2013

Stormwater Financing Report to Baltimore, Maryland

Prepared by

Environmental Finance Center
University of Maryland
November 30, 2013

This report was prepared by the University of Maryland Environmental Finance Center with support from the National Fish and Wildlife Foundation.

Project Lead

***Dan Nees, Senior Research Associate**, Environmental Finance Center,* dnees@umd.edu

*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.

Project team

Joanne Throwe, Director, jthrowe@umd.edu
Jennifer Cotting, Research Associate, jcotting@umd.edu
Eric Reed, Research Associate, ereed1@umd.edu

Photo credit: Willrusso via http://www.city-data.com/picfiles/pic385.php

Contents

Section 1: Introduction

The following document provides a final project report from the Environmental Finance Center (EFC) at the University of Maryland. The goal of the project was to expand the ability and capacity of local governments and communities to achieve water quality restoration goals and priorities through more efficient stormwater financing. This project was piloted in three key urban watershed communities throughout the Chesapeake Basin—Lynchburg, 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. Perhaps no issue better demonstrates the complexity, scale, and contentiousness of the Chesapeake Bay restoration effort better than financing urban stormwater management. As stormwater regulations at all levels of government have become more restrictive, local communities are facing significant financing obligations. The challenge is especially acute for those communities struggling to retrofit existing urban environments and development.

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

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

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

[2]Ibid.

[3]Ibid.

banks and alter river channels, potentially damaging public infrastructure like roads and bridges, as well as private property.

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

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

- Developing and implementing a stormwater financing system that is focused on performance and measurable, verifiable benefits to the environment and local water quality.
- Substantively engaging the private sector in a way that reduces program costs in the long-term and creates efficient environmental outcomes.
- Leveraging other community priorities and programs related to reducing the effects of urban blight, advancing sustainability programs, including urban agriculture, and accelerating economic development and job growth within the City.
- Partnering with the many existing nonprofit and environmental and social organizations across the City by establishing innovative public/private partnerships.

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

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

ideas within the community about the role of the environment and water quality management in the fabric of everyday life.

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

We understand that not everyone supports the use of fees as a way of financing stormwater programs. We are sure that everyone can agree, however, that regardless of how the revenue is generated, it is essential that each community have the capacity to address the stormwater issue effectively and that each ensure that every dollar is invested in a manner that maximizes return on investment, keeping costs low, efficiencies high, and local water clean. It was with that in mind that we implemented this project and created the following report.

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

As with any financing effort, establishing efficiencies related to Baltimore'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. We begin with an analysis of the two regulatory drivers that are expanding stormwater requirements within local urban communities across the Chesapeake region: the National Pollutant Discharge Elimination System (NPDES) permitting program and the Watershed Implementation Plans.

Section 2.1: Key Regulatory Drivers. Cities like Baltimore have been implementing relatively aggressive stormwater management programs for many years. Originally focused on flooding and volume control, stormwater became a more significant concern for communities across the country due to the 1987 amendments to the Clean Water Act, which required states to regulate stormwater emissions as a point source of pollution through the NPDES permitting plan. Over time, permit requirements have become even more restrictive for communities within the Chesapeake region as a result of the Bay restoration effort. The result has been a combination of federal laws and programs that have significantly increased the obligations of local stormwater programs. Coupled with newly strengthened state stormwater laws, the costs for managing complete programs are rising significantly. In the following section we address the key provisions of stormwater regulations and their impacts of financing within Baltimore.

The MS4 permitting process. Stormwater by its very nature is a diffuse or nonpoint source of water pollution. However, amendments made to the Clean Water Act in 1987 expanded the federal permitting program to include emission from stormwater. Polluted stormwater runoff is commonly transported through Municipal Separate Storm Sewer Systems (MS4s).

An MS4 is a system of conveyances that include, but are not limited to, catch basins, curbs, gutters ditches, manmade channels, pipes, tunnels, and/or storm drains that discharge into water bodies. For these conveyances, or system of conveyances to be recognized as an MS4, a state, city, town, village, or other public entity must own them. These conveyances must also not be part of a Publically Owned Treatment Works and may not operate as a combined sewer. Operators of large, medium, and regulated small MS4 systems are required to obtain NPDES permit coverage in order to discharge pollutants.[4] These designations (large, medium, and small) are based on urbanized areas as determined by census counts.

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

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

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

Generally, Phase I MS4s are covered under an individual permit and Phase II MS4s are covered by a general permit. Each regulated MS4 is required to develop and implement a stormwater management program (SWMP) to reduce the contamination of stormwater runoff and prohibit illicit discharges.[5]

Watershed Implementation Plans. The U.S. Environmental Protection Agency's (EPA) Chesapeake Bay TMDL uses "caps" to limit the amount of nitrogen, phosphorus and sediment that can be discharged into the Bay by the jurisdictions whose tributaries drain to it. The goal of the TMDL is to accelerate the restoration efforts that have been underway for three decades with the ultimate goal of restoring water quality and aquatic habitats throughout the Bay. As part of this process, action plans that define how each state, in conjunction with local and federal partners, will achieve and maintain the required nutrient reductions over time. These action plans are referred to as Watershed Implementation Plans (WIPs). WIP development has been a two-phase process. Phase I WIPs identified statewide strategies for reducing nutrients and sediments. In 2011, the Bay states worked with their local jurisdictions to develop plans for achieving statewide goals. These Phase II WIPs are designed to guide local-level nutrient reduction activities, with at least 60 percent of the necessary nitrogen, phosphorus and sediment reductions attained by 2017.[6]

Phase I jurisdictions in Maryland are entering—or have entered—the third five-year permit cycle. To that end, the Maryland Department of the Environment (MDE) has reached a tentative determination to issue an NPDES MS4 permit to the City of Baltimore. Under the conditions of the permit, Baltimore, as with the other permitted communities, is required to possess the legal authority to control storm drain system pollutants, continue mapping its storm sewer system, monitor stormwater discharges, and develop and implement comprehensive management programs. The permit requires the implementation of trash reduction strategies, and environmental site design for new and redevelopment projects to the maximum extent practicable. The City is also required to develop and implement plans to address waste load allocations established under EPA approved total maximum daily loads.[7]

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

[6] When compared to 2009 levels.

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

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

Baltimore's WIP. Baltimore's Phase II WIP describes how the City intends to achieve stipulated pollution reductions. Baltimore is an ultra-urban area, therefore only two source sectors for nutrient and sediment loadings are applicable: wastewater treatment plants and regulated stormwater. Baltimore's WIP, therefore, is concentrated on the regulated stormwater source sector.[8] There are several key issues worth noting related to the City's WIP strategy:

- First, it is a very short, concise document. In seven pages, the City describes in very general terms how it will achieve pollution load reductions. This is in contrast to Anne Arundel County for example, whose WIP is 81 pages long and describes in detail how it plans to accomplish load reductions. Though the document states that the City will complete a more detailed analysis of the link between the WIP and the MS4 permitting process, the brevity of the City's plan is related to one key issue: the direct connection to the City's MS4 permit, which raises a second issue.
- The City's WIP and MS4 permit are essentially the same document and process. Because advanced wastewater treatment is financed through the State's Chesapeake Bay Restoration Fund, the City's WIP is entirely focused on stormwater management. As per the City's pending MS4 permit, the City will restore 20 percent of the impervious area within the City's permit area. This restoration goal (equivalent to over 4,700 acres) will theoretically achieve the 2017 Interim goals of the Bay TMDL program.[9] This is again in contrast to Anne Arundel County where achieving the 20 percent impervious treatment goal will simultaneously achieve just 25 percent of the County's Bay TMDL load reduction requirement.[10]
- There is a stated desire to engage the private sector in the restoration process, especially as it relates to implementing projects on private lands. The City owns about 5 percent of the parcels within City limits, which equals about 5 percent of total impervious surface area. As a result, private sector engagement will be essential.
- Finally, the City is clear about the limitations of the implementation process in that there are relatively few practices that are included in the codified restoration process. This obviously restricts opportunities for creating implementation efficiencies.

Currently, there are about 350 structural BMPs within the City of Baltimore, with a majority located on private property. Upgrading these existing BMPs to increase treatment capacity and nutrient reduction is not considered a feasible option. Instead, the restoration efforts will be achieved by implementing a combination of new projects as follows:[11]

[8] Baltimore City Phase II Watershed Implementation Plan (WIP). July 2, 2012.

[9] Baltimore City Phase II Watershed Implementation Plan (WIP). July 2, 2012.

[10] Estimate provided by the former director of the Anne Arundel County Department of Public Works.

[11] Baltimore City Phase II Watershed Implementation Plan (WIP). July 2, 2012.

- About 20 percent by structural, traditional BMPs like bioretention areas, surface filtration systems, wet ponds and wetland areas;
- About 15 percent by impervious area removal, reforestation, urban tree planting and the use of alternative surfaces (such as green roofs and permeable pavement);
- About 10 percent Environmental Site Design treatment practices such as micro-practices; and,
- Any remaining portion by non-traditional BMPs such as stream restoration, inlet cleaning, street sweeping, and other practices (quantified benefits to be determined).[12]

The City will use a similar approach to achieve the remaining goals for 2025; however, the distribution of methods will change in anticipation of limited opportunities for structural, traditional BMPs and stream restoration projects.

Section 2.2: Anticipated Costs Associated with Implementing the WIP and NPDES Permit. By all accounts the WIP and MS4 processes will require Baltimore to dramatically expand and accelerate its stormwater management process. As a result, the City will make stormwater infrastructure investments far beyond anything it has experienced in the past. Specifically, the City has estimated that achieving the WIP and MS4 pollution reductions will cost around $250 million.[13] To that end, the next step in our analysis was to establish a more thorough planning-level understanding of the actual costs facing the City as a precursor to assessing the City's capacity for addressing those costs.

Below we provide an analysis of the City's anticipated costs associated with achieving stormwater management goals. This analysis was based on four key documents and resources:

- A draft report to the Bureau of Water and Wastewater Chief of Fiscal Services from Rafteus Financial Consultants (RFC) dated August 17, 2011. The report described a financial planning model that RFC developed in partnership with City staff. The model served as the basis for establishing a fee-based stormwater enterprise fund. A copy of the report is included in Appendix 1.
- A spreadsheet-based stormwater cost-of-service analysis dated March 3, 2012 provided to EFC by the Division Chief of the Surface Water Management Division of the Bureau of Water and Wastewater. A copy of the spreadsheet is included in Appendix 2.
- The City's MAST model results.
- The City's FY 2014 budget.

The purpose of this analysis was not to duplicate the work of the City and its consultants but rather to identify opportunities for expanding the efficiency, reach, and effectiveness of the City's stormwater program. To that end, we began with an assessment of the implementation costs and current program capacity.

[12] Baltimore City Phase II Watershed Implementation Plan (WIP). July 2, 2012.

[13] Baltimore City Phase II Watershed Implementation Plan (WIP). July 2, 2012.

Stormwater programs are made up of the multiple components including administration and financial management, engineering and planning, operations and maintenance, capital investment, water quality compliance, regulation and enforcement, public involvement and education, technology, and other miscellaneous activities. For our analysis we placed costs and expenses into two broad categories: administration and operations; and, capital investment.

Administration and Operating Expenses. Administration and operating expenses include the salaries, equipment, materials, and contractual services necessary for operating and maintaining stormwater infrastructure. In terms of MS4 permit compliance, these expenses are directly associated with; erosion and sediment control; illicit discharge detection; control of litter; property management and maintenance; and, public education and outreach. In short, these are the costs necessary for operating and maintaining the existing infrastructure.

The RFC report provided a detailed assessment of operating expenses based on the Fiscal Year (FY) 2012 operating budget. These expenses were used as the basis of the operating expenses in their model and associated financial plan. FY 2012 operating expenses included the annual budget of approximately $7.5 million for stormwater and the annual operating budget of approximately $4.0 million for street sweeping. Additional variable costs included necessary transfers to the general fund, overhead, and pension and retiree health care costs. The baseline FY 2012 budget was combined with the additions described above to arrive at the projection of operating expenses over the forecast period. The FY 2012 operating budget is presented in Table 1.

Capital Improvements Plan. The second stormwater management plan revenue requirement is capital-related expenditures, including debt service and revenue-funded capital spending. The RCF study used capital projections developed by the City's Stormwater Engineering Division through FY 2020. These projections were used as the basis of future capital and debt requirements in the model. The capital improvement plan (CIP) costs were presented in FY 2012 dollars and have been escalated by 3.5 percent annually to account for inflation, as shown in Table 1.

Table 1: Anticipated Operating and Capital Budget

	FY2012	FY 2013	FY 2014	FY 2014[14]	FY 2015	FY 2016	FY 2017
	Adj. Budget	*Budget*	*Budget*	*Proposed*	*Budget*	*Budget*	*Budget*
Projected Operating Budget							
Transfers	$ 1,463,541	$ 1,624,467	$ 1,737,721	$ 1,013,884	$ 1,819,110	$ 1,890,356	$ 1,961,558
Salaries	5,846,536	6,925,240	8,268,973	6,936,434	8,873,975	9,267,366	9,545,387
Other Personnel Costs	1,482,093	1,576,059	1,670,136	2,167,804	1,769,842	1,875,516	1,987,515
Contractual Services	4,169,032	4,294,103	4,422,926	3,424,031	4,555,614	4,692,282	4,833,051
Materials and Supplies	673,381	693,582	714,390	766,927	735,822	757,896	780,633
Equipment - $4999 or less	79,900	82,297	84,766	45,081	87,309	89,928	92,626
Equipment - $5000 or more	68,404	1,434,263	1,094,270	1,683,150	1,081,244	1,004,409	1,034,541
Grants, Subsidies, Contributions	25,000	25,000	25,000	0	25,000	25,000	25,000
Total	13,807,888	16,655,012	18,018,182	16,037,311	18,947,916	19,602,753	20,260,311
Anticipated Capital Requirements							
Debt Service							
Existing Debt Service		$ 912,414	$ 912,414	$912,414	$ 912,414	$ 912,414	$ 912,414
Proposed Debt Service				2,612,888	1,963,022	3,700,383	5,452,050
Total Debt Service		$912,414	$912,414	$3,525,302[15]	2,875,435	4,612,796	6,364,464
Revenue-Funded Capital Projects		11,063,287	10,325,868	4,706,000	7,106,420	8,662,364	6,486,252
Total Revenue Requirements	**$13,807,888**	**$28,630,712**	**$29,256,463**	**$20,743,311**	**$28,929,771**	**$32,877,914**	**$33,111,027**

[14] City of Baltimore Fiscal Year 2014 Budget; Agency Detail; Page 133.

[15] City of Baltimore Fiscal Year 2014 Capital Plan and Six Year Capital Plan Summary; page 6.

The next step in the RFC analysis was to determine the total revenue requirements associated with establishing an enterprise programs. This required addressing issues and factors such as:

- Variances for unknown expenses;
- Potential for inaccurate data (impervious area estimates, etc.);
- Allowance for uncollectible bills;
- Incentive and credit programs; and
- Ratepayer discounts.

Each of these adjustments increased the level of revenue the utility would need to recover in order to meet its obligations. Table 2 provides a summary of total estimated revenue requirements related to establishing a stormwater enterprise program in Baltimore as determined by RFC and reported to the City.

Table 2: Total Estimated Revenue Requirements

	2012	2013	2014	2015	2016	2017
Total Estimated Revenue Requirements	$13,807,888	$30,634,862	$31,304,416	$30,954,855	$35,014,978	$35,263,244

It should be noted that RFC's analysis was conducted before the passage of HB 987, and not all of the assumptions they make in their model are reflected in the City's current enterprise program, which we discuss below (for example, the square footage of impervious surfaces used to calculate and average ERU). To that end, we compared the RFC FY 2014 budget estimate to the actual recommended City of Baltimore 2014 budget (reflected in Table 1). Though there are variations in the operating budget, the primary differences are related to capital expenditures. In short, the RFC capital expenditure estimates are significantly higher than the actual recommendation. This will obviously impact the ability of the City to address capital projects necessary for achieving permit compliance.

In spite of the differences in the FY budget estimate to the actual recommendations, the RFC analysis provides a good initial assessment of the City's revenue and capacity requirements. For example, the report does a good job of demonstrating the challenge that many urban communities are facing: balancing existing infrastructure financing needs with new investment requirements. The study estimates the capital costs associated with addressing existing infrastructure problems through an aggressive asset management strategy. This increases capital requirements by as much as 40 percent in some years. Therefore, the costs associated with new WIP and the MS4 permit requirements cannot be divorced from existing infrastructure management needs.

In addition, the RFC analysis, as well as the City's cost estimates, demonstrates a significant expansion of the City's stormwater management program in the coming years. Though private firms will conduct much of the implementation, design, and construction, the City will have to add to its staff as well. The City is, of course, not unique in this respect. The region is about to experience a dramatic increase in the level of stormwater management over the next five

years; it is the capacity to meet that level of investment commitment effectively that we address in the following section.

Section 3: Assessment of Baltimore's Program Capacity

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

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.

Before addressing these three components specifically, we offer two important observations about the City's capacity to address stormwater management requirements:

- First, as with the other two communities that were part of this project, the City of Baltimore has significant capacity to finance and manage its stormwater program. The City has been addressing stormwater in earnest since the early 1990's, in addition to managing and administering other large enterprise programs such as water and wastewater management for a much longer period of time. Our goal with this project was not to identify any possible deficiencies in these financing and administrative systems, but rather identify what is possible in regards to creating efficiencies and improving effectiveness, specifically as it relates to the Surface Water Management Division within the Department of Public Works. Again, it is our belief that the City is about to dramatically expand its stormwater management program, but that expansion is based on a solid foundation.
- Like many other urban communities across the country, Baltimore is managing a host of environmental, social, and economic issues and challenges, and stormwater management is adding to those challenges. However, the City has a unique advantage over other communities in that it already has a very active private-sector community working to advance the interests of the City. Specifically, organizations like Blue Water Baltimore, Parks and People, the Baltimore Center for Green Careers, the Waterfront Partnership of Baltimore, and others have become essential leaders in the stormwater management effort and are well-positioned to help enable City leaders to achieve what can only be considered aspirational environmental goals and objectives.

Section 3.1: Generating Sufficient Program Revenue. The Surface Water Management Division (SWMD) of the Bureau of Water and Wastewater is responsible for the operation and maintenance of the stormwater collection system within the City. These responsibilities include management of surface water runoff in terms of the quantity of runoff and the quality of that runoff and its impact on the streams, waterways and the Chesapeake Bay. SWMD operates and maintains the City's system of 1,146 miles of storm drain pipe; 52,438 inlets; 27,561 manholes; 1,709 outfalls; four storm water pumping stations; and five large debris collectors. In addition, SWMD is responsibility for administration of the City's Stormwater management ordinance, the

City's Stormwater manual, and the stormwater permit issued by the State of Maryland.[16]

Historically, the funding for stormwater management has been provided through the City's General or Motor Vehicle Revenue Fund with a relatively small amount of funding from the Bureau's Water and Wastewater Utility Funds.[17] Of course, that all changed with the passage of House Bill 987 in Maryland and the associated development of the City's stormwater enterprise program.

Maryland House Bill 987 established the Stormwater Management – Watershed Protection Restoration Program. The passage of this bill resulted in mandatory stormwater financing and revenue programs within urban communities across the state. Specifically, the bill applies to counties and municipalities subject to Phase I MS4 permits and requires them to establish watershed protection and restoration programs. To fund the programs, each county and municipality must assess a stormwater remediation fee from property owners within its jurisdiction. The type of fee (flat, proportional or otherwise) was determined by each county or municipality, but each must take into account on- and off-site facilities, systems and activities that a property owner has in place to manage stormwater discharge, and must make exceptions for property owners demonstrating financial hardship. The stormwater remediation fee must go into a local watershed protection and restoration fund where it may be used, among other things, to improve county and municipal stormwater management systems, restore streams and wetlands, fund stormwater management planning, and provide grants to nonprofit organizations performing certain watershed restoration projects.[18]

Obviously HB 987 has had a direct impact on stormwater financing in Baltimore. For years the City has been considering and debating the need for a fee-based stormwater financing system, yet there had never been the political momentum necessary for establishing such a program. By design, HB 987 changed that dynamic, and the City now has a fee in place, which is referred to as the Watershed Restoration and Protection Fee (WRPF). Our aim is not to debate the politics that led to the passage of the City's new fee, but rather to address how well that fee system may or may not enable the City to achieve its stormwater management goals. We begin by looking at the level of revenue that will be generated.

Baltimore's Stormwater Fee. Baltimore is similar to the vast majority of the more than 1,500 communities across the country that have stormwater fee programs, in that the fees are based on an equivalent residential unit (sometimes referred to as an equivalent dwelling unit), or ERU. ERUs are usually based on the average square footage of impervious surface within the community; in Baltimore, one ERU is equivalent to 1,050 square feet (sq. ft.) of impervious surface area. Using ERUs as the basis, fees are then determined within two categories: single family properties and non-single family properties.

Fees for Single Family Properties: Baltimore has a three-tiered flat rate structure for single-family properties (SFP) based on impervious surface, summarized in Table 3.

[16] http://www.bluewaterbaltimore.org/. Last accessed November 1, 2013.

[17] RFC report; August 17, 2011.

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

Table 3: Baltimore Single Family Property Fee Schedule

Impervious Surface	Flat Fee
< 820 sq. ft	$10/quarter
820 – 1,500 sq. ft.	$15/quarter
> 1,500 sq. ft.	$30/quarter

Essentially the middle tier is the equivalent of a single ERU; the first and third tiers are then calculated from that starting point. Fees for SFPs range from $40 per year to $120 depending on the size of the structure and the associated amount of impervious surface on the property.

Fees for Non-Single Family Properties: All non-single family properties will be charged a fee based on a calculation of impervious surface on the property. Each property will be charged $15 per ERU per quarter, with a minimum of one ERU per property. The only exception is the structures of religious non-profits, which will be billed at $3 per ERU per quarter. Unlike the SFP calculation, the impervious surface within a non-SFP property is actually measured. The number of ERUs is calculated and rounded to the nearest whole number.

The dual rate structure will yield about $24 million in revenue in the first year. It is expected that the SFP tiers and the $15 per ERU per quarter fee for non-SFPs fee will remain stable for the next four years. Using the $24 million annual revenue as a starting point, we then compared anticipated revenue flows to the estimated revenue needs identified in the RFC report and model. In short, if the RFC estimates are an accurate reflection of the resources required to achieve permit compliance, the City is facing deficits each year between 2013 and 2017.

	2012	2013	2014	2015	2016	2017
Anticipated Revenue Needs	**$13,807,888**	**$30,634,862**	**$31,304,416**	**$30,954,855**	**$35,014,978**	**$35,263,244**
Anticipated Fee-Based Revenues	$13,807,888	$24,000,000	$24,000,000	$24,000,000	$24,000,000	$24,000,000
Anticipated Deficit	$0	$6,634,862	$7,304,416	$6,954,855	$11,014,978	$11,263,244

Section 3.2: Creating Efficiencies and Reducing Costs. Section 5 of this report provides a suite of recommendations for reducing costs and incentivizing more market-like efficiencies in the financing system. In short, these recommendations are based on the assumption that the private sector, when incentivized to do so, is well equipped to create efficiencies in the implementation process that can effectively reduce costs, improve performance, and reduce risk.

Baltimore, as with the other urban jurisdictions in Maryland, is in the rather unique position of being able to redefine and restructure its stormwater program as a result the establishment of its stormwater enterprise program, as well as the dramatic expansion of its stormwater investments necessitated by its new permit requirements. It is clear that the City recognizes

this opportunity and is taking steps towards incentivizing efficiency through more effective partnerships with the private sector. Two areas stand out: the City's stated focus on cost effectiveness; and, engagement with the private sector and nonprofits.

Focus on cost effectiveness. The City's WIP clearly states that cost effectiveness will be a primary determining factor when siting and constructing stormwater BMPs. In our opinion, this should be the foundation of the City's financing program, and including that goal statement in the WIP was an important signal to the marketplace and the private sector. We address this specifically in the recommendations section of this report.

Engaging the private sector and local nonprofits. The City has an established track record of working with the private sector, specifically through local watershed nonprofits such as Blue Water Baltimore. The expansion of the stormwater program is an opportunity to build on these relationships. This is especially important as it relates to engaging ratepayers in the community, both residential and commercial. New policy recommendations related to the Chesapeake Bay Program watershed model will allow, when enacted, local governments to receive more credit for activities related to homeowner stormwater management practices. Specifically, the proposed policies will:

- Allow localities to report aggregate implementation of acreage served by home-owner BMPs to the State rather than individual practices with a specific geographic address (localities would still have to maintain records on individual practices in order to verify the practice); and,
- Allow localities to utilize alternative verification methods for homeowner BMPs, such as sub-sampling of on-site inspections, homeowner self-inspection, electronic filing of digital photos to confirm homeowner BMPs. These alternative methods, some of which are still under development, would help to reduce the local staff burden that would be required under the proposed urban verification protocols for larger BMPs.[19]

These changes will enable local governments to get much more aggressive in their outreach efforts to residents in their jurisdictions, and leveraging existing public/private partnerships will be critical to keeping transaction costs low. Again, existing outreach and incentive building programs at organizations like Blue Water Baltimore will be essential for expanding City-financed public outreach programs. The City's existing capacity in this area is an important launching point for broader efforts.

Section 3.3: Leveraging multiple community priorities. In spite of the significant expansion in stormwater management activity that will occur within the next few years, it is still just one of many important programs and responsibilities within the City. In fact, when compared to other infrastructure programs—water, wastewater, and transportation specifically—stormwater will account for a relatively small investment, even with the more aggressive permitting responsibilities. For example, the stormwater program in the FY 2014 budget—the first to

[19] Memo from Tom Schueler, Chesapeake Bay Program Stormwater Coordinator to the Urban Stormwater Work Group. October 1, 2013. "Application of CBP-Approved Urban BMP Protocols to Credit Nutrient Reduction Associated with Installation of Homeowner BMPs." Page 1.

include stormwater fee revenue—represents just around 5 percent of the total budget for the Department of Public Works. When you include the budget for transportation—the other significant infrastructure program in the City—stormwater represent less than 4 percent of the total budget.

What this means for Baltimore and other similar urban jurisdictions is that investments in more effective stormwater management, including operations and capital investment, must be made within the context of broader community priorities and context. From an infrastructure perspective, the connections are obvious. Every time any infrastructure project is constructed, repaired, or redeveloped, it is essential to include stormwater management in the planning and implementation process. Of course this is made easier in terms of water and wastewater management in that stormwater is managed within the same department. Coordination with transportation projects is equally essential, obviously, and is aided by the fact that state and federal permit programs require aggressive stormwater treatment within the transportation right of way, which creates a vested interest in creating better coordination between transportation agencies and stormwater management programs.

Given the natural linkages that exist between stormwater and other infrastructure investment programs, as well as the City's expressed interest in taking advantage of those linkages, we focused our analysis on the less direct synergies that exist between stormwater management and other community priorities and initiatives. Specifically, we identified four programs and initiatives that we felt created the best opportunity for the City to expand the capacity and impact of the stormwater management program: sustainability; vacant and abandoned lots; urban agriculture; and, economic development.

Sustainability. Baltimore's sustainability program provides perhaps the most direct and potentially effective link between the City's stormwater financing program and other community priorities and objectives. The City has by all accounts one of the most aggressive and advanced sustainability programs in any urban community across the country. The Office of Sustainability has effective and talented leadership and staffing, has engaged outside experts and stakeholders in a substantive way, is comprehensive in its approach (linking environmental, social, and economic priorities), and has served as an effective organizing force around what are often disparate community programs. Though there are potential linkages between a variety of sustainability initiatives and programs and stormwater management, two stand out as potentially the most effective: the Growing Greener Initiative and the urban agriculture program.

Growing Green Initiative. One of the many challenges facing leaders in Baltimore is its shrinking population. As of July 1, 2012, the City's population stood at 621,342, an increase of just over 1,000 residents from the year before. This is significant because that small increase in growth ended about six decades of population decline. This has significant impacts on sustainability in general and stormwater management in particular because the City's 620,000 residents are paying to manage stormwater infrastructure that was built for more than 300,000 additional people. So, though uncontrolled population growth can be a real problem, in communities like Baltimore population growth is essential for long-term prosperity. The Growing Green Initiative

looks to "establish Baltimore as a green city of the future, one that is healthier, sustainable and economically sound."[20]

According to a 2012 white paper describing the initiative and its goals, the primary focus of the Growing Green Initiative is to reduce a primary negative impact of population decline, abandoned and vacant properties. To that end, the initiative has five key elements:

- System Based Green Stormwater Management: this element envisions a comprehensive stormwater management system that takes advantage of aggregated parcels of land, for integrated stormwater facilities that are incorporated as green elements of redevelopment strategies.
- Community Managed Open Spaces: this includes community adoption of vacant lots for vegetable gardens, pocket parks, and small recreational spaces.
- Parks and Open Spaces: this includes areas of new temporary greened spaces meant as a long term holding areas for future redevelopment, and proposed permanent parks that would be 'built out' upon redevelopment.
- Urban Agriculture: these areas would be leased to urban farmers to grow food commercially.
- Urban Forestry: this element includes street trees and vacant lot tree plantings associated with the TreeBaltimore program.

Each of these five elements either directly or indirectly impacts the City's stormwater management efforts. In fact, the initiative has specifically identified the stormwater utility fee as an opportunity to advance its goals:

> "If the opportunities are found to be as or more cost effective as the 10-year CIP forecast, then the stormwater utility could be used to assist in funding the implementation and maintenance of select green stormwater practices. Securing a portion of the stormwater utility revenue on an ongoing basis will likely be essential for successful implementation of the GGI."[21]

Clearly, coordination between the Growing Green Initiative and the City's stormwater management program will be essential, and in fact has begun.

Urban agriculture. One of the five Growing Green Initiative elements is the expansion of urban agriculture within the City. The goal is to put vacant properties into productive use and reduce maintenance costs, which are often disproportionate to other productive properties in an urban area. Urban agriculture obviously has the added benefit of helping to increase local production of and access to healthy foods. Urban agriculture could take a variety of forms, including produce farming, orchards, the cultivation of plants such as lavender that can be processed to produce essential oils, or the cultivation of plants that could be processed into biofuels. In addition, urban agriculture has the potential to focus on plant or tree nurseries,

[20] Baltimore Growing Green Initiative White Paper; August 1, 2012. Page 1.

[21] Baltimore Growing Green Initiative White Paper; August 1, 2012. Page 12-13.

which could have a potentially significant impact on the regional stormwater management economy.

Green Economy. Finally, there is an opportunity for the City to advance stormwater management in a way that also helps advance efforts to improve the City's economy. Again, one of the five elements of the Growing Green Initiative specifically, and the Sustainability program in general, is the growth of a green economy. As a result, there is an obvious connection between sustainability goals, stormwater, and the City's economic development goals. We address those connections specifically in the following section.

The overlap in the mission and goals of these City initiatives with local stormwater management needs and requirements clearly indicates an opportunity for Baltimore to improve the efficiency and reduce program costs across priorities through shared planning and implementation of these activities.

Section 4: Analytic Approach to the Economic Impact Assessments

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

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

Section 4.1: Introduction and Background. Much of the debate around with more restrictive water quality policies and regulations and their associated financing systems have been conducted in general terms. Regardless of one's position on stormwater management and water quality regulations, the frequent assumption is that the impacts and benefits are either all good or all bad. Like all public policy, however, the issue of impact and benefit is more nuanced. In fact, when assessing the impact, benefit, and potential structure of a policy or regulation, it is essential to consider that policy within the context of the specific community.

The goal of our economic impact analysis was to understand how more aggressive stormwater management programs and investments would specifically impact the three communities. 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 specific study characterizes the potential economic effects of the Watershed Implementation Plan process in three urban communities, focused on the county and municipal levels. The study attempts to measure 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, the assessment 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[22] 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.[23]

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. 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 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 examined, 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

[22] 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.

[23] 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.

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.[24]

Our study focuses on the three pilot communities. It does not assess how direct spending on WIP implementation within the pilot community is likely to generate economic benefits that positively affect the broader regional economy, (in other words, impacts to nearby communities beyond the 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 of the 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.[25]

Section 4.3: Estimating the Level of WIP Expenditures. Like all models, the accuracy of analysis provided by IMPLAN is directly related to the quality of the data and assumptions fed into the model. In the case of our analysis, the anticipated cost or estimated level of investment each community will be making in stormwater management practices varies across the three jurisdictions. For example, the City of Baltimore provided well-developed and highly detailed budgets of projected spending spanning the time period of 2013 to 2025. In contrast, the information available from Anne Arundel County and Lynchburg detailing anticipated WIP expenditures required some assumptions regarding how spending may occur. As a result, the process of assessing the potential economic impacts associated with stormwater investments necessitated considering a contentious issue associated with the Chesapeake Bay restoration effort: implementation costs. It also calls attention to the fact that future realized economic impacts may vary from those projected in this study depending upon the accuracy of our assumptions regarding fiscal expenditures.

[24] Ibid.

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

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 benefits.

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 choose between addressing stormwater infrastructure over other needs. The fact is, however, that 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 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.

Investment decisions required to achieve social and environmental objectives will have potentially significant economic 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. 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.[26] 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.[27]

Table 4. Industries Directly Impacted by Stormwater Investments.

IMPLAN Sector Code	Description	WIP Activity
36	Construction of other new nonresidential structures	Construction

[26] 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.

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

375	Environmental and other technical consulting services	Design and engineering
319	Wholesale trade businesses	Suppliers and equipment
393	Other private and educational services	Training
417	Commercial and industrial machinery and equipment repair and maintenance	Machine maintenance where specified

Table 5 below summarizes WIP costs provided by each jurisdiction. It reports projected WIP costs aggregated over the period 2014 to 2025. The range for total anticipated WIP implementation costs is substantial. Lynchburg has the lowest projected costs, $211 million. In contrast, Anne Arundel projects costs of $1.1 billion, which are over five times that of Lynchburg and approximately 4.5 times that of Baltimore.

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

Table 5 also highlights that the jurisdictions project differing levels of WIP expenditures between the two cost categories. Consistent with expectations, construction costs dominate 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 5: WIP Costs by Jurisdiction: 2014 – 2025*

	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**

*All costs reported in millions of 2013 dollars.

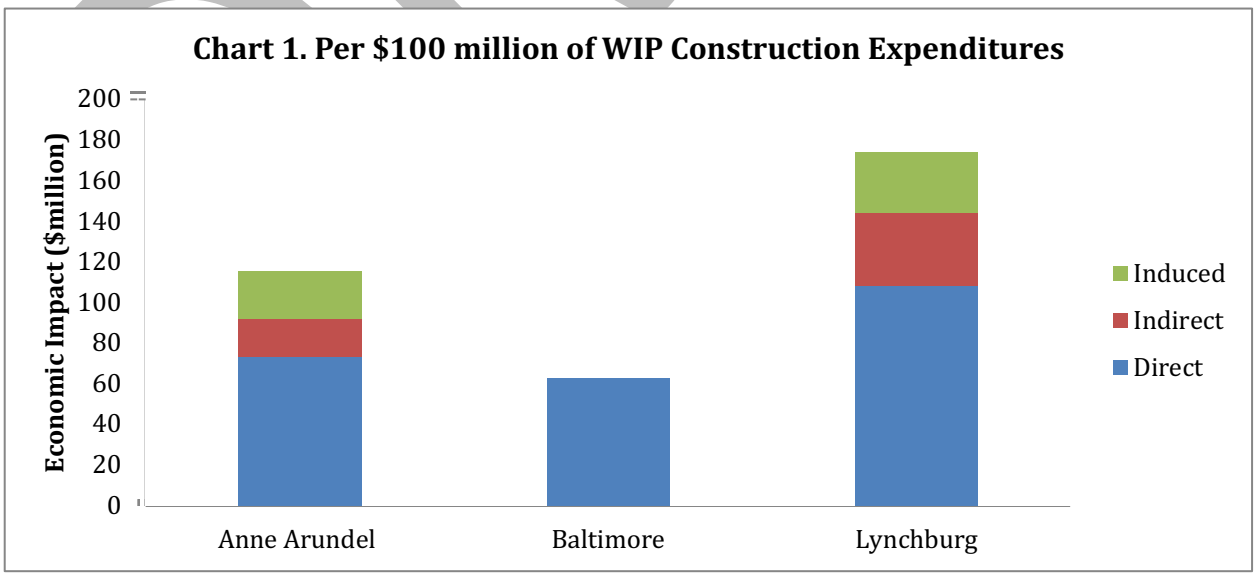
Economic Impacts. We present the economic impact assessments in terms of levels of implementation (rather than estimated total financing costs) and by the two implementation phases, construction and O&M. More specifically:

- 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.

Chart 1. Per $100 million of WIP Construction Expenditures



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, there are a number of reasons why this would be the case. 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 6, 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 6: Economic Impact Per $100 Million Invested in Stormwater BMP Construction

	Anne Arundel County	Baltimore	Lynchburg
Direct	$ 73,420,000	$ 62,730,000	$ 108,330,000
Indirect	$ 18,520,000	$ 9,130,000	$ 35,750,000
Induced	$ 23,220,000	$ 4,590,000	$ 29,760,000
Total	$115,160,000	$ 76,440,000	$ 173,850,000
Jobs	780	340	1,440

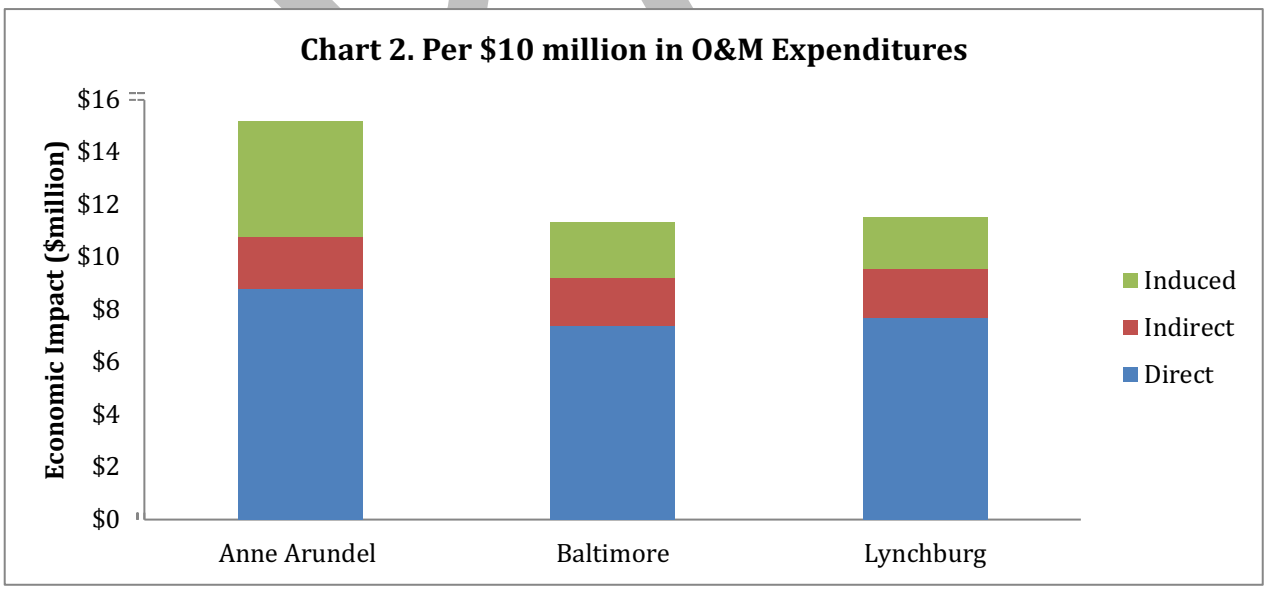
Direct investment in the construction of stormwater BMPs also leads to fiscal impacts to government at the local, state, and federal levels. These fiscal effects measure the changes associated with tax revenue flowing from direct and indirect taxes on households and businesses (e.g., wages, profits and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

Table 7: Fiscal Impacts Per $100 Million Invested in Stormwater BMP Construction

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

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

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



Unlike construction activity, O&M investments generally create an initial lift in labor demand and then sustain those jobs into the future. The positive employment gains represent real job

growth. Table 8 reports the job effect of a $10 million investment supporting O&M activity for stormwater management. Each $10 million investment potentially increases jobs. For Baltimore, the job growth equates to roughly 75 full time equivalents. In Lynchburg, the number is around 90; for Anne Arundel, it is 120. These projections are not year-on-year growth but rather a one-time lift in overall employment that is then supported into the future.

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

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

The fiscal gains to government as a result of supporting O&M activity are also positive. These fiscal effects measure the changes associated with tax revenue flowing from direct and indirect taxes on households and businesses (e.g., wages, profits and property), as well as licensing fees. Table 9 summarizes these impacts. In all three jurisdictions the magnitude of federal fiscal impacts are greater than state and local impacts. State and local fiscal impacts range between $560,000 and $800,000. Federal impacts range from $940,000 to $1.6 million.

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

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

Section 4.4: Summary of EIA Results. The benefits of protecting water quality are significant in urban communities. More importantly, effective stormwater management will create and maintain the quality of life that is essential for the growth and development of communities throughout the region. At the same time, addressing increasingly aggressive stormwater management is requiring new and more efficient means of meeting financing challenges. And though the primary focus in most communities will be to generate sufficient revenues and contain program costs, it will be essential for local leaders to coordinate stormwater financing activities with other community priorities and efforts. Our aim with this economic impact study was to help local communities better understand 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 HB 987, and 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. The economic impact in Baltimore that results from these investments will be minimized if economic conditions within the City remain the same.

As this study has demonstrated, stormwater management activities have the potential to become positive contributors to local economies and their associated businesses and industries. Every dollar invested in stormwater management and restoration activities has the potential to directly support jobs in a variety of industries and businesses, including product development, engineering, manufacturing and distribution, site design, and construction. The additional indirect and induced impacts will also be positive, affecting myriad activities, businesses, and industries at the local level. However, in the case of Baltimore, the opposite is also true. If the present economic conditions within the City persist, Baltimore will lose out to other communities across the region in regards to economic impacts associated with stormwater investments.

There will almost certainly be opponents of aggressive stormwater management programs that will see these results as an excuse for inaction and further reason to ignore the stormwater problem in communities like Baltimore. In our opinion, this would be a significant mistake. As the graphic below demonstrates, the economic impacts of stormwater management are reflections of broader economic conditions in the City. By choosing not to invest in stormwater management the City will do nothing to address the key issues that have resulted in lower economic impacts. These socioeconomic problems will persist and water quality will continue to suffer. Instead, it is our recommendation that the community use the stormwater management program as an opportunity to strengthen the City's economic base and reverse the conditions that have had a detrimental impact on the community's economy.

	Lynchburg, VA	**Baltimore, MD**	**Anne Arundel County, MD**
Population	77,000	621,000	550,500
Median Household Income	$38,000 (state average: $63,000)	$40,100 (state average: $72,000)	$85,700 (state average: $72,000)
Citizens below poverty line	23.2% (State average: 10.7%)	22.4% (State average: 9%)	5.5% (State average: 9%)
Median home value	$146,100 (state average:$254,600)	$163,700 (state average: $319,800)	$361,700 (state average: $319,800)

As this study shows, there are specific industries that will be directly impacted by increased stormwater investments in urban communities like Baltimore. In addition, over the next few years, there will be a buildup of stormwater investments across the region, especially in Maryland where the largest jurisdictions (referring to population) have been required to establish dedicated stormwater funding and financing programs. 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.

In addition, there are 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.[28] 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 Baltimore 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.

[28] *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 Baltimore'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. Therefore, we recommend establishing processes that will reduce those costs. Specifically, the following recommendation are based on three issues and priorities:

- We recommend establishing a performance-based financing system, designed to incentivize innovation and efficiency in the private sector;
- We recommend working within existing community structures, institutions, and organizations; and,
- We recommend coupling stormwater financing with other community goals and priorities.

Recommendation 1a: Shift to a Performance-Based Financing System. Our first recommendation to Baltimore is to begin the process of shifting from a traditional practice-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, Baltimore 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 responsibilities, the EFC believes that communities like Baltimore 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 Baltimore 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 financing 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.[29] 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.[30] 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 and 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.[31] 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 10: Comparing Traditional and Performance-Based Financing Systems

Traditional:	Performance-Based:
• Focus on known practices and technologies	• Focus on outcomes and efficiency, i.e. $/pound of pollution reduced
• Success is measured by levels of implementation	• Risk is effectively shifted to the private sector

[29] 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.

[30] Ibid.

[31] 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
	• Requires smaller, more streamlined and
• 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…"[32]

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.

  Baltimore is in an extremely advantageous position as a result of its decision to establish a dedicated revenue stream in support of stormwater management, though obviously that decision was in many ways made for the community via HB 987. Stormwater fees will enable the city to test new financing systems that go beyond existing stormwater

[32] 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.

management programs. And, the expectation of consistent revenue flow will incentivize entire industries to take action. Specifically, consistently allocating and investing revenue sends the message to the private sector that the community leaders are committed to solving the problem. Long-term funding commitments enable private firms and investors (including residents) to make capital investments with relative certainty. In turn, they will look for opportunities to reduce costs as a way of maximizing return on investment. Over time, performance goes up, costs go down, and goals are achieved efficiently.

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

  In a normal public procurement system, contracts are executed and agreed upon in advance of implementation activity. Though there are certainly incentives—legal and otherwise—on the part of contractors to implement projects as designed and contracted, the risk of project performance in fact remains with the public agency. A more efficient and less risky system would instead focus on investing in delivered projects. In effect, this would create a private nutrient banking system within the 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 and entirely assumed by the project managers as opposed to the public stormwater program. This means that the stormwater program managers will know with relative certainty that the pollution reductions have been made before payment is made. In effect, this type of system models mitigation banking programs that have been in place for many years.

- Robust modeling and data management systems: Any type of restoration financing system requires an understanding of where control practices and projects will have the greatest benefit to the environment. Performance payment systems are no exception.

  One of the concerns expressed in the City's Phase II WIP was the uncertainty associated with the performance of many urban stormwater management practices in regards to reducing nutrient and sediment emissions. As the WIP states very clearly, it is essential that the community advance its understanding of what works and what does not work in regards to mitigating stormwater pollution. This obviously requires models and databases that can accurately predict where the greatest environmental benefit will occur. We bring this up as an issue because we believe that a more market-like approach to financing will actually incentivize better science and modeling; and in fact, it should be a goal of the City to include effective monitoring in the performance-financing system. When private contractors

understand that priority will be given to projects that are able to demonstrate environmental performance, the marketplace will actually incentivize more effective monitoring and project evaluation techniques.

- Adaptive procurement systems: Finally, performance-financing systems are greatly benefited by a procurement process that is flexible and able to shift from project-based payments to performance-based purchases of pollution reductions. Of course, flexible, efficient, and adaptive are not terms that are usually associated with local procurement systems and their associated policies and procedures. In fact, by necessity, procurement is a conservative and cautious process that is designed to discourage the worst in human behavior rather than encourage what is best. As a result, implementing more performance-based systems require communities to think very differently about the procurement process. However, performance financing is actually in keeping with the spirit of local procurement policy: to get the most efficient and effective outcome per dollar invested.

  Making a shift in how projects are procured 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 provides an excellent model for Baltimore, which transitioned to an electronic and online-based procurement system beginning in 2007. Baltimore's CityBuy system is similar in approach and function to the North Carolina procurement model and could serve as a platform for local performance payment systems as well.

Using these four components as a foundation, Baltimore can reduce the costs associated with water quality restoration and protection significantly while at the same time incentivizing innovation.

Recommendation 1b: Establish a Proactive Stormwater Banking Program. Recently the City of Baltimore, in partnership with the Center For Watershed protection, undertook a process to incentivize the creation of stormwater banks on vacant and abandoned properties.[33] Specifically the goal of the project was to investigate the potential efficacy and efficiency of stormwater banks as a way of reducing the costs associated development and redevelopment activity within the City. And while mitigating the impacts associated with new growth is important, the banking structure has the potential to be equally effective in reducing the costs of addressing pollution from existing sources of impervious surfaces across Baltimore.

The premise of the stormwater banking project was based on development mitigation programs that enable developers to offset land disturbances with pre-constructed environmental banks. In the case of a stormwater bank, the credits generated would be, or could be, sold to developers as a way of providing a more cost-effective solution to treating

[33] The Environmental Finance Center was a subcontractor to the Center for Watershed Protection on the stormwater banking project, which is supported through a grant from the National Fish and Wildlife Foundation.

stormwater emissions entirely on site. Similar approaches are being implemented in other communities such as North Carolina and Washington, DC. And, while we strongly support the use of these types of development mitigation banks, their benefits need not be restricted to just mitigation for new development and redevelopment activities. In effect, the City itself is in a position to function as the conservation or mitigation buyer of environmental banking credits. As a result, they can take advantage of the same efficiencies and benefits afforded the development community in these types of schemes. In short, we recommend that the City take advantage of the banking system to address *existing* pollution rather than just the impacts from new development.

Of course the establishment of this type of banking program would require the City to implement the performance financing system described in Recommendation 1a. Private developers will establish these banks proactively when they are convinced that there will be market demand for the pollution reductions that are generated. This will require a very strong, codified signal from the City in regards to how it intends to invest revenues generated through its new stormwater utility.

Recommendation 1c: Establish an Offsite Fee Credit Program. The adoption and implementation of Recommendations 1a and 1b would enable the City of Baltimore to then implement a variety of innovative programs in the form of public/private partnerships. An example is the implantation of an off-site stormwater fee credit program. As we have discussed in various sections of this report, the primary tool for engaging ratepayers in a stormwater utility is through the use of a fee-credit.

To review, stormwater utility managers will offer ratepayers relief on their required fee—up to 50 percent in many cases—if the ratepayer agrees to install and maintain various stormwater management practices on their property. However, these types of credit programs are unlikely to incentivize private investment in best management practices for two primary reasons. First, the payback period, i.e. the amount of time it would take for a landowner to recoup their investment as a result of the reduced fees, is prohibitively long. The ratepayers with the highest fees by definition have the most impervious surfaces to manage, which means that the on-the-ground practices necessary for treating those impervious areas are expensive. The reduction in the fee, though enticing in some respects, is almost never enough to justify the construction and operations and maintenance costs. Second, for many commercial ratepayers (who make up the disproportional number of large ratepayers in almost all stormwater utilities) are often hesitant to convert property into stormwater best management practices. This is in effect taking land out of productivity, which is met with much resistance in a lot of cases. Over the past two years EFC has had many conversations with a variety of business owners across the City related to the stormwater fee. While the concerns associated with the fee are varied in their nature, one common theme is the desire to have options for reducing stormwater fees without taking land out of production. One potential way to address both of these barriers is through the use of an offsite stormwater fee-credit program.

An offsite fee-credit program would essential offer an opportunity for large ratepayers to reduce their stormwater fee by supporting offsite mitigation projects. The program would be based on the following four components and processes:

1. *Install stormwater practices on vacant and abandoned properties.* First, the project could, or perhaps should, focus on converting vacant and abandoned properties to permanent stormwater best management practices. With that as a foundation, the City would invest in stormwater practices that treat impervious surfaces as required in the City's permit. The resulting practices would result in the creation of fee-credits, which would be valued in terms of area treated. For example, one credit would be the equivalent of an acre of impervious area treated, or fraction thereof.

2. *Establish a stormwater mitigation fund through a public/private partnership.* Second, the City would partner with an existing nonprofit, or group of nonprofits, to establish a mitigation fund. Investments from the fund would be restricted to supporting stormwater practices, including operations and maintenance, on vacant and abandoned lots, similar to what was recommended in Step 1.

3. *Transfer fee-credits to the stormwater mitigation fund.* Next, the City would transfer ownership of the stormwater fee-credits to the public-private partner and the mitigation fund. The nonprofit partner would then sell those credits to commercial or even potentially residential ratepayers across the City. In return for purchasing the fee-credits, the City would reduce the ratepayers stormwater fee by an amount commensurate with the level of impervious treatment associated with the credit, up to 50 percent of the ratepayers total annual stormwater fee (this is in keeping with the City's existing credit program).

4. *The fund reinvests in additional stormwater practices and projects on vacant and abandoned properties.* Finally, the proceeds from selling the fee-credits would then be reinvested by the nonprofit partner into additional stormwater management projects on vacant and abandoned properties. At that point, additional credits would be created and could be marketed to other ratepayers across the City looking for fee relief.

The result of this type of system would be a revolving source of capital that would continue to support stormwater projects where they are most needed. The benefits to the private sector and the fee ratepayers are significant, including:

- Permanent fee relief without having to take land out of production;
- Tax relief in the form of philanthropic donations to the stormwater mitigation fund, which is managed and administered as a nonprofit; and,
- Public relations exposure through the use of a signage and marketing program.

There would also be real benefits to the public sector, including:

- An immediate infusion of private capital in support of stormwater management projects. Obviously the program would reduce revenue to the City in the long-term, but it would allow the City to generate new projects earlier in the process.
- The ability of the City to direct capital to those projects with the highest pollution reduction, which is something that traditional fee-credit programs are unable to do effectively.

- The establishment of a better connection between the City and the private ratepayers supporting in its stormwater utility.
- The reduction of urban blight impacts associated with vacant and abandoned lots (though the project would be beneficial even if it were implemented in other areas of the City).

Of course, there are a variety of issues that would need to be resolved in order for a system like this to work effectively, including:

- Identifying the most effective private partner;
- Addressing landownership issues and permanency of stormwater practices (which is an issue impacting many of the ideas associated with reclaiming vacant and abandoned properties);
- Ensuring long-term operations and maintenance agreements; and,
- Other legal and administrative issues and barriers, of which there are certain to be many.

In spite of these barriers, we believe that there are important advantages associated with this idea. Though the benefits of mitigation banks to the private sector is well established, we believe the opportunity also exists for stormwater banks to benefit existing stormwater ratepayers within Baltimore as well. This can be done specifically through the use of proactive stormwater banks and offsite mitigation tools.

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

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

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

recharge, or decreasing sediment runoff.[34] The availability of these choices provides local decision makers the flexibility and creativity to target specific geographic locations within the community and shape programs to fit other community priorities.

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

Rebate Programs Based on Geography. The geographically specific approach allows communities to fund projects in specific areas where BMP efficiencies may be higher or where impermeable surface area is disproportionately high. By focusing stormwater projects on properties that actually impact the receiving water bodies, the community is actually paying for treatment, rather than paying for stormwater management practices that do not perform. Targeting smaller areas within a community also provides a smaller footprint where new incentives can be piloted to determine their community-wide applicability.[35]

Stormwater rebate programs have been used extensively throughout the country and have proven very effective at engaging ratepayers in the restoration process. In Appendix 3 we highlight several that serve as effective models for Baltimore 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 asscoiated 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.[36] 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

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

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

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

local staff burden required under the proposed urban verification protocols for larger scale BMPs.[37]

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 effective private sector outreach tools and programs, these rebate programs will now offer the potential for local governments to get regulatory credit for the actions that result from these rebate programs. And, as our cost analysis indicates, many of the practices that would be the focus of a rebate program are often the most cost efficient and effective.

Recommendation 3: Test a Reverse Auction Program. Building on the rebate program, we recommend testing a reverse auction program. Unlike traditional subsidy and cost-share funding programs, which actually incentivize higher costs (the higher the costs, the greater the subsidy) reverse auctions use competitive behavior to drive costs down. A reverse auction reverses the roles of buyers and sellers. In an ordinary auction (also known as a forward auction), buyers compete to obtain a good or service, and the price typically increases over time. In a reverse auction, sellers compete to obtain business (in the case of water quality, to provide reduced pollution or BMPs), and prices typically decrease over time. In a typical auction, the seller puts an item up for sale. Multiple buyers bid for the item, and one or more of the highest bidders buy the goods at a price determined at the conclusion of the bidding. In markets with multiple sellers and a single buyer, reverse auctions can help to efficiently allocate a limited budget.[38]

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.[39]
- 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

[37] 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/.

[38] 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.

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

practices, the project resulted in nutrient emissions at prices far lower than equivalent USDA cost-share programs.[40]

- In 2010, the California Public Utilities Commission approved a reverse auction market to let renewable energy developers bid on small-scale projects under a program that would generate up to 1,000 megawatts for the state's three big investor-owned utilities and further spur the solar industry.[41]
- 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.[42]

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.[43] 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.[44]

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

---

[40] 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.

[41] 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.

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

[43] 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.

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

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 for most citizens. Reverse auctions can certainly add to the confusion. As a result, auction and rebate programs are effective only when the program is prefaced with an effective outreach program.

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

Recommendation 4: Expand the City's Urban Agriculture Program to Include Urban Nurseries. Finally, we offer a recommendation that focuses on linking Baltimore's stormwater management program with several other community priorities, including: economic development and job growth; reclaiming vacant and abandoned properties; and, advancing sustainability through a thriving and vibrant urban agriculture sector. Specifically, we recommend developing and implementing a codified effort to establish urban tree farms and nurseries on underutilized properties across the City.

One of the more impressive components of the City's sustainability program is the focus on urban agriculture and creating more benign and sustainable food systems. We applaud that effort and agree with the City's goal of creating a symbiotic relationship between that initiative and the stormwater management effort. However, the urban agriculture program could have a much more beneficial impact if it were to focus more on establishing urban nurseries and tree farms as a viable industry sector rather than just food-based operations.

It is clear that an increase in federal and state regulations will result in hundreds of millions if not billions of dollars in investment across the region related to stormwater management. And, recent trends indicate that local governments are increasingly shifting to green or natural

systems as part of their stormwater management programs. This does not even account for the existing urban nursery industry, which contributes billions of dollars in economic activity to the mid-Atlantic region. In short, there is a burgeoning market developing related to green infrastructure and urban nurseries; Baltimore appears to be uniquely positioned to take advantage of this market opportunity.

It is beyond the scope of this project to make detailed recommendations for establishing new industries within the City, but we do offer several observations to support our recommendation that the City investigate and develop this idea:

- The City is struggling with the issue of underutilized properties in the form of vacant and abandoned parcels. As a result, there is an opportunity for the City to reduce one of the most significant factor costs associated with urban nurseries: access to land.
- By incentivizing green industries like urban nurseries, currently unproductive land would be transformed in productive, taxpaying parcels – a distinct advantage over many other green strategies for addressing blight in the City.
- There is an inherent advantage to growing environmental media in the same environment in which it will be installed; this would presumably give urban-based companies a competitive advantage, and would reduce costs to customers, such as the City's stormwater program in the long-term.
- This type of program would go beyond the effort to create green jobs, and would instead focus on creating green industries, which is a state priority within the City.

We recognize that there are organizations, institutions, and agencies that are working diligently and effectively to advance economic development within the community. We provide this recommendation as a way of pointing out the obvious connection between the industry, the marketplace, and the goals of the stormwater management program. Further investigation, in our opinion, is warranted.

Section 6: Conclusion

This project report brings to a conclusion EFC's work in the City of Baltimore. As we have stated throughout this report, we feel that the City 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.

Acknowledgements:

EFC would like to thank the following people and organizations for their assistance throughout this two-year project:

In the City of Baltimore:

- Kimberly L. Burgess, Division Chief
  Department of Public Works, Surface Water Management Div.

The Business and Economic Outreach Network (BEACON) at Salisbury University:

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

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

Waterfront Partnership of Baltimore, Inc.:

- Laurie Schwartz, President

Appendix 1: Detailed IMPLAN Model Results

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

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

Table 1. Estimated Impacts per $100M in Construction

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

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

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

Detailed Construction Impact Estimates

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

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	262	$20,238,110	$36,630,498	$62,727,993
Indirect Effect	51	$3,116,526	$4,652,749	$9,127,447

Induced Effect	31	$1,592,537	$2,356,780	$4,587,087
Total Effect	344	$24,947,172	$43,640,030	$76,442,529

Detailed Annual Impact Estimates

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

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

Detailed Fiscal Impact Estimates from Construction

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

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

Table 6. Baltimore City Federal Fiscal Impacts from WIP Projects

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

Detailed Fiscal Impacts from Operations and Maintenance

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

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

Personal Tax: Other Tax (Fish/Hunt)	$0	$0	$0	$665	$0
Total State and Local Tax	$8,562	$0	$407,728	$126,392	$17,583

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

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

Anne Arundel County, Maryland

Table 9. Estimated Impacts per $100M in Construction

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

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

Impact Type	WIP Projects
Direct Effect	$8,810,626
Indirect Effect	$1,960,503

Induced Effect	$4,401,252
Total Effect	$15,172,382
Total Employment	118
State and Local Fiscal Impact	$798,990
Federal Fiscal Impact	$1,585,104

Detailed Construction Impact Estimates

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

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

Detailed Annual Impact Estimates

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

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

Detailed Fiscal Impact Estimates from Construction

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

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$0	$0	$0	$0	$8,254
Social Ins Tax- Employee Contribution	$11,686	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$27,076	$0	$0	$0	$0

Indirect Bus Tax: Sales Tax	$0	$0	$1,027,762	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$1,131,457	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$27,740	$0	$0
Indirect Bus Tax: Severance Tax	$0	$0	$0	$0	$0
Indirect Bus Tax: Other Taxes	$0	$0	$261,133	$0	$0
Indirect Bus Tax: S/L NonTaxes	$0	$0	$102,730	$0	$0
Corporate Profits Tax	$0	$0	$0	$0	$140,093
Personal Tax: Income Tax	$0	$0	$0	$1,414,359	$0
Personal Tax: NonTaxes (Fines - Fees)	$0	$0	$0	$348,923	$0
Personal Tax: Motor Vehicle License	$0	$0	$0	$52,088	$0
Personal Tax: Property Taxes	$0	$0	$0	$18,882	$0
Personal Tax: Other Tax (Fish/Hunt)	$0	$0	$0	$12,590	$0
Total State and Local Tax	$38,762	$0	$2,550,822	$1,846,841	$148,347

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

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

Detailed Fiscal Impacts from Operations and Maintenance

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

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$0	$0	$0	$0	$871

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

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

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

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	Corporations
Dividends	$0	$0	$0	$0	$9,530
Social Ins Tax- Employee Contribution	$24,165	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$55,988	$0	$0	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$1,183,184	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$1,571,072	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$29,073	$0	$0
Indirect Bus Tax: Severance Tax	$0	$0	$756	$0	$0
Indirect Bus Tax: Other Taxes	$0	$0	$282,255	$0	$0
Indirect Bus Tax: S/L NonTaxes	$0	$0	$188,628	$0	$0
Corporate Profits Tax	$0	$0	$0	$0	$129,134
Personal Tax: Income Tax	$0	$0	$0	$1,151,150	$0
Personal Tax: NonTaxes (Fines - Fees)	$0	$0	$0	$122,209	$0
Personal Tax: Motor Vehicle License	$0	$0	$0	$40,582	$0
Personal Tax: Property Taxes	$0	$0	$0	$25,676	$0
Personal Tax: Other Tax (Fish/Hunt)	$0	$0	$0	$12,493	$0
Total State and Local Tax	$80,152	$0	$3,254,967	$1,352,108	$138,665

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

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends	$3,213,698	$218,086	$0	$0	$0

Social Ins Tax- Employee Contribution	$3,168,054	$0	$0	$0	$0
Social Ins Tax- Employer Contribution	$0	$0	$373,351	$0	$0
Indirect Bus Tax: Sales Tax	$0	$0	$146,473	$0	$0
Indirect Bus Tax: Property Tax	$0	$0	$249,413	$0	$0
Indirect Bus Tax: Motor Vehicle Lic	$0	$0	$0	$0	$1,414,599
Indirect Bus Tax: Severance Tax	$0	$0	$0	$3,616,468	$0
Indirect Bus Tax: Other Taxes	$6,381,752	$218,086	$769,236	$3,616,468	$1,414,599

Detailed Fiscal Impacts from Operations and Maintenance

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

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

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

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

Appendix 2: Impacts by BMP

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	
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	
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	
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	
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	
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	
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	
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	
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	
Permeable Pavement w/ Sand, Veg. (New)	2.8	$282,071	$68,946	$93,549	$444,566	$16,972	$33,615	$0.33

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

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

Urban Stream Restoration	0	$692	$83	$331	$1,106	$87	$114
Bioretention (New - Suburban)	0	$1,189	$143	$570	$1,901	$150	$197
Bioretention (Retrofit - Highly Urban)	0	$1,189	$143	$570	$1,901	$150	$197
Vegetated Open Channels	0	$474	$57	$227	$757	$60	$78
Bioswale (New)	0	$723	$87	$346	$1,156	$91	$119
Permeable Pavement w/o Sand, Veg. (New)	0	$1,699	$204	$814	$2,717	$215	$281
Permeable Pavement w/ Sand, Veg. (New)	0	$2,366	$284	$1,138	$3,789	$301	$392

Lynchburg

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

Impact from Construction	**Employment Impact**	**Economic Impact**			**Total Economic Impact**	**Total Fiscal Impact**		**ROI**
		Direct	**Indirect**	**Induced**		**State and Local**	**Federal**	
Impervious Urban Surface Reduction	1.4	$135,807	$33,242	$27,795	$334,254	$7,121	$13,379	$0.35
Urban Forest Buffers	0.4	$34,752	$10,340	$8,688	$53,781	$1,374	$3,545	$0.64
Urban Grass Buffers	0.3	$24,906	$7,411	$6,226	$38,543	$985	$2,541	$0.64
Urban Tree Planting	1.1	$238,644	$37,294	$30,630	$306,568	$10,714	$12,662	$0.68
Wet Ponds and Wetlands (New)	0.3	$23,756	$6,758	$5,388	$36,347	$1,021	$2,452	$0.38
Wet Ponds and Wetlands (Retrofit)	0.6	$54,893	$15,938	$14,122	$84,953	$2,297	$5,798	$0.29
Dry Detention Ponds (New)	0.4	$39,635	$11,039	$9,520	$60,194	$1,763	$4,072	$0.37
Hydrodynamic Structures (New)	0.5	$41,383	$12,291	$10,478	$64,153	$1,648	$4,267	$0.53
Dry Extended Detention Ponds (New)	0.4	$39,635	$11,039	$9,520	$60,194	$1,763	$4,072	$0.37
Dry Extended Detention Ponds (Retrofit)	0.7	$59,888	$16,989	$15,037	$91,914	$2,604	$6,290	$0.27
Infiltration Practices w/o Sand, Veg. (New)	0.6	$54,811	$15,513	$13,561	$83,884	$2,385	$5,702	$0.33
Infiltration Practices w/ Sand, Veg. (New)	0.7	$57,271	$16,241	$14,198	$87,711	$2,482	$5,962	$0.33
Filtering Practices (Sand, above ground)	0.5	$46,506	$13,054	$11,408	$70,968	$2,049	$4,830	$0.32
Filtering Practices (Sand, below ground)	0.6	$49,213	$14,567	$12,757	$76,537	$1,987	$5,173	$0.37

Erosion and Sediment Control	0.3	$24,127	$7,154	$6,183	$37,464	$968	$2,512	$0.45
Urban Nutrient Management	0.8	$69,201	$20,629	$17,069	$106,899	$2,717	$6,982	$0.76
Street Sweeping	0.1	$6,862	$2,046	$1,693	$10,601	$269	$692	
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	
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	
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	
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	
Urban Forest Buffers	0.0	$752	$74	$299	$1,126	$36	$58
Urban Grass Buffers	0.0	$541	$53	$215	$809	$27	
Urban Tree Planting	0.0	$752	$75	$299	$1,126	$36	$58
Wet Ponds and Wetlands (New)	0.0	$474	$47	$189	$710	$23	
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	
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	

Dry Extended Detention Ponds (Retrofit)	0.0	$765	$76	$304	$1,145	$37	$59
Infiltration Practices w/o Sand, Veg. (New)	0.0	$538	$53	$214	$806	$26	$42
Infiltration Practices w/ Sand, Veg. (New)	0.0	$563	$56	$224	$843	$27	$44
Filtering Practices (Sand, above ground)	0.0	$890	$88	$354	$1,331	$43	$70
Filtering Practices (Sand, below ground)	0.0	$1,014	$100	$403	$1,517	$50	$80
Erosion and Sediment Control	0.0	$6	$1	$2	$9	$0	$0
Urban Nutrient Management	0.0	$19	$2	$8	$29	$1	$1
Street Sweeping	0.0	$280	$28	$111	$419	$13	$22
Urban Stream Restoration	0.0	$554	$55	$220	$829	$27	$44
Bioretention (New - Suburban)	0.0	$952	$94	$378	$1,424	$47	$75
Bioretention (Retrofit - Highly Urban)	0.0	$952	$94	$378	$1,424	$47	$75
Vegetated Open Channels	0.0	$379	$37	$151	$567	$18	$31
Bioswale (New)	0.0	$579	$57	$230	$866	$28	$44
Permeable Pavement w/o Sand, Veg. (New)	0.0	$1,360	$134	$541	$2,035	$68	$107
Permeable Pavement w/ Sand, Veg. (New)	0.0	$1,902	$187	$756	$2,846	$94	$149

Baltimore City

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

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

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

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

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

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

Appendix 3: Stormwater Rebate Case Studies

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

Beginning in September 2011 and spanning through 2012, select community leaders from public, private, and non-profit sectors as well as agency leaders combined their efforts with input from community members across the District to form the DC Sustainability Plan.[45] The "seven distinct topics" addressed by the sustainability plan are: Built Environment, Energy, Food, Nature, Transportation, Waste, and Water. Stormwater is integrated into three of the seven topics: Built Environment, Nature, and Water. The Green Roof and RiverSmart Homes rebate programs were discussed as ways to meet the goals of the water topic. Having the rebate programs integrated into a non-stormwater specific document is a way of informing the public not already aware of the programs of the possibility of stormwater management practice funding opportunities.

Green Roof Rebate Program. The green roof demonstration program was a precursor to the Green Roof Rebate program. The demonstration program was initiated in 2003 as a feasibility study on the installation of green roofs on commercial buildings in the District. In the period from 2004-2008, the funds were used to aid in the installation of eight green roofs covering expenses related to the technical, cost, and performance evaluations of each roof.[46] The grants issued as part of the demonstration project were intended to cover up to 20 percent of the capital cost of each green roof installation. Target buildings for this program initially included apartments and commercial and government buildings. Public access was factored into each of the eight roofs installed to provide awareness and increase possible interest in green roof technologies and use.

The green roof demonstration project ultimately evolved into the Green Roof Rebate program, and has been expanded to include residential as well as commercial and industrial properties. In 2007, the program offered $3 per square foot of green roof installation, which resulted in 12 green roof projects; this increased to $5 per square foot of installation in 2012-2013.[47] As of 2013-2014, the rebate amount has increased to $7 per planted square foot and up to $10 per square foot in the target sub-watershed areas.[48] The increased incentive offered to properties

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

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

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

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

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

RiverSmart Homes. The RiverSmart Homes rebate program is directed toward residential property owners who are interested in reducing stormwater runoff from their properties. In order to glean interest in 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 give-aways such as rain barrels and saplings.[49]

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 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.[50]

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.[51] 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

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

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

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

decentralized green stormwater infrastructure through private property installation of cisterns and rain gardens. The project offered insight on how to develop the RainWise program from an outreach and logistics perspective. The lessons learned during the pilot study include:[52]

- 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.[53] RainWise provides a 60 to 100 percent rebate[54] 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.[55] As of 2013, over 250 rain gardens and cisterns have been installed in Seattle with a goal of 3,005 total installations.[56,57]

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

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

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

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

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

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

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

water/sewer bill(s) 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.[58] Acceptable trees and size information are available on the Treebate website.

Montgomery County, Maryland. Montgomery County's RainScapes Rebate 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.[59] 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.[60]

RainSapes Neighborhood Program.[61] The RainScapes Neighborhood program focuses on neighborhoods that drain to the Potomac River; contribute runoff to nearby watershed restoration projects; have identified drainage problems and are in need of a more intense runoff reduction; and, have the support of an interested watershed group or community association. The goal of this program is to provide stormwater control to a minimum of 30 percent of the properties in a targeted neighborhood resulting in better stormwater control at the sub-watershed scale.

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

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

[60] 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.

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

Appendix 4: Reverse Auction Case Studies

Case Study 1: Reverse Auctions – Ohio

Cincinnati, Ohio

- **Key Features:**
    - Innovative financing in an urban setting
    - Effective engagement of citizens and the private sector

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

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

Case Study 2: Reverse Auctioning – Victoria

BushTender: Victoria, Australia

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

Case Study 3: Reverse Auctioning – New South Wales

Environmental Services Scheme: New South Wales, Australia

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

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