Options for Financing Chesapeake Bay Restoration in Pennsylvania

Environmental Finance Center, University of Maryland

November 2016

UNIVERSITY OF MARYLAND
ENVIRONMENTAL FINANCE CENTER

This report was produced by the **Environmental Finance Center at the University of Maryland** in College Park. For more than twenty years, EFC has served communities in the Mid-Atlantic region by addressing the *how-to-pay* issues associated with natural resource restoration and 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. For more information on EFC, please visit our website at: www.efc.umd.edu.

Prepared for the U.S. Environmental Protection Agency's Chesapeake Bay Program Office (CBPO) on behalf of the Commonwealth of Pennsylvania, this report provides a menu of financing options that Pennsylvania may use to pay for activities that reduce pollution in its agriculture and urban runoff sectors, in order to meet federally-mandated Total Maximum Daily Load targets. It is intended to inform both CBPO and the Pennsylvania Department of Environmental Protection as they evaluate effective strategies for financing Bay restoration.

EFC would like to thank the following individuals for their guidance and feedback:
Rich Batuik, EPA Chesapeake Bay Program Office
Jeanna Henry, EPA Region 3
Veronica Kasi, PA Department of Environmental Protection
Kelly Somers, EPA Region 3
Jeff Sweeney, EPA Chesapeake Bay Program Office
Julie Winters, EPA Chesapeake Bay Program Office
Andy Zemba, PA Department of Environmental Protection

Table of Contents

I. Introduction

The Chesapeake Bay Program Office (CBPO) commissioned the Environmental Finance Center (EFC) at the University of Maryland to assess options for Pennsylvania to finance water quality restoration activities that will enable the state to meet pollution reduction goals mandated in US EPA's Chesapeake Bay Total Maximum Daily Load (TMDL). While Pennsylvania has made strides towards TMDL goals – in particular for its point source pollution sector – it faces a significant uphill climb to achieve overall 2025 targets.

Intended to be used by both CBPO and the Pennsylvania Department of Environmental Protection (PA DEP), this report presents a menu of strategies for financing necessary pollution reductions. It builds on Pennsylvania's work to date in identifying technical, financial, and programmatic options for restoring the Chesapeake Bay as well as the state's own creeks and rivers. It is EFC's hope that the ideas presented in this report will inform the Commonwealth's efforts to develop a comprehensive financing action plan for achieving 2025 pollution reduction targets and maintaining those reductions over time.

The report is organized into three parts. It begins with a brief overview of Pennsylvania's role in Chesapeake Bay restoration and its progress toward meeting federally-mandated pollution reduction goals, based on data from the Chesapeake Bay Program partnership's Watershed Model, which draws on various sources to estimate pollutant loads for each major source sector.[1] Section 3 assesses Pennsylvania's financing gap in meeting 2025 TMDL targets for the state's urban runoff and agriculture sectors, two sectors that are falling significantly behind interim milestone goals. Finally, the heart of the report is Section 4, in which EFC presents a menu of options for financing TMDL implementation.

While Bay restoration activities are funded by various public and private actors, it is *state* governments that are ultimately being held responsible for meeting TMDL mandates. Therefore, this report focuses on strategies that the Commonwealth itself can use to fund pollution reduction activities. Like other states, Pennsylvania has two basic options for financing water quality restoration: pay for pollution reductions by augmenting existing revenue streams, or increase regulations related to stormwater and agriculture pollution, thereby shifting costs onto regulated entities. The Commonwealth can also reduce the cost of implementation by targeting investments to cost-effective practices in high-priority subwatersheds, building capacity of state agencies to more effectively pursue Bay goals, and employing specific financing approaches that achieve greater results at lower costs. An effective financing strategy is likely to involve some combination of these options.

Within those broad categories, specific options for financing restoration include:

Revenue

- Shift state budget allocations to dedicate more funding for restoration.

[1] Data cited in this report comes from the current version of the Watershed Model (Phase 5.3.2); an updated version, Phase 6, is under development. This report does not address any deficiencies with the current Model's data or assumptions.

- Expand existing state revenue programs, such as the proposed Growing Greener III or a new green bond for water quality.
- Consider issuing a revenue bond, which would invest in income-generating restoration projects such as riparian buffers, oyster harvesting, and manure-to-energy.
- Develop new tax- and/or fee-based funding sources, for example, the proposed water resource usage fee or a new nitrogen tax or fee.

Regulatory

- Ensure compliance with existing nutrient management regulations, as recommended by both US EPA and PA DEP.[2]
- Expand nutrient management and CAFO regulations to encompass additional farms and capture more of the unregulated pollutant load from the agriculture sector.
- Add pollution load limits to urban stormwater permits to capture more of the unregulated pollutant load from the urban runoff sector.
- Further limit wastewater treatment plant emissions and request that EPA reallocate a portion of agriculture or urban runoff sector loads to the WWTP sector.

Capacity building

- Augment staff capacity at state agencies to implement Bay restoration programs, especially to ensure compliance with nutrient management and stormwater regulations.
- Create a consolidated Water Quality Investment Fund.
- Manage Bay restoration investments through a single entity, such as PennVest.

Financing systems

- Shift to performance-based financing.
- Utilize reverse auctions for the purchase and sale of nutrient credits.
- Boost the effectiveness of the Commonwealth's water quality trading program.

Whatever combination of strategies Pennsylvania pursues as it seeks to adequately fund TMDL implementation, it will be important for Commonwealth leaders to underscore that investment in Bay restoration is also investment in the water quality of Pennsylvania's streams and rivers, the viability of the state's agriculture community, its residents' quality of life, and the long-term health and vitality of its economy.

[2] US Environmental Protection Agency. September 2015. "Addressing PA Gaps in Chesapeake Bay Restoration – Options Paper." Cited in Pennsylvania Department of Environmental Protection. January 21, 2016. *A DEP Strategy to Enhance Pennsylvania's Chesapeake Bay Restoration Effort.*

II. Pennsylvania's progress toward meeting Chesapeake Bay restoration goals

Pennsylvania plays a critical role in restoring the health of the Chesapeake Bay. While the state does not directly border the Bay, it makes up more than a third of its total watershed, and half of the state's land area drains to the Bay via the Susquehanna River, which provides 90% of the freshwater flow to the upper Bay and 50% of the Bay's total freshwater flow.[3] The state contributes a significant amount of the nutrient and sediment pollution flowing to the Bay, including a disproportionately high share of the Bay's nitrogen pollution load (see Table 1).[4]

To help restore the health of the Bay – as well as Pennsylvania's own local waterways – the Commonwealth has adopted rigorous pollution reduction targets. These goals are driven by the US EPA's Chesapeake Bay 2010 TMDL, which mandates levels of nutrient and sediment pollution reductions that must be achieved in each Bay state by 2025 in order to meet water quality standards for dissolved oxygen, water clarity, underwater Bay grasses, and chlorophyll a.[5] Table 1 shows final TMDL targets for Pennsylvania and for the watershed as a whole.

Table 1. Total Maximum Daily Load Annual Allocations, 2025 Targets (million lbs/year)

	Nitrogen	Phosphorous	Sediment
Total watershed	186	12.5	6,454
Pennsylvania	74	2.9	1,984
PA's current share of total pollutant load (2014)	47%	26%	32%
PA's target share of total pollutant load (2025)	40%	23%	31%

Source: US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 9/15/16: https://stat.chesapeakebay.net/?q=node/130

As part of the TMDL, each Bay state was required to develop a Watershed Implementation Plan (WIP) outlining a roadmap for achieving nutrient reductions in partnership with local and federal governments. The WIP process involves three phases: in the first phase, states allocated pollutant loads among sectors and described the steps that will be taken over time to meet 2025 goals. Phase II WIPs, completed in 2012, provided more detail on the initial strategies and spelled out how local governments will participate. Phase III plans are due to EPA in 2017 and must specify how the final reductions will be made. To aid with short-term planning, states submit two-year milestones outlining immediate commitments. In 2017, EPA will make Midpoint Assessments to determine whether states have achieved the prescribed 60% of total reductions.[6]

[3] Wikipedia. "Susquehanna River." Accessed 9/7/16: https://en.wikipedia.org/wiki/Susquehanna_River
[4] Shortle. April 2013. "Economics and Environmental Markets: Lessons from Water-Quality Trading." *Agricultural and Resource Economics Review 42/1.*
[5] US Environmental Protection Agency. December 2010. "Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorous and Sediment."
[6] US Environmental Protection Agency. Chesapeake Bay Total Maximum Daily Load website. Last accessed 9/14/16: https://www.epa.gov/chesapeake-bay-tmdl

Pennsylvania has been making some progress toward TMDL goals. EPA estimates that the state has achieved 27% of the nitrogen reductions, 31% of the phosphorous reductions, and 50% of the total suspended sediment reductions needed to achieve 2025 targets.[7] The state has significantly reduced nutrient discharges from point sources such as wastewater treatment plants and is also on track to meet its phosphorous pollution reduction goals.[8]

Despite these gains, current watershed modeling indicates that the Commonwealth is falling behind on its nitrogen and sediment reduction goals, especially from nonpoint sources in the urban stormwater and agriculture sectors. Table 2, below, shows progress made toward TMDL goals in each sector between 2009 and 2015, as well as where these levels should be, according to 2015 interim milestone targets. While the state's wastewater and CSO sector has actually achieved better than expected reductions since 2009, all other sectors are lagging significantly behind, and nitrogen pollution *increased* from both urban runoff and septic sources. The state is not on track to meet overall load reductions either by the 2017 Midpoint Assessment or by the final 2025 deadline.

Table 2. Load reduction between 2009 and 2014, compared to interim and final goals

Sector	Nitrogen	Phosphorus	Sediment
Agriculture			
Actual reduction	3.89%	-5.88% (increase)	1.07%
Target reduction, 2015 interim goal	12.18%	6.80%	16.64%
Target reduction, 2025 final goal	43.22%	33.24%	34.88%
Urban runoff			
Actual reduction	-0.17% (increase)	9.26%	7.32%
Target reduction, 2015 interim goal	4.19%	21.51%	22.14%
Target reduction, 2025 final goal	41.07%	44.72%	50.36%
Wastewater + CSO			
Actual reduction	19.19%	29.23%	19.05%
Target reduction, 2015 interim goal	11.94%	7.38%	-357.14% (increase)
Target reduction, 2025 final goal	26.52%	16.25%	-790.48% (increase)
Septic			
Actual reduction	-9.44% (increase)	n/a	n/a
Target reduction, 2015 interim goal	11.16%	n/a	n/a
Target reduction, 2025 final goal	25.32%	n/a	n/a

Sources: US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 9/15/16: https://stat.chesapeakebay.net/?q=node/130 and Pennsylvania Department of Environmental Protection. January 21, 2016. A DEP Strategy to Enhance Pennsylvania's Chesapeake Bay Restoration Effort.

The state's failure to meet interim targets has triggered initial backstop actions by EPA, including the withholding of nearly $3 million in federal funding for Chesapeake Bay work.[9]

[7] Pennsylvania Department of Environmental Protection. March 30, 2012. *Pennsylvania Chesapeake Watershed Implementation Plan – Phase 2.*
[8] Pennsylvania Department of Environmental Protection. January 21, 2016. *A DEP Strategy to Enhance Pennsylvania's Chesapeake Bay Restoration Effort.*
[9] Ibid.

III. The Commonwealth's Bay restoration financing gap

Comparing estimates of the cost to achieve TMDL goals for Pennsylvania's two primary nonpoint source pollution sectors – agriculture and urban runoff – to current levels of investment in nonpoint reduction efforts underscores that Pennsylvania faces a significant gap in funding Chesapeake Bay restoration.

a) Estimated cost of necessary pollution reductions – agriculture sector

More than a quarter of Pennsylvania's land area is currently in agricultural use,[10] and this sector contributes a larger share of the state's pollutant loads than all other sectors combined. In 2009, agriculture was responsible for 54% of the state's total load for both nitrogen and phosphorous (almost 63 million pounds and 1.8 million pounds, respectively) and 63% of its sediment load.[11]

Pennsylvania's most recent official report of progress toward final targets, completed in 2014, shows that the state needs to make significant progress for all three pollutant types if it is to meet 2025 targets. Over the coming ten years, the Commonwealth's agriculture sector needs to decrease annual nitrogen loads by 45%, phosphorous by 29%, and sediment by 35%. The magnitude of these targets is especially stark when compared to the state's recent performance; over the five-year period between 2009 and 2014, the Commonwealth reduced its agricultural nitrogen load by only 3.89% and its sediment load by 1%; phosphorous actually increased 5.88% during this timeframe.

Table 3, below, shows the total number of pounds that need to be reduced to meet 2025 targets. Nitrogen loading needs to drop by 29.52 million pounds per year, phosphorous by .74 million pounds per year, and sediment by 603 million pounds per year.

Table 3. Needed pollutant load reductions in the agriculture sector, 2014 – 2025
(million lbs/year)

	Nitrogen	Phosphorous	Sediment
Actual load, 2014	65.10	2.56	1,695
Target load, 2025	35.58	1.81	1,092
Total needed load reductions, by 2025	29.52	.74	603
Source: US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 9/15/16: https://stat.chesapeakebay.net/?q=node/130			

How much funding will be required to achieve these needed reductions is a matter for debate. The cost of preventing a pound of nutrient or sediment pollution from being delivered to the Bay varies considerably, depending on a number of factors such as which best management practice

[10] USDA Economic Research Service, Washington, DC. "Farm Income and Wealth Statistics." Last updated 8/30/16. http://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/data-files-us-and-state-level-farm-income-and-wealth-statistics.aspx

[11] US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 9/15/16: https://stat.chesapeakebay.net/?q=node/130

is used and where that BMP is located within the watershed. Some BMPs have been shown to remove pollutant loads far more cost effectively than others.[12] In its 2012 report on nutrient credit trading in the Chesapeake Bay watershed,[13] the Chesapeake Bay Commission drew data from the Chesapeake Bay Watershed Model to portray the relative cost-effectiveness of various agricultural and stormwater BMPs in removing nitrogen and phosphorous pollution. The cost range is striking, both across practices and within practices. The cost per pound of nitrogen reduced per year can be as low as a few dollars per pound for some BMPs (e.g. livestock exclusion, grass buffers) to as high as $600 per pound for others (e.g. upland precision intensive rotational grazing).[14] For phosphorous, costs can surpass $1,400 per pound for some practices (wetland restoration, tree planting, land retirement). **The median costs for agricultural BMPs are below $100 per pound of delivered nitrogen and below $1,000 per pound for phosphorous**. This is consistent with EFC's recent analysis for the state of Maryland regarding the cost of implementing its Watershed Implementation Plan; based on that state-specific analysis, the average cost per treated pound of nitrogen was estimated to be $26.[15]

Another way to gauge the costs of nutrient and sediment reduction is to estimate the value of a pound of treated pollution under a credit trading scenario, as several recent studies have done.[16] Again, prices vary widely depending on chosen assumptions and scenarios, such as whether states are first required to meet TMDL baselines before generating credits, whether point-to-nonpoint trading is allowed, and the degree to which inter-state trading is enabled. A 2013 Pennsylvania State University report on the economic impact of nutrient trading in the Chesapeake Bay watershed evaluated how many tradable pounds of nutrient pollution each state would have available at various price points, ranging from $2-20 per pound for nitrogen and $10-$100 per pound for phosphorous. Researchers estimated that, under one likely trading scenario, 4.3 million pounds of nitrogen would be available for trade throughout the Bay watershed at less than $20 per pound, and 2 million pounds would be available to trade at less than $10 per pound.[17]

This same Penn State report also attempted to estimate the aggregate cost of achieving TMDL targets for each Bay state's agriculture sector. The report's authors suggest that **it will cost Pennsylvania $378.3 million per year between 2011 and 2025 to fully implement all the agricultural BMPs called for in the state's WIP.**[18] This is the cost estimate considered by PA DEP to be most reliable,[19] and it seems reasonable when compared with EFC's

[12] James Shortle et al. August 2013. *Final Report: Building Capacity to Analyze the Economic Impacts of Nutrient Trading and Other Policy Approaches for Reducing Agriculture's Discharge into the Chesapeake Bay Watershed.*
[13] Chesapeake Bay Commission. May 2012. *Nutrient Credit Trading for the Chesapeake Bay: An Economic Study.* Available: http://www.chesbay.us/Publications/nutrient-trading-2012.pdf
[14] Ibid.
[15] Environmental Finance Center, University of Maryland. February 2015. *Maryland's Chesapeake Bay Restoration Financing Strategy Final Report.*
[16] See citations within this section for Chesapeake Bay Commission 2012 and Shortle et al 2013.
[17] James Shortle et al. August 2013. *Final Report: Building Capacity to Analyze the Economic Impacts of Nutrient Trading and Other Policy Approaches for Reducing Agriculture's Discharge into the Chesapeake Bay Watershed.*
[18] Ibid.
[19] Pennsylvania Department of Environmental Protection. January 21, 2016. *A DEP Strategy to Enhance Pennsylvania's Chesapeake Bay Restoration Effort.*

Maryland-specific cost estimate of $26 per pound of reduced nitrogen;[20] employing that figure for the 29.52 million pounds of needed nitrogen reductions in Pennsylvania's agriculture sector produces a figure of $767 million per year to achieve nitrogen targets alone. Both of these estimates have limitations: the Penn State figure reflects the cost of implementing BMPs called for in the state's WIP, which may or may not achieve needed nutrient and sediment reductions; and the EFC estimate is based on a Maryland-specific analysis. Yet another estimate comes from recent modeling completed by the Chesapeake Bay Program Office, which projects that Pennsylvania could achieve most of its agricultural load reductions by increasing state cost share assistance for agricultural BMPs by $80 million per year.[21] Further refinement of these cost estimates will be necessary as the Commonwealth charts a course to fund TMDL compliance.

b) Estimated cost of necessary pollution reductions – urban runoff sector

In Pennsylvania's portion of the Chesapeake Bay watershed, 206 communities are regulated by Municipal Separate Storm Sewer System (MS4) permits under the federal National Pollutant Discharge Elimination System. As of 2014, stormwater runoff accounted for 16.5% of the state's total nutrient pollutant load (nitrogen and phosphorous combined), and 19.8% of its sediment pollutant load. The majority of these loads come from urban areas that are regulated under federal MS4 permits – 55% of the nitrogen load, 68% of the phosphorous load, and 70% of the sediment load.[22]

As with the agriculture sector, the state is falling behind targets in its stormwater sector. Over the coming ten years, Pennsylvania needs to decrease annual nitrogen loads by 41%, phosphorous by 39% and sediment by 46%; these pollution reductions are quite aggressive when compared to reductions achieved between 2009 and 2014 (0.17% increase; 9.26% reduction, and 7.32% respectively).

Table 4 indicates the total number of pounds that need to be reduced to meet 2025 targets. Annual nitrogen loading will need to drop by 7.18 million pounds by 2025, phosphorous by .27 million pounds, and sediment by 241 million pounds.

Table 4. Needed pollutant load reductions in the urban runoff sector, 2014 – 2025
(million lbs/year)

	Nitrogen	Phosphorous	Sediment
Reported actual loads, 2014	17.44	.70	519
Target loads, 2025	10.26	.42	278
Total needed load reductions, by 2025	7.18	.27	241

Source: US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 9/15/16: https://stat.chesapeakebay.net/?q=node/130

[20] Environmental Finance Center, University of Maryland. February 2015. *Maryland's Chesapeake Bay Restoration Financing Strategy Final Report.*
[21] Veronica Kasi. 10/31/16. Pennsylvania Department of Environmental Protection. Personal communication with EFC.
[22] US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 9/15/16: https://stat.chesapeakebay.net/?q=node/130

As with the agriculture sector, the cost of abating nutrient and sediment pollutant loads from the urban runoff sector varies widely, depending on BMP selection and location, as well as whether credit trading is enabled between point and nonpoint sources and/or between states. The Chesapeake Bay Commission's 2012 analysis found that the cost per pound of nitrogen removed per year by various stormwater BMPs ranges from a few dollars for some practices (e.g. urban nutrient management) to close to $1,000 for others (e.g. urban filtering), with median costs above $300 per pound reduced.[23] For phosphorous, the cost per pound can be as high as $80,000, with median costs above $10,000 per pound.[24] Other studies in the Bay watershed have come up with higher estimates for the cost of reducing one pound of nitrogen pollution per year, ranging from $1,122[25] to $3,800.[26] EFC's 2015 study for the state of Maryland, which drew on the state's Watershed Implementation Plan as well as the Maryland Assessment and Scenario Tool, arrived at a much lower figure of $510 per pound of nitrogen removed.[27]

Acknowledging the wide ranges and the uncertainties involved in these estimates – and the fact that this literature review does not include costs for sediment – Table 5, below, estimates the cost range that could be required for Pennsylvania to comply with nitrogen and phosphorous targets for urban runoff. Because MS4-regulated communities are responsible for stormwater abatement in their jurisdictions, we also estimate the state's share of stormwater abatement costs for non-regulated emissions, assuming that the current share of non-regulated vs. regulated pollutant loads remains consistent through 2025 (according to 2015 modeling data, non-regulated emissions account for 52% of total nitrogen loads and 68% of phosphorous loads).[28]

Table 5. Cost range for achieving reductions in the urban runoff sector, 2014 – 2025

	Cost per lb removed (lower bound)	Cost per lb removed (upper bound)	Needed reduction (million lbs/year)	Total cost ($ billion)
Nitrogen	$300	$3,800	7.18	$2.15 - $27.28 ($1.12 - $14.19 state's share*)
Phosphorous	$10,000	$80,000	.27	$2.7 - $21.6 ($1.84 - $14.48 state's share*)

Source: US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 9/15/16: https://stat.chesapeakebay.net/?q=node/130

*Assuming present share of non-regulated vs. regulated pollutant loads remains consistent (52% nitrogen, 68% phosphorous).

c) Current funding levels and estimated financing gap

[23] Chesapeake Bay Commission. May 2012. *Nutrient Credit Trading for the Chesapeake Bay: An Economic Study.* Available: http://www.chesbay.us/Publications/nutrient-trading-2012.pdf

[24] Ibid.

[25] The Center for Watershed Protection. March 2013. *Cost-Effectiveness Study of Urban Stormwater BMPs in the James River Basin.* Available: http://www.essex.org/vertical/sites/%7B60B9D552-E088-4553-92E3-EA2E9791E5A5%7D/uploads/24_-_App_X_-_Cost_Effectiveness_Study.pdf

[26] Maryland Department of Environment. October 2014. Current Progress and Future Projections in Implementing MD's Blueprint for Restoration.

[27] Environmental Finance Center, University of Maryland. February 2015. *Maryland's Chesapeake Bay Restoration Financing Strategy Final Report.*

[28] US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 9/15/16: https://stat.chesapeakebay.net/?q=node/130

According to Pennsylvania's Nonpoint Source Funding Program annual reports, **about $140 million of federal and state funding is currently spent on nonpoint source pollution activities in Pennsylvania each year**,[29] and PA DEP asserts that the majority of this funding is devoted to BMP deployment (87% in 2014),[30] with the remainder funding personnel and operations. This includes expenditures from 11 state and 18 federal nonpoint source pollution programs (see Table 6).

Table 6. Nonpoint Source Funding in Pennsylvania, State and Federal Sources ($ million)

State sources	FY 2013	FY 2014
Department of Environmental Protection (DEP)		
Conservation District watershed specialists	2.079	2.136
Environment Stewardship and Watershed Protection (Growing Greener)	18.008	17.393
Chesapeake Bay Implementation Grant	3.787	3.591
Conservation District Fund Allocation Program (line item plus UGWF monies)	2.506	4.381
Dirt and Gravel Roads Pollution Prevention Program	3.528	20.854
PA Infrastructure and Investment Authority (PENNVEST)		
Grants for nonpoint source projects	3.712	6.523
Pennsylvania Department of Agriculture (PDA)		
Nutrient Management Fund (transfer)	2.714	2.714
Conservation District Fund Allocation Program (line item plus UCGW monies)	0.869	2.744
Resource Enhancement and Protection Tax Credits Available	10.000	10.000
Public Utilities Commission (PUC)		
Conservation District Funding from UGWF	0.0	3.750
Commonwealth Financing Authority		
Act 13 NPS Funding	10.959	3.147
State Funding Subtotal	**58.162**	**77.233**

Federal Sources	FY 2013	FY 2014
US Environmental Protection Agency (EPA)		
Section 319 Nonpoint Source Management Program	4.379	4.672
National Fish and Wildlife Foundation – Chesapeake Bay Small Watershed Grant (annual funding, PA-specific grants)	0.487	0.553
National Fish and Wildlife Foundation – Chesapeake Bay Innovative Nutrient and Sediment Reduction Grant (PA-specific grants)	1.207	1.916
USDA Natural Resources Conservation Service		

[29] Pennsylvania Department of Environmental Protection. Undated. *Non-Point Source Management Program Annual Report FFY 2014.*
[30] Pennsylvania Department of Environmental Protection. January 21, 2016. *A DEP Strategy to Enhance Pennsylvania's Chesapeake Bay Restoration Effort.*

Agricultural Management Assistance	0.280	1.080
Chesapeake Bay Watershed Initiative	9.100	0.0
Environmental Quality Incentive Program	21.100	21.790
Farm and Ranchland Protection Program	3.000	0.0
Agric Cons Easement Program (ag land easements)	0.0	4.620
Conservation Stewardship Program (new contracts)	0.700	0.350
Conservation Stewardship Program (funds obligated to pay on prior year contracts)	6.200	6.180
Grasslands Reserve Program	0.0	0.310
Healthy Forests Reserve Program	0.0	0.660
Wetlands Reserve Program	4.750	0.0
Agric Cons Easement Program (wetland reserve easements)	0.0	3.860
Wildlife Habitat Incentive Program	2.280	0.0
USDA Farm Service Agency		
Conservation Reserve Enhancement Program (includes financial incentives, cost share, and rental payments)	23.753	21.885
Biomass Crop Assistance Program	0.152	0.013
Grassland Reserve Program	0.618	0.150
Federal Funding Subtotal	78.006	68.039
TOTAL	136.168	145.272

Source: Pennsylvania Department of Environmental Protection. Undated. *Non-Point Source Management Program Annual Report FFY 2014.*
Notes: Excludes funds expended for Abandoned Mine Discharge abatement. UGWF = Unconventional Gas Well Fund.

It is important to note that these investments are for all nonpoint source reduction efforts statewide, not just for reducing nutrient and sediment pollution from agriculture and urban runoff sources in the Bay watershed. But even if all these funds were targeted to those pollutants, in those sectors, in that watershed, they would still fall significantly short of estimated revenues needed to address restoration requirements. If the current average funding level of $140 million per year stays consistent, the Commonwealth will invest a total of $1.4 billion between now and 2025, for all nonpoint source reduction efforts throughout the state. Comparing this with the above cost estimates for achieving needed reductions in the agriculture sector ($3.78 billion) and the lower bound for achieving needed nutrient reductions in the urban runoff sector ($2.96 billion in state responsibility) reveals **a funding gap of $5.34 billion over the coming ten years** (see Table 7).

Table 7. Funding gap, 2016 - 2025 ($ billion)

Lower-bound estimated cost to achieve TMDL goals for agriculture sector (all BMPs in WIP) [a] and urban runoff sector (N and P only)[b]	$6.74
Current average funding level for all statewide nonpoint source pollution reduction efforts [c]	$1.4
Gap	$5.34

[a] Total cost of implementing all agricultural BMPs called for in Pennylvania's Watershed Implementation Plan, per James Shortle et al. August 2013. *Final Report: Building Capacity to Analyze the Economic Impacts of Nutrient Trading and Other Policy Approaches for Reducing Agriculture's*

Discharge into the Chesapeake Bay Watershed.

[b] Estimates from Chesapeake Bay Commission. May 2012. *Nutrient Credit Trading for the Chesapeake Bay: An Economic Study.* Available: http://www.chesbay.us/Publications/nutrient-trading-2012.pdf

[c] Average of 2013 and 2014 totals, as reported in Pennsylvania Department of Environmental Protection. Undated. *Non-Point Source Management Program Annual Report FFY 2014.*

Given the significant uncertainties involved in predicting costs of WIP implementation and in accounting for current levels of Bay restoration investment, the actual figure likely differs from this estimate. Nevertheless, **there is no question that Pennsylvania is facing a significant funding gap.** Indeed, the Commonwealth is well aware of the need for additional resources in order to achieve TMDL goals. In its recent Bay restoration strategy document, PA DEP acknowledged that "Commonwealth agencies do not have the staffing or the cost-share assistance resources needed to meet Bay goals," and it called for obtaining up to several million dollars of new funding (presumably per year) for Bay compliance.[31]

As the Commonwealth seeks to fill this recognized gap, it is important to acknowledge that some gains can be made by spending current dollars more effectively. For example, both PA DEP and US EPA have recommended targeting agricultural cost share program funds to effective conservation practices in high-priority watersheds.[32] It has been estimated that choosing cost-effective BMP portfolios – defined as "a set of practices assigned to locations that minimizes the costs satisfying nitrogen, phosphorus, and sediment load allocation targets in each Chesapeake Bay jurisdiction" – could reduce Pennsylvania's cost of compliance by an impressive 36%.[33]

Additionally, PA DEP has stated that the current EPA Chesapeake Bay Model does not fully account for all restoration activity occurring in the state, in part because of inadequate BMP tracking and monitoring, and the Department has outlined a plan for remedying deficiencies in these programs.[34] **Improved BMP tracking would in effect reduce the cost of compliance** if it shows that the state in fact is closer to pollution reduction targets than presently thought.

Even with better targeted funding and improved BMP tracking, however, the fact remains that **if Pennsylvania is to meet TMDL targets for its agriculture and urban runoff sectors, it will need to significantly increase investment in Bay restoration activity.** Based on the above analysis, which assumes no changes to the existing financing system, the Commonwealth will need to commit $674 million annually to this work – $534 million more than is currently spent per year on all nonpoint source reduction efforts in the state.

[31] Pennsylvania Department of Environmental Protection. January 21, 2016. *A DEP Strategy to Enhance Pennsylvania's Chesapeake Bay Restoration Effort.*

[32] Ibid.

[33] J. Shortle, Environment & Natural Resources Institute, Penn State University. "The Costs to Agriculture of Saving the Chesapeake Bay" presentation. Accessed 9/12/16: http://files.dep.state.pa.us/Water/ChesapeakeBayOffice/CBMT_May2014_AgCostsChesapeakeBayTMDL.pdf

[34] Pennsylvania Department of Environmental Protection. January 21, 2016. *A DEP Strategy to Enhance Pennsylvania's Chesapeake Bay Restoration Effort.*

IV. Options for financing TMDL implementation

The scale of Pennsylvania's Bay restoration financing challenge and the rapidly-approaching implementation deadlines will likely require the Commonwealth to simultaneously expand existing revenue sources, employ new financing approaches, and boost the capacity of state departments to implement programs effectively. The financing options presented in this section are organized into three categories:

- Revenue and regulatory options: basic approaches available to the Commonwealth if it is to take control of the Bay restoration financing process and accelerate TMDL implementation.
- Capacity building options: opportunities for building state-level capacity to more effectively implement revenue and regulatory approaches.
- Financing system options: mechanisms for making investments more efficiently, thereby reducing the cost of implementation.

First, a few preliminary notes. As mentioned above, while Bay restoration activities are funded by various public and private sector actors, including municipalities, nonprofits, and businesses, it is ultimately the *state* that is being held accountable for achieving restoration goals and executing its Watershed Implementation Plan. For this reason, this section focuses on options available to the Commonwealth to meet its financing obligation. Further, while it is theoretically possible for Chesapeake Bay states to develop interstate financing arrangements to achieve Bay-wide restoration goals, it is beyond the scope of this project to investigate that possibility; further study in this area would be beneficial. And finally, the financing options presented here do not address technical issues such as the accuracy of the Chesapeake Bay Program partnership modeling processes or the efficacy of pollution load allocations.

a) Revenue and regulatory options

When it comes to paying for water quality protection and restoration, there is no magic bullet. Like other Bay states, Pennsylvania essentially has two options for achieving mandated pollution reductions, which may be pursued in some combination: raise revenue to fund actions that reduce pollution, and increase regulation in order to shift the cost of pollution reduction to other entities.

i. Expand state revenue programs.

Pennsylvania could accelerate TMDL implementation by ramping up investment in restoration practices – through expanded cost share programs as well as various innovative incentive programs such as subsidized insurance and loans for conservation practices in high-priority

watersheds.[35] However, all of this would need to be paid for, by increasing tax and fee revenue and/or by reallocating more of the state budget to Bay restoration. The benefit of funding implementation directly is that it would allow the Commonwealth to exert more complete control over the process.

Expand existing revenue programs, e.g. through new state bonds such as Growing Greener III. A current proposal by the Pennsylvania nonprofit Growing Greener Coalition represents one viable option for financing water quality restoration. The Growing Greener Environmental Stewardship Fund, established in 1999 by the Pennsylvania General Assembly, is a statewide fund that supports environmental projects such as greenway development, habitat conservation, open space preservation, and water quality restoration. Funded by state bonds (including a $625 million bond in 2005), landfill tipping fees, and contributions from the Marcellus Legacy Fund and the Oil and Gas Lease Fund,[36] this program has been one of the most important sources of revenue for statewide environmental restoration efforts, funding hallmark state programs such as the Resource Enhancement Agricultural Program and DEP's MS4 implementation program.[37]

However, funding for the program has decreased from an estimated average of $200 million per year in the mid-2000s to $57 million in 2016,[38] with all bond funding currently depleted.[39] The Growing Greener Coalition is calling for the program's revenue to be increased to approximately $315 million, with more than half dedicated to water quality restoration.[40] While the blueprint does not specify revenue sources, it presumably would be funded at least in part through a new state bond. According to the Coalition, a survey conducted in 2015 by Pennsylvania State University found that 90.7% of Pennsylvanians support increasing state funding to "conserve and protect open space, clean water, natural areas, wildlife habitats, parks, historic sites, forests, and farms."[41] Further, the Coalition asserts that the program leverages private, local, and federal matching dollars at a ratio of 1:2.[42] Growing Greener III presents an opportunity for the Commonwealth to more aggressively pursue nutrient and sediment TMDL targets in the agriculture and urban runoff sectors, if funds were to be dedicated to those needs.

A related option is for the Commonwealth to issue a "Bay bond" with funds specifically devoted to high-priority water quality restoration needs. A variant of this option that might be particularly attractive is a revenue bond, through which the Commonwealth would finance

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[35] These ideas and others are discussed in further detail in EFC's September 2016 report *Financial Incentives for Water Quality Protection and Restoration on Agricultural Lands in Pennsylvania.*

[36] Growing Greener Coalition. 9/19/16. Press Release. "PA Growing Greener Coalition Unveils Blueprint for Growing Greener III Program: Plan Details Need for Protecting Pennsylvania's Water, Land, and Other Natural Resources." Available: http://pagrowinggreener.org/gg3/

[37] Growing Greener Coalition. "Growing Greener III Package Proposal." Accessed 9/29/16: http://pagrowinggreener.org/wp-content/uploads/2016/09/GGIII-Distribution.pdf

[38] Growing Greener Coalition. 9/19/16. Press Release. "PA Growing Greener Coalition Unveils Blueprint for Growing Greener III Program: Plan Details Need for Protecting Pennsylvania's Water, Land, and Other Natural Resources." Available: http://pagrowinggreener.org/gg3/

[39] Growing Greener Coalition. "Growing Greener Environmental Stewardship Fund." Accessed 9/28/16: http://pagrowinggreener.org/issues/growing-greener/

[40] Growing Greener Coalition. 9/19/16. Press Release. "PA Growing Greener Coalition Unveils Blueprint for Growing Greener III Program: Plan Details Need for Protecting Pennsylvania's Water, Land, and Other Natural Resources." Available: http://pagrowinggreener.org/gg3/

[41] Ibid.

[42] Ibid.

[42] Growing Greener Coalition. "Growing Greener Environmental Stewardship Fund." Accessed 9/28/16: http://pagrowinggreener.org/issues/growing-greener/

projects with income-producing potential, such as riparian buffers comprised of fruit and nut trees, oyster or mussel harvesting operations, or manure-to-energy projects. Provided that these ventures produce adequate revenue for growers as well as quantifiable nutrient reductions, they could be a win-win solution.

Develop new tax- and/or fee-based funding sources. An obvious method for generating revenue is to increase existing taxes and fees or impose new ones; this approach has the advantage of raising *new* funds, rather than reallocating them from other state programs. One alternative is to impose a tax on nutrient and sediment emissions from all sources. Such pollution taxes have the benefit of directly dis-incentivizing the undesired activity (in this case, nutrient and sediment pollution), and when set at the appropriate rate, they can achieve reductions in the most economically efficient way and also catalyze the development of innovative pollution reduction technologies. They are also more easily administered than many regulatory programs, and they provide a flexible revenue stream because the rate can be adjusted over time as needed.[43]

Though pollution taxes are still relatively rare, there are a few case studies to draw lessons from. For example, New York City sought to replace the fuel oil that was used to generate most of the city's electricity with a lower-sulfur option. A surcharge on "dirty" fuels was set at a rate slightly higher than the market price for cleaner fuels. The surcharge in effect cancelled the economic benefit of polluting, which led to the discovery of cleaner fuel options.[44] The phase out of chlorofluorocarbons was also partly due to the use of a pollution tax. The 1987 Montreal Protocol was a landmark decision to remove the pollutant from the global system. However, in some respects the phase out didn't really kick in until the US implemented a tax on CFCs in 1990. Certainly the original cap and trade system may have worked effectively in the long-term, but the pollution tax appears to have worked well.[45] Other well-known examples of these kinds of taxes are those on cigarettes, fuel-inefficient vehicles, alcohol, and luxury goods.

There are barriers associated with implementing a new tax structure, including the challenge of identifying an appropriate tax rate, especially in an environment of multiple stakeholders such as Pennsylvania's farming community. In addition, pollution taxes are considered by some to be regressive, in that they can impose a disproportionate burden on lower-income consumers. But the most significant barrier is likely to be political opposition. Even though such a tax could be implemented in a revenue-neutral way, if accompanied by a reduction in other taxes for affected parties, it is not likely to enjoy broad support.

Given the current widespread aversion to general tax increases, *fees* are a potentially more palatable option. The Pennsylvania Legislature is currently considering a new fee that would raise funds for water restoration. Proposed by State Representative Mike Sturla via House Bill 2114, the "water resource usage fee" would be assessed on large withdrawals of water – greater

[43] Experimental Economics Center. "Advantages of Green Taxes." Accessed 9/29/16: http://www.econport.org/content/handbook/Environmental/pollution-control-revised/Advantages.html
[44] Charles Komanoff. 4/29/09. "Give Fees a Chance: Pollution Taxes Work." *The Grist.* Accessed on 9/29/16: http://grist.org/article/pollution-taxes-work/
[45] Ibid.

than 10,000 gallons per day – by consumers such as utilities, golf courses, and nuclear power plants.[46] The proposed rate is 1 penny per 100 gallons if the water is eventually returned to its source, and 1 penny per 10 gallons if it is not returned to its source. Municipal water plants and agricultural users would be exempt. Based on current usage rates, the fee has the potential to generate $245 million annually.[47] The current proposal calls for splitting these funds between the state's six major watersheds, but if reserved for Bay restoration alone, this revenue could make up a significant share of the funding gap.

A fee could also be assessed on nutrient or nitrogen emissions; this option is similar to the nutrient tax mentioned above, with a key difference: while a tax is primarily intended to raise revenue or dis-incentivize undesired activities, a fee is intended to recover some of the cost of providing a service to a beneficiary (in this case, the service would be treating nutrient emissions). To be politically acceptable, fees generally need to be directly linked to the cost of providing the service and applied uniformly and fairly to all beneficiaries (though perhaps exemptions could be made for certain entities such as agriculture operators), and funds raised through the fee need to be applied exclusively to providing the service.

ii. Regulate additional nutrient and sediment emissions.

In addition to paying for restoration activity via expanded or new state revenue, the other basic option available to the Commonwealth is to increase regulation, effectively transferring the TMDL financing obligation to regulated entities – businesses, communities, citizens.

PA DEP already recognizes its need to better enforce existing regulations within the agriculture and urban runoff sectors. The Department's *Strategy to Enhance Pennsylvania's Chesapeake Bay Restoration Effort*[48] is, in part, a response to US EPA directive to improve compliance. Related to agriculture, EPA has asked the Department to take a number of specific actions related to conducting additional farm inspections, ramping up implementation with manure management plans, increasing the number of nutrient management plans implemented on annual basis, and specifying the priority areas that will be targeted for nutrient management plan implementation, among others.[49]

Better enforcing existing regulations is an obvious first step. But to achieve TMDL goals, it may be necessary to impose tighter regulations. According to the Chesapeake Bay Program TMDL Tracker, a relatively small portion of nutrient and sediment emissions from the agriculture and urban runoff sectors come from regulated sources (see Table 8), suggesting that greater emissions reductions could be achieved by expanding the state's regulatory reach in those

[46] The Times Tribune Editorial Board. 6/20/16. "Small Fee for Cleaner Water." *The Times Tribune.* Accessed 9/25/16: http://thetimes-tribune.com/opinion/small-fee-for-cleaner-water-1.2057205
[47] PA Environment Editorial Board. 6/6/16. "Rep. Sturla Water Use Fee Bill Would Generate $245 Million/Year for Water Programs." *PA Environment Digest.* Available: http://paenvironmentdaily.blogspot.com/2016/06/rep-sturla-water-use-fee-bill-would.html
[48] US Environmental Protection Agency. September 2015. "Addressing PA Gaps in Chesapeake Bay Restoration – Options Paper." Cited in Pennsylvania Department of Environmental Protection. January 21, 2016. *A DEP Strategy to Enhance Pennsylvania's Chesapeake Bay Restoration Effort.*
[49] Ibid.

sectors. As discussed below, opportunities exist within the state's nutrient management regulatory framework, CAFO regulations, and urban MS4 permits.

Table 8. Percentage of total emissions from regulated sources, 2015

Sector	Nitrogen	Phosphorous	Sediment
Agriculture	2.25%	74.66%	0.44%
Urban runoff	47.72%	32.05%	29.76%

Source: US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 9/15/16: https://stat.chesapeakebay.net/?q=node/130 and

Enhance or expand nutrient management and CAFO regulations. Pennsylvania's current nutrient management law, enacted in 2005, requires farms subject to the regulations to develop and implement approved Nutrient Management Plans (NMPs), which specify how nutrients supplied on the farm and nutrients needed on the farm will be balanced, as well as what BMPs will be used to minimize the environmental impact from nutrients.[50] The regulations apply to Concentrated Animal Operations (CAOs), defined as any livestock or poultry farming operation that has more than 8 total animal equivalent units (AEUs) and exceeds 2,000 pounds of live animal weight per acre suitable for manure application. Farms with less than 8 AEUs are not required to have an approved nutrient management plan regardless of animal density.

Animal equivalent unit (AEU) = # of animals (average # on a typical production day) x average animal weight over production period (lb) / number of production days per year / 365

Source: PennState Extension

Only an estimated 5% of Pennsylvania's animal operations fall into the CAO category.[51] The other 95% are encouraged to *voluntarily* adopt NMPs, and the state's Clean Streams Law states that all farms should develop a manure management plan (MMP) in accordance with PA DEP's Manure Management Manual. However, there is no legal requirement for MMPs to be reviewed or approved.[52]

The other significant agriculture regulatory program[53] is the Concentrated Animal Feeding Operation (CAFO) program administered by PA DEP. Under federal Clean Water Act regulations, CAFOs are treated as point sources and must obtain NPDES permits.[54] In Pennsylvania, CAFOs are required to obtain a permit from PA DEP, which includes the provision that the operation must be implementing an approved Nutrient Management Plan. CAFOs are restricted from directly discharging pollutants to surface waters or land applying nutrients in excess of what is

[50] PennFuture. December 2011. *Agriculture and the Law: A Guide to Pennsylvania's Agricultural Laws and Regulations for Farmers and Their Neighbors.* Available: http://www.pennfuture.org/UserFiles/File/Water/RespFarm/Guide_PAlawsRegs_201112.pdf

[51] PennState Extension. "Nutrient Management Legislation in Pennsylvania: A Summary of the 2006 Regulations." Last accessed 9/29/16: http://extension.psu.edu/plants/nutrient-management/act-38/nutrient-management-legislation-in-pennsylvania-a-summary-of-the-2006-regulations

[52] PennState Extension. "Nutrient Management Legislation in Pennsylvania: A Summary of the 2006 Regulations." Last accessed 9/29/16: http://extension.psu.edu/plants/nutrient-management/act-38/nutrient-management-legislation-in-pennsylvania-a-summary-of-the-2006-regulations

[53] Another regulatory program affecting Pennsylvania farms is PA DEP's requirements related to erosion and sediment control.

[54] James Shortle et al. August 2013. *Final Report: Building Capacity to Analyze the Economic Impacts of Nutrient Trading and Other Policy Approaches for Reducing Agriculture's Discharge into the Chesapeake Bay Watershed.*

allowed in their NMP. DEP and county conservation district staff ensure compliance with CAFO permits via annual inspections.

There are likely manifold options for tightening agriculture regulations in order to transfer more of the load reduction responsibility to farmers. These might include lowering the thresholds for defining CAOs and CAFOs, in order to broaden the universe of farms subject to nutrient management and CAFO regulations. Nutrient Management Plan stipulations themselves could be made more stringent. Currently, it is permissible for only 15-20% of land-applied nutrients to be used by crops, with the remainder allowed to volatize or run off.[55] To fully assess opportunities for capturing more of this nutrient load, it would be worth conducting an analysis of other states' nutrient and manure management regulatory programs. Another fruitful investigation would be for PA DEP to identify options to better integrate the CAFO program with the other nutrient and sediment programs it administers, namely the TMDL and Chesapeake Bay Tributary Strategy programs.[56]

The need for PA DEP and the Department of Agriculture to ramp up compliance and increase the number of farms implementing manure and nutrient management plans has already been discussed. But it is worth noting a strategy for enhancing compliance among Pennsylvania's sizable Plain Sect farming community, which has traditionally avoided interaction with governmental agencies. It has been shown effective to employ the help of community-based organizations that can build relationships and trust with Plain Sect farmers and then provide guidance and information regarding conservation practices.[57]

Add pollution load limits to urban stormwater permits. In Pennsylvania's portion of the Chesapeake Bay watershed, 206 communities are regulated under the NPDES Phase II MS4 permit program administered by PA DEP. An option for capturing more of the unregulated share of stormwater runoff is for PA DEP to require nutrient and sediment pollution reductions as part of stormwater permits. The Department could take an indirect approach, requiring municipalities to treat a certain percentage of impervious surfaces, as has been done in Maryland. Or, a more direct approach would be to include nutrient and sediment load reductions in MS4 general permits, as has been done in Virginia. Either way, there is significant room for improvement in capturing more of the urban runoff load; in 2015 alone, nearly 8.9 million pounds of nitrogen came from unregulated sources in this sector.[58]

Clamp down on wastewater treatment plant emissions and reallocate sector loads. While this report is focused on meeting TMDL targets in the agriculture and urban runoff sectors, another option potentially available to the state (with EPA approval) could be to transfer a portion of other sectors' loads to the wastewater treatment plant (WWTP) sector, and then clamp down on

[55] PennFuture. December 2011. *Agriculture and the Law: A Guide to Pennsylvania's Agricultural Laws and Regulations for Farmers and Their Neighbors.* Available: http://www.pennfuture.org/UserFiles/File/Water/RespFarm/Guide_PAlawsRegs_201112.pdf
[56] Ibid.
[57] Philip Gruber. 6/20/16. "How to Work with the Amish on Conservation." *Lancaster Farming.* See also Chesapeake Bay Foundation. 2/15/13. "A Model for Conservation Practices on Amish Farms."
[58] US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 9/15/16: https://stat.chesapeakebay.net/?q=node/130 and

WWTP emissions. According to EPA, requiring the Commonwealth's roughly 200 significant wastewater facilities to reduce total nitrogen emissions from the current 6 milligrams/liter to 3 milligrams/liter would reduce nitrogen loading by about 3.6 million pounds per year,[59] at an estimated cost of $1.8 billion.[60] The state has the authority to go even further and regulate *all* emissions from WWTPs, achieving even greater load reductions.

All of these regulatory approaches have the benefit of shifting restoration costs to entities generating the pollution and incentivizing them to find efficiencies when complying with permits. But they are not totally without cost to state government; additional staffing costs will be associated with administering regulations and ensuring compliance.

b) Capacity building options

While not financing strategies per se, the capacity building options presented below would help the state effectively implement revenue and regulatory programs, both existing and expanded, and ensure that dollars invested actually achieve TMDL reductions. The Commonwealth would be responsible for costs associated with these options, but they have the potential to pay long-term dividends in the form of more effective and efficiently run programs.

i. Augment staff capacity to ensure regulatory compliance.

To effectively administer regulatory programs and build a "culture of compliance," state agencies need greater staff capacity to monitor projects, track compliance, and gauge effectiveness of investments. With more than 40,000 farms and 200 MS4 communities within the watershed, it is no small task for agency staff to ensure adherence with the state's agriculture and stormwater regulations. As PA DEP has acknowledged, "Commonwealth agencies do not have the staffing or the cost-share assistance resources needed to meet Bay goals."[61]

PA DEP has called for additional staff members devoted to implementing agricultural and stormwater components of Bay restoration work, especially to better ensure compliance with nutrient management laws and MS4 permits. To do this work, PA DEP says it needs 12 additional agricultural staff members (at an annual cost of $1,193,452) and 12 additional stormwater staff (at an annual cost of $1,271,052).[62] PA Department of Agriculture, which oversees the agricultural nutrient management program, and the Department of Conservation and Natural Resources likely face similar resource needs. Ensuring that state agencies have the capacity they need is not sufficient to achieve restoration goals, but it is an important first step.

[59] US Environmental Protection Agency. September 2015. "Addressing PA Gaps in Chesapeake Bay Restoration – Options Paper." Cited in Pennsylvania Department of Environmental Protection. January 21, 2016. *A DEP Strategy to Enhance Pennsylvania's Chesapeake Bay Restoration Effort.*
[60] Chesapeake Bay Program. 10/5/16. Interview with EFC.
[61] Pennsylvania Department of Environmental Protection. January 21, 2016. *A DEP Strategy to Enhance Pennsylvania's Chesapeake Bay Restoration Effort.*
[62] Ibid.

ii. Create a consolidated Water Quality Investment Fund.

Pennsylvania's Bay restoration investments currently flow through multiple programs at various state agencies. While these agencies each play an important role in protecting water quality, there could be benefits if all state Bay funding were to funnel through a single investment vehicle. Establishing a Water Quality Investment Fund would allow the Commonwealth to pool water quality investments, realize efficiencies that come with scale, and achieve greater on-the-ground impacts. Additionally, this vehicle would lend itself to a performance-based financing approach that aims to achieve the maximum pollution load reductions per dollar invested. This Fund would be capitalized with existing Bay restoration revenues (some portion of the $140 million total currently spent on all nonpoint source pollution activities in the state each year[63]), as well as any new or expanded revenue sources, such as a Bay bond, water usage fee, or nitrogen fee. Importantly, this Fund would be most effective if dedicated to making direct investments in best management practices and other concrete projects, rather than providing funding for agency staff to administer programs.

iii. Manage Bay restoration investments through a single entity.

A related option is for the Commonwealth to consolidate Bay restoration financing responsibilities in a single state agency, which would administer the Water Quality Investment Fund mentioned above. Pennsylvania Infrastructure Investment Authority (PennVest) is a particularly good candidate because of its expertise in managing investments across a range of finance mechanisms from traditional debt financing to water quality trading to SRF financing. PennVest would be in a position to target investments toward geographic or programmatic priorities, achieve efficiencies by pooling and coordinating water quality funding, and leverage state dollars with other capital such as federal, corporate, or philanthropic funds. Another significant benefit of shifting financing authority to an agency like PennVest is that it creates a firewall between water quality investments and regulatory programs, which would add a degree of independence and flexibility to Bay financing, freeing it up to achieve TMDL targets more quickly.

A scaled-down version of this option would be for each state agency involved in Bay restoration to coordinate all of its internal Bay-related initiatives into one intra-departmental office. This is the approach that PA DEP has proposed taking with the creation of its proposed Chesapeake Bay Office within DEP, which would be charged with ensuring the "proper development, implementation, and coordination of the Commonwealth's efforts for restoration of the Chesapeake Bay."[64]

[63] Pennsylvania Department of Environmental Protection. Undated. *Non-Point Source Management Program Annual Report FFY 2014.*
[64] Pennsylvania Department of Environmental Protection. January 21, 2016. *A DEP Strategy to Enhance Pennsylvania's Chesapeake Bay Restoration Effort.*

c) Financing system options

The following suite of options enable restoration funds to be spent more efficiently, which reduces the cost of TMDL implementation.

i. Shift to performance-based financing.

A powerful option for reducing implementation costs is for the Commonwealth to adopt a performance-financing approach, which focuses on the desired outcome rather than the means to get there. Paying for results rather than projects provides the incentive that project implementers need in order to find the most cost-effective and highest-performing practices. Adopting this approach within existing Bay restoration funding mechanisms and/or via a new water quality investment agency could save significant costs by employing resources to the most effective outcomes.

This represents a new way of doing business for many public revenue programs. One of the more common concerns about focusing on the cost effectiveness of restoration investments is that getting projects to the point of investment can require a variety of interventions that are not directly associated with water quality restoration. For example, overcoming cultural barriers (such as to agricultural conservation) through education and outreach, or providing technical assistance are often "off balance sheet" in that they do not show up in project proposals or cost estimates. However, the power of performance-based based financing is that the funding organization, for example PennVest, can require project implementers to be responsible for all project costs, including outreach, monitoring, and long-term technical assistance.[65]

Pennsylvania is already investigating the use of pay for success financing in the fields of early childhood education, human services, workforce development, and public safety.[66] In the pay for success model, state or local governments contract with private sector investors who provide up-front funding to service providers. The government agency later repays the investors, often with a bonus, as long as the program meets its goals for cost savings and other benefits. If the program fails, taxpayers pay nothing. This is a promising approach for saving taxpayer dollars, increasing investment in programs, and improving outcomes.[67] If pay for success gets off the ground in Pennsylvania, it would be well worth expanding it beyond social services to the water quality realm.

[65] Environmental Finance Center, University of Maryland. August 2016. *Chesapeake Bay Environmental Finance Symposium: Recommendations and Final Report.*

[66] Pennsylvania Office of the Governor. 5/25/15. Press Release: "Pennsylvania Releases Request for Information on 'Pay for Success' Opportunities. Available: http://www.prnewswire.com/news-releases/pennsylvania-releases-request-for-information-on-pay-for-success-opportunities-300055831.html

[67] Nonprofit Finance Fund. April 2016. *Pay for Success; The First Generation. A Comparative Analysis of the First 10 Pay for Success Projects in the United States.*

ii. Utilize a reverse auction to buy and sell nutrient credits.

Focusing on performance also opens the door to innovative financing mechanisms with the potential for even greater cost savings. A prime example is the reverse auction, in which sellers compete to supply buyers with a particular good or service – in this case, pounds of nutrient or sediment pollution abated. Because sellers are competing rather than buyers, prices are bid down rather than up.[68] Reverse auctions are used extensively in the private sector, and they have been modeled in environmental conservation settings as well, including in Pennsylvania's Conestoga Watershed. USDA has estimated that reverse auctions could generate cost efficiencies of up to 18% in some settings.[69] If that were to hold true in Pennsylvania's nutrient trading context, it could result in millions of dollars in cost savings.

PennVest already has the capacity and authority to conduct reverse auctions. If all of the current state investments in nonpoint source pollution reductions were transferred to PennVest to support a reverse auction program, the state would begin with more than $70 million annually, resources that could be targeted to the most efficient and effective restoration projects. These funds could be comingled and auctioned to the most efficient projects regardless of sector (agriculture, wastewater, stormwater, etc.), or they could remain targeted to particular sectors and auctioned separately.

Importantly, a reverse auction for nutrient credits would be a boon to Pennsylvania's agriculture community, as farmers realize a significant new revenue source by implementing conservation practices and generating valuable nutrient credits. Additionally, integrating conservation into their operations will position farmers to be more competitive in a market that increasingly values products raised in environmentally sustainable ways. Consumer demand for organic, local, and sustainable foods is growing at a significant pace, even from surprising sources such as Walmart, and farmers that can tap into this market have the potential to enjoy premium prices for their goods.

iii. Boost effectiveness of the Commonwealth's water quality trading program.

The potential of markets to achieve environmental goals more quickly, effectively, and at lower cost than traditional regulatory approaches is well documented.[70] Water quality trading (WQT) in particular is a market mechanism that has received much attention, especially in the Bay watershed. Unlike standard agriculture and stormwater pollution controls which require emissions to be addressed on site, WQT allows regulated entities to meet permit requirements by purchasing reductions elsewhere, which theoretically maximizes efficiency.

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[68] Selman, M., J. Guilling, J. St. John, and S. Greenhalgh. January 2007. "Paying for Environmental Performance: Using Reverse Auctions To Allocate Funding For Conservation." *World Resources Institute Policy Note.*

[69] Hellerstein, D., N. Higgins, and M. Roberts, USDA Economic Research Service. January 2015. "Options for Improving Conservation Programs: Insights from Auction Theory and Economic Experiments." *Economic Research Report No. ERR-181.*

[70] Shortle, James. April 2013. "Economics and Environmental Markets: Lessons from Water-Quality Trading." *Agricultural and Resource Economics Review* 42/1.

Pennsylvania is no stranger to the use of water quality trading systems; the Commonwealth has been implementing an innovative and well-regarded WQT since 2010,[71] and trading has been a centerpiece in Pennsylvania's Bay restoration strategy for years. Despite this program's success, however, WQT in the Commonwealth is not living up to its full promise. Challenges with establishing appropriate baselines, ensuring quality control, and most importantly generating demand via regulatory enforcement have beset Pennsylvania policymakers. The program could be made more robust if the Commonwealth were to pursue other options previously described in this report. For example, strengthening and better enforcing the Commonwealth's nutrient management, CAFO, and MS4 regulations could boost demand for credits.[72] Tighter CAFO regulations could also introduce a new buyer to the WQT market, as agricultural operations are put in a position to not only generate credits but also to purchase them. Additionally, given the capacity constraints at PA DEP, which currently manages the WQT program, it may be beneficial to transfer administration of the program to PennVest, which is well suited to manage market based programs. This coordinates with the previously-discussed option of consolidating all Bay financing within a single entity in order to streamline investments and achieve goals more efficiently.

Though the ultimate cost savings of WQT in Pennsylvania are not known, the process of developing an effective market – which requires consistent regulatory enforcement coupled with opportunities for flexible implementation – will contribute to a financing system that allocates resources to their most efficient and effective use.

V. Conclusion

The financing challenge facing Pennsylvania as it works to achieve its Chesapeake Bay restoration requirements is significant. Given the huge projected funding gap and the rapidly-approaching implementation deadlines, the Commonwealth will need to commit to a significant increase in funding, and it will likely need to implement a variety of aggressive and innovative regulatory and financing approaches. In spite of the challenge ahead, this moment also presents an opportunity for Pennsylvania leaders to restructure the Commonwealth's water quality financing system in a way that builds on what is already working and takes effective new approaches, in order to accelerate restoration of the state's rivers and the Bay to which they flow.

While it will be critical for Pennsylvania to determine which mix of financing strategies will be most appropriate and feasible in its own jurisdiction, one particularly viable path forward might be for the Commonwealth to fill the Bay restoration financing gap by implementing a combination of a water usage fee, a nitrogen fee, and/or a green or revenue bond, and then dedicate revenue to flow through PennVest, which would enable a reverse auction for transacting nutrient and sediment reduction credits. The value of this approach is that it would enable the Commonwealth to raise a level of funds sufficient to meet TMDL goals and to achieve

[71] J. O'Hara, M. Walsh, P. Marchetti. 2012. "Establishing a Clearinghouse to Reduce Impediments to Water Quality Trading." *The Journal of Regional Analysis and Policy* 42 (2). Available: http://www.jrap-journal.org/pastvolumes/2010/v42/v42_n2_a4_ohara_walsh.pdf

[72] National Network on Water Quality Trading. June 2015. *Building a Water Quality Trading Program: Options and Considerations. Available:* http://www.usda.gov/oce/environmental_markets/files/BuildingaWQTProgram-NNWQT.pdf

the greatest bang for its buck in terms of pollution reductions (in fact, using a reverse auction would likely reduce the overall cost of compliance significantly from current estimates). Perhaps more importantly, this approach brings significant benefit to the people of Pennsylvania: it protects the health of the state's streams and rivers; it infuses funds into the agriculture community by paying farmers for the valuable conservation practices they implement; it boosts the state economy and creates jobs in the water quality restoration sector; and it is likely to save millions of dollars overall in achieving the Commonwealth's mandated Bay restoration targets.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

December 15, 2016

Mr. Dan Nees, Director
Environmental Finance Center
University of Maryland
Preinkert Hall, Bldg. 054
College Park, MD 20742

Re: EFC Report, "Options for Financing Chesapeake Bay Restoration in Pennsylvania"

Dear Dan:

I want to take this time to acknowledge the response to our comments on the draft report. I also appreciate the time you and Julie Winters from the US Environmental Agency took to come to Pennsylvania to meet with a number of different state agency representatives, a representative from our Governor's Office, and members of our Pennsylvania delegation to the Chesapeake Bay Commission to provide an overview of the different options you describe in this report.

The report provides a good description of a number of different options that we can consider as we move forward with the development of our Phase 3 Watershed Implementation Plan and the funding of that plan.

Sincerely,

Veronica Kasi

Veronica Kasi
Manager

cc: Julie Winters, US EPA, Chesapeake Bay Program Office