigating the impacts of impervious areas. In short, though the Chesapeake Bay TMDL and WIP process have significant relevance at the State level, at this point, the only regulatory tool that applies to stormwater management is the MS4 permit. In other words, the WIPs are not regulated. Therefore, the County should focus on what is regulated. the MS4 permit. To that end, we conducted an analysis of how the County could achieve permit compliance in the most cost-effective manner possible.

The costs of achieving treatment of 20 percent of the County's impervious surfaces. Though the County's MS4 permit contains a number of activities and required processes that will require financial resources, the most significant and costly component of the permit is the requirement to treat 20 percent of the existing impervious surfaces that are not currently being treated to the maximum extent practicable. The total impervious are in the County is approximately 42,800 acres. Of this, 8,822 acres are owned and controlled by either federal, state, or Annapolis governments, which means it is not the County's responsibility to treat those areas. In addition, 9,791 acres are already managed by the County. This leaves 24,187 acres remaining to be treated. Applying the 20 percent treatment requirement means that the County must treat **4,837 acres** during the five-year permit term.

The County currently has capital improvement projects (CIP) for fiscal years 2013 – 2018, which will result in an additional 760 acres under management. The balance of acres requiring management by the end of the permit term is 4,077 acres. As discussed in Section 2.2 above, the County's plan for treating these acres includes retrofitting 258 public ponds and retrofitting 1,055 severely degraded outfalls.[21]

Using cost estimates provided by the Anne Arundel County Department of Public Works, which were articulated in the County's Phase II WIP, the estimated capital costs for retrofitting 258 public ponds will be $38,736,195. In addition, the total estimated capital costs for retrofitting 1,055 stormwater outfalls is $192,989,664, with a total estimated capital costs of $231,726,000. Finally, the total estimated operations and maintenance costs over the five-year permit cycle is $109,850,000. Total estimated costs for achieving the WIP is Table 5 provides a summary of these cost estimates.

Table 5: Estimated Costs of Achieving 20% Impervious Cover Treatment

	Retrofitting 258 Public Ponds	Retrofitting 1,055 SW Outfalls	Total
Capital Costs	$38,736,195	$192,989,664	$231,726,000
Operations and Maintenance			$109,850,000
Total			**$341,576,000**

Similar to our approach with the WIP cost estimates, we used these costs as a starting point for identifying a potentially more efficient approach for achieving the 20 percent reduction requirement.

[21] WIP Phase II Tier I Urban Stormwater Strategy; Table 4.3. Page 36.

Section 3: Assessment of Anne Arundel County's Program Capacity

The next step in our process was to assess Anne Arundel County's capacity to effectively address the investment needs described in the previous section. Specifically, our focus was on the resources and processes necessary for achieving NPDES permit compliance. To that end, we addressed the following program components:

- The ability to generate sufficient program revenue; and,
- The effectiveness in engaging the private sector.

Section 3.1: Generating Sufficient Program Revenue. One of the unique aspects of this project was the impact of Maryland House Bill 987, which established the Stormwater Management – Watershed Protection Restoration Program. The passage of that bill resulted in mandatory stormwater financing and revenue programs within urban communities across the state. Specifically, the bill applies to counties and municipalities subject to MS4 Phase I requirements and mandates the establishment of watershed protection and restoration programs. To fund the programs, each county and municipality must assess a stormwater remediation fee from property owners within its jurisdiction. The type of fee (flat, proportional, or otherwise) may be determined by the county or municipality, but it must take into account on- and off-site facilities, systems and activities that a property owner has in place to manage stormwater discharge, and must make exceptions for property owners demonstrating financial hardship. The stormwater remediation fee goes into a local watershed protection and restoration fund where it may be used, among other things, to improve county and municipal stormwater management systems, restore streams and wetlands, fund stormwater management planning and provide grants to nonprofit organizations performing certain watershed restoration projects.[22]

Obviously HB 987 has had a direct impact on stormwater financing in Anne Arundel County. For years the County has been considering and debating the need for a fee-based stormwater financing system, yet there had never been the political momentum necessary for establishing a program. By design, HB 987 changed that dynamic, and the County now has a fee in place, which is referred to as the Watershed Restoration and Protection Fee (WRPF). Our aim is not to debate the politics that led to the passage of Anne Arundel County's new fee, but rather to address how well that fee system may or may not enable the County to achieve its stormwater management goals. We begin by looking at the level of revenue that will be generated. It is important to note that though the County has passed a stormwater fee bill, there have been repeated efforts—some successful, some not—to revise and amend the legislation that created that program. Therefore, our analysis is based on the most current information available.

Anne Arundel County is similar to the vast majority of the more than 1,500 communities across the country that have stormwater fee programs, in that the fees are based on an equivalent residential unit, or ERU. ERUs are usually based on the average square footage of impervious surface within the community; in the case of Anne Arundel County, ERUs are set at 2,940ft^2 of impervious surface.

[22] http://www.saul.com/publications-alerts-830.html

Residential fees: The County calculates residential fees by basing the number of ERUs per household on zoning classification and development density—low, medium, and high. Homes in lower density zoning areas pay the equivalent of two ERUs per year, while homes in higher density zoning areas pay the equivalent of 40 percent of a single ERU. There are 150,844 billable residential properties, representing a total impervious surface area of 11,725, with total billable ERUs being 151,450. In addition, there are 2,178 billable ERUs in non-residential zoning areas; and, 2,489 billable ERUs in garden/high-rise condos. Table 6 provides a summary of the County's fee schedule.

Table 6: Watershed Restoration and Protection Fee Calculations[23]

Zone	Calculation	Yr. 1	Yr. 2	WRPF
R10	One (1) ERU x 0.4	$20.40	$27.20	$34
R15	One (1) ERU x 0.4	$20.40	$27.20	$34
R22	One (1) ERU x 0.4	$20.40	$27.20	$34
R1	One (1) ERU	$51	$68	$85
R2	One (1) ERU	$51	$68	$85
R5	One (1) ERU	$51	$68	$85
RA	One (1) ERU x 2	$102	$136	$170
RLD	One (1) ERU x 2	$102	$136	$170

As stipulated in the legislation that established the program, the fee per ERU will eventually be $85. However, the legislation also requires a phased in approach, collecting 60 percent of the fee in the first year, 80 percent in the second year, and 100 percent from that point on.[24]

Non-residential fees: For non-residential or commercial uses, the County bases ERUs on the actual level of impervious surface. Specifically, nonresidential structures are assessed the base rate of $85 for each ERU (2,940 sq. ft. of imperviousness). The total fee is calculated by dividing the total square feet of imperviousness on the property by the base ERU of 2,940 square feet, which is then multiplied by the base ERU Rate of $85. There are 155,416 billable non-residential ERUs; for a total billable ERUs of 311,533. This excludes all exempt properties; however, there are fee caps put in place based on the level of property taxes. Based on the graduated fee schedule, as well as the property tax cap, the total estimated revenue collections are approximately:

Year One: $14 million

Year Two: $18 million

[23] http://www.aacounty.org/DPW/Stormwater/stormwaterFAQ#.Uo-ZXY2G5QM

[24] http://www.aacounty.org/DPW/Stormwater/stormwaterFAQ#.Uo-ZXY2G5QM

Year Three and beyond: $22 million

Section 3.2: Creating Efficiencies and Reducing Costs. Our next step was to assess how well the County was establishing programs that will reduce costs and create financing efficiencies. Specifically, the EFC focused on how well the County is establishing its fee program to take advantage of the cost efficiency opportunities we identified earlier.

Section 5 provides a suite of recommendations that will enable the County to effective reduce costs while incentivizing innovation and implementation efficiency. Our recommendations focus on a common theme: effectively engaging the private sector in the restoration effort. Though the responsibility for managing and administering the County's stormwater program will always fall to the public sector, it is increasingly clear that the magnitude of the effort will require public agencies to effectively engage the private sector across a broad spectrum of activities.

Exclusive focus on specific best management practices. The County's strategy for addressing the 20 percent impervious surface treatment requirement focuses specifically and exclusively on two best management practices: retrofitting stormwater management ponds and retrofitting severely degraded outfalls. Cost estimates, therefore, are directly associated with these two approaches. As our cost analysis indicates, tremendous efficiencies can be gained by basing the implementation strategy on cost minimization—and implementation effectiveness—rather than becoming wedded to a particular practice or suite of practices. We recognize that County leaders feel strongly that the suite of practices it has identified, both to achieve the WIP and the MS4 permit, have benefits and impacts beyond those related to stormwater management and water quality restoration and protection. However, if the County's strategy is to achieve compliance in the most efficient manner possible, we would suggest that there are more effective options available.

Exclusive focus on public lands. In addition to the focus on two specific BMPs, the County is restricting its restoration activities to public lands. There appears to be little if any consideration given to substantially engaging the private sector. As we discuss in Section 4 of this report, the exclusion of the private sector in the implementation process results in lost opportunities for taking advantage of what the marketplace and the private sector do really well: reduce costs and create efficiencies. We do not intend to imply that the County has no interaction with private firms in the implementation process. The County, in fact, uses private firms exclusively for much of the design, engineering, and construction of water control structures and best management practices. In addition, the County uses a traditional procurement process for services, focused on a group of pre-qualified contractors. Beyond this traditional structured relationship with private firms, the County has largely disregarded restoration activity on private lands. And, there have been few, if any, attempts to incentivize innovation through market-like approaches to restoration implementation. Again, we address these issues specifically in Section 4 below.

Directly engaging ratepayers. Perhaps the most common way to engage the private sector in stormwater management programs is through the use of a fee credit. At least conceptually, fee credits help maintain the nexus between the level of user fees charged and the cost of providing services. Nationally more than a third of all stormwater utilities offer a fee credit of

some type.[25] In fact, Anne Arundel County's sole option for directly incentivizing engagement from the private sector is through the use of a fee-credit program.

Anne Arundel County's program is well-designed and thorough and provides opportunities for all ratepayers to participate. The County's website, as well as the Stormwater Remediation Fee and Credit Policy Guidance, is very thorough. However, given the relatively low fee level, it is unlikely that many ratepayers, especially residential ratepayers will take advantage of the fee. There are certainly ways for the County to maximize the effectiveness of the fee credit, but in and of itself, it will not result in significant activity from ratepayers, residential or commercial. This is due primarily to the fact that the fees are not set at a level that will create strong incentives for action.

Though fee credits are important (and in Maryland required by law), they are not sufficient in and of themselves to generate significant activity at the private level, unless the fees themselves are set high. We address options for building on the credit programs through other policy tools, such as rebate programs and performance-bidding systems, in the Section 5 of the report.

[25] 2012 Stormwater Utility Survey. A Black and Veatch Report. Page 4.

Section 4: Analytic Approach to the Economic Impact Assessments

Before providing recommendations for expanding the capacity and effectiveness of Anne Arundel County's stormwater financing system, we readdress the first deliverable of this project, an economic impact assessment related to stormwater investments within the County. In short, we re-evaluated the modeling results provided to Anne Arundel County officials earlier this year; the following section provides a summary of the modeling results. In short, the total estimated jobs supported as a result of stormwater investments has not changed; however, the economic multipliers have been revised downward. However, as was suggested in our first report to the community last year, Anne Arundel County remains in a very advantageous position to take advantage of the impacts related to stormwater management investments.

Economic development and growth have always been singularly important goals for most local governments and communities across the country. Over the past several years, two dynamics have intensified the debate around economic development in the Mid-Atlantic region: the severe global recession that began in earnest in 2008; and, the impact of environmental laws and regulations—either real or perceived—on the local and regional economies. The goal of this part of our project, which consisted of an economic impact assessment related to stormwater investments within Baltimore, Anne Arundel County, and Lynchburg, was to assess the anticipated economic impact of urban stormwater management investments, focusing specifically on the local impact of practices required as part of the federally mandated Chesapeake Bay restoration effort.

Our goal with this study was to inform local decision-making associated with financing and implementing stormwater restoration and protection efforts. By understanding the impacts associated with stormwater investments, our hope is that local communities will be better able to link water quality restoration programs and requirements with other community priorities, specifically economic development and growth. In addition, we sought to inform the public discourse associated with Chesapeake Bay restoration policies and regulations by highlighting the links between financing costs and desired community outcomes.

Section 4.1: Introduction and Background. Much of the debate around more restrictive water quality policies and regulations and their associated financing systems has been conducted in very general terms. Whether one is for or against more aggressive stormwater management and water quality regulations, the assumption is that the impacts and benefits are either all good or all bad, depending on which side of the issue you are on. We know, however, that like all public policy, the issue of impact and benefit is more nuanced than that. In fact, when assessing the impact, benefit, and potential structure of a policy or regulation it is essential to consider that policy within the specific context of the communities at hand. That was the impetus for this economic impact analysis. Our goal was to understand how the three communities we worked with would specifically be impacted by more aggressive stormwater management programs and investments. It was not our intent for the results of this assessment to be generalized to other communities across the region, but rather to help demonstrate a process that any community can and should implement to get a better understanding of how to structure aggressive environmental and infrastructure programs and policies.

Economic impact assessments (EIA) examine the effect of a policy or activity on the economy of a given area. This study characterizes the potential economic effects of the Watershed Implementation Process in three urban communities, focused on the county and municipal levels. Our study measures impacts in terms of changes in economic growth and activity rather than social and public welfare effects (e.g., health and environmental outcomes). Using leading indicators, such as output, income and jobs, it demonstrates how direct spending by local and county governments on stormwater management flows through the economy benefiting businesses and households.

Section 4.2: IMPLAN for Economic Modeling. Economists and policy analyst commonly use regional economy models to estimate the effects of changes in direct spending in the economy by households, business and government. This EIA uses IMPLAN (Impact Analysis of PLANning), an input-output model that was developed by the U.S. Department of Agriculture (USDA). IMPLAN tracks how direct spending flows through the economy, aggregating indirect effects on associated economic sectors supplying goods and services and induced effects in household consumption that are stimulated by resulting income and employment changes.

IMPLAN is well-established and builds on publicly collected information. It organizes the economy into more than 500 separate industries and has comprehensive regionally disaggregated data of the United States. It combines a set of extensive databases concerning economic factors, multipliers and demographic statistics. The model assesses the relationship between different economic sectors and describes how investments among those sectors work their way through the local economy. All of this is done through the use of economic and fiscal multipliers.

Economic multipliers[26] essentially define the pattern of purchases by industries and the associated distribution of jobs and wages by industry. Input-output models identify, for example, all the industries from which a stormwater management construction contractor purchases its supplies and in what proportion. IMPLAN then identifies the industries that are suppliers to these suppliers, or "second generation" suppliers. This continues until all major purchases are accounted for contributing to the construction contractor's original purchases. These original purchases are called "direct sales" and account for the direct impacts that spending will have on the local economy.[27]

In addition to the direct impacts on local economies, investments in stormwater infrastructure will also have indirect and induced impacts. Indirect impacts are the changes in inter-industry purchases as they respond to new demands of directly affected industry(s). In the case of green infrastructure and stormwater management, this would mean new purchases of machinery, supplies, plant-stock, etc. by upstream suppliers. Induced impacts typically reflect

[26] IMPLAN is able to estimate economic impacts by identifying direct impacts by sector, then developing a set of indirect and induced impacts by sector through the use of industry-specific multipliers, local purchase coefficients, income-to-output ratios, and other factors and relationships. RESI of Towson University. Thursday June 15th, 2006. http://www.cier.umd.edu/RGGI/documents/IMPLAN.pdf. Last accessed on January 30, 2013.

[27] A Study of the Economic Impact and Benefits of UC San Diego. Fiscal Year 2006-07. Prepared for: UC San Diego by CBRE Consulting, Inc. July 2008. Appendix A, page 2.

changes in spending from households as income increases due to additional production. This would include things such as food, housing, transportation, etc. It is in effect the composition of these indirect and induced impacts that create the multiplier effect in an economy, where a dollar invested works its way through that economic system.

The size of these indirect and induced effects depends upon the definition of the region being looked at as well as the nature of the economy within the region. A small region with a closed economy, where most needs are being met by industries and labor force located within the region, would keep many of the sales, earnings, and job impacts within the region. In regions like these, the multiplier effects would be relatively large. A large share of the effects is captured within the region. In contrast, a large region with an open economy, meaning an economy with a limited array of producers providing goods and services, would leak sales and economic activity to other regions. Because many purchases would be made from industries outside the local economy, the multiplier impacts on the local economy would be minimized.[28]

Our study focuses on the three pilot communities. It does not assess how direct spending on WIP implementation within the pilot community is likely to generate economic benefits that positively affect the broader regional economy, (that is, impacting on nearby communities beyond its jurisdictional borders). This focus is likely to understate economic benefits to the extent the pilot community has strong economic ties to its neighbors. For example, Baltimore City draws its workforce from residents within its boundaries as well as from surrounding areas. If Baltimore City experiences an economic stimulus creating new jobs, in our input-output framework, the economic benefits of the city's new jobs that are met by households residing outside of its borders are considered "leakage" and not included in our study.

We also conducted an analysis of the net fiscal impacts that estimated economic activity associated with stormwater management. The fiscal impacts are related to economic impacts. They measure how local, state, and federal tax receipts change in response to economic impacts on total business sales, wealth or personal income. Impacts on employment and associated population levels can affect government expenditures by changing demand for public services. Although related, fiscal impacts—including those associated with the operations and maintenance of stormwater practices—are not the same as economic impacts.[29]

Section 4.3: Estimating the Level of WIP Expenditures. Like all models, the accuracy of analysis provided by IMPLAN is directly related to the quality of the data and assumptions fed into the model. In the case of our analysis, the anticipated cost or estimated level of investment each community will be making in stormwater management practices varies across the three jurisdictions. For example, the city of Baltimore provided well-developed and highly detailed budgets of projected spending spanning the time period of 2013 to 2025. In contrast, the information available from Anne Arundel County and Lynchburg detailing anticipated WIP expenditures to a lesser degree requiring assumptions about how spending may occur. As a result, the process of assessing the potential economic impacts associated with stormwater

[28] Ibid.

[29] Glen Weisbrod; Burton Weisbrod. *Measuring the Economic Impacts of Projects and Programs.* Economic Development Research Group; April 1997. Page 2.

investments required us to address a contentious issue associated with the Chesapeake Bay restoration effort: implementation costs. It also calls attention to the fact that future realized economic impacts may vary from those projected in this study depending upon the accuracy of our assumptions regarding fiscal expenditures.

Analytic Limitations. The benefits associated with urban green infrastructure and stormwater management is actively discussed and debated. Stormwater management can deliver a wide range of benefits across the triple bottom line of environmental, social and economic. Environmental benefits include improved water quality and enhanced or restored habitats. Social or welfare benefits include improved public safety and enhanced quality of life in urban communities. These environmental and social impacts are important for the broader policy community to understand, especially as they relate to the Chesapeake Bay restoration effort. However, they largely feed into the process for setting the water quality goals for the Chesapeake. In other words, they define why it is important to finance stormwater management programs.

Implementing the WIPs requires and, to some extent, may drive investment decisions at the local level. Many communities are faced with tough spending choices among multiple community desires and needs, these choices may create a false dichotomy suggesting communities must chose between addressing stormwater infrastructure over other needs. The fact is, many investments—both public and private—are essential for maintaining the overall high-quality of life enjoyed by the region. Education, transportation, public safety, human health, and economic development are all essential in every community. Rather than rank one priority higher than the other, the approach used for the purposes of this project were related specifically to better understanding the linkages between community needs and being able to establish strategies for achieving multiple community goals. This includes restoring and protecting water resources.

These investment decision required to achieve social and environmental objectives will have economic —and often significant — impacts on the local economy of urban communities. It is the nature of the local economic effects on which this study focuses with the aim of providing information that can help guide local investment decisions. It is not our intention to engage in the debate about the appropriate role of government in financing stormwater management efforts. Rather, it is our intention to offer processes, tools, and policies that can improve the efficiency and effectiveness of government programs designed to achieve aspirational environmental and community goals and outcomes. ***An important first step in this process for many communities will be to understand the economic impact that investments will have in the community and how effective communities are in maximizing those impacts***.

Section 4.4: Results of Economic Impact Assessment. As previously explained, the goal of this study is to measure the anticipated level of economic activity associated with WIP implementation in the three pilot communities. Each jurisdiction has a unique WIP reflecting its particular location and development characteristics, as well as pre-existing investments in stormwater and MS4 requirements. As a result, the suite of BMPs identified for each jurisdiction's WIP is likely to share strong commonality. At the same time, the intensity and

scale of an individual BMP's adoption will likely vary across jurisdictions and play an important role in determining forecasted WIP implementation costs across the three jurisdictions.

WIP Costs. Assessing the economic impact associated with stormwater investments required understanding the various activities necessary for designing, planning, constructing, and maintaining best management practices (BMPs). As reported earlier, each pilot community provided information on forecasted WIP costs. In turn, the project team dissected anticipated stormwater spending over time in each community and assigned spending activities to specific industry classifications to the fullest extent possible given the level of detail in the data.[30] Where the data did not sufficiently detail the extent of the cost allocation over time and how specific BMPs varied, the project team had to make assumptions.

For Baltimore City, we based all modeling assumptions on project and cost information provided by the Department of Public Works, Surface Water Management Division. Baltimore City's forecasted costs are very detailed, allowing the analysis to include private land acquisition costs in construction phase estimates of BMPs and reliable yearly budget projections. Anne Arundel County cost estimates are based on its Chesapeake Bay TMDL Phase II Watershed Implementation Plan information provided by the Board of Public Works. For Lynchburg, the analysis required assuming cost projections based on two main sources: Chesapeake Bay TMDL and Final Phase I WIP Urban Stormwater Cost Estimates for City of Lynchburg by Greeley and Hansen.

The following table lists the primary industries directly impacted by stormwater investments, including their associated IMPLAN Sector Code. The project team identified these sectors based on the information provided by the pilot communities. In the case of Baltimore and Anne Arundel County, the industry classifications were based on a detailed analysis of past stormwater projects financed and implemented within the pilot communities. Lynchburg's actuarial data was limited, causing the project team used industry classifications associated with the two other pilot communities.[31]

[30] It is important to note that our study was based on existing industry sectors within the IMPLAN model. This is especially important as it relates to stormwater construction activities, which we classified as non-residential construction. Though it is certainly possible that designing, constructing, and maintaining stormwater best management practices has unique characteristics that would warrant a unique industry classification, there was not enough data available to establish that new classification at this time.

[31] Both Baltimore and Anne Arundel County are MS4 Phase 1 communities; as a result, their associated stormwater programs are more comprehensive in terms of scale than Phase 2 communities like Lynchburg. As a result, much of the activity associated with the WIP requirements will mirror many of the projects and practices that the communities have been financing over the past 20 years. Therefore, we used existing data from these two communities to develop industry classifications.

Table 7: Industries Directly Impacted by Stormwater Investments.

IMPLAN Sector Code	Description	WIP Activity
36	Construction of other new nonresidential structures	Construction
375	Environmental and other technical consulting services	Design and engineering
319	Wholesale trade businesses	Suppliers and equipment
393	Other private and educational services	Training
417	Commercial and industrial machinery and equipment repair and maintenance	Machine maintenance where specified

Table 8 below summarizes WIP costs provided by each jurisdiction. It reports projected WIP costs aggregated over the period 2014 to 2025. The range for total anticipated WIP implementation costs is substantial. Lynchburg has the lowest projected costs, $211 million. In contrast, Anne Arundel projects costs of $1.1 billion, which are over five times that of Lynchburg and approximately 4.5 times that of Baltimore.

The costs are allocated to one of two categories, construction or operation and maintenance (O&M). Construction costs account for expenditures supporting the design and build phases of a stormwater management practice. While this initial phase of a stormwater management project can span multiple years, its costs are generally viewed as a one-off, up-front capital expenditure. Once built, the BMP requires on-going, dedicated resources to support its operation and maintenance. The duration and scale of the O&M cost will depend up on the nature of the project. This division of WIP implementation costs aligns with budgeting practices.

Table 5 also highlights that the jurisdictions project differing levels of WIP expenditures between the two cost categories. Consistent with expectations, construction costs represent the lion share in all jurisdictions. However depending upon the jurisdiction, O&M costs contribute anywhere from 5 percent to one-quarter of total projected WIP. Lynchburg projects the highest ratio of construction to O&M costs. It anticipates its WIP costs to be nearly all construction related, with only 5 percent allocated to O&M. In Baltimore, O&M costs are around $42.5 million reflecting 18 percent of budgeted WIP costs. Anne Arundel projects the highest share of costs to O&M among the three pilot communities. O&M accounts for one-quarter of its projected $1.1 billion WIP budget.

Table 8: WIP Costs by Jurisdiction: 2014 – 2025[a]

	Construction		O&M		Total
	$	*%*	*$*	*%*	***$***
Baltimore	$197.8	82%	$42.5	18%	**$240.2**
Anne Arundel	$841.0	75%	$283.4	25%	**$1,124.4**
Lynchburg	$201.0	95%	$10.1	5%	**$211.1**

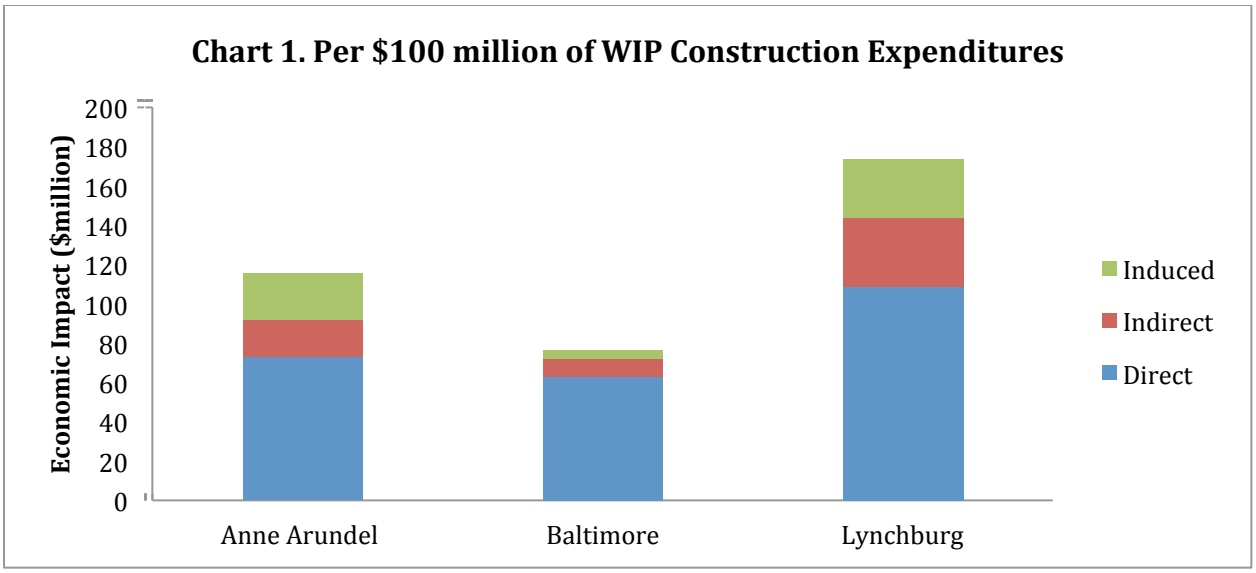
[a] All costs reported in millions of 2013 dollars.

Economic Impacts. We present the economic impact assessments in terms of levels of implementation (rather than estimated total financing costs) and by the two implementation phases, construction and O&M. More specifically:

- For construction activities, the economic impact in each community associated with each $100 million invested; and,
- For operations and maintenance, the economic impact is associated with each $10 million invested.

We present the findings this way for several reasons. Each of the three communities has estimated very different levels of activity in their stormwater programs. Reporting results as return for a given level of investment facilitates comparison across the pilot communities. In addition, the projected costs of WIP implementation in each community come with varying degrees of uncertainty. Rather than trying to predict what the final level of implementation will be (a prediction that would almost certainly turn out to be inaccurate), findings relate to levels of implementation reflecting averages.

Construction Impacts. Chart 1 summarizes the economic impacts of a WIP's construction projects associated with $100 million invested. Total economic impact varies across the pilot communities. Both Anne Arundel County and Lynchburg generate a positive return for their community. In Anne Arundel County, $100 million invested in stormwater BMP construction generates $115 million in economic benefits. For Lynchburg, the subsequent economic benefits flowing from $100 million investment in construction is nearly $174 million. In comparison, our modeling indicates Baltimore City would experience a much lower return. For every $100 million spent on BMP construction, the city would gain just over $76 million in economic benefits.



The lower return for Baltimore is not surprising given its role in, and relationship to, the regional economy. Each geographic location has a unique set of multipliers that determines the portion of the economic impact that stays within that area and the portion of the economic impact that leaks to surrounding communities. The low return in economic activity most likely reflects the extent to which direct investment within the city's limits has substantial flows (i.e., "leakages") to its neighbors rather than BMPs having a generally lower positive return.

While the relatively high impact associated with stormwater investments in Lynchburg is striking, a number of reasons why this would be the case stands out. First, Lynchburg is a well-established urban community in a relatively rural region of the state of Virginia. In other words, the city's economy is in some respects "closed" when compared to the other two pilot communities. Second, the modeling data associated with BMP costs and industry designations for Lynchburg are based on literature reviews and studies of other communities rather than on actuarial data as is the case in Baltimore and Anne Arundel County. This element of uncertainty suggests that the actual impact may differ for Lynchburg over time. Regardless, our study indicates Lynchburg can expect a healthy economic multiplier associated with its stormwater management investments.

Construction activity tends to generate a sharp spike in labor demand. As reported in Table 9, all three pilot communities should experience temporary workforce gains. Following patterns seen in the economic impact projections, a $100 million investment supports around 1,440 jobs during the construction phase for Lynchburg. Construction activity in Anne Arundel supports around 780 jobs. For Baltimore, the demand for labor is less than half of what could be experienced in Anne Arundel County.

Table 9: Economic Impact Per $100 Million Invested in Stormwater BMP Construction

	Anne Arundel County	Baltimore	Lynchburg
Indirect	$ 18,520,000	$ 9,130,000	$ 35,750,000
	$ 23,220,000	$ 4,590,000	
Total	$115,160,000	$ 76,440,000	$ 173,850,000
Jobs	780	340	1,440

Direct investment in the construction of stormwater BMPs also leads to fiscal impacts to government at the local, state and federal levels. These fiscal effects measure the changes associated with tax revenue flowing from direct and indirect taxes on households and businesses (eg, wages, profits and property), as well as licensing fees. Table 7 summarizes these impacts. In all three jurisdictions the magnitude of federal fiscal impacts are greater than state and local impacts. Notably, the relative difference in the scale of these effects is not as large across the three pilot communities. State and local fiscal impacts range from $3.9 million and $4.8 million. Federal impacts range from $5 million to $12 million.

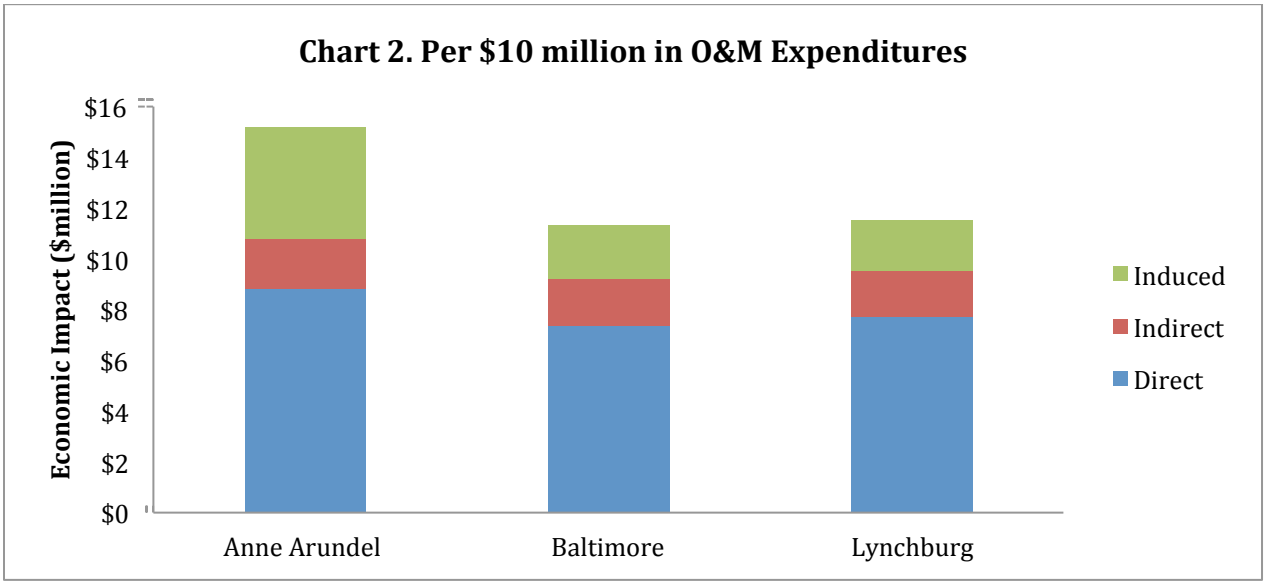
Table 10: Fiscal Impacts Per $100 Million Invested in Stormwater BMP Construction

	Federal	State and Local
Anne Arundel County	$ 8,950,000	$ 4,580,000
Baltimore	$ 5,006,500	$ 3,930,000
Lynchburg	$ 12,400,000	$ 4,826,000

Operations and Maintenance Impacts. The scale and nature of projected O&M expenditures is different from capital costs. Recall Table 2 reported O&M costs accounting for, at most, 25 percent of projected WIP implementation costs. In addition, O&M tend to be on-going activities requiring repeated annual fiscal commitments. Given these factors, this EIA analyzes O&M costs separate from construction. The economic impacts of O&M investments are reported as annual impacts per $10 million of O&M investment.

Our analysis shows O&M costs affect the economy of each pilot community quite differently from construction activity. Per annual investment of $10 million in O&M, between $11 million and $15 million in economic benefits are potentially stimulated. In other words, O&M expenditures in all three pilot communities generate sustained, positive net economic benefits. As shown in Chart 2, Baltimore and Lynchburg would experience similar impacts, not only in scale but also in terms of how the benefits flow through its economy. Indirect and induced equate to roughly $4 million per annum and account for one-third of the total benefits. Anne

Arundel County shows much higher return per $10 million in O&M expenditures, with total benefits projected to be around $15 million per year.



Unlike construction activity, O&M investments generally create an initial lift in labor demand and then sustain those jobs into the future. The positive employment gains represent real job growth. Table 8 reports the job effect of a $10 million investment supporting O&M activity for stormwater management. Each $10 million investment potentially increases jobs. For Baltimore, the job growth equates to roughly 75 full time equivalents. In Lynchburg, the number is around 90; for Anne Arundel, it is 120. These projections are not year-on-year growth but rather a one-time lift in overall employment that is then supported into the future.

Table 8: Estimated Annual Impact Per $10 Million Invested in Stormwater O&M

	Anne Arundel County	Baltimore	Lynchburg
Direct	$ 8,810,000	$ 7,380,000	$ 7,700,000
Indirect	$ 1,960,000	$ 1,860,000	$ 1,850,000
Induced	$ 4,400,000	$ 2,100,000	$ 1,990,000
Total	$ 15,170,000	$ 11,350,000	$ 11,540,000
Jobs	120	75	90

The fiscal gains to government as a result of supporting O&M activity are also positive. These fiscal effects measure the changes associated with tax revenue flowing from direct and indirect taxes on households and businesses (eg, wages, profits and property), as well as licensing fees. Table 9 summarizes these impacts. In all three jurisdictions the magnitude of federal fiscal

impacts are greater than state and local impacts. State and local fiscal impacts range between $560,000 and $800,000. Federal impacts range from $940,000 to $1.6 million.

Table 9: Fiscal Impacts Per $10 Million Invested in O&M

	Federal	State and Local
Anne Arundel County	$ 1,590,000	$ 800,000
Baltimore	$ 940,000	$ 560,000
Lynchburg	$ 970,000	$ 630,000

Section 4.4: Summary of EIA Results. The benefits of protecting water quality are significant in urban communities. More importantly, effective stormwater management will create and maintain the quality of life that is essential for the growth and development of communities throughout the region. At the same time addressing increasingly aggressive stormwater management is requiring new and more efficient means of meeting financing challenges. And though the primary focus in most communities will be to generate sufficient revenues and contain program costs, it will be essential for local leaders to coordinate stormwater financing activities with other community priorities and efforts. Our aim with this economic impact study was to help local communities better understanding the economic impacts associated with stormwater investments, so that they can more effectively capitalize on linkages between water quality restoration programs and requirements with other community priorities, specifically economic development and growth.

The combination of more aggressive permit requirements, mandatory financing mechanisms resulting from HB987, as well as more restrictive state-based laws regulating the impact of new development on water resources, will result in billions of dollars in stormwater investments over the coming years. Based on our assessment it appears that Anne Arundel County is in a very advantageous position for taking advantage of the impacts that will result from those investments. In addition, as this study shows, there are specific industries that will be directly impacted by increased stormwater investments in urban communities. As a result, communities need to take proactive action to ensure that they have the capacity within specific industries to manage increased spending so that it has the maximum impact on their community.

Input-output models demonstrate the unique interactions between the industries that are directly, and even indirectly, impacted by stormwater investments; and community leaders should ensure that the infrastructure is in place to guarantee these interactions occur effectively and efficiently. Stormwater management activities impact a broad variety of industries and disciplines across local economies. A recent study conducted by the Philadelphia's Green Economy Task Force indicates that constructing and maintaining stormwater infrastructure will require the engagement and interaction of industries in manufacturing and service industries, including: manufacturing and distribution; site design;

construction; monitoring; and, operations and maintenance.[32] Within each of these activities, there are many more associated sub-activities that will influence the impact that investments have on a local economy. An important part of future economic development activities in these pilot communities, as well as other communities across the region, will be to develop a clearer understanding of these industry interactions in their own community and to establish processes for strengthening and securing those connections.

The results of this study provide a platform for Anne Arundel County to structure stormwater programs that advance broader community goals, while at the same time creating and expanding other community programs, such as economic development, that take advantage of significant stormwater investment activities.

[32] *Gray to Green: Jumpstarting Private Investment in Green Stormwater Infrastructure* (Philadelphia SBN's Green Economy Task Force).

Section 5: Recommendations for Moving Forward

Establishing an enterprise fund has been a major step forward in Anne Arundel County's efforts to meet stormwater management obligations. The next logical step in the financing process will be to implement systems and processes that reduce costs even further, thereby reducing the fiscal impact on the County. To that end, we offer the following key recommendations to the County:

- Shift to a performance-based financing program that incentivizes efficiency and innovation; and,
- Use the performance-based system to test innovative financing tools and programs such as reverse auctions and consumer rebate programs

Recommendation 1: Shift to a Performance-Based Financing System. Our first recommendation to Anne Arundel County is to begin the process of shifting from a traditional procurement-based stormwater financing system to one that is based on performance and effective engagement with the private sector. Below we provide a thorough description of the key components of performance financing systems. The structure is simple in concept, however. In a performance system, Anne Arundel County stormwater managers and leaders would pay for the direct delivery of environmental benefits, such as reductions in nutrient and sediment pollution, rather than funding levels of implementation, i.e. projects constructed. The shift, though subtle, would have a transformational impact on the County's financing efficiency. Rather than becoming handcuffed by expected or perceived implementation costs, the EFC believes that communities like Anne Arundel County have an opportunity to dramatically reduce the costs associated with achieving state mandated restoration goals, while at the same time protecting important natural resources that are integral to community's culture, heritage, and quality of life.

Performance-based financing systems. The implementation of fee-based financing program in Anne Arundel County has created an opportunity to think very differently about how to achieve the greatest project efficiencies and performance. Specifically, there exists an opportunity for urban communities to establish financing programs that are designed around incentivizing cost reduction and efficiency through the use of pay-for-performance systems designed to incentivize private firms, businesses, and residents to maximize environmental benefit per every dollar spent.

What differentiates performance systems from traditional financing systems is the focus on environmental outcomes (improvements in water quality, for example) rather than outputs (the numbers of practices installed). Traditional public sector financing programs focus on achieving a pre-determined outcome in the most efficient way possible. In other words, publically financed programs and agencies create incentives for achieving a certain level of activity. This makes sense when considering traditional capital investments in critical infrastructure such as roads, schools, or water and wastewater infrastructure. This type of system does not make sense when the goal is to achieve a certain level of environmental performance over time. In these situations, it is necessary to shift financing from pre-determined activities or outputs to desired outcomes or results. In other words, the focus of

investments should be on achieving an environmental goal in the most efficient way possible. This is in effect, performance-based financing.

Performance payment systems tie individual incentives to the level of environmental services actually created – performance payment systems are the most direct payment approach.[33] As described in a working paper published by the Institute for Environmental Decisions, the performance payment system looks more like paying a salesperson a commission for completed sales while an output-based approach would be the equivalent of paying an hourly wage for time spent interacting with potential buyers.[34] This type of financing creates tremendous positive incentives because it allows the suppliers of environmental services to identify the most efficient and effective options available. The result is the greatest amount of environmental and community benefit per dollar invested.

In regards to the Watershed Implementation Plans, the benefits of a performance-based financing system are potentially significant. If investments are predicated on pounds of nutrient pollution reduced rather than practices installed, there is an inherent incentive built into the financing system to improve efficiency. By increasing performance at any given price point, a project implementer has an opportunity to increase their return on investment. This incentive is much less impactful in the activity-based system because the reductions in cost could be at the expense of pounds removed from the system.

Perhaps the greatest advantage of implementing a performance-based financing system is that it will shift implementation and financing risk from public agencies and programs to private entities or project managers seeking to create and sell nonpoint source reductions.[35] With the burden of proof on project managers to document performance, it will be up to them to determine how nutrients will be reduced. Rather than being confined to choose nutrient control actions from a preselected suite of BMPs, project managers would be allowed to experiment with the most effective ways to reduce pollutant loading. This would allow landowners and operators the flexibility to determine how best to prevent pollutants from entering waters – this type of choice is at the core of an effective market-based solution.

[33] B. Roe, A. Zabel. "Performance payments for environmental services: Lessons from economic theory on the strength of incentives in the presence of performance risk and performance measurement distortion." Institute for Environmental Decisions; working paper. June 2009. Page 3.

[34] Ibid.

[35] Stephenson, K., P. Norris, and L. Shabman, 1998. "Effluent Allowance Trading: The Nonpoint Source Challenge." Contemporary Economic Policy 16(4):412-421.

Table 10: Comparing Traditional and Performance-Based Financing Systems

Traditional:	Performance-Based:
• Focus on known practices and technologies	• Focus on outcomes and efficiency, i.e. $/pound of pollution reduced
• Success is measured by levels of implementation	• Risk is effectively shifted to the private sector
• Few incentives to innovate and reduce costs	• Incentives on the part of the private sector to innovate and reduce costs
• Public sector maintains financing risk	• Requires smaller, more streamlined and efficient public institutions; more effective government
• Requires relatively large public programs and administration	• Greater value gained per dollar invested

Of course, the suggestion to implement this type of system is not new. In fact, a BMP cost study conducted by a team of economists on behalf of Maryland DNR in 2009 suggested that the best way to reduce these costs was to shift funding to a more performance-based system. Wieland, et al state:

> "The true costs of reducing nutrients from surface waters of the State are obscured by the fact that existing programs pay for implementing qualified BMPs and not for directly reducing nutrients. Existing programs do not offer to buy a specified amount of nutrient reduction at some agreed upon price as would happen in a market or performance-based payment regime that sought to specifically buy nutrient reductions. Instead, they compensate participants for implementing BMPs that will, in varying amounts, mitigate nutrient pollution in the state's waters…"[36]

Putting the system into action. Contrary to much of the debate regarding public/private partnerships, performance-based financing systems do not require complicated or exotic institutions or arrangements. They do, however, require some key components to work effectively, including: long-term revenue; a focus on results; robust modeling and data; and, adaptable and flexible procurement systems.

- Sustainable revenue streams: The cornerstone of performance payment systems is the interaction between public agencies and the private sector. The vast potential of performance financing exists due to the fact that private actors—residents, businesses, investors, entrepreneurs, and associated industries—are motivated and incentivized to achieve environmental goals. In short, these incentives are based on the opportunity to

[36] Wieland, R., Parker, D., Gans, W., Martin, A. "Cost and Cost Efficiencies of Some Nutrient Reduction Practices in Maryland." Prepared for the National Oceanic and Atmospheric Administration Chesapeake Bay Program Office, and the Maryland Department of Natural Resources. April 28, 2009. Page 46.

generate profits, reduce costs, and maximize community welfare. This all requires sustainable revenue streams.

Anne Arundel County is in an extremely advantageous position as a result of its decision to establish a dedicated revenue stream in support of stormwater management. Stormwater fees will enable the city to test new financing systems that go beyond existing stormwater management programs. And, the expectation of consistent revenue flow will incentivize entire industries to take action. Specifically, consistently allocating and investing revenue sends the message to the private sector that the community leaders are committed to solving the problem. Long-term funding commitments enable private firms and investors (including residents) to make capital investments with relative certainty. In turn, they will look for opportunities to reduce costs as a way of maximizing return on investment. Over time, performance goes up, costs go down, and goals are achieved efficiently.

- A focus on delivered results: The uncertainty associated with environmental restoration and protection efforts like stormwater management creates tremendous risk for the public sector. In short, it is often very difficult and time consuming to get functioning projects on the ground. This risk comes with costs that ultimately reduce the efficiency of restoration projects. A more effective approach is to transfer that risk to the private sector. The marketplace is much more adept at mitigating financing risk; it is, in fact, what drives market action.

  In a normal public procurement system, contracts are executed and agreed upon in advance of implementation activity. Though there are certainly incentives—legal and otherwise—on the part of contractors to implement projects as designed and contracted, the risk of project performance in fact remains with the public agency. A more efficient and less risky system would instead focus on investing in delivered projects. In effect, this would create a private nutrient banking system within the County. Project performance risk would shift to the private banks themselves and as a result would ultimately improve the effectiveness of stormwater investments.

  In a performance-based financing system, private investors and project managers finance and implement restoration projects and then sell the associated pollution reductions—in the form of credits—to stormwater managers. As a result, the risks associated with project performance and entirely assumed by the project managers as opposed to the public stormwater program. This means that the stormwater program managers will know with relative certainty that the pollution reductions have been made before payment is made. In effect, this type of system models mitigation banking programs that have been in place for many years.

- Robust modeling and data management systems: Any type of restoration financing system requires an understanding of where control practices and projects will have the greatest benefit to the environment. Performance payment systems are no exception. This requires models and databases that can accurately predict where the greatest environmental benefit will occur. The goal is to target investments in a way that reduces performance risk even further, thereby reducing costs and improving efficiencies. Anne Arundel County is in a uniquely advantageous position in regards to modeling given the sophistication of the

system currently in use.

- Adapting procurement systems: Finally, performance-financing systems are greatly benefited by a procurement process that is flexible and able to shift from project financing-based payments to performance-based purchases of pollution reductions. It is not a difficult transition to make. In fact, shifting to performance payments enables a community to rely on its existing procurement system, which keeps administrative costs low. A good example of the type of performance system referenced here is the North Carolina Ecosystem Enhancement Program (NCEEP). NCEEP is able to disseminate Request for Proposals (RFPs) for water mitigation credits through their state procurement system. Through this method, the state is able to connect with bidders through a market approach using a platform already in place. This system could serve as a platform for local performance payment systems as well, in which the local government can use procurement platforms for other projects to meet their WIP and TMDL requirements.

Using these four components as a foundation, Anne Arundel County can reduce the costs associated with water quality restoration and protection significantly while at the same time incentivizing innovation. In the next section, the EFC offers recommendations for moving forward to make this system a reality.

Recommendation 2: Implement a Stormwater Rebate Program. When determining how to achieve the goals laid out in the Watershed Implementation Plan and the stormwater permit, communities typically think big and focus on placing BMPs on publicly available lands. As we demonstrated in Section 2 of this report, capital costs for these projects are often high and efficiencies may be limited due to the geographic location of the available lands. In order to meet stormwater goals in a cost effective manner, communities will need to expand their horizons to include homeowner BMPs and private properties where, when aggregated, can provide nutrient reductions for lower costs. If incentive programs are expanded, increased awareness and interest in stormwater management practice installation could result in larger nutrient reductions over time.

Stormwater rebate programs are designed to incentivize property owners to decrease stormwater runoff and/or increase stormwater quality exiting their property, assisting the community in meeting their stormwater goals. Rebates offer a property owner the opportunity to install specific practices that either decrease the runoff volume or increase the runoff water quality leaving the property. By offering incentives to both residential and commercial properties, communities like Anne Arundel County can target areas and BMPs with the highest return on investment. And, while rebate programs have often been used strictly as public outreach tools, new policy changes at the Chesapeake Bay Program office will enable local governments to receive regulatory credit for the on-the-ground results that the programs achieve. ***In short, rebate programs are about to become legitimate options for reducing the costs associated with permit compliance.***

When setting up a stormwater rebate program, the local decision makers should decide what BMPs will qualify and what properties are eligible for receiving stormwater rebates. The choice of BMP may be based on environmental or community goals, such as increasing groundwater

recharge, or decreasing sediment runoff.[37] The availability of these choices provides local decision makers the flexibility and creativity to target specific geographic locations within the community and shape programs to fit other community priorities.

Rebate Program and Outreach. One of the key aspects of all rebate programs is community outreach. In order to get public involvement in BMP installation, there needs to be public awareness. That awareness is brought about by disseminating information on stormwater management and its necessity in improving the health of the Chesapeake Bay or other impacted water bodies. Opening the public's eyes to projects that can be done at a residential level to help mitigate stormwater pollution through pilot projects, workshops, fliers and other media is the first step to creating successful rebate programs.

Rebate Programs Based on Geography. The geographically specific approach allows communities to fund projects in specific areas where BMP efficiencies may be higher or where impermeable surface area is disproportionately high. By focusing stormwater projects on properties that actually impact the receiving water bodies, the community is actually paying for treatment, rather than paying for stormwater management practices that do not perform. Targeting smaller areas within a community also provides a smaller footprint where new incentives can be piloted to determine their community-wide applicability.[38]

Stormwater rebate programs have been used extensively throughout the country and have proven very effective at engaging ratepayers in the restoration process. In Appendix 4 we highlight several that serve as effective models for Anne Arundel County to consider in the future.

Overcoming Barriers to Utilizing Residential BMPs in Meeting Reduction Credits on Permits.
Though rebate programs offer tremendous promise in creating efficiencies through more effective implementation targeting, there are barriers that need to be overcome, specifically as they relate to implementation costs. Perhaps the greatest barrier to the widespread adoption of rebate programs has been the inability to get regulatory credit for associated nutrient and sediment reductions. This is an especially significant problem as it relates to the Chesapeake Bay TMDL and the WIPs. Homeowner BMPs have not been issued credit on stormwater permits because individually, the reduction in nutrients and sediment loads is considered insignificant on a watershed scale. However, residential practices will soon be creditable for localities and states as a result of upcoming policy changes at the Chesapeake Bay Program.[39] Specifically, in order to effectively achieve residential BMP credit approval, two key policy changes are being suggested: the allowance of homeowner BMPs to be aggregated per locality;

[37] EPA. *Managing Wet Weather with Green Infrastructure Municipal Handbook Incentive Mechanisms;* EPA-833-F309-001; June 2009.

[38] EPA. *Managing Wet Weather with Green Infrastructure Municipal Handbook Incentive Mechanisms;* EPA-833-F309-001; June 2009.

[39] Chesapeake Stormwater Network. Homeowner BMP Guide. 2013. http://chesapeakestormwater.net/2013/04/homeowner-bmp-guide/.

and, the utilization of alternative BMP verification methods, which would decrease the local staff burden required under the proposed urban verification protocols for larger scale BMPs.[40]

These proposed changes to the residential BMP reporting protocols will have a tremendous impact on the effectiveness of stormwater rebate programs. In addition to serving as very effective private sector outreach tools and programs, these rebate programs will now offer the potential for local governments to get regulatory credit for the actions that result from these rebate programs. And, as our cost analysis indicates, many of the practices that would be the focus of a rebate program are often the most cost efficient and effective.

Recommendation 3: Test a Reverse Auction Program. Building on the rebate program, we recommend testing a reverse auction program. Unlike traditional subsidy and cost-share funding programs, which actually incentivize higher costs (the higher the costs, the greater the subsidy) reverse auctions use competitive behavior to drive costs down. A reverse auction reverses the roles of buyers and sellers. In an ordinary auction (also known as a forward auction), buyers compete to obtain a good or service, and the price typically increases over time. In a reverse auction, sellers compete to obtain business (in the case of water quality, to provide reduced pollution or BMPs), and prices typically decrease over time. In a typical auction, the seller puts an item up for sale. Multiple buyers bid for the item, and one or more of the highest bidders buy the goods at a price determined at the conclusion of the bidding. In markets with multiple sellers and a single buyer, reverse auctions can help to efficiently allocate a limited budget.[41]

Reverse auctions are used widely in business-to-business settings; in fact many project-bidding systems are based on reverse auction processes. Over the past several years, reverse auctions have been used to transact a variety of environmental and energy related products and services, including water quality. For example:

- In Cincinnati, Ohio US EPA researchers tested a reverse auction-bidding program as part of an urban residential stormwater management project. Interestingly, the researchers discovered that many residents were willing to install certain best management practices for free.[42]
- Valparaiso, Indiana implemented a stormwater-based reverse auction in 2011 in an effort to reduce flow to the city's combine sewer overflow system. The project focused on residential customers and resulted in cost efficiencies of more than 16 percent in some cases.
- The World Resources Institute and a team of partner organizations tested a reveres auction program in the Conestoga River watershed in Pennsylvania. Focusing on agricultural

[40] Schueler, Tom. *Application of CBP-Approved Urban BMP Protocols to Credit Nutrient Reduction Associated with Installation of Homeowner BMPs*. http://chesapeakestormwater.net/2013/04/homeowner-bmp-guide/.

[41] Beall, S., Carter, C., Carter, P., Germer, T., Hendrick, T., Jap, S., Kaufmann, L., Maciejewski, D., Monczka, R., and Peterson, K., (2003), "The Role of Reverse Auctions in Strategic Sourcing, CAPS Research Report," CAPS Research, Tempe, AZ.

[42] See Case Study 1 in Appendix 4 for more detail.

practices, the project resulted in nutrient emissions at prices far lower than equivalent USDA cost-share programs.[43]

- In 2010, the California Public Utilities Commission approved a reverse auction market to let renewable energy developers bid on small-scale projects under a program that would generate up to 1,000 megawatts for the state's three big investor-owned utilities and further spur the solar industry.[44]
- A project in Victoria, Australia called BushTender, based on the USDA CRP program here in the United States, used a reverse auction system to incentivize landowners to commit to fence off and manage an agreed amount of their native vegetation for a set period of time. The success of the project led to a similar project in New South Wales, Australia.[45]

While environmental auction mechanisms have been applied in agricultural settings, it is a novel approach to urban stormwater management, and the extent to which private homeowners will participate in such a program has not been tested.[46] As stated above, however, the experiences in Valparaiso and Cincinnati offer effective case studies for how these types of tools, when structured correctly, offer real opportunities to achieve water quality improvements on private land.

How auctions work. To achieve the goal of cost-effectiveness in managing stormwater runoff, policy instruments must encourage residential homeowners (as well as commercial landowners) to participate in the program at their minimum required level of compensation to install best management practices. In a reverse auction whose goal is to purchase environmental goods or services, bids are specified in terms of cost per environmental outcome achieved (in the case of local stormwater programs, acres of impervious surface treated or amount of water retained or detained on site) and are then ranked from lowest to highest, allowing the administrators of the auction to determine which bids are most competitive. The very nature of reverse auctions makes them cost-effective as they allow auction administrators to identify and purchase the lowest cost environmental outcomes.[47]

As with performance-financing systems in general, reverse auctions need their own infrastructure to function effectively, including flexible procurement systems, effective watershed models, and sustainable and dedicated revenue. However, the experiences in Indiana and Ohio have demonstrated that perhaps the most important need is effective

[43] Suzie Greenhalgh, Jenny Guiling, Mindy Selman, and Jonathan St John. "Paying For Environmental Performance: Using Reverse Auctions to Allocate Funding for Conservation." WRI Policy Note. Environmental Markets: Reverse Auctions No.3. January 2007.

[44] Todd Woody. "California approves reverse auction renewable energy market." Reuters. December 16, 2010. http://blogs.reuters.com/environment/2010/12/16/california-approves-reverse-auction-renewable-energy-market/ . Last accessed January 10, 2012.

[45] See Case Studies 2 and 3 in Appendix 4 for more detail.

[46] Thurston, H.W.; Taylor, M.A.; Shuster, W.D.; Roy, A.H.; Morrison, M.A. Using a reverse auction to promote household level stormwater control. Environmental Science & Policy 13 (2010) 405-414. Page 407. Published on line April 20, 2010.

[47] "Paying For Environmental Performance: Using Reverse Auctions to Allocate Funding for Conservation."

education and outreach.

As with the rebate programs, education and outreach are often critical to program success, and reverse auctions are no different. For example, the projects in both Valparaiso and Cincinnati relied on effective education and outreach to make them successful. In spite of the heavy attention that stormwater management garners among policymakers, it is still considered a relatively nascent issue by most citizens. Reverse auctions can certainly add to the confusion. As a result, auction and rebate programs are effective only when the program is prefaced with an effective outreach program.

In spite of the perceived complexity of reverse auction programs, they exemplify what is most important and potentially most powerful in regards to performance financing system. When structured appropriately, these systems accomplish two things. First, they take advantage of the tremendous power of the marketplace to drive down costs and create efficiencies. There is in fact no system in the world that is as effective at creating innovative, cost-effective outcomes as the marketplace, and reverse auctions capture that innovation and efficiency very effectively. Second, and perhaps just as importantly, when structure correctly, reverse auctions specifically, and performance financing in general, establish very clear barriers and codes of practice within the marketplace. There is no question that markets can be very effective at achieving community goals more effectively. There is also no question that markets can wreak havoc when allowed to function in an uncontrolled way. In fact, it could be argued that the global recession of the past few years was at least in part the result of reduced market oversight in many financial sectors. However, environmentally based reverse auctions and performance systems create real parameters and delivery metrics that require the private sector to perform and remain accountable. In addition, when structure appropriately, these types of systems create levels of transparency that are often lacking in other public financing systems.

Section 6: Conclusion

This project report brings to a conclusion EFC's work in Anne Arundel County. By focusing on a few key elements in the financing system—efficiency, performance, and effective partnerships with the private sector—the County can achieve its stormwater goals well into the future.

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- Dr. Memo Diriker, Executive Director
- Sarah Bunch, Assistant Director

BEACON Dr. Diriker and Ms. Bunch led the economic impact assessment process.

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- Robert Wieland, Owner

Mr. Wieland led the cost evaluation and modeling process.

Appendix 1: Detailed IMPLAN Model Results

The following tables provide complete modeling results related to the economic impact assessment. For the sake of comparison, we provide results from each of the three pilot communities.

Baltimore City results per $100M (Construction) and $10M (O&M)

Table 1. Estimated Impacts per $100M in Construction

Impact Type	WIP Projects
Direct Effect	$62,727,993
Indirect Effect	$9,127,447
Induced Effect	$4,587,087
Total Effect	$76,442,529
Total Employment	344
State and Local Fiscal Impact	$3,930,586
Federal Fiscal Impact	$5,006,511

Table 2. Estimated Annual Impacts per $10M in Operations and Maintenance

Impact Type	WIP Projects
Direct Effect	$7,382,541
Indirect Effect	$1,864,804
Induced Effect	$2,103,088
Total Effect	$11,350,433
Total Employment	75
State and Local Fiscal Impact	$560,265
Federal Fiscal Impact	$940,933

Detailed Construction Impact Estimates

Table 3. Baltimore City Estimated Economic and Employment Impact of WIP Projects Per $100M in Construction

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	262	$20,238,110	$36,630,498	$62,727,993
Indirect Effect	51	$3,116,526	$4,652,749	$9,127,447
Induced Effect	31	$1,592,537	$2,356,780	$4,587,087
Total Effect	344	$24,947,172	$43,640,030	$76,442,529

Detailed Annual Impact Estimates

Table 4. Baltimore City Estimated Economic and Employment Impact of WIP Projects Per $10M in Operations and Maintenance

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	48	$3,020,735	$4,546,804	$7,382,541
Indirect Effect	12	$774,113	$1,155,240	$1,864,804
Induced Effect	15	$799,774	$1,322,541	$2,103,088
Total Effect	75	$4,594,622	$7,024,585	$11,350,433

Detailed Fiscal Impact Estimates from Construction

Table 5. Baltimore City State and Local Fiscal Impacts from WIP Projects

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$0	$0	$0	$0	$328,572
Social Ins Tax- Employee Contribution	$7,372	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$31,717	$0	$0	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$1,100,752	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$1,197,498	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$29,431	$0	$0
Indirect Bus Tax: Severance Tax	$0	$0	$0	$0	$0
Indirect Bus Tax: Other Taxes	$0	$0	$421,544	$0	$0
Indirect Bus Tax: S/L NonTaxes	$0	$0	$69,629	$0	$0
Corporate Profits Tax	$0	$0	$0	$0	$152,621
Personal Tax: Income Tax	$0	$0	$0	$478,064	$0
Personal Tax: NonTaxes (Fines - Fees)	$0	$0	$0	$88,598	$0
Personal Tax: Motor Vehicle License	$0	$0	$0	$15,229	$0
Personal Tax: Property Taxes	$0	$0	$0	$7,161	$0
Personal Tax: Other Tax (Fish/Hunt)	$0	$0	$0	$2,398	$0
Total State and Local Tax	$39,089	$0	$2,818,854	$591,450	$481,194

Table 6. Baltimore City Federal Fiscal Impacts from WIP Projects

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$1,169,013	$364,963	$0	$0	$0
Social Ins Tax- Employee Contribution	$1,182,226	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$0	$0	$270,283	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$125,873	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$207,777	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$0	$0	$737,036
Indirect Bus Tax: Severance Tax	$0	$0	$0	$949,340	$0
Indirect Bus Tax: Other Taxes	$2,351,239	$364,963	$603,933	$949,340	$737,036

Detailed Fiscal Impacts from Operations and Maintenance

Table 7. Baltimore City State and Local Fiscal Impacts from WIP Projects Per $10M in Operations and Maintenance

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$0	$0	$0	$0	$978
Social Ins Tax- Employee Contribution	$2,581	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$5,981	$0	$0	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$164,279	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$180,854	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$4,434	$0	$0
Indirect Bus Tax: Severance Tax	$0	$0	$0	$0	$0
Indirect Bus Tax: Other Taxes	$0	$0	$41,740	$0	$0
Indirect Bus Tax: S/L NonTaxes	$0	$0	$16,421	$0	$0
Corporate Profits Tax	$0	$0	$0	$0	$16,605
Personal Tax: Income Tax	$0	$0	$0	$102,067	$0
Personal Tax: NonTaxes (Fines - Fees)	$0	$0	$0	$19,418	$0
Personal Tax: Motor Vehicle License	$0	$0	$0	$2,855	$0
Personal Tax: Property Taxes	$0	$0	$0	$1,386	$0
Personal Tax: Other Tax (Fish/Hunt)	$0	$0	$0	$665	$0
Total State and Local Tax	$8,562	$0	$407,728	$126,392	$17,583

Table 8. Baltimore City Federal Fiscal Impacts from WIP Projects Per $10M in Operations and Maintenance

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$236,987	$22,423	$0	$0	$0
Social Ins Tax- Employee Contribution	$233,622	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$0	$0	$43,035	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$16,883	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$28,749	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$0	$0	$136,109
Indirect Bus Tax: Severance Tax	$0	$0	$0	$223,126	$0
Indirect Bus Tax: Other Taxes	$470,609	$22,423	$88,667	$223,126	$136,109

Anne Arundel County, Maryland

Table 9. Estimated Impacts per $100M in Construction

Impact Type	WIP Projects
Direct Effect	$73,419,474
Indirect Effect	$18,518,579
Induced Effect	$23,219,487
Total Effect	$115,157,539
Total Employment	776
State and Local Fiscal Impact	$4,584,773
Federal Fiscal Impact	$8,949,926

Table 10. Estimated Annual Impacts per $10M in Operations and Maintenance

Impact Type	WIP Projects
Direct Effect	$8,810,626
Indirect Effect	$1,960,503
Induced Effect	$4,401,252
Total Effect	$15,172,382
Total Employment	118
State and Local Fiscal Impact	$798,990
Federal Fiscal Impact	$1,585,104

Detailed Construction Impact Estimates

Table 11. Anne Arundel County Estimated Economic and Employment Impact of WIP Projects Per $100M in Construction

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	442	$26,290,178	$35,196,475	$73,419,474
Indirect Effect	135	$8,670,461	$11,606,596	$18,518,579
Induced Effect	199	$7,941,310	$15,338,478	$23,219,487
Total Effect	776	$42,901,948	$62,141,549	$115,157,539

Detailed Annual Impact Estimates

Table 12. Anne Arundel County Estimated Economic and Employment Impact of WIP Projects Per $10M in Operations and Maintenance

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	64	$5,774,957	$6,159,603	$8,810,626
Indirect Effect	16	$849,258	$1,276,063	$1,960,503
Induced Effect	38	$1,505,264	$2,907,470	$4,401,252
Total Effect	118	$8,129,479	$10,343,135	$15,172,382

Detailed Fiscal Impact Estimates from Construction

Table 13. Anne Arundel County State and Local Fiscal Impacts from WIP Projects Per $100M in Construction

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$0	$0	$0	$0	$8,25
Social Ins Tax- Employee Contribution	$11,686	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$27,076	$0	$0	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$1,027,762	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$1,131,457	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$27,740	$0	$0
Indirect Bus Tax: Severance Tax	$0	$0	$0	$0	$0
Indirect Bus Tax: Other Taxes	$0	$0	$261,133	$0	$0
Indirect Bus Tax: S/L NonTaxes	$0	$0	$102,730	$0	$0
Corporate Profits Tax	$0	$0	$0	$0	$140,09
Personal Tax: Income Tax	$0	$0	$0	$1,414,359	$0
Personal Tax: NonTaxes (Fines - Fees)	$0	$0	$0	$348,923	$0
Personal Tax: Motor Vehicle License	$0	$0	$0	$52,088	$0
Personal Tax: Property Taxes	$0	$0	$0	$18,882	$0
Personal Tax: Other Tax (Fish/Hunt)	$0	$0	$0	$12,590	$0
Total State and Local Tax	$38,762	$0	$2,550,822	$1,846,841	$148,34

Table 14. Anne Arundel County Federal Fiscal Impacts from WIP Projects Per $100M in Construction

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$2,007,583	$278,218	$0	$0	$0
Social Ins Tax- Employee Contribution	$1,979,069	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$0	$0	$203,869	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$79,981	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$136,192	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$0	$0	$1,148,336
Indirect Bus Tax: Severance Tax	$0	$0	$0	$3,116,679	$0
Indirect Bus Tax: Other Taxes	$3,986,651	$278,218	$420,042	$3,116,679	$1,148,336

Detailed Fiscal Impacts from Operations and Maintenance

Table 15. Anne Arundel County State and Local Fiscal Impacts from WIP Projects

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$0	$0	$0	$0	$871
Social Ins Tax- Employee Contribution	$2,187	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$5,067	$0	$0	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$171,581	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$188,893	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$4,631	$0	$0
Indirect Bus Tax: Severance Tax	$0	$0	$0	$0	$0
Indirect Bus Tax: Other Taxes	$0	$0	$43,595	$0	$0
Indirect Bus Tax: S/L NonTaxes	$0	$0	$17,150	$0	$0
Corporate Profits Tax	$0	$0	$0	$0	$14,791
Personal Tax: Income Tax	$0	$0	$0	$268,209	$0
Personal Tax: NonTaxes (Fines - Fees)	$0	$0	$0	$66,167	$0
Personal Tax: Motor Vehicle License	$0	$0	$0	$9,878	$0
Personal Tax: Property Taxes	$0	$0	$0	$3,581	$0
Personal Tax: Other Tax (Fish/Hunt)	$0	$0	$0	$2,387	$0
Total State and Local Tax	$7,255	$0	$425,851	$350,222	$15,663

Table 16. Anne Arundel County Federal Fiscal Impacts from WIP Projects Per $10M in Operations and Maintenance

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$375,734	$56,580	$0	$0	$0
Social Ins Tax- Employee Contribution	$370,397	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$0	$0	$34,035	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$13,353	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$22,737	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$0	$0	$121,243
Indirect Bus Tax: Severance Tax	$0	$0	$0	$591,025	$0
Indirect Bus Tax: Other Taxes	$746,132	$56,580	$70,125	$591,025	$121,243

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Table 17. Estimated Impacts per $100M in Construction

Impact Type	WIP Projects
Direct Effect	$108,333,333
Indirect Effect	$35,749,052
Induced Effect	$29,763,160
Total Effect	$173,845,545
Total Employment	1,411
State and Local Fiscal Impact	$4,825,892
Federal Fiscal Impact	$12,400,140

Table 18. Estimated Annual Impacts per $10M in Operations and Maintenance

Impact Type	WIP Projects
Direct Effect	$7,696,206
Indirect Effect	$1,853,626
Induced Effect	$1,992,650
Total Effect	$11,542,481
Total Employment	90
State and Local Fiscal Impact	$626,917
Federal Fiscal Impact	$974,917

Detailed Construction Impact Estimates

Table 19. Lynchburg Estimated Economic and Employment Impact of WIP Projects Per $100M in Construction

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	877	$33,825,076	$43,980,539	$108,333,333
Indirect Effect	268	$15,025,604	$21,087,586	$35,749,052
Induced Effect	266	$10,095,819	$18,069,706	$29,763,160
Total Effect	1,411	$58,946,500	$83,137,831	$173,845,545

Detailed Annual Impact Estimates

Table 20. Lynchburg Estimated Economic and Employment Impact of WIP Projects Per $10M in Operations and Maintenance

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	57	$2,642,972	$4,776,242	$7,696,206
Indirect Effect	14	$615,578	$1,078,624	$1,853,626
Induced Effect	18	$675,116	$1,208,565	$1,992,650
Total Effect	90	$3,933,666	$7,063,442	$11,542,481

Detailed Fiscal Impact Estimates from Construction

Table 21. Lynchburg State and Local Fiscal Impacts from WIP Projects Per $100M in Construction

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$0	$0	$0	$0	$9,53
Social Ins Tax- Employee Contribution	$24,165	$0	$0	$0	$
Social Ins Tax- Employer Contribution	$55,988	$0	$0	$0	$
Indirect Bus Tax: Sales Tax	$0	$0	$1,183,184	$0	$
Indirect Bus Tax: Property Tax	$0	$0	$1,571,072	$0	$
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$29,073	$0	$
Indirect Bus Tax: Severance Tax	$0	$0	$756	$0	$
Indirect Bus Tax: Other Taxes	$0	$0	$282,255	$0	$
Indirect Bus Tax: S/L NonTaxes	$0	$0	$188,628	$0	$
Corporate Profits Tax	$0	$0	$0	$0	$129,13
Personal Tax: Income Tax	$0	$0	$0	$1,151,150	$
Personal Tax: NonTaxes (Fines - Fees)	$0	$0	$0	$122,209	$
Personal Tax: Motor Vehicle License	$0	$0	$0	$40,582	$
Personal Tax: Property Taxes	$0	$0	$0	$25,676	$
Personal Tax: Other Tax (Fish/Hunt)	$0	$0	$0	$12,493	$
Total State and Local Tax	$80,152	$0	$3,254,967	$1,352,108	$138,66

Table 22. Lynchburg Federal Fiscal Impacts from WIP Projects Per $100M in Construction

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$3,213,698	$218,086	$0	$0	$0
Social Ins Tax- Employee Contribution	$3,168,054	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$0	$0	$373,351	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$146,473	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$249,413	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$0	$0	$1,414,59
Indirect Bus Tax: Severance Tax	$0	$0	$0	$3,616,468	$0
Indirect Bus Tax: Other Taxes	$6,381,752	$218,086	$769,236	$3,616,468	$1,414,59

Detailed Fiscal Impacts from Operations and Maintenance

Table 23. Lynchburg State and Local Fiscal Impacts from WIP Projects Per $10M in Operations and Maintenance

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$0	$0	$0	$0	$1,178
Social Ins Tax- Employee Contribution	$1,585	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$3,677	$0	$0	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$186,793	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$248,037	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$4,591	$0	$0
Indirect Bus Tax: Severance Tax	$0	$0	$121	$0	$0
Indirect Bus Tax: Other Taxes	$0	$0	$44,565	$0	$0
Indirect Bus Tax: S/L NonTaxes	$0	$0	$29,780	$0	$0
Corporate Profits Tax	$0	$0	$0	$0	$15,974
Personal Tax: Income Tax	$0	$0	$0	$77,163	$0
Personal Tax: NonTaxes (Fines - Fees)	$0	$0	$0	$8,191	$0
Personal Tax: Motor Vehicle License	$0	$0	$0	$2,719	$0
Personal Tax: Property Taxes	$0	$0	$0	$1,717	$0
Personal Tax: Other Tax (Fish/Hunt)	$0	$0	$0	$837	$0
Total State and Local Tax	$5,262	$0	$513,875	$90,628	$17,152

Table 24. Lynchburg Federal Fiscal Impacts from WIP Projects Per $10M in Operations and Maintenance

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$210,881	$17,328	$0	$0	$0
Social Ins Tax- Employee Contribution	$207,886	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$0	$0	$58,943	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$23,119	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$39,380	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$0	$0	$174,969
Indirect Bus Tax: Severance Tax	$0	$0	$0	$242,411	$0
Indirect Bus Tax: Other Taxes	$418,767	$17,328	$121,442	$242,411	$174,969

Appendix 2: Impacts by BMP

Table 1. Anne Arundel County Economic Impact Estimates BMP: Impact from Construction

BMP	Employment Impact	Economic Impact			Total Economic Impact	Total Fiscal Impact		ROI
		Direct	Indirect	Induced		State and Local	Federal	
Impervious Urban Surface Reduction	1.2	$135,502	$25,155	$30,751	$191,408	$10,485	$14,219	$0.31
Urban Forest Buffers	0.3	$27,752	$6,783	$9,204	$43,739	$1,670	$3,307	$0.33
Urban Grass Buffers	0.2	$19,889	$4,861	$6,596	$31,346	$1,197	$2,370	$0.33
Urban Tree Planting	1.4	$193,067	$23,196	$21,008	$237,266	$18,537	$17,058	$0.30
Wet Ponds and Wetlands (New)	0.2	$23,054	$5,202	$7,804	$36,060	$1,561	$2,880	$0.39
Wet Ponds and Wetlands (Retrofit)	0.6	$58,646	$13,495	$22,241	$94,382	$3,996	$7,881	$0.44
Dry Detention Ponds (New)	0.4	$39,230	$8,606	$12,760	$60,595	$2,723	$4,817	$0.38
Hydrodynamic Structures (New)	0.4	$35,858	$8,658	$12,582	$57,099	$2,234	$4,473	$0.36
Dry Extended Detention Ponds (New)	0.4	$39,230	$8,606	$12,760	$60,595	$2,723	$4,817	$0.38
Dry Extended Detention Ponds (Retrofit)	0.7	$65,041	$14,549	$23,686	$103,276	$4,538	$8,578	$0.43
Infiltration Practices w/o Sand, Veg. (New)	0.6	$56,689	$12,650	$19,803	$89,042	$3,910	$7,259	$0.41
Infiltration Practices w/ Sand, Veg. (New)	0.6	$59,036	$13,230	$20,733	$92,999	$4,069	$7,585	$0.41
Filtering Practices (Sand, above ground)	0.5	$48,331	$10,693	$16,665	$75,689	$3,369	$6,160	$0.41
Filtering Practices (Sand, below ground)	0.5	$48,938	$11,596	$18,596	$79,130	$3,207	$6,516	$0.42
Erosion and Sediment Control	0.2	$22,480	$5,373	$8,244	$36,096	$1,440	$2,906	$0.39
Urban Nutrient Management	0.5	$50,362	$12,496	$15,500	$78,358	$2,897	$5,654	$0.29
Street Sweeping	0.0	$4,994	$1,239	$1,537	$7,770	$287	$560	$0.29
Urban Stream Restoration	0.6	$56,885	$13,380	$22,257	$92,521	$3,800	$7,759	$0.44
Bioretention (New - Suburban)	0.4	$43,591	$10,003	$14,705	$68,300	$2,884	$5,398	$0.37
Bioretention (Retrofit - Highly Urban)	9.7	$163,883	$38,377	$61,255	$263,515	$58,346	$114,348	$0.42
Vegetated Open Channels	0.2	$22,695	$5,166	$7,347	$35,208	$1,502	$2,740	$0.36
Bioswale (New)	0.4	$38,907	$8,916	$14,104	$61,927	$2,630	$5,069	$0.41

Permeable Pavement w/o Sand, Veg. (New)	2.0	$201,479	$49,247	$66,821	$317,547	$12,122	$24,010	$0.33
Permeable Pavement w/ Sand, Veg. (New)	2.8	$282,071	$68,946	$93,549	$444,566	$16,972	$33,615	$0.33

Table 2. Anne Arundel County Economic Impact Estimates BMP: Annual Impact from O&M

BMP	Employment Impact	Economic Impact			Total Economic Impact	Total Fiscal Impact	
		Direct	Indirect	Induced		State and Local	Federal
Impervious Urban Surface Reduction	0	$687	$83	$329	$1,099	$86	$113
Urban Forest Buffers	0	$939	$113	$450	$1,502	$120	$156
Urban Grass Buffers	0	$675	$81	$324	$1,080	$84	$112
Urban Tree Planting	0	$393	$113	$450	$1,502	$120	$156
Wet Ponds and Wetlands (New)	0	$592	$71	$284	$947	$74	$98
Wet Ponds and Wetlands (Retrofit)	0	$592	$71	$284	$947	$74	$98
Dry Detention Ponds (New)	0	$956	$115	$458	$1,529	$122	$158
Hydrodynamic Structures (New)	0	$2,742	$329	$1,314	$4,385	$347	$454
Dry Extended Detention Ponds (New)	0	$956	$115	$458	$1,529	$122	$158
Dry Extended Detention Ponds (Retrofit)	0	$956	$115	$458	$1,529	$122	$158
Infiltration Practices w/o Sand, Veg. (New)	0	$672	$81	$322	$1,075	$84	$111
Infiltration Practices w/ Sand, Veg. (New)	0	$703	$85	$337	$1,125	$89	$115
Filtering Practices (Sand, above ground)	0	$1,111	$134	$532	$1,777	$141	$183
Filtering Practices (Sand, below ground)	0	$1,266	$152	$307	$2,025	$160	$209
Erosion and Sediment Control	0	$8	$1	$4	$12	$1	$1
Urban Nutrient Management	0	$24	$3	$11	$38	$3	$3
Street Sweeping	0	$350	$42	$168	$560	$45	$58
Urban Stream Restoration	0	$692	$83	$331	$1,106	$87	$114
Bioretention (New - Suburban)	0	$1,189	$143	$570	$1,901	$150	$197

Bioretention (Retrofit - Highly Urban)	0	$1,189	$143	$570	$1,901	$150	$197
Vegetated Open Channels	0	$474	$57	$227	$757	$60	$78
Bioswale (New)	0	$723	$87	$346	$1,156	$91	$119
Permeable Pavement w/o Sand, Veg. (New)	0	$1,699	$204	$814	$2,717	$215	$281
Permeable Pavement w/ Sand, Veg. (New)	0	$2,366	$284	$1,138	$3,789	$301	$392

Lynchburg

Table 3. Lynchburg Economic Impact Estimates BMP: Impact from Construction

Impact from Construction	Employment Impact	Economic Impact			Total Economic Impact	Total Fiscal Impact		ROI
		Direct	Indirect	Induced		State and Local	Federal	
Impervious Urban Surface Reduction	1.4	$135,807	$33,242	$27,795	$334,254	$7,121	$13,379	$0.35
Urban Forest Buffers	0.4	$34,752	$10,340	$8,688	$53,781	$1,374	$3,545	$0.64
Urban Grass Buffers	0.3	$24,906	$7,411	$6,226	$38,543	$985	$2,541	$0.64
Urban Tree Planting	1.1	$238,644	$37,294	$30,630	$306,568	$10,714	$12,662	$0.68
Wet Ponds and Wetlands (New)	0.3	$23,756	$6,758	$5,388	$36,347	$1,021	$2,452	$0.38
Wet Ponds and Wetlands (Retrofit)	0.6	$54,893	$15,938	$14,122	$84,953	$2,297	$5,798	$0.29
Dry Detention Ponds (New)	0.4	$39,635	$11,039	$9,520	$60,194	$1,763	$4,072	$0.37
Hydrodynamic Structures (New)	0.5	$41,383	$12,291	$10,478	$64,153	$1,648	$4,267	$0.53
Dry Extended Detention Ponds (New)	0.4	$39,635	$11,039	$9,520	$60,194	$1,763	$4,072	$0.37
Dry Extended Detention Ponds (Retrofit)	0.7	$59,888	$16,989	$15,037	$91,914	$2,604	$6,290	$0.27
Infiltration Practices w/o Sand, Veg. (New)	0.6	$54,811	$15,513	$13,561	$83,884	$2,385	$5,702	$0.33
Infiltration Practices w/ Sand, Veg. (New)	0.7	$57,271	$16,241	$14,198	$87,711	$2,482	$5,962	$0.33
Filtering Practices (Sand, above ground)	0.5	$46,506	$13,054	$11,408	$70,968	$2,049	$4,830	$0.32
Filtering Practices (Sand, below ground)	0.6	$49,213	$14,567	$12,757	$76,537	$1,987	$5,173	$0.37
Erosion and Sediment Control	0.3	$24,127	$7,154	$6,183	$37,464	$968	$2,512	$0.45
Urban Nutrient Management	0.8	$69,201	$20,629	$17,069	$106,899	$2,717	$6,982	$0.76
Street Sweeping	0.1	$6,862	$2,046	$1,693	$10,601	$269	$692	$0.76
Urban Stream Restoration	0.6	$54,085	$15,980	$14,195	$84,260	$2,199	$5,743	$0.31
Bioretention (New - Suburban)	0.5	$46,856	$13,476	$11,557	$71,889	$1,977	$4,823	$0.45
Bioretention (Retrofit - Highly Urban)	1.9	$163,548	$47,983	$42,006	$253,537	$7,120	$18,221	$0.36
Vegetated Open Channels	0.3	$25,026	$7,147	$6,086	$38,258	$1,067	$2,559	$0.48

Bioswale (New)	0.4	$38,288	$11,049	$9,666	$59,002	$1,614	$4,000	$0.35
Permeable Pavement w/o Sand, Veg. (New)	2.8	$525,454	$75,112	$63,137	$390,703	$9,988	$25,762	$1.78
Permeable Pavement w/ Sand, Veg. (New)	3.9	$353,436	$105,157	$88,391	$546,984	$13,984	$36,066	$0.64

Table 4. Lynchburg Economic Impact Estimates BMP: Annual Impact from O&M

Annual Impact from Operations and Management	Employment Impact	Economic Impact			Total Economic Impact	Total Fiscal Impact	
		Direct	Indirect	Induced		State and Local	Federal
Impervious Urban Surface Reduction	0.0	$550	$54	$219	$823	$27	$43
Urban Forest Buffers	0.0	$752	$74	$299	$1,126	$36	$58
Urban Grass Buffers	0.0	$541	$53	$215	$809	$27	$42
Urban Tree Planting	0.0	$752	$75	$299	$1,126	$36	$58
Wet Ponds and Wetlands (New)	0.0	$474	$47	$189	$710	$23	$37
Wet Ponds and Wetlands (Retrofit)	0.0	$474	$47	$189	$710	$23	$37
Dry Detention Ponds (New)	0.0	$765	$76	$304	$1,145	$37	$59
Hydrodynamic Structures (New)	0.0	$2,195	$217	$873	$3,285	$108	$173
Dry Extended Detention Ponds (New)	0.0	$765	$76	$304	$1,145	$37	$59
Dry Extended Detention Ponds (Retrofit)	0.0	$765	$76	$304	$1,145	$37	$59
Infiltration Practices w/o Sand, Veg. (New)	0.0	$538	$53	$214	$806	$26	$42
Infiltration Practices w/ Sand, Veg. (New)	0.0	$563	$56	$224	$843	$27	$44
Filtering Practices (Sand, above ground)	0.0	$890	$88	$354	$1,331	$43	$70
Filtering Practices (Sand, below ground)	0.0	$1,014	$100	$403	$1,517	$50	$80
Erosion and Sediment Control	0.0	$6	$1	$2	$9	$0	$0
Urban Nutrient Management	0.0	$19	$2	$8	$29	$1	$1

Street Sweeping	0.0	$280	$28	$111	$419	$13	$22
Urban Stream Restoration	0.0	$554	$55	$220	$829	$27	$44
Bioretention (New - Suburban)	0.0	$952	$94	$378	$1,424	$47	$75
Bioretention (Retrofit - Highly Urban)	0.0	$952	$94	$378	$1,424	$47	$75
Vegetated Open Channels	0.0	$379	$37	$151	$567	$18	$31
Bioswale (New)	0.0	$579	$57	$230	$866	$28	$44
Permeable Pavement w/o Sand, Veg. (New)	0.0	$1,360	$134	$541	$2,035	$68	$107
Permeable Pavement w/ Sand, Veg. (New)	0.0	$1,902	$187	$756	$2,846	$94	$149

Baltimore City

Table 5. Baltimore City Economic Impact Estimates BMP: Impact from Construction

BMP	Employment Impact	Economic Impact			Total Economic Impact	Total Fiscal Impact		ROI
		Direct	Indirect	Induced		State and Local	Federal	
Impervious Urban Surface Reduction	0.8	$103,912	$20,273	$22,705	$146,890	$617,510	$1,235,018	$0.01
Urban Forest Buffers	0.2	$22,975	$5,739	$6,444	$35,158	$957	$2,543	$0.08
Urban Grass Buffers	0.1	$16,465	$4,113	$4,618	$25,197	$687	$205	$0.08
Urban Tree Planting	0.9	$131,984	$15,913	$17,724	$165,621	$10,891	$12,991	($0.09)
Wet Ponds and Wetlands (New)	0.2	$18,123	$4,233	$5,291	$24,648	$867	$2,094	$0.07
Wet Ponds and Wetlands (Retrofit)	0.4	$45,381	$10,802	$14,611	$70,794	$2,141	$5,508	$0.08
Dry Detention Ponds (New)	0.3	$30,613	$6,971	$8,695	$42,379	$1,519	$3,511	$0.06
Hydrodynamic Structures (New)	0.3	$29,107	$7,208	$8,603	$44,918	$1,251	$3,325	$0.08
Dry Extended Detention Ponds (New)	0.3	$30,613	$6,971	$8,695	$46,279	$1,519	$3,511	$0.06
Dry Extended Detention Ponds (Retrofit)	0.5	$49,997	$11,597	$15,637	$77,231	$2,451	$6,014	$0.07
Infiltration Practices w/o Sand, Veg. (New)	0.4	$45,832	$10,645	$13,857	$70,334	$2,227	$5,409	$0.12
Infiltration Practices w/ Sand, Veg. (New)	0.4	$43,905	$10,174	$13,242	$67,321	$2,140	$5,178	$0.03
Filtering Practices (Sand, above ground)	0.3	$37,404	$8,586	$11,164	$57,154	$1,848	$4,397	$0.07
Filtering Practices (Sand, below ground)	0.4	$38,529	$9,409	$12,312	$60,251	$1,732	$4,621	$0.09
Erosion and Sediment Control	0.2	$17,949	$4,412	$5,536	$27,896	$790	$2,105	$0.08
Urban Nutrient Management	0.4	$42,701	$10,776	$11,213	$64,690	$1,718	$4,543	$0.07
Street Sweeping	0.0	$4,234	$10,698	$1,112	$6,415	$171	$450	$1.68
Urban Stream Restoration	0.4	$44,249	$10,744	$14,568	$69,562	$2,025	$5,409	$0.09
Bioretention (New - Suburban)	0.3	$34,634	$8,209	$10,034	$52,877	$1,611	$3,968	$0.07

Bioretention (Retrofit - Highly Urban)	1.8	$828,655	$207,747	$224,452	$1,260,854	$11,537	$23,001	$5.81
Vegetated Open Channels	0.2	$18,109	$4,260	$5,072	$27,441	$847	$2,041	$0.07
Bioswale (New)	0.3	$30,373	$7,198	$9,390	$46,962	$1,432	$3,606	$0.08
Permeable Pavement w/o Sand, Veg. (New)	1.4	$166,796	$41,666	$46,786	$255,248	$6,955	$18,455	$0.08
Permeable Pavement w/ Sand, Veg. (New)	2.0	$233,514	$58,332	$65,501	$357,348	$9,736	$25,838	$0.08

Table 6. Baltimore City Economic Impact Estimates BMP: Annual Impact from O&M

Annual Impact from Operations and Management	**Employment Impact**	**Economic Impact**			**Total Economic Impact**	**Total Fiscal Impact**	
		Direct	**Indirect**	**Induced**		**State and Local**	**Federal**
Impervious Urban Surface Reduction	0.0	$456	$51	$148	$654	$55	$89
Urban Forest Buffers	0.0	$624	$69	$202	$895	$75	$122
Urban Grass Buffers	0.0	$448	$50	$145	$643	$55	$88
Urban Tree Planting	0.0	$624	$69	$202	$895	$75	$122
Wet Ponds and Wetlands (New)	0.0	$393	$44	$127	$564	$48	$76
Wet Ponds and Wetlands (Retrofit)	0.0	$393	$44	$127	$564	$48	$76
Dry Detention Ponds (New)	0.0	$634	$70	$205	$910	$75	$125
Hydrodynamic Structures (New)	0.0	$1,820	$202	$589	$2,611	$220	$357
Dry Extended Detention Ponds (New)	0.0	$634	$70	$205	$910	$77	$125
Dry Extended Detention Ponds (Retrofit)	0.0	$634	$70	$250	$910	$77	$125
Infiltration Practices w/o Sand, Veg. (New)	0.0	$446	$49	$144	$640	$55	$88
Infiltration Practices w/ Sand, Veg. (New)	0.0	$467	$52	$151	$670	$57	$91
Filtering Practices (Sand, above ground)	0.0	$738	$82	$239	$1,058	$89	$144
Filtering Practices (Sand, below ground)	0.0	$841	$93	$272	$1,206	$103	$164

Erosion and Sediment Control	0.0	$5	$1	$2	$7	$0	$1
Urban Nutrient Management	0.0	$16	$2	$5	$23	$1	$3
Street Sweeping	0.0	$234	$26	$76	$336	$28	$46
Urban Stream Restoration	0.0	$459	$51	$49	$659	$56	$90
Bioretention (New - Suburban)	0.0	$789	$87	$255	$1,132	$96	$155
Bioretention (Retrofit - Highly Urban)	0.0	$796	$88	$258	$1,142	$97	$156
Vegetated Open Channels	0.0	$314	$35	$102	$451	$39	$61
Bioswale (New)	0.0	$480	$53	$155	$688	$59	$95
Permeable Pavement w/o Sand, Veg. (New)	0.0	$1,128	$125	$365	$1,618	$137	$222
Permeable Pavement w/ Sand, Veg. (New)	0.0	$1,577	$175	$511	$2,262	$192	$307

Appendix 3: Stormwater Rebate Case Studies

Washington, DC. Washington, DC has incentivized stormwater management through the use of rebate programs for residential, commercial, and industrial properties. The RiverSmart Homes program offers rebates to residential property owners who install approved practices and the Green Roof Rebate program offers a certain dollar amount per square foot of green roof installation, with a higher incentive for properties located in targeted sub-watersheds. Information on the rebate programs is in an easily accessible format online, which fosters public outreach efforts.

Beginning in September 2011 and spanning through 2012, select community leaders from public, private, and non-profit sectors as well as agency leaders combined their efforts with input from community members across the District to form the DC Sustainability Plan.[48] The "seven distinct topics" addressed by the sustainability plan are: Built Environment, Energy, Food, Nature, Transportation, Waste, and Water. Stormwater is integrated into three of the seven topics: Built Environment, Nature, and Water. The Green Roof and RiverSmart Homes rebate programs were discussed as ways to meet the goals of the water topic. Having the rebate programs integrated into a non-stormwater specific document is a way of informing the public not already aware of the programs of the possibility of stormwater management practice funding opportunities.

Green Roof Rebate Program. The green roof demonstration program was a precursor to the Green Roof Rebate program. The demonstration program was initiated in 2003 as a feasibility study of the installation of green roofs on commercial buildings in the District. In the period from 2004-2008, the funds were used to aid in the installation of eight green roofs covering the technical, cost, and performance evaluations of each roof.[49] The grants issued as part of the demonstration project were intended to cover up to 20 percent of the capital cost of each green roof installation. Target buildings for this program initially included apartments and commercial and government buildings. Public access was factored into each of the eight roofs installed to provide awareness and increase possible interest in green roof technologies and use.

The green roof demonstration project ultimately evolved into the Green Roof Rebate program, and has been expanded to include residential as well as commercial and industrial properties. In 2007, the program offered $3 per square foot of green roof installation, which resulted in 12 green roof projects; this increased to $5 per square foot of installation in 2012-2013.[50] As of 2013-2014, the rebate amount has increased to $7 per planted square foot and up to $10 per square foot in target sub-watershed areas.[51] The increased incentive offered to properties in

[48] Sustainability DC. *Sustainable DC Plan,* 2012.

[49] Chesapeake Bay Foundation. *Green Roof Demonstration Project Final Report October 2003-September 2008,* September 15, 2008.

[50] District Department of the Environment. Green Roofs in the District. http://ddoe.dc.gov/greenroofs.

[51] Anacostia Watershed Society. Green Roofs. http://www.anacostiaws.org/programs/stewardship/green-roofs.

targeted areas increases interest in areas where the return on environmental and economic investments is the highest.

RiverSmart Homes. The RiverSmart Homes rebate program is directed toward residential property owners who are interested in reducing stormwater runoff from their properties. In order to glean interest in the RiverSmart program, the District Department of the Environment has installed nine RiverSmart Homes demonstration sites, one in each Ward. The RiverSmart Homes rebate website explains that installation of one or more of the approved practices delivers benefits beyond runoff reductions. The resulting reduced lawn area can save property owners money, spent onwater bills and oil and gas for mowers, as well as time otherwise spent on lawn maintenance.

Previous attempts at incentivizing residential stormwater management practices have provided the District with insight on how to improve residential outreach. These insights include: ensuring outreach meetings occur in areas easily accessible by public transportation, determining when BMP installation and management should not be the sole responsibility of the homeowners, and considering transportation needs when incentivizing via give-aways such as rain barrels and saplings.[52]

The rebate program keeps costs low by focusing on best management practices that minimize cost. There are five approved stormwater reduction technologies: shade tree planting, rain barrels, pervious pavers, rain gardens, and/or bayscaping. Difficulties previously encountered in unsuccessful incentive programs are taken into account by leading the homeowners through the entire installation process. First, a DDOE employee conducts a site visit and surveys the homeowner's land. A report is then generated that lays out all of the possible stormwater management practices applicable to the property, and the homeowner can select practices of interest. The installation of each practice is overseen by a DDOE employee. After installation, the final project is inspected and if the work is done properly, up to $1,200 for the installation is covered. DDOE maintains contact with the homeowners to answer questions about maintenance and encourages the homeowners to install more stormwater management practices on their property.[53]

Seattle, Washington. Seattle, recognizing that 98 percent of the city has already been developed, has identified stormwater control as one of four primary strategies to decreasing the pollution entering Puget Sound.[54] In order to reduce stormwater runoff volume to the Sound in a cost effective manner, Seattle has developed an incentive program for homeowners called RainWise.

Residential Outreach Investigation. Prior to developing the RainWise rebate program, Seattle Public Utilities conducted a two-year, EPA-funded pilot project to evaluate the use of

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[52] Saari, Steve, King, Catherine, and Wasiutynski, John. *DC's RiverSmart Homes Program—Addressing NPS Pollution at the Residential Level.* DDOE and USEPA.

[53] Saari, Steve, King, Catherine, and Wasiutynski, John. *DC's RiverSmart Homes Program—Addressing NPS Pollution at the Residential Level.* DDOE and USEPA.

[54] Environmental Works. *Opportunities for Seattle Home and Business Owners: Rebates and Incentives. http://eworks.org/blog/?p=576.*

decentralized green stormwater infrastructure through private property installation of cisterns and rain gardens. The project offered insight on how to develop the RainWise program from an outreach and logistics perspective. The lessons learned during the pilot study include:[55]

- Directly inviting residents to a public meeting, either via telephone or door-to-door contact, were the most effective outreach methods.
- Mail solicitation will not be able to be completely automated, there will be address duplicates, commercial properties and out of area addresses to take care of manually.
- Planning for how to address placing BMPs on rental properties is important in communities with a high percentage of this property type.
- Assessing properties for eligibility can be time-consuming.
- Consider contracting and procurement processes prior to the installation of practices, as staff time for customer service "hand holding" for tasks such as siting, final design presentation, and homeowner sign can be intensive.

The Seattle Public Utilities department incorporated these lessons into the development of the RainWise rebate program.

RainWise Rebate Program. The RainWise program was started in 2010 as a way to incentivize stormwater runoff control on private properties. The RainWise rebate program in Seattle was designed to target homeowners in specific combined sewer overflow basins where stormwater quantity and quality has proven to be an issue. In order for properties to apply, residences must reside in the specific target areas, have the BMP installed by a licensed contractor, have the BMP inspected by a Seattle Public Utilities inspector, which includes having an infiltration test done, and have the rebate paperwork filled out and submitted within 90 days of BMP approval.[56] RainWise provides a 60 to 100 percent rebate[57] to cover most of the cost of installing either of the two BMPs approved for rebate – cisterns and rain gardens – with an average rebate of around $4,000.[58] As of 2013, over 250 rain gardens and cisterns have been installed in Seattle with a goal of 3,005 total installations.[59,60]

Portland, Oregon. The City of Portland has implemented several successful green infrastructure incentive programs including the Ecoroof and downspout disconnection programs. The success of these programs was a result of strong political backing and the

[55] Lichten, Keith H. and Struck, Scott. (2010). *Low Impact Development 2010 Redefining Water in the City.* Reston, VA, ASCE.

[56] Seattle Public Utilities. RainWise Rebates for Cisterns and Rain Gardens. http://www.seattle.gov/util/EnvironmentConservation/Projects/DrainageSystem/GreenStormwaterInfrastructure/RainWise/Rebates/index.htm

[57] Seattle Public Utilities. *Sewage Overflow Prevention 2011 Annual Progress Report.*

[58] Seattle Public Utilities. Be RainWise. 120920_2744rainwise1pager.ai wgab.

[59] King County. Combined Sewer Overflow Control, King County is going RainWise. http://www.kingcounty.gov/environment/wastewater/CSO/BeRainwise.aspx.

[60] City of Seattle Seattle Public Utilities. Residential RainWise Program SEPA Determination of Non-Significance (DNS). 2013.

community's environmental ethic. Portland's Treebate Program offers a resident credit on water/sewer bills for planting trees. A credit of half the purchase price per tree up to $15 for a small tree, $25 for a medium tree, or $50 for a large tree is available. The tree must be planted between September 1, 2013 and April 30, 2014 and a Treebate form must be submitted by April 30, 2014 to be eligible for the credit.[61] Acceptable trees and size information are available on the Treebate website.

Montgomery County, Maryland. Montgomery County's RainScapes Rewards Program is funded by the County's Water Quality Protection Charge and issues rebates up to $2,500 for residential projects and $10,000 for commercial, multi-family, or institutional projects that meet specific design criteria.[62] The funding for the RainScapes program is limited, and rebates are on a first-come, first-serve basis. Acceptable BMPs include: canopy trees, conservation landscaping-replacement of turf or invasive species, dry wells, green roofs, permeable pavers and porous concrete, pavement removal, rain gardens, cisterns and rain barrels. The county has a goal of treating 50 impervious acres by 2015.[63]

RainSapes Neighborhood Program.[64] The RainScapes Neighborhood program focuses on neighborhoods that drain to the Potomac River; contribute runoff to nearby watershed restoration projects; have identified drainage problems and are in need of a more intense runoff reduction; and, have the support of an interested watershed group or community association. The goal of this program is to provide stormwater control to a minimum of 30 percent of the properties in a targeted neighborhood resulting in better stormwater control at the sub-watershed scale.

[61] The City of Portland Oregon Environmental Services. Treebate Program Details. 2013. http://www.portlandoregon.gov/bes/article/314187

[62] Montgomery County, Maryland Department of Environmental Protection. RainScapes Rewards Rebates Program. http://www6.montgomerycountymd.gov/dectmpl.asp?url=/content/dep/water/rainrebate.asp.

[63] Montgomery County, Maryland Office of Management and Budget. Approved FY 2011 Operating and Capital Budget. http://www.montgomerycountymd.gov/OMB/FY11/appr/psp_toc.html#top.

[64] Montgomery County, Maryland Department of Environmental Protection. RainScapes Neighborhood Program. http://www6.montgomerycountymd.gov/dectmpl.asp?url=/content/dep/water/rainneighborhood.asp.

Appendix 4: Reverse Auction Case Studies

Case Study 1: Reverse Auctions – Ohio
Cincinnati, Ohio

- **Key Features:**
    - Innovative financing in an urban setting
    - Effective engagement of citizens and the private sector
- **Overview:** US EPA researchers in the Mt. Airy region of Cincinnati used a reverse auction system to encourage residents of the Shepherd Creek watershed to adopt individual stormwater management practices of rain gardens and rain barrels. The aim of this project is to install numerous rain barrels and rain gardens across the watershed and then to monitor stormwater runoff in the creek for any changes in water volume and quality.
- **Implementation:** In order to raise awareness about green stormwater management and to distribute rain gardens and barrels to individuals in the watershed, researchers conducted two reverse auctions, one in 2007 and one in 2008. Over 400 residences were invited to participate where they could bid on how much they should be paid in order for rain barrels and gardens to be installed on their property (installation and maintenance were free for home owners.
- **Advantages:** Unexpectedly, the majority of people who participated in the reverse auction actually bid $0. Two hundred bids were received, ranging from a low of paying nothing to a high of $500, and researchers worked with contractors to install nearly 170 rain barrels and 81 rain gardens by mid-2008. In total, 25 percent of residential properties, distributed throughout the watershed, ended up with one of these "green water management facilities."

  Researchers are currently in their third and final year of collecting data from the Shepherd Creek watershed. One other facet of this study involves closely monitoring ten rain gardens and ten rain barrels in the watershed. The results of this research could help quantify how much rainwater is actually detained by these technologies.
- **For more reading:** "Can Rain Barrels and Gardens Help Keep Sewage in the Sewers?" Science Matters Newsletter. US EPA Office of Research. January 2011. http://www.epa.gov/research/sciencematters/january2011/rainbarrels.htm

Case Study 2: Reverse Auctioning – Victoria

BushTender: Victoria, Australia

- **Key Features:**
    - Relies on a robust, state-led assessment methodology
    - Reverse auction mechanism sets price of the contracts
- **Overview:** BushTender is a program administered by Victoria's Department of Sustainability and Environment (DSE). The program is based on the USDA CRP program. In exchange for payments from the State government, landholders commit to fence off and manage an agreed amount of their native vegetation for a set period of time. The first BushTender Trial was completed in 2002 in the north central and northeast regions of the state.
- **Implementation:** Implementation occurs over seven steps: (1) Expressions of Interest – Landholder expresses interest; (2) Site Assessment – Field officer contacts each eligible landholder to arrange a state-led site assessment; (3) Draft Management Plans – Landholders identify the actions they are prepared to undertake and the Field Officer prepares a draft management plan as the basis for a bid; (4) Submission of Bids – Landholders have the opportunity to submit a sealed bid declaring the amount of payment being sought to undertake the agreed plan; (5) Bid Assessment – Bids are assessed objectively on the basis of the current conservation significance of the site, the estimated gain in vegetation condition and/or security offered through the agreed landholder management actions, and the price. Funds are then allocated based on cost-effectiveness; (6) Management Agreement – Successful bidders are offered a Management Agreement based on the previously agreed draft Management Plan; and (7) Reporting and Payments – Periodic payments to landholders and reporting will occur over the five-years as specified in the agreement. Contracted landholders are required to submit a report each year of the five-year Management Agreement on their commitments and management actions, or achievement of biodiversity outcomes.
- **Advantages:** The reverse auctioning mechanism lowers the cost of each project being funded. The pilot program resulted in many of the bids being implemented for less than the NRE would have been willing to pay had they negotiated directly with landholders. Additionally, NRE field staff concluded that the pilot contained sites of high or very high conservation significance, including 24 new populations of rare or threatened plant species.
- **Challenges of Application:** The site assessment conducted by field officers requires a significant level of capacity from the administering agency. In addition, great objectivity is needed by both the materials used to assess projects and the field officers conducting assessments. Lastly, in order to determine the program's effectiveness, verification and monitoring must occur randomly throughout the five-year contract.
- **For more reading:**
    - Department of Sustainability and Environment: http://www.dse.vic.gov.au/conservation-andenvironment/biodiversity/rural-landscapes/bushtender/how-bushtender-works

Case Study 3: Reverse Auctioning – New South Wales

Environmental Services Scheme: New South Wales, Australia

- **Key Features:**
    - Unlike the Bush Tender trial, the Ecosystem Services Investment Fund pilot is broader, covering biodiversity, salinity, acid sulfate soils, carbon sequestration as well as soil and nutrient management.
    - Requires farmers to take positive action to change current land management practices
    - Reverse auction mechanism sets price of the contracts
- **Overview:** Inspired by BushTender, the New South Wales (NSW) government launched a pilot project known as the Environmental Services Scheme that pays 20 farmers to take part in a three-year, $2 million pilot to provide environmental services on their properties. The program is jointly managed by the NSW Department of Infrastructure, Planning and Natural Resources, and NSW State Forests. The farmers whose bids are successful work with an environmental services team to develop a management plan that regenerates parts of their land. Once the regeneration work has been carried out, the government will pay the farmers.

  Implementation: The government allocated $20 million to create an Environmental Services Investment Fund (ESIF), which would provide incentives to land managers to manage their properties for specific environmental outcomes. The project first identified the following six types of environmental services to be examined: carbon sequestration, terrestrial biodiversity benefits, salinity benefits, soil benefits, water quality, and acid sulfate soil benefits. Secondly, the project identified the following eight practices to be selected: establishing perennial pastures, improving management of existing perennial pastures, establishing commercial tree plantings, establishing environmental plantings of trees or shrubs, regeneration of native vegetation, establishing saltbush, engineering works, and reintroducing natural wetting or drying cycles in former wetlands or estuarine areas.
- **Advantages:** As of the 2003 Progress Report, the following outcomes were listed: (1) Distribution and number of contracts; (2) Types of farming system selected; (3) Range and area of land use changes selected; (4) Effectiveness of the selection process; (5) Property planning standards; and (6) Cost-effectiveness of process.
- **Challenges of Application:** Although the selection of specific environmental services and practices will generate anticipated results, there may be innovative and more cost-effective practices left out because of the stringent participation guidelines.
- **For more reading:**
    - New South Wales Projects: http://www.dpi.nsw.gov.au/research/projects/projects-on-the-web?sq_content_src=%2BdXJsPWh0dHAlM0ElMkYlMkZ3d3dpLmFncmljLm5zdy5nb3YuYXUlMkZwcm9qZWN0c2VhcmNoJmFsbD0x