Appendix B. Sector Reports

Agriculture Sector

Background

Since the development and implementation of the Phase II Watershed Implementation Plan, Maryland farmers have made great progress towards achieving the Chesapeake Bay TMDL. Reductions achieved to date come from the successful implementation of several key conservation programs at MDA that offer assistance to the agricultural community. Voluntary locally-led conservation has been the cornerstone to Maryland agriculture reducing nutrients and sediment to the Chesapeake Bay.

The installation of additional BMPs on agricultural land was accomplished with a combination of technical assistance, provided by Maryland's SCDs and other conservation partners, coupled with State and federal financial incentives. As of FY17, approximately 924,000 acres of agricultural land is managed under a Soil Conservation and Water Quality Plan and nearly 800,000 acres of cropland is cultivated using no-till or conservation tillage practices. In addition, over 57,000 acres of riparian buffers have been planted and 9,500 acres of wetlands have been restored or created.

For over 30 years, the Maryland Agricultural Water Quality Cost-Share (MACS) Program has provided cost-share up to 87.5 percent on the installation of many structural conservation practices. Between FY09 and FY17, MACS provided $54.6 million in grant funding toward the installation of 4,435 practices. In addition, $5.8 million in State financial assistance and $3.6 million from the poultry industry was provided to transport 1.1 million tons of manure from farms with excess or for alternative uses. The State also utilizes portions of the BRF and Trust Fund to incentivize the planting of cover crops following the harvest of summer grain crops. In 2017, the Maryland Cover Crop Program provided $25.6 million in incentive payments to farmers to plant over 560,000 acres of cover crops.

A complete list of Agricultural Best Management Practices implemented as of FY17 can be found in tables B-2 and B-3. Maryland agriculture will build on the success of these programs and our partnerships to continue achieving the remaining WIP reductions.

Programmatic Achievements

- Phosphorus Management Tool (PMT) regulations
- Animal Waste Technology Fund
- Manure Matching Services
- Soil Health and Climate Change Initiatives
- Agricultural Certainty Program
- Nutrient Trading

Trends

Agriculture has made significant strides in reducing nutrient and sediment pollution since 1985, with the 2017 Mid-Point assessment showing that it met its goals for both phosphorus and sediment. While agriculture fell short of its nitrogen goal for the Midpoint Assessment, it has nonetheless made consistent progress in reducing nitrogen and is on track to meet its Phase III WIP goals by 2025 (Figure B-1).

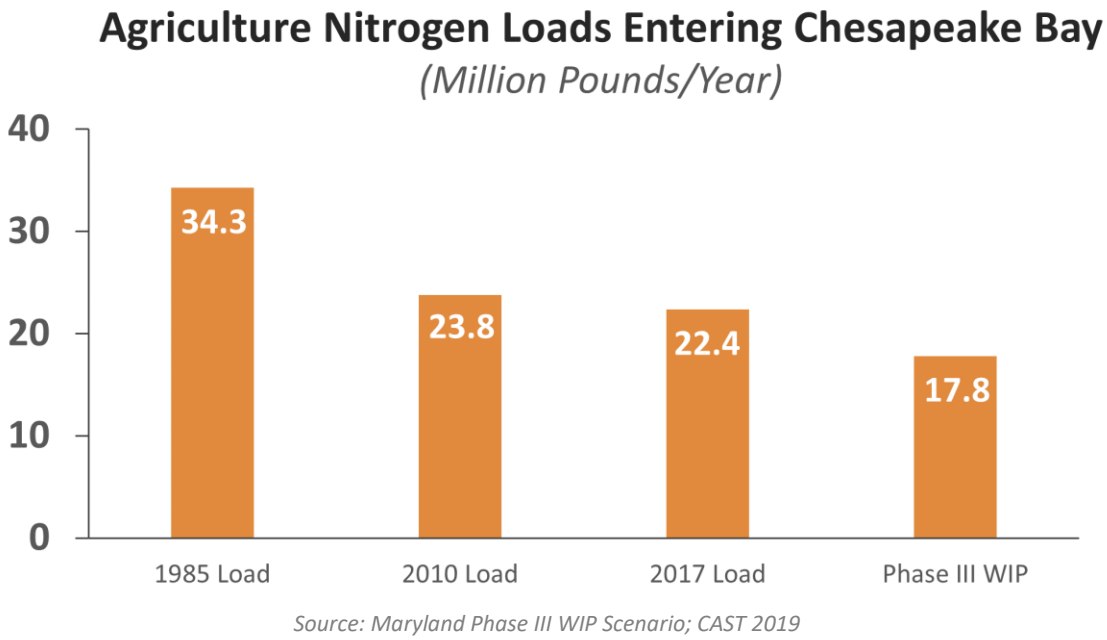


Figure B-1: *Reductions in nitrogen achieved by agriculture since 1985.*

Phase III Development Process for the Agricultural Sector

To develop the Phase III Watershed Plan for Agriculture, MDA actively engaged the agriculture community in Maryland. The department recognized and understood the importance of having a direct dialogue with stakeholders to not only provide an update on progress toward achieving the State's 2025 Chesapeake Bay restoration commitments, but also review background information regarding the accounting of agricultural conservation on the landscape and formulating a realistic plan.

Local Engagement

In cooperation with the Harry Hughes Center for Agroecology, Maryland Department of Agriculture facilitated a kick-off meeting on July 25, 2018 with key agriculture stakeholders to begin outlining the framework for the Phase III WIP. While it was important to provide a general overview of the WIP process, discussions during this Agriculture Leadership Roundtable focused on strategies to increase the adoption of conservation measures to further reduce nutrient losses on agricultural land. A summary of recommendations include:

- Improve the collection of information regarding the implementation of existing conservation practices
- Better enforcement of existing regulations
- Reduce barriers of conservation adoption between tenants and landowners
- Streamline and align current financial incentive programs to foster increased adoption of conservation
- Leverage Pay For Performance options to further incentivize conservation
- Recognize the importance of and building stronger partnerships with agribusiness and nongovernmental organizations
- Ensure the most productive land remains in agriculture production
- Collaborate with institutes of higher education concerning additional research in the development and implementation of conservation practices
- Ensure adequate and properly trained technical resources are available to assist the agricultural community

In addition, the department facilitated a series of locally-led agricultural stakeholder meetings in the summer of 2018 within each of the 23 counties (Table B-1). These meetings were modeled after the Phase II local outreach meetings conducted in 2011, and were organized by the local Soil Conservation Districts (SCDs). The meetings were open to the general public, but a diverse group of stakeholders that represented and specialized in working with the agricultural community were invited to attend. While participation varied by county, attendees included farmers, SCD planners, engineers, technicians, USDA Natural Resources Conservation Service and Farm Services Agency, University of Maryland Extension, county agricultural coordinators, agriculture service providers, representatives from local watershed organizations, Chesapeake Bay Foundation, The Nature Conservancy, Maryland Farm Bureau, Delmarva Poultry Institute, dairy industry, county planning staff, Department of Public Works staff, and health department staff. Over 500 people participated in the meetings.

Stakeholder meetings began with information on current agricultural practices installed and discussed opportunities for further implementation with existing farm management practices and programs. The meetings also focused on local capacity to provide further reductions and commitments by participants to implement and develop a workable local strategy. Each meeting culminated with a revised implementation schedule of conservation measures that stakeholders felt were realistic and achievable by 2025. The county's plan was then assessed using the Chesapeake Bay Program's Chesapeake Assessment Scenario Tool (CAST) to ensure adequate nutrient load reductions compared to the WIP Phase II level of effort. Overall, each county was successful in reaching and/or achieving its allocation by 2025.

Table B-1: *Schedule of County WIP Meetings.*

Date	Time	County	Location
7/25/2018	8:30am - 2:40pm	Anne Arundel	Agriculture Leadership Roundtable DoubleTree 210 Holiday Court Annapolis, Maryland 21401

Date	Time	County	Location
8/7/2018	1:30-3:30 pm	Worcester	County Library Snow Hill Branch 307 North Washington Street Snow Hill, Maryland 21863
8/8/2018	9:30-11:30 am	Somerset	Somerset county Ag Building 30730 Park Drive Princess Anne, Maryland 21853
8/8/2018	1:30-3:30 pm	Wicomico	County UMD Extension Office 28647 Old Quantico Rd Salisbury, MD 21802
8/9/2018	9:30-11:30 am	Dorchester	County Office Building 501 Court Lane Cambridge, MD 21613
8/9/2018	1:30-3:30 pm	Talbot	Talbot County Community Center 10028 Ocean Gateway Easton, MD 21601
8/21/2018	9:30-11:30 am	Caroline	4H Park 8230 Detour Rd Denton, MD 21629
8/21/2018	1:30-3:30 pm	Queen Anne's	County Planning & Zoning 110 Vincit Street, Suite 104 Centreville, MD 21617
8/22/2018	9:30-11:30 am	Cecil	County Admin Building 200 Chesapeake Blvd, Suite 2100 Elkton, MD 21921
8/22/2018	1:30-3:30 pm	Kent	UMD Extension 709 Morgnec Rd #202 Chestertown, MD 21620
8/23/2018	9:30-11:30 am	Harford	Harford SCD 3525 Conowingo Rd Street, MD 21154
8/23/2018	1:30-3:30 pm	Baltimore Co.	Baltimore County Ag Center 1114 Shawan Road # 4 Cockeysville, MD 21030
8/28/2018	9:30-11:30 am	Carroll	Maryland Cooperative Extension 700 Agricultural Center Dr. Westminster, MD 21157
8/28/2018	1:30-3:30 pm	Frederick	Frederick County Extension Office 300 Montevue Ln. Frederick, MD 21701

Date	Time	County	Location
8/29/2018	9:30-11:30 am	Howard	Lisbon Fire Hall 1330 Woodbine Rd Woodbine, MD 21797
8/29/2018	1:30-3:30 pm	Montgomery	Montgomery Co. SCD 18410 Muncaster Road Derwood, MD 20855-1421
8/30/2018	9:30-11:30 am	Prince George's	Prince George's Soil Conservation District 5301 Marlboro Race Track Road, Suite 100 Upper Marlboro, MD 20772
8/30/2018	1:30-3:30 pm	Anne Arundel	Maryland Department of Agriculture 50 Harry S. Truman Parkway Annapolis, MD 21401
9/5/2018	1:30-3:30 pm	Garrett	UMD Extension 1916 MD Highway Mt. Lake Park, MD 21550
9/6/2018	9:30-11:30 am	Allegany	Allegany College of Maryland 12401 Willowbrook Road Cumberland, MD 21502
9/6/2018	1:30-3:30 pm	Washington Co.	Washington County Division of Emergency Services 16232 Elliott Parkway Williamsport, MD 21795
9/7/2018	1:30-3:30 pm	St. Mary's	St. Mary's Ag Center 26737 Radio Station Way B Leonardtown, MD 20650
9/13/2018	9:30-11:30 am	Charles	Charles Soil Conservation District 4200 Gardiner Road Waldorf, MD 20601
9/13/2018	1:30-3:30 pm	Calvert	Harriet E. Brown Center, Room 113 901 Dares Beach Road Prince Frederick, MD 20678

Coordinating Federal Resources in Agriculture

MDA is coordinating with USDA's Natural Resources Conservation Service (NRCS) to maximize the application of federal resources toward WIP achievement. Beginning in FY11, NRCS approached MDA to request a list of practices that were part of the existing two-year milestones. Through this effort, NRCS committed to focus programmatic resources available to Maryland farmers, providing prioritized funding to those practices that were part of the goals. This effort continues through the Environmental Quality Incentive Program and the Chesapeake Bay Watershed Initiative. The MACS Program leverages State

funding by cost sharing the implementation of individual BMPs funded through federal programs.

In addition, the CREP, first instituted in Maryland 1997, seeks to treat 100,000 acres of sensitive agricultural land in the State. Currently, approximately 59,000 acres are under CREP agreements in Maryland. CREP will play an integral role incentivizing the implementation of forest and grass buffers, wetland restoration and treating Highly Erodible Land acres. These correlations of effort with USDA will enhance Maryland's ability to meet WIP targets.

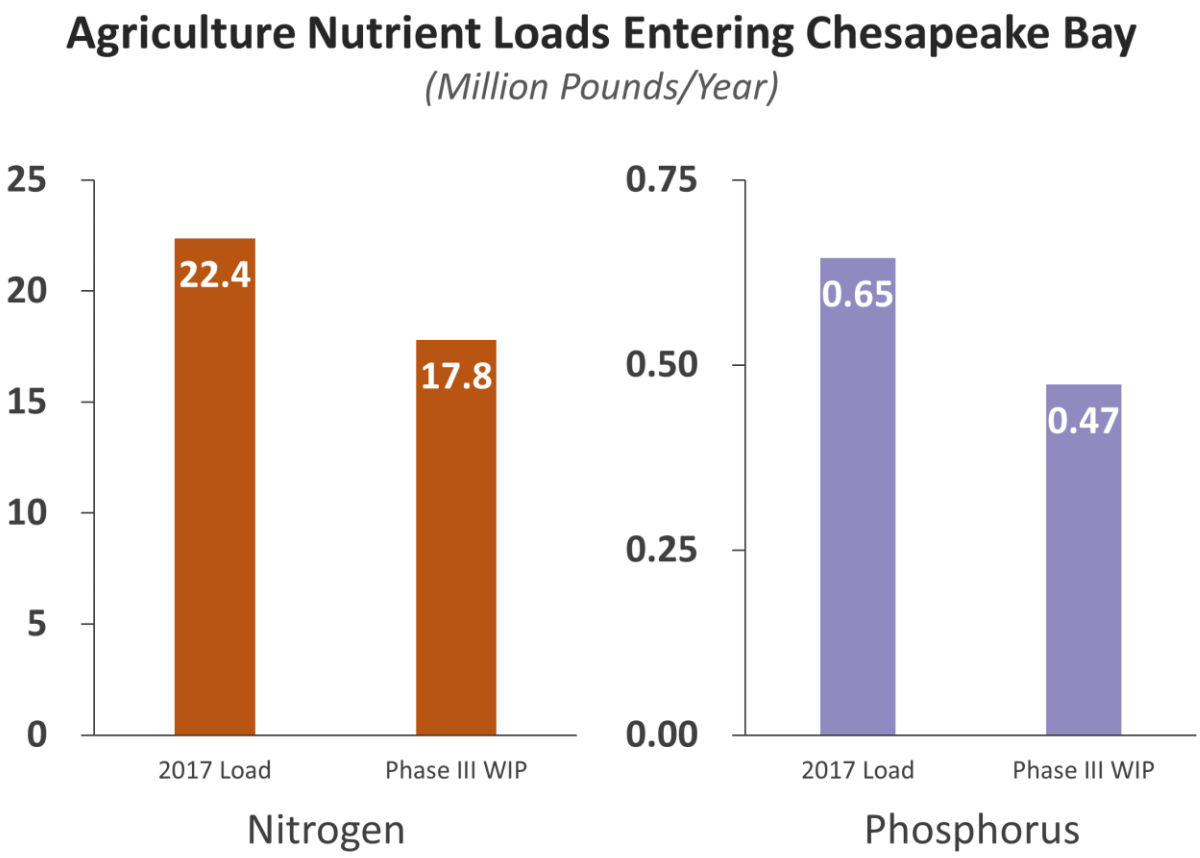
Phase III WIP Agriculture Strategies

Table B-2: *Annual Phase III WIP Agriculture BMP Practices.*

BMPs to be Implemented Annually	Unit	2017 Progress w/Verification	2025 Goal
Conservation Tillage	Acres/Year	194,122	248,111
Cover Crops - Commodity	Acres/Year	81,983	81,998
Cover Crops - Traditional	Acres/Year	476,815	478,391
Cropland Irrigation Management	Acres/Year	118,586	142,732
High Residue Tillage	Acres/Year	647,072	643,284
Manure Incorporation	Acres/Year	133,718	133,816
Manure Injection	Acres/Year	7,931	7,226
Manure Transport	Tons/Year	77,758	97,366
NM Placement	% Acres/Year	<10%	20%
NM Rate N/P	% Acres/Year	<10%	35%/10%
NM Timing	% Acres/Year	<10%	10%
Nutrient Management	% Compliance	61%	70%
Poultry Litter Treatment	% Operations/Year	-	75%
Soil Conservation and Water Quality Plans	Acres/Year	923,896	1,054,607

Table B-3: *Structural Phase III WIP Agriculture BMP Practices.*

Additional Structural Practices to be Implemented	Unit	2017 Progress w/Verification	2025 Goal
Agricultural Drainage Management	Acres Treated	4,836	23,292
Agricultural Stormwater - Poultry	% Operations		65%
Alternative Crops	Acres	14	100
Animal Waste Storage - Dairy	% Animal Units	>75%	90%
Animal Waste Storage - Other Livestock	% Animal Units	<20%	50%
Animal Waste Storage - Poultry	% Animal Units	100%	100%
Barnyard Runoff Control	Acres	1,045	1,234
Cropland Conversion to Pasture	Acres	6,971	10,118
Dairy Precision Feed Management	% Animal Units		90%
Forest Buffers	Acres	18,725	20,274
Grass Buffers	Acres	38,863	43,706
Horse Pasture Management	Acres	2,015	2,763
Land Retirement - Open Space	Acres	17,235	23,053
Livestock Exclusion	% Animal Units		90%
Loafing Lot Management	Acres		84
Mortality Composters	% Animal Units	100%	100%
Non-Urban Stream Restoration	Linear Feet	74,301	135,601
Nursery and Greenhouse Runoff Capture and Reuse	Acres		1,691
Off Stream Watering without Fencing	% Animal Units	<10%	10%
Phosphorus Sorbing Materials in Ag Ditches	Acres	100	100
Prescribed Grazing	Acres	11,857	19,983
Shoreline Management	Linear Feet		32,370
Tree Planting	Acres	3,865	4,461
Wetland Restoration	Acres	9,487	13,620



Source: Maryland Phase III WIP Scenario; CAST 2019

Figure B-2: *Current and projected agriculture total nitrogen and phosphorus loads entering Chesapeake Bay relative to Phase III WIP goals.*

Phase III WIP Implementation

As originally committed in the Phase II Watershed Implementation Plan, MDA will continue to promote and account for the implementation of conservation on agricultural land in Maryland to meet Bay restoration efforts. MDA will rely heavily on the existing conservation partnership between USDA NRCS and FSA, local SCDs, and other State agencies and institutions to deliver the necessary conservation programs to meet goals outlined above. In addition, the Department is excited to partner with many non-governmental organizations to promote the adoption of voluntary conservation on Maryland farms.

To accomplish the Phase III WIP for agriculture, MDA intents to employ a multi-faceted approach. Foremost, it is critical that all existing conservation measures have been properly accounted and credited before additional implementation is considered. Identifying and developing solutions to overcome barriers associated with conservation adoption as well as leveraging new opportunities to enhance and/or develop new programs are also vital.

Accounting for Current Conservation

Better Data

Throughout the county stakeholder meetings, concerns were raised regarding the characterization of agriculture in the Chesapeake Bay Model. Baseline assumptions, such as acres in production, number and type of animals, and manure being generated in each county, have all been questioned. To help better inform the Chesapeake Bay Model, MDA, working through the Chesapeake Bay Program's Agriculture Workgroup, will explore opportunities to more accurately quantify agricultural production. Specifically, the Department will explore the expansion of data being collected on the Nutrient Management Annual Implementation Report, consider the development of industry-specific surveys, and collaborate with industry related to nutrient applications and animal production.

Resource Improvements

In looking forward to Phase III, MDA has recognized the importance of documenting the efforts of the agricultural community to install practices without the technical or financial assistance of the department and its partners. With the certification process of Resource Improvements, MDA has placed an emphasis on utilizing its many programs to document those practices that, while not meeting NRCS standard criteria, are still providing a water quality benefit. Resource improvements are found through the following processes:

- During the development or when updating a conservation plan.
- During BMP verification of other WIP-eligible BMPs.
- During MACS spot checks or quality assurance reviews.
- During nutrient trading evaluations.
- During agricultural certainty evaluations.
- During Farm Stewardship Certification and Assessment Program Evaluations.

Finalized in 2015, MDA developed the Non Cost-Shared Best Management Practice and Resource Improvement Practice Verification Procedures Manual. In it, soil conservation planners, technicians, and other MDA staff are provided certification forms that can be filled out and incorporated into a conservation plan to document farmer-installed conservation efforts. Like many processes, this requires investigative work, including an interview with the cooperator or landowner to determine eligibility and to record WIP-specific data required to pass a certification. Each of the 18 resource improvements has a dedicated one-page description and certification form that details the mandatory visual indicators required for eligibility.

In 2016, MDA held trainings with personnel to educate on identification of resource improvements. This process will continue to be highlighted going forward. To date, a total of 430 individual resource improvement practices have been identified in Maryland. A challenge going forward will be to identify those practices that have been installed on operations that have yet to form a relationship with MDA or its partners.

BMP Verification

Beginning in the fall of 2016, and in response to the mandate that all states and sectors strengthen the accountability and transparency of reported BMP practices, MDA established the BMP Verification Task Force. This group, currently comprised of five individuals, is charged with verifying that installed BMPs that are eligible for nitrogen and phosphorus reduction within the Bay model are functioning as intended and are achieving a water quality benefit. To fulfill this obligation, task force members work regionally and within each SCD to provide a third-party analysis of the data provided within Soil Conservation and Water Quality Plans and MDA's Conservation Tracker database. Working on three-week intervals in each SCD, task force members (verifiers), compare information for installed BMPs that was inputted into conservation tracker with the information provided in each respective conservation plan. After noting any discrepancies in data and mapping BMPs within ArcGIS, verifiers collaborate with SCD personnel to visit farm operations and assess the water quality functionality of each reported BMP.

Each BMP is verified as it relates to its NRCS standard or resource improvement definition as provided by the CBP verification framework. After assessment, BMPs receive one of the following status determinations: Meets Standard, Does Not Meet Standard, No Longer Present or Does Not Exist, or Meets Standard but No Animals Present (Figure B-3). Each of these determinations can be accompanied with an administrative flag, prompting the SCD to provide or correct data during a bi-monthly reconciliation process. For BMPs that do not meet standard, the SCD is given one year to work with the cooperator to bring the BMP back into water quality functionality.

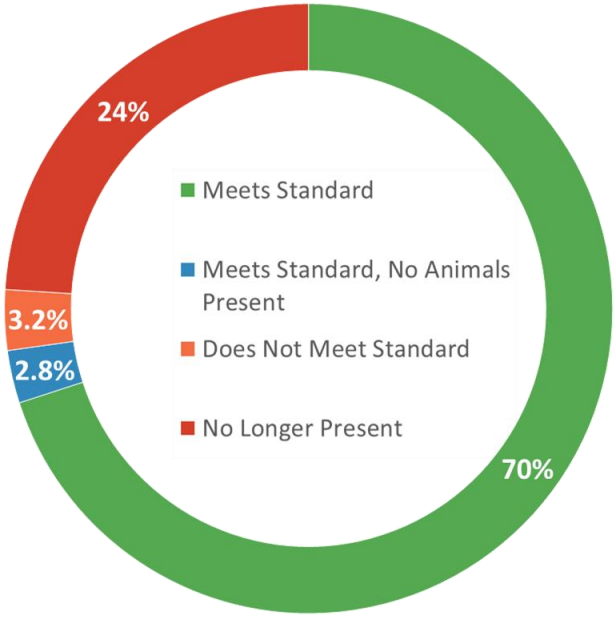


Figure B-3: *Maryland BMP Status Determinations.*

To date, the BMP Verification Task Force has verified over 35 percent of the total WIP-eligible BMPs installed in Maryland, totaling approximately 11,500 BMPs. In doing so, the task force has evolved a rigorous logic for handling and documenting field assessment data. Using this logic, the task force remains in constant contact with each SCD, requesting reconciliation data such as retirement dates for

historical BMPs, as well as the documentation of new BMP data discovered by verifiers upon completion of a farm assessment.

Key Challenges and Opportunities

Enforcing Regulatory Compliance

The Department's Nutrient Management Program is responsible for regulatory oversight of nutrient applications and proper animal waste management on agricultural land. Regulatory compliance has dropped the last few years, but there are several reasons for the decline. Several years ago the program began targeting farms for inspection based on information provided on the Annual Implementation Report (AIR) that seemed suspect based on the initial review. When the program collected soils data as a result of PMT requirements, those farms that did not submit soil data were specifically targeted for review. In addition, traditional targeted reviews continued for various other reasons. The program believes the concept of targeting farms instead of complete random sampling has had a positive impact, but it has lowered the compliance rate. We believe the compliance rate will naturally improve due to this process. Many of those out of compliance are for expired or incomplete plans, which means they are technically out of compliance but not necessarily creating water quality issues. In fact we have encountered many farms with expired plans that were following the old plan, but were found to be out of compliance.

Compliance with nutrient management requires more than having a current plan and properly implementing that plan. While on farm for reviews, the specialists also inspect the property to determine if animals are excluded from streams, and if stream buffers are in place. The program also monitors compliance with winter spreading restrictions, temporary stockpile of organics, and the progress of enhanced nutrient management practices such as split applications of nitrogen. If it is determined that setbacks or buffers have not been provided, a notice of violation is given to the operator along with a date for completion and a scheduled re-inspection. The program has been successful in getting farmers to install stream fencing as well as waste storage structures needed to meet the State's winter spreading prohibition. Planning also promotes no-tillage and minimum tillage leading to nutrient reductions.

Maryland Agricultural Water Quality Cost-Share Program (MACS)

MACS grants allow farmers to install highly valued BMPs on their farms that help Maryland meet nutrient and sediment goals outlined in its federally approved WIP to restore the Bay. All of the practices adopted by MACS that meet water quality criteria for controlling soil loss or animal waste are eligible to receive State funding when installed by farmers. Subsequently implementation of most of the practices automatically aligns with the WIP.

Any one or combination of MACS adopted practices allows a farm operation to address or prevent control of agriculturally related nonpoint water pollution specific to that operation's needs, which in turn supports meeting the 2025 WIP goals. While the MACS program contributes up to 87.5 percent of the eligible cost-share dollars, conversely the farm operation may contribute more than 12.5 percent, providing the

operation the latitude by which to select a desired BMP for the operation. Provided farmers continue to install new practices between now and 2025 the remaining gap will continually be addressed.

Farmers' future participation in the MACS program will be warranted by 1) their ability to choose BMPs that align with not only water quality goals but also their operations management and sustainability, 2) their needs to meet regulatory requirements associated with water quality, and, 3) their desire to support WIP goals.

As the WIP is more aggressively promoted it may be necessary to make administrative changes to the MACS Program to enhance program delivery while remaining consistent with program regulations.

Animal Waste Technology Fund

Reauthorized in 2013, MDA's Animal Waste Technology Fund provides grants to companies that demonstrate innovative technologies on farms and alternative strategies for managing animal manure. These technologies may generate energy from animal manure, reduce on-farm waste streams, or repurpose manure by creating marketable fertilizer and other products and by-products. To date, the program has issued $5.85 million in grants to six companies. A full list of current grant recipients is available at mda.maryland.gov/resource_conservation/Pages/innovative_technology.aspx.

As these technologies become fully operational, the manure may experience transformation in the nutrient content of the raw manure, stabilizing the material for improved uses, or both. MDA will also be evaluating grantee's projects as they relate to a new conservation practice approved by the CBP - Manure Treatment Technologies. Beginning in 2014, the following manure treatment technologies were evaluated for nutrient reduction benefits:

- Thermochemical conversion,
- Composting,
- Anaerobic Digestion,
- Settling,
- Mechanical Solid-Liquid Separation, and
- Wet Chemical Treatment.

After academic evaluation of the technologies, including available literature, nutrient removal credit was approved for thermochemical and composting technologies, or any technology with direct monitoring of nutrient removal. The remaining manure treatment technologies are presumed to alter the moisture content of the manure making it easier to transport. MDA anticipates as knowledge of treatment technologies increases within the agricultural community, it may offer viable options for some operations to better utilize the benefits of their manure source. MDA will track and report these outcomes consistent with the CBP protocols.

Maryland Agricultural Certainty Program

The Maryland Agricultural Certainty Program was established to accelerate the implementation of conservation practices to meet local, State, and Chesapeake Bay pollution reduction targets while rewarding farmers for being environmental stewards and showing leadership in preventing and controlling soil erosion and nutrient runoff. In addition, it allows farmers to make the long-term commitments and business decisions necessary in planning for the future by giving them assurance of regulatory predictability during the ten-year enrollment period.

Since inception, MDA has promoted the benefits associated with the program, but has had limited success. Although the program's growth has been slow, MDA continues to respond to inquiries and assess farms. The Department is evaluating potential regulatory changes to not only allow both owners and operators to participate in the program, but also reduce the paperwork burden on applicants.

MDA is currently evaluating vacancies within the Oversight Committee and seeks to address these concerns with the Committee once re-established.

Healthy Soils Initiative

In 2017, the Maryland General Assembly established the Maryland Healthy Soils Program to promote practices that improve the health, yield and profitability of soils in the State of Maryland. While these practices aim to increase biological activity in the soil and sequester carbon, many of these practices also prevent soil erosion and reduce nutrient loss on agricultural land. As the program is established and promoted, the department will identify and develop methods to quantify the soil health co-benefits associated with the implementation of the WIP.

Workforce Development

Since the establishment of the first SCD in Maryland, conservation professionals have been the cornerstone in evaluating and recommending solutions to address resource concerns on working lands. Farmers rely on the technical expertise provided by these dedicated conservationists to not only ensure resource concerns are being addressed, but also assist them in navigating through various State and federal programs.

As the role of the conservationist has evolved over time, so has the knowledge and skills to recommend and implement practices on agricultural land. As identified during the local WIP meetings, additional technical resources will be needed to accomplish the Phase III WIP by 2025. Further, as recommended in the Chesapeake Bay Commission's report Boots on the Ground, it is necessary to increase technical assistance capacity to address the complexity and delivery of services. To " Enhance the Job Climate for Governmental Conservation Professionals Providing Technical Assistance," as recommended in the report, MDA is committed to work with the institutions of higher education to expand educational opportunities to encourage the development of a conservation workforce.

The NRCS has established essential knowledge, skills, and abilities leading to conservation planning certification. Training and proficiency levels must be achieved to obtain conservation planner certification. A similar curriculum is in development for technician that will be administered through NRCS.

Recruitment and retention for positions funded with the Trust Fund grant are seen by employees as short term grant positions. Until recently, few of these entry level positions included benefits which has caused retention to be challenging in some districts. Experienced district staff have spent countless hours training these Trust Fund-supported positions only to see them leave before they are achieving meaningful production levels and in the process lowering the production level of the staff doing the training. Permanent State positions will offer long term stability and improve retention and development of experienced staff.

Natural Filters on Public Lands Sector

Background

Natural filters practices improve both water quality and habitat by protecting, enhancing and restoring riparian buffers, wetlands, streams and living shorelines. "Natural filters on Other Public Lands" was developed as a separate strategy in the Phase II WIP due to these practices' important ability to provide co-benefits, many of which contribute to the goals and outcomes of the 2014 Chesapeake Bay Watershed Agreement. One of the key co-benefits provided by these practices is increased climate resilience, which will be integral to help the State prepare for, and respond to, the impacts of climate change. This strategy is being expanded for the Phase III WIP to incorporate additional practices and define new goals for implementation by 2025. Public lands were defined in Phase II as those managed by the Maryland Department of Natural Resources (DNR), other State agencies, the federal government and local governments. The definition of public lands for Phase III will not include federal government property because it will be accounted for as part of a separate WIP. As with the Phase II strategy, natural filters implementation on private agricultural lands is captured in the agricultural section of the WIP.

Trends

The Phase II natural filters strategy was focused on four main practices: tree planting, wetland restoration, streamside forest buffers and natural filters on other public lands. Specific performance metrics for 2010-2018 are provided in the "Phase III Strategy" section below. The most successful practice to date has been wetland restoration, in which most of the progress was achieved through the implementation of two large-scale projects. The wetland goal for Phase 3, presented below, was developed with the assumption that no large scale projects will be implemented. A significant acreage of tree planting was implemented through the Million Trees Initiative (MTI), also known as the Forest Brigade; however, less than half of the ambitious Phase II goal was achieved.

Strategies

The Phase III natural filters strategy is composed of the practices detailed below. The first four practices were also part of the previous strategy; their Phase II goals and progress are provided along with updated goals for Phase III. In general, many of the opportunities for natural filters practices on public lands have already been implemented during the first and second phases of the WIP. The opportunities that remain may pose obstacles or be less cost effective than the projects implemented to date. Although the goals set for tree planting, wetland restoration, and buffers are modest due to these challenges, three new practices are being added to expand the strategy for Phase III. This strategy is also very closely connected to Conservation Plus (Land Use Policy BMP), which is described in the Accounting For Growth section (see section PSC Decisions on Accounting for Growth) of this report. Conserved lands may provide additional opportunities for the practices within this natural filters strategy to be implemented.

There are several additional considerations that should be kept in mind when implementing this strategy. The first is that stable funding is imperative to support construction as well as ongoing maintenance and monitoring, which are crucial to ensure long term project success. Climate impacts, such as changes to precipitation patterns, need to be considered as a part of project design and maintenance. Adaptive management should be incorporated into the project timeline, when possible, so that project performance can be maximized by making adjustments post-construction.

A) Tree Planting

Forests are our most strategically important natural resource. Trees protect water quality, clean our air and provide wildlife habitat. One large tree can eliminate 5,000 gallons of stormwater runoff each year, and well placed trees can help reduce energy costs by 15 to 35 percent. This strategy focuses on upland tree planting; urban tree planting is accounted for in the stormwater strategy.

Phase II goal: Plant trees for a total of 3,450 acres by 2017
2010 - 2018 progress: 1,356 acres
This acreage is composed of trees planted through the MTI, Trust Fund grants and MS4 permit compliance projects as reported to the MDE. As such, it is likely not a full accounting of tree plantings on public lands implemented across the State.

Phase III goal: 800 acres
Estimated cost: $8,200,000
This goal was developed to reflect the fact that the opportunities identified for tree planting on State owned lands, as assessed through the MTI, have already been planted during the previous phases of the WIP; and reflects planting implementation supported by the Trust Fund and without consideration of MS4 plantings as they are captured in the stormwater strategy. This estimated cost is based on the assumption that the trees will be planted by a contractor and will include site preparation as necessary, installation of tree protection, and some maintenance costs during the maintenance period, which may include replacement of dead trees. Tree planting is eligible under the Trust Fund competitive solicitation, Trust Fund natural filters, and Water Quality Trading

Program. Details on these funding opportunities are provided below under Funding and Partnerships.

B) Wetland Restoration

Wetlands are highly valuable lands in terms of their abilities to improve water quality and provide important habitat for many species.

Phase II goal: Restore 555 acres to meet the 2011 milestone commitment, and 100 acres annually through 2017 (for a total of 1,155 acres)
2010 - 2018 progress: 4,601 acres
This total reflects wetland restoration supported by Trust Fund grants and wetland acreage gains reported to MDE's Wetlands and Waterways Program.

Phase III goal: 175 acres
Estimated cost: $875,000
Wetland restoration will also be achieved through stream restoration (see section E below). The 175-acre wetland goal is independent of any wetland restoration implemented through stream restoration projects. Wetland restoration is eligible under the Trust Fund competitive solicitation, Trust Fund natural filters, Community Resilience Grant Program, Comprehensive Flood Management Grant Program, and Water Quality Trading Program. Details on these funding opportunities are provided below under Funding and Partnerships.

C) Streamside Forest Buffers

Streamside forest buffers are linear wooded areas along rivers and streams that help filter nutrients, sediments and other pollutants from runoff. These buffers remove nutrients from groundwater and also provide both terrestrial and aquatic habitat.

Phase II goal: Increase streamside forest buffers by 645 acres by 2017
2010 - 2018 progress: 617 acres
This total is composed of buffer plantings from the MTI, plantings supported by Trust Fund grants and plantings reported to MDE for MS4 permit compliance.

Phase III goal: 350 acres
Estimated cost: $3,587,500
This goal was developed to reflect the fact that the opportunities identified for buffer planting on State owned lands, as assessed through the MTI, have already been planted during the previous phases of the WIP. The width of the streamside forest buffer is critical to its function. Where possible, larger buffers (100 feet) should be prioritized to provide maximum water quality benefits, as well as other ecosystem services. Stream migration is likely to increase with the incidence of large storms; larger buffers provide additional room for changes in channel course. Forest buffers will also be achieved through stream restoration (see section E below). The 350-acre buffer goal is independent of any buffer plantings implemented through stream restoration

projects. Buffer plantings are eligible under Trust Fund competitive solicitation and its natural filters program. Details on these funding opportunities are provided below under Funding and Partnerships.

D) Natural Filters on Other Public Lands

Phase II goal: Increase partnerships with State agencies, nonprofits, universities, local governments and the federal government to explore potential for natural filter implementation on their lands.
2010 - 2018 progress: An inventory of natural filters opportunities on State lands was performed in support of the Phase I WIP. The opportunities identified were further investigated and those that were able to be implemented were completed. Examples of programs involving multiple State agencies include the MTI, in which DNR partnered with the State Highway Administration (SHA) and the Maryland Department of Public Safety and Correctional Services (MDPSCS) to plant trees on land owned or managed by DNR. DNR has also supported tree planting on county-owned lands through Trust Fund grants. All acreage planted on public lands through these programs is reported as part of sections A and C above.

Phase III goal: Continue working with State and local land managers to build partnerships for natural filter implementation.

E) Stream Restoration

Stream restoration refers to a suite of practices used to improve the function of degraded streams, including natural channel design, regenerative stormwater conveyance (RSC), and legacy sediment removal. The water quality benefits attained through a stream restoration project depend on the project design and may be credited through prevented sediment, instream denitrification, floodplain reconnection and dry channel RSC as a retrofit. Stream restoration has become a popular technique to improve water quality and make progress towards MS4 permits and county WIP goals; the Trust Fund supported 6 miles of stream restoration on public lands between 2010 and 2018, the majority of which was on county lands. In addition, approximately 3 miles of stream restoration along Piney Run is being implemented through a partnership between DNR, SHA, and the Maryland Department of Health (the land owner) as part of the first phase of a multi-phase restoration initiative. Stream restoration is eligible for funding under the Trust Fund competitive solicitation, Trust Fund natural filters, Water Quality Trading Program and Comprehensive Flood Management Grant Program. Details on these funding opportunities are provided below under Funding and Partnerships.

Phase III goal: 6 miles
Estimated cost: $22,207,680

F) Living shorelines (Shoreline Management)

The living shoreline technique used to protect, restore, enhance or create natural shoreline habitat through the application of erosion control measures. Living shorelines may include the use of fiber coir logs, sills, groins, breakwaters or other natural components in combination with soil substrate (such as sand) and marsh plantings. Shoreline erosion is a natural process, and living shoreline practices should only be pursued if they will maintain sand movement, nutrient cycling and natural shoreline dynamics as opposed to solely armoring against erosion.

Phase III goal: 3,000 linear feet
Estimated cost: $1,800,000

Living shorelines are eligible under the Trust Fund competitive solicitation, Water Quality Trading Program, Community Resilience Grant Program, Comprehensive Flood Management Grant Program, and loans available with the State Shoreline Conservation Service. Details on these funding opportunities are provided below under Funding and Partnerships.

G) Oyster aquaculture

An adult oyster can filter up to 50 gallons of water daily. In doing so, it helps to improve water quality by assimilating nutrients into its tissue and shell, removing sediment particles from the water column, increasing the availability of bioavailable nitrogen to bacteria and depositing particles that may become buried on the bottom. Oyster aquaculture (shellfish farming) will be pursued through this strategy on State-owned bottom.

Phase III goal: 350,000 total bushels with a per year implementation (Table B-4).

Table B-4: *Recommended harvest of oysters from 2019 to 2025.*

Year	Recommended Harvest (Bushels)
2019	5,000
2020	25,000
2021	30,000
2022	45,000
2023	65,000
2024	85,000
2025	95,000

Estimated cost: $17,500,000
The cost for oyster aquaculture reductions will be distributed among public and private entities. For example, the Oyster Recovery Partnership has received a Trust Fund grant to develop an

oyster cooperative to create and implement a revolving fund to support sustainable oyster harvest and reduce nutrients in the Chesapeake Bay. The revolving fund will create a self-sustaining and long term structure linkage between economic development, sustainable management and water quality restoration. Oyster aquaculture is eligible for funding under the Innovative Technology Fund, Maryland Shellfish Aquaculture Financing Fund, Maryland Remote Setting Shellfish Aquaculture Financing Fund, Water Quality Trading Program, and through private investment from oyster aquaculturalists. Details on these funding programs is provided in the Funding and Partnerships subsection below.

H) Oyster reef restoration

Oyster reef restoration practices refers to planting oysters (e.g., spat-on-shell, single oysters), substrate (e.g., shell, stone), or both directly on the bottom to enhance oyster biomass in areas where harvesting is not permitted (e.g., sanctuaries). The nitrogen and phosphorus reduction effectiveness for the oyster reef restoration-assimilation BMPs are driven by oyster tissue and shell biomass; and additional nitrogen is also removed via microbial denitrification.

Table B-5: *Maryland's oyster reef restoration implementation by sanctuary.*

Sanctuary	Acres Restored (Current)	Acres Restored (Future)	Total Acres	Future MD Cost (Millions)
Harris Creek	350	0	350	$0.7
Little Choptank River	338	19	357	$2.1
Tred Avon River	83	42	125	$1.9
Upper St. Mary's	35	TBD	35 + TBD	TBD
Manokin River	0	TBD	TBD	TBD
Total	806	61	867	$4.7

Phase III Goal: 867 acres
Estimated Cost: $4,700,000
Oyster reef restoration is funded using state capital funds. Removal rates are derived by the Oyster BMP Expert Panel, which utilized data from oyster monitoring efforts in Harris Creek and other oyster studies. Annual reductions are 24 lbs Nitrogen removed/acre/year by assimilation in oyster shell and tissue and 57 lbs Nitrogen removed/acre/year net denitrification reef enhancement; 4 lbs Phosphorus removed/acre/year by assimilation in oyster shell and tissue.

Key Challenges and Opportunities

Natural filters practices have many co-benefits or "ecosystem services." Forests and wetlands are home to a variety of flora and fauna and restoring forests, wetlands, and streams can create new habitat for these species, or improve upon existing habitat. Outdoor recreation is a significant economic driver in

Maryland, with this industry contributing $14.4 billion per year in spending to the State's economy (Outdoor Industry Association 2018 report). A significant benefit of using natural filters is the impact they have on the local hydrology. Natural filters in watersheds surrounding drinking water reservoirs improve local water quality, decreasing the cost of treating the water that over 60 percent of Marylanders rely on for drinking water. Natural filters also increase groundwater recharge, helping to ensure streams do not go dry during low flow seasons or periods of drought, and store rainfall in soils, lessening the need for human-made stormwater infrastructure. In estimated quantities, the natural filters practices implemented between 2010 and 2018 reduce 6.7 billion gallons of surface runoff and allow for 1.4 billion gallons of groundwater recharge every year. They also take up nearly 3,000 tons of carbon per year, helping Maryland meet its GHG reduction goals.

Funding and partnerships

There are a number of funding programs and partnerships that will help to make progress towards the Phase III strategy goals:

- **Trust Fund competitive solicitation** - Managed by DNR on behalf of the State of Maryland, the Trust Fund issues an annual solicitation for efficient and cost effective non point source pollution reduction projects; this funding opportunity allocates an average of $20 M each year (dependent on annual revenue) to local implementation projects. Projects funded through this solicitation can include natural filters BMPs, such as tree planting, wetland restoration, riparian buffers, living shorelines and stream restoration, and may be implemented on state owned or other public lands. Trust Fund proposals are reviewed and selected based on multiple criteria, including nutrient and sediment reductions to be achieved, geographic targeting and readiness and ability to proceed. The most competitive proposals include projects that will yield cumulative water quality benefits (as opposed to annual reductions), are able to be credited and reported for annual progress implementation, achieve multiple co-benefits (such as climate resilience), and apply natural and nature-based design approaches that also provide habitat and ecological uplift. DNR and SHA Memorandum of Understanding (MOU) - These two State agencies initiated a MOU in October 2016 to facilitate the implementation of water quality projects on State lands owned or managed by DNR that SHA can use towards its permits. A MOU that extends to all Maryland Department of Transportation units is being developed.

- **Trust Fund natural filters** - A separate portion of the Trust Fund budget allocates an additional $6 M of funding that specifically targets the implementation of natural filters BMPs, such as tree planting, wetland restoration, riparian buffers and stream restoration. Priority is given to projects on state and local public lands. DNR Chesapeake and Coastal Service restoration specialists work closely with a variety of partners on these projects to maximize the achievement of co-benefits, specifically habitat and ecological improvements. Community Resilience Grant Program (CRGP) - Managed by DNR, the CRGP provides funding support to Maryland communities to help them become more resilient to climate hazards related to flooding. A portion of the funding made available through this program is for the design of nature-based projects, including living shorelines.

- **Comprehensive Flood Management Grant Program (CFMGP)** - Administered by MDE in partnership with MEMA, the CFMGP promotes the development of local flood management plans, funds studies of watersheds, and supports capital projects for flood control and watershed management. These funds, which total $10M for FY20-23, can be used for natural filters projects that also yield flood management benefits, including stream and shoreline restoration and wetland creation and restoration.

- **Innovative Technology Fund** - All nonpoint source practices are eligible for research and development, as well as commercialization investments, under Maryland's Innovative Technology Fund (ITF). The ITF is funded at $1,000,000/year with the budget divided equally among the research and development, and commercialization programs. To date, the ITF has supported seven oyster aquaculture companies to improve equipment and techniques that will increase oyster biomass. These investments will not only expand the oyster aquaculture industry but many of the developments will also assist Maryland with its oyster restoration goals. Algal Flow-way Technology and Floating Treatment Wetlands have been supported with research and development funds and both have been approved for model credit through the Bay Program expert panel process. These restoration techniques may become future natural filter strategies.

- **Maryland Shellfish Aquaculture Financing Fund -** In partnership, DNR and Maryland Agricultural and Resource-Based Industry Development Corporation (MARBIDCO) provide affordable financing to watermen and other parties who want to start or expand commercial shellfish aquaculture operations in Maryland. The University of Maryland Extension (UME) is also contributing to this effort by providing training and business planning assistance to current and prospective shellfish growers. Loan proceeds can be used to purchase shell, seed, spat or equipment (depending on the source of funds). Both bottom culture and water column (cages or floats) projects are eligible.

- **Maryland Remote Setting Shellfish Aquaculture Financing Fund** - Working in collaboration with DNR and using Maryland Port Administration (MPA) funds, this program provides affordable financing to commercial watermen who want to start or expand shellfish remote setting (nursery) aquaculture operations. The nursery grower purchases larvae from a hatchery and places it in a tank containing cultch for the larvae to set on. Spat on shell setting systems consist of a tank, pump, piping and valves, and a blower to provide low pressure air to circulate larvae during setting. Seed (larvae), shell (substrate), and tank heaters (during cooler months) are also needed.

- **DNR and SHA Memorandum of Understanding (MOU)** - These two State agencies initiated a MOU in October 2016 to facilitate the implementation of water quality projects on State lands owned or managed by DNR that SHA can use towards its permits. A MOU that extends to all Maryland Department of Transportation units is being developed.

- **DNR Land Acquisition and Planning (LAP) Programs** - LAP uses a targeting approach for the Program Open Space program that considers restoration opportunities. Opportunities for natural filters identified could be implemented on parcels that are purchased. A similar approach could be

applied to the Rural Legacy Program.

- **Community Resilience Grant Program (CRGP)** - Managed by DNR, the CRGP provides funding support to Maryland communities to help them become more resilient to climate hazards related to flooding. A portion of the funding ($16.55M total for FY18-22) made available through this program is for the design and construction of nature-based projects, including living shorelines and wetland restoration.

- **Maryland's Water Quality Trading Program (WQTP**) - A collaboration between MDE and MDA, the WQTP creates a public market for nitrogen, phosphorus and sediment reductions that was developed to accelerate the pace and reduce the cost of water quality project implementation. Several natural filters practices are on the list of BMPs approved for trading, including wetlands, stream restoration, tree planting, shoreline management, and oyster aquaculture.

- **Regional Greenhouse Gas Initiative** - Proceeds from emission allowances sold at quarterly options could be partially invested in land based carbon sequestration practices like tree planting or agricultural practices, as is done in some other States that participate in RGGI. However, this is not currently done in Maryland and would likely require amendment of the current laws governing the fund allocation.

- DNR's Shoreline Conservation Service works with property owners to obtain loans for living shoreline projects. More information is available: http://dnr.maryland.gov/ccs/Pages/livingshorelines/ftassistance.aspx

There are also opportunities to further explore the science around restoring healthy aquatic communities or keystone species and how that can help increase nutrient uptake and reduce delivered loads. Calculating nutrient reductions from oyster aquaculture is the first foray into this arena, but many living resources in Chesapeake Bay (e.g., submerged aquatic vegetation, menhaden) and its freshwater tributaries (e.g., mussels, benthic macroinvertebrates) have the ability to consume and sequester nutrients directly or indirectly. Developing science-based methods to account for and quantify these nutrient co-benefits of healthy aquatic systems may offer additional cost effective solutions to Bay restoration.

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- DNR Parcel Evaluation Tool: geodata.md.gov/greenprint/
- Fielddoc: fielddoc.org/
- Watershed Resources Registry: watershedresourcesregistry.org/

Phase III WIP Septic Strategies

Septic Upgrades

Maryland has two main programs for implementing BAT septic upgrades. First, upgrades are funded through the State's BRF Septic Fund, and second, BAT treatment is required on all new systems in the Critical Area. It is important to note that a portion of the BRF Fee paid by households on septic systems is used to pay for cover crops.

The department will continue to pay for BAT upgrades through the BRF Septic Fund. Funding priority is ranked based on six categories: (1) failing OSDS in the Critical Area, (2) failing OSDS outside the Critical Area, (3) non-conforming[25] OSDS in the Critical Area, (4) non-conforming OSDS outside the Critical Area 5) other OSDS in Critical Area, including new construction 6) other OSDS outside Critical Area, including new construction. All installations and subsequent operation and maintenance of nitrogen reducing units are tracked by MDE's WSA Wastewater Permits Program in a secure database.

Regulations mandate any new construction of a septic system or repair of a septic system within the Critical Area must utilize BAT. Within the Chesapeake Bay watershed, the Critical Area covers land located within 1,000 feet of the tidal waters. This land is deemed to be of crucial importance to the health of the Bay, and due to its proximity the delivery of nitrogen from OSDSs has been estimated to be much greater than from systems located higher up in the watershed. Septic systems located outside the Critical Area are not required to install BAT units, however a significant level of BAT implementation is still being done in these areas through the BRF Septic Fund.

Maryland's BAT Technical Review Committee (TRC) currently lists a variety of pre-approved manufacturer units capable of reducing nitrogen discharged into a septic system by 50 percent or greater. The BAT TRC continues to review newer technologies to include in the pre-approved categories. In addition, the TRC has approved additional reduction by utilizing BAT units in concert with particular OSDS that are capable of reducing nitrogen effluent by 30 percent, hence increasing the total nitrogen reduction to 80 percent or greater.

From 2016-2018 Maryland spent roughly $10.1 million annually for roughly 1,000 BAT units installed (BRF 2018). Maryland's Water Quality Trading Program allows non-required septic upgrades to be installed to generate nitrogen credits. It is intended that this will act as an additional driver of septic implementation.

Septic Strategy 1: Provide incentives for OSDS upgrades to BAT

Maryland will continue to implement septic upgrades through its BRF Septic Fund. This strategy estimates implementation of 1,000 upgrades per year and assumes an average reduction of 5.5 pounds per year per household, yielding an annual reduction of 5,500 pounds of nitrogen per year delivered to the Bay. Over a seven-year period, 2019 to 2025, this will result in a reduction of 40,000 pounds of nitrogen.

[25] systems that do not conform with current regulations

Septic Strategy 2: Require BAT for systems installed in the critical area

Maryland will continue to require that new OSDSs in the Critical Area use BAT treatment. It is estimated that on average approximately 200 systems are installed per year, yielding average per household reductions of 7.5 pounds per year. Cumulatively this results in 10,000 pounds per year prevented by 2025.

Septic Strategy 3: Accelerate BAT through WQ trading

Maryland will promote using septic upgrades as a mechanism for generating credit to meet NPDES permit requirements. We acknowledge that there will be a reduction; however, that reduction will be used to meet NPDES permit requirements so no estimate figure is provided here.

Septic Connections

Maryland has invested over $1.2 billion in ENR upgrades for wastewater treatment plants, and by 2022, around 98 percent of the State's wastewater treatment capacity will be operating at this high treatment level. In order to maximize the benefit from this investment, the State must continue to pursue opportunities to connect additional septic systems to sewers. On average, from 2016 to 2018, 100 onsite sewage disposal systems were connected annually to sewer (BRF Advisory Committee 2018). And from 2016-2018 Maryland spent roughly $1.3 million annually per roughly 100 septic connections (BRF 2018). The anticipated annual load reduction per household connected to sewer is a slightly over 8 pounds of nitrogen delivered to the Bay, with an average cost below $100 per pound[26] (CBP 2017, MDE 2016). Accelerating the pace of connections is a priority in this phase of the WIP, and Maryland is pursuing several options to achieve this. For example, the funding and approval process has been streamlined, which is anticipated to generate increased interest for public sewer connections for areas with problem sewage disposal systems. One project of note is on southern Kent Island, where 1,500 systems are being connected to sewer.

The State is specifically pursuing sewer connection opportunities for campgrounds, mobile home parks and Bermed Infiltration Ponds (BIPs). BIPs are above-ground facilities that typically serve multiple homes. Beyond connections to existing sewer systems, the management action may involve replacing the existing treatment facility with a different treatment system such as a package plant[27].

The State will continue working directly with county governments and officials to increase the number of connections statewide. Implementation of this strategy is time consuming, as it requires extensive local planning and significant funding allocations. There are also many communities that cannot be connected to sewer due to local zoning and "no growth" sewer lines. Annual reductions will continue to be modest at a statewide scale, but on a finer scale these projects can provide significant nitrogen reductions in rural

[26] mde.maryland.gov/programs/Water/TMDL/TMDLImplementation/Documents/Data_and_Tools/BMP_Unit_Cost_Estimates_Phase_5-3-2.xlsx

[27] Package plants are pre-manufactured treatment facilities used to treat wastewater in small communities or on individual properties. According to manufacturers, package plants can be designed to treat flows as low as 0.002 MGD or as high as 0.5 MGD, although they more commonly treat flows between 0.01 and 0.25 MGD (Metcalf and Eddy, 1991).

watersheds with few other nutrient sources. Perhaps more importantly, the public health impact at this level can be substantial.

Septic Strategy 4: Connect households on OSDSs to sewer

This strategy assumes that septic connections to sewer will occur at a pace of 300 systems per year. This equates to reductions of 2,400 pounds per year, or 16,800 pounds by 2025. These connections will be funded through a combination of funding sources, including the BRF Wastewater Fund and State Revolving Loan Fund. There is expected to be a small phosphorus increase of less than 100 pounds associated with this work. Maryland will look for opportunities to accelerate this work, and update projections in its two-year milestones accordingly.

Septic Strategy 5: Pursue higher-level treatments systems

Maryland will continue to investigate the use of *in situ* and *ex situ* treatment, as described in the 2014 report, Recommendations of the Onsite Wastewater Treatment Systems Nitrogen Reduction Technology Expert Review Panel, including elevated sand mounds and shallow-placed pressure-dosed dispersal. Where possible, the State will develop crediting mechanisms through its permits or trading program to incentivize these practices.

Septic Strategy 6: Pursue additional reduction strategies for "high-benefit" reductions

Maryland will continue to investigate additional septic strategies for addressing septic loads that provide a maximum benefit, either in terms of cost effectiveness for nitrogen removal or non-nutrient impacts, including public health and drinking water quality. Examples of potential opportunities include focusing on BIPs, mobile home parks and campgrounds, as opportunities to fund sewer connections or construct package plants or other small wastewater treatment facilities. The State is not projecting load reductions for this strategy in this document; however, a review of alternatives will be conducted and an adaptive management approach will be conducted through the two-year milestone process.

Septic Stewardship Plans and Septic Pumping

Recent legislation (HB1765 2018) makes funding available to county governments that adopt Septic Stewardship Plans. Septic Stewardship Plans must describe jurisdictions' goals, consistent with the WIP nitrogen reduction goal and describe funding mechanisms to support the plan. To get credit for septic pumping under this plan, OSDS tanks must be pumped on a routine cycle. Based on numbers from P6 CAST, the anticipated annual load reduction for pumping an OSDS is about 0.4 pounds of nitrogen per household. The law also allows for financial assistance to homeowners for the cost of pumping out a septic system. Currently, county-based programs are too varied to provide an estimate of the annual cost of pumping across the State. The Septic Stewardship Plans provide a mechanism for local jurisdictions to develop plans that incorporate local priorities targeted toward goals beyond nitrogen reductions. For example, at the jurisdiction's discretion, a plan could be written to focus on subsurface source water protection zones.

Several counties already have voluntary rebate incentive programs to encourage OSDS pumping. Through the adoption in local codes one county (Queen Anne's County) already requires OSDS pumping every five years and that compliance documentation be provided to local officials.

Septic Strategy 7: Incentivize Septic Pumpouts

Maryland will continue to offer credit to incentivize septic pumpouts. It is anticipated that the State will credit 10,000 pumpouts per year. Estimating a household reduction of 0.4 pounds per system, the total reduction is 4,000 pounds.

Key Challenges and Opportunities

Currently MDE has programs with individual databases pertaining to septic discharges, groundwater discharge permits and BAT OSDS systems. Development of one integrated database could ensure that information is represented in the intended manner.

Staffing at the State and local level continues to be a challenge for septic implementation. The process of evaluation of OSDS requires education, experience and a unique crossover of science, engineering and public health, generally by Licensed or Registered Environmental Health Specialists. The industry standards exist for this career path, however lack of outreach and financial incentives limit interest in this field of work. MDE operates the OSDS/BAT program with personnel trained in identifying problems with individual systems but also relies on county government officials with the same background to implement septic regulations in the same manner. Expanding the awareness of the employment series through outreach would improve the staffing issues and the counties to the benefit of the entire program.

Long-term strategy

The 2008 Final Report of the Advisory Committee on the Management and Protection of the State's Water Resources, known as the Wolman Report (Wolman, 2008)[28], provides a bedrock synthesis related to protecting water supplies, and many of these ideas are brought forward in this section. The State must continue to pursue the implementation of recommendations from this document particularly those with the potential to drive nitrogen reductions in the OSDS sector. At a glance, the Wolman Report provides guidance on prioritizing issues related to funding, climate change and growth; and more specifically on issues such as long term monitoring, public health initiatives and infrastructure resilience.

MDE programs that currently intersect with the management of the OSDS sector include: (1) permitting, (2) compliance of installation and repair data, (3) stormwater, (4) wetlands, (5) water supply and (6) TMDL planning. A cooperative outlook on management will also serve to support other fact finding ventures. Concurrent to the development of the Phase III Chesapeake Bay WIP, the Integrated Water Planning Program at MDE is developing a technical directive with Tetra Tech to assess elements that influence the impact of OSDS on nitrogen loading and co-benefits. While the WIP accounting is based on nutrient load reductions, resulting in nitrogen reductions driving the implementation in the OSDS sector, it is becoming increasingly apparent that only focusing on nitrogen reductions from the OSDS sector (at the exclusion of co-benefits) is not a cost effective process for reducing nutrients to the Chesapeake Bay.

[28] mde.maryland.gov/programs/Water/water_supply/Documents/WolmanReport_Vol1.pdf

These co-benefits include: (1) protecting public health, (2) improved source water quality, (3) reduced water treatment costs in rural Maryland, (4) critical infrastructure resilience, (5) MS4 permit and trading credit and (6) improved property values.

Strategies for co-benefits

Existing federal groundwater protection programs are spread across roughly eight distinct parts of Title 40 of the Code of Federal Regulations (EPA Groundwater Issues). These programs provide a network of mechanisms for data collection on the activities impacting groundwater and the subsurface environment. Through the Groundwater Protection Program under the Safe Drinking Water Act, the Water Supply Program at MDE has emphasized preventative measures to avoid public health issues (MDE 2013). These data collection activities authorized by the Safe Drinking Water Act need to be refined and refocused, so that they can be functional in an increasingly real-time planning environment.

Groundwater management driven by source water protection requires monitoring data. In the State of Maryland, there have already been a series of documents that have called for additional monitoring resources to be developed to effectively and sustainably manage groundwater supplies (MDE 2013). In order to support these data collection efforts, there could be innovative fee structures based on water appropriation (MDE 2013). Regardless of how a monitoring program is supported, it is becoming increasingly evident that this type of data collection is critical to protecting public health. Examples of why this is critical are: (1) the expansion of groundwater recharge zones for community groundwater supplies and (2) the increasing uncertainty as to whether new and emerging contaminants of concern (potentially mobilized in septage) could be materializing in water withdrawals due to wider subsurface cones of depression (MDE 2013).

One near-term possibility to begin to focus data collection activities on protecting public health is to encourage subsurface source water protection zones be written into septic stewardship plans (MDE 2013). This should include a jurisdictional analysis of the cost of water treatment at community and private groundwater wells. Including source water protection zones in septic stewardship plans would lead to local jurisdictions managing their resources with higher resolution data, with guidance and data compilation being provided at the State level by MDE.

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Stormwater Sector

Background

Streams in Maryland's urban areas are consistently found to have degraded biology due to stressors driven by impervious surfaces, such as altered hydrology, morphology, and water chemistry, as well as increased water temperature and sedimentation. Unsightly trash and debris, and fecal bacteria pollution can also make urban streams unsuitable for recreation and other uses. Because these problems are linked to stormwater and the urban landscape, a healthy aquatic ecosystem cannot be restored without specifically mitigating the impacts of legacy impervious surface areas.

Local jurisdictions, including counties and municipalities, have developed ordinances and enforcement programs to implement and approve stormwater practices for new development and redevelopment, and Maryland Department of the Environment (MDE) reviews these local programs to ensure consistency with State law and regulations. Stormwater practices implemented for new development and redevelopment on State or federal lands are approved by MDE. Older developments (pre-2000) generally do not have water quality practices in place to control stormwater runoff and mitigate associated pollution impacts. To address stormwater from these older developments, Maryland's NPDES Municipal Separate Storm Sewer System (MS4) permits require that stormwater restoration practices be applied to impervious surfaces (roads, parking lots, roof tops, etc.) that have not been treated to the maximum extent practicable. The MS4 permit restoration requirement represents Maryland's key strategy for addressing nutrients and sediment pollution associated with stormwater runoff that impacts both Chesapeake Bay and non-tidal waters.

Trends

According to EPA's Chesapeake Bay watershed model estimates (Phase 6 CAST), nutrient loads from impervious surfaces and lawns—collectively referred to as urban stormwater loads—accounted for 17.4% of Maryland's 2017 nitrogen loads to the Bay and 18.3% of phosphorus loads. Compared with the nutrient reductions from the State's farms and wastewater treatment plants, the pace of progress in reducing urban stormwater loads is slower. While controls to address stormwater pollution cannot be rapidly deployed, they are a critical piece of Maryland's long-term plan for restoring the Bay and its non-tidal waters.

Several factors limit the pace of implementation in the urban sector. First, management practices that address stormwater pollution generated by impervious surfaces must be dispersed throughout the watershed instead of building a single facility at one centralized location as in the case of a wastewater treatment plant. Second, most stormwater restoration practices must be designed and permitted, so a significant planning effort is needed for each individual practice. Further, land for these practices must be identified and potentially acquired. This can impose significant costs, or require private landowner permission, in addition to any construction expenses. These planning requirements and capital costs mean that staffing and municipal budgets limit the rate of progress.

Another challenge is the heterogeneity of urban nutrient sources, which include air deposition, lawn fertilizer, erosion, and leaking sanitary pipes. The result is that no single source control initiative can fully

address all sources. Therefore, the restoration activities for the urban sector are not limited to traditional stormwater practices, like bioretention and wet ponds, but also cover alternative practices[29] such as street sweeping, reforestation on urban land, stream restoration, and shoreline management.

Recognizing the multiple water quality impacts from stormwater means that care should be taken to select specific restoration practices that provide both a nutrient reduction benefit for the Bay as well as address other important local stressors. This is a departure from previous planning exercises where cost-benefit was optimized by finding the least expensive approach for reducing only nutrients and sediment. A different way to maximize the impact of money spent on stormwater management is to expand the benefit across multiple water quality objectives. When assessing the cost-benefit of a stormwater strategy, selecting and placing practices that maximize the number of pollutants treated becomes more important. Most of this watershed-scale and site-level planning is done at the county or municipal level, not by the State. One of the State's key roles, while developing programs to improve water quality, is building broad flexibility into the MS4 permits so that jurisdictions can select the most appropriate suite of stormwater management practices to address local problems.

Furthermore, with increased intensity and frequency of rainstorm events, sea level rising, and flooding occurring on a more regular basis, climate change impacts and how they affect stormwater quantity and quality must also be considered in this restoration process. When upgrading infrastructure to handle today's environmental concerns, consideration must also be given to how these practices will operate in the future, and whether they make the State more resilient to climate change.

Maryland is committed to adapting its stormwater program in response to climate change by establishing an emergency dam repair fund and a revolving loan dam fund for maintaining critical stormwater management infrastructure and dams. By maintaining these structures, the State is also preventing further loss of nutrients and sediments that would continue to occur if these facilities were left unmaintained or failed. Maryland is also committed to making programmatic changes in the future to its erosion and sediment control and stormwater programs by funding academic research into the latest climate science that can inform design guidelines for increased precipitation events. Maryland has begun this work by engaging with the State university system to perform downscaled precipitation modeling, the results of which may help to inform design guidelines.

The slower pace of restoration progress in the urban stormwater sector relative to wastewater and agriculture means that stormwater discharges will make up a larger proportion of the State's nutrient loads by 2025 - approximately 20% and 19% of the nitrogen and phosphorus loads, respectively. Reduction opportunities outside the stormwater sector will concurrently decrease, and stormwater management will become a more important part of Maryland's nutrient reduction portfolio. The result is that maintaining the statewide target pollution levels after 2025 will require continuing stormwater management implementation. The long lead time for putting practices in the ground means that a stormwater management program cannot be quickly ramped up, and in order to provide regulatory certainty beyond a five-year planning horizon, it is important for this WIP to establish a long-term pace of implementation.

[29] Alternative practices from MDE's Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated Guidance document (MDE, 2014)

Phase III WIP Stormwater Strategies

The stormwater strategies described in this section rely on a sustained pace of implementation, recognizing that the arc of restoration will need to continue well beyond 2025 and a single permit cycle. The practices that are installed today may remain on the landscape for decades or more, and the importance of choosing the right options cannot be overstated. This means an even greater focus on the quality of practices, in terms of the full environmental benefit they provide, in terms of how they enable Maryland's communities to adapt to a changing climate and in terms of limiting the annual maintenance they will require.

Maryland's NPDES Stormwater Permits and Other Stormwater Management Programs

Impacts from flow-driven stressors (e.g., sediment, bacteria) in urban watersheds are required to be mitigated under the State's MS4 permits. Maryland has developed dozens of TMDLs for nutrients, sediment, and other pollutants in its streams and lakes that assign waste load allocations (WLAs) to permitted stormwater dischargers. According to the CWA, permitted discharges must be consistent with the assumptions and requirements of available WLAs. Maryland's MS4 permits accomplish this by requiring restoration plans for impervious surface areas and TMDL WLAs, with the former establishing a pace of restoration and the latter establishing a water quality based framework for measuring progress. Since many of the practices that improve stream health also reduce the load of nutrients reaching the Bay, stormwater controls for nontidal TMDLs are essential components of Maryland's WIP. More information on stormwater restoration practices can be found in Maryland's Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated guidance document.

Individual MS4 Permits

The previous (fourth-generation) Phase I MS4 permits established a rate of restoration equivalent to twenty percent of the untreated impervious area within the jurisdiction. To support the development of the next generation (fifth-generation) Phase I MS4 permits (see figure SW-1) the Department considered what pace of implementation can reasonably be expected in each five-year permit term, including limitations on the physical capacity to complete this level of work, i.e., staff, contractors, land availability, permitting delays. Additionally, as the inventory of stormwater management practices for each county increases, a greater share of its annual budget will need to be dedicated to operations and maintenance. This approach corresponds with the idea of local feasibility, or in the context of the CWA, the maximum extent practicable (MEP), instead of defining a restoration pace to meet specific allocations by 2025.

Recent MS4 implementation and trend analysis indicates that permittees (nine counties, Baltimore City and the State Highway Administration) should be capable of annually restoring two percent of their impervious surface areas that currently have little or no stormwater treatment. While this level of implementation will be used in the Phase III WIP analysis for estimating load reductions, the Department will continue to work with permittees on an MEP analysis that will indicate what is feasible. This MEP analysis will take into consideration the physical and financial capacity of a jurisdiction to perform restoration, and the need for making significant and continual progress toward Bay and local water quality improvements. The analysis will also consider the impact of updated BMP efficiencies approved by the

CBP Partnership. Permittees will also have the flexibility to meet a portion of their restoration requirements through water quality trading. As progress must continue past 2025 for certain sectors to meet the WLAs assigned in the Bay TMDL, it is anticipated that significant restoration requirements will be maintained in the sixth- and seventh-generation permits. This will be done through subsequent MEP analysis that will be conducted at the outset of each permit term to update the pace based on the latest information available. Figure B-4 depicts Maryland's MS4 permitted areas.

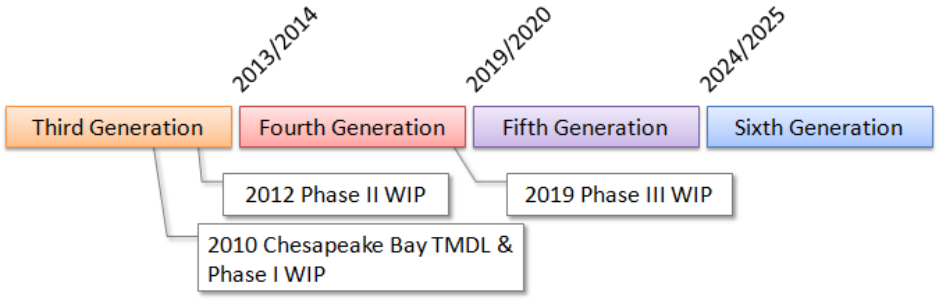


Figure B-4: *Chronology of Maryland's Phase I MS4 Permits.*

Maryland's eleven Phase I MS4 permittees include the State Highway Administration, Baltimore City and the State's nine most populous counties—Anne Arundel, Baltimore, Carroll, Charles, Frederick, Harford, Howard, Montgomery, and Prince George's. SHA's current (fourth-generation) permit covers discharges from storm sewers that the agency owns or operates in the State's Phase I and Phase II MS4 jurisdictions (Figure B-5).

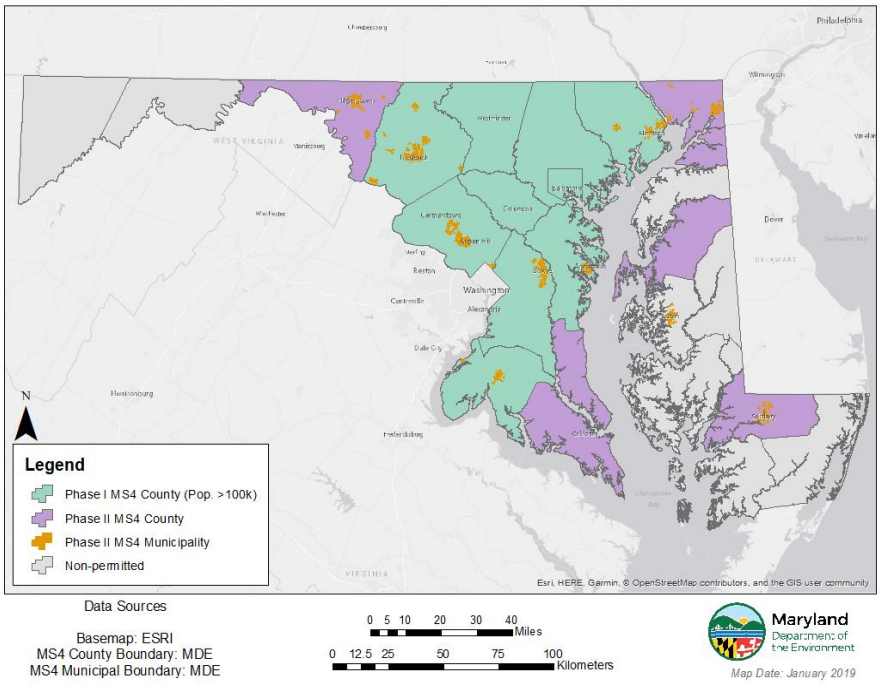


Figure B-5: *Phase I and Phase II MS4 permitted areas in Maryland.*

SW Strategy 1: Complete any remaining retrofit requirement from fourth-generation Phase I MS4 permits that was achieved through water quality trading

The fourth-generation Phase I MS4 permits required restoration of twenty percent of the untreated impervious area within the jurisdiction. Any MS4 jurisdiction that meets its fourth-generation permit restoration requirements through water quality trading will need to complete its twenty percent restoration requirement through stormwater practices in its subsequent MS4 permit, anticipated to expire in 2024. These practices include those listed in the 2014 Accounting Document (or subsequent updates) as Runoff Reduction (RR) practices, Stormwater Treatment (ST) practices, or Alternative Urban practices.

SW Strategy 2: Maximum Extent Practicable retrofit of untreated impervious acres in fifth-generation Phase I MS4 permit

Recent MS4 implementation and trend analysis indicates that permittees (nine counties, Baltimore City and the State Highway Administration) should be capable of annually restoring two percent of their impervious surface areas that currently have little or no stormwater treatment. Based on untreated impervious acre baselines established in the fourth-generation permits, there were 172,000 acres of untreated impervious acres. The Department will work with MS4 jurisdictions to determine what is the MEP for retrofitting impervious acres in fifth-generation permits. Permittees will also have the option of using water quality trading for meeting a portion of their restoration requirements.

SW Strategy 3: Maximum Extent Practicable retrofit of untreated impervious acres in sixth-generation Phase I MS4 permits

The sixth generation Phase I MS4 permits should maintain a similar level of effort to the fifth generation permits. This will represent additional significant impervious surfaces restoration over the permit period. Because the permit will not be issued until mid-2024, only a small fraction of the work will be completed by 2025.

General Stormwater Permits and laws

Phase II General MS4 permits

Two Phase II general MS4 permits took effect in October 2018, one covering *counties and municipalities* with a population of under 100,000 and the other covering *federal and state stormwater dischargers*, apart from SHA. The permits adopted a framework similar to the one set up for the Phase I permittees, with a twenty percent retrofit requirement of untreated impervious areas. Permittees must plan to have this restoration work in place by 2025. These two permits cover nearly 20% of the State's developed impervious land, which together with the Phase I permittees, result in almost 90% of Maryland's developed impervious acres being under an NPDES stormwater permit with a restoration requirement. Several of the Phase II permittees have already established dedicated funding mechanisms to support their restoration work, including Gaithersburg, Rockville, Salisbury, and Takoma Park.

SW Strategy 4: Twenty percent retrofit of untreated impervious acres in second- and third-generation Phase II permits for small MS4s

Maryland's second-generation NPDES General Permit for small MS4s, MDR055500, was effective on October 31, 2018. Under this permit, six counties and 29 towns and cities are to "develop planning strategies and work toward implementing water quality improvement projects" to restore twenty percent of their "existing developed lands that have little or no stormwater management" by 2025. As of the writing of this plan, the permittees have not yet submitted to MDE their impervious area estimates, but a preliminary analysis of untreated impervious areas in these municipalities estimated 55,000 acres. Twenty percent equates to 11,000 acres of restoration, or the equivalent, by 2025. A portion of these reductions may be achieved through water quality trading.

SW Strategy 5: Twenty percent retrofit of untreated impervious acres in second- and third-generation Phase II permits for State and federal MS4s

Maryland's second-generation NPDES General Permit for State and federal small MS4s, MDR055501, was effective on October 31, 2018. Under this permit, State and federal permittees are to "develop planning strategies and work toward implementing water quality improvement projects" to restore twenty percent of their "existing developed lands that have little or no stormwater management" by 2025. As of the writing of this plan, the State and federal entities have not yet estimated their impervious areas, but a rough estimate of untreated impervious acres for this permit is 20,000 acres. Twenty percent equates to 4,000 acres of restoration, or the equivalent, by 2025.

General Stormwater Permits

In addition to these two newer Phase II general MS4 permits, two other general stormwater permits have been established since the development of the Phase II WIP. These general permits also include requirements to address nutrient discharges and their impacts on the Bay. First, the *general permit for industrial stormwater dischargers*, effective 2014, created a restoration requirement for retrofitting twenty percent of the permittees' untreated impervious areas, consistent with the Phase I MS4 permits. Second, the 2014 *stormwater permit for construction activities* specifies that fertilizer applications on construction sites must comply with statutes from Maryland's Fertilizer Use Act of 2011.

Maryland's Fertilizer Use Act, described in detail in the Phase II WIP, applies not just to construction sites, but to all applicators of fertilizer to non-agricultural turf. Among other requirements, it stipulates a certification and licensing program for professional applicators and restricts commercial applications of nitrogen and phosphorus fertilizer both in quantity and seasonal timing. For fertilizer purchased by homeowners, phosphorus is banned, except in specific cases such as starter or organic fertilizer, and concentrations of nitrogen are capped. The Chesapeake Bay Program's Expert Panel on Urban Nutrient Management found decreases in phosphorus and nitrogen in lawn fertilizer sold in Bay states between 2006 and 2010, and it is expected that an analysis from USGS to be published in 2019 will show further reductions.

SW Strategy 6: Complete restoration requirement under industrial stormwater general permit

Under the 2014 and subsequent General Permits for Discharges from Stormwater Associated with Industrial Activities, permittees will complete and maintain their retrofit requirements of 20% of their untreated impervious surfaces. Any new permittees will be expected to meet these conditions.

SW Strategy 7: Continue application of erosion and sediment control and fertilizer management requirements in construction stormwater general permit, and include the option of using polymers to decrease turbidity

Under the 2014 General Permit for Stormwater Associated with Construction Activity, erosion and sediment controls (ESC) were specified that are consistent with Level 2 ESC in the Chesapeake Bay Program's 2014 report, Recommendations of the Expert Panel to Define Removal Rates from Erosion and Sediment Control Practices. The upcoming permit will include the option for permittees to use polymers to reduce turbidity.

Non-MS4 Jurisdictions

While the impact of the fertilizer law should be seen across Maryland, the installation of practices to manage stormwater continues to be a challenge outside of jurisdictions covered by stormwater permits. However, only a fraction of the State's pre-2000 developed impervious acreage—about ten percent based on an analysis of spatial data used for P6 CAST development—is not covered under an MS4 permit. Nevertheless, there are many locations in these areas with the potential for significant nutrient reductions. First, because fewer restoration projects have been installed in these jurisdictions, many common and low cost opportunities are still available. The jurisdictions are also less space limited than the more highly-developed portions of the State, meaning that land acquisition is potentially less expensive. Finally, the location of impervious areas adjacent to agricultural fields, also provides a potential to treat large nutrient loads from both land uses with the same BMPs. There is not enough urban land, however, for this to be a large driver of statewide reductions. Additionally, the budgets needed to support a large-scale effort, similar to that of the MS4s, would be difficult to fund. Accepting that overall reductions will be limited, the impetus then is to fund the projects which provide a substantial individual benefit per dollar spent, including nutrient reductions, ecosystem health, and societal benefit.

Under the Phase III WIP, projects in non-MS4s will continue to be funded by many of the same mechanisms as under Phase II. The Bay Restoration Fund (BRF) and the Chesapeake and Atlantic Coastal Bays Trust Fund will continue to offer funding for qualifying projects. Other smaller funding mechanisms, such as the 319 Nonpoint Source Grant Program and the Chesapeake Bay Trust, provide funding as well. Two new programs were recently created that could potentially fund these types of projects. The Clean Water Commerce Act (CWCA) budgets a maximum of $10 million annually in State fiscal years 2020 and 2021 to purchase low cost nutrient and sediment reductions through a reverse auction framework, where credits are purchased from the lowest-bidding seller. Maryland's Water Quality Trading Program (WQTP) currently allows MS4 jurisdictions to achieve a portion of their restoration work outside of their counties, as long as they are in contiguous Bay watershed segments. A non-MS4 county sharing a watershed with an MS4-permitted county, for example, could install a stormwater practice and trade the reductions to the MS4 county to help them in meeting their restoration requirement.

The State of Maryland hosted its Fall 2018 WIP Regional Workshops and used those sessions as opportunities to get local feedback about WIP implementation. Non-MS4 jurisdictions consistently mentioned a lack of funding and staff as barriers to putting projects in the ground. Several programs are currently in place to address the shortfalls in staffing and technical expertise, such as the five Maryland Sea Grant Extension Watershed Specialists, and the Regional Watershed Services Manager hired under Chesapeake Bay Program's Innovative Nutrient and Sediment Reduction grants program, but the State may need to consider ways to build off of the success of these programs. In terms of money, new ways to fund projects should be pursued, including by modifying existing funding programs or using them in innovative ways, or by developing new funding streams as necessary. Roadside ditch management projects, for example, could yield cost-effective reductions by treating impervious and agricultural runoff collectively, thereby elevating urban projects in the rankings for State funding. Alternatively, expanding the geographical area to SHA road systems that are in unpermitted rural areas but in the same Bay watershed segments as MS4 permitted road systems could open opportunities to accelerate restoration progress. Finally, during the Fall 2018 WIP Workshops, some local practitioners raised concerns that are critical to the sustainability of this restoration process. For example, while counties and municipalities are required to inspect stormwater facilities owned by Homeowner Associations (HOAs) and ensure that they are being maintained, the proliferation of smaller ESD to the MEP practices is making these local administrative tasks more onerous. Advances in stormwater management design that can reduce maintenance costs will become increasingly important.

SW Strategy 8: Implementation of stormwater practices in non-MS4 jurisdictions

The State will continue to offer grants for stormwater pollution controls and will look for opportunities to improve its programs to accelerate implementation in areas not covered by stormwater permits. Improvements, like the ones described above, may include refinements to grant funding procedures, growth of the WQTP, and the provision of additional technical staff support at a local level.

In order to best serve local communities and fund projects that address water quality, community resilience and climate impacts, the State is issuing a Common Application that will leverage funds for water quality restoration through the Chesapeake and Atlantic Coastal Bays Trust Fund, with other State and federal funds available through the Resiliency Restoration Program, Coastal Zone Management Program with NOAA, and the Chesapeake Bay Implementation Grant with EPA. This Common Application will increase accessibility to State financial resources while promoting integrated projects that improve water quality and protect critical infrastructure.

SW Strategy 9: Continue to minimize impact of stormwater pollution from new development through implementation of programs such as Environmental Site Design and the Forest Conservation Act.

Through the administration of the Stormwater Management Act of 2007 and the 1991 Forest Conservation Act, Maryland will continue to minimize the increases of nutrient loadings from new development. The Stormwater Management Act requires that Environmental Site Design be used on new development, with the objective of replicating the hydrology of woods in good

condition. The Forest Conservation Act specifies that a portion of forest on new development be retained or replanted.

Stormwater Sector Challenges and Opportunities

As discussed throughout Maryland's WIP, climate change impacts and how they affect water quantity and quality must also be considered in this restoration process. One potential approach that can be used to achieve climate resilience co-benefits, until better science and technology are available to address impacts of climate change, is the use of Continuous Monitoring and Adaptive Control (CMAC) systems. To be successful, these systems need to be fully integrated in a comprehensive stormwater management retrofit that includes water quality features and dam safety considerations. CMAC technology alone does not improve water quality or quantity management.

Opportunities exist for wider application of low-cost, priority practices with high co-benefits that are most effective if widely applied across the landscape, such as tree canopy (40% goal statewide), forest buffers (70% goal Bay wide), and rain gardens. Examples of existing funded programs for tree plantings include Healthy Forests/Healthy Waters rural residential tree planting (competitive grants from the Chesapeake and Coastal Bays Trust Fund), Backyard Buffers giveaway bags of 15-30 tree seedlings (federal Chesapeake Bay Implementation Grants), Marylanders Plant Trees $25 coupons, and tree planting cost-share from the Mel Noland Woodland Incentive Program for rural residential tree planting. Challenges are expanding funding to meet continued demand as familiarity with and interest in the programs spread, expanding eligibility more broadly across the landscape, having consistent funding that builds confidence in participation, and developing partnerships that can leverage limited State staff.

The State will continue to use its stormwater implementation to make progress toward its 2014 Chesapeake Bay Watershed Agreement goals. The Vital Habitats goal, for example, includes outcomes focusing on creating and reestablishing tidal and non-tidal wetlands, restoring riparian buffer and increasing tree canopy. The State will look to achieve a rate of living shoreline creation of around 40,000 linear feet per year, resulting in the annual creation of 25 acres of tidal marsh. Maryland will also look at mechanisms for increasing its rate of forest buffer creation in order to contribute to the watershed-wide goal of 900 acres of forest buffer restoration per year.

Technical Assistance in the Stormwater Sector

There is broad support and need in Maryland for enhanced technical assistance delivery to low-capacity communities, especially for stormwater management. In 2018 regional meetings to gather feedback from local partners for the Phase III WIP, Maryland State agencies frequently heard that a lack of adequate technical assistance is a clear barrier to maximizing nutrient reduction potential, particularly in non-MS4 jurisdictions. Choose Clean Water Coalition (January 2019) also identified information and technical expertise deficiencies in many local jurisdictions, and recommended more assistance to local governments in identifying existing available financial resources, communicating needs to State and Federal partners, and connecting local governments with potential partners in the private and nonprofit sectors.

Maryland Sea Grant Extension's team of five watershed restoration specialists (WRS) continues to work with local governments, citizen groups, and individuals to improve water quality across Maryland.

Extension recommends (January 2019) expansion of this technical assistance delivery system to help counties and communities comply with water quality goals and improve the Bay. Participants at a forum (September 2018) held by the Local Government Advisory Committee to the Chesapeake Bay Executive Council recognized the effective and successful model of Maryland's Watershed Assistance Collaborative, which includes the WRS, but acknowledged that to meet the needs of communities throughout the State, greater capability to supplement or build local capacity is needed.

Participants in the 2015 Healthy Waters Round Table (report) identified the need to support existing local staff with extra capability to accelerate WIP implementation on the Eastern Shore. A 2017 National Fish and Wildlife Foundation grant to the Chesapeake Bay Foundation (CBF), matched by MDE and six local Eastern Shore jurisdictions, began to address this need. The grant funds a pilot project to develop increased stormwater management capacity and facilitate a collaborative regional structure among cities and towns using a circuit rider model. In suggestions for Maryland's Phase III WIP (February 2019), CBF noted that investments in local planning and implementation capacity remain an unmet need that could be filled by additional effective targeted or shared technical assistance.

Maryland will continue to investigate enhanced technical assistance delivery for stormwater management implementation. In addition, MDE will look for more opportunities to directly provide specialized assistance to local partners, through the WRS and other circuit riders.

Wastewater Sector

Background

The wastewater sector of the Phase III WIP covers discharges of treated municipal wastewater and industrial process water, as well as releases of untreated effluent from sewer collection systems. Wastewater is the second-largest source of nutrient pollution in Maryland, currently accounting for approximately 21% of the nitrogen that the State contributes to the Chesapeake Bay. Although septic systems are used to treat wastewater, strategies to address the pollution contribution from septic systems are discussed separate in this report (See Septic Section on page B-20).

In 2005, States in the Chesapeake Bay region began to implement a new wastewater permitting process that limited the amount of nitrogen and phosphorus that significant wastewater treatment plants in the region could discharge. The term significant point sources discussed in this document means a subset of all municipal and industrial point sources located in the Chesapeake Bay watershed that have been identified by EPA and its partner jurisdictions as either discharging significant amounts of nitrogen and phosphorus. To meet the nutrient limits, and with the establishment of Maryland's Chesapeake Bay Restoration Fund in 2004, municipal facilities in the State are being upgraded with nutrient reduction technology, including biological nutrient removal (BNR) and enhanced nutrient removal (ENR).

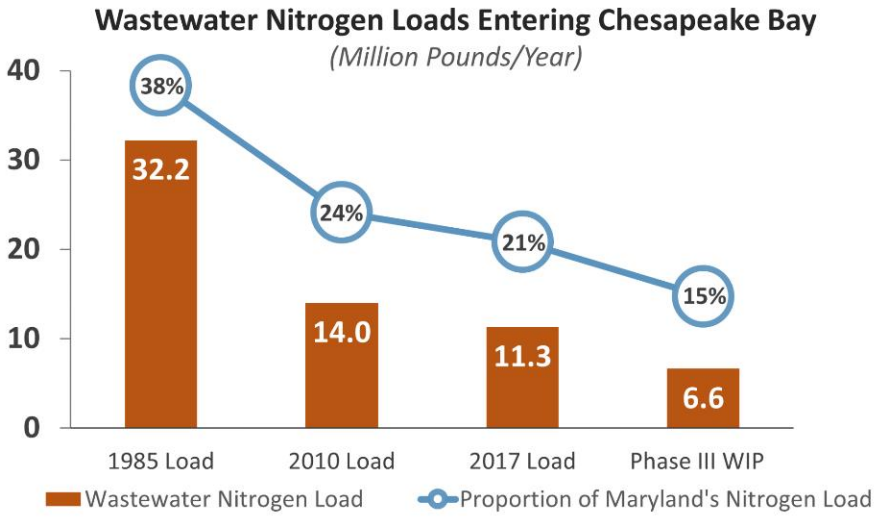
In the Phase II WIP, the largest nitrogen load reductions from any sector, about 5.5 million pounds/year, were attributed to the point source sector. Of that amount, the greatest reductions were to be achieved by upgrading significant municipal wastewater treatment plants. These plants, defined as having discharge

flows of 0.5 million gallons per day or greater, make up about 95 percent of the municipal wastewater flow.

Maryland has been a leader addressing pollution reduction in the wastewater sector and was the first state in the Chesapeake Bay region to commit to implement this state-of-the-art technology on the State's 67 largest wastewater treatment plants, accounting for 95% of our wastewater flow.

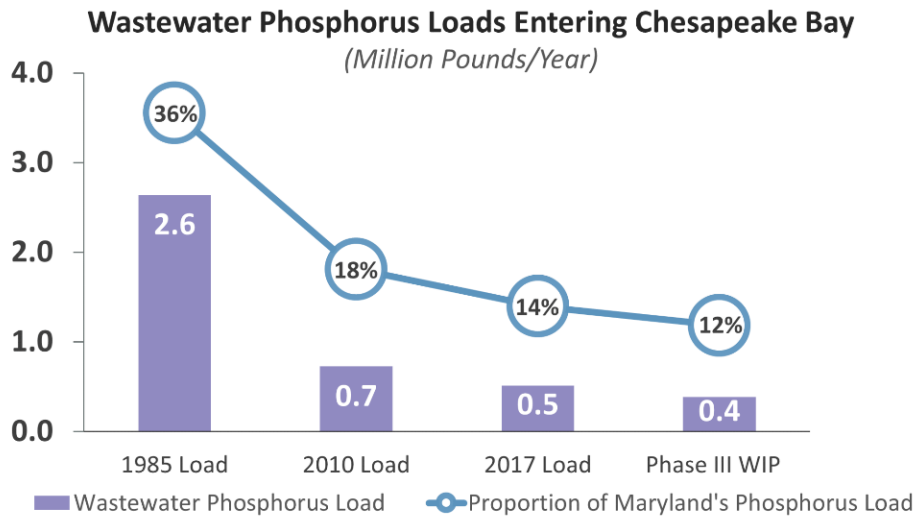
Trends

Reductions in annual nutrient loads from wastewater sources have been substantial, and between 1985 and 2017, nitrogen and phosphorus loadings dropped by over twenty million and two million pounds, respectively. The figures below show the reductions to date, as well as those projected to occur by 2025. For both nutrients, the wastewater contributions are anticipated to drop from over a third of the State's annual total load, to less than a sixth. A major future challenge for this sector is that having reduced loads so significantly to date and with the additional anticipated reductions by 2025 (Figures B-6 and B-7), opportunities for further pollution reductions will be more limited.



Source: Maryland Phase III WIP Scenario; CAST 2019

Figure B-6: *Nitrogen loading trends in Maryland since 1985.*



Source: Maryland Phase III WIP Scenario; CAST 2019

***Figure B-7:** Phosphorus loading trends in Maryland since 1985.*

Phase III WIP Wastewater Strategies

For the strategies described below, the reduction estimates are calculated using a 2018 baseline year, which follows Maryland's 2018 fiscal year: July 1, 2017 to June 30, 2018.

Significant Publicly-Owned Treatment Works Upgrades

The upgrade of Maryland's largest publicly-owned treatment works (POTWs) to enhanced nutrient removal (ENR) tertiary treatment technology has been, along with agriculture, one of the main drivers of Maryland's WIP reductions. In 2004, the Bay Restoration Fund (BRF) was established as a funding mechanism for these projects, and Maryland has been able to deploy them quickly relative to the magnitude of the reductions they achieve. Upgrades are cost-effective, with per pound nitrogen reductions costing less than $100[30], and while they do not provide the broad array of ecosystem benefits that are expected to result from other sectors, such as stormwater implementation, reductions from upgrades are highly certain and immediate. End-of-pipe monitoring, reported through Discharge Monitoring Reports, assures that facilities are operating as designed. Wastewater treatment plants are a relatively small contributor of sediments to the Bay, with 2017 CAST results showing the sector accounting for one tenth of a percent of the statewide load; therefore, it is not expected that wastewater upgrades will yield a significant reduction of sediment loads with respect to Bay water quality.

[30] .chesbay.us/Publications/cost%20effective.pdf

mde.maryland.gov/programs/Water/TMDL/TMDLImplementation/Documents/Data_and_Tools/BMP_Unit_Cost_Estimates_12.23.2016.pdf

.mde.maryland.gov/programs/Water/TMDL/TMDLImplementation/Documents/Data_and_Tools/BMP_Unit_Cost_Estimates_Phase_5-3-2.xlsx

ENR, as defined in Maryland Code is a technology capable of reducing nitrogen to 3 mg/L and phosphorus to 0.3 mg/L. This is lower than previous technologies in the State like secondary treatment and Biological Nutrient Removal (BNR), which are expected to achieve nitrogen concentrations of 18 mg/L and 8 mg/L, respectively. The State defines "significant" POTWs as those with design capacities of 0.5 million gallons per day or above. There are six[31] federal and 66 non-federal significant POTWs in the State discharging to the Bay, plus Blue Plains Wastewater Treatment Plant, which is located in Washington, DC but receives municipal effluent from Maryland. The BRF has budgeted $1.2 billion for the 67 non-federal POTW upgrades.

Wastewater Strategy 1: Complete remaining ENR upgrades for non-federal significant POTWs through the Bay Restoration Fund

The Phase II WIP described strategies for both the federal and non-federal POTWs. All 67 of the non-federal POTWs were planned to be upgraded with the Bay Restoration Wastewater Fund (BRF-Wastewater). Between 2006, when the first ENR upgrades went online, and the end of 2018, the State completed 59 of the BRF-funded upgrades, with over 85% of its 715 MGD capacity operating at ENR. The remaining eight BRF-funded facilities are scheduled to be complete by the end of 2022 —The City of Westminster WWTP, Conococheague WWTP, Frederick City WWTP, Freedom District WWTP, Hampstead WWTP, Maryland Correctional Institution WWTP, Patapsco WWTP and Princess Anne WWTP. These plants account for around 100 MGD of the State's total capacity and should provide a nitrogen load reduction of around 4 million pounds per year and a phosphorus reduction of 100,000 pounds per year. The majority of the reductions—above 95 percent—will come from the upgrade of Patapsco WWTP which is scheduled to be complete in 2019. Funding for these projects has already been allocated through the BRF.

Wastewater Strategy 2: Complete the remaining federal significant POTW ENR upgrade

Maryland had also issued permits to the significant federal POTWs requiring them to meet ENR permit limits, and to date, five of the six have completed their upgrades. The five facilities that have been upgraded are: Naval Support Facility Indian Head, APG, APG Edgewood Area, Fort Detrick, and Fort Meade.

The remaining federal ENR upgrade is for the USDA East Side WWTP, which is currently under construction and the treatment process is expected to be complete before 2025. The anticipated nitrogen and phosphorus reductions are 3,000 pounds per year and 300 pounds per year, respectively.

[31] Appendix F of the Phase II WIP lists permit MD0023523, US Naval Academy (now Naval Support Activity Annapolis WWTP) as a significant federal POTW, however, the facility flow capacity was downgraded to 0.3 MGD (from 0.7 MGD) at the request of Navy during the latest permit renewal. Due to the lack of adequate size 24 hour holding pond for shellfish protection, the facility is prohibited to discharge more than 0.15 MGD until an adequate holding pond is built. As for the commitment for ENR upgrade, Navy had signed a consent decree issued by EPA in late 2018 (document attached) agreeing to build an ENR facility to meet the nutrient requirements in the current discharge permit.

Non-Significant POTW Upgrades

While the upgrades to larger POTWs are scheduled to be complete by 2022, Maryland continues to fund upgrades to POTWs with design capacities below 0.5 million gallons per day, called non-significant municipal facilities. At the end of 2018, five BRF-funded minor POTWs were in operation in the Bay watershed, with eleven more planned for completion by 2025. When complete, these five facilities should provide annual reductions of approximately 50,000 pounds of nitrogen and 10,000 pounds of phosphorus. These reductions represent less than one percent of the planned wastewater reductions from 2010 to 2025, however, they are cost effective relative to other structural practices[32]. Furthermore, since minor POTWs are typically located in rural watersheds, they may be the only local opportunity for permitted reductions. Beyond the BRF-funded upgrades, four other minor plants are operating at ENR treatment, bringing to twenty the total number of planned projects. At the end of 2018, funding was still available for additional non-significant POTW upgrades, so the number of completed projects for 2025 may exceed the estimate here.

Wastewater Strategy 3: Complete eleven remaining ENR upgrades for non-significant POTWs through the BRF, and continue to pursue additional upgrade opportunities

Eleven non-significant POTWs are scheduled to either be upgraded to ENR, or replaced with an ENR facility by 2025. These are: Betterton WWTP, Chesapeake City WWTP, Elk Neck State Park, Hancock Wastewater Lagoon, Harbourview WWTP, Oxford WWTP, Preston WWTP, Trappe WWTP, Twin Cities WWTP, Tylerton WWTP and Victor Cullen WWTP. These upgrades are anticipated to provide a nitrogen reduction of 25,000 pounds per year and a phosphorus reduction of 5,000 pounds per year. Funding for these projects has already been allocated through the BRF.

POTW Upgrades and Performance Incentives

As is shown in the figure B-8 below, the average nitrogen effluent concentration for POTWs in Maryland has dropped from 18 mg/L in 1985 to 7 mg/L in 2017.

[32] A structural stormwater best management practice (BMP) is defined in the as a stationary and permanent BMP that is designed, constructed and operated to prevent or reduce the discharge of pollutants from stormwater or any other pollution source sector.

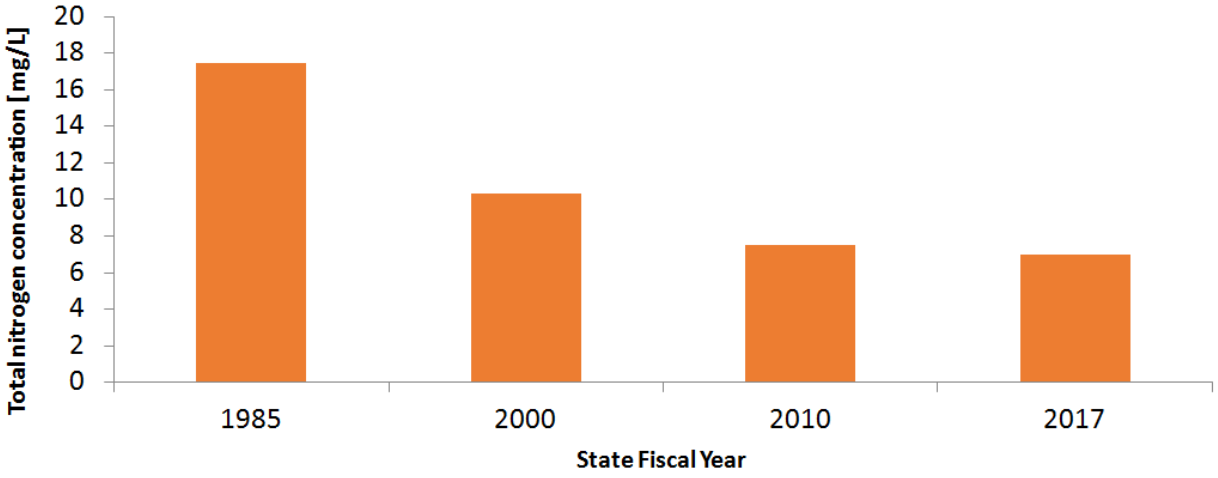


Figure B-8: *Historic average nitrogen discharges from municipal plants in Maryland's portion of the Chesapeake Bay watershed.*

Average nitrogen concentrations from the upgraded POTWs can be reduced to 3.0 mg/L or below. Maryland has performed a statewide nitrogen reduction analysis that shows that by achieving an average nitrogen concentration of 3.25 mg/L in the significant POTWs as an aggregate, the State will be able to meet its overall statewide target.

Currently, Maryland has several mechanisms in place to reach lower than permit limits effluent concentrations in ENR facilities. First, NPDES permits for significant POTWs require plants to operate below 4 mg/L on an annual basis, a requirement that is consistent with the allocations established under the 2010 Chesapeake Bay TMDL. Second, there are three programs in place to incentivize POTWs to achieve concentrations lower than 4 mg/L of nitrogen in their effluent—BRF Wastewater Fund Operations and Maintenance (O&M) Grants, the Clean Water Commerce Act (CWCA) and the Water Quality Trading Program (WQTP).

1) BRF O&M Grants are available to POTWs that achieve annual nitrogen and phosphorus discharge concentrations at or below 3 mg/L and 0.3 mg/L respectively. There has been strong participation in this program, and in FY2018, the BRF Wastewater Fund spent $4.8 million on grants to 41 qualifying facilities.
2) Under the CWCA, facilities can submit bids to sell nitrogen, phosphorus and sediment reductions to the BRF. Funds are disbursed annually based on a ranking process that prioritizes proposals offering the lowest cost per pound of reduction. To qualify to sell nitrogen reductions, POTWs must operate below 3 mg/L. The CWCA began in SFY 2018 and is funded through 2021, with $6M allocated for 2019, and $10M allocated in each of the remaining years. Through 2018, no POTW had submitted a bid or received funding through this mechanism.
3) Maryland established the WQTP in 2018, allowing NPDES permittees to meet and maintain pollutant load limits through the acquisition of credits generated by pollutant load reductions elsewhere in Maryland's portion of the Chesapeake Bay watershed as long as the trade does not cause or contribute to a violation of State water quality standards. POTWs at ENR are allowed to generate tradable credit by operating below 3 mg nitrogen/L, the same performance threshold as the CWCA. In early 2018, several facilities certified reductions, which were used to meet county

or industrial SW MS4 permit requirements. It is important to note that these trades are considered temporary, as any required nutrient and sediment reductions achieved through trading would eventually need to be met through appropriate stormwater practices.

Between 2019 and 2025, as part of the two-year milestones, Maryland will need to continue to assess the aggregate impact of these programs. With a number of large plants starting their ENR treatment processes, several years of additional discharge data will be necessary to assess the overall statewide performance. As is shown in Figure B-9, the largest three dischargers of wastewater from Maryland—Back River Wastewater Treatment Plant, Blue Plains Wastewater Treatment Plant and Patapsco Wastewater Treatment Plant— account for over half the State's capacity, meaning that a handful of plants have a significantly large impact on the State's overall loadings. If future participation in the programs above is not sufficient to meet the State's loading goals, consideration will need to be given to whether the programs need to be adjusted.

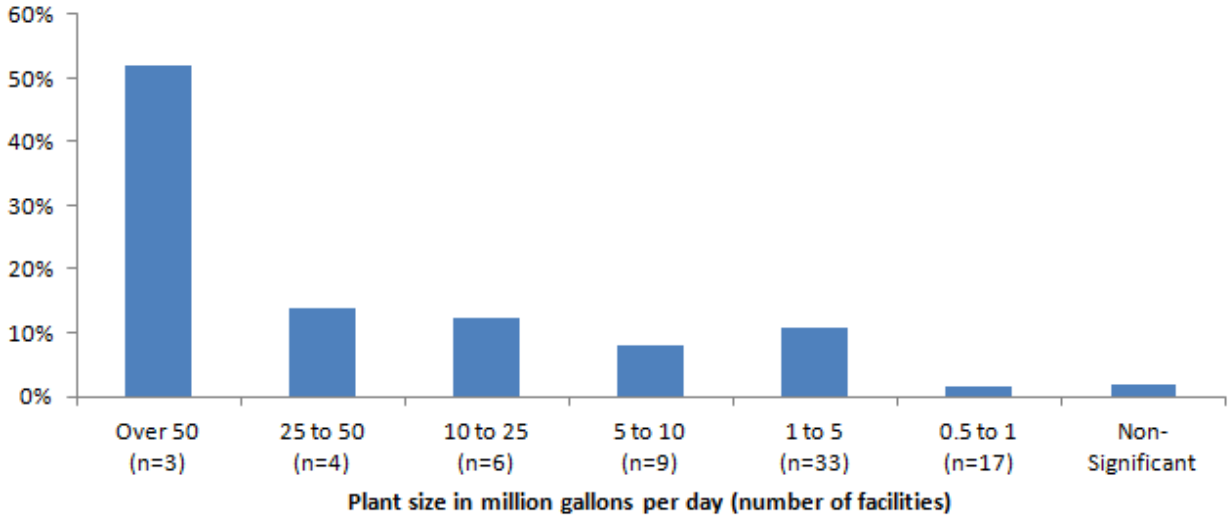


Figure B-9: *Percent of statewide flow capacity based on plant size.*

Wastewater Strategy 4: Continue to incentivize POTW performance to achieve lower nutrient discharge concentrations

Based on the feasible reduction commitments established by other source sectors to be achieved by 2025, Maryland will be able to meet its Phase III WIP targets if its significant POTWs reach an annual average nitrogen concentration of 3.25 mg/L. To help achieve this goal, and as described above, Maryland will continue to provide O&M grants to POTWs that discharge effluent concentrations below 3 mg/L of nitrogen and 0.3 mg/L of phosphorus. Funding of 10% of the BRF fee collected each year (roughly $10 million per year) has been allocated to O&M grants. In addition, through its administration of the CWCA and WQTP, the State anticipates that facilities will be further incentivized to lower their effluent concentrations. During subsequent milestone periods, Maryland will continue to assess its plant performance to determine whether the suite of incentives is sufficient to enable the State to meet its overall target. Using an anticipated statewide significant POTW annual flow of 600 MGD, each reduction of 0.25 mg/L in

nitrogen concentration in plant effluent should yield a load reduction of 425,000 pounds per year. Continuing implementation in the other source sectors for additional reductions beyond 2025 remain a priority component of Maryland's WIP in combination with the performance goal for the POTWs.

Sewer and other Infrastructure Projects

Maryland is helping to finance a variety of sewer improvement projects through the BRF and through low interest loans offered through the Water Quality Revolving Loan Fund (WQRLF). These include projects to deal with combined sewer overflows (CSOs), sanitary sewer overflows (SSOs) and inflow and infiltration (I/I).

It is important to note that while the nutrient load reductions from CSO and SSO elimination are fairly small compared to the total project cost, the public health benefit of these projects can be substantial, with untreated sewage being directed toward a treatment plant rather than into Maryland's waters. CSOs represent approximately 0.2% and 0.4% of the total wastewater TN and TP loads to the Bay, respectively. SSOs represent approximately 0.1% and 0.4% of the total wastewater TN and TP loads to the Bay, respectively.

Combined Sewer Overflows

Combined sewer systems (CSSs) are collection systems that simultaneously collect sanitary sewage and surface runoff, and are designed to discharge to a treatment plant. During wet weather, CSOs may occur when a CSS's capacity is exceeded, resulting in the discharge of untreated waste directly to the environment. In Maryland, two approaches are being used to address CSOs—sewer separation, where the combined sewer is replaced with separate sanitary and storm sewer systems, and capture and treat, where a storage facility is constructed at the POTW to handle large inflow events.

Since the Phase II WIP, the CSO in Cambridge has been eliminated, and the remaining five CSOs in the state— Allegany County, Cumberland, Frostburg, LaVale and Westernport—are all located in western Maryland. Consent Decrees and Long Term Control Plans (LTCPs) are in place for all of the CSOs, and all are scheduled to be finished by 2023.

WW Strategy 5: Address CSOs through the implementation of LTCPs

Four of the remaining CSSs in Maryland, Allegany county, Frostburg, LaVale and Westernport will be addressed through sewer separation projects and the remaining combined sewer in Cumberland, will be addressed with a storage facility (a capture and treat system). These projects are all covered by LTCPs and are scheduled to be complete by 2023. The Chesapeake Bay Watershed Model estimates that CSO loads of 20,000 pounds per year of nitrogen and 2,000 pounds per year of phosphorus will be eliminated as a result of this work.

Sanitary Sewer Overflows

SSOs in Maryland are being addressed through Consent Decrees (CDs) with Baltimore City, Baltimore county and the Washington Suburban Sanitary Commission (WSSC). These CDs prescribe enhanced

programs such as sewer cleaning and inspections, and measures to address illicit connections, roots and oils.

The CD covering Baltimore City's SSOs requires the city to address deficiencies in its sewer system contributing to SSOs by 2030. The majority of this work will be completed by 2025, with the completion of the Back River WWTP Headworks Project in 2021. Wastewater is currently conveyed to the Back River WWTP through an aging interceptor pipe which can cause ten-mile-long sewer backups leading to overflows into Jones Falls. The Headworks Project, estimated by Baltimore City to cost $430M, will improve sewage flow by replacing the pipe with a more modern system that includes eight pumps and new screening and grit removal facilities. It is anticipated that the volume of overflows will decrease by over 80 percent by 2021, with the remainder to be addressed by 2030. Because SSOs are a violation of the Clean Water Act, their elimination is not given TMDL credit, however reductions from SSO elimination should reduce, while small, real nutrient loads to the Bay beyond what is estimated in the model, in addition to provide public health benefits. The annual reduction from the Baltimore City SSO project is anticipated to be less than 20,000 pounds of nitrogen and 2,000 pounds of phosphorus annually.

WW Strategy 6: Address SSOs through Consent Decrees

There are currently CDs with Baltimore City, Baltimore county and WSSC to address SSOs. Eighty percent of the overflow volumes from Baltimore City are scheduled to be addressed by 2021, with the remainder of the overflows to be eliminated by 2030. The implementation of sewershed repair and replacement plans under the Baltimore county CD are scheduled to be completed by 2020[33]. Remedial measures under the WSSC SSO CD are required to be in place by 2024[34]. A portion of the sewer improvements in Baltimore City will be funded through the BRF, while the majority of funding will come from local sources, including using loans through the WQRLF. Actual nutrient reductions from the SSO work are anticipated to be around 11,100 pounds per year of nitrogen and 2,000 pounds per year of phosphorus, however, because SSOs are illegal, and a violation of the Clean Water Act, reduction credit from these projects will not be counted toward the WIP.

The third category of BRF-funded sewer rehabilitation is I/I projects, which aim at reducing water entering sanitary sewers through cracks or leaks in the sewer pipes or through inappropriate connections. These flows can be significant, especially in older collection systems, with some plants attributing up to a quarter of their flows to I/I. Lowering the influent flows to POTWs reduces effluent discharges, yielding a corresponding decrease in loads. Due to weather fluctuations and uncertainty involved in remediating buried infrastructure, it is difficult to forecast the impact of planned I/I work, so no anticipated reductions are being estimated in this report. Given the high levels of I/I however, these reductions are likely to be substantial.

WW Strategy 7: Continue to fund I/I projects

[33] resources.baltimorecountymd.gov/Documents/Public_Works/consentdecreefinal.pdf#page=35

[34] wsscwater.com/files/live/sites/wssc/files/PDFs/Final_CD_w_Signatures_1010853.pdf#page=20

wsscwater.com/business--construction/sewer-repair-replacement--rehabi/sanitary-sewer-overflow-consent.html

Maryland continues to upgrade and rehabilitate its sanitary sewer infrastructure through the BRF, addressing inflow and infiltration of stormwater and groundwater into the sewer collection system. Due to the highly variable nature of the annual flows and the challenges of forecasting the impacts of future projects, no planned credit from these projects will be included in the WIP.

Industrial Facilities

Significant Industrial Facilities

For Maryland's eight significant industrial facilities, the Phase II WIP strategy adopted the individual loading allocations identified in Maryland's 2008 Tributary Strategies. As of the end of 2018, five of the facilities had nutrient targets written into their permits consistent with the Phase II WIP and another facility is anticipated to have its permit issued with nutrient targets in 2019. Of the remaining two facilities, one, the Maryland and Virginia Milk Producers Cooperative Association has transferred its flow and allocation to the Little Patuxent Water Reclamation Plant, as was described in Appendix F of the Phase II WIP. The other permit (NPDES number MD0001201) was last issued to ISG Sparrows Point, Inc., which has changed its operations from a steel plant (now dismantled) to a treatment plant operation for stormwater and potentially other new and legacy sources.

WW Strategy 8: Complete the issuance of permits to significant industrial dischargers with nutrient limits consistent with the Phase II WIP

Under the Phase III WIP Maryland's significant industrial facilities will maintain the targets assigned to them in the Phase II WIP. The associated nutrient load reduction identified under the Phase II WIP for these facilities has been achieved. Maryland will continue to issue significant industrial permits consistent with the Phase II WIP, however, since the load has already been achieved, no additional reductions will be required in the Phase III WIP.

Non-Significant Industrial Facilities

The Phase II WIP identified 1,038 non-significant industrial facilities with permits to discharge nutrients or with the potential to discharge nutrients into Maryland's surface waters, including estimates of nutrient discharges for each facility. Based on these loading estimates, the Phase II WIP specified a 15.6 percent reduction in nitrogen discharges from non-significant industrial sources between 2009 and 2017 and a 33 percent reduction to 2025. Maryland committed to further refine its estimates of loads from these facilities, a project that was completed in 2013. The improved data was used to calibrate the Phase 6 Chesapeake Bay Watershed Model, and is used to assess annual progress. In order to meet the WIP reductions, for the issuance of new permits, the State has proposed loading targets and reduction schedules where appropriate. Under the Phase III WIP, Maryland will continue to work toward its Phase II WIP goal.

WW Strategy 9: For non-significant industrial facilities, continue to propose NPDES permits that will include loading targets and schedules for reductions

In the Phase II WIP, Maryland committed to a 15.6% reduction of non-significant industrial end-of-pipe nitrogen loads by 2017 and a 33% reduction by 2025. By 2017, non-significant industrial

nitrogen loads had decreased by 18.7 percent, or 100,000 pounds per year end of pipe. Meeting the Phase II WIP target will yield an additional reduction of 75,000 pounds per year end of end of pipe. This corresponds to a 60,000 pound reduction to the Bay. No narrative phosphorus reduction goal was established in the Phase II WIP, however, the reductions from phosphorus have already exceeded 50 percent. No further phosphorus reductions will be anticipated in the Phase III WIP.

Another driver of reduced costs and accelerated pollution reduction implementation from industrial facilities is water quality trading. Industrial facilities that adopt nutrient or sediment limits into their permits can be eligible to generate tradable credits. Maryland's first permit to allow for trading under the new regulations was issued to the Dundalk Marine Terminal in 2018. The permitted discharge covers water that is withdrawn from Baltimore Harbor and treated using an Algal Flow-Way Technology, a system that converts nutrients to algal biomass which can then be harvested. Since the WQTP program is less than one year old, it is not possible to anticipate the 2025 participation in the program; however, the State will continue to work closely with facilities interested in generating credits in order to encourage a robust water quality trading market.

Dredged Material Containment Facilities

The Maryland Port Administration (MPA) continues to operate two Dredged Material Containment Facilities (DMCFs) in Baltimore Harbor—Cox Creek DMCF and Masonville DMCF. Nutrient discharges from these facilities are covered under a single overlay permit issued in 2015, with allocations consistent with the Phase II WIP. The DMCF at Hart Miller Island is no longer receiving dredged material. While the facility continues to have regulated discharges, the nutrient loads are minimal. For DMCFs further from the harbor, including Poplar Island, the Phase III WIP will follow the strategy described in the Phase II WIP Appendix A.

WW Strategy 10: For any DMCF permit that is reissued, continue to maintain allocations consistent with the Phase II WIP

Active DMCFs have received permits consistent with the Phase II WIP. No additional reductions will be assigned in the Phase III WIP.

WW Strategy 11: Work closely with facilities interested in generating nutrient reduction credits in order to encourage a robust trading market

Maryland will continue to work with municipal and industrial facilities interested in entering the trading market. The WQTP is intended to be a driver of reduced costs and accelerated implementation of reductions toward the WIP, both accelerating and reducing the cost of implementation. Reductions from facilities required to meet their baseline will result in reductions toward the WIP, and for POTWs, these will be accounted for in WW Strategy 4, performance incentives. Trades used to meet NPDES permit requirements will be accounted for in the individual NPDES permittee reduction strategies.

Wastewater Sector Challenges

Adaptive management will be critical to maintaining Maryland's wastewater reductions. Plant performance will be continually assessed to verify that the suite of programs and incentives is effective in meeting wastewater targets. Funding programs, mechanisms, and processes will likewise be evaluated to ensure they support achievement of lower effluent concentrations in ENR facilities.

A robust trading market for municipal and industrial treatment facilities could provide additional incentive to lower discharge concentrations. Beyond 2025, continuing implementation in other source sectors, especially stormwater and septic, is necessary in combination with the performance goal for the POTWs.