Strategies for Financing Chesapeake Bay Restoration in Virginia

Prepared by the University of Maryland Environmental Finance Center for the Chesapeake Bay Program Office on behalf of the Commonwealth of Virginia

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About the Environmental Finance Center

The Environmental Finance Center (EFC) at the University of Maryland is part of a network of university-based centers across the country that works to advance finance solutions to local environmental challenges. Our focus is protecting natural resources by strengthening the capacity of local decision-makers to analyze environmental problems, develop effective methods of financing environmental efforts, and build consensus to catalyze action. Our goal is to equip communities with the knowledge and tools they need to create more sustainable environments, more resilient societies, and more robust economies.

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Background and purpose

Virginia has demonstrated a strong commitment to restoring the health of the Chesapeake Bay as well as the state's own local waterways.[1] Since the Chesapeake Bay Total Maximum Daily Load (TMDL) was enacted in 2010, Virginia has invested more than $350 million in nonpoint source pollution reduction projects statewide.[2] The Commonwealth has made steady progress toward implementing its Chesapeake Bay Watershed Implementation Plan (WIP) and achieving target load reductions. It has advanced particularly impressive gains in abating point source pollution, and the Commonwealth's nutrient credit trading program is a model for the region.

However, Virginia has recognized a need for greater levels of investment in Bay restoration, especially for practices that support attainment of goals in the state's agriculture and stormwater sectors, which are making slower-than-needed progress in order to meet final 2025 TMDL targets. Virginia has also identified a need to amend its existing Bay financing mechanisms so that funding is more predictable and stable from year to year, and so that state water quality investments are as efficient and effective as possible.

The Chesapeake Bay Program Office (CBPO) asked the University of Maryland Environmental Finance Center (EFC) to help Virginia identify creative financing solutions that will meet these needs. Through interviews with Virginia state agency staff as well as a review of the Commonwealth's existing funding streams for Chesapeake Bay restoration activities, EFC has identified opportunities for the Commonwealth to both close its Bay restoration funding gap as well as improve the way in which it finances restoration. These strategies focus on state-level opportunities because, though Bay cleanup is funded by various public and private actors, it is state governments that are ultimately accountable for meeting TMDL mandates.

It is EFC's hope that the ideas presented in this report will inform Virginia's efforts to (1) increase revenue flow for water quality restoration in a way that is stable and sufficient, (2) take advantage of opportunities to leverage private sector investment in Bay restoration, and (3) find efficiencies as the Commonwealth accelerates compliance with restoration targets. Virginia's success in these regards would make it a model for other Bay jurisdictions seeking to make the best use of public funds for water restoration.

Virginia's financing challenge and opportunity

Watershed modeling indicates that Virginia is on track to meet statewide interim targets for 2017, in part because it has achieved better than expected gains in its point source sector. However, the Commonwealth is falling behind targets in its stormwater sector (for all three pollutants: nitrogen, phosphorous and sediment) and, to a lesser degree, in its agriculture sector (for sediment). The current pace of progress in these sectors, if not accelerated, will be insufficient to meet final targets by 2025.

In addition to a need for greater levels of investment in these nonpoint source pollution sectors, an evaluation of Virginia's existing funding programs and financing mechanisms reveals opportunities for improvement in how the Commonwealth funds WIP implementation. Specifically, changes could help

[1] Virginia's Bay restoration commitment has been made in numerous venues, including the 2014 Chesapeake Bay Watershed Agreement, signed by all six states in the Bay watershed as well as the District of Columbia.
[2] See Section 2.4 for information on historic funding levels for nonpoint source pollution reduction in Virginia.

stabilize funding over time, make the state financing system more market-like and performance-driven, and accelerate attainment of water quality goals.

Report organization and menu of financing strategies

The report is organized into three parts. It begins, in Section 1, with a brief overview of Virginia'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 and Virginia's interim reporting to US EPA.[3] Section 2 assesses the scale and nature of the financing challenge that Virginia is facing and provides an estimate of the Commonwealth's funding gap in meeting 2025 TMDL targets for its agriculture and stormwater sectors. The heart of the report is Section 3, which presents a menu of options for financing water quality restoration in a way that is both sufficient and effective.

These strategies are organized into three categories:

1. Narrow the compliance and funding gap by accelerating key programmatic, technological, and regulatory or incentive-based improvements.
2. Raise additional revenue for Bay restoration particularly through fees and/or taxes.
3. Improve the efficiency and stability of state funding by taking a more market-like approach to water quality investing and by pursuing strategies that set the stage for effectively engaging the private sector and the marketplace in support of restoration goals.

[3] 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. The Watershed Model draws on various sources to estimate pollutant loads for each major source sector. This report does not address any deficiencies with the current Model's data or assumptions.

1. Progress toward Bay restoration goals

Virginia plays a critical role in restoring the health of the Chesapeake Bay. More than half the state's land area drains to the Bay, and nearly three quarters of its residents live within the watershed.[4] Virginia makes up approximately 37% of the watershed's land area and contributes 22% of nitrogen, 28% of phosphorous, and 34% of sediment entering the Bay.[5]

To help restore the Bay – as well as Virginia'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 jurisdiction by 2025 in order to meet water quality standards for dissolved oxygen, water clarity, underwater Bay grasses, and chlorophyll a.[6] Table 1 shows final TMDL targets for Virginia and for the watershed as a whole.

"Our commitment to the Chesapeake Bay is unwavering. The ecologic and economic attributes of the bay demands continued restoration and protection."

- Molly Joseph Ward, Virginia Secretary of Natural Resources

Table 1. Total Maximum Daily Load annual allocations, 2025 targets (million lbs/year)

	Nitrogen	Phosphorous	Sediment
Total watershed	207.57	14.46	7,340.53
Virginia	52.59	6.40	3,251.38

Source: US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 11/4/16: https://stat.chesapeakebay.net/?q=node/130. Loads simulated using 5.3.2 version of Watershed Model and wastewater discharge data reported by Bay jurisdictions. Progress data updated 4/19/2016.

As part of the TMDL, each Bay jurisdiction 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 2018 and must specify how the final reductions will be made. To assess progress toward restoration goals and aid with short-term planning, states submit two-year milestone reports which outline recent achievement and near-term commitments. These milestone reports afford Bay jurisdictions flexibility in determining how they will meet long-term goals.

Current watershed modeling indicates that Virginia is making good progress toward achieving TMDL targets. In its most recent two-year milestone evaluation, completed June 2016, US EPA reported that Virginia had achieved interim statewide targets for nitrogen and phosphorous, and that it is on track to

[4] USDA Natural Resources Conservation Service. Virginia and the Chesapeake Bay. Accessed 11/14/16: https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/va/home/?cid=nrcs142p2_018880

[5] As of 2015. Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 11/4/16: https://stat.chesapeakebay.net/?q=node/130. Loads simulated using 5.3.2 version of Watershed Model and wastewater discharge data reported by Bay jurisdictions. Progress data updated 4/19/2016.

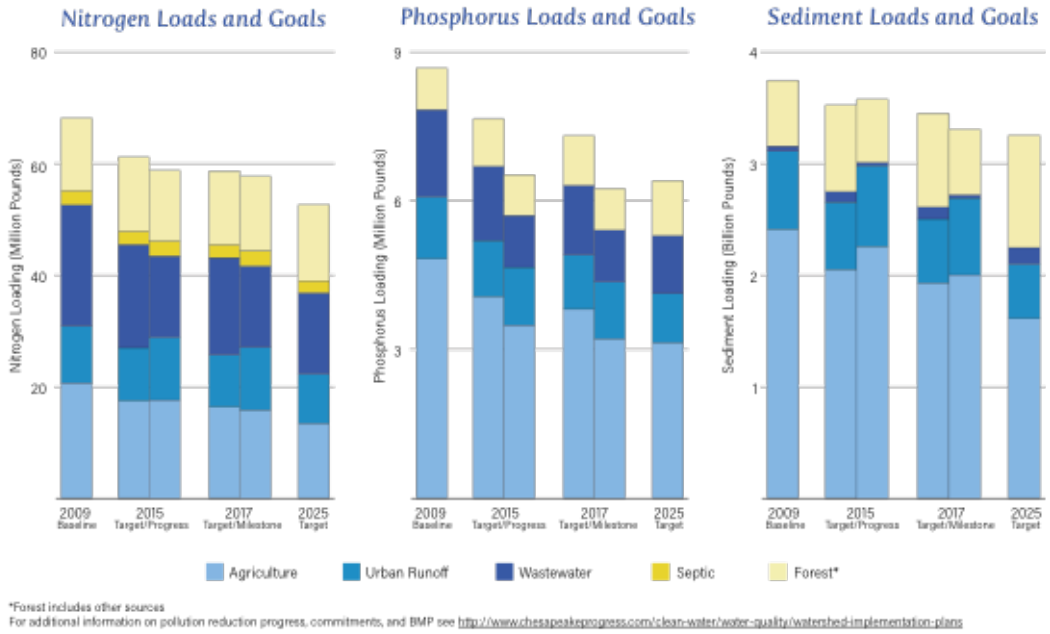
[6] US Environmental Protection Agency. December 2010. "Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorous and Sediment."

meet all statewide goals for 2017, the target for having in place all pollution reduction measures necessary to achieve 60% of final 2025 goals.[7] Gains have been particularly impressive in Virginia's wastewater sector, which has achieved better than expected load reductions.

Watershed modeling indicates that Virginia is meeting interim statewide targets for nitrogen and phosphorous and is on track to meet all statewide goals for 2017.

Progress has not been even across source sectors, however. While the state's wastewater sector is over-performing, Virginia is failing to meet targets in its stormwater sector for all three pollutants – nitrogen, phosphorous and sediment.[8] To a lesser degree, the state's agriculture sector is also deficient in keeping pace with target allocations, particularly for sediment. Incorporation of new data from the 2012 agricultural census accounted for a slight increase in estimated sediment loads and therefore caused the state to miss its statewide 2014-2015 target for sediment. Figure 1, below, depicts pollutant loads in each source sector, compared to baseline as well as interim and final targets.

Figure 1. Virginia's pollutant loads and goals, by sector



Source: US EPA. June 2016. EPA Evaluation of Virginia's 2014-2015 Milestone Progress and 2016-2017 Milestone Commitments to Reduce Nitrogen, Phosphorous, and Sediment.

The Commonwealth is well aware of the need to ramp up implementation in its stormwater and agriculture sectors. In numerous public forums, Virginia representatives have acknowledged that the significant progress in the wastewater sector has allowed time to begin accelerating efforts to address nonpoint source loads. In the next section, we consider the scale and estimated cost of necessary load reductions in these sectors, and we assess challenges associated with existing state water quality financing mechanisms more broadly.

[7] US Environmental Protection Agency. June 2016. Evaluation of Virginia's 2014-2015 and 2016-2017 Milestones. https://www.epa.gov/sites/production/files/2016-06/documents/va_2014-2015_-_2016-2017_milestone_eval_06-17-16.pdf
[8] Ibid.

2. The Commonwealth's financing challenge and opportunity

Comparing estimates of the cost to achieve TMDL goals for Virginia's agriculture and stormwater sectors to current levels of investment in nonpoint reduction efforts underscores the need for greater levels of investment in Bay restoration. Perhaps more importantly, an analysis of the Commonwealth's major revenue streams and funding mechanisms for restoration indicates that there is opportunity to make state investments more consistent, efficient, and effective over the long term.

2.1. Scale and cost of load reductions in Virginia's agriculture sector

Agriculture is Virginia's largest industry, generating $52 billion annually in economic impact and providing nearly 311,000 jobs.[9] Nearly a third of Virginia's Bay watershed is in agricultural use,[10] and this sector contributes a substantial share of the state's overall pollutant load to Bay tributaries. In 2015, agriculture was responsible for 30% of the state's total nitrogen load, 54% of its phosphorous load, and 63% of its sediment load.[11]

Current watershed modeling indicates that in order for Virginia's agriculture sector to achieve final TMDL targets, it will need to decrease annual nitrogen loads by 4.13 million pounds (a 24% reduction over current levels), phosphorous by .31 million pounds (10% reduction), and sediment by 643.75 million pounds (29% reduction). These are significant drops, especially compared with the state's performance over the past decade, when Virginia's agricultural conservation efforts produced a 15% reduction in nitrogen loads, a 28% reduction in phosphorous, and a 6% reduction in sediment.

How much funding will be required to achieve these reductions is uncertain. One recent estimate, developed by the Virginia Department of Conservation and Recreation in collaboration with agricultural and conservation stakeholders, finds that a total of approximately $1.66 billion in state, federal, and farmer-provided funds may be needed between 2017 and 2025 to effectively implement all agricultural best management practices (BMPs) called for in Virginia's statewide WIP.[12] Approximately half of this funding ($813 million) is projected to come from state sources, primarily in the form of direct funding for Virginia's agricultural cost share program. If appropriated, these funds are expected to be sufficient to meet final 2025 targets. The estimate does not include BMPs installed fully at the expense of the agricultural producer or landowner.

Another estimate of the aggregate cost of implementing agricultural BMPs can be generated through the Chesapeake Assessment Scenario Tool (CAST), a web-based program that enables users in the Bay watershed to estimate the pollutant load reductions and costs associated with various BMP scenarios. Designed to replicate the results of the Chesapeake Bay Program's Watershed Model, CAST helps

[9] Virginia Department of Agriculture and Consumer Services. "Virginia Agriculture Fact and Figures." Accessed 12/5/16: http://www.vdacs.virginia.gov/markets-and-finance-agriculture-facts-and-figures.shtml

[10] USDA Natural Resources Conservation Service. "Virginia and the Chesapeake Bay." Accessed 11/14/16: https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/va/home/?cid=nrcs142p2_018880

[11] US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 11/4/16: https://stat.chesapeakebay.net/?q=node/130. Loads simulated using 5.3.2 version of Watershed Model and wastewater discharge data reported by Bay jurisdictions. Progress data updated 4/19/2016.

[12] Virginia Secretary of Natural Resources. November 2016. *FY 2016 Chesapeake Bay and Virginia Waters Clean-Up Plan.* Available: http://leg2.state.va.us/DLS/h&sdocs.nsf/5c7ff392dd0ce64d85256ec400674ecb/69413f3e0dc162d285257fb00062a1fb?OpenDocument

planners find the most cost-effective suite of BMPs for achieving desired load reductions. Under a scenario that assumes full implementation of all agricultural and manure management BMPs in Virginia's WIP, CAST generates a total annualized cost $427,086,412.[13] Multiplying this figure by the nine years between 2017 and 2025 gives an aggregate total of $3.84 billion, significantly higher than the DCR estimate.

These aggregate cost estimates assume that fully implementing the BMPs called for in the Commonwealth's WIP will achieve necessary load reductions. Another way to estimate costs is to multiply needed reductions (pounds) by the cost of preventing a pound of pollution from entering the Bay. Several recent studies have attempted to estimate the per-pound cost of keeping nitrogen and phosphorous out of the Bay, and these analyses show that costs can range significantly, depending on which BMPs are used and where the practices are located within the watershed.[14] One analysis found that the cost per pound of nitrogen reduced annually 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), and that for phosphorous, costs can surpass $1,400 per pound for some practices (wetland restoration, tree planting, land retirement).[15] Median values, however, were estimated to be below $100 per pound for 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.[16]

Nutrient credit trading also places a value on each pound of nutrient pollution abated. In Virginia's well-established Chesapeake Bay Watershed Nutrient Credit Exchange Program, which allows trading between point and nonpoint sources within several major river basins, the trading price for a pound of permanently-offset phosphorous is $10,800 - $24,000 depending on the river basin.[17] Annualizing $24,000 using a 3.5% rate and a 30-year project life produces a figure of around $1,300 per pound, which is similar to the numbers arrived at above.

In Section 2.3, below, we average these various estimates to produce a ballpark projection of the costs to achieve additional required load reductions in Virginia's agriculture sector.

2.2. Scale and cost of load reductions in Virginia's stormwater sector

Stormwater runoff accounts for about a fifth of the state's overall pollutant load.[18] A significant share of these loads – 60% of nitrogen, 51% of phosphorous, and 47% of sediment – come from urban areas that are regulated via Municipal Separate Storm Sewer System (MS4) permits under the federal

[13] Chesapeake Assessment Scenario Tool. "2025 WIP – Virginia Summary Results." Scenario created 7/23/2012. (Cost to implement all BMPs in Virginia's WIP. Based on 2010 initial loads.)
[14] 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.*
[15] Chesapeake Bay Commission. May 2012. *Nutrient Credit Trading for the Chesapeake Bay: An Economic Study.*
[16] Environmental Finance Center, University of Maryland. February 2015. *Maryland's Chesapeake Bay Restoration Financing Strategy Final Report.*
[17] USDA Natural Resources Conservation Service. "Stoking Demand for Nutrient Credits in Virginia: Good News for Farmers and for the Chesapeake Bay." Accessed 3/6/17: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/emkts/?cid=nrcseprd354814
[18] In 2015, stormwater accounted for 19% of Virginia's total nitrogen load, 18% of the phosphorous load, and 20% of the sediment load. Source: US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. https://stat.chesapeakebay.net/?q=node/130. Loads simulated using 5.3.2 version of Watershed Model and wastewater discharge data reported by Bay jurisdictions. Progress data updated 4/19/2016.

National Pollutant Discharge Elimination System.[19] Virginia contains 11 MS4 Phase I (large and medium) permittees and 104 MS4 Phase II permittees.[20] These communities and entities are required by their permits to "reduce stormwater pollutant discharges to the maximum extent practicable in a manner that protects the water quality of nearby streams, rivers, wetlands and bays."[21]

To meet 2025 targets, Virginia's stormwater sector – including both regulated and unregulated sources – will need to decrease annual nitrogen loading by 2.42 million pounds (22% reduction in the coming decade over current levels), phosphorous by .18 million pounds (16% reduction), and sediment by 233.88 million pounds (32% reduction). These are aggressive targets, especially considering that loads from regulated sources within the state's stormwater sector have actually been *increasing* over the past decade for all three pollutant types. According to the Chesapeake Bay model, for the sector as a whole – regulated and unregulated – phosphorous loads declined 7% over the past ten years, but nitrogen increased 11% and sediment increased 4%.

As with the agriculture sector, estimates of the cost of abating stormwater pollutant loads vary widely, depending on BMP selection and location, as well as whether credit trading is enabled between point sources (e.g. permitted communities) and nonpoint sources and/or between states. An analysis by the Chesapeake Bay Commission 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.[22] For phosphorous, the cost per pound can be as high as $80,000, with median costs above $10,000 per pound.[23] 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[24] to $3,800.[25]

The Chesapeake Assessment Scenario Tool can also be used to estimate the aggregate cost of implementing stormwater controls called for in Virginia's WIP. This scenario generates a total annualized cost of $875 million,[26] which multiplies out to a total of $7.88 billion between 2017 and 2025. About half of this ($4.13 billion) could be expected to be the Commonwealth's share, assuming that it is responsible for stormwater pollutant loads from unregulated sources, and that the current breakdown of regulated and unregulated loads remains steady.[27]

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[19] US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 11/4/16: https://stat.chesapeakebay.net/?q=node/130. Loads simulated using 5.3.2 version of Watershed Model and wastewater discharge data reported by Bay jurisdictions. Progress data updated 4/19/2016.

[20] Virginia Department of Environmental Quality. June 14, 2016. MS4 Permittee List. Available: http://www.deq.virginia.gov/Programs/Water/StormwaterManagement/VSMPPermits/MS4Permits.aspx

[21] Virginia Department of Environmental Quality. Municipal Separate Storm Sewer System (MS4) Permits. Accessed 11/14/16: http://www.deq.virginia.gov/Programs/Water/StormwaterManagement/VSMPPermits/MS4Permits.aspx

[22] 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

[23] Ibid.

[24] 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

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

[26] Chesapeake Assessment Scenario Tool. "2025 WIP – Virginia Summary Results." Scenario created 7/23/2012. (Cost to implement all BMPs in Virginia's WIP. Based on 2010 initial loads.)

[27] 2015 share of non-regulated pollutant loads = 59.8% nitrogen, 51.1% phosphorous, 46.6% sediment; 52.5% average across pollutant types. Source: US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 11/4/16: https://stat.chesapeakebay.net/?q=node/130. Loads simulated using 5.3.2 version of Watershed Model and wastewater discharge data reported by Bay jurisdictions. Progress data updated 4/19/2016.

2.3. Estimated funding needs for agriculture and stormwater sectors

EFC averaged the above cost estimates to arrive at a combined total of $641.33 million per year to achieve 2025 load targets in Virginia's agriculture and stormwater sectors (see Table 2). This need may be compounded by decreased federal funding for restoration in coming years, since federal sources have historically supplied about half the total funding needed for NPS activities. It is also important to note that this is only a rough estimate – derived in part from studies conducted in other Bay jurisdictions – intended to give a sense of Virginia's funding need. Further refinement of cost estimates is in order as Virginia charts a course to fully fund TMDL compliance.

Table 2. Estimated funding need to meet targets in VA's agriculture and stormwater sectors

	Annual cost ($ million)	Aggregate cost, 2017 – 2025 ($ billion)
Agriculture	203.69	2.07
Stormwater	437.64	5.21
TOTAL	641.33	7.28

Note: See Appendix for more detailed cost calculation tables. These figures were derived in part from a literature review of Bay watershed cost analyses; see Sections 2.1 and 2.2 for sources.

2.4. Current Bay restoration funding levels and sources

Approximately $100 million in state and federal funding is spent on nonpoint source (NPS) pollution reduction in Virginia each year (see Table 3, below). This figure represents average annual funding from major sources for NPS activities statewide, not just for nutrient and sediment pollution in the Bay watershed. Nor does it account for every NPS dollar spent in Virginia. However, it is a helpful point of comparison for the cost estimate identified above. Even if all NPS funds were targeted to Bay restoration, current funding levels lag behind what is needed. The funding gap could be as great as $6.38 billion over the coming nine years.

In addition, there are opportunities to modify the ways in which Virginia finances Bay restoration. To understand these opportunities, below we profile major state sources of funding for Bay restoration in Virginia: the Water Quality Improvement Fund (WQIF), the Stormwater Local Assistance Fund, and the Clean Water Revolving Loan Fund.

Table 3. Funding levels from major state and federal sources for nonpoint source pollution reduction in Virginia, 2013 - 2016 ($)

	2013	2014	2015	2016	Annual Average
STATE					
Water Quality Improvement Fund	33,150,456	8,234,871	32,061,628	27,497,491	25,236,112
Stormwater Local Assistance Fund	N/A	35,000,000	20,000,000	5,000,000	20,000,000
Clean Water Revolving Loan Fund*	9,750,000	1,322,300	2,705,275	4,550,000	4,581,894
State Match for CWA Section 319 Grants (via VA DCR)	1,955,334	2,090,615	2,047,041	2,075,461	2,042,113
FEDERAL					
Environmental Protection Agency					
Clean Water Act (CWA) Section 319 Nonpoint Source Management Implementation Grants	1,236,661	1,872,937	1,944,234	1,680,352	1,683,546

CWA Section 117(d) Technical Assistance and General Assistance Grants	2,287,000	3,437,621	3,920,238	3,448,400	3,273,315
CWA Section 117(e)(1)(A) Chesapeake Bay Implementation Grants†	2,257,599	3,037,406	2,386,889	2,848,727	2,632,655
US Department of Agriculture Natural Resources Conservation Service					
Environmental Quality Incentive Program grants	19,830,000	24,732,000	22,222,000	not avail	22,261,334
Conservation Stewardship Program	7,537,001	7,085,001	6,937,001	not avail	7,186,334
Regional Conservation Partnership Program	N/A	combined with 2015	18,800,000	5,394,000	12,097,000
TOTALS	**58,983,527**	**123,426,995**	**96,060,178**	**53,878,828**	**100,994,303**

* Excluding funds for point source pollution prevention (i.e. wastewater). Reported amounts are for 2014, 2015, 2016, and 2017. Some of these funds are federal.

† Federal funds plus state match.

Sources:
David Dowling, VA Department of Conservation and Recreation. 2/12/17. Communication with EFC.
USDA Natural Resources Conservation Service, Washington, DC. "Conservation Stewardship Program." Last updated 7/15/15. http://www.nrcs.usda.gov/Internet/NRCS_RCA/reports/fb08_cp_cstp.html
USDA Natural Resources Conservation Service, Washington, DC. "NRCS Conservation Programs." Last updated 7/15/15. http://www.nrcs.usda.gov/Internet/NRCS_RCA/reports/fb08_cp_eqip.html
USDA. 2017. "Regional Conservation Partnership Program: Investing in Virginia."
Valerie Thomson, VA Department of Environmental Quality. 2/9/17 and 4/7/17. Communication with EFC.

2.4.1. Water Quality Improvement Fund

Virginia's Water Quality Improvement Fund (WQIF) is the single largest source of funding for nonpoint projects in the Commonwealth. Established via the Virginia Water Quality Improvement Act of 1997 and administered by the Virginia Department of Environmental Quality and the Department of Conservation and Recreation, the Fund's purpose is "to provide Water Quality Improvement Grants to local governments, soil and water conservation districts, institutions of higher education and individuals for point and nonpoint source pollution prevention, reduction and control programs."[28]

The Fund is capitalized annually via state real estate recordation fees as well as 10% of any state surplus general funds in fiscal years when there is a surplus.[29] Additional funds are occasionally added to the WQIF via budget allocations approved by the General Assembly and Governor. WQIF is a non-reverting fund, meaning that any unspent money left at the end of the fiscal year – as well as any interest earned – remains in the Fund for use in future years.[30] As Table 4 indicates, capitalization levels have fluctuated dramatically from year to year, ranging from $8.2 million to $70.7 million over the past eight years.

Table 4. Water Quality Improvement Fund historic funding levels, and % increase (decrease) each year

Fiscal Year	General Fund surplus ($)	Recordation fees ($)	Other appropriation ($)	Total appropriation ($)	Increase (decrease) from previous year
2010	-	0	20,000,000*	20,000,000	-
2011	32,798,700	8,509,725	-	41,308,425	107%
2012	-	8,866,566	-	8,866,566	(79%)
2013	21,979,048	11,171,408	-	33,150,456	274%
2014	-	8,234,871	-	8,234,871	(75%)

[28] Code of Virginia. §10.1-2128.B.
[29] Virginia Secretary of Natural Resources. November 2016. *FY 2016 Chesapeake Bay and Virginia Waters Clean-Up Plan*. Available: http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/RD4002016/$file/RD400.pdf
[30] Virginia Secretary of Natural Resources. 2012. *Virginia Water Quality Improvement Fund Guidelines.* Available: http://www.deq.virginia.gov/Portals/0/DEQ/Water/ChesapeakeBay/Nov2006WQIFGuidelines-updated_5-15-12.pdf

2015	23,897,500	8,164,128	-	32,061,628	289%
2016	0	8,615,603	18,881,888**	27,497,491	(14%)
2017	61,708,800	9,090,240	-	70,799,040	157%

*American Recovery and Reinvestment Act + DCR interest

**WQ reserve + special GF

Source: David Dowling, Virginia Department of Conservation and Recreation. 7/15/17. Communication with EFC.

WQIF has two sub-funds: the Virginia Natural Resources Commitment Fund (VNRCF) and the Nutrient Offset Fund. VNRCF, created in 2008, supports the installation of agricultural BMPs and associated technical assistance via the Virginia Agricultural Best Management Practices Cost-Share Program. Its enabling statute specifies that funds be distributed as such: 55% for matching grants for BMPs within or partially within the Chesapeake Bay watershed, 37% for matching grants for BMPs outside the Chesapeake Bay watershed, and 8% for technical assistance by soil and water conservation districts.[31] The amount provided for technical assistance in recent years has been around 12% based on Soil and Water Conservation District Budget Template analyses and has been set out in the Appropriations Act.[32] The Nutrient Offset Fund, created in 2008 and amended in 2017, was designed to purchase nutrient credits from point or nonpoint source reductions in tributaries that have already met reductions required by state or federal law, including the Chesapeake Bay TMDL.[33] To date, this sub-fund has not been capitalized.[34]

The nonpoint source components[35] of the WQIF – outlined below – aim to improve water quality throughout the Commonwealth and specifically within the Chesapeake Bay watershed to implement the Bay TMDL WIP.[36] WQIF nonpoint funding for agricultural best management cost-share is made according to a funding distribution policy approved annually by the Virginia Soil and Water Conservation Board (VSWCB).[37]

(1) Agricultural Best Management Practices Cost-Share Program (VACS). Administered by the Virginia Soil and Water Conservation Board and the Department of Conservation and Recreation in close partnership with the state's 47 soil and water conservation districts, this program supports the voluntary implementation of conservation BMPs on agricultural lands, in order to reduce nutrient and sediment pollution. BMPs eligible for funding are those that are identified as cost-effective in the VACS Manual, and the preference for installation is areas with the highest nutrient loads. State cost-share payments are periodically coupled with federal funds via the US Department of Agriculture, reducing the farmer's expense to as little as 10% of total eligible project costs.[38]

[31] Code of Virginia. §10.1-2128.1. Virginia Natural Resources Commitment Fund established. 2008; 2009; 2011. Available: http://law.lis.virginia.gov/vacode/title10.1/chapter21.1/section10.1-2128.1/

[32] David Dowling, Virginia Department of Conservation and Recreation. 7/15/17. Communication with EFC.

[33] Virginia Legislature 2017 Session. HB 2311. A bill to amend and reenact § 10.1-2128.2 of the Code of Virginia, relating to the Nutrient Offset Fund; sale of credits. Available: http://lis.virginia.gov/cgi-bin/legp604.exe?171+ful+HB2311E.

[34] Russ Baxter, Deputy Secretary of Natural Resources. 7/8/16. Interview with EFC.

[35] WQIF also has a point source program, which supports the installation of nutrient reduction technology at point source discharges within the Bay watershed. Since its inception in 1998, the point source program has received a total of $909.3 million in appropriations. Source: Virginia Secretary of Natural Resources. November 2016. *FY 2016 Chesapeake Bay and Virginia Waters Clean-Up Plan.* Available: http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/RD4002016/$file/RD400.pdf

[36] Virginia Secretary of Natural Resources. November 2016. *FY 2016 Chesapeake Bay and Virginia Waters Clean-Up Plan.* Available: http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/RD4002016/$file/RD400.pdf

[37] Virginia Soil and Water Conservation Board. May 2016. *Policy and Procedures on Soil and Water Conservation District Cost-Share and Technical Assistance Funding Allocations (Fiscal Year 2017).* Available: http://dswcapps.dcr.virginia.gov/htdocs/agbmpman/Policy_2017.pdf

[38] Virginia Department of Conservation and Recreation. Program Year 2017. *Virginia Agricultural Cost Share Manual.* Available: http://dswcapps.dcr.virginia.gov/htdocs/agbmpman/agbmptoc.htm

(2) **Conservation Reserve Enhancement Program (CREP).** WQIF funds support Virginia's participation in USDA's Conservation Reserve Enhancement Program, which provides cost-share assistance to eligible landowners for "establishment of riparian buffers and wetland restorations, as well as rental payments (up to 15 years) for removing environmentally sensitive land from agricultural production and planting grasses or trees that will improve water quality and waterfowl and wildlife habitat."[39] Federal funds cover 50% of BMP installation costs, with state match varying from 25% - 50% depending on funding availability.

(3) **Strategic Nonpoint Source Water Quality Initiatives.** WQIF funds support other water quality initiatives that address nonpoint source pollution needs, with a particular focus on "priority, cost effective, and innovative initiatives" that measurably improve water quality.[40] These projects are undertaken in collaboration with other state agencies, soil and water conservation districts, planning district commissions, local governments, educational institutions and individuals on nonpoint source pollution reduction, education, research and implementation projects. Examples have included incentives for agricultural and urban nutrient management activities; alternative waste management and reuse alternatives for animal waste products; diet and feed management projects to reduce nutrient content and more efficiently manage animal wastes; animal waste transport projects; riparian buffer initiatives and other effective forest management programs; conservation easement programs; and innovative urban stormwater and effective urban BMP practices and restoration projects.[41]

(4) **Cooperative Nonpoint Source Pollution Programs with Local Governments.** WQIF funds are also used to provide matching funds to local governments to support projects that address local nonpoint pollution issues, such as developing stormwater management programs, rehabilitating septic systems, and implementing effective urban BMPs. In 2016, $3.4 million in WQIF funds were made available via a competitive grant program to help local governments implement nonpoint source pollution control projects. Priority was given to projects with the highest pollution reduction compared to dollars requested, as well as to projects that maximized reduction in nitrogen, phosphorous and sediment (within the Chesapeake Bay watershed). The eight projects selected for funding address issues such as stormwater management, septic system rehabilitation, and shoreline erosion control.[42]

2.4.2. Stormwater Local Assistance Fund

Another significant source of funding for nonpoint source pollution reduction projects is Virginia's Stormwater Local Assistance Fund (SLAF).[43] Created by the General Assembly in 2013,[44] the SLAF provides matching grants to local governments to plan, design, and implement cost-effective BMPs that

[39] Virginia Secretary of Natural Resources. November 2016. *FY 2016 Chesapeake Bay and Virginia Waters Clean-Up Plan.* Available: http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/RD4002016/$file/RD400.pdf
[40] Virginia Secretary of Natural Resources. November 2016. *FY 2016 Chesapeake Bay and Virginia Waters Clean-Up Plan.* Available: http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/RD4002016/$file/RD400.pdf
[41] Virginia Secretary of Natural Resources. 2012. *Virginia Water Quality Improvement Fund Guidelines.* Available: http://www.deq.virginia.gov/Portals/0/DEQ/Water/ChesapeakeBay/Nov2006WQIFGuidelines-updated_5-15-12.pdf
[42] Virginia Secretary of Natural Resources. November 2016. *FY 2016 Chesapeake Bay and Virginia Waters Clean-Up Plan.* Available: http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/RD4002016/$file/RD400.pdf
[43] Russ Baxter, Deputy Secretary of Natural Resources. 7/8/16. Interview with EFC.
[44] Parameters for administering the Fund were specified in Item 360 in Chapter 860 of the Acts of Assembly (the Commonwealth's 2013-2014 Budget).

reduce pollutant loads from stormwater runoff.[45] SLAF is administered by the State Water Control Board and the Department of Environmental Quality, and funds are allocated each year via a competitive grant application process.[46] Grants range from $50,000 to $5 million and cover 50% of eligible costs for planning, designing and installing BMPs. For grant applications to be ranked competitively, projects must demonstrate that they can cost-effectively reduce total phosphorous, a representative pollutant for stormwater. As of July 2017, SLAF funds may be used to purchase nonpoint source nutrient credits.[47]

The SLAF consists of proceeds from bonds authorized by the General Assembly, as well as "sums appropriated to it by the General Assembly and other grants, gifts, and moneys as may be made available to it from any other source, public or private."[48] The Fund also retains any interest it earns. Like WQIF, funding levels have experienced significant year-to-year swings. In 2014 and 2015, the SLAF received $35 million and $20 million respectively in bond funds, and in FY 2016, it received a $5 million appropriation. For the current (2017) grant-making cycle, $20 million is available.[49] Like the WQIF, the SLAF is a non-reverting fund; funds left at the end of the year remain in the Fund rather than reverting to the general fund.

The Fund has undergone three grant-making cycles (see Table 5). In the first two funding cycles, DEQ did not expend all available funds because the Department felt that not all proposed projects were cost-effective at reducing pollution, meaning that they did not meet DEQ's threshold of $50,000 or less to treat each pound of Total Phosphorous, a representative pollutant.[50] The Fund received no new appropriation for 2017.

Table 5. Stormwater Local Assistance Fund historic funding levels

Fiscal year	New appropriation ($ million)	Carry-over ($ million)	Funds available ($ million)	Funds requested ($ million)	Funds authorized ($ million)	Number of funded projects
2014	35	None	35	39.37	22.94	71 projects in 31 localities
2015	20	8	28	21.61	21.49	64 projects in 25 localities
2016	5	3.5	8.5	36.03	8.49	17 projects in 17 localities

Sources:
Melanie Davenport, Virginia Department of Environmental Quality. 12/19/13. "Memo: Authorization of SLAF Project Funding List." Available: http://www.deq.virginia.gov/Portals/0/DEQ/Water/ConstructionAssistanceProgram/signed_memo.pdf
Valerie Thomson, Virginia Department of Environmental Quality. 12/4/14. "Memo: Authorization of FY 2015 Project Funding List." Available: http://www.deq.virginia.gov/Portals/0/DEQ/Water/ConstructionAssistanceProgram/FY15_SLAF_Memo.pdf
Valerie Thomson, Virginia Department of Environmental Quality. 2/26/16. "Memo: Authorization of FY 2016 SLAF Project Funding List." Available: http://www.deq.virginia.gov/Portals/0/DEQ/Water/ConstructionAssistanceProgram/signed_authorization_memo-FY16.pdf

[45] Virginia Department of Environmental Quality. 3/2/16. News Release: "Virginia authorizes $8.5 million for local stormwater projects." Available: http://www.deq.virginia.gov/info/newsreleases.php?show=2808
[46] Virginia Department of Environmental Quality. December 2016. *Stormwater Local Assistance Fund Program Guidelines*. Available: http://www.deq.virginia.gov/Portals/0/DEQ/Water/ConstructionAssistanceProgram/SLAF%20Guidelines%20Final-2016.pdf?ver=2016-12-15-092450-670
[47] Ibid.
[48] Virginia Department of Environmental Quality. October 2015. *Stormwater Local Assistance Fund Program Guidelines.* http://www.deq.virginia.gov/Portals/0/DEQ/Water/ConstructionAssistanceProgram/SLAF_Guidelines_10-2015-v3.pdf
[49] Virginia Department of Environmental Quality. Stormwater Local Assistance Fund website. Accessed 1/18/17: http://www.deq.virginia.gov/Programs/Water/CleanWaterFinancingAssistance/StormwaterFundingPrograms/StormwaterLocalAssistanceFund(SLAF).aspx
[50] Valerie Thomson, Virginia Department of Environmental Quality. 12/4/14. "Memo: Authorization of FY 2015 Project Funding List." Available: http://www.deq.virginia.gov/Portals/0/DEQ/Water/ConstructionAssistanceProgram/FY15_SLAF_Memo.pdf

2.4.3. Clean Water Revolving Loan Fund

Created in 1987 and managed by the Department of Environmental Quality on behalf of the State Water Control Board (SWCB), the Virginia Clean Water Revolving Loan Fund (VCWRLF) provides low-interest loans to support water quality improvement projects throughout the state. For its first decade, the Fund focused on improving publicly-owned wastewater collection and treatment facilities, but its scope has been expanded to address agricultural and other nonpoint source pollution issues. Today, the Fund operates loan programs related to wastewater, agricultural BMPs (though this program has been suspended indefinitely), brownfield remediation, land conservation, stormwater, and living shorelines.

VCWRLF's Storm Water Loan Program, authorized in 2010 by the General Assembly, provides low interest loans "for construction of facilities or structures or implementation of best management practices that reduce or prevent pollution of state waters caused by stormwater runoff from impervious surfaces."[51] Loans are available to local governments (county, city or town) as well as municipal public service authorities. This program receives no special appropriation of funding and therefore relies on existing VCWRLF revenue. By law, VCWRLF financing for stormwater projects "can only be available in fiscal years when loan requests for eligible wastewater treatment facilities designed to meet the state's water quality standards have first been satisfied, unless otherwise required by law."[52]

Guidelines for the administration of stormwater loans were developed by the DEQ's Clean Water Financing and Assistance Program, on behalf of the SWCB. Applications are accepted yearly, and funding priority is given to jurisdictions that have an adopted stormwater control program, projects that address pollution in a water body that is in violation of water quality standards, and local governments subject to an MS4 discharge permit. A portion of funding may be provided in form of principal forgiveness, with preference given to localities that have a dedicated source of revenue for their stormwater management program.[53]

Since its inception in 1988, VCWRLF has provided approximately $3 billion in low-interest loan funding to support more than 950 point and nonpoint source pollution reduction projects. Over the past four years, the Fund has made $4.5 million in loans for nonpoint source efforts statewide.[54]

2.5. Scale and nature of the Commonwealth's financing challenge

Virginia's most pressing Bay restoration financing challenge is arguably its funding gap. As suggested above, average annual federal and state investments of $100 million may need to be increased more than sixfold in order for Virginia to achieve additional mandated load reductions in its two primary NPS sectors. Given the significant uncertainties involved in predicting costs of WIP implementation and in accounting for all existing sources of Bay restoration investment, the actual figure likely differs from this estimate.

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[51] Virginia Department of Environmental Quality. *Virginia Clean Water Revolving Loan Fund Storm Water Loan Program Guidelines*. Accessed 12/5/16: http://www.deq.virginia.gov/Programs/Water/CleanWaterFinancingAssistance/StormwaterFundingPrograms/StormwaterLoans.aspx

[52] "However, it is important to note that, starting in federal fiscal year 2010, EPA began requiring that a certain portion of the annual funding for the VCWRLF go to green reserve projects. Since most eligible stormwater projects meet the Green Project Reserve (GPR) criteria, it may be necessary to fund stormwater projects in fiscal years when all the wastewater facilities' projects have not been satisfied (under the "unless otherwise required by law" provision), in order to meet the GPR requirement." Virginia Department of Environmental Quality. *Virginia Clean Water Revolving Loan Fund Storm Water Loan Program Guidelines.* Accessed 12/5/16: http://www.deq.virginia.gov/Programs/Water/CleanWaterFinancingAssistance/StormwaterFundingPrograms/StormwaterLoans.aspx

[53] Virginia Department of Environmental Quality. *Virginia Clean Water Revolving Loan Fund Storm Water Loan Program Guidelines.* Accessed 12/5/16: http://www.deq.virginia.gov/Programs/Water/CleanWaterFinancingAssistance/StormwaterFundingPrograms/StormwaterLoans.aspx

[54] Valerie Thomson, Virginia Department of Environmental Quality. 2/9/17. Communication with EFC.

Nevertheless, it is clear that historic investment levels have been insufficient to keep pace with needed load reductions, especially in Virginia's stormwater and agriculture sectors, and that future investments must increase if the Commonwealth is to reach 2025 targets.

Beyond this basic need for additional funding, there is also an opportunity for the Commonwealth to modify its existing revenue streams and funding mechanisms in order to make state investments more efficient, thereby stretching every dollar as far as possible. A particular challenge with Virginia's current financing system is that two of the state's biggest sources of funding for water quality protection and restoration – the Water Quality Improvement Fund and the Stormwater Local Assistance Fund – experience dramatic shifts in funding levels from year to year. WQIF is largely capitalized by general fund budget surpluses, which means that funding can vary widely and that it may not receive any funding from this source in lean years. SLAF is capitalized through bonds and budget appropriations, with no guarantee of ongoing funding at even a minimal level. This creates a system with considerable inconsistency and unpredictability, which in effect increases the cost of capital.

In addition, the Commonwealth may be able to adopt a more market-like approach to financing water quality restoration, one that invests only in the highest-performing projects and that leverages other available capital to move funds where and how they can achieve greatest impact. Virginia has already laid the groundwork for taking this approach. Both WQIF and SLAF have flexibility to carry over funds from year to year, offering the potential to pool and funnel funds into the highest-yield projects, and both programs have integrated performance as a key element of funding criteria. The Commonwealth can build on these practices in a comprehensive and systematic way, and it may consider integrating additional market-like features, so that Virginia's water quality investment system achieves the greatest load reductions at the lowest cost. The next section discusses such opportunities, as well as other options for effectively funding and financing water quality restoration.

Virginia has already laid the groundwork for taking a more market-based, performance-driven approach to water quality restoration financing.

3. Strategies for sufficiently and efficiently financing Bay restoration

Below we present options that the Commonwealth may pursue to reduce its Bay funding gap. These strategies are organized into three broad categories. The first includes improvements in technology, BMP tracking, and agricultural conservation incentives – ideas that are not financing approaches but would in effect reduce the compliance gap and free up funds for additional restoration needs. The second category of options addresses revenue generation at the state level. Finally, we review strategies to make the Commonwealth's funding and financing system more predictable, more market-like, and ultimately more efficient at achieving the greatest load reductions at the lowest cost. EFC believes it is this final category of options that offers greatest potential to drive down costs, leverage additional capital, and achieve impact.

3.1. Accelerate programmatic and technological improvements and expand incentives for nutrient management planning

Improved tracking of voluntarily-installed BMPs, technological advancements in restoration practices, efficiency gains in water quality programs, and enhancements to the Bay Model have all been identified as opportunities for reducing costs and improving Virginia's progress toward TMDL goals.[55] Some of these improvements – such as better tracking and reporting of implemented BMPs, as well as improved accounting for such practices in the Bay Model – would in effect reduce the cost of compliance by showing that the Commonwealth is closer to pollution reduction targets than modeling currently indicates. Virginia is working to improve its ability to account for voluntarily-implemented BMPs (i.e. those implemented without state or federal cost-share assistance), via the development of a program that records implementation and financial data associated with all on-the-ground BMPs. This program was expanded in 2016 to account for practices associated with Resource Management Plans and Conservation Plans.[56]

Other strategies – such as finding program efficiencies and accelerating advancements in technology so that BMPs remove greater pollutant loads at the same or lower cost – free up dollars that may then be invested in additional compliance practices. A related way to stretch funds is to target investments toward BMPs that have been proven to be effective, and those installed in priority watersheds where they are likely to have the greatest impact on pollutant loads. A study in Pennsylvania found that choosing cost-effective BMP portfolios – defined as "a set of practices assigned to locations that minimizes the costs of satisfying nitrogen, phosphorus, and sediment load allocation targets in each Chesapeake Bay jurisdiction" – could reduce that state's cost of compliance by an impressive 36%.[57] Virginia does prioritize restoration funds in this way through its agricultural cost-share program. These dollars are targeted toward BMPs that have been shown to be cost-effective, as well as to practices installed in "hydrologic units with the highest potential to contribute agricultural NPS pollution to

[55] Virginia Secretary of Natural Resources. November 2016. *FY 2016 Chesapeake Bay and Virginia Waters Clean-Up Plan.* Available: http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/RD4002016/$file/RD400.pdf

[56] Efforts to track voluntary BMPs (those implemented with public financial support) have only had limited success to date despite data application improvements. DCR remains hopeful that RMPs will enable the collection of voluntary BMP data. Source: David Dowling, Virginia Department of Conservation and Recreation. 7/15/17. Communication with EFC.

[57] 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

surface and ground waters."[58] Further study may enable finer prioritization, and there may be opportunity to extend this approach to other sectors beyond agriculture. An even more effective approach would be to shift from targeted practices and watersheds to targeted *outcomes*; this strategy of performance-driven financing is discussed in greater detail later.

Also falling within this category are regulatory and incentive-based strategies. While these options do not create new funds or change how the Commonwealth finances restoration, they can play a key role in narrowing the funding and compliance gap. Watershed modeling indicates that a large portion of Virginia's agriculture and stormwater pollutant loading comes from non-regulated sources (see Table 7). This is particularly striking in the state's agriculture sector, where only a small fraction of nitrogen, phosphorous, and sediment emissions come from regulated sources, e.g. confined animal feeding operations, as Virginia's agricultural water quality improvement programs are largely voluntary in nature. In the stormwater sector, a little more than half of the nitrogen and phosphorous loads stem from unregulated sources, namely areas that are not subject to MS4 discharge permits.

Table 7. Percentage of total loads from non-regulated sources, 2015

Sector	Nitrogen	Phosphorous	Sediment
Agriculture	98.5%	97.1%	99.8%
Stormwater	59.8%	51.1%	46.6%

Source: US Environmental Protection Agency Chesapeake Bay Program. TMDL Tracker. Accessed 11/4/16: https://stat.chesapeakebay.net/?q=node/130. Loads simulated using 5.3.2 version of Watershed Model and wastewater discharge data reported by Bay jurisdictions. Progress data updated 4/19/2016.

Imposing tighter restrictions on emitters of agricultural and stormwater pollution shifts some of the restoration cost from the Commonwealth to regulated entities, who may be in a better position to find cost efficiencies. Options might include lowering the threshold for agricultural operations that are required to receive a Confined Animal Feeding Operation permit, making nutrient management planning mandatory in the agriculture sector and for certain landowners in the stormwater sector, and tightening pollution load limits in urban stormwater permits.

However, it is important to note that expanded regulatory programs require additional staff time and costs to administer, and new regulations are rarely politically popular. In recent years, several legislative proposals that would have required mandatory agricultural BMPs in Virginia have failed to gain support. Instead of expanding regulatory regimes in its nonpoint source sectors, Virginia has focused on incentivizing voluntary pollution reduction activities among unpermitted entities. A primary example of this approach is the state's Resource Management Plan (RMP) Program, created in 2011 by the General Assembly to "promote greater and more consistent use of voluntary agricultural practices across the state."[59] This DCR-administered program provides an incentive for farmers to make and fully implement an RMP, by guaranteeing they will have a safe harbor from future mandatory regulations related to implementing the Bay TMDL. Another incentive for implementing an approved RMP is that it can be used as a baseline for participating in the state's nutrient credit exchange program. As of June 1, 2017, 380 plans covering 89,794 acres have been developed, the vast majority of which are in the Chesapeake Bay watershed.[60]

[58] Virginia Department of Conservation and Recreation. 2017. *Virginia Agricultural BMP Cost-Share Program (VACS) Guidelines.* Available: http://dswcapps.dcr.virginia.gov/htdocs/agbmpman/Guidelines/Guidelines_2017.pdf
[59] Commonwealth of Virginia. March 2012. *Phase II Watershed Implementation Plan.*
[60] Watlington, Christine. Virginia Department of Conservation and Recreation. 7/15/17. Communication with EFC.

Another incentive-based initiative was launched in 2015 under WQIF's strategic water quality initiatives funding category. Through a competitive grant process, funds were made available to certified nutrient management planners to write nutrient management plans for agricultural operators, with a focus on unpermitted confined animal operators. As a result of these grants, 24 nutrient management plans were developed for unpermitted operations, covering 2,779 acres statewide. The program was scaled up in 2016 in a second round of funding; it is expected that this round will result in the development of nutrient management plans for 23,788 acres on unpermitted operations and an additional 22,844 acres on permitted operations.[61]

Nutrient management planning also occurs within unpermitted portions of the state's stormwater sector; for example through a DCR program that subsidizes the development of nutrient management plans on golf courses. Fertilizer application on nonagricultural land is regulated by Virginia law, and DEQ provides assistance to local governments to develop and implement local stormwater management plans. A report by the Secretary of Natural Resources has found that the majority of urban acreage not under nutrient management plans is privately owned and therefore that making additional progress in the stormwater sector will require enhanced efforts to educate and assist homeowners and other private landowners, as is done through Virginia's Cooperative Extension Master Gardener programs.[62] An option for meeting needs in unpermitted areas might be to target Stormwater Local Assistance Fund dollars there. This was the topic of a special meeting held in the fall of 2016 by the General Assembly's Natural Resources Committee, and it merits additional study to identify and promulgate effective strategies.

As in the stormwater sector, progress within the unpermitted portions of Virginia's agricultural sector will require additional nutrient management planning and implementation. In the Chesapeake Bay watershed, 87% of all dairy farms (337) are unpermitted, and less than half of these (141) have nutrient management plans in place.[63] The Secretary of Natural Resources has called for more funding – approximately $150,000 per year – to retain planning consultants to prepare nutrient management plans for these and other unpermitted animal operations.[64]

Given the popularity and effectiveness of incentive-based programs such as RMP, nutrient planning grants, and homeowner education programs, the Commonwealth may find it beneficial to expand these programs. This could achieve cost efficiencies and bring Virginia closer to final TMDL targets, but it would also require additional state funding, a topic addressed next.

3.2. Increase state funding for water quality restoration

To maintain and accelerate progress toward TMDL goals – including through expanded incentive programs that capture a greater share of pollution from unregulated sources as discussed above – the Commonwealth will need to increase funding for water quality initiatives. Key options for generating revenue are discussed below; none will come as a surprise to the Commonwealth. It is also no secret that launching a new revenue program will not be administratively or politically easy. For this reason, any new revenue-generating campaign should be coupled with initiatives to reduce compliance costs and leverage outside funds, options discussed in the following section. Additionally, it will be important for the

[61] Virginia Secretary of Natural Resources. November 2016. *FY 2016 Chesapeake Bay and Virginia Waters Clean-Up Plan.* Available: http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/RD4002016/$file/RD400.pdf
[62] Ibid.
[63] Ibid.
[64] Ibid.

Commonwealth to develop a reliable cost estimate before designing new revenue structures, so that funds raised are sufficient to achieve desired impact. This is essential for building public trust.

3.2.1. Issue state bonds for water restoration

Immediate bay restoration needs may be funded through the issuance of state bonds, such as green bonds whose proceeds are dedicated to implementing water quality practices. The Commonwealth may use its general obligation bonding authority; these bonds require approval by the General Assembly and a majority of Virginia voters through state referendum. The last time Virginians approved general obligation debt was in 2002,[65] which suggests this might not be an immediately likely avenue. Another option is the public building authority bond, which is issued by the Virginia Public Building Authority upon approval by the General Assembly. Public building authority bonds have been used in Virginia for point source projects such as combined sewer separation and wastewater treatment plant projects, and they are also authorized for stormwater projects.[66]

An obvious advantage of bond financing is that it generates upfront capital to meet immediate needs; bonds also require future users of the benefit to share in its cost. However, debt financing constitutes a long-term liability and needs to be paid back by future taxes or fees or through the use of general funds at the expense of other priorities.

3.2.1. Implement new tax- and/or fee-based funding structures

States can finance major public needs via existing revenue sources (usually the general fund), which requires reallocating budget funds from other programs. But the only mechanisms for generating *new* revenue at scale are taxes and fees. Revenue from any new tax or fee structures could be used to buttress WQIF and SLAF funding, since these programs have been effective and popular, or they could be used to capitalize a new, dedicated Bay restoration fund as discussed later.

One alternative in this category is a tax on nutrient and sediment discharges. Pollution taxes have the benefit of directly dis-incentivizing the undesired activity (in this case, water pollution), and when set at the appropriate rate, they can achieve reductions in the most economically efficient way and 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.[67] Though pollution taxes are still relatively rare, there are a few case studies to draw lessons from, such as New York City's tax on "dirty" fuel oils which led to the discovery of cleaner fuel options[68] and the 1990 federal tax on chlorofluorocarbons, which contributed to the global phaseout of this pollutant.[69] A local-level example of a pollution tax is Fairfax County, Virginia's stormwater tax, which assesses 1 cent per $100 of property value on properties within a designated assessment district.[70] This mechanism differs slightly from a stormwater fee, discussed below.

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[65] Virginia Department of the Treasury. "General Obligation Bonds." Accessed 5/15/17: https://www.trs.virginia.gov/Debt/obligation.aspx
[66] Russ Baxter, Deputy Secretary of Natural Resources. 7/8/16. Interview with EFC.
[67] Experimental Economics Center. "Advantages of Green Taxes." Accessed 9/29/16: http://www.econport.org/content/handbook/Environmental/pollution-control-revised/Advantages.html
[68] 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/
[69] Ibid.
[70] Water Environment Federation. Undated. "The Stormwater Challenge" slide deck. Available: https://www.epa.gov/sites/production/files/2017-01/documents/session_5_french.pdf

There are barriers associated with implementing a pollution tax, including the challenge of identifying an appropriate tax rate. 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, i.e. 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. Fees differ from taxes in that they are assessed in order to recover some of the cost of providing a service to a beneficiary, rather than simply raising revenue or dis-incentivizing undesired activities. 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), and funds raised through the fee need to be applied exclusively to providing the service.

Pennsylvania and Delaware have recently considered statewide fees to fund water quality initiatives. Pennsylvania's proposed "water resource usage fee" would be assessed on large withdrawals of water – greater than 10,000 gallons per day – by consumers such as utilities, golf courses, and nuclear power plants. The proposed rate is 1 cent per 100 gallons if the water is eventually returned to its source, and 1 cent 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.[71]

Delaware's proposed "clean water fee" would be assessed on a per-household and per-business basis, with rates based on property value. Tax-exempt properties would be assessed a reduced rate, and agricultural properties would be assessed under separate rules. Parcels in towns with stormwater utilities would also receive fee reductions. The proposed fee could generate $30 million per year for flood abatement and water quality projects throughout the state.[72] Depending on how the mechanism is designed, it could be argued that it functions more like a tax than a fee. This was the case with Maryland's Bay Restoration Fund, a fee assessed on residents served by wastewater treatment plants or on-site sewage disposal systems and used to upgrade treatment plants.[73] While this fee actually functioned more like a tax, the more important point is that it has been incredibly effective at achieving its purpose – reducing nitrogen pollution to local waterways and the Bay. When building public support for any new statewide fee/tax, it will behoove state leaders to emphasize its potential to achieve goals.

Another fee-based option is the stormwater utility fee. While a local rather than state funding source, stormwater fees are increasingly being used around the country to provide a sufficient, dedicated funding for stormwater management. By shifting the responsibility for managing – and financing – stormwater to the local level, powerful financing efficiencies can be achieved. Virginia law authorizes localities to establish stormwater utility fees or service charges to support their stormwater management programs.[74] A number of stormwater utilities already exist in Virginia communities, including Chesapeake, Hampton, James City, Newport News, Norfolk, Portsmouth, Prince William County, Richmond, Suffolk, and Virginia Beach.[75] The Commonwealth could encourage other jurisdictions to follow suit, through outreach,

[71] 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
[72] Montgomery, Jeff. 5/6/15. "Delaware bill would give $30M yearly to clean water." *The News Journal.* Available: http://www.delawareonline.com/story/news/local/2015/05/06/delaware-clean-water/70909144/
[73] Maryland Department of the Environment. "Bay Restoration Fund" website. Accessed 5/23/17: http://www.mde.state.md.us/programs/Water/BayRestorationFund/Pages/index.aspx
[74] Code of Virginia. §15.2-2114
[75] US Environmental Protection Agency Region III. 2008. *Funding Stormwater Programs.* Available: https://www3.epa.gov/npdes/pubs/region3_factsheet_funding.pdf

training, and technical assistance. It could further spur the adoption of stormwater fees by offering incentives to jurisdictions that have them, such as priority review or bonus points on state grant applications or a reduction in required local match for funding programs.

3.3. Improve efficiency and consistency of state financing

Regardless of whether Virginia pursues revenue generation strategies in the near term, the Commonwealth can reduce its Bay restoration funding gap by changing the way it pools and invests water quality funds. The following ideas could help move the Commonwealth toward a more market-like approach to water quality investing. Further, they set the stage for more effectively engaging the private sector and the marketplace in support of Bay restoration goals – a topic of considerable recent interest in the Bay watershed.[76] Private firms can play a number of roles in achieving TMDL goals, from designing and installing BMPs to providing investment capital to managing entire restoration projects via public-private partnerships. The benefits of such engagement include enhanced innovation, expedited implementation, and reduced costs of compliance. But in order for private companies and funders to engage, they need the right set of enabling conditions to be in place, especially (1) predictable demand, project expectations, and permitting and procurement rules, and (2) flexibility in how projects are designed, financed, and implemented.

3.3.1. Channel restoration funds through an independent financing entity

As discussed, a major shortcoming of Virginia's current Bay restoration financing system is the inconsistency of funding from year to year. Virginia is currently investigating ways to address this challenge. In its 2017 session, the General Assembly directed the Department of Conservation and Recreation to establish a stakeholder advisory group to evaluate methods to stabilize the fluctuations in funding for Agricultural BMPs.[77] The study is also to consider the impact on the staffing and technical assistance needs of the Soil and Water Conservation Districts to ensure that staffing requirements do not fluctuate or exceed their annual ability to fully implement and oversee practices with the funding made available. The stakeholder advisory group has commenced the study process and its recommendations and final report are due November 2017.[78]

To maximize the efficiency, consistency, and flexibility of state and federal water quality investments, Virginia could consider channeling all water quality restoration funding through an independent financing agency or authority. This entity would have the authority and flexibility to:

- Pool capital from various sources including state, federal, private investors, and even philanthropic donors, so that public funding can more effectively be used in concert with these sources of capital.
- Spend these funds over time on the highest-yield projects, investing when effective projects are ready to be funded, not when public budgeting cycles dictate;

[76] This was the topic of the Chesapeake Bay Environmental Finance Symposium, held April 2016. See: Environmental Finance Center, University of Maryland. August 2016. *Chesapeake Bay Environmental Finance Symposium: Recommendations and Final Report.*

[77] This study must include, at a minimum, (i) considering increasing the portion of any deposit to the Water Quality Improvement Fund (WQIF) directed to the WQIF reserve, (ii) limiting the portion of the WQIF reserve that may be utilized in any given year, (iii) evaluating the combined revenues available from the WQIF and the Natural Resources Commitment Fund as a step in establishing appropriate expenditures from the combined funds in a given fiscal year, and (iv) distributing any funds to be deposited into the WQIF pursuant to the provisions of Chapter 21.1 of Title 10.1, Code of Virginia, across a biennial period.

[78] David Dowling. Virginia Department of Conservation and Recreation. 7/15/17. Communication with EFC.

- Establish performance criteria for water quality investments and award funding based on this criteria (and adapt criteria as new information becomes available over time); and
- Facilitate water quality trades within a state or regional credit financing system.

This entity could administer existing water quality funds, and/or it could manage a new fund in the case of a revenue generation mechanism. Pooling together Virginia's varied water quality revenue streams would allow the Commonwealth to realize efficiencies that come with scale and to improve coordination and prioritization, which would ultimately accelerate impact. Further, channeling these funds through an independent entity isolated from public budgeting cycles would improve the flexibility of investments and stabilize funds over time. It would also create a firewall between water quality investments and regulatory programs, enabling investments to be focused exclusively on water quality performance goals. All of this is critical for leveraging private capital, as the private sector values clear expectations and measurable outcomes. quickly.

An example of an entity that functions this way is the Pennsylvania Infrastructure Investment Authority (PennVEST). Created in 1988, PennVEST is state authority charged with improving water quality by providing low-interest loans and grants for the design and construction of wastewater, drinking water, and stormwater infrastructure projects.[79] PennVEST also manages the state's nutrient trading program, serving as a clearinghouse for nitrogen and phosphorous credits. The agency invests an average of $284 million in grants and loans annually,[80] with revenue coming from the Clean Water State Revolving Fund, the Drinking Water State Revolving Fund, state general obligation bonds, PennVEST revenue bonds, and loan repayments and interest earnings.[81] The agency has the above-outlined capacities: the ability to pool, hold, and leverage revenue; to facilitate nutrient credit trading; to manage investments across a range of finance mechanisms from traditional debt financing to water quality trading; and to target investments toward nonpoint source pollution reduction projects likely to achieve strong results.

Among existing entities in Virginia, a possible candidate to serve as an independent Bay restoration financing entity may be the Virginia Resources Authority (VRA). VRA provides a range of low-cost financing solutions to Virginia localities for infrastructure needs across a range of sectors. Should the Commonwealth wish to explore this strategy, a good starting point would be to assess the capacity of VRA to perform the financing functions described above.

3.3.2. Advance a systematic focus on performance

A powerful option for reducing implementation costs and engaging the private sector is to adopt a comprehensive performance financing approach. This approach focuses on the desired outcome rather than the means to get there. Paying for results (e.g. pounds of nutrients or sediment reduced) instead of projects provides the incentive that project implementers need in order to find the most cost-effective and highest-performing practices. It also provides clear expectations and rules of engagement, one of the key enabling conditions for private sector engagement.

Virginia has already demonstrated a commitment to performance-driven financing, with both WQIF and SLAF embedding outcomes into their funding criteria. For example, in a 2016 WQIF grant competition for

[79] Pennsylvania Association of Conservation Districts. April 2014. "PennVEST Nonpoint Source Program: Frequently Asked Questions." Available: http://pacd.org/webfresh/wp-content/uploads/2012/03/FAQsApril2014Rev1.pdf
[80] Paul Marchetti, PennVEST. Communication with EFC, 6/15/17.
[81] Brion Johnson, PennVEST. 2012. "Financing Clean Water Projects for Pennsylvania" presentation. Available: "http://www.dvrpc.org/EnergyClimate/WSTP/pdf/Presentations/Pennvest.pdf

local NPS projects, funding priority was given to projects with the highest pollution reduction compared to dollars requested, as well as to projects that maximized reduction in nitrogen, phosphorous and sediment.[82] SLAF has adopted a policy whereby funds will only be awarded to projects with costs below $50,000 per pound total phosphorous removed per year.[83]

Examples like these lay the groundwork for Virginia to take a more robust and systematic approach toward performance-driven financing. This could be pursued through an explicit policy adopted by a new Bay restoration financing entity or for a new Bay restoration fund, or the approach could be integrated into existing Bay restoration funding programs and mechanisms. Either way, a performance approach would require reductions in pounds of pollutants delivered to local waterways, with payments to contractors being contingent on those outcomes. This is a shift away from funding a suite of priority BMPs or watersheds (as Virginia's agricultural conservation program currently does), toward funding a suite of outcomes that can be measured and documented over the life of the project or another acceptable timeframe.. Project managers – those closest to the project – would be given the flexibility to find the best methods for achieving reductions. A challenge with this approach is the cost of monitoring, measuring, and verifying outcomes. However, building these costs into contracts not only accounts for them upfront; it creates an incentive to improve the efficiency of monitoring procedures.

A specific performance-based financing mechanism that Virginia might consider is the pay for success contract. In this model, state or local government agencies contract with private sector investors who provide up-front funding to a service provider, which in the case of water restoration may be a private landowner, nutrient credit aggregator, watershed organization or other similar party. The service provider conducts whatever activities are necessary to produce the desired outcome – e.g. pounds of pollution abated. If this can be achieved at a cost below what the government agency has agreed to pay, the remainder is profit to the investor. The government agency then repays the investors, often with a bonus, if the program meets its goals. If the program fails, taxpayers pay nothing. The pay for success model offers significant benefits to the public sector, including improved performance (as better performance equals a greater return on investment), increased innovation, and reduced costs. The model also transfers risk from the public to the private sector, which is usually better equipped to efficiently mitigate that risk.[84]

Virginia is already pursuing pay for success financing for early childhood health care,[85] and the model is being used nationwide in various fields including early childhood education, criminal justice, human services, and workforce development. It has been less tested in the water quality realm, though the District of Columbia Water and Sewer Authority is piloting a pay for success financing program for stormwater retention projects. This approach merits additional study and testing, including whether it can be effectively undertaken at the state level or if it would be more appropriate for the Commonwealth to encourage local-level pay for success financing.

[82] Virginia Secretary of Natural Resources. November 2016. *FY 2016 Chesapeake Bay and Virginia Waters Clean-Up Plan.* Available: http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/RD4002016/$file/RD400.pdf

[83] Valerie Thomson, Virginia Department of Environmental Quality. 12/4/14. "Memo: Authorization of FY 2015 Project Funding List." Available: http://www.deq.virginia.gov/Portals/0/DEQ/Water/ConstructionAssistanceProgram/FY15_SLAF_Memo.pdf

[84] The Pay for Success Learning Hub, maintained by the Nonprofit Finance Fund, is a repository for information on this model and includes an assessment tool for governments to evaluate readiness to implement such a program.

[85] Virginia Office of the Governor. 3/11/15. "Virginia Receives Federally Funded Support to Advance Pay for Success in Early Childhood Health Care." Available: https://governor.virginia.gov/newsroom/newsarticle?articleId=7964

3.3.3. Augment the impact of Virginia'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.[86] Water quality trading (WQT) in particular is a market mechanism that has received much attention 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 in principle maximizes efficiency.

Virginia is a regional leader in the use of water quality trading systems; the Commonwealth has been implementing its innovative and well-regarded Chesapeake Bay Watershed Nutrient Credit Exchange Program since 2005. This program could become even more robust by implementing some of the other strategies previously discussed, such as tightening Virginia's nutrient management and/or stormwater regulations, which could boost demand for credits,[87] as well as transferring administration of the program to VRA or another entity that is suited to efficiently manage market-based programs.

An independent financing entity may also be able to undertake more innovative trading methods such as 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.[88] 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.[89]

The Commonwealth's WQT program may also achieve greater impact by shifting to a mitigation banking model in which funding preference is given to on-the-ground projects that have been demonstrated to cost effectively reduce pollution. Through this approach, Virginia's Bay restoration financing entity would purchase credits from established water quality restoration banks, particularly those with that meet the highest standards for performance and cost savings. By ensuring that reductions are achieved prior to financing, the banking approach shifts the risk to the supplier. Further, if it is used for voluntary or unregulated reductions, rulemaking would be less cumbersome than it would be in a regulated market.

Finally, to the degree that Virginia's credit trading system can be integrated with other programs throughout the Bay watershed as they are developed, there is opportunity to reduce the basin-wide cost of compliance and accelerate implementation of overall Bay restoration goals.

3.3.4. Pursue public-private partnerships

Regardless of whether Virginia pursues the previous options, it may be able to harness the power of the private sector by forging public-private partnerships at state and local levels. The potential use of public-private partnerships (P3s) for stormwater management in particular has attracted a great deal of

[86] Shortle, James. April 2013. "Economics and Environmental Markets: Lessons from Water-Quality Trading." *Agricultural and Resource Economics Review* 42/1.
[87] 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
[88] 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.*
[89] 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.*

attention throughout the Bay region. A P3 is a contractual arrangement between a public agency and a private sector entity, through which the parties collaboratively deliver a good or service and share in bearing the potential risks and rewards.[90] P3s can be used for an entire project or for selected aspects, such as financing, design, construction, operations and maintenance, and monitoring and evaluation.

P3s are relatively new in the nonpoint source realm, though they have been used extensively in other sectors including wastewater, transportation, and military housing. Benefits of these arrangements include lower costs, expedited projects, improved asset management, and development of innovative strategies and technologies. P3s can also be designed to achieve specific economic development goals, such as a P3 in Prince George's County, Maryland, which requires that a certain percentage of project activities be conducted by small, local, and minority-owned businesses (see the Appendix for a case study of this project).

Despite their benefits, P3s are not a pot of gold. State and local governments will still need to identify reliable revenue streams (taxes, fees, grants, tolls, revolving loan funds, etc). When these dedicated revenue streams are available, however, a P3 may be able to better manage and leverage them. These arrangements are also particularly valuable in cases when it is important to reduce public sector risk or to avoid adding public sector capacity.

3.3.5. Invest in key markets and industries associated with the restoration effort, and integrate water restoration with economic development initiatives

Virginia understands that clean water is the foundation for a healthy economy and that water quality investments can stimulate significant economic activity. Yet there may be opportunity to better integrate the restoration effort with broader statewide economic development initiatives. This could efficiently advance Virginia's water quality restoration goals while simultaneously moving forward other state priorities, including job creation and economic growth.

The first opportunity is to develop industries and products that support clean water. A number of sectors with high growth potential – including sustainable agriculture and fisheries, urban green infrastructure, eco-tourism, and nature-based recreation – are predicated on clean water. With its tidewater heritage, Virginia is associated with such clean water industries, and further growth in these sectors could attract new businesses and skilled workers, improve quality of life for citizens, and enhance the state's infrastructure foundation for long-term economic growth and development.

Second, there is the opportunity to target investment in BMPs that also support the local economy. A study conducted by the EFC in 2013 showed that investments in stormwater management practices, for example, have an impact on local economies similar to the impact of other industries such as construction.[91] There is compelling evidence that effective water quality investments will pay real dividends to state and local governments, and projects could be selected with an eye toward accelerating that economic impact. This approach to using water quality investments to spur local economic development activity is a key element of the above-mentioned stormwater public-private partnership in Prince George's County, Maryland, which is on its way to becoming a national model in achieving multiple community economic and financing goals.

[90] The National Council for Public-Private Partnerships. "7 Keys to Success." Accessed 7/20/14: http://www.ncppp.org/ppp-basics/7-keys/
[91] University of Maryland Environmental Finance Center. 2013. *Stormwater Financing Economic Impact Assessment: Anne Arundel County, MD; Baltimore, MD; Lynchburg, VA.*

Third, the Commonwealth can investigate incentives to grow innovative initiatives that both generate revenue and function as restoration practices in and of themselves. Some examples include oyster farming, cultivating fruit and nut trees within forest buffers, and installing waste-to-energy systems; all of these have capacity not only to create jobs but also to improve water quality. Virginia may benefit from fostering such innovative enterprises through startup incubators, business development assistance programs, entrepreneurial training, accelerator programs, revenue bonds for seed funding, and similar efforts.

4. Conclusion

Virginia is a regional leader in advancing efforts to restore the health of the Chesapeake Bay as well as its own rivers and coastal waters. The Commonwealth now has an opportunity to increase investment in activities that will enable the state to meet TMDL targets on schedule, and simultaneously to pursue innovative financing approaches that will enable these investments to go as far as possible in achieving on-the-ground results.

The options presented in this report are just that – options that the Commonwealth may consider as it charts a course toward achieving its goals of sufficiently and efficiently funding water quality restoration. While some strategies are traditional, tested approaches, others represent a dramatically new way of doing business. All will require skillful leadership and execution, as well as broad-scale support from Virginians. But the payback of taking bold steps toward impactful water quality financing is significant: clean and healthy waters that sustain Virginia's economic vitality and the well-being of its current and future citizens.

Appendix

Table 8. Estimated costs of achieving N, P, and S pollutant load reductions in Virginia's agriculture sector

Source	Annual cost ($ million)	Aggregate cost, 2017 - 2025 ($ billion)
VA Dept. of Conservation and Recreation annual funding needs assessment	184	1.66
Chesapeake Assessment Scenario Tool (CAST)	427	3.84
Per-pound cost, N and P	0.08	0.72
Average	203.69	2.07

Notes: CAST scenario assumes full implementation of BMPs in Virginia's WIP, based on 2010 initial loads. Per-pound nutrient reduction cost estimates use the median values for agricultural BMPs per a literature review ($100/lb N, $1,000/lb P). See Section 2.1 for discussion and sources.

Table 9. Estimated costs of achieving N, P, and S pollutant load reductions in Virginia's stormwater sector

Source	Annual cost ($ million)	Aggregate cost, 2017 - 2025 ($ billion)
Chesapeake Assessment Scenario Tool (CAST)	875	7.88
Per-pound cost, N and P	0.28	2.53
Average	437.64	5.21

Notes: CAST scenario assumes full implementation of BMPs in Virginia's WIP, based on 2010 initial loads. Per-pound nutrient reduction cost estimates use the median values for stormwater BMPs per a literature review ($300/lb N, $10,000/lb P). See Section 2.2 for discussion and sources.

Table 10. Estimated cost of abating nitrogen and phosphorous in Virginia's agricultural and stormwater sectors

	Median cost ($/lb)	Required load reduction (million lbs)	Total cost ($ million)
Agriculture sector			
Nitrogen	100	4.13	413
Phosphorous	1,000	0.31	310
Stormwater sector			
Nitrogen	300	2.42	726
Phosphorous	10,000	0.18	1800
TOTAL COST			3,249

Notes: Median costs derived from literature review; see Sections 2.1 and 2.2 for discussion and sources.

Public-private partnership case study: Clean Water Partnership, Prince George's County, MD.[92]

A hallmark example of a stormwater P3 in the Chesapeake Bay region is the Clean Water Partnership, a 30-year agreement between Prince George's County, Maryland and Corvias Solutions, a private stormwater management firm. Finalized in spring 2015, this agreement aims to install green infrastructure and low-impact development practices on up to 4,000 acres of impervious surface throughout the County, in order to ensure compliance with federal MS4 permit requirements.

Corvias will manage the design, construction, and long-term maintenance of stormwater infrastructure; the County expects that this integrated approach will "maximize the efficiencies and savings for the entire life cycle of the green infrastructure assets,"[93] as well as transfer risks associated with construction and

[92] Prince George's County Clean Water Partnership website. "Frequently Asked Questions." Accessed 7/20/14: http://thecleanwaterpartnership.com/faqs/

[93] Ibid.

maintenance from the public sector to the private sector. Prince George's County has committed to invest $100 million between 2016 and 2019 to plan, design, and construct projects on the first 2,000 acres. Projects will be completed across the County and may be contiguous; priority will also be given to green infrastructure installations that support the goals of various County strategic plans.

The Clean Water Partnership is unique in its scale – it is attempting to manage urban stormwater and meet federally mandated requirements *county-wide*. The program is also unique in its workforce and economic development goals; at least 30% of project activities are to be completed by local, minority-owned small businesses, with a workforce training element folded into the program. This partnership is still in its infancy, and the Bay community should watch closely to evaluate its progress and determine whether it is a model for the rest of the region.