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Stormwater Financing Report to Lynchburg, Virginia

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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.

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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 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, Virginia; Baltimore, Maryland; and, Anne Arundel County, Maryland. 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. Urban communities throughout the Chesapeake Basin 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.

Lynchburg, Virginia offers an interesting case study in how stormwater management must be integrated into other pressing and expensive infrastructure priorities. Lynchburg is an independent City in the Commonwealth of Virginia, with a 2010 population of 75,568. The City is located in the foothills of the Blue Ridge Mountains and is bounded on one side by the James River. The City is one of three communities in the state with a combined sewer system (CSO), which comprises approximately 6 square miles of the 50 square miles within the City limits. The City has been under a Consent Order since 1994 for their CSO system and their current Long Term Control Plan is for complete separation of the combined sewer system.

The CSO retrofits represent Lynchburg's largest capital program, with over $180,000,000 spent to date and an estimated $325,000,000 remaining. The City also operates a regional wastewater treatment plant, which may require up to $80,000,000 in upgrades. On top of those significant investments, the City estimates that stormwater management costs required to achieve Chesapeake Bay water quality obligations, as well as to meet the City's stormwater permit obligations, will likely exceed $100,000,000. Given the size of the community, the expected costs associated with water resource protection and restoration is daunting. Using this background as a starting point, our strategy was to identify ways for the community to reduce its stormwater program costs while at the same time ensuring that investments into stormwater management have the greatest benefit and impact as possible.

This report provides a comprehensive look at Lynchburg's stormwater financing program and a path forward for improving the program's efficiency and effectiveness. In Section 2 we provide a detailed description of the regulatory issues that are driving the City's stormwater program and their potential impact on financing systems. In addition we conduct a thorough assessment of costs and the expected obligations facing the City. In Section 3 we assess Lynchburg's existing capacity to address implementation costs, including an evaluation of how well the City is engaging ratepayers and the private sector. Section 4 provides a revised economic impact assessment related to stormwater investments. And, in Section 5 we provide key recommendations for moving forward. We begin, however, by providing a summary of key findings and observations.

Key Findings:

- ***The expected costs associated with achieving the City's stormwater management obligations do not appear to be as high as previously estimated.*** Perhaps the most significant outcome of this study was the development of a much better understanding of the costs associated with implementing stormwater management programs in Lynchburg. Specifically, our analysis indicates that when maximizing for efficiency and performance, and then allocating resources accordingly, the City of Lynchburg is in an ideal position to dramatically reduce the costs of achieving very aspirational stormwater management goals associated with the Chesapeake Bay TMDL and the Watershed Implementation Plans.
- ***The City's decision to implement a stormwater utility was a major step towards program sustainability.*** Lynchburg's decision to implement a fee-based stormwater utility was forward thinking and a major step towards program sustainability in the long-term. By ensuring the existence of dedicated and sustainable revenue, the City has positioned itself to take advantage of innovative financing approaches and programs. What is most striking about the City's efforts to establish the fee is how it contrasts with the other two communities that were part of his project study. The debate in Maryland over state law requiring fee-based stormwater utilities in large urban jurisdictions has been contentious, often visceral, and at many points misinformed. Though the process for establishing the fee in Lynchburg was certainly arduous and at times difficult, the community was self-motivated to establish their enterprise program and as a result have been able to focus their efforts on improving program performance and efficiency. The next step will be to establish processes that effectively engage the private sector thereby reducing risks and implementation costs.
- ***There has been a major shift in how the Commonwealth is addressing MS4 permits.*** The establishment of the stormwater utility came at a very important time for Lynchburg given the recent focus at the state level on strengthening stormwater management permits and regulations. In the future communities like Lynchburg will be required to implement stormwater programs that go beyond traditional permit requirements, with more of a focus being given to achieving water quality goals. This will require long-term revenue and financing commitments, the basis of which Lynchburg has already established.

- ***There will be significant positive economic impacts in the City related to stormwater investments.*** Part of EFC's work on this project consisted of an economic impact study related to stormwater investments. Our analysis indicates that Lynchburg is well positioned to maximize this economic impact in the future. This means that stormwater investments will not only benefit the City through cleaner water but will also become an important part of the City's economy.
- ***There are opportunities to leverage the private sector to reduce program costs.*** Finally, we believe that Lynchburg is in a very unique position of being able to redefine how it implements its stormwater financing systems in the future. Through the use of performance and market-like financing structures the City can ensure that costs stay low and program effectiveness stays high. This type of approach will require establishing processes that effectively leverage the unique resources and abilities that the private sector can offer.

Lynchburg has an opportunity to transform its stormwater financing efforts and to make clean water part of the City's foundation and infrastructure into the future. Our goal with this project was 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 City. In order to achieve aspirational stormwater management goals, it is essential that every community have the capacity to address the issue effectively and to 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: Regulatory Drivers and Anticipated Implementation Costs

As with any financing effort, establishing efficiencies related to Lynchburg'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)[1] permit requirements as described in Lynchburg's MS4 permit.[2] We begin with a description of these two programs and their potential impact on Lynchburg's financing system.

Section 2.1: Virginia's Watershed Implementation Plans for the Chesapeake Bay. In accordance with EPA expectations, the state-based Watershed Implementation Plans (WIP) are designed to accomplish a set of pollution allocation goals identified in the Chesapeake Bay TMDL. EPA recognizes that it will take time to develop the level of detail the jurisdictions are expected to include in their WIPs.[3] As a result, the WIP development process has been divided into two distinct phases.

<u>Phase I Watershed Implementation Plan:</u> The initial Phase I Plans provided by the Bay states are intended to provide EPA information to consider when it establishes waste-load and load allocations within each of the 92 segments listed as impaired. The Phase I WIPs include a description of the authorities, actions, and control measures (to the extent possible) that will be implemented to achieve these point and nonpoint source TMDL allocations.

<u>Phase II Watershed Implementation Plan:</u> The Phase II WIPs provided more detailed, locally based strategies for achieving Chesapeake Bay restoration goals. The Virginia plan was developed with the assistance of a Stakeholder Advisory Group convened by the Secretary of

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[1] 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.

[2] 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.

[3] Virginia Department of Environmental Quality. http://www.deq.virginia.gov/Programs/Water/ChesapeakeBay/ChesapeakeBayWatershedImplementationPlan.aspx.

Natural Resources and submitted to EPA on March 30, 2012. Integral to these locally-based strategies was a revision to urban stormwater management regulations and responsibilities.

Specifically, the Commonwealth will utilize the MS4 permitting process (described below) to ensure BMP implementation on existing developed lands achieves nutrient and sediment reductions equivalent to Level 2 (L2) scoping run reductions by 2025. Level 2 implementation equates to an average reduction of 9 percent of nitrogen loads, 16 percent of phosphorus loads, and 20 percent of sediment loads from impervious regulated acres and 6 percent of nitrogen loads, 7.25 percent of phosphorus loads and 8.75 percent sediment loads beyond 2009 progress loads for pervious regulated acreage.[4] As a result of these policy and regulatory changes, communities like Lynchburg have been assigned nutrient and sediment reduction responsibilities that are anticipated to be achieved within the timeframe of the TMDL implementation process.

Section 2.2: The MS4 Permitting Program. Discharges from municipal separate storm sewer systems (MS4) are regulated under the Virginia Stormwater Management Act, the Virginia Stormwater Management Program (VSMP) Permit regulations, and the Clean Water Act as point source discharges. MS4 regulations were developed and implemented in two phases. Implementation of the first phase began in the early 1990s and required that operators of MS4s serving populations of greater than 100,000 people (per the 1990 decennial census) apply for and obtain a permit to discharge stormwater from their outfalls. The second phase of MS4 regulations became effective March 23, 2003, and required that operators of small MS4s in "urbanized areas" (as defined by the latest decennial census) obtain a permit to discharge stormwater from their outfalls.[5]

Based on population size and density, Lynchburg is considered a small MS4, and as such is regulated under the General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems. Under the general permit, small MS4s must develop, implement and enforce a program that includes the following six minimum control measures:

- Public education and outreach on stormwater impacts;
- Public involvement and participation;
- Illicit discharge detection and elimination;
- Construction site stormwater runoff control;
- Post-construction stormwater management in new development and redevelopment; and,
- Pollution prevention/good housekeeping for municipal operations.

Similar to the Phase I programs, small MS4 programs must be designed and implemented to control the discharge of pollutants from their storm sewer system to the maximum extent practicable in a manner that protects the water quality in nearby streams, rivers, wetlands, and

[4] Commonwealth of Virginia Phase II Watershed Implementation Plan. March 12, 2012. Page 24.

[5] Virginia Department of Environmental Quality. http://www.deq.virginia.gov/Programs/Water/StormwaterManagement/VSMPPermits/MS4Permits.aspx.

bays.[6] What makes the requirements in Virginia unique is the apparent changing definition of the word *practicable* as a result of more restrictive stormwater management requirements.

The shift in regulatory focus. As a result of the WIP strategy described in the previous section, communities are now required to incorporate water quality control measures into their stormwater programs in ways not seen in the past. This in turn will require communities like Lynchburg to become much more sophisticated in their stormwater management activities, and will require innovative approaches to keep costs low and efficiencies high.

In September 2011, EPA conducted a review of Virginia's urban stormwater programs. At the same time, the programs' organizational management was undergoing an internal restructuring.[7] As a result of these processes, the state revised its Phase 2 MS4 permit process to include obligations related to achieving the Chesapeake Bay TMDL. In effect, the TMDL became linked to the state's NPDES permitting program. State regulators will utilize enforceable MS4 permit language requiring MS4 operators to develop, implement, and maintain Chesapeake Bay Watershed Action Plans consistent with the WIP. MS4 operators will be given three full permit cycles (15 years) to implement the necessary reductions to meet the L2 implementation levels. Baseline efforts for all MS4s will be based upon 2009 progress loads. The baseline effort will be continued with an expectation of an additional five percent reduction of loads for existing developed lands to be met by the end of the first permit cycle.[8]

Again, these changes to the MS4 permitting process, especially for Phase 2 communities like Lynchburg, are profound. No longer will permit obligations be limited to implementing the six minimum control measures in a general permit. In effect, the state has begun the process of linking the WIP process to the MS4 permitting process. Therefore, the WIPs are now relevant in that they impact permitted activities. Therefore, Lynchburg's focus moving forward should be to:

- Achieve the existing permit requirements in the most efficient way possible; and,
- Put the foundation in place for a more extensive implementation process to address future permit requirements.

We address both priorities later in the report.

Section 2.3: Assessment of Implementation 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, the City of Lynchburg recently established a stormwater enterprise program. As part of that process, it was necessary for City leaders to assess program needs and anticipate 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

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[6] Ibid.

[7] Commonwealth of Virginia Phase II Watershed Implementation Plan. March 12, 2012. Page III.

[8] Commonwealth of Virginia Phase II Watershed Implementation Plan. March 12, 2012. Page 24

presuming the corresponding estimates to be accurate and sufficient. To that end, our focus was related to the costs associated with making 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.

In October 2011 the environmental engineering firm Greeley and Hansen provided the City of Lynchburg with a memorandum titled, "Chesapeake Bay TMDL and Final Phase I WIP Urban Stormwater Cost Estimates for City of Lynchburg".[9] The memo attempts to provide Lynchburg officials with a relative understanding of the scale of financing necessary to achieve the stormwater component of the WIP. In summary, the report provides cost estimates that range from $109 million to $201 million depending on the use of the urban nutrient management BMP.[10]

The estimated annual costs were between $12 million and $22 million. According to Greeley and Hansen, the higher cost estimate is based on Table 2.1 and Table 2.2 in Virginia's Phase I WIP document. Table 2.2 identifies the pounds of Total Phosphorus (TP) allocated to urban stormwater in each basin. The cost estimate considered the retrofits required to reduce the nutrient loads from EPA's estimate of loads in 2009 to the urban runoff allocations required by 2025. The cost estimate is based on Table 6-4.1 in Virginia's Phase I WIP. It sets stormwater implementation goals in terms of percentage of impervious and pervious land that must be treated with specific types of BMPs. This table assumes additional reductions will occur from applying the nonstructural BMP "Urban Nutrient Management" on 90 percent of urban pervious lands.[11] In addition, Greeley and Hansen's estimates assume that all implementation will take place on public lands.

Our goal was to use these cost estimates to develop a planning-level estimate of stormwater management costs as a starting point for reducing those costs in the future. Our strategy was to evaluate annualized costs for achieving Lynchburg's TMDL pollution load allocations using VAST as the performance standard for various combinations of pollution reduction practices in the City.[12] VAST 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

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[9] Greeley and Hansen. "Chesapeake Bay TMDL and Final Phase I WIP Urban Stormwater Cost Estimates for City of Lynchburg". October 11, 2011.

[10] Widespread application of the urban nutrient management would enable the City to achieve nutrient reductions at lower costs. The higher costs assume that urban nutrient management would not be credited in the Chesapeake Bay Program model.

[11] Greeley and Hansen. "Chesapeake Bay TMDL and Final Phase I WIP Urban Stormwater Cost Estimates for City of Lynchburg". October 11, 2011. Page 1. For more information, see: *Commonwealth of Virginia: Chesapeake Bay TMDL Phase I Watershed Implementation Plan; Revision of the Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy.* November 29, 2010. Pages 17 and 92.

[12] VAST is the Virginia Assessment Scenario Tool.

VAST, it is difficult to know the additional effect of any pollution reduction practice that is layered upon up-gradient[13] 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.

After using VAST as the performance measure for the impact 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 a reporting scenario that identifies what has been undertaken to reduce pollution loads to date. The 2025 scenario is taken to be a planning tool for how Lynchburg intends to meet its Watershed Implementation Plan (WIP). The cost-attentive (CA) scenario has been developed as part of this project to lower Lynchburg's expected costs of TMDL compliance.

There are many caveats to our approach to evaluating pollution reduction scenarios and their costs. Much depends on the starting conditions. In all three scenarios, we started with 2010 land use, septic, and animal data. Beyond starting conditions, there is the assumption that VAST accurately reflects the impact of reduction practices on pollution loads exported from Lynchburg. There are known examples wherein this is not the case (i.e., CSS loads); and, there are likely other ways in which VAST 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 the uncertain accuracy of VAST'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.[14] Moreover, the way in which factor costs are used to develop implementation cost estimates depend on a number 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 Lynchburg's WIP.

Table 1a, below, provides a comparison of VAST-predicted nitrogen export across the three scenarios.   Tables 1b and 1c report the same thing for phosphorous and sediments, respectively.

[13] Up-gradient is referring to practices installed higher up topographically in the watershed.

[14] 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.

Table 1a: Comparison of Nitrogen Export from Lynchburg Land Uses Across Three Scenarios

Sector	Land-Use	Lynchburg2012 Load - Edge of Stream	LynchburgCA Load - Edge of Stream	Lynchburg2025 Load - Edge of Stream
Forest	Forest	32,960	34,026	32,960
Forest	Harvested forest	3,131	1,607	1,674
Urban	Regulated impervious developed	32,870	28,997	28,936
Urban	Non-regulated impervious developed	8,361	8,363	7,361
Urban	Regulated pervious developed	86,395	78,011	80,606
Urban	Non-regulated pervious developed	21,145	20,277	19,700
Water	water	1,989	1,989	1,989
Total Land Use Nitrogen Loads		186,851	173,270	173,228

Table 1b: Comparison of Phosphorous Export from Lynchburg Land Uses across Three Scenarios

Sector	Land-Use	Lynchburg2012 Load - Edge of Stream	LynchburgCA Load - Edge of Stream	Lynchburg2025 Load - Edge of Stream
Forest	Forest	2,026	2,091	2,026
Forest	Harvested forest	180	74	79
Urban	Regulated impervious developed	10,236	8,905	8,823
Urban	Non-regulated impervious developed	2,604	2,594	2,244
Urban	Regulated pervious developed	8,873	7,936	8,049
Urban	Non-regulated pervious developed	2,172	2,070	1,957
Water	Water	177	177	177
Total Land-Use Phosphorous Loads		26,267	23,848	23,355

Table 1c: Comparison of Sediment Export from Lynchburg Land Uses across Three Scenarios

Sector	Land-Use	Lynchburg2012 Load - Edge of Stream	LynchburgCA Load - Edge of Stream	Lynchburg2025 Load - Edge of Stream
Forest	Forest	825,397	852,088	825,397
Forest	Harvested forest	96,871	40,066	42,589
Urban	Regulated impervious developed	3,908,808	2,537,213	3,210,536
Urban	Non-regulated impervious developed	994,321	997,603	816,694
Urban	Regulated pervious developed	2,039,306	1,725,881	1,835,962
Urban	Non-regulated pervious developed	499,109	430,816	438,494
Total Sediment Loads		8,363,811	6,583,667	7,169,671

In summary, the mix of pollution abatement practices comprising the cost-attentive scenario generates 13,581 pounds more nitrogen reduction than the 2012 scenario and 43 pounds less reduction than the 2025 scenario. With respect to phosphorous, the cost-attentive scenario generates 2,420 pounds more reduction than the 2012 scenario but 492 pounds less reduction than the 2025 scenario. With respect to sediments, the cost-attentive scenario generates 1,780,144 pounds more reduction than the 2012 scenario and 586,003 pounds more reduction than the 2025 scenario. This latter statistic is somewhat surprising, given the correlation typically thought to exist between phosphorous and sediments.

In the tables in Appendix 1, we show the BMPs employed to achieve the pollution export reduction reported in the previous three tables. These tables show the amount of each BMP implemented, the estimated annualized costs for implementing a unit of each BMP and the product of these factors. At the bottom of each scenario's table, we sum these costs for a total scenario cost. For convenience, annual costs for the 2012 scenario are $1,222,155, for the cost-attentive scenario, $1,542,443, and for the 2025 scenario, $7,049,706. Table 1d below provides a summary comparison of the Greeley and Hansen annual cost estimates alongside the EFC annual cost estimates. Very simply, when maximizing for efficiency and performance, and then allocating resources accordingly, the City of Lynchburg is in a position to dramatically reduce the costs of achieving very aspirational stormwater management goals.

Table 1d: Estimated Annual WIP Costs

EFC Estimates			Greeley and Hansen Estimates	
2012 Scenario	**Cost-Attentive Scenario**	**2025 WIP**	**Reductions to meet WLA in WIP (Table 2.2)**	**Virginia WIP Assumptions in Table 6-4.1**
$1,222,155	**$1,542,443**	**$7,049,706**	**$22,000,000**	**$12,000,000**

Cost Assumptions. The review of Lynchburg's BMP implementation costs undertaken by Greeley and Hansen uses Virginia's Phase I WIP's rather general scoping estimates for the scale of BMP implementation required under the TMDL load allocation for Virginia. Total costs are obtained by multiplying implementation requirements by unit BMP implementation costs. Unit implementation costs are estimated with values developed by the Center for Watershed Protection (CWP). For many urban stormwater BMPs, CWP valuations also form the basis for Chesapeake Bay Program Office (CBPO) unit cost estimates.

King and Hagan's background estimates are also used for many of the CBPO cost estimates.[15] Their values tended to account for specific design and site preparation costs, additional to construction costs. Greeley and Hansen use a fixed ratio of construction costs (35 percent) to estimate design and preparatory work. King and Hagan also distinguish between new

[15] King, D. and Hagan, P. (2011). Costs of Stormwater Management Practices in Maryland Counties. Maryland Department of the Environment. October 10. Ref. No. [UMCES] CBL 11-043.

development and retrofit projects in their cost estimates, with retrofit projects generally incurring a higher cost. Greeley and Hansen's Table 14 also has a range of values, but it is less clear what is causing the differences between estimates for the same BMP.

In the table below, we report some of Greeley and Hansen's CWP-based cost estimates alongside CBPO cost estimates. It is clear from this table that median values for Greeley and Hansen's estimates are higher than comparable values from CBPO estimates. On average, Greeley and Hansen's costs are 16.5 percent higher than CBPO costs. It is beyond the scope of this project to evaluate which estimates are more representative of likely implementation costs. In fact, the actual costs will be highly dependent on site conditions and land values. However, there remains the possibility that with the appropriate modeling capabilities, the City of Lynchburg will be able to minimize implementation costs by identifying the most efficient construction and pre-construction sites.[16]

Table 2: BMP Cost Evaluation

		Capital Cost (G&H)	Construction & Pre Construction (CBPO)		
			Low	Median	High
Permeable Pavement	A	$141,000	$77,910	$100,994	$126,964
	B	$735,000			
Grass Channel	A	$35,000	24,000	24,000	24,000
	B	$77,000			
Bio Retention	A	$84,000	$23,728	$35,334	$66,376
	B	$139,000	$34,603	$57,746	$107,591
Infiltration	A	$84,000	$23,728	$35,334	$66,376
	B	$92,000	$47,457	$70,668	$132,751
Ext. Detention Pond	A	$17,000	$2,623.23	$5,286.20	$11,923.75
	B	$21,000	$10,731.38	$26,987.42	$51,192.64
Filtering Practices	A	$111,000	$21,642	$80,823	$127,028
	B	$139,000	$21,642	$80,823	$127,028
Wetland	A	$39,000	$2,385	$4,034	$15,262
	B	$59,000	$10,731	$26,987	$51,193
Wet Pond	A	$28,000	$3,696	$11,616	$45,708
	B	$42,000	$10,731	$26,987	$51,193

Practicality. As a planning tool, VAST presumes that the level of BMP implementation specified by a user in any scenario is practical up to 100 percent of the treatable acres. We noted that our cost-attentive scenario was created in the absence of certainty as to whether enough land could be found to install the proposed BMPs in that scenario. Here, we evaluate the issue of available land using an on-line record of municipal property.

[16] Appendix 2 provides a more thorough description of the factors that influence stormwater best management practice costs, as well as a detailed summary of how those factors influence specific best management practices.

The listing of Lynchburg City Properties tracks a variety of characteristics of each property, including, but not limited to: parcel ID, address, property class (i.e., whether it belongs to the City or City schools), acres in the parcel, land value and value of improvements on the land. This list of properties is 649 records long. Almost half of those listings (301) assign a zero to acreage. Whether this is absent information or truly zero land size is unknown, but we take it at face value and treat the zero acres as unavailable. Of the remaining 348 properties, 282 are less than four acres in size. There are 66 properties of four acres or more. We restrict our interest to this latter set of properties.

The 66 properties with more than four acres sum to a total of 1,257 acres. Of those properties, 35 have no improvements. Parcels greater than four acres and having no (stated) improvements total 531 acres. While it might be feasible to use properties that have existing improvements, we begin with a more limiting assumption that only non-improved acres would be used to site water quality BMPs. Thus we begin with 531 available acres.

To evaluate whether the specification of BMPs made in our cost-attentive scenario is feasible given the amount of publicly owned land, we need to know how many acres are required by the BMPs in our scenario. Most BMPs specified in a VAST scenario are valued in terms of acres treated. Forest buffers and pervious pavers are the exceptions. To estimate the number of acres needed to treat the specified number of acres, we use the Chesapeake Bay Program Office's (CBPO) cost estimates for urban BMPs. Those cost estimates often use a value for land in their costing of BMPs and, for that reason, they need to have a standard expectation for how much land will be required, given a specified area of treatment.

In the Table 3 below, we provide a record of the BMPs specified in our cost-attentive scenario along with the percentage of treated acres required for the BMP as per CBPO estimates. As noted in the preceding paragraph, forest buffers are given in terms of "acres in buffers". Thus, the 400 acres assigned to this BMP account for more than half the total acres required for the level of treatment specified in the scenario. In any event, the 753 acres required under that specification is greater than the number of acres available in our evaluation of City properties. If all the City property parcels greater than four acres in area and possessing no improvements were used to implement the BMPs specified in the scenario, we would still be 222 acres short.

Table 3: BMP Treatment Acres Required

BMP Name	Amount of BMP Submitted	Unit	Land-Use	BMP Share of Treated Area	BMP Acres
Forest Harvesting Practices	124	Acres	Harvested forest		
Dry Extended Detention Ponds	500	Acres treated	Non-regulated pervious developed	0.1	50
Dry Detention Ponds and Hydrodynamic Structures	400	Acres treated	Regulated impervious developed	0	0
Dry Extended Detention Ponds	1500	Acres treated	Regulated impervious developed	0.1	150

Bioswale	500	Acres treated	regulated pervious developed	0.04	20
Dry Extended Detention Ponds	1000	Acres treated	regulated pervious developed	0.1	100
Urban Forest Buffers	400	Acres treated	regulated pervious developed	1	400
Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no under drain	5	Acres treated	Urban land with CSS	0.1	0.54
Wet Ponds and Wetlands	800	Acres treated	Urban land with CSS	0.04	32
Urban Stream Restoration	900	Feet	Urban land-no CSS		
Total BMP Area Needed					**752.538**

This analysis demonstrates that available land is a major factor in determining where and how the City will be able to implement stormwater best management practices. The Greeley and Hansen report assumes that all stormwater treatment must be implemented on public lands. This is actually a reasonable assumption; the vast majority of local stormwater management agencies implement capital projects and assets under their direct control, i.e. on public or eased lands. Therefore, if there are not enough acres in the public domain necessary for achieving pollution reductions, it will be necessary to build structural practices underground to catch and infiltrate runoff, which dramatically increases costs, as demonstrated in the Greeley and Hansen report. Even in situations where there is enough land in the public domain to achieve pollution reduction goals, by restricting implementation to public lands, stormwater managers lose the opportunity to reduce costs and increase efficiencies through effective engagement of the private sector. This is equally important in regards to MS4 permit requirements, which are addressed in the following section.

Anticipated costs to meet current permit BMP requirements. As addressed above, the Commonwealth's new Phase II MS4 permit requirements will obligate the City of Lynchburg to reduce 5 percent of its waste load allocation, within the first five-year permit cycle. Using the cost-attentive analysis provided above, this will require achieving the following annual pollution reductions:

	Cost-Attentive Scenario	5% Reduction Requirement
Nitrogen	173,270	8,664
Phosphorus	23,848	1,192
Sediment	6,583,667	329,183

There are clearly many combinations of practices that the City can employ to achieve the five percent reduction over the next five years; the actual strategy for achieving compliance will be based on how best to reduce costs in the long-term. We address this specifically later in this report.

Stormwater Infrastructure Operations and Maintenance. One of the most overlooked aspects of the increasing use of water quality control structures in urban communities is the impact on operations and maintenance budgets and resources. Operation and maintenance (O&M) costs are post-construction activities that provide upkeep for stormwater BMPs. Reoccurring annual costs include site inspection during and after construction, labor, materials, energy, landscape maintenance equipment, structural maintenance, dredging, disposal of sediments, and litter removal.

Additionally, determining O&M costs requires an estimate of the useful life of the BMP to be made and as well as the estimation of a discount factor to be used in the derivation of an annualized BMP O&M cost. The level of O&M required will depend on the complexity of the BMP. For example, a 2009 study surveyed BMP maintenance practices and found that constructed wetlands and porous pavements required more informed maintenance than other BMPs because of the level of complexity of the technology.[17] Typically, O&M costs are estimated as a percentage of base construction costs, and can often approach 20 percent depending on the type of BMP and level of maintenance adopted.[18] Over time, operations and maintenance costs can actually approach the level of initial construction costs.[19]

O&M costs often create strong incentives to focus stormwater management activities on large-scale structural practices. Though it is important to incentivize onsite mitigation to the maximum extent practicable, many advanced best management practices, including small-scale green infrastructure projects, can often require significant operations and maintenance, which can be difficult and expensive to monitor for performance without adequate systems in place. By consolidating many small-scale disturbances into a large-scale BMP, municipalities like Lynchburg can significantly reduce O&M costs while at the same time ensuring the long-term performance of the project.

[17] Erickson, Andrew J.; Gulliver, John S.; Weiss, Peter T.; and Wilson, C. Bruce, "Survey of Stormwater BMP Maintenance Practices" (2009). Paper 1.

[18] EPA (1999). Preliminary Data Summary of Urban Storm Water BMP. Chapter 6.

[19] Greeley and Hansen use an O&M cost estimate of 5 percent of construction costs.

Section 3: Assessment of Lynchburg's Existing Program

The next step in our process was to assess Lynchburg's capacity to effectively address the investment needs described in the previous section. Our focus was on three primary areas:

1. The ability to generate sufficient program revenue;
2. The effectiveness in engaging the private sector; and,
3. The effectiveness of coupling stormwater management with other community initiatives and priorities.

Section 3.1: Generating Sufficient Program Revenue. As we described at the beginning of this report, this project was implemented in three urban communities. In addition to Lynchburg, Virginia, the project included work in the City of Baltimore and Anne Arundel County in Maryland. Unlike Lynchburg, these are two large urban jurisdictions that are regulated under Phase I of the MS4 permitting program. As such, they are both subject to a law recently passed by the Maryland General Assembly requiring all Phase I permit holders in the state to establish fee-based stormwater management financing systems. In other words, not only are stormwater activities regulated within these urban jurisdictions, the manner in which the programs are financed is also now prescribed by law. To be sure, the law has created a significant amount of consternation and political handwringing over the rights of local government and the adverse impacts of the new fees.

This, of course, is in direct contrast to Lynchburg, Virginia. Lynchburg too has a stormwater fee in place, which was developed and implemented without the coercion of the Commonwealth or state regulators. Quite simply, the fee was established through the leadership of the staff at the Department of Water Resources (formally the Department of Utilities) in partnership with the City's elected officials. We do not intend to imply that the process was without controversy of difficulty; rather, our intention is to highlight the importance of the City's decision to codify a dedicated funding stream in support of stormwater activities and programs. As is the case with the vast majority of the more than 1,500 communities across the country that have implemented fee-based stormwater programs, the decision to do so in Lynchburg was motivated by local decision-making and the desire to improve the efficiency of the City's stormwater program. It is our opinion that the stormwater fee will do just that.

Lynchburg's stormwater enterprise fee. Lynchburg's stormwater fee is similar in construct to the majority of the fee systems in place across the country. For single-family residential properties, the fee is based on square footage of impervious surface, with properties placed in three categories (small, medium, large) based on total impervious area. Fees range from $2 per household per month to $6.40 per household per month. Total annual fee-based revenue in 2013 was $2,736,000, and will increase to $3,120,000 in 2014.

As is the case with most public programs and agencies, the bulk of the expenses associated with managing and administering a stormwater program is associated with labor and salaries.[20] Stormwater management has become a highly complex activity requiring the input and

[20] Please keep in mind that these are expenses associated with managing and administering a program. These expenses are distinct from those associated with designing and constructing stormwater control structures.

engagement of multiple disciplines, skillsets, and occupations. Specifically, activities range from planning and engineering, operations and maintenance, administration, and project management, as is reflected in the City's 2014 budget.

Given the EFC cost estimates provided in the previous section, it is clear that the stormwater program managers have budgeted sufficient resources to finance water quality improvements and control measures throughout the existing permit cycle. Therefore, the primary focus should be to implement systems that reduce long-term implementation costs as much as possible as a way of preparing for what will, by all accounts, become much more restrictive restoration requirements related to future permit cycles. That is our primary focus in ***Section 5*** of this report.

Section 3.2: Achieving Permit Compliance. By all accounts, Lynchburg has a highly sophisticated program that is innovative, efficient, and effective. In addition, the program is supported through a dedicated fee (addressed below) that enables effective planning and implementation of permit requirements. That said, a recent audit by EPA Region III demonstrates how complex and difficult it is to ensure that administrative expenses are resulting in effective program compliance. EPA identified three permit violations related to three of the six minimum control measures, including:

- *Pollution prevention/good housekeeping for municipal operations,* including eliminating illicit discharges from public works yards, storage yards, fleet or maintenance shops, and outdoor storage areas;
- *Construction site stormwater runoff control,* including developing, implementing and enforcing procedures to reduce runoff from construction activities; and,
- *Post-construction stormwater management in new development and redevelopment,* including ensuring the adequate long-term maintenance of structural stormwater management facilities.

Clearly, addressing these violations, as well as maintaining the effective work being done to comply with the other three minimum control measures, will require the City to allocate administrative resources effectively.

Section 3.3: Creating Efficiencies and Reducing Costs. The City's experience with the EPA audit process provides an example of how complex stormwater management programs have become. Again, our analysis and assessment of the Lynchburg program makes it clear that the City is operating a sophisticated and effective stormwater program. We remain impressed with the quality of the program staff and the capacity of the City's stormwater leaders to advance innovative and effective projects, outreach efforts, and financing initiatives. The goal of the City's stormwater program should be to apply its innovative thinking and capacity to efforts that can reduce costs and create efficiencies.

As our analysis in Section 2 of this report demonstrated, two things will be essential for keeping stormwater costs low in the future: ensuring flexibility in the financing system, thereby taking advantage of those projects and practices that generate the greatest pollution reductions per dollar invested; and, establishing effective links with the private sector. To that end, our assessment of Lynchburg's stormwater program addressed how well the City was engaging the residents and businesses within the community. This assessment serves as the foundation of our recommendations in Section 5.

Stormwater Fee Credits. 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.[21]

In Lynchburg, residents that implement stormwater best management practices on their properties can qualify to receive a reduction in their stormwater fee. If approved, each device will earn the property owner a credit of 20 percent of the stormwater utility fee, up to a maximum credit of 50 percent of the fee. No property owner can receive a credit of greater than 50 percent of the fee. The City has approved four BMPs for inclusion in the fee program: rain barrels, rain gardens, vegetated filter strips, and pervious pavers.

Lynchburg's fee credit program is actually indicative of similar programs across the country in that very few ratepayers are incentivized to control stormwater emissions on their property. This is generally the case for two reasons. First, the reduced fee, even those up to 50 percent as in Lynchburg, are not high enough to cover the cost of most best management practices, though there as some, such as downspout disconnections, that can be implemented with very low costs. Second, most communities do not advertise their programs extensively. Though Lynchburg has done an excellent job in providing detailed information related to the stormwater program in general and the fee credit specifically, there has been little activity or requests for fee credits to date. As a result, the opportunity to substantively engage ratepayers in a way that results in activity on their property is not taking place.

It should be noted that Lynchburg's program is relatively new and as ratepayers become more familiar with the program, there is the likelihood that more will take advantage of the fee credit. This is especially true for some of the larger commercial ratepayers facing higher monthly fees. In Section 5, we identify opportunities for expediting private engagement through financial incentive programs.

Section 3.4: Linking Stormwater to Other Community Priorities. Successful implementation of stormwater management programs will not only improve local water quality, but will also presumably result in other environmental and community benefits. Our aim with this part of the capacity assessment was to establish a process that will allow decision makers in Lynchburg to understand the impact and scale of potential collateral benefits related to other environmental, social, and economic development efforts within the City. Virtually every community project has a stormwater runoff component and identifying opportunities to overlay stormwater actions into community investment projects can result in real financing efficiencies. For example:

[21] 2012 Stormwater Utility Survey. A Black and Veatch Report. Page 4.

- A housing rehabilitation project or the removal of an abandoned building can create opportunities to reduce levels of impervious surfaces;
- Road and trail construction and improvements provide options to employ innovative new technologies such as semi-permeable pavers, curb and gutters, and vegetative filters;
- Urban tree planting and canopy projects create opportunities for water quality uptake and reduced runoff through tree infiltration; and,
- Flooding abatement projects can result in improved retention of stormwater through the construction of bio-infiltration best management practices.

The EFC project team worked with the staff of the City of Lynchburg, Virginia to identify opportunities to coordinate and leverage stormwater financing with the City's 11-point sustainability program. The EFC team reviewed and assessed operational budgets, capital improvement programs, and various planning and strategic documents to gain a better understanding of how stormwater management investments either will or would have the potential to reduce costs through program synergies. We then identified how similar efforts in other communities across the country could effectively inform Lynchburg decision-making.

Sustainable City Initiative. In 2008, staff from various Lynchburg governmental agencies began working on a Sustainable City Initiative with the purpose of providing a framework by which the principles of sustainability could be utilized in developing policy and in the City's day-to-day practices. A goal of the Sustainable City Initiative is to foster improved inter-departmental communication, which will lead to effectiveness and efficiencies in long-term planning, as well as day-to-day City operations. The work to date has strengthened working relationships among departments, encouraged collective ownership for problem solving, and stands to improve long-term planning and maximization of resources.[22]

The primary deliverable of the Sustainable City Initiative is the 11-element sustainability guidance document that outlines the principals of sustainability utilized in developing City policy. After a detailed examination of the sustainability initiative, the EFC identified elements and agencies that are in alignment with stormwater management including: economic development, healthy and active living, infrastructure, land use, natural and environmental resources, and transportation. There are projects that fit within each of these elements that have been included in the City's Capital Improvement Program budget. If the City of Lynchburg could use a project's connections with stormwater management as a means to prioritize the City projects, the cost of stormwater management could be reduced.

The following table describes the stated priorities within each of the 11 sustainability elements. The City has appropriated funding to support projects that help realize these principles, and many of these anticipated projects have stormwater components. As a result, components of the sustainability plan will, by default, help finance the City's stormwater management efforts. Table 4 depicts how the Lynchburg Sustainability Principles and potential stormwater management efforts overlap.

[22] http://www.lynchburgva.gov/sustainablelynchburg

Table 4: Stormwater/Sustainability Overlaps

Lynchburg Sustainability Principle	Potential Overlaps with Stormwater	Minimum Control Measures Likely Addressed
Arts and Culture	Library, museums, community center including new buildings and upgrades (example: 5th Street Corridor upgrade) in Arts & Cultural District. Includes museum and recreation building repairs.	Illicit Discharge Detection and Elimination (MCM#3). Developing and implementing a plan to detect and eliminate illicit discharges to the storm sewer system could be addressed during new building construction or with building/road upgrades.
Citizen Engagement and Social Capital	Engage citizens through public education, Citizens Police Academy, Citizens for Clean Lynchburg, Ready Lynchburg.	Public education and Outreach (MCM#1) and Public Participation/Involvement (MCM#2). Providing opportunities for citizens to participate. Also, educational outreach to raise awareness of stormwater issues with public project improvements.
Economic Development	Multiple projects designed to stimulate economic development include: Brownfields Initiative 2011, redevelopment Forum, Corridor Study, Multimodal Transportation Initiative (Kemper Street), OED Transportation Advocacy Group, and City Enterprise Zones. Creation of funding streams for projects that have stormwater components (New Revolving Loan Fund for LEED projects and for small businesses) also the Facade Grant Program to redevelop the facades which can reduce runoff.	Road and building improvements and construction provide opportunities to reduce stormwater and meet the following MCMs: Illicit Discharge Detection and Elimination (MCM #3), Construction Site Runoff Control (MCM#4), Post-Construction Site Runoff Control (MCM #5), and Pollution Prevention / Good Housekeeping (MCM #6) with potential training of municipal staff to reduce runoff from new projects.
Healthy and Active Living	Stormwater runoff reductions can be realized through the projects associated with healthy and active living including trail construction, parking lots at recreational facilities, pedestrian sidewalk plans and other sidewalk improvements through Safe Routes to School. Projects also include removal or improvement of blighted buildings and conversion to open space or new buildings with reduced stormwater runoff.	Road, trail, sidewalk, and building construction provide opportunities to meet the following MCMs: Illicit Discharge Detection and Elimination (MCM #3), Construction Site Runoff Control (MCM#4), Post-Construction Site Runoff Control (MCM #5), and Pollution Prevention / Good Housekeeping (MCM #6) with potential training of municipal staff to reduce runoff from new projects.
Infrastructure	Projects under infrastructure improvements include stormwater BMPs such as Roadways, new energy efficient buildings, construction and upgrades to the wastewater treatment plan, water and sewer line upgrades/replacements, and tree plantings.	Road, trail, sidewalk, and building construction provide opportunities to meet the following MCMs: Illicit Discharge Detection and Elimination (MCM #3), Construction Site Runoff Control (MCM#4), Post-Construction Site Runoff Control (MCM #5), and Pollution Prevention / Good Housekeeping (MCM #6) with potential training of municipal staff to reduce runoff from new projects.

Land Use	Reductions in stormwater can be realized through projects earmarked under the land use principle including historic renovations (5th Street, Lynchburg Neighborhood Development Foundation and Dept of Community Development). Stormwater retrofits can also be achieved through other projects such as Walmart greyfield redevelopment, Brownfields at Allen-Morrison, and construction of a Diamond Hill Community Center, Jefferson Street improvements, Traditional Neighborhood Developments improvements for Wyndhurst and Cornerstone, Wards Road connectivity improvements, City Market Lofts in Downtown, and the Parlor Lofts' renovations, along with the Lower Bluffwalk renovations and Kemper Cluster Commercial Developments planned. Projects such as 8 parks and trail improvements provide stormwater retrofit options (as noted above in other principles) as well.	Road, trail, sidewalk, and building construction provide opportunities to meet the following MCMs: Illicit Discharge Detection and Elimination (MCM #3), Construction Site Runoff Control (MCM#4), Post-Construction Site Runoff Control (MCM #5), and Pollution Prevention / Good Housekeeping (MCM #6) with potential training of municipal staff to reduce runoff from new projects.
Lifelong Learning	Stormwater improvements can be achieved through improvements in road and sidewalks for Lynchburg College transit and community centers. Public outreach could be through education, workforce development training, and the youth high school citizen's academy in stormwater issues.	Public education and Outreach (MCM#1) and Public Participation/Involvement (MCM#2). Providing opportunities for citizens to participate. Also, educational outreach to raise awareness of stormwater issues with public project improvements.
Natural and Environmental Resources	Stormwater improvements achieved through illegal discharge retrofits, stream makeover efforts, rain gutter disconnects, tree plantings, rain barrels, and pet waste pick up bags. Education and outreach through public involvement in community markets, retrofit workshops, and Nature Zone programming (outreach at Kemper Street).	Road, trail, sidewalk, and building construction provide opportunities to meet the following MCMs: Illicit Discharge Detection and Elimination (MCM #3), Construction Site Runoff Control (MCM#4), Post-Construction Site Runoff Control (MCM #5), and Pollution Prevention / Good Housekeeping (MCM #6) with potential training of municipal staff to reduce runoff from new projects. Public education and Outreach (MCM#1) and Public Participation/Involvement (MCM#2). Providing opportunities for citizens to participate.

Neighborhoods	Stormwater reduction through building and sidewalk improvements and construction. Specific projects include Cornerstone Development, Wyndhurst Development, Downtown Revitalization, Stadium Park / Allen-Morrison demolition, NGO housing organizations, and trail to Kemper Street. Also identified Ready Lynchburg Initiatives, Facade Enhancements, real estate rehab, renovation of Aubrey Barbour Park, CDBG funds for Tinbridge Hill neighborhood improvements, rebuilding D Street bridge, 5th Street improvements, and replacing old septic systems to facilitate sewer extensions.	Road, trail, sidewalk, and building construction provide opportunities to meet the following MCMs: Illicit Discharge Detection and Elimination (MCM #3), Construction Site Runoff Control (MCM#4), Post-Construction Site Runoff Control (MCM #5), and Pollution Prevention / Good Housekeeping (MCM #6) with potential training of municipal staff to reduce runoff from new projects.
Safe Community	Emergency Services including fire, rescue, and flood improvements. Flood abatement can result in reduced stormwater runoff.	Post-Construction Site Runoff Control (MCM #5), and Pollution Prevention / Good Housekeeping (MCM #6) with potential training of municipal staff to reduce runoff from new projects.
Transportation	Stormwater improvements can be achieved through transportation projects including Downtown Parking Plan, regional bike plan, trail improvements, 5th street overlay, Wards Road Pedestrian Plan, Safe Routes to School, public and private transit services, and expansion of Kemper Street/ Buchanan Street to 5th Street.	Road, trail, sidewalk, and building construction provide opportunities to meet the following MCMs: Illicit Discharge Detection and Elimination (MCM #3), Construction Site Runoff Control (MCM#4), Post-Construction Site Runoff Control (MCM #5), and Pollution Prevention / Good Housekeeping (MCM #6) with potential training of municipal staff to reduce runoff from new projects.

Through a review of the Fiscal Year operating Budgets for 2013 and 2014, as well as a review of the 2013-2017 and 2014-2018 Capital Improvement Programs, funds were identified for projects that will reap stormwater reductions. A cost savings for the City can be realized if the pre-approved capital improvement projects are implemented with a focus on stormwater improvements throughout construction, post-construction, outreach, and staff trainings. This will require pre-project planning and inter-departmental communications to ensure the projects are implemented with a focus on stormwater reduction, where possible. In this way, MS4 permit requirements are met through capital improvement projects in a way that promotes and advances the 11 principles of Sustainable Lynchburg.

Section 4: Analytic Approach to the Economic Impact Assessments

Before providing recommendations for expanding the capacity and effectiveness of Lynchburg's stormwater financing system, we readdress the first deliverable of this project, an economic impact assessment related to stormwater investments within the City. In short, we re-evaluated the modeling results provided to Lynchburg 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, Lynchburg 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 around 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: Background. Much of the debate associated with 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 stormwater management programs 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[23] 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.[24]

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 changes in spending from households as income increases due to additional production. This

[23] 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.

[24] 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.

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.[25]

Our study focuses on the three pilot communities. It does not assess how direct spending on stormwater management 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.[26]

Section 4.3: Estimating the Level of Stormwater 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 investments required us to address a contentious issue associated with the Chesapeake Bay

[25] Ibid.

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

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.[27] 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.[28]

Table 5. 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	Design and engineering

[27] 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.

[28] Both Baltimore and Anne Arundel County are MS4 Phase I communities; as a result, their associated stormwater programs are more comprehensive in terms of scale than Phase II 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.

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 6 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 6 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 6. 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**

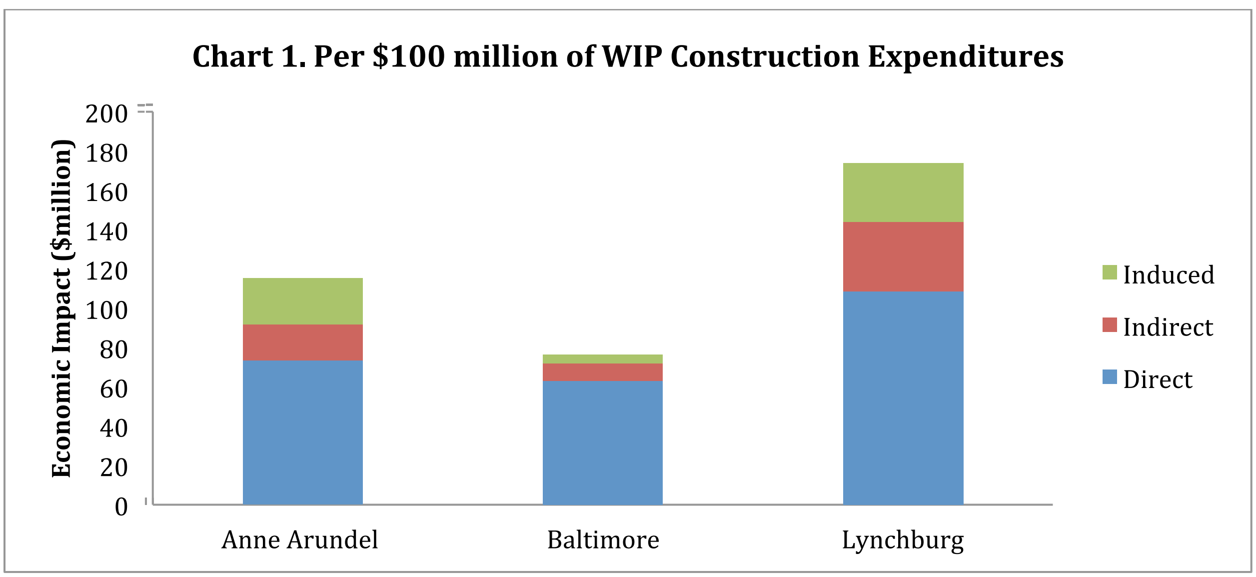
[a] All costs reported in millions of 2013 dollars.

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 7, 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 7. 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

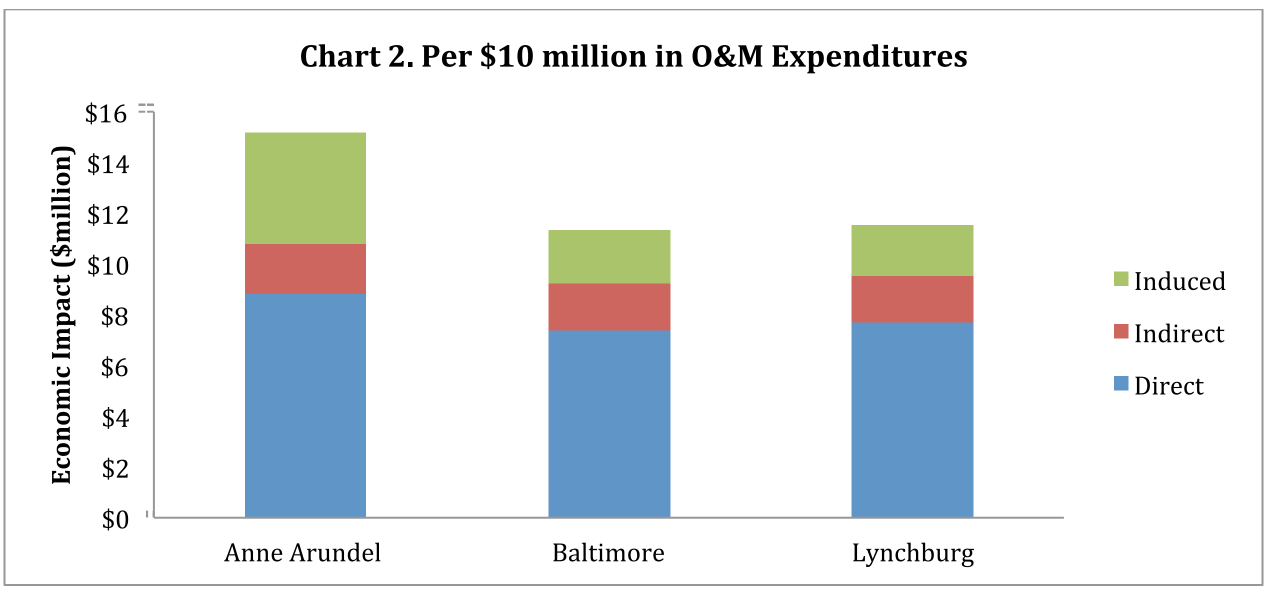
Direct investment in the construction of stormwater BMPs also leads to fiscal impacts to government at the local, state and federal levels. These fiscal effects measure the changes associated with tax revenue flowing from direct and indirect taxes on households and businesses (eg, wages, profits and property), as well as licensing fees. Table 8 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 8. 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 9 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 9. Estimated Annual Impact Per $10 Million Invested in Stormwater O&M

	Anne Arundel County	Baltimore	Lynchburg
	$ 8,810,000	$ 7,380,000	$ 7,700,000
Indirect	$ 1,960,000	$ 1,860,000	$ 1,850,000
	$ 4,400,000	$ 2,100,000	
Total	$ 15,170,000	$ 11,350,000	$ 11,540,000
	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 (e.g., wages, profits and property), as well as licensing fees. Table 10 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 10. 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 Lynchburg 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 like Lynchburg. 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.[29] 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 Lynchburg 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.

[29] *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 Lynchburg'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 City. As discussed in the previous section, the City's stormwater permit obligations will require addressing pollution reductions as described in the Watershed Implementation Plan. Though these requirements are manageable with existing systems in the short-term, they will become significantly more stringent and presumably more costly in the long-term. Therefore, we recommend establishing processes that will reduce those costs. Specifically, we recommend establishing a performance-based financing system, designed to incentivize innovation and efficiency in the private sector.

Recommendation 1: Shift to a Performance-Based Financing System. Our first recommendation to Lynchburg 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, Lynchburg 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 City's financing efficiency. Rather than becoming handcuffed by expected or perceived implementation costs, the EFC believes that communities like Lynchburg 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 Lynchburg 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 therefore the most direct payment approach.[30] 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.[31] 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 as well as MS4 permits, 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.[32] 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.

Table 11. 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

[30] 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.

[31] Ibid.

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

• 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…"[33]

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

  Lynchburg 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

[33] 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.

sends the message to the private sector that the community leaders are committed to solving the stormwater 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 City. 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 are 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. As Lynchburg advances its stormwater program, the development of these modeling tools will be essential.

- 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, Lynchburg 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 cost. 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 Lynchburg 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, City officials should decide what BMPs will qualify, such as the four best management practices that are part of the existing fee-credit program, and what properties are eligible for receiving stormwater rebates.

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.[34]

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 Lynchburg 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 the 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.[35] 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; 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.[36]

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

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

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

[36] 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/.

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.[37]

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.[38]
- 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 practices, the project resulted in nutrient emissions at prices far lower than equivalent USDA cost-share programs.[39]
- 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

[37] 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.

[38] See Case Study 1 in Appendix 5 for more detail.

[39] 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.

generate up to 1,000 megawatts for the state's three big investor-owned utilities and further spur the solar industry.[40]

- 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.[41]

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.[42] 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.[43]

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 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.

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[40] 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.

[41] See Case Studies 2 and 3 in Appendix 5 for more detail.

[42] 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.

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

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.

The rebate program, reverse auction and performance financing systems are all based on the basic premise that stormwater management is a community priority requiring equal engagement from the public and private sectors. These three processes, though a clear diversion from the City's existing financing systems, are imminently doable and would have a profound impact on the City's stormwater financing system.

Recommendation 4a: Improve Communication and Financing Coordination Within City Government. Stormwater managers in Lynchburg have an opportunity to maximize co-financing opportunities in myriad projects across the City. Specifically, the Sustainable City Initiative provides an effective structure for advancing stormwater goals through City government activities. To that end, we offer a series of case studies and examples of how other communities across Virginia and the region have been able to improve governmental effectiveness and stormwater management efficiencies through communication and organizational tools and strategies.

Communication Strategies. Taking advantage of these opportunities, however, will require the City to establish both intra- and inter-departmental communications strategies. The City has acknowledged the absence of a structured communication platform to better organize each shared project. The ability to visualize collaborative funding and goals of each department per shared project would enable more efficient use of City dollars and time. To that end, we offer governmental communication examples from other communities across the country.

Winchester, Virginia's Natural Resource Advisory Board. Municipalities have employed various mechanisms to help cross-share information and allow staff to understand where there are project overlaps and potentials to reduce stormwater through other projects. For example, the City Council of Winchester, Virginia passed an ordinance to create a Natural Resources Advisory

Board (NRAB). The NRAB is comprised of Council-appointed staff from various departments for the express purpose of facilitating a thorough review of all City projects with the goal of identifying common service areas related to natural resource protection and restoration. Specifically, NRAB was charged with identifying potential project overlaps and opportunities to improve stormwater runoff. The progress of all stormwater, sediment, and nutrient reductions is tracked to facilitate Bay TMDL progress reporting and optimize project efficiency. Based on input from NRAB, the City engineer has been able to more accurately account for tree plantings and garner increased TMDL credits, which were accounted for in the Virginia Assessment Scenario Tool (VAST) through which localities report Bay TMDL goal achievements to the state.

Program Coordination in Warwick Township, Pennsylvania. In Pennsylvania, Warwick Township is well known throughout Lancaster County as one of the most proactive communities managing stormwater. Due to the leadership exhibited by the Township Manager, the Township has developed an integrated water resource approach over the past two decades that incorporates stormwater management into every aspect of its municipal functions.

The Warwick Town Managers goal is to continue development of a holistic approach to stormwater management practices across all sectors, as well as the region. The EFC has been working with Warwick and surrounding localities to examine how each municipality finances its stormwater management activities and provided recommendations regarding improving the cost-effectiveness. The study helped Warwick Township develop a long-term strategic planning method for meeting its capital needs, specifically focused on storm sewer and municipally-owned BMP repair, replacement, and maintenance. This goal is aligned with the Township's desire to continue integrating stormwater management practices across all Township activities. The Warwick Town Manager maintains oversight of all projects within the Township and through overarching knowledge, can ensure stormwater facets are integrated in all municipal projects. Using a centrally-based point person that oversees all municipal activities has proven a powerfully effective approach.

One final example of shared stormwater programing that has resulted in financial savings can be found between the small towns of Edinburg and Mount Jackson in Virginia. The towns, located five miles apart, coordinated the joint purchase of a street sweeping vehicle to service the roads of both towns. The towns adopted a resolution and MOU to share the maintenance and operation costs and schedule usage in each jurisdiction. The equipment sharing has resulted in a decreased sediment load from the streets in both jurisdictions and keeps the per capita costs to a minimum for town residents versus each jurisdiction having purchased and maintain their own.

Recommendation 4b: Improve Organizational Strategies. The Fifth Street road project in Lynchburg is an example of the progress that can be made on a phase-by-phase basis with improved communication. During Phase I of the project, there was a lack of communication between the community members, business owners, and the City, which resulted in the closure of access roads to local business. During Phase II, there was signage implemented that allowed businesses to inform their customers of alternative business access. If Lynchburg had a process to disseminate information across City departments and into the community, projects could be implemented more efficiently. Below we provide examples of how other communities have integrated organizational tools into their decision-making processes.

Municipal Website in Philadelphia, Pennsylvania. The Philadelphia Water Department (PWD) hosts a website that offers a comprehensive approach to stormwater. It serves as a one-stop-shop for technical data as well as outreach and education materials for reaching the general public through both traditional methods and social media platforms. The PWD site includes interactive watershed information, connects community members with opportunities to get involved, and describes practices the community can use to reduce runoff. This type of web presence can be an efficient way of addressing MCMs 1 and 2 while effectively engaging residents and other community stakeholders in stormwater management. The site can be found at www.phillywatersheds.org.

New York CityStat. New York CityStat (NYCStat) is web-based decision-support program that provides access to essential data, reports, and statistics related to City services through nine distinct databases. In particular, the Citywide Performance Reporting tool (CPR) and the Street Conditions Observation Unit (SCOUT) are the databases that hold the most promise as models for the City of Lynchburg's effort to be more organized and collaborative.

The CPR tool contains statistics, long-term trends and specific agency outcome measures for eight different citywide themes including administration, community services, economic development and business affairs, education, infrastructure, legal affairs, public safety and social services. CPR enables the public to view agency performance and trends graphically, research specific city measures, compare trends over a five year period and break out specific measures into citywide themes that involve multiple agencies and disciplines. If the NYCStat model were to be adapted using Lynchburg's sustainability elements as the citywide themes, stormwater management could be a performance criterion within each element, which could facilitate many of the housekeeping requirements of MCM 6.

SCOUT is an interactive map program that uses City road condition data collected by a team of inspectors who drive each street in the City monthly. These data are processed and the agencies responsible any necessary repairs or maintenance are notified of current needs. With the addition of a stormwater infrastructure layer, this type of interactive map system could be useful in Lynchburg as a visual tool for identifying opportunities to link stormwater operations and maintenance planning with roads planning.

Baltimore CityStat. **–** The Baltimore CityStat platform is a modification of the NYCStat that evaluates the performance statistics of the City's agencies. Each agency has a CityStat analyst responsible for collecting and analyzing data according to predetermined metrics. The data are then organized into graphs, charts, tables, and maps which are reviewed at the monthly and bi-monthly Mayoral meetings. A process flow diagram for Baltimore's CityStat Program is shown in Figure 1.

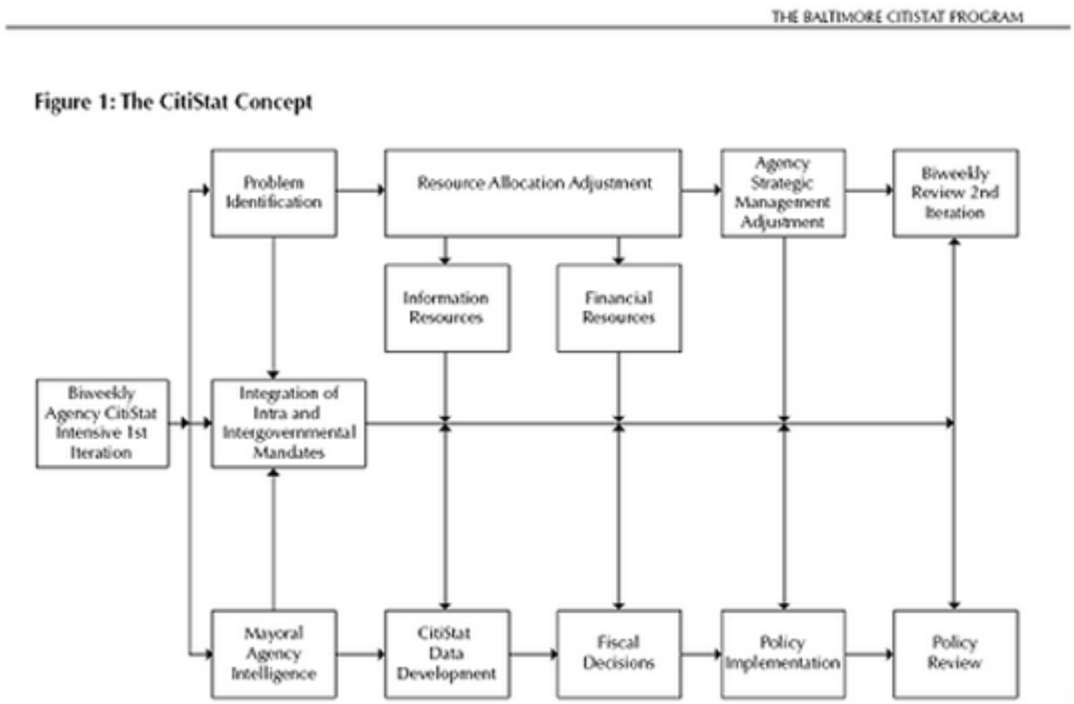

Figure 1: Process flow diagram of the CityStat Program

There are four tenants that CityStat: accurate and timely intelligence shared by all, rapid deployment of resources, effective tactics and strategies, and relentless follow-up and assessment. These tenants keep City agencies on target and hold them accountable for their progress on projects while increasing the overall efficiency. This model facilitates an increase in the efficiency of City operations, as well as improved lines of communication within and between agencies and departments.

Other effective project management tracking tools provide visual feedback to easily identify project overlaps.

GIS Mapping in Calvert County, Maryland. ArcGIS is a mapping tool that Calvert County used to organize and present the County's capital improvement plan (Figure 2). This Geographic Information System (GIS) is a platform that enables data sharing between agencies. While this model would require each agency have a staff member trained in GI, this type of information sharing would enable more holistic planning and allow for water quality practices to more easily be incorporated into other community projects.

The EFC conducted a preliminary mapping exercise to demonstrate the overlaps between capital improvement plan projects and those that would support stormwater management requirements. A similar exercise could plot projects identified in the Sustainable Lynchburg Plan and the City's FY14 operating budget. This would enable the City to consider how best to incorporate stormwater management activities into projects that already have funds allocated to them. In additional to having a visual medium for interagency sharing of information, being able to address capital improvement needs, sustainability goals, and water quality activities simultaneously again creates efficiencies that reduce implementation costs.

Recommendation 4c: Improve Communication between Lynchburg and State Agencies. Stormwater management can be achieved through interdepartmental communications (as presented above), as well as through improved communications with state or regional agencies.

Potential Use of Hazard Mitigation Funds. Several Virginia local governments have made use of Virginia Department of Emergency Management (VDEM) hazard mitigation funds following a federal disaster declaration to minimize localized flooding issues and realize stormwater benefits. Hanover County, for example, had frequent flooding and stormwater conveyance problems in a particular neighborhood. VDEM worked with the County to use hazard mitigation funding to build several stream culverts to handle stream bank overflows and erosion issues, thereby reducing stormwater runoff. Henrico County used similar hazard mitigation funding to implement BMPs to prevent stormwater scouring after heavy rains.

Leveraging the Soil and Water Conservation District. Northern Virginia Soil & Water Conservation District (SWCD) staff members have noted that many local governments are not aware that their regional conservation district can help communities meet their MCM requirements. This SWCD staff has worked closely with Fairfax County and homeowner associations to offer technical service on drainage and erosion issues on private properties, provide pond management, construct rain gardens, assist with soil stabilization, and BMP placements. In addition to technical assistance, the Northern Virginia SWCD lends localities support in stewardship and education to help meet MCMs 1 and 2 by coordinating volunteers and providing public outreach on stormwater issues. Jurisdictions can use SWCD staff to extend municipal staff for best management practice inventories, monitoring and record keeping reducing municipal personnel costs.

Recommendation 4d: Improve Communication Between the City and Non-Governmental Organizations. Improved communication and engagement between the City and non-governmental organizations (NGOs) can also yield cost-effective stormwater management improvements.

Cambridge, Maryland and the Eastern Shore Land Conservancy. The Eastern Shore Land Conservancy (ESLC) is a private organization that facilitated dialogues within Cambridge, Maryland to raise awareness among local elected officials and City planners about the many community projects that had stormwater improvement components (streetscape improvements, bike trail, blighted building renovations, etc.), as well as how cross-sharing information can lead to co-financing and achieve stormwater cost savings. During the organization's work in Cambridge, Maryland, ESLC staff participated in a dozen or more City Council meetings to discuss current and planned municipal projects to help Council members better understand opportunities to optimize projects and implement stormwater practices where practicable. As a result, the City's gateway improvement project, designed to foster future economic development, incorporated stormwater practices including rain gardens and interpretive signage that describes to the public the water quality improvements achieved.

Warren County, Virginia and the Appalachian Trail Connector. Another example of a third-party facilitating the implementation of local stormwater practices comes from Warren County, Virginia. Warren County received a grant to develop a cross-County recreational trail that would link to the Appalachian Trail and better connect parts of the County to the town of Front Royal. Warren County's staff hired a consultant to assist with the design of the trail connector for the purposes of encouraging hiker traffic into the jurisdictions to spur economic development. The consultant has worked to improve the "stormwater awareness" of local officials and has incorporated design features that decrease runoff from the trail and limit stream crossings. This will reduce sediment and erosion in adjacent waters and reduce stormwater runoff during rainfall events. The new trail's materials and alignments are being designed to meet both the Appalachian Trail goals as well as reducing stormwater runoff.

Stream Revitalization in Mercersburg, Pennsylvania. Another third-party model involves coordination among multiple project partners in the Borough of Mercersburg, Pennsylvania. While the project is not driven by a stormwater permit, local water quality goals will be addressed as a part of a trails project designed to restore an impaired segment of Johnston Run while addressing other community objectives such as public health, economic development and local heritage.

The proposed three-quarter mile trail will be a recreational asset as well as an educational tool, incorporating ecotrail elements such as trails stops that feature: the role of reed plants in filtration; the value of tree plantings for bank stabilization; the significance of native versus invasive plant species; and, opportunities to improve water quality, using the knowledge derived from recent aquatic studies. This holistic approach has required coordination among a host of project partners including Borough staff and elected officials, the National Park Service, a local wellness nonprofit organization, a private engineering firm, the County Conservation District, and a water quality monitoring team from Dickenson College. Future phases of the Johnston Run revitalization effort will engage adjacent municipalities to improve a larger segment of the Run. By leveraging the capacity and resources of multiple partners and taking a holistic approach to a local trails project, local goals for water quality and public health improvements are being advanced.

Section 6: Conclusion

This project report brings to a conclusion EFC's work in the City of Lynchburg. As we have stated throughout this report, we feel that the City of Lynchburg is uniquely positioned to build and advance a stormwater program that is innovative, effective, and very efficient. By focusing on a few key elements in the financing system—efficiency, performance, and effective partnerships with the private sector—the City can achieve its stormwater goals well into the future. For questions or to provide comments related to this study, please contact Dan Nees, Senior Research Associate at dnees@umd.edu.

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- Sarah Bunch, Assistant Director

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- Robert Wieland, Owner

Mr. Wieland led the cost evaluation and modeling process.

Appendix 1: BMP Cost Scenarios

Table 1: BMPs and Costs for the 2012 Scenario

BMP Name	Amount of BMP Submitted	Unit	Land-Use	Percent Implemented	Unit Cost	Total Cost
Dry Detention Ponds and Hydrodynamic Structures	973	Acres treated	Urban land with CSS	5.11	759	$738,545
Erosion and Sediment Control	198	Acres treated	Construction-all	100	529	$104,980
Dry Extended Detention Ponds	388	Acres treated	Urban land with CSS	2.04	191	$74,060
Urban Filtering Practices	37	Acres treated	Urban land with CSS	0.2	2321	$86,295
Forest Harvesting Practices	5	Acres	harvested forest	91.4	64	$292
Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain	5	Acres treated	Urban land with CSS	0.03	846	$4,551
Urban Nutrient Management	147	Acres	Pervious urban-all	0.98	52.5	$7,714
Urban Stream Restoration	273	Feet	Urban land-no CSS		60.36	$16,496
Wet Ponds and Wetlands	698	Acres treated	Urban land with CSS	3.67	271	$189,220
Cost for all BMPs						**$1,222,155**

Table 2: BMPs and Costs for the Cost-Attentive Scenario

BMP Name	Amount of BMP Submitted	Unit	Landuse	Percent Implemented	Unit Costs	Total Costs
Forest Harvesting Practices	124	Acres	Harvested forest	99.25	$64	$7,936
Dry Extended Detention Ponds	500	acres treated	Non-regulated pervious developed	21.05	$191	$95,500
Dry Detention Ponds and Hydrodynamic Structures	400	acres treated	regulated impervious developed	14.6	$759	$303,600
Dry Extended Detention Ponds	1500	acres treated	regulated impervious developed	54.74	$191	$286,500
Bioswale	500	acres treated	regulated pervious developed	5.37	$689	$344,500
Dry Extended Detention Ponds	1000	acres treated	regulated pervious developed	10.75	$191	$191,000
Urban Forest Buffers	400	acres in buffers	regulated pervious developed	4.12	$94	$37,732
Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain	5	acres treated	Urban land with CSS	0.03	$846	$4,551
Wet Ponds and Wetlands	800	acres treated	Urban land with CSS	4.29	$271	$216,800
Urban Stream Restoration	900	Feet	Urban land-no CSS		$60	$54,324
Cost of all BMPs						**$1,542,443**

Table 3: BMPs and Costs for the 2025 (WIP) Scenario

BMP Name	Landuse	BMP Amount Calculated	Unit	Unit cost	Total cost
Dry Detention Ponds and Hydrodynamic Structures	regulated pervious developed	331.84	acres treated	$759	251,867
Dry Detention Ponds and Hydrodynamic Structures	CSS pervious developed	96.85	acres treated	$759	73,509
Dry Detention Ponds and Hydrodynamic Structures	regulated impervious developed	86.28	acres treated	$759	65,487
Dry Detention Ponds and Hydrodynamic Structures	nonregulated pervious developed	81.27	acres treated	$759	61,684
Dry Detention Ponds and Hydrodynamic Structures	nonregulated impervious developed	21.95	acres treated	$759	16,660
Dry Detention Ponds and Hydrodynamic Structures	CSS impervious developed	21.13	acres treated	$759	16,038
Dry Extended Detention Ponds	regulated pervious developed	727.87	acres treated	$191	139,023
Dry Extended Detention Ponds	CSS pervious developed	212.44	acres treated	$191	40,576
Dry Extended Detention Ponds	regulated impervious developed	189.26	acres treated	$191	36,149
Dry Extended Detention Ponds	nonregulated pervious developed	178.26	acres treated	$191	34,048
Dry Extended Detention Ponds	nonregulated impervious developed	48.14	acres treated	$191	9,195
Dry Extended Detention Ponds	CSS impervious developed	46.35	acres treated	$191	8,853
Forest Harvesting Practices	harvested forest	4.75	acres	$64	304
Impervious Urban Surface Reduction	regulated impervious developed	172.07	acres	$14,214	2,445,803
Impervious Urban Surface Reduction	nonregulated impervious developed	43.77	acres	$14,214	622,147
Impervious Urban Surface Reduction	CSS impervious developed	42.14	acres	$14,214	598,978
Street Sweeping 25 times a year	regulated impervious developed	155.1	acres	$460	71,346
Street Sweeping 25 times a year	nonregulated impervious developed	39.45	acres	$460	18,147
Street Sweeping 25	CSS impervious	37.98	acres	$460	17,471

times a year	developed				
Urban Filtering Practices	Regulated pervious developed	312.08	acres treated	$2,321	724,338
Urban Filtering Practices	CSS pervious developed	91.09	acres treated	$2,321	211,420
Urban Filtering Practices	regulated impervious developed	81.15	acres treated	$2,321	188,349
Urban Filtering Practices	Non-regulated pervious developed	76.43	acres treated	$2,321	177,394
Urban Filtering Practices	Non-regulated impervious developed	20.64	acres treated	$2,321	47,905
Urban Filtering Practices	CSS impervious developed	19.87	acres treated	$2,321	46,118
Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain	Regulated pervious developed	340.72	acres treated	$846	288,249
Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain	CSS pervious developed	99.45	acres treated	$846	84,135
Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain	regulated impervious developed	88.59	acres treated	$846	74,947
Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain	Non-regulated pervious developed	83.45	acres treated	$846	70,599
Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain	Non-regulated impervious developed	22.54	acres treated	$846	19,069
Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain	CSS impervious developed	21.7	acres treated	$846	18,358
Urban Nutrient Management	Regulated pervious developed	1599.92	acres	$53	83,996
Urban Nutrient Management	CSS pervious developed	466.97	acres	$53	24,516
Urban Nutrient Management	Non-regulated pervious developed	391.84	acres	$53	20,572
Urban Stream Restoration	Non-regulated pervious developed	205.63	feet	$60	12,412
Wet Ponds and Wetlands	Regulated pervious developed	823.66	acres treated	$271	223,212
Wet Ponds and	CSS pervious developed	240.4	acres	$271	65,148

Wetlands			treated		
Wet Ponds and Wetlands	Regulated impervious developed	214.17	acres treated	$271	58,040
Wet Ponds and Wetlands	Non-regulated pervious developed	201.73	acres treated	$271	54,669
Wet Ponds and Wetlands	Non-regulated impervious developed	54.48	acres treated	$271	14,764
Wet Ponds and Wetlands	CSS impervious developed	52.45	acres treated	$271	14,214
For All BMPs					**$7,049,706**

Appendix 2: Review of Stormwater Management Costs

In the urban environment, it is often difficult to find appropriate vacant property and unconstrained physical space adjacent to individual development projects to mitigate water quality impacts. This problem is especially acute in areas where land development, utilities, and other infrastructure severely restrict the feasible construction of water quality treatment.

In such areas, as an alternative, reliance is often placed on installing underground manufactured treatment devices, which have specific maintenance requirements and can be very expensive. Location of on-site treatment is often not compatible with existing landscapes or land use contexts. Finally, the proliferation of many small water quality mitigation sites results in questionable environmental benefits, substantial project development and regulatory review cost and increased demands for maintenance.[44]

The stormwater management requirements associated with the Chesapeake Bay restoration effort will exacerbate these issues in urban communities like Lynchburg. In order to reduce overall implementation costs to the maximum extent practicable, it is necessary to understand the factors and variables that influence the cost of stormwater best management practices (BMPs) We begin with a look at specific cost categories, followed by an analysis of the variables that influence specific BMP costs.

Cost Categories. Based on review of the literature, the EFC has separated the total cost of stormwater BMPs into the following categories: land costs, pre-construction, construction, capital costs, operation and maintenance, and program administration. These cost elements encompass the majority of costs associated with stormwater BMPs.

Land: Managing stormwater in urban areas is complex and potentially expensive for a variety of reasons, not the least of which is the cost and limited availability of land. In fact, the cost of land is often the most significant variable impacting stormwater BMP costs (see EPA 1999). Clearly, land costs can vary widely among communities (see King 2011), as well as within communities. As a result, land costs can significantly influence the potential impact of market tools such as stormwater banks and in-lieu fees.

In general, land valuation is based on an estimate of the *highest and best use* of the land, i.e. the use of the land that is reasonably probable, legally permitted, physically possible, economically feasible and results in the highest value for a property. The estimated market or appraised value of land can vary, significantly at times, from the *value-in-use* and the *investment value* of land. The *investment value* of land is the value of land to the owner or prospective owner for investment or operational objectives, and the *value-in-use* is the value to one particular user of the net present value of the cash flows that the land is expected to generated for a particular activity under a specific use. These differences between investment

[44] *Water Quality Mitigation Banking.* Final Report. December 2009. Submitted by: Anil K. Agrawal,The City College of New York, New York, NY 10031; Andreas Fekete, RBA Group; Fred Scherrer, RBA Group; Bryan VanderGheynst, RBA Group. Region 2 Transportation Research Center.

value, value in use, and market value of land provide motivation for buyers and sellers trade in the market place.[45,46]

Key components of land costs include:

- Easement costs. Projects that are installed on private lands without fee simple purchase will require a property easement to ensure adequate operations and maintenance (O&M) over the life of the practice. This results in two corresponding cost issues. First, eased property must always be restored to as-good or better condition after O&M activities. Second, an easement essentially results in loss of use or loss of development rights to the property owner.
- Opportunity costs. An opportunity cost is the cost of an alternative that must be forgone in order to pursue a certain action. As it pertains to the valuation of land, the opportunity cost of land is the cost to the owner of giving up the utility generating uses of the property when the land is taken out of service. In a stormwater setting, opportunity costs are associated with the devaluing of land when it is taken out of service and is repurposed for stormwater treatment with regards to previous or potential land use. The derivation of opportunity costs involve making an assumption that a property owner faces increasing opportunity costs for land that is taken out of service for other uses (Thurston 2006).

  The opportunity cost and associated value of land is often not considered in many BMP cost assessments, and as a result, BMP cost estimates are often significantly undervalued. However, it is important to distinguish between land valuation, opportunity cost and accounting or realized cost. The King and Hagan report correctly incorporates the value of developable land—either public or private—into BMP cost estimates. However, developable public land only becomes an accounting or realized cost if the forgone activity would have actually occurred and would have resulted in some sort of revenue or cash flow to the community. Many publically financed best management practices are installed on lands that are technically developable but are not slated for development in the foreseeable future, if ever. Therefore, there is no revenue cost to the community.
- Land acquisition and transaction costs. Acquisition costs are site specific and depend on the type of BMP being installed. Components of the cost to acquire land include time to identify land, legal fees, commissions and brokerage fees, title search fees, appraisal fees, governmental fees, and settlement fees.

Pre-construction costs: Before construction can begin, remediation sites have to be prepared. Pre-construction costs are incurred before the BMP can be installed, and include: surveying; design work; permitting; geotechnical testing; and transaction costs, including legal fees, time to acquire and identify project site, and land acquisition (addressed above).

Site conditions significantly influence pre-construction costs associated with urban best management practices. Mitigation projects in urban environments often require significant site preparation, including demolition activity. Finally, as with any permitted construction activity,

[45] Joseph F. Schram, Jr. (January 2006). Real Estate Appraisal. Rockwell Publishing. P 36. ISBN 978-1-887051-25-5.

[46] International Valuation Standards, 2011.

there are sediment and erosion control activities that must be accounted for including silt fencing and sediment trapping. Pre-construction costs average between 10-40 percent of overall construction costs (see King and Hagan 2011).

Construction: The primary cost of any best management practice is the actual construction and installation. Construction costs consist of the cost of excavation, primary erosion and sediment control, control structure installation, appurtenances costs, landscaping, and BMP specific installation costs. Expenditures for professional and technical services required for the construction of the stormwater BMP are also included in construction costs. Construction costs are dependent upon the BMP being installed, and can vary widely (see King and Hagan 2011). As with pre-construction costs, site conditions have a significant impact on the variability of construction costs. Hydrology, soil type, and topography can result in significant variations in construction costs from site to site, which will potential impact banking and in-lieu fee programs.

Cost of capital: Cost of capital must be considered for any capital project, such as stormwater management. Cost of capital is defined as the opportunity cost of the funds employed as the result of an investment decision; it is equivalent to the rate of return that a business or institution could earn if it chose another investment with equivalent risk. Included in the cost of capital calculation is the cost of debt. King and Hagan used a uniform rate of 3 percent over a 20-year borrowing period. Please note that the cost of capital can vary from site to site or institution to institution, depending on the party securing the credit and also depending on risk differences.

Operations and maintenance: Operation and maintenance costs (O&M) are post-construction activities that provide upkeep for stormwater BMPs. Re-occurring annual costs include site inspection during and after construction, labor, materials, energy, landscape maintenance equipment, structural maintenance, dredging, disposal of sediments, and litter removal. Additionally, determining O&M costs requires an estimate of the useful life of the BMP, as well as an estimation of the discount factor to be used in the derivation of an annualized BMP O&M cost. The level of O&M required will depend on the complexity of the BMP. Erickson et al. (2009) performed a survey of stormwater BMP maintenance practices and found that constructed wetlands and porous pavements required more informed maintenance than other BMPs because of the level of complexity of the technology. Typically, O&M costs are estimated as a percentage of base construction costs, ranging from <1-20 percent depending on BMP and level of maintenance adopted (EPA 1999). Over time, operations and maintenance costs can actually approach the level of initial construction costs.

O&M costs actually represent one of the key benefits associated with stormwater banking and in-lieu fee programs. Though it is important to incentivize onsite mitigation to the maximum extent practicable, many advanced best management practices, including small scale green infrastructure projects, can require significant operations and maintenance, which can be difficult and expensive to monitor for performance. By consolidating many small scale disturbances into a large-scale BMP, local governments can significantly reduce O&M costs while at the same time ensuring the long-term performance of the project.

Additionally, determining O&M costs requires an estimate of the useful life of the BMP to be made and as well as the estimation of a discount factor to be used in the derivation of an annualized BMP O&M cost.

Program administration: Program administration entails the process or activity of running a business or enterprise. The establishment of stormwater banks and in-lieu fee programs presents unique administrative challenges for municipal stormwater management programs. Administrative costs are primarily, though not exclusively, based on labor requirements.

Appendix 3: 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	Corporation
Dividends	$0	$0	$0	$0	$328,5
Social Ins Tax- Employee Contribution	$7,372	$0	$0	$0	
Social Ins Tax- Employer Contribution	$31,717	$0	$0	$0	
Indirect Bus Tax: Sales Tax	$0	$0	$1,100,752	$0	
Indirect Bus Tax: Property Tax	$0	$0	$1,197,498	$0	
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$29,431	$0	
Indirect Bus Tax: Severance Tax	$0	$0	$0	$0	
Indirect Bus Tax: Other Taxes	$0	$0	$421,544	$0	
Indirect Bus Tax: S/L NonTaxes	$0	$0	$69,629	$0	
Corporate Profits Tax	$0	$0	$0	$0	$152,6
Personal Tax: Income Tax	$0	$0	$0	$478,064	
Personal Tax: NonTaxes (Fines - Fees)	$0	$0	$0	$88,598	
Personal Tax: Motor Vehicle License	$0	$0	$0	$15,229	
Personal Tax: Property Taxes	$0	$0	$0	$7,161	
Personal Tax: Other Tax (Fish/Hunt)	$0	$0	$0	$2,398	
Total State and Local Tax	$39,089	$0	$2,818,854	$591,450	$481,1

Table 6. Baltimore City Federal Fiscal Impacts from WIP Projects

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

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	Corporatior
Dividends	$0	$0	$0	$0	$8,2
Social Ins Tax- Employee Contribution	$11,686	$0	$0	$0	
Social Ins Tax- Employer Contribution	$27,076	$0	$0	$0	
Indirect Bus Tax: Sales Tax	$0	$0	$1,027,762	$0	
Indirect Bus Tax: Property Tax	$0	$0	$1,131,457	$0	
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$27,740	$0	
Indirect Bus Tax: Severance Tax	$0	$0	$0	$0	
Indirect Bus Tax: Other Taxes	$0	$0	$261,133	$0	
Indirect Bus Tax: S/L NonTaxes	$0	$0	$102,730	$0	
Corporate Profits Tax	$0	$0	$0	$0	$140,0
Personal Tax: Income Tax	$0	$0	$0	$1,414,359	
Personal Tax: NonTaxes (Fines - Fees)	$0	$0	$0	$348,923	
Personal Tax: Motor Vehicle License	$0	$0	$0	$52,088	
Personal Tax: Property Taxes	$0	$0	$0	$18,882	
Personal Tax: Other Tax (Fish/Hunt)	$0	$0	$0	$12,590	
Total State and Local Tax	$38,762	$0	$2,550,822	$1,846,841	$148,3

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

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

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

Lynchburg, Virginia

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	Corporatior
Dividends	$0	$0	$0	$0	$9,5
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	$129,1
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	$138,6

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

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporation
Dividends	$3,213,698	$218,086	$0	$0	$
Social Ins Tax- Employee Contribution	$3,168,054	$0	$0	$0	$
Social Ins Tax- Employer Contribution	$0	$0	$373,351	$0	$
Indirect Bus Tax: Sales Tax	$0	$0	$146,473	$0	$
Indirect Bus Tax: Property Tax	$0	$0	$249,413	$0	$
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$0	$0	$1,414,5
Indirect Bus Tax: Severance Tax	$0	$0	$0	$3,616,468	$
Indirect Bus Tax: Other Taxes	$6,381,752	$218,086	$769,236	$3,616,468	$1,414,5

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	$1,17
Social Ins Tax- Employee Contribution	$1,585	$0	$0	$0	$
Social Ins Tax- Employer Contribution	$3,677	$0	$0	$0	$
Indirect Bus Tax: Sales Tax	$0	$0	$186,793	$0	$
Indirect Bus Tax: Property Tax	$0	$0	$248,037	$0	$
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$4,591	$0	$
Indirect Bus Tax: Severance Tax	$0	$0	$121	$0	$
Indirect Bus Tax: Other Taxes	$0	$0	$44,565	$0	$
Indirect Bus Tax: S/L NonTaxes	$0	$0	$29,780	$0	$
Corporate Profits Tax	$0	$0	$0	$0	$15,97
Personal Tax: Income Tax	$0	$0	$0	$77,163	$
Personal Tax: NonTaxes (Fines - Fees)	$0	$0	$0	$8,191	$
Personal Tax: Motor Vehicle License	$0	$0	$0	$2,719	$
Personal Tax: Property Taxes	$0	$0	$0	$1,717	$

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

Impacts by BMP

Anne Arundel County

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)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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	Economic Impact	Total	Total Fiscal Impact	ROI

	Impact	Direct	Indirect	Induced	Economic Impact	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 4: Stormwater Rebate Case Studies

Washington, DC. Washington, DC has incentivized stormwater management through the use of rebate programs for residential, commercial, and industrial properties. Th RiverSmart Homes program offers rebates to residential property owners who install approved practices and the Green Roof Rebate program offers a certain dollar amour per square foot of green roof installation, with a higher incentive for properties locat 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.[47] 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, a Water. The Green Roof and RiverSmart Homes rebate programs were discussed as w to meet the goals of the water topic. Having the rebate programs integrated into a n stormwater specific document is a way of informing the public not already aware of t programs of the possibility of stormwater management practice funding opportunitie

Green Roof Rebate Program. The green roof demonstration program was a precurso the Green Roof Rebate program. The demonstration program was initiated in 2003 a feasibility study of the installation of green roofs on commercial buildings in the Distr 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.[48] The grants issued as part of the demonstration project were intended to cover up to 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.[49] As of 2013-2014, the rebate amount has increase to $7 per planted square foot and up to $10 per square foot in target sub-watershed areas.[50] The increased incentive offered to properties in targeted areas increases

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

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

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

[50] Anacostia Watershed Society. Green Roofs. http://www.anacostiaws.org/programs/stewardship/gr roofs.

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 on water 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 giveaways such as rain barrels and saplings.[51]

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.[52]

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.[53] 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 decentralized green stormwater infrastructure through private property

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

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

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:[54]

- 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.[55] RainWise provides a 60 to 100 percent rebate[56] 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.[57] As of 2013, over 250 rain gardens and cisterns have been installed in Seattle with a goal of 3,005 total installations.[58,59]

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

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

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

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

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

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

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

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 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.[60] 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.[61] 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.[62]

RainScapes Neighborhood Program. The RainScapes Neighborhood program[63] 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.

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

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

[62] 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.

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

Appendix 5: 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% 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 rain water 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 northcentral 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