I. Introduction

Chesapeake Bay restoration has been a priority for the State of Maryland, its citizens, and Chesapeake Bay watershed jurisdictions since the foundation of the Chesapeake Bay Program (CBP) in 1983 and signing of the first watershed restoration agreement. By the mid-1990s, jurisdictions were still not meeting Chesapeake Bay's water quality standards, and it was designated as impaired under the federal Clean Water Act (CWA) framework. Leaders across the watershed signed an updated Bay agreement in 2000, including state governors, the Mayor of the District of Columbia, the EPA Administrator, and the Chair of the Chesapeake Bay Commission. This updated agreement committed to "correct the nutrient and sediment-related problems in the Chesapeake Bay and its tidal tributaries"[6] sufficient to remove it from the federal list of impaired waters by 2010. Jurisdictions also agreed that if these voluntary commitments were not sufficient to restore the Bay by 2010, the CBP partnership would pursue the regulatory CWA approach and develop a Total Maximum Daily Load (TMDL). In the late 2000s, when it became clear that the voluntary water quality agreement had not fully restored the Bay, the CBP partnership transitioned to the regulatory CWA framework and began developing the Chesapeake Bay TMDL.

The TMDL quantifies how much pollution, specifically nitrogen, phosphorus, and sediments must be reduced to achieve Chesapeake Bay water quality standards. Water quality standards are the regulatory requirements (e.g., dissolved oxygen, water clarity - see COMAR 26.08.02.03-3[7]) that the Chesapeake Bay must meet to support healthy living resources like crabs, oysters, and striped bass. The TMDL is calculated using multiple computer models including watershed, estuarine, water quality, and sediment transport. These models are calibrated with real-world field monitoring data to simulate environmental conditions. Because the TMDL does not specify how or where to achieve pollution reductions, Bay jurisdictions develop watershed implementation plans (WIPs) to identify the type, number, and location of pollution reduction practices planned to restore water quality. Jurisdictions then translate these pollution reduction practices identified in their WIPs into scenarios and run them through the CBP modeling framework to demonstrate the achievement of water quality standards.

This current plan represents the third phase of the WIP. It is designed to achieve Maryland's 2025 TMDL pollution targets and incorporates lessons learned from Phases I and II. The Phase I WIP identified and accelerated strategies and deadlines for practices to achieve 70 percent of the pollution reductions by 2017. The Phase I WIP was finalized in December 2010 commensurate with the development of the 2010 TMDL and during a time when EPA was updating its scientific modeling framework. This first WIP demonstrated how pollution targets could be achieved at the major basin scale (i.e., Eastern Shore, Potomac, Susquehanna, Western Shore, and Patuxent basins) and was a starting point for finer scale planning during the Phase II process.

Maryland's Phase II WIP refined geographic resolution for implementation efforts and used the 2025 restoration deadline consistent with the TMDL. Initially, EPA intended for jurisdictions to develop the Phase II WIP at the county geographic scale; however, EPA decided in October 2011 to scale back its expectations for geographic specificity due to data and model limitations. Although jurisdictions again

[6] chesapeakebay.net/documents/cbp_12081.pdf

[7] www.dsd.state.md.us/comar/comarhtml/26/26.08.02.03-3.htm

used the major basin scale, most local partners provided the State information at a county scale as the basis of the basin scale plans. The State supported county analyses by assigning stormwater pollution reduction targets at a finer level than is available in EPA's Bay watershed model. This underlying county scale planning provided further assurance of implementation beyond that of the Phase I WIP because the county governments and soil conservation districts that conduct many of the implementation actions operate at the county scale.

After the Phase II WIP, the CBP partnership agreed to conduct a 2017 Midpoint Assessment (MPA) to evaluate jurisdictions' progress in achieving 60 percent of the necessary TMDL pollution reductions. Maryland exceeded the 60 percent MPA phosphorus and sediment goals in 2017 and was 36 percent of the way towards achieving the nitrogen targets. However, Maryland will exceed the 60 percent nitrogen goal when it completes upgrades at its 67 major WWTPs. As of January 2019, upgrades are complete at approximately 90 percent of these plants (59 of 67 complete), with five of the eight remaining plants anywhere from 88-98 percent complete, two still in planning or design, and work on one plant not yet started.

Additionally, the MPA provided an opportunity to incorporate improved science and monitoring results into the Chesapeake Bay modeling framework and update 2025 pollution reduction targets. The Phase 6 modeling suite established updated State-basin targets to ensure the jurisdictions WIP's attained water quality standards upon implementation. Table 2 provides nutrient targets for each of Maryland's five major basins; Appendix F describes the process for calculating these targets.

Table 2: *Maryland's Phase III WIP nutrient pollution targets by major basin.*

Major Basin	Phase III WIP Target* *(Million lbs/yr)*	
	Nitrogen	Phosphorus
Eastern Shore of Chesapeake Bay	15.6	1.29
Patuxent River Basin	3.1	0.30
Potomac River Basin	15.8	1.09
Susquehanna River Basin	1.6	0.05
Western Shore of Chesapeake Bay	9.6	0.95
Total	**45.8**	**3.68**

*****Phase III WIP reductions subject to change upon EPA review.

For the Phase I and II WIPs, Maryland used the allocation approach from the Chesapeake Bay TMDL to assign finer-scale goals for the Bay segment and county levels. Maryland based this methodology on applying a constant percent reduction, State-wide, to the hypothetically reducible load from each watershed. For the Phase III WIP, and in recognition that there are varying levels of pollution reduction progress across sectors, Maryland adopted a feasibility approach to achieve 2025 targets. Maryland recognizes that accelerated progress in both the wastewater and agricultural sectors will be primarily responsible for the State achieving its 2025 restoration targets. Because wastewater and agriculture are the two highest loading sectors, these planned accelerated reductions will be sufficient to achieve current 2025 targets.

Beyond 2025, the stormwater and septic sectors are required to contribute their fair share by making steady long-term reductions while factoring in affordability. For stormwater, reductions occur over multiple five-year MS4 permit cycles. Septic system reductions incorporate a menu of practices, including septic upgrades, pumpouts, sewer connections, financial incentives, and a focus on public health priorities. Slowing and reversing the loss of natural lands, restoring ecosystems, and increasing natural filters are also critical to restoring the Bay, adapting to future conditions, and mitigating climate change impacts. The natural lands, conservation plus, and protection chapters (Appendices B and D) contain strategies to protect and restore the State's natural filters. Maryland worked closely with local jurisdictions throughout the Phase III WIP process to develop this feasibility based approach and document local strategies in county summary documents (Appendix C).

This Phase III WIP documents the strategies and programs that Maryland and local jurisdictions will put in place to achieve these basin targets by 2025. Also, EPA established expectations[8] for what information each jurisdiction should include in their WIP.

These EPA Expectations include:

1. Programmatic and Numeric Implementation Commitments between 2018 and 2025;
2. Comprehensive Local, Regional, and Federal Engagement Strategies and Commitments;
3. Adjustments to Phase III WIP State-Basin Targets and the Phase II WIP Source Sector Goals;
4. Development and Implementation of Local Planning Goals;
5. PSC Decisions on Accounting for Growth;
6. PSC Decisions on Conowingo Dam;
7. PSC Decisions on Climate Change.

While Maryland's Phase III WIP is designed to remain consistent with EPAs expectations and achieve the TMDL nutrient and sediment targets, the State also is strongly committed to the broader goals outlined in the current (2014) Chesapeake Bay Agreement[9]. These broader goals include sustainable fisheries, vital habitats, reduction of toxic contaminants, healthy watersheds, land conservation, stewardship, public access, environmental literacy, and climate resiliency. Maryland participates on multiple Chesapeake Bay goal implementation teams to implement and track related strategies. Because of their close connection to water quality, many of the Phase III WIP sections and strategies also contribute to achieving these broader Bay restoration goals.

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8 epa.gov/sites/production/files/2018-06/documents/epa-phase-iii-wip-expectations-6-19-18.pdf and "Clarification of Accounting for Growth Expectations for the Phase III Watershed Implementation Plans (WIPs), February 5, 2019.

9 chesapeakebay.net/what/what_guides_us/watershed_agreement

II. Programmatic and Numeric Implementation Between 2018 and 2025

Maryland has 53 tidal subwatersheds (Figure 3) within the five major basins (Figure 4) that must achieve their specific water quality standards. The State input Phase III WIP pollution reduction practices (Table 3 lists core practices) into the Bay watershed model, along with their geographic location, to calculate expected reductions of nitrogen, phosphorus, and sediment into Chesapeake Bay's tidal waters by 2025. Subsequently, Maryland aggregated the subwatershed pollution reductions by pollutant-sector (Tables 4-6) to determine if the State met its 2025 planning targets. Furthermore, Maryland projected the pollution reduction trends beyond 2025 (Figure 5) to characterize future sector growth and associated increases in pollution loads. Appendix B provides detailed descriptions of pollution reduction programs and practices by sector.

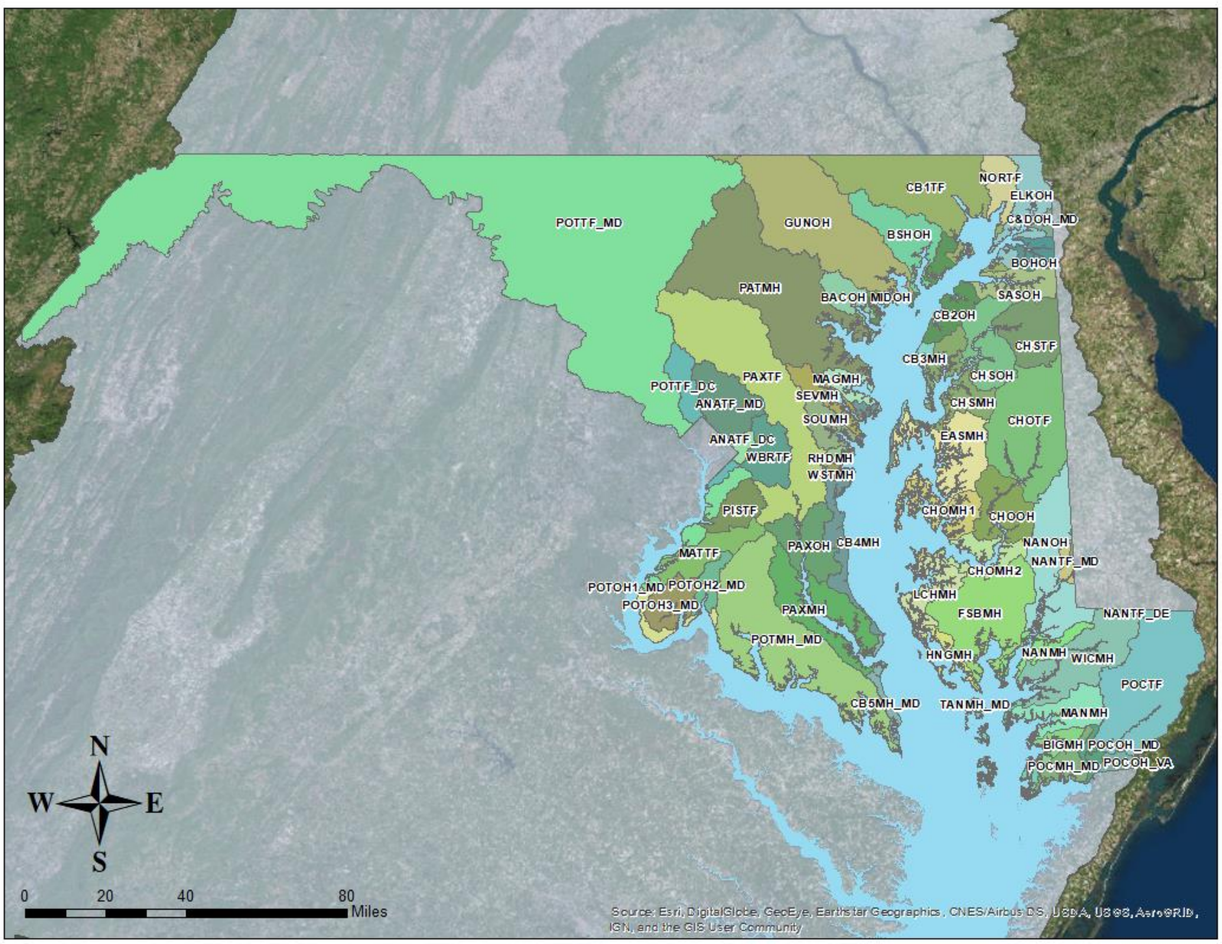

Figure 3: Maryland's 53 tidal subwatersheds draining into Chesapeake Bay.

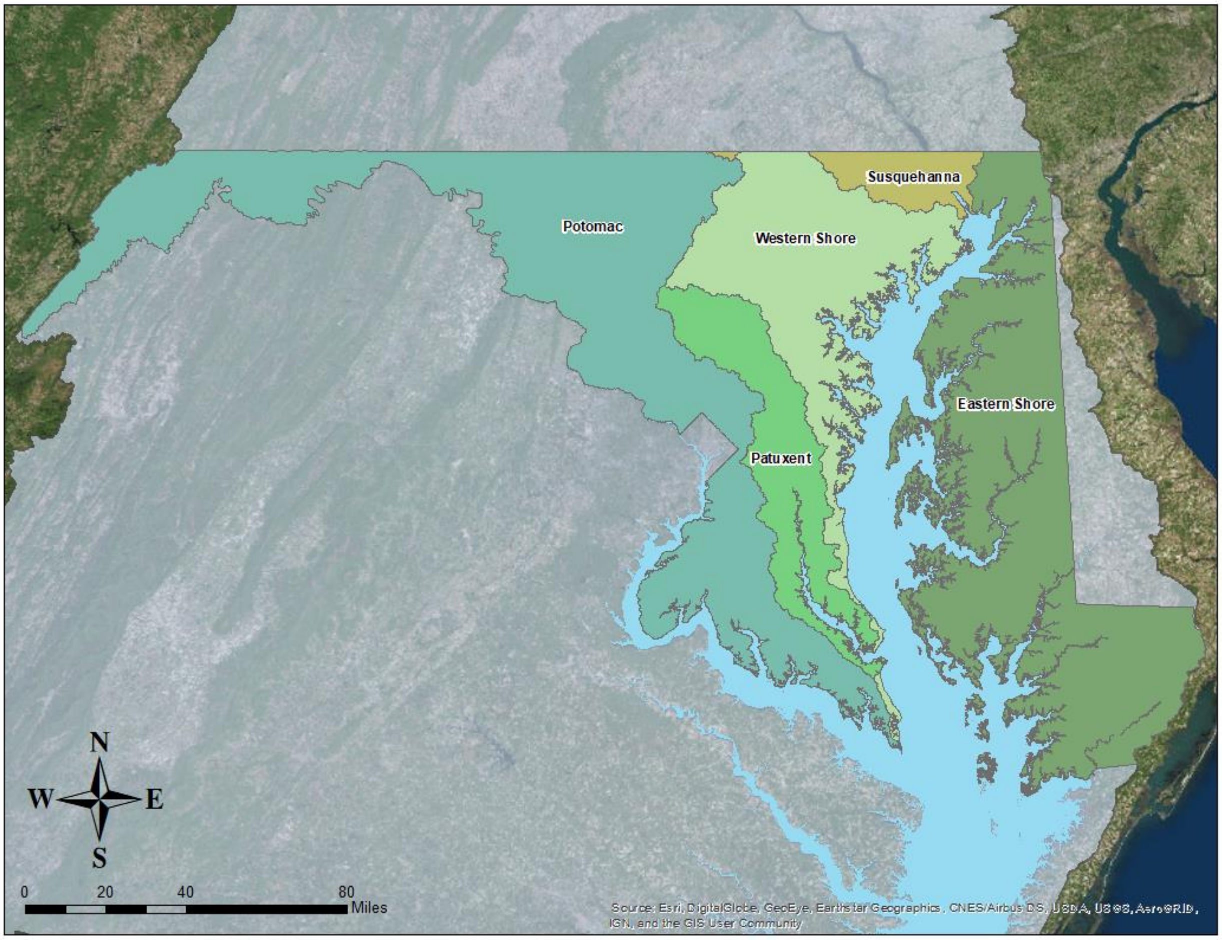

***Figure 4**: Maryland 5 major basins for which EPA has assigned pollution targets.*

***Table 3:** Core aspects of Maryland's Phase III WIP strategy. NOTE: The table below is not intended to capture all practices, just the highlights. For details on each sector's strategies, refer to Appendix B.*

Sector	Core Phase III WIP Strategies	TN Reduced *(lbs TN EoT/yr)*	TP Reduced *(lbs TP EoT/yr)*	Cost
Agriculture *Maintain Current Practices*	Conservation Technical Assistance *(1 million acres of Conservation Plans + Design & Oversight of all BMP implementation)*	1,100,000	53,000	$13,800,000
	Nutrient Management Compliance	1,600,000	76,000	$3,100,000
	Cover Crops | ***470,000 acres/year***	2,300,000	2,000	$25,500,000/yr
	Manure Transport | ***100,000 tons/year***	228,000	26,000	$2,000,000/yr

Sector	Core Phase III WIP Strategies	TN Reduced *(lbs TN EoT/yr)*	TP Reduced *(lbs TP EoT/yr)*	Cost
Agriculture ***Future Practices***	Verification of existing BMPs	87,500	1,500	$3,500,000
	Implementation of Additional BMPs *(The Maryland Agricultural Water Quality Cost-Share (MACS) Program)*	652,000	10,600	$65,100,000
Atmospheric Deposition of Nitrogen ***Potential future practices not currently counted towards Maryland's Phase III WIP***	126 Petition to EPA *(Optimization of power plants to 5 upwind states)* ***No WIP credit***	250,000	-	Unknown
	Green House Reduction Act *(Plan for a 40% reduction in GHGs by 2030)*	No estimate	-	Unknown
	Regional Greenhouse Gas Initiative *(Regional cap and trade program for power plants)*	No estimate	-	Unknown
	Clean and Renewable Energy Standard (CARES) (100% clean electricity by 2040)	No estimate	-	Unknown
	Transportation Initiatives *(Mobile source emission reduction programs (fuel standards, MPG, and Evs))*	No estimate	-	Unknown
	Maryland EmPOWER *(Residential and commercial energy efficiency program)*	No estimate	-	Unknown
Atmospheric Deposition of Nitrogen ***Potential future practices not currently counted towards Maryland's Phase III WIP***	Volkswagen Settlement *(NOx mitigation projects in high emitting sectors)*	No estimate	-	Unknown
	Maryland's 2019 Petition to the Ozone Transport Commission *(Optimization of power plants in Pennsylvania)* ***No WIP credit***	No estimate	-	Unknown

Sector	Core Phase III WIP Strategies	TN Reduced *(lbs TN EoT/yr)*	TP Reduced *(lbs TP EoT/yr)*	Cost
Conservation Practices	Land Conservation; Local and State-level land conservation and land use programs and policies that prevent nutrient pollution	85,000	6,000	$125,000,000/yr *(Maryland Agricultural Land Preservation Foundation (MALPF) for 2019-2025, Rural Legacy Program, and Program Open Space-Stateside)*
Natural Filters on Public Lands	Upland Tree Planting and Streamside Forest Buffers | ***1,150 acres***	8,000	700	$11,900,000
	Wetland Restoration | ***175 acres***	600	50	$875,000
	Stream Restoration | ***6 miles***	2,500	2,250	$22,400,000
	Shoreline Management (Living Shoreline Technique) | ***0.56 miles***	150	100	$1,800,000
	Oyster Aquaculture | ***350,000 bushels***	20,000	1,000	$17,500,000
	Oyster Reef Restoration | ***867 acres***	65,000	3,300	$4,700,000
Natural Filters on Other Lands	Accelerate pace of tree planting and wetlands creation through financial and permit incentives	Captured in Agriculture and Stormwater Strategies		
Septic	Best Available Technology (BAT) Upgrades | ***6,440 systems***	40,000	-	$70,100,000
	Connection to Wastewater Treatment Plants (WWTP) | ***1,600 connections***	16,800	-	$9,100,000
	Septic Pumping *(Not available until Septic Stewardship Plans developed by 2021)*	-	-	TBD - Septic Stewardship
Stormwater	Complete current Phase 1 Municipal Separate Storm Sewer (MS4) permits restoration requirement *(completion dates: 2018 and 2019)* | ***20,000 impervious acres***	85,000	43,000	$1,180,000,000

Sector	Core Phase III WIP Strategies	TN Reduced *(lbs TN EoT/yr)*	TP Reduced *(lbs TP EoT/yr)*	Cost
	Complete new Phase 1 MS4 restoration requirement *(completion dates: 2023 & 2024)* | ***17,500 impervious acres***	86,000	12,000	$1,195,000,000
	Complete Current Phase 2 MS4 restoration requirement *(completion date: 2025)* | ***3,000 impervious acres***	15,000	6,000	$208,000,000
	Miscellaneous implementation on non-MS4 counties *(e.g. trading, trust fund)* | ***400 impervious acres***	3,000	400	$42,000,000
Wastewater	Complete Bay Restoration Fund (BRF)-Funded Enhanced Nutrient Removal (ENR) upgrades to 67 significant municipal wastewater plants	4,000,000	100,000	Fully Funded Pre-WIP III
	Continue funding ENR upgrades for non-significant municipal plants through the BRF *(11 additional plants by 2025, for a total of 16)*	25,000	5,000	$50,000,000
	Provide Operations and Management (O&M) Grant through the BRF for facilities achieving nitrogen discharge concentrations of 3.0 mg/L	425,000	No additional planned reductions	$10,000,000/yr
	Incentivize higher treatment levels (beyond 3.0 mg/L of nitrogen) through water quality trading and the Clean Water Commerce Act (through 2021)	No estimate	No estimate	$10,000,000/yr
	Complete upgrades to federal significant municipal plant	3,000	300	No State costs
	Continue minor industrial reductions	No estimate	No estimate	No State costs
	Maintain achievement of significant industrial Waste Load Allocations	No additional reductions	No additional planned reductions	No State costs

Sector	Core Phase III WIP Strategies	TN Reduced *(lbs TN EoT/yr)*	TP Reduced *(lbs TP EoT/yr)*	Cost
Wastewater	Implement sewer projects to address combined sewer overflows (CSOs), sanitary sewer overflows (SSOs) and inflow and infiltration (I/I)	20,000	2,000	$40,000,000

Natural loads include a category for stream bed and bank loads in the Phase 6 Chesapeake Bay Model. The stream loads are impacted by upland land use and BMPs. Thus, a stream's nutrient load is reduced by applying upland BMPs to developed and agricultural land surrounding a stream. Recognizing that these stream nutrient reductions are the result of implementation by the Agriculture and Stormwater source sectors, Maryland attributed those natural nitrogen reductions back to the corresponding sector (Table 4). Additionally, many counties are restoring streams as part of their MS4 stormwater permits. The reductions from these practices are also attributed back to the Stormwater sector.

These model outputs demonstrate that Maryland has sufficient practices across sectors to achieve its 2025 pollution targets and remain below its nitrogen target past 2045 (Figure 5). With a feasibility based approach, progress is not even across sectors. The wastewater and agricultural sectors achieve the most substantial nitrogen reductions from 2017 progress levels, 41 percent, and 20 percent respectively, while stormwater achieved a 2 percent reduction, and septic sector loads decreased by 1 percent.

Table 4: *Nitrogen: Statewide current & Phase III WIP loads delivered to Chesapeake Bay.*

Source Sector: Nitrogen	2017 Progress* (M lbs TN/yr)	Phase III WIP* (M lbs TN/yr)	Change in Load* (M lbs TN/yr | Percent)
Agriculture **	22.4	17.8	-4.6 | -20%
Natural ***	8.1	8.1	0.0 | 0%
Septic	3.1	3.1	0.0 | -1%
Stormwater **	9.4	9.2	-0.2 | -2%
Wastewater	11.3	6.6	-4.7 | -41%
Total	**54.2**	**44.8**	**-9.4 | -17%**

*** Note: Individual values may not total add to totals due to rounding.**

** *Agriculture and stormwater reductions include natural load reductions, -0.16 and -0.09 M lbs. TN/yr. respectively. These reductions are attributed to practices implemented by the agriculture and stormwater sectors.*

*** Includes atmospheric deposition of nitrogen to tidal waters.

Table 5: *Phosphorus: Statewide current & Phase III WIP loads delivered to Chesapeake Bay.*

Source Sector: Phosphorus	2017 Progress* (M lbs TP/yr)	Phase III WIP* (M lbs TP/yr)	Change in Load* (M lbs TP /yr | Percent)
Agriculture	0.65	0.47	-0.17 | -26%
Natural	1.83	1.72	-0.11 | -6%
Stormwater	0.67	0.66	-0.01 | -2%
Wastewater	0.51	0.39	-0.12 | -24%
Total	**3.67**	**3.24**	**-0.42 | -12%**

Table 6: *Sediment: Statewide current & Phase III WIP loads delivered to Chesapeake Bay.*

Source Sector: Sediment	2017 Progress* (M lbs TSS/yr)	Phase III WIP* (M lbs TSS/yr)	Change in Load* (M lbs TSS/yr | Percent)
Agriculture	259	186	-74 | -28%
Natural	6,903	6,688	-216 | -3%
Stormwater	405	394	-11 | -3%
Wastewater	7	9	+2 | +26%
Total	**7,575**	**7,277**	**-299 | -4%**

*** Note: Individual values may not total add to totals due to rounding.**

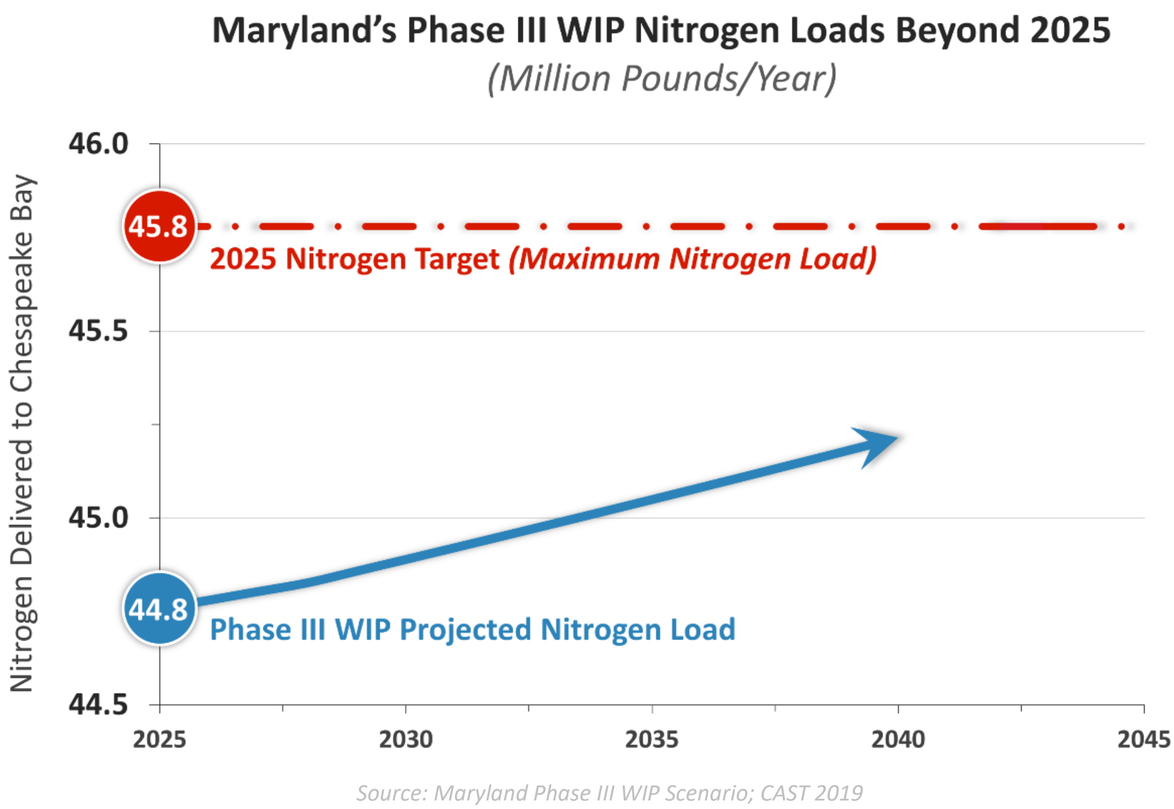

Figure 5: *Total Nitrogen projected from Phase III WIP strategies implementation. Shown relative to total nitrogen target.*

III. Comprehensive Local, Regional, and Federal Engagement Strategies and Commitments

Engagement During WIP Implementation

Due to their central implementation roles, county, municipal, federal, and soil conservation district (SCD) staff who conduct restoration are the primary stakeholders involved in Maryland's Phase III WIP implementation. Approaches to engagement vary by the pollution source sector. Appendix A lists specific engagement activities during WIP development.

Agriculture: Maryland Department of Agriculture (MDA) held a meeting in each county, facilitated by the local SCD, to develop revised county-level plans and incorporate them into Maryland's Phase III WIP.

Stormwater: Maryland Department of the Environment (MDE) held meetings with each county's public works staff to discuss county goals and Maryland's Phase III WIP. Maryland engages with Phase I MS4s during permit renewal and review of mandatory biennial financial assurance plans and annual progress reports. MDE engage Phase II jurisdictions and facilities one-on-one and in small groups to discuss permit requirements and financial assistance. MDE, Maryland Sea Grant Extension, and NGOs work with and engage non-MS4 communities.

Wastewater & Septic: MDE met with environmental health directors from Maryland's counties to discuss local onsite disposal goals and the State's Phase III WIP. MDE and the Maryland Association of Municipal Wastewater agencies continue engagement through the permitting process.

Federal Facilities: MDE engages federal facilities through participation in the Federal Facilities Workgroup. Appendix E summarizes U.S. Department of Defense implementation.

Engagement and Communication Goals

To facilitate successful local engagement in the Phase III WIP process, EPA expected[10] Bay jurisdictions to devise strategies to engage local, regional, and federal partners. It is critical that governments, agricultural communities, and other local partners are involved in WIP development to ensure plans are realistic, reflect local priorities, benefit communities, and identify needed resources, such as funding and technical support.

Expected products from Maryland's local engagement vary by sector, permit status, and local needs. To best assist local partners, the State customizes its engagement to local needs and capacities. Engagement targets Maryland's partners most directly involved in implementation, such as soil conservation districts and local governments.

Discussion of implementation funding is essential to engagement activities. State and local partners continue to refine funding strategies to achieve Bay restoration goals and make reductions beyond 2025.

Strategies

Target Audiences

Local Leaders: Maryland's Phase III WIP will succeed only by coordinating policymaking and restoration commitments with local leaders. Local elected officials and agricultural community leaders, including district managers and Maryland Association of Soil Conservation Districts boards, have particularly important roles. Moving forward, the governor's Bay Cabinet continues to correspond with and engage local leaders. MDE also engages local government leaders through the Maryland Association of Counties (MACo) and Maryland Municipal League conferences.

Technical Partners: MDE maintains technical contacts that share their experiences and identify successful model programs. These technical partners are knowledgeable in disciplines that inform WIP implementation, including tree planting, climate change, and urban source sector management.

[10] U.S. Environmental Protection Agency's Expectations for the Phase III Watershed Implementation Plans, June 2018.

Practitioners: Practitioners: Practitioners are the primary stakeholders involved in Maryland's Phase III WIP implementation. In general, practitioners are county, and municipal governments, federal land owners, such as the Department of Defense, SCDs, the Watershed Assistance Collaborative, and National Fish and Wildlife Foundation staff who conduct implementation activities.

Approaches to practitioner engagement vary by the pollution source sector:

Agriculture: MDA leads agriculture sector engagement, primarily through listening sessions and meetings, to identify barriers and opportunities in implementation and track progress towards WIP goals.

Stormwater: MDE discuss local progress on stormwater with each county's public works staff. To best address individual needs, Maryland engages sub-sectors:

- **Phase I MS4:** Phase I permits in Maryland require the restoration of a percentage of a jurisdiction's impervious surface area. Maryland's Phase III WIP incorporates Phase I MS4 nutrient reductions from restoration and other permit requirements. MDE engages Phase I MS4s during permit renewal, review of required biennial financial assurance plans, and annual progress reports. In addition to regular phone calls and emails with stormwater managers, MDE also participates in stormwater meetings organized by MACo to discuss Bay restoration and local water quality improvement.

- **Phase II MS4:** MDE engages Phase II jurisdictions and facilities one-on-one and in small groups to discuss permit requirements and financial assistance. Maryland's Phase III WIP incorporates Phase II MS4 nutrient reductions from permit requirements. MDE regularly engages permittees during their annual report reviews, which include constructive feedback.

- **Non-MS4:** Maryland Sea Grant Extension's watershed restoration specialists are trusted messengers for WIP implementation, especially for non-MS4 stormwater. Extension specialists assist communities with identifying funding, implementing restoration projects, BMP tracking, engaging community leaders, and more. Also, several NGOs facilitate Phase III WIP communication with local partners. MDE collaborates with these messengers to coordinate local engagement.

Septic: MDE engaged with environmental health directors identifies barriers and opportunities in implementation and to track progress toward meeting WIP goals for onsite wastewater systems.

Wastewater: MDE engages permitted wastewater facilities through the permitting process. Maryland Association of Municipal Wastewater Agencies also facilitates communication with the wastewater sector.

Local Challenges and Opportunities

Maintenance and Verification

Local governments provide much of the on-the-ground implementation needed to achieve Maryland's Bay restoration targets. These local government partners are installing physical infrastructure, including larger capital projects, like upgrading wastewater plants, and smaller scale stormwater retrofits that are designed to reduce pollution at its source. Like all infrastructure projects, proper installation and maintenance of pollution reduction practices are necessary to achieve their intended function. Maryland approved verification protocols to ensure pollution reduction practices are working correctly and count towards credit. [11] Local jurisdictions, soil conservation districts, and other partners who are implementing these projects identified maintenance, verification, funding, programs, and accounting as resource challenges that impact restoration progress.

Restoration Capacity

Local partners need continued resources to build restoration capacity. These resources can be in the form of permitting assistance, technical assistance, knowledge transfer, more dedicated staff, and financial incentives. Needs vary regionally, by sector, and within individual jurisdictions. Because there is no one-size-fits-all solution to local challenges, ongoing local engagement and capacity building are necessary throughout the implementation process.

Key Messages

Maryland continuously re-evaluates key messages based on new information on barriers, opportunities, and progress. These general messages will likely remain prominent throughout WIP implementation:

- Work with upwind states through key programs and partnerships, like the Regional Greenhouse Gas Initiative (RGGI), and through appropriate legal actions;
- Work with upstream states and ensure EPA is holding all jurisdictions accountable;
- Ensure all watershed states do their part and are held accountable;
- Maintain a strong commitment to restoration and resiliency;
- Invest in restoration practices that reduce increased pollution resulting from climate change and consider their placement on the landscape for future maintenance;
- Support full funding at the federal, State and local levels for Bay and local waterway restoration and prevention of degradation;
- Stretch funding by using market-based and other innovative finance approaches to create a restoration economy;
- Implement the Clean Water Commerce Act and other mechanisms to fund cost-effective nutrient reduction practices;
- Support reduction of pollution loads from Conowingo Dam through the CWIP and other strategies, including water quality certification;
- Maintain steady restoration progress in the stormwater sector through ongoing MS4 restoration requirements over current and future permit cycles; and
- Plan for continued implementation beyond 2025.

[11] Maryland BMP verification protocols are available at https://mde.maryland.gov/programs/Water/TMDL/TMDLImplementation/Documents/BMP%20Verification/MD_Verification%20Protocols_Master_Doc.pdf

Key Messengers

Key messengers are entities on which the State relies to help deliver communications and engage local governments on the Phase III WIP. In addition to the Departments of Environment and Agriculture, other important messengers include Maryland Department of Planning, Maryland Department of Natural Resources, and numerous NGOs.

Tools and Resources

Engagement takes place in the form of webinars, meetings, fact sheets, phone calls, written correspondence, and training. Table 7 lists the target audiences along with example activities for each. For more examples of engagement activities, see the section on WIP development engagement and communication. In addition, MDE continues to update its Chesapeake Bay webpages[12] to ensure that WIP information is readily available to a broad audience.

Table 7: *Target audiences and associated outreach activities.*

Target Audience	Activities
Local leaders	• Letters • Workshops • Conferences • Meetings
Practitioners	• Workshops • Webinars • Surveys • Meetings • Emails
Technical partners	• Phone calls
Other stakeholders	• Meetings • Emails

IV. Adjustments to Phase III WIP State-Basin Targets and the Phase II WIP Source Sector Goals

In July 2018, the Chesapeake Bay Program (CBP) Partnership agreed on nitrogen and phosphorus planning targets, established at the major basin scale. Maryland received targets for the Eastern Shore, Patuxent River Basin, Potomac River Basin, Susquehanna River Basin, and the Western Shore.

Maryland's Phase III WIP state-basin targets are provided in Table 8. The targets are established at a major basin scale so that Maryland has targets for the Eastern Shore, the Patuxent River Basin, the Potomac River Basin, the Susquehanna River Basin and the Western Shore. Appendix F provides a detailed description of the process used in establishing the final targets. Maryland's Phase III WIP surpasses the statewide nitrogen and phosphorus targets by 1,000,000 pounds per year and 440,000 pounds per year, respectively. Reductions achieved beyond the targets will be used to meet future reduction requirements, including those due to climate change.

Sediment loads are managed in the Chesapeake Bay Total Maximum Daily Load to specifically address the water clarity/submerged aquatic vegetation (SAV) water quality standards. Research has shown that

[12] MDE's Chesapeake Cleanup Center: https://mde.maryland.gov/programs/water/TMDL/TMDLImplementation/Pages/cb_tmdl.aspx

the water clarity/SAV water quality standard is generally more responsive to nutrient load reductions than it is to sediment load reductions. This is because algae fueled by nutrients can block as much, or more, light from reaching SAV as suspended sediments.

The sediment targets developed for the Phase III Watershed Implementation Plans (WIPs), as they have been for previous WIPs, will be formed on the basis of the sediment load delivered to the Chesapeake Bay associated with management actions taken to address the Phase III WIP nitrogen and phosphorus targets. In other words, the Best Management Practices (BMPs) that are identified in this WIP to meet the Phase III WIP nitrogen and phosphorus targets will be run through the Chesapeake Bay Program (CBP) partnership's Phase 6 suite of modeling tools, and the resulting sediment loads will form the basis for the Phase III WIP sediment targets. These sediment loads will be adjusted proportionally to account for any overshooting or undershooting of the Phase III WIP nitrogen and phosphorus targets. An additional 10% allowance will be added to the calculated Phase III WIP sediment target in each major basin.

The resulting final Phase III WIP sediment targets will be appended to this final Phase III WIP in October 2019, once they have been approved by the CBP partnership. The Phase III WIP sediment targets will not affect the BMPs called for in the WIP and are not intended to be the driver for implementation moving forward.

Table 8: *Maryland's Phase III WIP nutrient pollution targets by major basin.*

Major Basin	Phase III WIP Target *(Million lbs/yr)*	
	Nitrogen	Phosphorus
Eastern Shore of Chesapeake Bay	15.6	1.29
Patuxent River Basin	3.1	0.30
Potomac River Basin	15.8	1.09
Susquehanna River Basin	1.6	0.05
Western Shore of Chesapeake Bay	9.6	0.95
Total	**45.8**	**3.68**

V. Development and Implementation of Local Planning Goals

In the Phase II WIP, Maryland used an equity-based approach to set local targets where each jurisdiction and pollution source sector received a goal that would achieve a similar percentage of pollution reductions. Through this approach, the State assumed that similar pollution reductions in each sector would require a similar level of effort. As Maryland implemented the Phase II equity approach, it was clear that some sectors, such as stormwater and septic, faced significant implementation challenges.

Upgrades to stormwater and septic systems often require additional resources and face more roadblocks to implementation than other sectors. These roadblocks include private landowner permission, long planning horizons, and the preparation and approval of engineering plans and permits. Once in the ground, these practices achieve modest reductions relative to large capital projects, like wastewater upgrades. A sustained effort is needed to build the number of these practices and make significant future reductions.

Understanding these challenges, Maryland took a different approach in Phase III to setting local goals. The State met with local implementers, including county governments and Soil Conservation Districts (SCDs), to understand their planned implementation efforts between now and 2025 and identify the challenges and strategies that could increase the pace of work. Local jurisdictions gave these local Best Management Practice (BMP) planning scenarios to the State to run through the Chesapeake Assessment Scenario Tool (CAST) model. This model run determined the loads generated by the scenarios and set goals for each local jurisdiction and sector for 2025.

The State compiled this information in county summary sheets (Appendix C) that are components of the statewide strategy. These summary sheets describe anticipated implementation across sectors planned between now and 2025 and resulting estimated nitrogen goals by sector for each county. Additionally, Maryland recognizes that there is an additional level of effort required beyond 2025 to achieve some sector goals and maintain others.

Maryland uses these goals as the basis for tracking local implementation progress through two-year milestones and the annual progress evaluation process. Additionally, the State tracks its overall progress through sector and basin targets. While the primary goal of the WIP is to meet nitrogen, phosphorus, and sediment goals, it is necessary to recognize that there are other benefits to implementation. Such benefits include flood control, new public recreational spaces, sustainable infrastructure, climate mitigation, and aquatic resource improvements to local streams and waterways.

VI. Accounting for Growth

Background

For consistency with the 2010 TMDL, EPA expects jurisdictions to describe how they will offset increased nutrient and sediment loads resulting from growth. Further, EPA asks jurisdictions to consider using NPDES regulations to offset or adjust source sector goals for new loads. Jurisdictions should also describe the programs and regulations that they intend to implement to maintain existing beneficial land covers. EPA allows jurisdictions to factor growth projections into their milestone commitments.

Maryland established an Accounting for Growth (AfG) Workgroup in 2013, after completing the Phase II WIP, to find common ground, clarify areas of disagreement, and make recommendations for an AfG policy in advance of formally proposing regulations. The 2013 AfG workgroup achieved consensus on all but two key policy issues: (1) calculating the allocation of loads for new development and determining associated offset requirements and; (2) establishing geographical boundaries for pollution trading. While Maryland has nutrient trading regulations to address trading geographies, the State has not yet determined the specific nitrogen offset requirements for growth. The State's ultimate goal is to have a balanced AfG program that is succinct, cost-effective, and easy to explain.

Because Maryland does not have regulations in place to offset increased loads from new sector growth, the State currently offsets loads through accelerated pollution reductions in the wastewater and agricultural sectors. Additionally, Maryland has land conservation, preservation, and growth management programs that limit growth impacts to the natural environment. To sustain Chesapeake Bay restoration and accommodate projected growth, Maryland needs to implement an adaptive growth policy through the accountability and adaptive management framework. This framework must regularly revisit sector-loading trends and provide sufficient offsets to stay under the State's pollution reduction targets.

Trends

Maryland is expected to grow by approximately 15,000 households per year through 2045, resulting in increased nutrient pollution[13]. Overall, Maryland projects that expected load reductions under the Phase III WIP will overcompensate for new loads from development and increased agricultural animal populations beyond 2045. This section details pollution reduction and growth trends by each sector and programs in place to curtail new pollution.

Agriculture:
According to SDAT, which tracks acres subject to the agricultural transfer tax, Maryland lost about 5,103 acres of farmland in 2018. The annual loss of farmland has been historically low in Maryland since the Great Recession in 2008. During the housing boom of the early 2000s, annual loss was much higher. For example, in 2004, according to SDAT, the State lost 22,451 acres of farmland. The Bay Program has projected a continued loss of farmland through 2025.

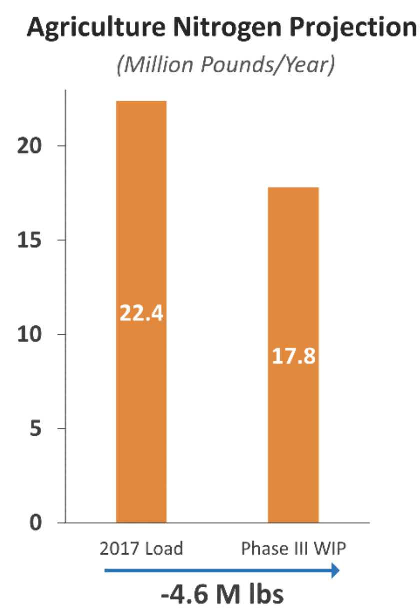

Figure 6: *Current and projected nitrogen loads to Chesapeake Bay from agriculture.*

Forest Loss:
Current projections (CAST "current zoning" scenario for Maryland) estimate 3,000-acres of forest loss annually. Forest is vital to Bay health because it produces the lowest nutrients and provides many co-benefits, including carbon sequestration, the shading, and cooling of streams, and wildlife habitat. Slowing, and ideally reversing forest loss, is imperative to sustaining the health of Maryland's local waters and the Chesapeake Bay.

[13] Maryland Department of Planning, Projections and State Data Center, August 2017

To minimize the loss of State forest resources during land development, Maryland enacted the Forest Conservation Act (FCA) in 1991. Any activity requiring an application for a subdivision, grading permit, or sediment control permit on areas 40,000 square feet (approximately 1 acre) or larger is subject to the FCA and requires a Forest Conservation Plan. During the first fifteen years of implementation, FCA was responsible for the review of 199,925 acres of forest. Of those nearly two hundred thousand acres, Maryland saw 120,638 acres of forest retained, 71,885 acres cleared, and 21,461 acres planted with new forest. Thus, at least twice as many acres were protected or planted as were cleared.

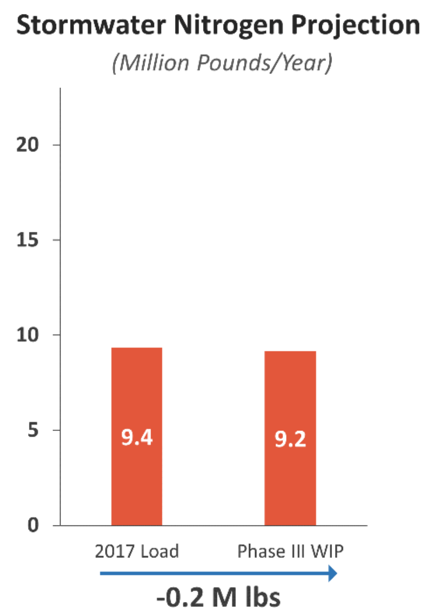

Figure 7: Current and projected nitrogen loads to Chesapeake Bay from stormwater.

Forest restoration and a 2025 conservation goal are part of the Vital Habitats goals in the 2014 Chesapeake Bay Watershed Agreement. This conservation goal sets to "protect an additional two million acres of lands throughout the watershed—currently identified as high conservation priorities at the federal, state, or local level—including 225,000 acres of wetlands and 695,000 acres of forest land of highest value for maintaining water quality." Appendix D provides information on Maryland's land conservation programs. Appendix B identifies tree planting and riparian buffers goals to help meet Bay agreement goals.

Figure 8: Current and projected nitrogen loads to Chesapeake Bay from septic.

Stormwater:

Current projections from 2018 -2025 (CAST "current zoning" scenario for Maryland) estimate new development creates 900-acres of impervious per year. Unabated, new growth would result in an approximately 2 percent increase in stormwater nitrogen loads by 2025. However, due to stormwater pollution reduction practices, the stormwater sector is expected to offset this growth and decrease nitrogen loads by about 190,000 pounds from current loads (Figure 5). After agriculture and wastewater, stormwater is Maryland's third highest nutrient loading sector to the Bay at approximately 17 percent of the total nitrogen load. By 2025, stormwater nitrogen pollution is estimated to comprise 20 percent of Maryland's nitrogen loads to the Chesapeake Bay. To address stormwater impacts from new development, Maryland implemented the "Stormwater Management Act of 2007" (Act). Before this Act, Maryland's Stormwater Design Manual encouraged environmental site design (ESD) through a series of credits. The Act requires that ESD, through the use of nonstructural best management practices and other better site design techniques, be implemented to the maximum extent practicable. ESD practices infiltrate stormwater into vegetation and soils, reducing nitrogen loads from new development.

On-Site Disposal Systems:
Current projections (CAST "current zoning" scenario for Maryland) estimate approximately 1,700 new on-site disposal systems (septic systems) per year between now and 2025. Nitrogen loads from septic systems will decrease by an estimated total of 40,000 pounds from 2018 to 2025 (Figure 8). The State and local governments partially offset this growth by upgrading an average one thousand two-hundred conventional septic systems per year to best available technology (BAT)[14]. By 2025, Maryland's septic loads are expected to comprise approximately 7 percent of the overall nitrogen load to the Chesapeake Bay.

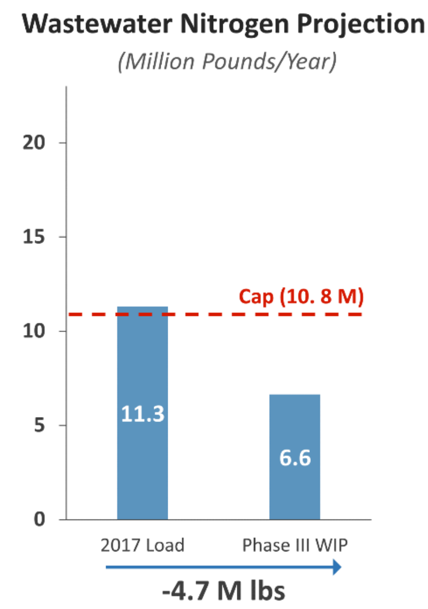

Figure 9: *Current and projected nitrogen loads to Chesapeake Bay from wastewater.*

Centralized Wastewater:
Maryland's 67 major wastewater treatment plants have NPDES total nitrogen, total phosphorus, and suspended solids permit limits to control the effluent concentration and volume of daily flow discharged. Approved design capacities (Table 9) are the basis for loading limits. These major plants are projected to be below their nitrogen pollution cap in 2025 by approximately 4.7 million pounds (Figure 9) because they are not at full design flows and because the State is upgrading them all to "best available technology." This projection also accounts for the assumption that wastewater flows will continue to grow by approximately 0.6 percent each year[15].

In short, over performance in the wastewater sector is more than enough to offset anticipated growth in the urban and agricultural sectors. Wastewater loads will be approximately 4.2 million pounds below its loading cap through a combination of better treatment performance (3.25 mg/L total nitrogen) than required under permit and operating below full design flows (Figure 9).

Table 9: *Design capacity and average daily flows for Maryland's major wastewater treatment plants.*

WWTP	Approved Design Capacity (MGD)	Average Flow (MGD)*
Aberdeen	4.000	1.677
Aberdeen-APG	2.800	0.596

[14] Maryland BAT database
[15] This estimate is based on MDP's population projections published in August 2017. The percent increase assumes a constant percent growth from 2015 to 2025, from 5.99M to 6.34M people. While growth is presented as a statewide number, plant flow increases were based on county-specific projections.

WWTP	Approved Design Capacity (MGD)	Average Flow (MGD)*
Aberdeen-APG Edgewood	3.000	0.592
Annapolis	13.000	7.880
Back River	180.000	135.048
Ballenger Creek	18.000	6.692
Beltsville USDA East	0.620	0.281
Blue Plains	169.600	114.572
Boonsboro	0.530	0.302
Bowie	3.300	1.483
Broadneck	6.000	4.503
Broadwater	2.000	1.004
Brunswick	1.400	0.527
Cambridge	8.100	2.639
Celanese	2.000	1.490
Centreville	0.500	0.095
Chesapeake Beach	1.500	0.775
Chestertown	1.500	0.639
Conococheague	4.100	2.292
Cox Creek	15.000	9.957
Crisfield	1.000	0.557
Cumberland	15.000	7.469
Damascus	1.500	0.749
Delmar	0.850	0.687
Denton	0.800	0.412
Dorsey Run	2.000	1.455
Eastern Correctional Institute	1.140	0.529
Easton	4.000	2.463
Elkton	3.050	1.732

WWTP	Approved Design Capacity (MGD)	Average Flow (MGD)*
Emmitsburg	0.750	0.495
Federalsburg	0.750	0.272
Fort Detrick	2.000	0.840
Fort Meade	4.500	3.538
Frederick	8.000	5.943
Freedom District	3.500	2.017
Fruitland	0.800	0.593
Georges Creek	0.600	0.907
Hagerstown	8.000	6.732
Hampstead	0.900	0.510
Havre de Grace	2.275	1.928
Hurlock	1.650	1.231
Indian Head	0.500	0.352
Joppatowne	0.950	0.851
Kent Island	3.000	1.916
La Plata	1.500	1.098
Leonardtown	0.680	0.538
Little Patuxent	25.000	18.271
Marlay Taylor (Pine Hill Run)	6.000	3.737
Maryland City	2.500	1.241
Maryland Correctional Institute	1.600	0.873
Mattawoman	20.000	9.290
Mayo Large Communal	0.820	0.359
Mount Airy	1.200	0.707
Northeast River	3.000	1.104
NSWC-Indian Head	0.500	0.403
Parkway	7.500	6.230

WWTP	Approved Design Capacity (MGD)	Average Flow (MGD)*
Patapsco	73.000	55.584
Patuxent	7.500	5.149
Perryville	1.650	0.664
Piney Orchard	1.200	0.593
Piscataway	30.000	24.204
Pocomoke City	1.470	0.962
Poolesville	0.750	0.507
Princess Anne	1.260	0.551
Salisbury	8.500	4.359
Seneca Creek	26.000	14.008
Snow Hill	0.500	0.322
Sod Run	20.000	10.893
Swan Point	0.600	0.109
Talbot County Region II	0.660	0.346
Taneytown	1.100	0.735
Thurmont	1.000	0.630
US Naval Academy	1.000	0.080
Western Branch	30.600	19.957
Westminster	5.000	4.702
Winebrenner	1.000	0.206
Total Volume	**787.555**	**535.636**

*Based on data from State Fiscal years 2016-2018

Strategies

Accounting for Growth

Maryland has a four-pronged strategy to account for growth in the Phase III WIP. These strategies consider growth impacts to the 2025 restoration deadline and address growth in loads beyond 2025:

1. *Projected 2025 Conditions Have Been Built into the 2025 Pollution Reduction Targets*

In developing the Phase III WIP to meet 2025 pollution reduction targets, the CBP's Principals Staff Committee (PSC) agreed in December 2017 to use 2025 projected conditions to account for growth impacts on land use and populations. Consequently, Maryland's Phase III WIP strategies have already accounted for projected 2025 growth in calculating each sector's load reduction. The Chesapeake Bay Program (CBP) modeling team will confirm each jurisdiction's Phase III WIP pollution reduction practices on their 2025 forecasted conditions to ensure practices account for growth and achieve restoration targets.

2. *Maryland's Current Land Use Policy BMPs Conservation and Protection Plans Have Been Incorporated in the 2025 Land Use*

CBP allowed Bay jurisdictions to modify the future land use scenarios for projecting 2025 growth conditions to reflect existing and proposed conservation and protection efforts, such as agricultural and forest conservation, and growth management (e.g., local zoning). Because Maryland and local governments have many existing land use preservation and protection programs in place, the State included these programs in a Conservation Plus scenario (Appendix D) and incorporated it into the Bay model. This process allowed Maryland to take credit for the nutrient load reductions from these programs. This credit helps to account for a specific portion of future projected growth in loads.

Maryland worked to have existing State and local Land Use Policy BMPs credited for load reductions. There is also the possibility of getting additional credit for new Land Use Policy BMPs that entities propose to implement through 2025. However, Maryland has not yet determined the load reduction effect of new Land Use Policy BMPs, including expanded and targeted land preservation programs.

3. *Maryland's Resource Protection Programs and Associated Strategies for Increasing Those Protections are Being Incorporated into the Phase III WIP*

Appendix D describes current natural and aquatic resource protection and conservation programs, as well as the strategies for programmatic improvement. Because the model cannot quantify this information, it represents a qualitative approach to managing growth and land change. However, this approach is essential to successful Bay cleanup because it is significantly less expensive than restoration to protect and conserve high functioning ecosystems and the lands on which they depend.

4. *Adaptive Management to Address Growth in Loads Post-2025*

Maryland projects that expected load reductions under the Phase III WIP overcompensate for the growth in loads from development and agriculture and keep the State under its Phase III WIP nutrient targets beyond 2045. Through two-year milestones and associated progress evaluations, Maryland uses an adaptive management process to ensure any growth in loads does not exceed restoration targets.

Challenges and Opportunities

Once achieved, Maryland will need to maintain the Bay TMDL beyond 2025. The anticipated load increases from Conowingo Dam, population growth, and climate change highlight the importance of Maryland having a proactive and adaptive policy that addresses growth in pollution loads. In order to maintain the Bay TMDL after 2025, Maryland needs to continue to achieve sufficient load reductions that offset increases in loads from growth. Post-2025 load reductions can contain a variety of measures, including continued MS4 permit implementation, innovative WWTP technology improvements, land use policy BMPs (defined below, i.e., Conservation Plus), and accounting for growth policies. The types of post-2025 load reductions needed will depend on specific growth patterns, trends, and implementation of the adaptive management framework to establish appropriate offsets to new pollution.

VII. Maryland's Holistic Approach to Addressing Conowingo Dam's Pollution Impacts

Scientific analysis shows that Bay watershed jurisdictions need to reduce an additional six million pounds of nitrogen and 260,000 pounds of phosphorus to mitigate the water quality impacts of the Conowingo Dam's lost trapping capacity. This lost capacity threatens the ability of both the State and the region to meet their Chesapeake Bay clean up goals.

In 2018, the Chesapeake Bay Program (CBP) partnership unanimously agreed on the need to develop an additional plan to address loads from Conowingo. This plan, called the Conowingo Watershed Implementation Plan (CWIP), is to specifically reduce pollution associated with the loss of the Conowingo Dam's capacity to trap sediment in the reservoir behind the dam. Recently, EPA took an important step by issuing a Request for Applications (RFA) for work on the CWIP. Furthermore, EPA plans to award one to three cooperative agreements for work that supports the efforts of the watershed jurisdictions, along with other partners, to restore the Bay. The work proposed by the RFA includes facilitating the development and implementation of a Conowingo WIP, the development of a comprehensive financing strategy and implementation plan, and the development of a system for tracking, verifying, and reporting results. The CBP partnership is still developing the CWIP timeline and will release it for public comment sometime after the jurisdictions' WIPs.

Maryland made significant progress toward solving environmental problems stemming from the Conowingo Dam. This progress includes EPA's recognition of the CWIP multi-state strategy. The CWIP involves hiring a third-party fundraiser, project coordinator, and Maryland's selection of a winning bidder to carry out a pilot project for dredging, beneficial reuse, and characterization of sediments behind the dam. Furthermore, the Hogan administration issued a comprehensive set of environmental protection requirements to Exelon Corporation, the owners of Conowingo Dam, as conditions for dam relicensing. These environmental protections, in combination with the CWIP, encompass Maryland's multi-pronged, multi-state, and public-private strategy to address water pollution impacts associated with the Conowingo Dam.

Maryland Environmental Service (MES), in coordination with MDE and the Governor's Bay Cabinet, selected the joint venture Northgate Dutra to carry out a pilot project. This pilot will test the quality of sediment throughout the Conowingo reservoir, as well as dredge and beneficially repurpose a small portion of the reservoir. The purpose of this test is to create a market for the cost-effective recovery of potentially useful material that now threatens water quality in the Susquehanna River and the Chesapeake Bay. The proposed pilot project schedule provides for the work to be substantially complete in 2019.

Concurrently, Exelon is seeking a 50-year federal license renewal for the dam's operation. Under federal law, and as part of the Federal Energy Regulatory Commission's relicensing process, Exelon is required to obtain a Clean Water Act, Section 401 Water Quality Certification from the State for the continued operation of the dam. The certificate enforces the requirement that the facility's operation complies with State water quality standards.

In 2018, the Hogan administration issued a comprehensive environmental plan for the Conowingo Dam, Susquehanna River, and the Chesapeake Bay to drive major restoration and pollution prevention efforts upstream and downstream of the dam. The plan, contained in a Water Quality Certification issued by MDE, includes special conditions for the proposed dam relicensing. Relicensing requires the applicant, Exelon Generation Company LLC, to reduce water pollution that flows from the dam to the Susquehanna River and the Chesapeake Bay. The certification requires Exelon to improve conditions for aquatic life, including changes in its control of water flow from the dam, and installation of equipment to improve migration of fish to upstream spawning areas. Additionally, the certification requires Exelon to improve its management of debris that collects at the dam, including conducting a feasibility study on a solar-powered trash collection wheel.

This multi-pronged, multi-state, public-private strategy to address impacts to Chesapeake Bay from Conowingo Dam ensures all appropriate partners are working together to solve this challenging pollution problem. More information will be provided to the public once it is available.

VIII. Climate Change

Background: PSC Three-Part Strategy

The Chesapeake Bay region is projected to experience changes in temperature, sea level, and precipitation as a result of climate change (Najjar, et al. 2010; Johnson et al., 2016). These changes are expected to affect nutrient and sediment loads to the Chesapeake Bay, and in turn, affect the Bay's health (Sinha et al., 2017, Wang et al., 2017; Irby, et al. 2018; Herman, et al. 2018; Linker, et al., 2018). Preliminary estimates show that Bay watershed jurisdictions need to reduce an additional 9 million pounds of nitrogen and 0.5 million pounds of phosphorus to respond to both current reduction goals and climate change. Models attribute an estimated 2.2 million pounds of the watershed-wide nitrogen load to Maryland. The CBP Partnership is still refining these preliminary estimates.

Members of the Principals Staff Committee (PSC), who represent the Bay-state governors, agreed to a three-part adaptive management process in March, 2018. This process recognizes that information is needed to refine estimates of future changes in nutrient and sediment loads and their impact on Bay water quality. Similarly, more information is needed to quantify changes in the effectiveness of pollution control BMPs resulting from climate change.

The PSC's three-part strategy going forward includes:

1. **Incorporate Climate Change into Phase III WIPs:** Include a narrative strategy in the Phase III WIPs that describes Bay watershed and local jurisdictions' current action plans and strategies to address climate change.
2. **Understand Climate Change Science:** The CBP Partnership will sharpen the understanding of the impacts of climate change on the Bay and identify research needs, improve the understanding of BMPs, and refine nutrient and sediment load estimates for each jurisdiction in March 2021.
3. **Incorporate Climate Change into Milestones:** Bay jurisdictions will account for additional nutrient and sediment loads, as well as improved understanding of BMPs, beginning in September 2021. A Phase III WIP addendum, 2022-2023 two-year milestones, or both will reflect these changes.

Although climate adaptation is the primary climate-change-related directive for the Phase III WIP, mitigation of greenhouse gases is also of pressing importance. Consequently, in developing Maryland's Phase III WIP, MDE sought to identify nutrient and sediment control strategies that can both help mitigate the increase in greenhouse gases and help adapt to anticipated climate impacts where possible.

Trends

Climate Science: Historic Trends & Projections

Greenhouse gasses, including carbon dioxide (CO2) and methane (CH4), trap the sun's heat in Earth's atmosphere (Wogan, 2013). This natural process, by which gasses trap heat in the Earth's atmosphere, is called the greenhouse effect and is necessary to sustain most life on the planet. However, since the industrial revolution, humans have radically increased the amount of these gasses in the atmosphere and are causing the greenhouse effect to trap more heat. This increased thermal energy is leading to gradual, long term changes to regional climates, such as increased air temperatures and changes in precipitation.

Of particular concern, the greenhouse effect is expected to cause more variable and extreme day-to-day weather, including more intense storms. In 2016 and 2018, two such storms hit old town Ellicott City, Maryland. These storms produced an extraordinary one in one thousand years rainfall, a 0.1% per year probability, twice in the same city in only two years. Maryland can also expect to experience periodic, intense dry spells and heat waves.

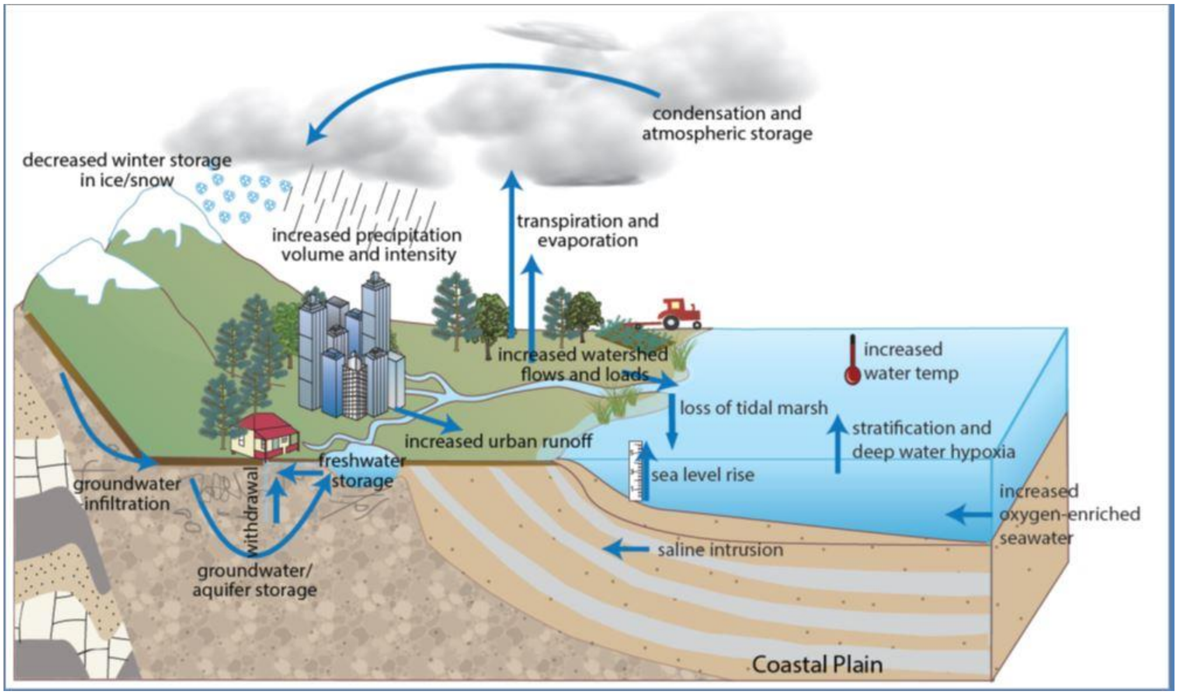

Figure 10: *Key changes on the land and in the water that are expected to impact the Chesapeake Bay. (Source: CBP modified, Univ. MD IAN 2011).*

On the land, increased precipitation volume and intensity are expected to cause more nutrient and sediment runoff into the Bay. As of 2017, the average annual precipitation in parts of Maryland has already increased as much as 10 percent compared to the first half of the 1900s (Easterling et al.). Maryland's average annual precipitation is projected to increase an additional 10 percent from current amounts by 2100 (Easterling et al.). Additionally, more intense storms are expected to change the effectiveness of BMPs to control pollution runoff. Watershed computer models are used by the CBP partnership to estimate future changes like these on the landscape.

In the Chesapeake Bay, more pollution runoff from the land, increased water temperatures, changes in salinity, sea level rise,[16] and changes in pH, among other things, interact in complex ways to impact water quality (Figure 10). These changes impact algal growth, water clarity, and dissolved oxygen levels, all of which affect fish, crabs, oysters, and other living resources. Hydrodynamic and water quality modeling tools are used to estimate some of these changes in the Bay.

The costs to human life, livelihoods, and the economy from climate-induced extreme weather are severe and increasing. Figure 11, sometimes called a Haywood Plot, depicts by month and year the accumulated number of weather-related disaster events costing more than $1 billion. Six of the last ten years exceeded

[16] For planning purposes, the likely range (66% probability) of the relative rise of mean sea level expected in Maryland between 2000 and 2050 is 0.8 to 1.6 feet, with about a one-in-twenty chance it could exceed 2 feet and about a one-in one hundred chance it could exceed 2.3 feet. Later this century, rates of sea level rise increasingly depend on the future pathway of global emissions of greenhouse gases during the next sixty years: mde.maryland.gov/programs/Air/ClimateChange/MCCC/Documents/sea levelRiseProjectionsMaryland2018.pdf

the average number of storms costing more than $1 billion. Years 2011 and 2017 tied for the national record of 16 $1 billion storms, with 2017 setting record overall storm costs of $306.2 billion. This record year shattered the previous record of $214.8 billion (CPI-adjusted) in 2005 from the impacts of Hurricanes Dennis, Katrina, Rita, and Wilma[17].

These enormous costs are raising questions, nationally and in Maryland, whether building and rebuilding should continue in areas with repeat catastrophic weather events. As the State continues to invest in BMPs to restore the Bay, it must carefully consider their placement to avoid areas that are at risk from the most severe climate impacts

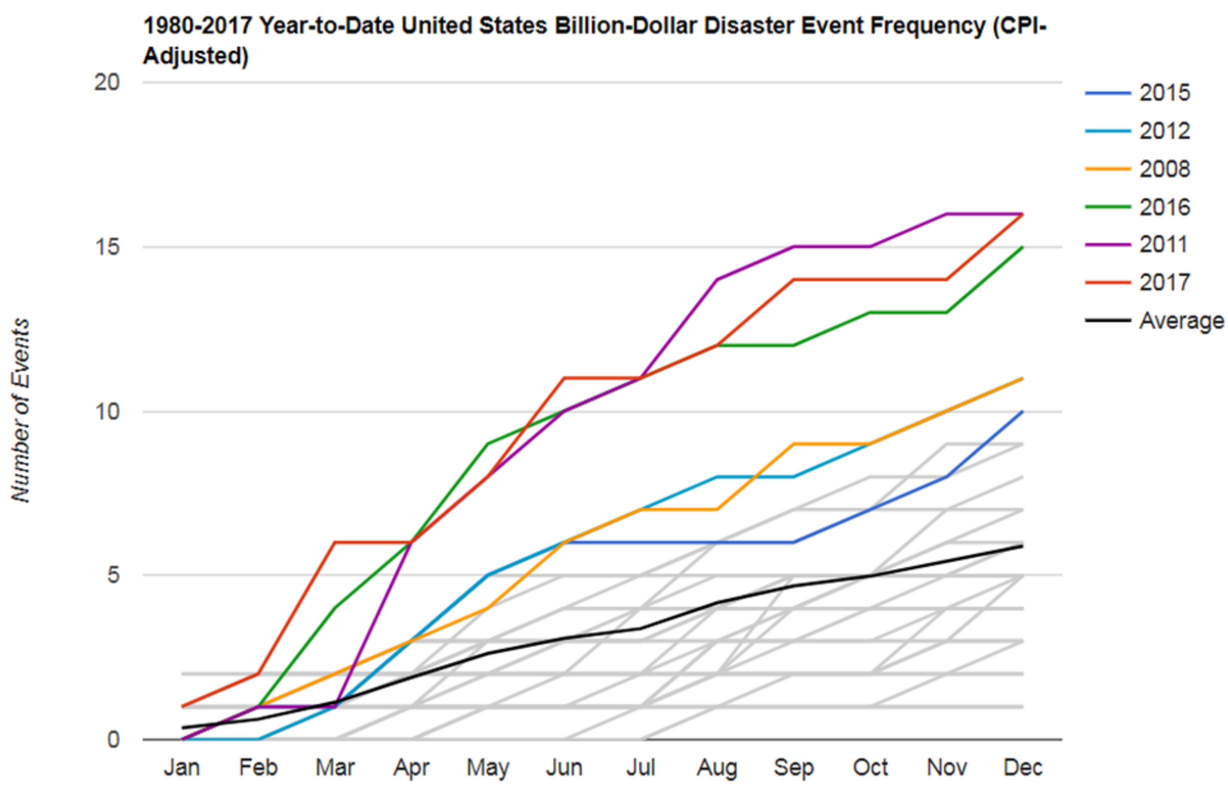

__Figure 11:__ Cumulative number of disaster events, in a given year, that exceed one billion dollars in damage. Source: Smith, A B, NOAA Climate.gov.

The United Nations' International Panel on Climate Change (IPCC) issued a special report in October 2018 on a 1.5 degree centigrade (1.5°C) temperature increase from pre-industrial levels. It highlighted the devastating climate impacts that could be avoided by limiting the temperature rise to 1.5°C. Limiting the rise to 1.5°C requires a 45 percent reduction of anthropogenic greenhouse gas (GHG) emissions from the 2010 baseline by 2030 and achievement of zero net emissions[18] by 2050 (UN IPCC 2018).

The urgency of this scientific finding has driven Maryland to elevate the importance of GHG mitigation in the Bay restoration strategy. Fortunately, broadening the lens to consider the intersection of climate

[17] **Smith, A B, NOAA Climate.gov**

[18] According to the IPCC definition, net zero emissions are achieved when anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period.

mitigation, climate adaptation, and nutrient reduction offers new management efficiencies and financing opportunities.

Strategies

The State identified strategies that address both climate change management and Bay restoration including the existing foundation of climate change plans, action strategies, legal authorities, and governance structures. This comprehensive foundation will help assure integration of climate change management with Chesapeake Bay WIP implementation.

1. WIP Strategies that Address Climate Change

Maryland's Phase III WIP includes actions that primarily reduce nutrients and sediments while also mitigating or adapting to a changing climate. These State actions also provide information to develop BMP implementation scenarios that better address nutrient and sediment loads resulting from climate change.

General Climate Strategies

Several strategies apply broadly, including developing new science and several aspects of funding the Phase III WIP. These general strategies are:

Strategy 1: Climate Science & Research

Maryland is committed to adopting improved climate science by including refined nutrient reduction goals in 2021, BMP efficiencies into a future WIP addendum, two-year milestone commitments in 2022, or both. Research may be needed to meet future load requirements and understand how future conditions affect the State's ability to meet its water quality targets. The State will pursue:

- **BMP Site Selection and Design:** Design and site BMPs that are expected to persist and perform in a changing climate. The State's early efforts reflect this commitment, including 2013 guidance, *Best Management Practices: Preserving Clean Water in a Changing Climate*. Part of Maryland's strategy is to engage with the CBP partnership in ongoing BMP design and siting research[19].

- **Trends Analyses:** Review current climate data and trends that may affect load targets, including sea level, precipitation patterns, temperature, and ecosystem response.

- **Saltwater Intrusion:** Investigate the impact of saltwater intrusion on soil composition and the potential for nutrient leaching from soils. Maryland will also investigate adaptation options, like salt-tolerant plants that soak or take up nutrients.

[19] In 2017 the Chesapeake Bay Program Science and Technology Advisory Committee (STAC) Workshop released a Report, *Monitoring and Assessing Impacts of Changes in Weather Patterns and Extreme Events on BMP Siting and Design*. Although it was inconclusive about the quantitative impacts of climate change on BMPs, it laid the foundation for continued evaluation of this subject.

- **Beyond 2025:** Acknowledge that climate conditions will continue to change after 2025. The State anticipates that 2050 climate projections will inform future Bay restoration strategies.

Strategy 2: Local Engagement and Education

Maryland is committed to advancing the capacity of State and local government agencies, infrastructure organizations, and businesses to develop and implement sound climate change initiatives. These climate initiatives will ensure current and future public health, security, and economic prosperity. To achieve this vision, the State, in partnership with the Association of Climate Change Officers, has established the Maryland Climate Leadership Academy.

The Maryland Commission on Climate Change (MCCC) workgroup on Education, Communication, and Outreach (ECO) is another institutionalized avenue for local engagement. The MCCC Adaptation and Response Working Group (ARWG) coordinates closely with Maryland's Bay restoration process and includes local engagement in its annual work plan.

Strategy 3: Incentives and Funding

Maryland anticipates Bay restoration costs to rise for at least four reasons. First, increasingly frequent and severe extreme weather events will damage BMPs and necessitate more inspections, maintenance, or replacement. Second, more BMPs need to be installed to compensate for an anticipated loss of BMP pollution reduction efficiency. Third, additional BMPs are likely needed to address increased future pollution loads. Fourth, restoration actions will entail more complex multidisciplinary considerations, as exemplified in the *Climate Smart Framework and Decision Support Tool*, developed by the Chesapeake Bay Program (Johnson, Z. 2018).

The following are strategies that Maryland is committed to implementing:

- **Existing Restoration Funding Sources:** Refine restoration and resource conservation criteria for grant prioritization to favor projects that include climate co-benefits. This prioritization includes review criteria for State land conservation and preservation purchases.

- **Volkswagen Settlement Funding:** Maryland received $75.7 million in settlement funds from Volkswagen's illegal pollution emissions. Much of this money will be used to electrify transportation in Maryland, which will reduce CO_2 emissions and decrease nitrogen deposition to the Chesapeake Bay.

- **Coast Smart Construction Criteria:** The State developed the Coast Smart Construction Infrastructure and Design Guidelines in 2014 to increase the resilience of State capital investments to sea level rise and coastal flooding. In 2018, legislation expanded the application of criteria to other projects which may create additional opportunity to implement resilient designs. Coast Smart practices include identifying, protecting, and maintaining ecological features that buffer a project from the impacts of future sea level rise, coastal flooding, or storm surge. Protecting and maintaining these ecological features is a co-benefit to Bay restoration.

- **Managing Forests:** The State plants and manages forests to capture carbon on both public and private lands. Enrolling unmanaged forests into management regimes enhances forest productivity which increases rates of carbon sequestration in forest biomass and the amount of carbon stored in harvested durable wood products. Trees in urban areas directly impact Maryland's carbon budget by helping to offset some of the greenhouse gas emissions from power production and vehicles, reducing heating and cooling costs and energy demand by moderating temperatures around buildings and slowing the formation of ground level ozone as well as the evaporation of fuel from motor vehicles. Implementation is supported by several other Maryland laws and programs that include outreach and technical assistance for municipalities to assess and evaluate their urban tree canopy goals and plant trees to meet those goals.

- **Resiliency through Restoration Initiative:** Recognizing that coastal habitats help buffer communities from climate-related impacts, the state launched a new Resiliency through Restoration Initiative. The department state provides technical and financial assistance to restore, enhance and create coastal habitat with the goal of protecting Maryland communities and public resources from extreme weather and climate-related events.

- **Department of Natural Resources/Department of Transportation Memorandum of Understanding:** The Maryland Department of Natural Resources has partnered with the State Highway Administration (SHA) in an effort to lead by example in restoring the Chesapeake Bay and local waters. State parks will provide opportunities for the State Highway Administration to implement restoration projects required by their Federal Stormwater Permit (MS4) and their nutrient and sediment reduction goals required under the Bay Total Maximum Daily Load (TMDL). A Memorandum of Understanding was signed in 2013 to initiate this program and is currently being updated to provide additional guidance. This MOU will increase the rate of restoration projects on state and public lands and will provide opportunities to focus on projects that offer cumulative benefits for climate, water quality and habitat.

- **Innovative Technology Fund:** Expand the scope of eligible techniques and technologies to include consideration of climate aspects of Innovative Technology Fund project proposals. The State will invest in the research, development, and commercialization of solutions addressing climate mitigation to help accelerate the adoption of climate resiliency and GHG mitigation.

- **Climate Mitigation and Adaptation Synergies:** Many Bay restoration actions sequester large amounts of GHGs. These include protecting and restoring tidal wetlands and seagrass ecosystems (coastal blue carbon), forest conservation, forest management, conversion of non-forest to forest, riparian forest buffers, and healthy soils practices (collectively called terrestrial carbon removal). Maryland commits to aligning its GHG reduction strategy (i.e., the Greenhouse Gas Reduction Act (GGRA) plan) with its Bay restoration strategy to generate mutually beneficial results that are greater than the sum of their parts:

    - Better alignment of management resources used to implement and track mutually beneficial practices can result in cost efficiencies and better outcomes;

- Recognizing that actions that generate monetary value associated with both nutrient and carbon reductions should translate to greater public and private financing opportunities and incentive frameworks.

The following are preliminary ideas that Maryland will consider:

- **Water Quality and Climate Change Resiliency Portfolio:** Maryland works to restore the Chesapeake Bay and improve its environmental and economic resilience to a changing climate. Many of the actions needed to achieve these objectives are similar. Yet, many practitioners do not coordinate these actions as much as they could, or should, to maximize benefits to both. This effort identifies a long term portfolio of natural infrastructure projects that optimize water quality, living resources, GHG reduction, and other environmental benefits. Moreover, this effort reduces the risks posed by a changing climate to the commercial economies and recreational opportunities essential to Maryland's working coast. Having a pipeline of identified projects better prepares Maryland and its communities to build climate resilience by taking advantage of existing and emerging funding opportunities that promote the use of natural infrastructure. The State has identified potential funding opportunities:

    - **Climate Funding Sources:** There are climate and hazard mitigation oriented grants that the State has not traditionally targeted for Bay restoration outcomes or complementary water quality and climate benefits. Maryland could explore these funds for their potential to achieve restoration co-benefits. This strategy is similar to the Community Resilience Grant Program that funds climate resiliency projects with water quality benefits, as well as the new Federal Emergency Management Administration job aid that allows the use of hazard mitigation grant funding for restoration projects that build resilience.

    - **Expansion of Maryland's Building Resiliency through Restoration Initiative:** Maryland could explore opportunities that expand incentives for projects that build resilience and reduce the vulnerability of communities and infrastructure from the impacts of extreme weather events, climate hazards, and flooding.

    - **Strategic Energy Investment Fund (SEIF)**: Sales of CO2 credits generate funds for investments in energy efficiency, clean energy, and renewable energy. These investments reduce air emissions and associated land deposition, thus contributing to the State's climate and water quality goals. Administered by the Maryland Energy Administration, the potential exists for SEIF energy investments to provide further co-benefits by leveraging energy efficiency grants with water quality financing (e.g., funding energy efficiency grants for wastewater treatment plants to increase their financial capacity to afford pollution controls).

    - **Climate Cost Estimate and Funding Options:** Maryland could investigate options for achieving additional load reductions and identifying associated costs due to climate change. As needed, the State could explore options for generating further revenue to cover any additional public sector costs. The State would outline funding options for any identified additional public sector costs when it submits its implementation strategy to reduce climate change loads in the Phase III WIP addendum, the 2022-2023 two-year milestones, or both.

- **Carbon Markets for Nutrient Reduction Practices:** Maryland's GGRA plan is accomplishing the reduction of GHG emissions. This plan includes participation in the RGGI, a cap-and-invest framework for large, fossil fuel-fired electric power generators. Furthermore, Maryland could explore the development of a carbon market that credits nutrient reduction practices with GHG co-benefits. This carbon market would augment programs that incentivize the implementation of BMPs associated with Bay restoration. Practices, such as cover crops, riparian buffers, and conservation provide water quality benefits while also improving soil health and sequestering carbon.

Strategy 4: Accountability

Maryland includes accountability strategy elements to ensure that Bay restoration planning and implementation have climate resilience co-benefits:

- **Two-Year Milestones:** Maryland documents the adaptation of its Chesapeake Bay nutrient reduction strategies to climate change through specific actions in its two-year milestone framework.

- **Emerging (Long-Term) Strategies:** Maryland will identify incremental research and development steps in future two-year milestone commitments to ensure that emerging reduction strategy options remain on track.

- **Comprehensive Strategy for Reducing Maryland’s Vulnerability to Climate Change (Phase I & II):** This comprehensive strategy sets implementation targets for each adaptation action. The Adaptation and Response Workgroup of the MCCC oversees a review of progress on these implementation targets. The State will align WIP commitments with this comprehensive strategy and its accountability tracking framework.

- **BMP Verification:** Maryland’s BMP verification protocols provide the foundation for the likely increased frequency of inspection and maintenance that will be necessitated by the stresses of climate change-induced extreme weather (MDE 2016).

Climate Change Strategy Highlights by Source Sector

Agriculture

- **Current WIP Strategies:**

  - Many traditional agricultural BMPs provide environmental benefits beyond water quality. Practices such as residue and tillage management, cover crops, crop rotations, composting, riparian buffers, biomass plantings, and rotational grazing, among others, support and enhance soil health. These practices increase organic matter, sequester carbon in the soil, reduce soil erosion, promote nutrient cycling, improve water retention, and reduce competition from weeds and pests.

- **Contingency and Long-Term Strategies:**
  - Innovative animal waste management technologies offer energy savings and GHG emissions reductions that are climate co-benefits.
  - Agricultural Wetland Incentives: Maryland could explore revising State investment prioritization criteria and policies to incentivize land conservation easements that promote the conversion of flooded or salt-impacted agricultural lands to wetlands. The process could explore the use of wetlands mitigation funds and public-private partnership opportunities with stakeholders who value diverse habitat for birds and other wildlife. Where appropriate, Maryland could explore the introduction of salt-tolerant crops. Similar partnerships have helped accelerate trout habitat restoration and conservation in the State.
  - Cropland irrigation with wastewater effluent has the potential to reduce nutrients to the Bay while creating climate resiliency by assuring a reliable supply of water for crops. Although some degree of crop irrigation with wastewater effluent is currently occurring in Maryland, it is currently not used as an explicit agricultural nutrient management practice.
- **Programmatic and Educational Outreach Strategies:**
  - In collaboration with conservation partners, MDA is developing a Healthy Soils Program focused on accelerating educational outreach and promotion of a wide variety of agricultural and climate management co-benefits.

Wastewater Treatment Plants

- **Current WIP Strategies:**
  - Land application of wastewater treatment plant biosolids increases the organic content of sandy soils, thereby increasing carbon and water retention.
  - Energy-saving pumps lower long-term wastewater treatment implementation costs and reduce GHG emissions.
- **Contingency and Long-Term Strategies:**
  - Anaerobic digestion of food waste at WWTPs utilizes existing centralized facilities, provides an energy source, reduces a large waste stream to landfills, reduces GHG emissions, and offers cost savings[20].

Septic Systems

- **Current WIP Strategies:**

[20] https://archive.epa.gov/region9/waterinfrastructure/web/pdf/why-anaerobic-digestion.pdf

- Mounting solar panels on OSDS.
- Setback OSDS from waterbodies to prevent flooding.
- Bermed infiltration pond removal in response to sea level rise.

Urban and Suburban Stormwater, Including Erosion and Sediment Control

- **Current WIP Strategies:** In addition to reducing nutrient and sediment pollution, the base mission of stormwater management provides climate resilience from erosion control, groundwater recharge, flood control, and stream channel protection. Maryland adapts its stormwater programs to climate change by maintaining and repairing critical stormwater management infrastructure, including dams.

- **Contingency and Long-Term Strategies:**

  - The State could explore establishing an emergency dam repair fund and revolving loan fund for fortifying Maryland's stormwater management infrastructure for increased precipitation events. Fortifying these structures would also ensure continued nutrient processing and uptake that occurs in impoundments.
  - Stormwater BMP Siting and Design: Based on the outcome of research into how precipitation changes will affect stormwater design storms, Maryland is considering changes to its erosion and sediment control and stormwater programs.

- **Programmatic and Educational Outreach Strategies:**

  - Maryland continues to leverage its funding to support projects that inform how climate impacts interact with stormwater management practices. The State could consider additional funding or other strategies that facilitate ongoing academic research into stormwater design guidelines for increased precipitation events.

Conservation and Natural and Working Lands

- **Current WIP Strategies:** Conservation and management of natural and working lands reduce nutrient loading to the Bay and promotes climate resilience. Several intentional strategies include:

  - Forest harvesting on State lands employs practices that sequester carbon. These practices include utilizing broader buffers, where half the buffer is out of an active management zone, and variable-density harvesting. Variable-density harvesting leaves different types of trees to provide habitat and seed sources. The trees left unharvested may be a combination of single trees, providing desired seed sources or serve as a future snag, or clumps of trees selected because they are in a wetter area or contain mast-bearing species (such as hickory or beech). Adaptive Silviculture for Climate Change collaborates with partners, including Baltimore City, to work on a regional effort to develop locally appropriate techniques. These efforts create more diversity in the landscape providing enhanced resiliency.
  - The Sustainable Forestry Initiative, forestry boards, and Forestry Stewardship Council are evaluating sustainable forestry certification programs for opportunities to enhance climate resiliency. MDA, U.S. Forest Service, forestry stewardship councils and University of

Maryland-Cooperative Extension are developing new conservation easement mechanisms to promote adaptation stewardship activities on private lands.

- Maryland is working to promote the use of locally produced woody biomass for generation of thermal energy and electricity. Energy from forest by-products can be used to offset fossil fuel-based energy production and associated greenhouse gas emissions. There are many end users that could potentially benefit from such a program, including Maryland's public schools which could employ wood heating and cooling; hospitals which could utilize wood as a primary heating/cooling source; municipalities which could utilize local fuel markets as a key component of their urban tree management programs; and all rural landowners who would have access to a wood fuel market.
- The "Marylanders Plant Trees" program, is a $25 coupon reimbursement program targeting individuals wishing to plant a tree. It enables very small lot owners to purchase a tree valued at $50 or more and reduce the cost by the use of the $25 coupon.
- Program Open Space (POS) directs its funding towards GreenPrint Targeted Ecological Areas. Wetlands that support coastal resilience, as well as climate change adaptation areas for future wetlands are noted as key ecological benefits. These benefits are provided by areas along the shoreline where natural habitats, such as marshes and coastal forests, have the potential to reduce the impact of coastal hazards to the adjacent coastal communities by dampening waves, stabilizing sediment and absorbing water. This recent enhancement complements existing land conservation criteria that avoids conserving lands that will be inundated by sea-level rise and targets adaptation areas important for wetland migration. The Stateside Program Open Space scorecard provides the ecological, resiliency and management justification that Maryland's Board of Public Works relies upon to approve funding for land conservation.
- The Accounting for Maryland's Ecosystem Services framework provides economic values for seven non-market ecosystem services, including carbon sequestration, nitrogen removal, groundwater recharge, and stormwater mitigation that have climate resilience value. Among the Ecological Benefits assessed are the Coastal Community Resiliency and Future Wetland Habitat scores. The Coast Community Resiliency score describes the potential of a parcel's existing natural habitats, such as marshes and coastal forests, to reduce the impact of coastal hazards to adjacent coastal communities. The Future Wetland Habitat score identifies areas important for inland wetland migration resulting from sea level rise that will support high value coastal habitats of the future. Among the Ecosystem Services assessed are the parcel-level biophysical and economic values of annual Net Carbon Sequestration in forests and wetlands. Carbon sequestration directly offsets carbon emission within the state of Maryland and represents a critical component to the GGRA workplan. This component of the tool allows for identification and conservation of natural habitats providing high carbon sequestration benefits.
- Encouraging broader riparian buffers along stream corridors to allow for channel migration resulting from increased precipitation.
- In addition to forests, wetlands are known to be very efficient at sequestering carbon. The state is planting forested stream buffers and pursuing the creation, protection and restoration of wetlands to promote carbon sequestration through several means including the Natural Filters Program, which restores wetlands and buffers on state and public lands to meet water quality goals and is provided through the Chesapeake and Atlantic Coastal Bays Trust Fund. Projects such as the Pocomoke River restoration encourages broader

riparian buffers along stream corridors to allow for channel migration resulting from increased precipitation.

- **Contingency and Long-Term Strategies:**
  - Maryland could enhance shoreline suitability analyses and conduct property owner and marine contractor social marketing research to increase the adoption of living shoreline erosion techniques. Landowners simply do not recognize the value of living shorelines when compared to traditional structures like bulkheads and revetments. Likewise, contractors play an important role in recommending the best practices to landowners, so they need to have the knowledge to confidently build and maintain living shorelines as well as to provide accurate cost estimates for installation to the public. Living shorelines provide coastal communities resilience to sea level rise while reducing erosion and ecosystem benefits.
  - Maryland could evaluate the reuse of dredged material for living shorelines and other beneficial uses, including marsh elevation enhancement (i.e., thin layer placement), that help communities respond to rising sea levels, sequester carbon and provide for potential commercial or recreational uses.

2. Supporting State and Local Legislative, Governance and Strategic Climate Frameworks

For over a decade, Maryland has developed an extensive set of plans, action strategies, legal authorities, and governance frameworks to mitigate and adapt to climate change. This foundational framework enables more rapid progress on WIP implementation than would otherwise be possible. Elements of this framework include:

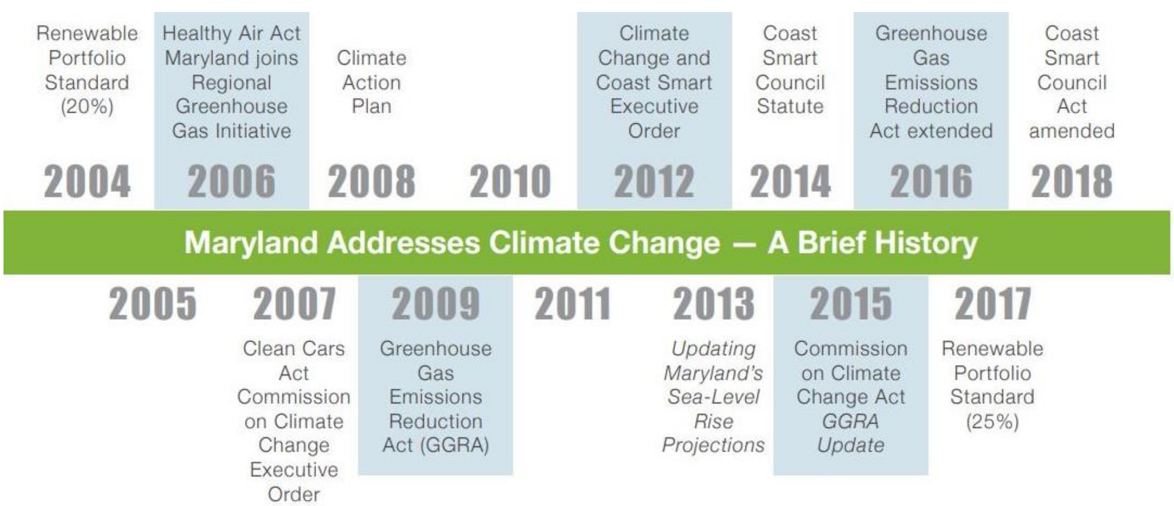

Figure 12: *Brief History of Maryland's Climate Actions. Source: University of Maryland Center for Environmental Science (UMCES) Sea Level Rise Projections for Maryland 2018.*

A. Legislative and Executive Actions

Maryland has historically been at the forefront of states taking action to address both the drivers and consequences of climate change. Over the past decades, the State has consistently advanced efforts to combat climate change with legislation and policy initiatives (Figure 12).

B. Governance Structures for Managing Climate Change

Maryland institutionalizes its commitment to addressing climate change in governance structures that span state, regional, national, and international levels:

State Level

At the state level, the State charges the MCCC with advising the governor and General Assembly "on ways to mitigate the causes of, prepare for, and adapt to the consequences of climate change.” An executive order established the MCCC in 2007 and the State codified it into law in 2015.

A 26 member steering committee leads the MCCC with broad representation, including State agency cabinet members. Maryland aligns the climate aspects of it Bay restoration strategy with the four workgroups of the MCCC: the Adaptation and Response Working Group; the Education, Communication, Outreach Working Group; the Mitigation Working Group; and the Scientific and Technical Working Group. The State expects the MCCC, in concert with the governor’s Chesapeake Bay Cabinet, to play a central role in advancing Maryland’s Chesapeake Bay climate adaptation actions.

The MCCC and its workgroups annually provide recommendations and strategies that align with the two-year Bay restoration milestones addressing climate change. The following link details the activities of the MCCC and its workgroups: mde.maryland.gov/programs/Marylander/Pages/mccc.aspx.

Regional Level

Regionally, Maryland is a signatory to the 2014 Chesapeake Bay Watershed Agreement, which includes a Climate Resiliency Goal. Maryland is committed to this goal, the monitoring and assessment outcome, and the adaptation outcome.

Maryland is also a member of the RGGI. The RGGI is a cooperative effort to cap and reduce power-sector CO2 emissions among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

National & International Levels

Nationally, and internationally, Maryland is a member of the U.S. Climate Alliance of 17 states and the territory of Puerto Rico. Members of the Climate Alliance are committed to doing their share towards meeting international climate agreements. These governance structures institutionalize leadership processes and coordination that help provide avenues for accelerated learning, technology transfer, and adoption of best practices. Moreover, these structures and leadership processes support a framework of accountability.

C. State and Local Climate Change Plans and Strategies

Maryland's commitment to addressing climate change is reflected, in part, by a variety of plans and strategies. The State's foundational adaptation strategies, which were developed by the Adaptation and Response Workgroup of the MCCC, are found within the *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change*:

- *Phase I: Sea Level Rise and Coastal Storms* (Johnson, 2008).
- *Phase II: Building Societal, Economic and Ecological Resilience* (Boicourt, 2010).

The Adaptation and Response Working Group tracks progress on the actions outlined in the comprehensive strategy. Many of the strategies recommended by the working group and implemented by the state relate to BMP implementation that reduce nutrient and sediment loads or slows the growth in loads by preserving natural lands.

The State also incorporates local plans in addressing climate change. Six local governments developed plans between 2008 and 2018 that either directly or indirectly address climate change impacts. Furthermore, 15 of Maryland's counties and Baltimore City have specifically mentioned climate change and the effects of climate change in their comprehensive plans (Maryland Department of Planning, 2018).

3. Implementation Guidance

Providing implementation guidance is part of Maryland's strategy for aligning Bay restoration and climate change management. Although technical materials and tools have been developed to guide restoration in the context of climate change, the field is new and rapidly evolving. The following websites provide some of the latest information:

Maryland Commission on Climate Change: The commission coordinates climate change activities for the State, including mitigation, adaptation, science and education, communication, and public outreach.

Maryland Department of Environment: The Air and Radiation Administration leads the State's efforts on greenhouse gas mitigation.

Maryland Department of Natural Resources: DNR plays a significant role in climate adaptation, with an emphasis on mitigating coastal hazards and protecting and restoring the resilience of natural resources.

Chesapeake Bay Program Climate Resiliency Workgroup: The workgroup coordinates climate-related efforts to address climate resilience for the CBP Partnership as deemed a priority of the Chesapeake Bay watershed.

Challenges and Opportunities

Climate change presents significant challenges for achieving Bay restoration goals. However, many opportunities exist to leverage commonalities between managing climate change and Bay restoration:

- **Chesapeake Bay Water Quality will be Affected by Climate Change:** Climate change is predicted to increase nutrient and sediment loads to the Chesapeake Bay and will change water quality characteristics including water temperature, dissolved oxygen, and clarity. The CBP partnership is committed to developing refined quantified estimates of these pollution loads and water quality impacts in 2021.

- **Pollution Control Practices will be Affected by Climate Change:** BMPs used to control water pollution will likely become less effective at controlling extreme storm events and damaged from the stresses of climate change. The CBP partnership is committed to better understanding these impacts and making adjustments to management practices in 2022 via two-year milestone commitments.

- **The Cost of Achieving and Maintaining Chesapeake Bay Water Quality Goals will be Affected by Climate Change:** More restoration practices will be necessary if the water quality impacts of increased nutrient and sediment loads are not offset by climate change altering the flow and circulation of the Bay. This impact from climate change, in addition to BMPs becoming less effective and requiring more maintenance, could cause an increase in the cost of restoring the Bay. In anticipation of this, Maryland is committed to investigating ways of funding the incremental increase in cost.

- **Bay Restoration Mitigates Greenhouse Gases in Addition to Adapting to Climate Change:** The main interest in accounting for climate change in the Phase III WIP is to adapt to impending shocks from the changing conditions. However, many restoration practices that sequester carbon in soil and plant matter also have significant nutrient reduction benefits. Aligning Maryland's GHG reduction actions with Bay restoration actions offers the prospect of powerful financing synergies borne out the recognition of increased value for the same action.

- **Quantifying Maryland Specific Air Reductions:** Maryland is evaluating reductions in nutrient deposition from State-specific regulations and facilities, beyond federally mandated requirements. This line of inquiry can potentially benefit climate change and Bay restoration management goals mutually. Please see Appendix G for detailed information on Maryland's Phase III WIP air deposition strategy.

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IX. Reasonable Assurance and Accountability Framework

Section 303(d) of the CWA requires that a TMDL be "established at a level necessary to implement the applicable water quality standard (WQS)." Federal regulations [40 CFR 130.2(i)] also define a TMDL as "the sum of the individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background." Section 7 of the 2010 Chesapeake Bay TMDL requires jurisdictions to provide reasonable assurance that they will achieve nonpoint source component of the TMDL and the LAs. EPA does this to ensure that the expected voluntary nonpoint source reductions are realistic and achievable and that the regulatory WLA is set at the appropriate level to achieve WQS.

Balanced Approach of Regulations and Incentives

Maryland uses a balanced approach of regulations and incentives to ensure that the State meets WQS and that the TMDL allocations are achievable. On the regulatory side, Maryland has tools under both the Federal CWA and State law that set numeric permit limits, restoration conditions, or other requirements for the regulated community. Some examples across sectors include:

- Federal NPDES permit limits on WWTP pollution discharges;
- Federal and State restoration requirements for areas under municipal separate storm sewer permits (MS4s), which require stormwater management retrofit practices;
- State requirements for agricultural nutrient management plans;
- State BAT requirements for onsite (septic) systems in the Critical Area (within 1,000 feet of tidal shorelines).

The State backs these regulatory requirements with effective compliance and enforcement programs that, where necessary, can implement legal backstops to ensure restoration progress.

Also, Maryland has pollution sources that do not have regulatory cleanup requirements, such as small communities with no Bay restoration requirements for pre-law stormwater discharges (non-MS4s). These non-regulated pollution sources play an essential role in achieving Bay restoration targets. Due to budgetary constraints and a lack of funding sources, financial incentives are critical drivers of restoration progress for these non-MS4 jurisdictions. Some examples of incentive programs to drive restoration progress through voluntary efforts include: Maryland's cover crop program supported through the BRF; local stormwater remediation projects funded through the Trust Fund; operations and maintenance incentives to improve wastewater treatment performance beyond regulatory requirements; and, BRF to upgrade failing septic systems outside of the Critical Area.

Moreover, restoration progress, whether driven through regulations or incentives, is not even across sectors. Accelerated pollution reductions through wise use of enhanced technology and capacity at WWTPs, as well as on farms, are the primary drivers of Maryland's success in meeting its 2025 Bay restoration targets. Challenges in the stormwater and septic sector, including numerous distributed systems over large areas, private property interests, longer implementation horizons, and required engineering plans and approvals limit the pace of restoration. Therefore, continued steady progress in both the stormwater and septic sectors is necessary to ensure that pollution reductions keep pace with increased loads from climate change and growth. Phase 1 and 2 MS4 permits now cover over 90 percent of Maryland's developed landscape and are legally enforceable mechanisms to ensure steady restoration progress. The State ensures continued steady progress in the septic sector through upgrades, sewer hookups, and the recent septic stewardship law that helps local jurisdictions with septic maintenance through pumpouts.

Locally-Driven Restoration and Leveraging Co-benefits

County governments, municipalities, soil conservation districts, farmers, citizens, and NGOs are the boots on the ground implementing restoration practices through permits or grant/incentive programs. Sufficient local capacity and close collaboration with these local partners ensures successful Chesapeake Bay restoration. To ensure continued local progress, restoration practices must be cost-effective, achievable, and provide benefits to communities while addressing local challenges, like flooding. State agencies work with local partners to develop strategies that address barriers through two-year milestones and progress evaluations. These adaptive strategies accelerate implementation that is cost effective and meets local needs. Already, Maryland is forming a workgroup to improve technical assistance delivery to local partners, as well as working with those partners to develop a strategic implementation plan for addressing local restoration challenges.

Financial Assurance, Creating a Restoration Economy and Driving Innovation

In FY00–18, Maryland spent approximately $8.4 billion on Chesapeake Bay restoration activities (Table 10), $3 billion of which the State appropriated within the last three years. This amount includes funding for activities that directly reduce nutrient and sediment inputs to the Bay (e.g., cover crops and WWTP upgrades), activities that indirectly support Bay restoration (e.g., monitoring, education, outreach), and activities that prevent or minimize future degradation of the Bay (e.g., land conservation).

Recent actions that are important to highlight are:

1. Full funding of the Trust Fund;
2. Increased focus on cost efficiency in both the BRF and Trust Fund;
3. Development of an operational Water Quality Trading Program;
4. Passage of the Clean Water Commerce Act;
5. Progress on addressing the impacts of the pond behind the Conowingo Dam reaching its long term sediment and nutrient trapping capacity.

Table 10: *Fiscal Year 2000 - Fiscal Year 2018 Maryland Bay restoration funding summary.*

Category	Total Fiscal Year 00 - Fiscal Year 18 Funding Amount (millions)*
Bay Cabinet Agencies (DNR,MDE,MDA,MDP,) Bay Restoration Funds	$4,774 M
Land Conservation(POS and Rural Legacy)	$615 M
Agricultural Land Preservation	$487 M
GO Bonds[21]	$1,583 M
Transportation[22]	$1,534 M
Education	$101 M
Total	**$8,414 M**

Important caveats and approximations must be recognized in interpreting Table 10:

1. **Data is not consistent over time:** Records are less accessible and, therefore, reported funding amounts are less reliable for the beginning of this period than more recent years.

2. **Not all funding goes directly to reducing pollutant loads to Chesapeake Bay:** Bay Restoration involves a diversity of vital functions beyond reducing nitrogen, phosphorus, and sediments entering the Bay. For example, water quality monitoring is essential to track progress and direct future actions to the most cost-effective practices; education and outreach are essential to providing Maryland students and citizens with access to and appreciation for a restored Bay; and smart growth and land conservation programs minimize growth impacts and protect the Bay from future degradation. All of these examples, among others, are essential aspects of restoration but do not directly result in reductions in pollutant loadings. As a result, it is inappropriate to divide the total cost presented in this report by the number of pounds pollutant reduction to get a dollar amount per pound reduced.

3. **Judgment calls are necessary for identifying a program as Bay Restoration:** Many state agency programs and budget categories contribute to restoration, as well as other non-Bay related efforts. For consistency, this analysis only contains those programs that are estimated to have more than 50 percent of their activities related to Chesapeake Bay restoration.

While total Bay restoration funding by State agencies varies, the total restoration funds have increased significantly over the last decades. To illustrate, the first three years of the evaluation, FY00-FY02, total

[21] Includes Maryland Department of the Environment Revenue Bonds issued in FY 2016.
[22] Includes Maryland Department of Transportation spending from FY 2009 through FY 2018.

funds were around $800 million. Conversely, the past three evaluated years, FY16-FY18, funding was over $2.5 billion, an increase of over 200%. This increase was driven, in part, by the creation and subsequent funding increases in the two primary Bay restoration Special Funds: The Bay Restoration Fund, and the Chesapeake and Atlantic Coastal Bays Trust Fund.

Table 11 presents the preliminary estimates of overall State costs for key Phase III WIP strategies by sector. These amounts do not account for the estimated $1.6 billion that local governments will spend through 2025 to complete the current Phase 1 and 2 MS4 permits. Phase 1 jurisdictions are required to develop financial assurance plans demonstrating the financial capacity to achieve their stormwater permit requirements. This table also does not include federal funding sources for Chesapeake Bay restoration, such as Chesapeake Bay Restoration and Accountability Grants, Chesapeake Bay Implementation Grants, or federal funding for the Chesapeake Bay Program.

Table 11: *Preliminary estimates of annual State implementation costs by sector to achieve Bay restoration targets.*

Sector	State's Estimated Sector Costs for Key Strategies*
Wastewater	$110-million/yr
Stormwater (does not include transportation)	$90-million/yr
Septic	$11.4-million/yr
Natural Lands	$7.4-million/yr
Agriculture	$54.2-million/yr
Total	**$273-million/yr**

*Costs compiled from Table 1 WIP strategy costs

Table 12 identifies State funding programs for in-ground Chesapeake Bay restoration practices. Comparing this funding to the costs above suggests that Maryland has enough fiscal capacity to assure it will meet Chesapeake Bay's WQS. However, it is important to realize these are preliminary estimates based on current year funding and estimated implementation costs. This analysis also does not factor in the substantial federal and local funding sources that fund implementation efforts to achieve Maryland's TMDL targets. An analysis of current and projected Bay funding will be done by Maryland's Bay Cabinet on an annual basis to confirm Maryland's continued fiscal capacity to achieve and sustain our 2025 WIP targets.

Table 12: *Key State funding programs and amounts for Chesapeake Bay restoration projects.*

Program(s) Name	State's 2019 Program Funding Levels
Bay Restoration Fund Wastewater & Water Quality Revolving Loan Fund	$306-million/yr*
Bay Restoration Fund Septic	$15-million/yr
Clean Water Commerce Act	$6-million/yr
Chesapeake and Atlantic Coastal Bays Trust Fund	$53-million/yr
Maryland Agricultural Cost Share	$9-million/yr
Total	**$389-million/yr**

*Includes $150-million in revenue bonds. Successive years anticipated to be $22-million

In addition to traditional funding approaches, the Hogan administration is pursuing market-based strategies that are designed to stimulate a restoration economy and reduce costs. Nutrient trading is one such tool that allows an entity to purchase non-mandated pollution reductions from another entity. This nutrient trading creates a marketplace that drives innovation across sectors to develop the most cost-effective pollution reduction practices. Moreover, other innovative financing strategies, like the Clean Water Commerce Act and the CWIP, drive innovation by creating funding streams for the most cost-effective practices and by developing collaborative funding models, like public-private partnerships, to reduce public costs of restoration. Aligning Maryland's GHG reduction actions with Bay restoration actions that also significantly sequester carbon can leverage and diversify financing to accelerate pollution reduction practices. Additionally, Maryland is pursuing water reuse technologies that benefit its citizens with long term water supply sustainability, while also reducing pollution loads to the Chesapeake Bay[23].

Accounting for and Leveraging Conservation and Protection Programs

Protecting Maryland's ecologically significant lands, aquatic resources, and wildlife are among the most effective ways to sustain Bay restoration. Protecting these lands ensures the lowest levels of pollution loading by preventing them from being converted to higher pollution land uses, such as new development, that would set Maryland further behind in its restoration goals. Maryland is ensuring its land conservation programs are fully accounted for in the Bay restoration and if fully funding land conservation programs for future acquisitions. Additionally, the State is reviewing current conservation and protection program effectiveness, through monitoring results and other measures, in achieving goals. Maryland is evaluating these programs to further leverage restoration opportunities on conserved and protected lands.

[23] mde.maryland.gov/programs/Water/waterconservation/Pages/water_reuse.aspx

Holistic Ecosystem Management

Although Maryland's Phase III WIP is designed to maintain consistency with EPA's expectations and achieve the TMDL nitrogen, phosphorus, and sediment targets, Maryland is also strongly committed to the broader goals outlined in the current (2014) Chesapeake Bay Agreement[24]. Included in these Bay agreement goals are sustainable fisheries, vital habitats, reducing toxic contaminants, healthy watersheds, land conservation, stewardship, public access, environmental literacy, and climate resiliency. These watershed goals provide critical feedback loops that improve water quality. These improvements can be through aquatic resources, such as restored fisheries providing nutrient uptake and water filtration services, or nitrogen and carbon uptake in the plant tissue of submerged aquatic vegetation. Water quality improvements can also come from land-based practices, including wetlands and forest buffers, which capture and process nutrients before they enter surface waters. Maryland's commitment to this broader ecosystem management framework helps the State achieve its TMDL restoration targets while maintaining the productivity of the Bay's living resources that strengthen local economies.

Accountability and Adaptive Management Framework

As part of the accountability and adaptive management framework, the Chesapeake Bay Program (CBP) partners develop short term goals, called milestones, to ensure restoration progress. Milestones identify the restoration practices, programs, policies, and resources that jurisdictions commit to implementing over two-year periods. EPA evaluates jurisdictions' progress toward achieving their milestone commitments and takes appropriate federal actions, as necessary, to help jurisdictions remain on track.

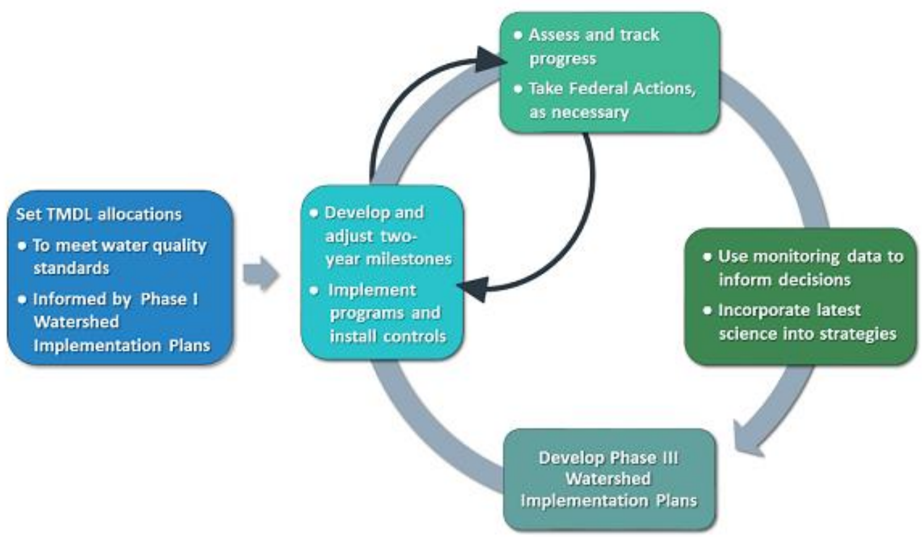

Figure 13: *Chesapeake Bay TMDL Accountability Framework. Graphic courtesy of the EPA Chesapeake Bay Program web site at epa.gov/chesapeake-bay-tmdl/ensuring-results-chesapeake-bay.*

24 chesapeakebay.net/what/what_guides_us/watershed_agreement

Maryland submitted its 2018-2019 milestones to EPA in January 2018 and expects to submit 2020-2021 milestones in January 2020. These milestones serve as essential checkpoints along the path to restoring the Bay by 2025 and include annual evaluations to gauge progress. Milestones provide Maryland the opportunity to adaptively manage the restoration process, incorporate new science on restoration practices performance, and apply key lessons learned from the successes or failures of Phase III WIP. Chesapeake Bay water quality and living resources data are also used to ensure that results are being seen in the Bay, as well as to adjust, as necessary, to new science or changing conditions.

X. Conclusion

There are both substantial challenges and significant opportunities in restoring and protecting the Chesapeake Bay watershed and rich natural heritage that defines this region. To do so, Marylanders must sustain the collective will to revive this national treasure, work to control costs, stimulate a restoration economy, leverage local and regional partnerships, and create private or public partnerships. Moreover, they must implement restoration practices that achieve multiple benefits, promote and adopt innovation, and adaptively manage and build on restoration successes. Finally, successful Chesapeake Bay restoration depends on Maryland's continued strong leadership in the CBP partnership, full commitment from upstream states, and EPA's maintenance of a strong restoration oversight and accountability role.

The Chesapeake Bay is a dynamic system influenced by natural ecosystem processes and the pressures of climate change, population growth, land use changes, and invasive species. Maryland and CBP are committed to the science that informs policy development, measures the effectiveness of management actions, and decisively shows that Bay jurisdictions must sustain restoration beyond 2025. As one participant keenly observed during the State's local engagement process: 2025 is not the end of Bay restoration, but rather another benchmark on the restoration journey.