Charting a Course to 2025

A Report and Recommendations for the Chesapeake Executive Council on How to Best Address and Integrate New Science and Restoration Strategies Leading up to 2025

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Acronym Page

- 4D = 4-Dimensional (as in 4D Interpolator)
- Bay TMDL = Chesapeake Bay Total Maximum Daily Load BMPs = Best Management Practice
- B-WET = Bay Watershed Education and Training
- CAST = Chesapeake Assessment Scenario Tool
- CESR = Comprehensive Evaluation of System Response (report developed by the Chesapeake Bay Program's Scientific and Technical Advisory Committee)
- CBP = Chesapeake Bay Program
- CMC = Chesapeake Monitoring Cooperative
- DEIJ = Diversity, Equity, Inclusion and Justice
- EC = Executive Council
- eLIT = Environmental Literacy Tool
- EPA = Environmental Protection Agency
- GIT = Goal Implementation Team
- HBCU = Historically Black College and University
- IDF = Intensity, Duration and Frequency
- IIJA = Infrastructure Investment and Jobs Act
- IRA = Inflation Reduction Act
- LEA = Local Education Agencies
- LGAC = Local Government Advisory Committee
- MOU = Memorandum of Understanding
- MS4 = Municipal Separate Stormwater System
- MWEE = Meaningful Watershed Educational Experience
- NOAA = National Oceanic and Atmospheric Administration
- PCB = polychlorinated biphenyls
- PFAS = per-and-polyfluoroalkyl
- Phase III WIP = Phase III Watershed Implementation Plan
- PSC = Principals' Staff Committee
- SAC = Stakeholders Advisory Committee
- SSRF = Strategic Science and Research Framework
- STAC = Scientific and Technical Advisory Committee
- STAR = Scientific, Technical Assessment and Reporting Team
- USDA = U.S. Department of Agriculture
- USFS = U.S. Forest Service
- USFWS = U.S. Fish and Wildlife Service
- USGS = U.S. Geological Survey

Section 1: Executive Summary

In October 2022, the Chesapeake Executive Council charged the Principals' Staff Committee with recommending a critical path forward that prioritizes and outlines the next steps for meeting the goals and outcomes of the *Chesapeake Bay Watershed Agreement* leading up to and beyond 2025. The Executive Council Charge to the Principals' Staff Committee: Charting a Course to 2025 and Beyond ("Charge") asked the Principals' Staff Committee to report back to the Executive Council at their 2023 annual meeting with recommendations on how to best address and integrate new science and restoration strategies leading up to 2025.

Signed in 2014, the most recent *Watershed Agreement* has 10 goals and 31 outcomes, several of which have target completion dates of 2025. As a first step toward developing these recommendations, the Charge asked for an update on the progress that the outcomes are making in attaining their goals, including a look at the work that remains to be completed and gaps to be addressed. This assessment revealed that 18 outcomes are on course, two are uncertain pending upcoming data updates and 11 are off course and will not be met by 2025.

Additionally, the Charge directed the Principals' Staff Committee to consider the following:

- Identify new and emerging scientific data and studies which could modify our progress reporting and adaptive management approach, as well as the goals and outcomes under the *Watershed Agreement*.

- Enhance our monitoring and reporting capabilities to improve our understanding of existing conditions and trends.

- Define the existing and emerging challenges (e.g., climate change conditions, increasing population growth (both human and animal), diversity, equity, inclusion and justice considerations) to accomplishing the partnership's work under the *Watershed Agreement*, and how addressing those challenges might alter our collective restoration priorities, including the possibility of extending the target date for completing restoration of water quality beyond 2025.

- Identify opportunities to leverage action across multiple goals and outcomes of the *Watershed Agreement*.

In consideration of the above requests, the Reaching 2025 steering committee worked with subject matter experts to assess how emerging science, monitoring and analysis can help address existing and growing threats, as well as the progress made, and challenges associated with meeting the Chesapeake Bay Total Maximum Daily Load (Bay TMDL) and implementation of the Phase III Watershed Implementation Plans (WIPs). The report also examines the partnership's response to climate change and diversity, equity, inclusion and justice (DEIJ), and progress and challenges related to the Forest Buffers and Wetlands outcomes. These are specifically called out in the report as they are "keystone" outcomes in that they provide significant conservation and restoration benefits to not only local waters and the Chesapeake Bay, but also to several other *Watershed Agreement* outcomes. Each of these subsequent sections include further detail on the challenges, current opportunities and recommendations on how to best progress to 2025.

When tallied up, this report contains close to 200 different recommendations for accelerating progress across each *Watershed Agreement* outcome over the next 18 months. These several recommendations have been consolidated into a concise critical path forward for the partnership, found on page 7, but the many other detailed recommendations found throughout this report should be considered in accelerating progress to 2025.

The Chesapeake Bay Program acknowledges that while progress is being made on all goals, the targets of all 31 outcomes will not be met by 2025. The Outcome Attainability assessment, beginning on page 30, shares several observations as to why some outcomes have been successful while others are lagging. These challenges are similar across the partnership, ranging from staffing shortages to delays caused by the Covid-19 pandemic to increasingly serious emerging threats, such as climate change. The proposed critical path forward accounts for work already in progress, with an eye to new scientific reports and findings, and increased funding opportunities to help accelerate implementation for our lagging outcomes.

Nonetheless, the Chesapeake Bay is without a doubt in better shape than it was in 1983, when the Chesapeake Bay Program was created with the signing of the first *Chesapeake Bay Agreement*. This is in large part due to the hard work, consistent efforts and steadfast commitment of the jurisdictions in the Chesapeake Bay watershed, along with their many local government units, dedicated non-profit partners and strong federal partners.

Efforts in outlining and developing this document were aided by the Reaching 2025 steering committee, which consisted of representatives from the seven watershed jurisdictions, federal agencies, non-governmental organizations and advisory committees. This report will be provided to the Executive Council at their 2023 meeting, as well as the Beyond 2025 steering committee to help form the foundation for the next phase of Chesapeake Bay protection and restoration.

Section 2: Critical Path Forward

- **Accelerate investments.**
    - Thanks to the American Rescue Plan Act, Infrastructure Investment and Jobs Act and increased state investments, the Chesapeake Bay Program will accelerate restoration activities over the next 18 months with a particular emphasis on addressing lagging outcomes.

- **Integrate emerging science and monitoring.**
    - Recent scientific reports and findings have provided further understanding of how the Chesapeake Bay and its surrounding watershed are responding to the implementation of best management practices (BMPs), impacts from climate change and a rise in environmental stewardship, to name a few. The Chesapeake Bay Program is already investigating as to how the findings in such recent reports as the *A Comprehensive Evaluation of System Response*, *Rising Watershed and Bay Water Temperatures*, *Enhancing Chesapeake Bay Partnership Activities by Integrating Social Science* and *Enhancing the Chesapeake Bay Program Monitoring Networks* (note: this is not an exhaustive list) can be integrated into the partnership's work. These are significant scientific findings that recommend an increased focus on geographic targeting, social science, robust monitoring networks, the environmentally and economically important shallow waters of the Bay and addressing rising water temperature implications, and as such will take time and careful planning to be fully represented in the next phase of Bay restoration. Where appropriate and possible, the partnership will integrate this emerging science now.

- **Fast-track action plans.**
    - Over the past few years and in recent months, several action plans have been put into place across the partnership. The Chesapeake Bay Program will lean harder into the implementation of these plans moving toward 2025. These include, but are not limited to, the jurisdictions' Phase III WIPs, *Diversity, Equity, Inclusion and Justice (DEIJ) Strategy*, *Implementation Plan*, state riparian buffer action strategies, Wetlands Action Plan and *Climate Change Directive—Workplan*.

Section 3: Bay TMDL/Phase III WIPs

In May 2009, then-President Barack Obama issued Executive Order 13508: Chesapeake Protection and Restoration, which called for the protection and restoration of the Chesapeake Bay. The Bay TMDL was at the core in meeting this Executive Order, along with responding to consent decrees in Virginia and the District of Columbia and fulfilling requirements under the federal Clean Water Act. Established by the U.S. Environmental Protection Agency (EPA) in 2010 to reduce the amount of nutrients and sediment flowing into the Chesapeake Bay from its tributaries, the Bay TMDL recognized the Chesapeake Bay Program goal of having all pollutant reduction practices in place by 2025 that will eventually result in attainment of water quality standards. Under the Accountability Framework, jurisdictions and the federal agencies agreed to develop two-year milestones, to identify and track actions being made to reduce nitrogen, phosphorus and sediment loads to the Bay.

The jurisdictions developed WIPs to help them determine how they will meet their pollutant reduction goals. Phase I WIPs were developed in 2010, with Phase II WIPs put into place in 2012. The Phase III WIPs were developed in 2019 to describe how the jurisdictions intended to meet their pollutant reduction targets by 2025. Additionally, many of the important components needed for the 2025 WIPs Outcome to be successful are in place, including targeting mechanisms, tracking systems, roles, responsibilities, cost estimates and implementation plans. Key challenges related to climate change, the trapping capacity of the Conowingo Dam reservoir and increasing growth have been identified and quantified, and commitments to address them are in place. The Chesapeake Bay Program acknowledges that the partnership will not meet their 2025 targets but has made incredible progress along this journey. Specifically, 100% of sediment reductions are estimated to be met by 2025, along with 51% of nitrogen reductions and 60% of phosphorus reductions (*Note: These percentages are based on 2022 progress data*).

The 2025 WIPs Outcome calls for 100% of practices to be in place by 2025 that would meet pollutant reduction goals, understanding that it will take time for those practices to have a water quality response. However, it is now understood that all practices will not be in place by the end of 2025. This is due to several factors, which include: insufficient regulatory and voluntary measures not being in place to incentivize implementation in the nonpoint source sectors, water quality standards attainment needed for the deep waters of the Bay and continually changing conditions such as climate change and increasing development pressures throughout the watershed.

Specific progress made by the jurisdictions in implementing their Phase III WIPs is reported on the *ChesapeakeProgress* website. As of 2022, computer simulations show that between 2009—the Bay TMDL baseline—and 2022 credited management actions are estimated to result in the following:

- Fourteen percent overall **nitrogen** decrease from 297.8 million pounds in 2009 to 255.9 million pounds in 2022, meeting 51% of the goal to reduce nitrogen by 2025.

- Thirteen percent overall **phosphorus** decrease from 17.2 million pounds in 2009 to 14.9 million pounds in 2022, meeting 60% of the goal to reduce phosphorus by 2025.

- An almost 5% overall **sediment** decrease from 18.9 billion pounds in 2009 to just under 18 billion pounds in 2022, meeting 100% of the goal to reduce sediment by 2025.

These computer simulations show the following jurisdiction-specific breakdown of overall pollutant reductions between 2009 and 2022:

- **Delaware**: Has not met its pollutant reduction targets for nitrogen, phosphorus or sediment. Reported and credited BMPs have achieved 29% of nitrogen, 31% of phosphorus and 73% of sediment goals.

- **District of Columbia**: Has met its targets for all three pollutants. Reported and credited BMPs have achieved 100% of the nitrogen, phosphorus and sediment targets.

- **Maryland**: Has not met its pollutant reduction targets for nitrogen or phosphorus but did meet its sediment goal. Reported and credited BMPs have achieved 60% of nitrogen, 39% of phosphorus and 100% of sediment reductions.

- **New York:** Has not met its pollutant reduction targets for nitrogen, phosphorus or sediment. Reported and credited BMPs have achieved 60% of nitrogen, 72% of phosphorus and 22% of sediment reductions.

- **Pennsylvania**: Has not met its pollutant reduction targets for nitrogen, phosphorus or sediment. Reported and credited BMPs achieved 21% of nitrogen, 48% of phosphorus and 49% of sediment reductions.

- **Virginia**: Has not met its pollutant reduction targets for nitrogen or phosphorus but has met its target for sediment. Reported and credited BMPs have achieved 84% of nitrogen, 70% of phosphorus and 100% of its sediment reductions.

- **West Virginia**: Has met its targets for all nitrogen and sediment. Reported and credited BMPs have achieved 95% of phosphorus reductions.

Challenges

The following challenges have been identified as impeding the jurisdictions' progress in meeting their Phase III WIP targets:

- **Pollution from nonpoint sources**: Stormwater and agricultural runoff account for the two largest sources of pollutants flowing into the Chesapeake Bay. Although some stormwater and agricultural sources are regulated via the federal Clean Water Act permitting program many are not. It is to be noted that often state regulatory requirements and programs cover more non-point sources than the federal Clean Water Act. With over 83,000 farms, increasing development, a changing agricultural sector due to market and economic forces, and more frequent and heavier rainfall occurring from climate change, controlling pollutants from nonpoint sources and increased runoff remains a significant challenge.

- **Climate change**: Impacts from a changing climate, particularly extreme weather events, contribute to an erratic and increasing flow and delivery of nutrients and sediment into the Chesapeake Bay. Projections have estimated that the partnership will need to account for additional nutrient pollutant reductions to meet applicable water quality standards. In December 2020, the Principals' Staff Committee reached consensus that the jurisdictions would be expected to account for additional nutrient and sediment loads due to 2025 climate change conditions in an addendum to their Phase III WIPs and/or their two- year milestones beginning in 2022.

- **Conowingo Dam**: Between 2014-2016, the partnership became aware that the reservoir behind the Conowingo Dam was filling more quickly than anticipated, and its trapping capacity for sediment and nutrients was being impacted by sediment transport and scouring events, leading to an increase in pollutants flowing into the Chesapeake Bay. In late 2017, the Principals' Staff Committee agreed to address the additional pollutant loads resulting from the Conowingo Dam's lack of trapping capacity through a separate WIP. The final Conowingo WIP was approved by the Principals' Staff Committee in September 2021 and the first two-year milestones for the Conowingo WIP were submitted to EPA in January 2022. While the Conowingo WIP has not yet been implemented, funding has been committed by Maryland, New York and Pennsylvania to initiate implementation in the Susquehanna River Basin.

- **Chesapeake Assessment Scenario Tool (CAST):** The Chesapeake Bay Program recently approved and completed several updates to the model, which include the following:
    - Addressed new and unaccounted pollutant loads post-2025 as data updates to CAST show a higher level of effort is needed to achieve the 2025 targets.

    - Developed a short-term, interim resolution for fertilizer data concerns before moving forward with updating the current version of CAST, as well as a long-term resolution for the Phase 7 model.

    - Updated the process for incorporating data into CAST to include additional safeguards to prevent data analysis errors and to assess the reasonability of modeling results after partnership protocols are applied.

- **Staff capacity and technical assistance**: These are the two largest needs identified by the jurisdictions in meeting their 2025 pollutant reduction goals. New funding sources are welcome and essential to achieve the partnership's goals and outcomes. In order for federal, state and local governments to use these new sources effectively and efficiently, it is important that the funding allows for both implementation and technical assistance to support administration and management. Additionally, due to various factors, many environmental, agricultural and natural resource agencies have lost a considerable number of staff and resources, which impacts efforts to fully implement Phase III WIP commitments. These needs must be supplemented by effective workforce development and training to account for staff transitions. Short-term funding should also have minimal funding restrictions in order to expedite implementation goals.

- **BMP verification process**: The BMP Verification Ad-hoc Action Team has worked to address various issues related to verification, but BMP verification remains a significant challenge across

the partnership. Some of these include restricted access to certain federal data (however, a U.S. Department of Agriculture-Environmental Protection Agency Task Force has been convened to develop recommendations to address this challenge), minimal resources to conduct BMP verification and issues with access to operations. The most common concern is whether to prioritize limited state technical capacity to verify existing BMPs and/or implement new BMPs.

- **Miscellaneous**: The Covid-19 pandemic, and recent avian flu outbreak, has impacted partners' ability to work directly with landowners, and limited access to BMP implementation and verification. Additionally, recent inflationary pressures have impacted partners, most notably with respect to the cost of materials and labor to implement BMPs, as well as to maintain these BMPs and our monitoring networks. Current CAST cost estimates may not reflect current costs due to inflation.

Current Opportunities

While the above points are listed as challenges, many of them are also opportunities that can lead to the acceleration of progress. For example, limited staff to oversee the influx of new funding from the Infrastructure Investments and Jobs Act and Inflation Reduction Act, among others, is impacting state and local jurisdictions' ability to spend the money in an efficient and effective manner. However**,** the increase has allowed for more BMPs to be implemented and technical assistance to be expanded. The new funding typically has specific new and/or different requirements on reporting, procurements and how and where it can be used in order to be eligible to take advantage of it. But increased outreach activities are leading to opportunities to leverage available resources to fund the implementation of nonpoint source BMPs.

The increased funding has also led to a larger allocation of resources to existing grant programs, such as the Chesapeake Bay Stewardship Fund, which includes the Pennsylvania Most Effective Basins program. The Most Effective Basins program funds projects that will accelerate the implementation of cost-effective agricultural BMPs. The Chesapeake Bay Stewardship Fund is managed by the National Fish and Wildlife Foundation but funded by the EPA.

Thanks to the consistent reporting of jurisdictional progress through the two-year milestones, we are able to note incremental progress in achieving the pollutant reduction targets of the Phase III WIPs and identify areas that may need improvement. Although 100% of the practices and controls to achieve applicable water quality standards will not be in place by 2025, as called for under the Bay TMDL (with the understanding that it will take time for these practices to have a water quality response), the partnership continues to make steady progress in reducing pollutant loads flowing into the Chesapeake Bay.

Recommendations on Progressing to 2025

The following actions should be taken over the next two years by the Chesapeake Bay Program to help accelerate progress for each jurisdiction's Phase III WIPs goals:

- Non-regulated nonpoint source pollution is where future reduction efforts will need to be focused based on the jurisdictions' WIP commitments in the agricultural sector. Expand the existing conversation around how to address pollution from nonpoint sources, in coordination with jurisdictional and federal agency nonpoint source management programs. To that end, the Principals' Staff Committee approved the creation of an action team to explore the possibility of establishing an Agricultural Advisory Committee. Recommendations from the action team will be presented to the Executive Council at its annual meeting.

- Continue the conversation around how to include new scientific findings and monitoring results beyond 2025 that will impact the partnership's commitment to meeting the goals of the Phase III WIPs and Bay TMDL moving forward. Some of these new findings include reports developed by the Bay Program's Scientific and Technical Advisory Committee, such as: *Rising Watershed and Bay Water Temperatures—Ecological Implications and Management Responses*, *Increasing Effectiveness and Reducing the Cost of Nonpoint Source Best Management Practice Implementation: Is Targeting the Answer, Overcoming the Hurdle: Addressing Implementation of Agricultural BMPs Through a Social Science Lens* and *Achieving Water Quality Goals in the Chesapeake Bay: A Comprehensive Evaluation of System Response*. The Phase 7 suite of modeling tools is currently in development and will incorporate as much as this new science as possible.

- Craft succinct messaging that acknowledges that the partnership will not meet their water quality goals by 2025 but affirm that we will not take our foot off the gas toward making progress. Messaging will also account for successes toward meeting the Bay TMDL, as well as acknowledge the significant conservation practices adopted by different sectors across the watershed (e.g., agriculture, wastewater).

- Maintain a focus on addressing increased loads attributed to climate change and population growth and implement the Conowingo WIP.

- Begin the discussion around new, innovative approaches to meet the jurisdictions' Phase III WIP goals that can be considered beyond 2025.

- Explore how an increased focus on permanent land conservation and on land use that supports permanently protected natural filters as a durable avenue can contribute to the achievement of Bay TMDL and Phase III WIP goals.

- Jurisdictional partners should assess wastewater actions under the Infrastructure Investment and Jobs Act, as well as other infrastructure funding, to see how these sources can help in meeting Phase III WIP wastewater goals.

Section 4: Emerging Science, Monitoring and Analysis

Science, monitoring and analysis are essential to assess the status and variability of water quality and living resources throughout the Chesapeake Bay watershed. Monitoring networks, or interconnected systems of monitoring stations, equipment and personnel involved in monitoring a suite of criteria to track environmental changes, provide insights on key parameters such as water quality, climate change, contaminants and living resources. Monitoring data is also required to build, operate and enhance the partnership's suite of modeling tools. These models are used to develop pollutant reduction strategies and to make predictions about current and future ecosystem conditions that inform living resource management. Research and data analysis reveal trends over time and quantify the responses of living resources to changes in the ecosystem.

Challenges

Science, monitoring and analysis needs are tracked by the Chesapeake Bay Program through the Scientific, Technical Assessment and Reporting Team (STAR) Strategic Science and Research Framework (SSRF) database, as well as the assessment of the partnership's current monitoring networks, prepared for the Principals' Staff Committee (PSC) in 2022. The SSRF and monitoring assessment reveal the following challenges:

- Monitoring is insufficient at the spatial and temporal scales required to support the assessments needed for many Bay Program outcomes.

- More research is needed to analyze monitoring data and understand how changes in water quality and environmental conditions are affecting habitat quality and the abundance and distribution of ecologically and commercially important species.

- Secure dedicated funding is not available to provide additional capacity to develop metrics, indicators and sampling designs, or to analyze monitoring data and address priority research questions.

Current Opportunities

Although there are existing long-term funding challenges, the Chesapeake Bay Program, through the use of Infrastructure, Investment and Jobs Act (IIJA) funding, has maintained capacity to monitor 19 physical, chemical and biological characteristics throughout the year in the Bay and its tributaries. These specific networks include tidal and nontidal monitoring networks, as well as monitoring of submerged aquatic vegetation (SAV), benthic communities and land use.

- **Tidal Water Quality Monitoring Program**: The current tidal monitoring network has 154 active stations throughout the Chesapeake Bay, whose data informs the annual tidal water quality assessment that gauges the health of the Bay. Some of the parameters measured include water temperature, salinity levels, nutrients and dissolved oxygen.

- **Non-Tidal Monitoring**: The non-tidal monitoring network has 123 active stations throughout the Chesapeake Bay watershed, which includes River Input Monitoring (RIM) stations located on the nine largest rivers in the watershed. Results from nontidal network data include, but are not limited to, pollutant loads and trends.

- **SAV Monitoring**: The monitoring of underwater grasses uses a three-tiered approach. This approach consists of the annual Bay-wide aerial survey, the SAV Watchers Program, which engages local watershed groups and volunteers and the SAV Sentinel Site Program. This combination of monitoring efforts allows for the best estimation of SAV acreage and density, while collecting detailed habitat and water quality data and providing educational volunteer opportunities to communities at the same time.

- **Chesapeake Bay Benthic Macroinvertebrate Monitoring:** Benthic species monitoring provides an excellent snapshot of environmental conditions in the Bay and its tidal tributaries, focused on the summer season. Benthic species in the Chesapeake Bay tidal waters include clams, worms, oysters and mussels who live at the bottom of the Bay and cannot easily move—if at all—to escape stressors like unhealthy water quality conditions.

- **Community Science Efforts**: The Chesapeake Monitoring Cooperative (CMC) is a regional partnership that provides technical, logistical and outreach support to volunteers and watershed organizations for the integration of volunteer-based and nontraditional water quality and benthic macroinvertebrate monitoring data into the Chesapeake Bay Program. Currently, over 100 non-traditional, community and volunteer-based monitoring groups are involved with water quality and macroinvertebrate monitoring. Over 800,000 data points have been recorded in the CMC's Chesapeake Data Explorer.

- **Land Use and Land Cover Monitoring Network**: High-resolution (i.e., one-meter by one-meter) land use and land cover data for each county in the watershed are used to show how the landscape of the Chesapeake Bay watershed is changing. The dataset is remapped every four years to monitor changes in tree canopy, map wildlife habitat and ecologically sensitive lands, and determine where environmental restoration can provide the highest benefit. This information has recently been used to inform the Land Use Methods and Metrics Outcome and to develop the Tree Canopy Status and Change Fact Sheets.

The partnership's monitoring networks are taking advantage of current funding opportunities, including those appropriated through IIJA, to meet their needs and enhance understanding of the Bay ecosystem. The EPA, through IIJA funding has been able to support almost all recommendations from the assessment of the partnership's current monitoring networks. Recent advances in geospatial analysis, high-resolution monitoring (spatially and temporally) and biological and physical modeling will allow new management paradigms to emerge to address well known conservation challenges including those emerging with climate change and increased development pressure. Some examples include:

- Land Use Land Cover Data Project.

- Targeted shallow-water and habitat suitability modeling.

- Development of the 4-Dimensional (4D) Interpolator (model to assess Bay and tidal water quality criteria).

- Ecological thresholds (e.g., shoreline hardening, impervious surfaces, temperature).

- High frequency hypoxia sensors.

- Expanded use of satellite data for monitoring and machine learning for data analysis.

Additionally, increased focus on local engagement, social science, living resources and geographic targeting are preparing the Chesapeake Bay Program for the best way to integrate emerging science findings beyond 2025. Highlights of these efforts include:

- **Local Engagement and Education**: Regional partnerships with federal, state and local governments, nonprofits, local communities and other entities are critical to finding collaborative solutions that support both Chesapeake Bay restoration and the people that live, work and recreate within its watershed.

- **Social Science**: When the 2014 *Chesapeake Bay Watershed Agreement* was signed, it was the first time that signatory partners recognized the importance of understanding the role that residents of the watershed play in helping with Bay restoration. Efforts to utilize social science to understand the multidimensional interrelationships between people and the environment are increasing. For example, in fall 2020, the University of Maryland Center for Environmental Science completed *Enhancing Chesapeake Bay Partnership Activities by Integrating Social Science*. This document summarizes recommendations for advancing social science integration, or the use of knowledge from multiple social science disciplines to develop or adapt methods, to address the *Watershed Agreement* goals. The recommendations include ideas for prioritizing interdisciplinary research, supporting social science applications and strategically applying social science within and across institutions.

- **Data Analysis and Synthesis**: Progress is being made where federal and state agencies have focused their research funding and data analysis capacity with the needs of the Bay Program. These agencies have also modified their grant programs to increase the number of grantees that have been historically underrepresented in the environmental and marine science fields. Additionally, efforts are underway to better synthesize the abundance of scientific data and knowledge to communicate a more comprehensive story about how the ecosystem is changing and the implications of these changes. A few examples are highlighted below.
    - By aligning research funding with the outcomes of the *Watershed Agreement*, the National Oceanic and Atmospheric Administration (NOAA) has helped to improve habitat suitability models and provide a better understanding of climate and other environmental variability impacts on fish species and their habitats. This research has also resulted in the quantification of ecosystem services provided by restored oyster reefs and other habitats, including the economic returns that restoration activities provide communities.

    - The U.S. Geological Survey is working to expand data analysis efforts to support GITs and workgroups by:
        - Developing a more strategic, science-based approach to better target federal and state resources to the places and activities that will accelerate progress for multiple outcomes. This effort is presented in a data hub containing a collection of maps and applications that can evaluate restoration and landscape initiatives that are relative to the goals and outcomes of the *Watershed Agreement*.

        - Understanding the factors that are affecting stream health, fish habitat and aquatic conditions.

        - Characterizing the risks to coastal ecosystems and their implications for waterbirds.

        - Informing prioritization for land protection and maintenance of healthy watersheds.

    - NOAA is drawing on research findings and data analysis to develop seasonal summaries of water quality parameters found within the Chesapeake. The reports look at water temperature, dissolved oxygen and salinity levels compared to their average, and note how any potential anomalies are impacting the living resources of the Bay. These summaries are intended to contribute to ecosystem-based management and use data from the Chesapeake Bay Interpretive Buoy System, as well as the NOAA CoastWatch satellite program.

    - An updated Chesapeake Basin-wide Index of Biotic Integrity (Chessie BIBI) report is being used to quantify stream health across the watershed. The report suggests that environmental stressors on streams is slowly lessening, although it is speculative at this time to identify what factors are responsible for this improvement. The Stream Health Workgroup is exploring additional metrics for a variety of environmental stressors to help future investigations characterize Chesapeake watershed health and assess the reasons for the current trends.

Recommendations on Progressing to 2025

To ensure science, monitoring and data analysis continue to provide critical support in the implementation of the Watershed Agreement outcomes through 2025 and that emerging science is considered and integrated in the Chesapeake Bay Program's work, the following recommendations are offered:

- Continue to investigate long-term funding sources, partnering across agencies and institutions, to maintain Chesapeake Bay Program core water quality monitoring networks, as well as the monitoring networks supporting all outcomes. Additionally, support modeling efforts and complete new water quality monitoring network developments funded in response to the PSC Monitoring Review Report recommendations. As new monitoring plans are developed, increase data analysis and interpretation efforts to maximize the value of these monitoring networks. Support innovative mechanisms to analyze, communicate and apply this new information.

- Research, develop, document and adopt habitat assessment protocols using high resolution satellite-based imagery and other new technologies (e.g., vertical water column high resolution water quality monitoring) to support a more efficient, effective and comprehensive evaluation of the Chesapeake Bay ecosystem.

- Incorporate recommendations from Scientific and Technical Advisory Committee (STAC) reports.
    - The *Comprehensive Evaluation of System Response* suggests shifting the Bay TMDL framework, which is supported by the legal requirements of the Clean Water Act, toward considering multiple means of improving living resources. However, significant enhancement of living resources can be reached without complete attainment of water quality standards by focusing on additional management actions (e.g., living shorelines, improving benthic habitat). Thus, focusing investments on these other factors could improve the composition and abundance of living resources for any given level of water quality improvement.

    - Recommendations from the *Rising Watershed and Bay Water Temperatures* report demonstrates that warming waters will make it more difficult for the Chesapeake Bay Program to meet its water quality and living resources goals, and recommends that the partnership incorporate water temperature considerations more explicitly into its goals, outcomes and management strategies.

- Plan for and implement high-resolution monitoring and modeling in prioritized areas to provide feedback on living resources and habitat conditions. This can lead to improved indicators linking environmental change and living resource responses that can be integrated with existing synthesis products and used to evaluate the vulnerability of key species and habitats to guide management.

- Enhance capacity building and community engagement strategies to develop a collective vision resulting in scientifically informed conservation and restoration practices that achieve the Watershed Agreement outcomes in prioritized geographies involving the full hierarchy of local to federal governments, nonprofits and others.

- Incorporate more social information and data (e.g., population, languages spoken, household income) into geospatial products to foster increased understanding of the demographics, motivations, values, interests and vulnerabilities of communities across the watershed to ensure that implementation strategies are formed by data and align with local communities. To move the work of social science across outcomes, the Chesapeake Bay Program must strategically evaluate how to support this work. Inclusion of social scientists in projects and on staff will provide the expertise needed to incorporate more social information and enhance efforts.

Section 5: Climate Change/DEIJ

The 2014 *Chesapeake Bay Watershed Agreement* included outcomes for Diversity, Climate Adaptation, and Climate Monitoring and Assessment. However, as implementation of the *Watershed Agreement* progressed, the Chesapeake Bay Program recognized that these outcomes did not fully address the broad nature of these cross-cutting issues.

To expand and better define these bodies of work, the Chesapeake Bay Program released a DEIJ strategy in April 2020, *Restoration from the Inside Out: A Diversity, Equity, Inclusion and Justice Strategy for the Chesapeake Bay Program* (DEIJ Strategy), that was followed later that year by a *Statement in Support of Diversity, Equity, Inclusion and Justice*, signed by the Executive Council. The statement commits to strengthening DEIJ throughout the partnership with an emphasis on engaging, recruiting and retaining an ethnically and racially diverse staff and leadership, fostering an inclusive workplace and ensuring long-term relationships with underrepresented organizations and communities that result in informed and mutually beneficial decisions and outcomes. In December 2021, the Chesapeake Bay Program, with input from partners and the public, released the DEIJ Implementation Plan, which presents a roadmap for advancing the recommendations in the strategy.

In 2021, the Executive Council signed a directive in reference to climate change, *Collective Action for Climate Change* (Climate Directive). This directive acknowledges the consequences that a changing climate is bringing to the Chesapeake Bay watershed, particularly acknowledging those habitats, peoples, communities and industries that are disproportionately impacted. It explicitly states that while every jurisdiction is taking steps to combat climate impacts (e.g., rising water and air temperatures, sea level rise, saltwater intrusion, shift in the range of species), to address these issues through the entire Bay watershed requires a collaborative response. The directive addresses the threats of climate change in all aspects of the partnership's work, prioritizes communities and habitats most vulnerable to ever-increasing risks, seeks to apply the best scientific, modeling, monitoring and planning capabilities of the Chesapeake Bay Program, and connects Bay restoration goals with emerging opportunities in climate adaptation, mitigation and resilience. The partnership released the Climate Change Directive Work Plan to support this work in July 2022.

Challenges

Despite the effort to accelerate work in these two critical areas, large-scale progress has been challenging. Several key challenges are shared across the two bodies of work, including:

- **Limited Capacity**: The directives for climate and DEIJ are ambitious, far reaching and appropriate, and purposely intended to be widespread across all entities within the Chesapeake Bay Program. Yet this work has been left without sufficient or consistent dedicated support. The capacity of the workgroups to implement DEIJ or climate resiliency efforts is limited because their priorities are focused on advancing the outcomes of the *Watershed Agreement* within their specific content areas.

- **Accountability and Institutional Change:** The Chesapeake Bay Program has taken important steps in identifying gaps and challenges to advance DEIJ and climate work, but the partnership lacks clear, effective metrics, accountability and organizational support to successfully carry out these goals. The DEIJ Strategy and the Climate Directive provide roadmaps for advancing this work and while the Climate Resiliency and Diversity workgroups have championed progress, it takes cross-outcome champions, time, leadership commitment and accountability to put the organizational infrastructure in place and foster the cultural shifts needed to support successful implementation over time. The Chesapeake Bay Program and its partners have invested in numerous tools and guidance resources, but these can assist efforts only if their use is emphasized and instituted with support from leadership.

- **Lack of Coordination**: Individual state and federal agencies, as well as non-profit partners and local governments, are advancing critical work on climate and DEIJ issues across the watershed. Beyond the workgroups, the partnership is making additional progress on meeting the objectives of the directives, but in an uncoordinated, unaccountable and undocumented manner. The Chesapeake Bay Program operates through Goal Implementation Teams (GITs) and their respective workgroups, which are largely siloed without the necessary structure to work towards cross-cutting outcomes like DEIJ and climate. While good work is happening within these teams, limited capacity exists for tracking and coordinating this work. This results in inefficiencies, missed opportunities and a lack of understanding about the breadth of work occurring.

- **Inadequate Alignment of Resources**: With passage of the IIJA and Inflation Reduction Act (IRA), there has been a tremendous influx of federal funding and technical assistance for climate change resilience and environmental justice efforts. While some funding has been targeted for the Chesapeake Bay, a significant portion is allocated through national competitive grant programs and is awarded to efforts that are separate from the outcomes and directives that the partnership has been tasked with achieving. Inconsistent coordination towards aligning implementation of Bay-focused funding and enabling access to national funding programs has limited the use and potential impact of these resources. Without a shared understanding of how Chesapeake Bay Program and other federal grant funding is being applied towards the outcomes at the state level and without a strategic approach to maximize broader funding opportunities for climate and DEIJ solutions in the watershed, there will continue to be a gap. Currently, the primary funding workgroups use to support their DEIJ and climate work is through the GIT-funding process. This competitive pool of funds only allows for small-scale projects that don't move the needle forward at the pace needed to meet the expectations outlined in the directives.

- **Scientific and Technical Uncertainties:** There is recognition that the Bay of the future will not be the Bay of the past. The Chesapeake Bay Program is at the forefront of current scientific understanding of climate change processes in the airshed, watershed, tidal Bay and living resources. However, there is a need to understand how changing watershed and Bay conditions will influence implementation practices and affect living resources and ecosystems. Additional research is needed to estimate the future conditions of the Bay and its watershed under different scenarios of management.

Current Opportunities

The Diversity and Climate Resiliency workgroups are making progress toward the outcomes included in the *Watershed Agreement*. In some cases, this also advances the work of the directives.

The Climate Resiliency Workgroup was successful in moving a handful of projects forward by identifying those considered to be high priority based on the partnership's interest. This allowed the workgroup to lead collaboration across multiple GITs and stakeholders resulting in the following specific deliverables:

- Synthesis of resilience and social vulnerability metrics to inform targeting criteria for tidal marsh adaption projects, with plans for reviewing metrics for other natural infrastructure projects, such as living shorelines, oyster structures and forest buffers.

- Inclusion of climate impacts (sea level rise) in the Chesapeake Bay Program's suite of modeling tools.

- Development of air temperature and precipitation change indicators.

- Completion of the STAC sponsored report, *Rising Watershed and Bay Water Temperatures—Ecological Implications and Management Responses*.

- Provided advisory support to the Urban Stormwater and Modeling workgroups for the development of future projected intensity, duration and frequency (IDF) curves that account for changes in precipitation in Maryland and Virginia. These future projected IDF curves are being used to inform improvements to stormwater infrastructure design and management under changing climate conditions.

- In collaboration with Virginia Tech, completed a literature review on BMP climate uncertainties to assess how climate change and variability affect nutrient and sediment cycling and BMP performance.

The partnership is pursuing additional activities that will advance the objectives of the Climate Directive and help the Chesapeake Bay Program address the threats of climate change through its work to restore and protect the Bay and its watershed:

- Developing a fully operational analysis of the Chesapeake Bay Program 2035 Climate Change Assessment by 2025. This assessment of the influence of 2035 climate change conditions on the Bay TMDL and the partnership's watershed and tidal water quality goals will be operational by 2025 and applied in the next generation Phase 7 models to ensure planned nutrient and sediment reductions are sufficient under 2035 climate conditions.

- Improving understanding and implementation of climate resilient BMPs. The partnership is developing decision support tools identified by the Urban Stormwater Workgroup's memo, *Recommendations on Next Steps to Advance Efforts to Maintain Resilience of Stormwater BMPs* and generating information and methods to quantify potential impacts on the nutrient and sediment removal efficiencies of urban stormwater, agriculture and other BMPs due to changing future hydrology.

- Engaging stakeholders in development of a strategic, landscape-scale tidal wetland restoration plan which identifies consensus siting criteria and identifies a pathway to the protection, restoration and migration of tidal wetlands in the Chesapeake Bay watershed.

- Updating climate science needs identified through the Strategic Science and Research Framework.

Similarly, the Diversity Workgroup undertook the following opportunities to make progress toward the Diversity outcome:

- Continually presenting and hosting numerous partnership-wide trainings, webinars and guest speakers on DEIJ.

- Establishment of memorandums of understanding (MOUs) with regional Historically Black Colleges and Universities (HBCUs).

- Training and coordination to ensure more equitable grant funding and offerings.

- Establishment of the Workforce Action Team and associated workforce landscape assessment with the Education Workgroup, aiming to improve pathways to green jobs and to diversity the workforce within those fields.

- Launching the C-StREAM summer internship program with the Chesapeake Research Consortium to engage underrepresented or first-generation college students in environmental research and management internships within Chesapeake Bay Program partner organizations.

- Tracking past and ongoing DEIJ efforts among the partnership to meet the goals and outcomes of the *Chesapeake Bay Watershed Agreement*.

The partnership is pursuing additional opportunities in which to improve DEIJ and implement the DEIJ Strategy.

- Offering a contractual opportunity to expand capacity to connect with diverse and underserved audiences throughout the watershed to accelerate local conservation efforts.

- A Strategic Engagement Team has been established to provide initial consultation to workgroups on DEIJ, communications, stewardship, local engagement and social science actions that could be woven into their work to aid in the progress of their outcomes.

- A cooperative project was initiated with the EPA National Center for Environmental Economics to analyze the distributional implications of Chesapeake Bay restoration expenditures, particularly for disadvantaged communities and communities with environmental justice concerns.

Recommendations on Progressing to 2025

The following recommendations are provided to address cross-cutting priorities in the Chesapeake Bay Program, as well as to meet the current priorities of the Diversity and Climate Resiliency workgroups.

- **Foster Champions and Operationalize DEIJ and Climate:**
    - Leadership-level visibility and direction are needed to promote systemic change within the Chesapeake Bay Program to effectively include and amplify diverse voices and participants in our work and to ensure the partnership considers and addresses the impacts of climate change effectively.

    - Foster and support champions who take initiative in integrating DEIJ and climate change into the work of the partnership by expanding opportunity for training, knowledge sharing and cross-outcome collaboration on these topics.

    - Create accountability by establishing reporting and review cycles for all GITs on climate change and DEIJ actions and impacts.

    - Utilize the robust body of existing tools and resources developed by the Climate Resiliency and Diversity workgroups, as well as partner organizations to support practice and reinforce why these issues are important to achieving the partnership's goals.

    - Include an emphasis on DEIJ and climate change in onboarding materials and ensure that the workload for advancing these objectives is spread equitably.

- **Provide Dedicated Cross-Outcome Coordination**:
    - Strategically evaluate how to support and facilitate cross-outcome, distributed DEIJ and climate change work. Network theory and other coordination models should be used to determine how best to structure this work.

    - Direct resources to secure high-level, cross-partnership climate and DEIJ coordinators to provide collaboration, coordination, consultation, guidance and strategic direction across multiple Chesapeake Bay Program groups.

- **Improve Coordination on Funding:**
    - Convene funders, potential recipients and intermediaries to improve understanding of national and Bay-specific funding programs and strategies for accessing these programs for climate and environmental justice.

    - Align resource planning efforts to capitalize on existing and new funding and technical support resources with the goal of creating lasting capacity in communities, with an emphasis on underserved and overburdened communities, for critical restoration and climate resilience projects.

    - Identify shared funding and project priorities and opportunities for aligning short- and long-term funding proposals for national programs that could advance climate resilience and adaptation, as well as environmental justice objectives.

Section 6: Forest Buffers/Wetlands

While each of the 31 outcomes of the *Chesapeake Bay Watershed Agreement* are vital to improving the health of our local waterways and the Chesapeake Bay, it is possible that no two outcomes are more critical to improving water quality, climate resiliency and habitat than forest buffers and wetlands.

The Chesapeake Bay Program has recognized the importance of both outcomes since its inception. Both habitats were included as objectives for restoration in the 1987 *Chesapeake Bay Agreement*— "Protect, enhance and restore wetlands, coastal sand dunes, forest buffers and other shoreline and riverine systems important to water quality and habitat."

While each of the 31 outcomes of the *Chesapeake Bay Watershed Agreement* are vital to improving the health of our local waterways and the Chesapeake Bay, the partnership has identified two outcomes to emphasize in the near-term, forest buffers and wetlands, as critical to improving water quality, climate resiliency and habitat. In fact, 10% of planned nitrogen reductions are estimated to come from forest buffer plantings alone. Both provide a wealth of ecosystem benefits to the people that live, work and recreate within the watershed. Wetlands provide habitat for a diversity of terrestrial and aquatic species, while recharging groundwater and helping to stabilize climatic influences. Forest buffers help to cool air and stream temperatures, benefiting brook trout and other types of fish, sequester carbon from reaching the atmosphere and help support healthy stream ecosystems. Both habitats provide crucial barriers between nutrient and sediment pollutants flowing off the land and into nearby waterways, helping to reduce the impacts of storms and flooding on downstream communities. Work undertaken to further these "keystone outcomes" aids in progressing the other 29 of the *Watershed Agreement*.

Fundamental changes to grant funding and current implementation programs are needed to generate the significant increase required to meet the goals set in the outcomes for both forest buffers and wetlands. The Forest Buffers and Wetlands outcomes are unique in that they require changes to land use and cover. As the majority of the land in the watershed is privately owned, it will take willing landowners and effective incentives to achieve these outcomes. Numerous efforts to accelerate these outcomes have been implemented over the past several years to varying degrees of success. In 2022, stakeholders for each outcome were brought together for a series of workshops to discuss restoration efforts, review barriers to implementation, and develop strategies and action plans for increasing progress. Recommendations from jurisdictional Wetland Action Plans and Riparian Buffer Action Strategies are reflected at a high-level in the below recommendations, and further commitments made by the jurisdictions in these documents should be followed to accelerate progress toward meeting both outcomes.

Challenges

The process for funding, implementing and maintaining each outcome is complex with several barriers to accelerating implementation.

- **Implementation programs**: New, innovative programs are needed to accelerate progress in reaching buffer and wetlands goals. Existing cost-share programs can be challenging for some landowners to navigate, with complex requirements and high out-of-pocket costs for landowners. Flexible, turnkey programs resulting in no cost solutions for landowners have proven to be successful in helping with forest buffer implementation. New models should also be considered in how to effectively distribute funding and where needed, to compensate landowners for the conversion of productive agricultural lands to develop new buffers or wetlands.

- **Dedicated funding**: The current increase in federal funding for environmental restoration has provided significant advances but often, these funds are not exclusively targeted to forest buffers and wetlands. Grant programs often do not account for the myriad of needs required for successful plantings and restoration of wetlands and forest buffers, such as funding. Funding is needed to conduct ongoing maintenance to ensure plantings perform their ecosystem functions, as well as for the long-term. Funding agreements eventually expire and in the case of restoration projects that take multiple years, like wetlands, it is critical to ensure uninterrupted funding.

- **Outreach and engagement**: Increased engagement and outreach with landowners is needed to further the forest buffers and wetlands outcomes. Streamlined communications in plain language is needed to emphasize the value of these practices, as implementation can result in trade-offs (e.g., shading out crops adjacent to buffers, future development capabilities, regulatory oversight for wetlands). Time and effort are needed to build long-lasting and trust-worthy relationships with these audiences.

- **Capacity**: Implementation funding has grown through such bills as the IRA and IIJA however, short-term grants can make it challenging for organizations to support an increase in staff for a finite time. Increased technical and administrative capacity is needed, mainly at the state agency and NGO level, to develop and submit project proposals, produce, and manage grants, review and issue project permits, and conduct the needed outreach, planting and maintenance required to meet the wetlands and forest buffers outcomes, as well as the goals in the jurisdictions' Phase III WIPs. For the forest buffer outcome, in areas where intensive outreach programs are in place, landowner demand to plant buffers has exceeded capacity for planting and maintenance, so inadequate capacity limits outcome progress. Additionally, retaining staff is as essential as building a new workforce, as it provides continuity and builds trust with landowners.

- **Tracking and verification:** It is a challenge to accurately track, report and verify the acreage of forest buffers and wetlands restored. Due to the variety and complexity of our funding sources, the broad range of nonprofits working in this space and different mechanisms for tracking implementation in each jurisdiction, practices are not always reported. For buffers, their credit in CAST expires after 15 years, meaning the jurisdictions will need to verify the plantings are still present and functioning as intended. For wetlands, the Chesapeake Bay Program approved the recommendation that wetland BMPs reported in CAST will not expire. The Forestry and Wetlands workgroups are cognizant of challenges related to BMP reporting, verification and data use. As such, they have developed supplemental tracking tools, as well as changed methods for applying the data in Chesapeake Bay Program environmental indicators—especially information related to the many functional benefits of wetlands and forest buffers outside of water quality gains.

- **Emerging threats**: Although forest buffers and wetlands are critical practices for increasing the resilience of ecosystems and communities to climate change, climate change can impose challenges for successfully establishing and maintaining forest buffers and wetlands. Land subsidence, sea level rise, flooding, drought and increases in air and water temperature are just some of the ways in which a changing climate is impacting buffers and wetlands. Moving forward, practitioners will need to incorporate climate change considerations into species selection, site design and maintenance planning. Additionally, land use conversion remains an increasing threat to wetlands and forest buffers. As forests and farmlands transition into residential and commercial regions, land is lost to restore these critical resources. Trees are cut down and wetlands are filled in, losing critical wildlife habitat, increasing the flow of polluted stormwater into our waterways, eroding land, contributing to a rise in flooding, lessening the ability to sequester carbon and mitigate future climate effects.

Current Opportunities

Despite these challenges, both outcomes have several ongoing activities that are helping them to achieve success.

- In 2022, the Chesapeake Riparian Forest Buffer Leadership Workshop and Restoring Wetlands of the Chesapeake Bay Watershed Workshop, convened professionals from across the watershed to strategize on how to accelerate progress toward these outcomes.
    - Chesapeake Riparian Forest Buffer 2022 Leadership Workshop Summary and Next Steps
    - Restoring Wetlands of the Chesapeake Bay Watershed Workshop Action Plan

- As an outcome of the Chesapeake Riparian Forest Buffer Leadership Workshop, each of the jurisdictions developed their own riparian forest buffer action strategies to identify ways in which they can uniquely progress buffer implementation over the next 5-10 years.

- A reorganization of the Wetlands Workgroup recently occurred, to focus efforts on both non-tidal and tidal wetland restoration and enhancement. Even though the outcome as currently written doesn't reflect non-tidal and tidal wetlands individually, this shift allows workgroup members to prepare for how they would like to address changes in the outcome post-2025.

- Both outcomes have worked across other Chesapeake Bay Program GITs, workgroups and advisory committees to fill information and data gaps. Some of this work includes recent STAC reports like, *Rising Watershed and Bay Water Temperatures—Ecological Implications and Management Responses* and workshops, *Evaluating an Improved Systems Approach to Crediting: Consideration of Wetland Ecosystem Services*.

- A growing momentum to expand existing flexible and effective buffer programs to complement current CREP funding.

- GIT-funded projects, like *Maintaining Riparian Forests in Stream Corridor Restoration*, emphasize the important role that forest buffers play in overall stream ecosystem health, and the in-progress, *Mapping Non-Tidal Wetlands in Areas with Outdated Wetlands Maps*, develops a new approach to cost-effectively model the location of non-tidal vegetated wetlands.

Recommendations on Progressing to 2025

While the forest buffers and wetlands outcomes will not be met by 2025, the following strategies will help to accelerate progress over the next two years:

- Establish clear geographic and numerical targets, measures of success, accounting systems and monitoring protocols for tidal wetland restoration.

- Ensure conservation of existing and new forest buffers and wetlands to protect the investments being made in restoring these critical habitats.

- Utilize federal, state and local investments and resources to conserve areas that have the hydrology and proximity to become wetlands.

- Support effective, flexible buffer and wetland programs to limit out-of-pocket costs for landowners, provide maintenance, fund practices on a rolling basis and limit eligibility requirements.

- Build and retain professional staff capacity to scale-up implementation of both buffers and wetlands and offer high-quality technical and maintenance services.

- Align new and existing funding mechanisms specifically for capacity building, to aid communities and organizations on the ground to help accelerate implementation efforts, prioritizing efforts to build a diverse workforce.

- Cultivate partnerships to support sustained funding and to coordinate outreach and technical assistance efforts.

- Develop more strategic approaches and increase capacity for outreach and engagement. These could include:
    - Encourage time and effort to cultivate relationships with private landowners to understand their barriers to wetlands and forest buffers. Develop targeted communications materials for different audiences (e.g., landowners, policymakers, agricultural technical service providers) that emphasize the value and co-benefits of forest buffers and wetlands using case studies and success stories.

    - Ensure messages are in easily understood terms, spread frequently and through a variety of communications mediums to ensure all audiences are being reached.

- Expand tracking and reporting to ensure all forest buffers and wetlands are appropriately accounted for and verified. In particular, develop a strategy to conduct outreach to nonprofits, state agencies, local governments and other entities to ensure they know how to report their work to the new wetlands tracking tool that will be available in fall 2023. Additionally, review current tracking systems to make sure everything is working normally and being reported accurately. Consider use of the high-resolution land use and land cover data to track gains and losses in forest buffers and wetlands.

- Explore additional funding options to enhance data collection and ensure the wetlands tracker remains upgraded.

- Watershed jurisdictions should require that a portion of any type of on-the-ground grant funding go toward the maintenance of forest buffers and wetlands for at least three years. It is noted that wetland restoration efforts often require federal permits, which already require mandatory maintenance and inspection requirements.

- Increase champions to contribute and advocate for catalyzing funding, staff and resources to increase the rate of forest buffer and wetlands implementation.

- Management Board representatives should meet formally with all agencies within their jurisdiction once a year to discuss progress and ensure barriers are removed and remain out of the way to increase the potential of meeting the Wetlands outcome. Evaluate the benefits of creating jurisdiction-based Wetlands Workgroups that are responsible for engaging agencies, organizations and landowners in a collective effort to advance Wetland Action Plans.

Section 7: Outcome Attainability Assessment

The Executive Council charge calls for updates on the attainability of the 31 outcomes of the *Chesapeake Bay Watershed Agreement* in reaching their goals. These snapshots provide an overview of their current status, challenges toward meeting their goals, opportunities to date and recommendations on accelerating progress toward 2025. This assessment found that 18 of our outcomes are considered to be on course, 11 are off course and two are uncertain pending upcoming data updates.

In assessing the 31 outcomes, a number of patterns emerged among the on course and off course outcomes, leading to the following observations.

- While both quantitative and qualitative outcomes can be effective, successful qualitative outcomes require concrete milestones and measures of progress to evaluate their effectiveness.

- Successful quantifiable outcomes have clear geographic and numerical targets, measures of success, accounting systems and monitoring protocols in place.

- Jurisdictional and federal commitments, costs, roles and responsibilities must be clear. The success of many quantitative outcomes is driven by federal champion and/or coordinator looking across the watershed, in coordination with one or more state or non-governmental champions or coordinators for regional relevance and legitimacy.

- Ambitious outcomes are inspiring and can help drive change, but they must be established with a reasonable understanding of the costs, commitments, responsibilities and their importance for restoring local waterways and the Chesapeake Bay.

- Outcome efforts must operate at the appropriate scale in order to make progress. For broader outcomes, such as climate change or diversity, establishing or modifying to focus on manageable pieces of these challenges, while maintaining a sense of their place in the larger context, could generate meaningful progress.

- Working with local communities, governments and non-profit organizations is essential to identify high-priority geographies and targeted efforts in small catchments, in order to align outcomes with local partner needs and priorities. Identifying priority geographies to implement measures to achieve outcomes and matching those with local partners would accelerate progress.

- While several federal and state agencies provide staffing and funding for Chesapeake Bay restoration, it is the EPA that has regulatory oversight, dedicated staff and funding to work across the entire partnership. However, EPA's annual funding is modest compared to the total annual investment in the region. A mechanism to match Chesapeake Bay Program needs with staff support and funding from across the partnership could be instituted to support its growth and effectiveness.

OUTLOOK ON COURSE	OUTLOOK OFF COURSE
Blue Crab Abundance Outcome	Wetlands Outcome
Blue Crab Management Outcome (Complete)	Black Duck Outcome
Oysters Outcome	Brook Trout Outcome
Forage Fish Outcome	Submerged Aquatic Vegetation Outcome
Fish Habitat Outcome	Forest Buffers Outcome
Stream Health Outcome	Tree Canopy Outcome
2017 Watershed Implementation Plans (WIPs) Outcome (Complete)	2025 Watershed Implementation Plans (WIPS) Outcome
Fish Passage Outcome	Diversity Outcome
Water Quality Standards Attainment and Monitoring Outcome	Toxic Contaminants Policy and Prevention Outcome
Toxic Contaminants Research Outcome	Student Outcome
Local Leadership Outcome	Climate Adaptation Outcome
Protected Lands Outcome	
Land Use Methods and Metrics Development Outcome	
Land Use Options and Evaluations Outcome	
Public Access Outcome	
Sustainable Schools Outcome	
Environmental Literacy Planning Outcome	
Climate Monitoring and Assessment Outcome	

Outlook Uncertain:

The outlook of the Healthy Watersheds Outcome and the Stewardship Outcome are considered uncertain pending additional analysis.

Sustainable Fisheries Goal

CHESAPEAKE BAY WATERSHED AGREEMENT

"Protect, restore and enhance finfish, shellfish and other living resources, their habitats and ecological relationships to sustain all fisheries and provide for a balanced ecosystem in the watershed and Bay."

Photo by Carlin Stiehll/Chesapeake Bay Program

Blue Crab Abundance Outcome

OUTLOOK ON COURSE

Outcome

Maintain a sustainable blue crab population based on a target of 196* million adult females. Refine population targets through 2025 based on best available science.

**The original target of 215 million was revised in November 2020 based on the best available science as outlined in the outcome language.*

Status

The abundance of adult female blue crabs in the Chesapeake Bay has not fallen below the threshold of 72.5 million since 2014, which indicates a sustainable population based on the management framework derived from the 2011 benchmark stock assessment, which was last updated in 2020. The female exploitation rate, or the percentage removed from the population in a year, has not exceeded the threshold of 37% since 2007, suggesting that actions to manage the female blue crab population have been effective. The Blue Crab Abundance Outcome is on course and expected to be met by 2025.

What has helped achieve success since 2014?

- The jurisdictions adopted new female-specific management reference points (the target and threshold numbers for abundance and harvest) in November 2020 based on the 2017 Blue Crab Stock Assessment Update, which included more recent survey and harvest data.
- A Goal Implementation Team funded report and related science workshop were conducted to better understand factors that affect blue crab abundance and recruitment, and to inform fishery management.
- In 2021, the Chesapeake Bay Stock Assessment Committee (CBSAC) created a Blue Crab Harvest Reporting document to record each jurisdiction's efforts to track blue crab harvest and provide recommendations for improving the accuracy of commercial and recreational harvest data.

What challenges have hindered progress?

- Additional science and research to improve the stock assessment model such as characterization of model uncertainty and bias.
- Research/monitoring to quantify the impact of environmental conditions (e.g., water temperature, oxygen concentrations) and climate change (e.g., coastal currents/flow, shifting distributions) on blue crab recruitment and abundance.

If on course, what is needed to continue current trajectory?

- Complete a new benchmark stock assessment and identify management reference points based on the model results.
- Fund research that will address data gaps identified in the science workshop, including ecosystem drivers of blue crab population.

Blue Crab Management Outcome

OUTLOOK
COMPLETED

Outcome

Manage for a stable and productive crab fishery including working with the industry, recreational crabbers and other stakeholders to improve commercial and recreational harvest accountability. By 2018, evaluate the establishment of a Bay-wide, allocation-based management framework with annual levels set by the jurisdictions for the purpose of accounting for and adjusting harvest by each jurisdiction.

Status

The Chesapeake Bay's commercial and recreational blue crab fisheries are managed by the State of Maryland, the Commonwealth of Virginia and the Potomac River Fisheries Commission, based on guidance from the 2011 Chesapeake Bay Stock Assessment. The management framework uses female-specific reference points (target and threshold numbers) to indicate the sustainability of the blue crab population and inform management decisions. In 2017, Maryland, Virginia and the Potomac River Fisheries Commission decided to maintain use of this framework rather than moving to a new, allocation-based framework. This decision was guided by constituent feedback and the perspectives of the agencies that manage the fishery. The Blue Crab Management Outcome is completed.

What has helped achieve success since 2014?

- The completion of an assessment that evaluated the need for a framework that would allocate an annual total allowable catch of male and female blue crabs. The assessment took into consideration feedback from constituents, the Maryland Tidal Fisheries Advisory Commission, the Potomac River Fisheries Commission and the Virginia Crab Management Advisory Committee.
- An agreed-upon and functioning female-specific management framework in conjunction with a partnership of blue crab management agencies, industry stakeholders and scientists working together to better understand the blue crab population and fishery.
- Prioritization of ongoing efforts to improve estimates of blue crab harvest and other sources of mortality.

What challenges have hindered progress?

- This outcome is completed.

Oysters Outcome

OUTLOOK ON COURSE

Outcome
Continually increase finfish and shellfish habitat and water quality benefits from restored oyster populations. Restore native oyster habitat and populations in 10 tributaries by 2025 and ensure their protection.

Status
Ten tributaries have been selected for large-scale oyster restoration in Maryland and Virginia. In 2020, Virginia added an 11th bonus tributary in the Elizabeth River). Seven of the original 10 tributaries are considered to be restored and are in the monitoring and evaluation phase. This work constitutes the largest oyster restoration project in the world. The Oysters Outcome is on course and will be met by 2025, although monitoring and evaluation of some of the restoration sites will continue past 2025.

What has helped achieve success since 2014?

- Developing a strong framework upfront, that includes science, planning, common goal setting, success criteria and partner development.
- A strong commitment to monitoring, allowing partners to track success relative to well-established criteria.
- Collaborating and sharing information with a broad array of stakeholders and interested parties, ensuring they are engaged during the planning process and implementation phase.
- Consistent federal and state funding for construction and hatchery support.
- University of Maryland's Horn Point oyster production facility produced over five billion oyster larvae to support restoration.
- Research into the ecosystem services provided by restored reefs and its associated economic impact helped make the case for continued funding.

What challenges have hindered progress?

- Operating at a globally unprecedented scale required risk, novel thinking and significant resources (approximately $100M).
- Poor water quality, sedimentation, disease and, in some places, low natural recruitment from other oysters.
- Continued reef stewardship is key, including maintaining the areas as oyster sanctuaries (non-harvest status) and ensuring sufficient water quality to allow for thriving oyster populations.
- Construction issues on a few reefs have resulted in the need for modification or removal.
- Not all communities are supportive of the restoration effort.

If on course, what is needed to continue current trajectory?

- Continued commitment by the states (Maryland and Virginia) to allow the construction and protection of non-harvest (sanctuary) oyster reefs.
- Continued funding and technical support from a wide range of partners, including federal agencies, state agencies, NGOs and academics.
- Continued support for reef monitoring and tracking progress toward the '10 tributaries' outcome.

Forage Fish Outcome

OUTLOOK ON COURSE

Outcome

Continually improve the partnership's capacity to understand the role of forage fish populations in the Chesapeake Bay. By 2016, develop a strategy for assessing the forage fish base available as food for predatory species in the Chesapeake Bay.

Status

In 2020, the Forage Action Team developed an Indicator Development Plan that prioritized seven indicators that could be developed with existing data and have clear management applications. Four of these indicators are currently under development or ready for development and will help provide insight into the status of forage species in the Bay. The Forage Fish Outcome is on course.

What has helped achieve success since 2014?

- A 2014 Scientific and Technical Advisory Committee workshop and report, *Assessing the Chesapeake Bay Forage Base*.
- GIT-funded research that developed a suite of forage indicators and consumption profiles for representative predators in the Chesapeake Bay and investigated environmental drivers of forage population trends.
- NOAA-funded research developing habitat suitability models for key forage species.
- The Indicator Development Plan, which prioritized indicators to describe the status of forage species.

What challenges have hindered progress?

- Completing the development of forage status and trends indicators.
- The ability to clearly communicate to policymakers the need for strategies to manage forage species as they are an ecosystem factor that could impact currently managed species such as striped bass.
- Developing science-based management strategies to mitigate the impacts of habitat loss, shoreline development, dissolved oxygen and pollution on forage species.
- Including more focused surveys in under-sampled shallow water to enhance assessments.

If on course, what is needed to continue current trajectory?

- Develop Chesapeake Bay specific striped bass prey consumption estimates and condition index. Complete indicator development, publish a synthesis of indicators and implication on forage status and trends, and integrate the indicators into NOAA's seasonal summaries and State of the Ecosystem Reports.

Fish Habitat Outcome

OUTLOOK ON COURSE

Outcome

Continually improve effectiveness of fish habitat conservation and restoration efforts by identifying and characterizing critical spawning, nursery and forage areas within the Bay and tributaries for important fish and shellfish, and use existing and new tools to integrate information and conduct assessments to inform restoration and conservation efforts.

Status

Several assessments of tidal and non-tidal fish habitats across the Chesapeake Bay watershed have been conducted and are ongoing. These habitat studies also have the potential to inform shoreline restoration management. Additional studies have linked environmental variability to fish populations, resulting in adjustments to fishery management risk assessments. The Fish Habitat Outcome is on course.

What has helped achieve success since 2014?

- Developing a greater understanding of the requirements and threats to Chesapeake Bay fish species through research and literature review.
- Publishing an inventory of tools, maps and datasets related to fish habitat.
- Development of a fish habitat assessment tool to support government agencies, non-profits and local community members engaged in the conservation and restoration of fish habitat.
- Prioritizing fish habitat stressors including, shoreline hardening, impervious surfaces, forest buffer loss, temperature increases and low dissolved oxygen.
- Establishing shoreline hardening thresholds and related impacts on forage fish.

What challenges have hindered progress?

- A mismatch in fish habitat team member expertise, capacity and constituent needs.
- Difficulty finding team members willing to lead specific projects.

If on course, what is needed to continue current trajectory?

- Successfully endorse and receive funding for partners to implement innovative fish habitat enhancement projects such as co-locating oysters, mussels and submerged aquatic vegetation.
- Provide technical support for fish habitat restoration projects applying for Infrastructure Investment and Jobs Act, Inflation Reduction Act and other funding sources.
- Develop a fish and habitat risk assessment that draws from recently completed research, habitat assessments and water quality observations to evaluate the linkages between changing Bay conditions and aquatic living resources.
- Establish or continue to support and enhance regulatory processes that protect and restore wetland riparian buffers.
- Communicating and including fish habitat considerations in Watershed Implementation Plans, fisheries management and other local planning processes.

Vital Habitats Goal

CHESAPEAKE BAY WATERSHED AGREEMENT

"Restore, enhance and protect a network of land and water habitats to support fish and wildlife, and to afford other public benefits, including water quality, recreational uses and scenic value across the watershed."

Photo by Will Parson/Chesapeake Bay Program

Wetlands Outcome

OUTLOOK OFF COURSE

Outcome

Continually increase the capacity of wetlands to provide water quality and habitat benefits throughout the watershed. Create or reestablish 85,000 acres of tidal and non-tidal wetlands and enhance function of an additional 150,000 acres of degraded wetlands by 2025. These activities may occur in any land use (including urban), but primarily occur in agricultural or natural (undeveloped) landscapes.

Status

In-between 2010 and 2021, initial data from the National Environmental Information Exchange Network (NEIEN) showed that 16,000 acres of wetlands were created or restored on agricultural lands, representing an 18.8% achievement of the 85,000-acre goal. The rate of this gain in wetlands acreage is not currently adequate to achieve the outcome target. While progress shows that wetlands are being restored and created across the watershed, the total acres of wetlands are also decreasing due to land subsidence, climate change and development pressures. At this time, wetlands acreage accounting is problematic, in part, due to the inability to accurately track loss or gains in wetlands across the watershed and assess whether our activities are yielding the desired progress. The Wetlands Workgroup will refine the outcome to recognize the effect of climate change, development and water quality on outcome achievement. Additionally, the workgroup will develop achievable targets specific to tidal and nontidal wetlands. The Wetlands Outcome is off track and will not meet 2025.

What has helped achieve success since 2014?

- The development of a new wetlands accounting system is near completion.
- Many projects funded under the Chesapeake Bay Program's GIT funding process.
- The development of communications products for decision-makers.
- Collaboration with other GITs, workgroups and organizations on reports, workshops and meetings to discuss barriers to wetland implementation and identify innovative approaches to achieve multiple *Watershed Agreement* goals and outcomes.
- Both tidal and nontidal wetlands have been approved as best management practices (BMPs).
- The Wetlands Action Workshop and Plan.
- Science and Technical Advisory Committee workshops related to wetlands ecosystem crediting and the influence of water temperature rise.
- Bipartisan Infrastructure Law has created opportunities for increased wetlands funding for strategic planning, capacity and implementation.
- Collaboration between partners within jurisdictions.
- Department of Defense (DOD) Readiness and Environmental Protection Integration and Sentinel Landscape Program Partnership that have leveraged DoD funds for off-base wetland protection and conservation, as well as two new DOD Sentinel Landscapes that were designated in coastal Virginia.

What challenges have hindered progress?

- Incomplete or unavailable tracking information to assess progress toward restoring, creating or enhancing wetlands.
- A lack of capacity and support for workgroup members and staff, including no workgroup chair(s), resulting in a year and half without a workgroup meeting.
- A prolonged vacancy in the Wetlands Workgroup staffer position.

- Lack of capacity (including grant writing/management, outreach to landowners, project design and construction, post-construction monitoring, etc.) within government agencies NGOs, and the private sector.
- Climate change and land subsidence.
- There are still challenges among the partnership in agreement on definitions for enhancement; additionally, since enhancement is not a best management practice, the National Environmental Exchange Network does not provide a way to track it.
- Lack of jurisdictional representatives on the Wetlands Workgroup; those that attend often cannot speak to all the programs in their jurisdiction that cover wetlands.
- A significant amount of Wetlands Workgroup time was spent on wetland verification with the Best Management Practice Verification Ad-Hoc Action Team and GIS wetland mapping.
- Matching fund challenges to take advantage of cost-share restoration programs.

If off course, what is needed to accelerate progress?

- Significant engagement and building long-term capacity to implement wetland projects across localities, state and federal sectors, NGOs and industry.
- Address preferential implementation of stream projects (or other best management practices) for Bay TMDL crediting, including resulting resource trade-offs and unintended consequences.
- Develop and implement effective incentives for the agriculture community for implementation.
- Supporting capacity for jurisdictions and partners with the needs related to wetland projects: permitting, complex design and construction.
- Use existing regulatory staff for outreach to homeowners, paying them adequately for the needed expertise.
- Address the challenges related to the cost of restoring and/or enhancing tidal wetlands, particularly in the face of sea level rise projections and land use competitions when the landscape is highly valued as a working waterfront, urban/suburban or private waterfront property.
- Continuity of communication product development.
- Establish or continue to support and enhance regulatory processes that protect and restore wetlands and riparian buffers.
- Use social science to address any significant advances in ecology and socio-economic understanding around wetlands.

Black Duck Outcome

OUTLOOK OFF COURSE

Outcome

By 2025, restore, enhance, and preserve wetland habitats that support a wintering population of 100,000 Black Ducks, a species representative of the health of tidal marshes across the watershed. Refine population targets through 2025 based on best available science.

Status

The Black Duck Outcome was developed using data provided by the Atlantic Coast Joint Venture's Black Duck Decision Support Tool. In 2017, the tool estimated that an additional 151,272 acres of wetland habitat were necessary to support a wintering population of 100,000 Black Ducks. This acreage is in addition to the established baseline of 566,477 acres. A recent update to the tool allowed sufficient and insufficient watersheds to be identified, along with their conservation status, indicating where additional protection, restoration or enhancement is needed. Since the Black Duck Outcome is dependent on the Wetlands Outcome, and the Wetlands Outcome is off course, the Black Duck Outcome is also off course and will not be met by 2025. The migratory nature of the Black Duck lifecycle allows external factors outside of the Chesapeake Bay watershed to influence the population and climate change impacts are shifting the species range. Because of this there is little that the current outcome can do to actually benefit the Black Duck population. In fact, Black Duck populations have been stable since the 1960's. We believe that the outcome will need to be revised and broadened to represent the population of wintering waterfowl under climate change, sea level rise and subsidence scenarios. The Black Duck Outcome is off course and will not be met by 2025.

What has helped achieve success since 2014?

- Completion of the Black Duck Decision Support Tool provided a trackable habitat-based outcome to work towards the 100,000 Black Duck population goal.
- Continued updates to the Black Duck Decision Support Tool have identified areas where there is sufficient and insufficient wetland quantity and quality to support the desired population of Black Ducks.
- The completion of the bioenergetics modeling for the refuges in the face of sea-level rise and land-use changes, which showed the importance of underwater grasses as a food resource for wintering Black Ducks.
- Conservation and protection of coastal lands, particularly marsh migration corridors, to allow for future Black Duck habitat.

What challenges have hindered progress?

- The Mid-Winter Waterfowl Survey never provided population estimates for waterfowl species as described in the original outcome. The Mid-Winter Waterfowl survey monitors trends in waterfowl populations but not Black Ducks specifically. As a result, it has never been possible to count the number of Black Ducks in the Chesapeake Bay watershed, which is why the outcome was modified to a habitat-based outcome.
- In terms of value to Black Ducks, not all habitat conservation is equal. It is uncertain whether the number of acres of wetlands restored under the Wetlands Outcome are quality habitat for Black Duck.
- Present efforts for wetland restoration do not prioritize Black Ducks.
- It has been a challenge to collect the necessary data for the outcome.
- Degraded habitat conditions due to climate impacts, shoreline disturbance and food availability.

If off course, what is needed to accelerate progress?

- An increase of implementation projects that focus on Black Duck habitat conservation.
- Increased funding for wetland restoration and capacity in workgroup members and staff.
- The development of a tracking system that collects the acres of restored Black Duck habitat.

Stream Health Outcome

OUTLOOK ON COURSE

Outcome

Continually improve stream health and function throughout the watershed. Improve health and function of ten percent of stream miles above the 2008 baseline for the watershed.

Status

The 2008 baseline for the Stream Health Outcome indicator is the six-year interval between 2006 and 2011, and progress is measured in successive six-year intervals. The indicator, known as the Chesapeake Basin-wide Index of Biotic Integrity (Chessie BIBI), is calculated from stream macroinvertebrate data collected and shared by federal, state, local and community monitoring programs. Statistical estimates based on the data indicate about 61.7% of stream miles in the watershed likely supported healthy communities during the baseline period. Estimates rose 6.1% to 67.8% in the subsequent six-year interval (2012—2017). While there is no guarantee this improving trend will persist or be detectable in the upcoming six-year interval (2018—2023), this trend appears to be moving in the desired direction. The Stream Health Workgroup is currently implementing a plan to develop additional metric(s) to complement the Chessie BIBI. These metrics are intended to be established over the next five years and are necessary to understand and communicate how streams respond to management actions. These additional metrics will help us view how stream health is changing on a smaller timescale than the Chessie BIBI, which will be useful in monitoring responses to management actions and other local and watershed-wide changes. The Workgroup developed a three-phase plan to identify primary stressors to stream health and function, identify best watershed management actions to reduce those stressors and develop non-biologic indicators of stream health. Work has just begun on the final phase of this plan to identify appropriate metrics that may be used as indicators. The Stream Health Outcome is on course.

What has helped achieve success since 2014?

- Assembly and management of a standardized database for the shared stream macroinvertebrate data.
- Cumulative effects of multiple actions over decades undertaken under the auspices of the Clean Water Act, and with support from implementing state and federal regulatory and voluntary programs, have improved stream water quality and reduced loss/degradation of existing streams from direct and indirect impacts.
- Funding to identify the extent in which management actions improve stream health and the multiple stressors that impact it.
- Funding to establish the baseline for the Stream Health Outcome indicator.
  Studies, research and tools developed by partners, including looking at the impact of climate change on freshwater streams and Maryland's stream temperature Total Maximum Daily Load.

What challenges have hindered progress?

- Funding is not guaranteed to complete the Workgroup's long-term plan to create one or more non-biological metrics to complement the Chessie BIBI in assessing stream health.
- Inconsistent funding causes delays in progress on logic and action plan items.
- Inconsistent or absent participation from state representatives on the Workgroup.

- Gaps in the monitoring data's spatial and temporal coverage make it difficult to directly estimate percentages of healthy streams in the pre-baseline (2000-2005), baseline (2006-2011) and first interval (2012-2017) periods.
- Stream health is complex and multivariate, thus reliance on a single indicator (Chessie BIBI) may miss key components of overall stream health and have limited our ability to track overall changes.

If on course, what is needed to continue current trajectory?

- Continued funding for data management and Chessie BIBI analysis and to expand stream biological monitoring efforts in poorly sampled regions of the watershed.
- Habitat preservation throughout the watershed for high quality streams and sensitive natural areas.
- Expanded focus from TMDL and water quality improvements to more holistic watershed improvements by identifying stressors to stream health and prioritizing management actions to reduce those stressors.
- Beyond 2025, the outcome will be reevaluated to account for climate change and population growth while continuing to improve stream health as measured by the Chessie BIBI scores.

Brook Trout Outcome

OUTLOOK OFF COURSE

Outcome
Restore and sustain naturally reproducing brook trout populations in Chesapeake Bay headwater streams, with an eight percent increase in occupied habitat by 2025.

Status
Changes in land use and climate continue to have significant detrimental impacts on brook trout habitat. The resources available to mitigate these impacts are insufficient to adequately sustain and restore brook trout populations at the necessary scale to achieve the outcome. A more accurate and comprehensive system to document gains and losses in brook trout habitat is being developed as current data are incomplete. An assessment completed by the Eastern Brook Trout Joint Venture in 2015 showed that wild brook trout occupy 33,200 square kilometers of habitat within the Chesapeake Bay watershed. This includes the streams they share with brown trout and/or rainbow trout. There are 13,500 square kilometers of "wild brook trout only" streams, which was the baseline established for this outcome. Intervention and continued data support are needed to increase the rate of implementation and monitoring of conservation and restoration activities. The Brook Trout Outcome is off course and will not be met by 2025.

What has helped achieve success since 2014?

- Science and management efforts to better understand landscape-scale impacts, climate change, brook trout genetics, groundwater effects on stream temperature and direct stressors.
- Gains in brook trout occupancy resulting from workgroup members and other stakeholder action such as reintroduction, connecting fragmented habitats and mitigating stressors.
- Prioritizing 10 "Priority Level 1" regions (sub-watersheds with the best chance for sustaining wild brook trout populations) for brook trout conservation in the watershed.
- The availability of several decision support tools, such as the Trout Unlimited Eastern Brook Trout Conservation Portfolio and the Riparian Restoration for Climate Change Resilience Tool.
- Public outreach and awareness of threats to brook trout habitat.
- Funding from the National Fish and Wildlife Foundation and other sources which have provided the opportunity for much-needed brook trout research, monitoring efforts and tool development and upkeep.

What challenges have hindered progress?

- There is a limited capacity to implement and coordinate actions at the scale necessary to overcome the detrimental impacts to brook trout habitat throughout the watershed.
- Difficulties in developing cross-Goal Implementation Team collaborations and developing synergies across common goals and objectives.
- A lack of staffing resources to collect and analyze data that is necessary to track progress toward the outcome.
- Funding is not adequate to restore and sustain brook trout populations across the watershed, which is necessary to overcome the detrimental impacts to their habitat.
- The COVID-19 pandemic contributed to delays in some activities.
- Each state is unique, there is no one-size fits all approach.
- Impacts of land use and climate change provide damaging effects to brook trout habitat.

If off course, what is needed to accelerate progress?

- Increase resources and capacity to implement and coordinate actions at the scale necessary to overcome the detrimental impacts to brook trout habitat throughout the watershed. More specifically, each state should have dedicated funding for:
    - New staff and funding for an aggressive Aquatic Organism Passage Program partnering with state departments of transportation.
    - Land conservation to protect high-quality brook trout watersheds, groundwater spring sources and floodplains through fee acquisition or conservation easements.
    - Staff and resources for habitat improvements (e.g., large wood additions, riparian plantings).
- The Brook Trout Workgroup will reassess the outcome, lessons learned from managers and practitioners, and recent research results to provide a more relevant outcome and metrics for post-2025. This will include evaluating the impact of likely climate and land-use change scenarios.

Fish Passage Outcome

OUTLOOK ON COURSE

Outcome
Continually increase access to habitat to support sustainable migratory fish populations in the Chesapeake Bay watershed's freshwater rivers and streams. By 2025, restore historical fish migration routes by opening an additional 132 miles every two years to fish passage. Restoration success will be indicated by the consistent presence of alewife, blueback herring, American shad, hickory shad, American eel and brook trout, to be monitored in accordance with available agency resources and collaboratively developed methods. *
**In January 2020, the outcome was modified from the original language.*

Status
During the reporting period including 2020-2021, 32.6 additional stream miles were opened to fish passage, less than the two-year target of 132 miles. This target, set in accordance with the best available science, was established in January of 2020 after the Fish Passage Workgroup reached the goal set in the *2014 Chesapeake Bay Watershed Agreement* in 2016.

While the miles opened from 2020-2021 fall well below the biennial target and overall opened miles have declined over the past few years, the Fish Passage Workgroup does not expect this to be an ongoing trend. The workgroup is working on additional projects with a focus on identifying and correcting undersized and poorly constructed stream crossings that have created fish blockage. This new focus is expected to result in some fluctuations in progress toward the biennial target of 132 fish passage miles. However, based on the expected trajectory of this work and since the current rate of miles added averages 619 miles every two years, the fluctuations in miles added are expected to continue to average above the biennial target. The Fish Passage Outcome is on course and expected to be met by 2025.

What has helped achieve success since 2014?
- Dam removals and culvert replacements, particularly in Pennsylvania, who leads the nation in removing dams
- Workgroup members have worked with dam safety programs to highlight dam removal benefits, such as public safety, reduced liability and resilience.
- The development of the guidance document, "Recommendations for Aquatic Organism Passage at Maryland Road-Stream Crossings (2021)".
- The U.S. Army Corps of Engineers released guidance on mitigation crediting for dam removals and other river obstructions.
- Collaboration with partners, including county and local governments helps more projects succeed.

What challenges have hindered progress?
- Many dams are privately owned, and owners are unwilling to pursue removal.
- The COVID-19 pandemic largely halted all fish passage activities and likely will affect outcome progress for 2020 and 2021.
- Inconsistencies with how fish passage projects are being tracked, so the outcome has been under-reporting progress across the watershed.

- More road safety assessments need to be funded, along with determining the presence of target aquatic species.
- Cost and complexity of many remaining dam removal projects has slowed progress.

If on course, what is needed to continue current trajectory?

- Several projects are underway and are expected to be completed by 2025.
- Workgroup partners must take advantage of the available infrastructure grants.
- Grants already submitted or near submittal, must be funded.
- Broaden workgroup engagement to include federal and state departments of transportation.
- Funding from the Infrastructure Investment and Jobs Act will be used to expand the dam removal and culvert initiatives while addressing resilience.

Submerged Aquatic Vegetation (SAV) Outcome

OUTLOOK OFF COURSE

Outcome

Sustain and increase the habitat benefits of submerged aquatic vegetation (SAV) in the Chesapeake Bay. Achieve and sustain the ultimate outcome of 185,000 acres of SAV Bay-wide necessary for a restored Bay. Progress toward this ultimate outcome will be measured against a target of 90,000 acres by 2017 and 130,000 acres by 2025.

Status

Between 2014 and 2018, SAV expanded by almost 33,000 acres in the Chesapeake Bay, reaching approximately 108,000 acres in 2018, the highest acreage recorded since Bay-wide surveys began in 1984. Because of this record increase, SAV acreage exceeded the 2017 target of 90,000 acres between 2015--2018. Between 2018 and 2019, however, over 44,000 acres were lost, approximately one-third of the Bay's SAV. This loss has been attributed to degraded water clarity following two years of above-normal precipitation and subsequent high flows. Since that time, SAV has slowly begun to rebound, with the most recent data, collected in 2022, showing 76,462 acres of SAV throughout the Bay and its tidal tributaries. Additional years of increased acreage will help clarify whether this recent gain is the start of a new positive trend, but it is unlikely that the interim goal of 130,000 acres will be reached by 2025. The interim goal of 130,000 acres remains attainable in the future if additional management actions are taken to ensure long-term and consistent improvements in water clarity and shallow water habitat protection. The SAV Workgroup, however, recommends reevaluating the ultimate SAV acreage goal of 185,000 acres to determine if it should be updated. This goal was based on historical SAV distribution in Chesapeake Bay and conditions that may not be met again in the future given the projected effects of climate change. The SAV Outcome is off course and will not be met by 2025.

What has helped achieve success since 2014?

- Management solutions, including the Bay TMDL, have contributed to overall SAV recovery. Most notably, nutrient reductions allocated by the Bay TMDL facilitated the expansion of widgeon grass (*Ruppia maritima*) in the mid and lower Bay.
- Methods to collect, process and store SAV seeds have improved, and direct, small-scale, SAV restoration efforts have contributed to SAV acreage in years of SAV expansion.
- Collaboration with riverkeepers, watershed groups and other partners to implement the Chesapeake Bay SAV Watchers program has contributed to community engagement and understanding of SAV habitat value.
- Increased research and monitoring have contributed to an improved understanding of SAV ecology, restoration and the effects of climate change impacts.

What challenges have hindered progress?

- The Bay TMDL has reduced nutrient and sediment pollution and has contributed to overall SAV recovery in Chesapeake Bay. Watershed Implementation Plans (WIPs), however, are behind schedule, so reductions have been inadequate to consistently improve water clarity to the extent necessary for Bay-wide SAV goal attainment.
- Climate change impacts—including increased water temperature, episodic heat events and increased volume and intensity of precipitation—have also hindered progress toward attainment of the 2025 interim SAV goal. Specifically, rising water temperatures and isolated

heat events have contributed to the consistent loss of eelgrass (*Zostera marina)*, a heat-intolerant species, in the lower Bay. Widgeongrass, a heat-tolerant species, has now expanded to become the most abundant species of SAV in the mid and lower Bay. While widgeongrass expansions facilitated by nutrient reductions have fueled many of the Bay-wide SAV recovery trends documented, its vulnerability to chronic and episodic influxes of nutrient-loaded watershed run-off (mostly from springtime precipitation events) hinders consistent and lasting gains in SAV acreage over time.

- Existing statutes, regulations and policies related to protecting SAV in Chesapeake Bay were reviewed as part of a GIT-funded project and were found to be inadequate in providing effective protection of existing and recovering SAV. However, this review included recommendations for improved protection that are being considered by federal and state management agencies.
- The competition for shallow water habitat among multiple program goals has led to shallow water use conflicts and habitat trade-offs that have impacted SAV recovery potential in Chesapeake Bay.
- Inadequate staffing, training and funding have hindered the ability of Chesapeake Bay Program partners to conduct research, enforce laws and regulations, review permit applications for projects that impact SAV and directly restore SAV to the extent necessary to meet the needs of the outcome.

If off course, what is needed to accelerate progress?

- SAV is dependent on good water quality conditions to recover, expand and thrive. Two recent studies concluded that under projected climate conditions and current Bay TMDL nutrient reduction allocations, SAV in the Chesapeake Bay may continue a modest recovery but not reach its ultimate acreage goal. Nutrient and sediment reductions *beyond* those currently allocated in the Bay TMDL, however, would mitigate climate impacts and accelerate SAV recovery in the Bay.
- An improved understanding of how climate change and human actions will affect the health and benefits provided by each of the Bay's SAV communities (freshwater, brackish and high salinity) is needed. This community-specific understanding of both patterns and processes could be obtained by funding the SAV Sentinel Site Program and would allow resource managers to tailor management strategies to each community, protecting and restoring SAV throughout the Bay more effectively.
- Significant financial investments have proven effective for habitat and species restoration throughout the Chesapeake Bay (i.e., *Crassostrea virginica*, eastern oysters). To accelerate progress toward SAV goal attainment, similar investments for SAV restoration are necessary to expand research and upscale direct SAV planting capacity.
- Horned pondweed (*Zannichellia palustris)* grows abundantly in the mid-Bay but is not captured in the Bay-wide aerial monitoring program because it deteriorates before that portion of the Bay is surveyed. An expanded monitoring effort would improve our understanding of the distribution and abundance of this species in the mid-Bay, contribute its abundance to the SAV acreage goal, and facilitate improved protection and conservation of the habitat and ecosystem services it provides.
- An approach or analysis that employs structured decision making to manage habitat trade-offs and shallow water use conflicts equitably and effectively, would provide a framework for how and when to allow for trade-offs that impact SAV and, ideally, accelerate progress toward SAV goal attainment.

Forest Buffers Outcome

OUTLOOK OFF COURSE

Outcome

Continually increase the capacity of forest buffers to provide water quality and habitat benefits throughout the Chesapeake Bay watershed. Restore 900 miles of riparian forest buffers per year and conserve existing buffers until at least 70% of riparian areas in the watershed are forested.

Status

The pace and scale of forest buffer implementation across the watershed is inadequate to meet the ambitious goals set in the 2014 *Chesapeake Bay Watershed Agreement* or in the Watershed Implementation Plans (WIPs) put in place by the seven jurisdictions. The Chesapeake Bay Program has not met its goal for riparian forest buffers since 2002, often achieving less than 10% on an annual basis. To meet the goals laid out in the Phase III WIPs, over 3,000 miles of forest buffers would need to be planted between 2022 and 2025. The Forest Buffers Outcome is off course and will not be met by 2025.

What has helped achieve success since 2014?

- Increased implementation of flexible buffer programs that have been popular with landowners.
- Development of state Riparian Forest Buffer Action Strategies to help identify pathways to accelerate implementation over the next 5-10 years.
- Additional state and federal funding available for tree planting initiatives.
- Ongoing work to fill information gaps, including the Scientific and Technical Advisory Committee's *Rising Watershed and Bay Water Temperatures* report and the Goal Implementation Team-funded *Maintaining Forests in Stream Restoration* project.

What challenges have hindered progress?

- Insufficient capacity for technical assistance, planting and maintenance. Much more technical assistance is needed to find, recruit and assist landowners.
- Inconsistencies in funding and program delivery, particularly in relation to Conservation Reserve Enhancement Program (CREP).
- Conserving mature forest buffers. Additional buffer conservation easement programs are needed to incentivize permanent conservation of forest buffers.
- Constraints with nursery supply to ensure the quality and quantity of tree stock will be available to meet ambitious planting goals.

If off course, what is needed to accelerate progress?

- Support sustained investments in effective, standalone flexible buffer programs (both existing and new programs).
- Additional consistent, coordinated leadership across the watershed, including at the Chesapeake Executive Council, to ensure efficient, dedicated and sustainable programs are in place.
- Build and retain capacity in staff, contractors and outreach.
- Track and maintain accountability for implementing the recently developed state Riparian Forest Buffer Action Strategies.
- Improved verification of buffers, including developing more cost-effective approaches.
- Leverage the benefits of riparian forest buffers for increasing climate resiliency and carbon sequestration in the watershed as the Chesapeake Bay Program addresses climate change effects.

Tree Canopy Outcome

OUTLOOK OFF COURSE

Outcome
Continually increase urban tree canopy to provide air quality, water quality and habitat benefits throughout the Chesapeake Bay watershed. Expand urban tree canopy by 2,400 acres by 2025.

Status
The most recent tree canopy data shows a net loss of over 25,000 acres of tree canopy across the Chesapeake Bay watershed. While it may take 10-15 years for tree plantings to be reflected in the aerial imagery used for producing the land use/land cover data, the 8,300 acres planted so far are not enough to mitigate the losses. Much effort is needed to reverse the trend of net losses and achieve the net gain specified in the outcome. The Tree Canopy Outcome is off course and will not be met by 2025.

What has helped achieve success since 2014?

- The development and release of high-resolution land use/land cover change data for the period 2013-2014 and 2017-2018 to more accurately track tree canopy gain and loss.
- In the past two years, urban tree canopy has gained national and global attention as a key arena for building equity and climate resilience in communities.
- Vital state and local programs in place to assist with tree plantings and management.

What challenges have hindered progress?

- The need to develop or strengthen new local and state policies that help conserve and maintain canopy where possible.
- Addressing tree inequity will require substantial resource investments in community-based solutions, robust and inclusive community engagement efforts and deliberate policy/program/funding adjustments to ensure these communities receive first priority in financial and technical assistance.
- Constraints with nursery supply to ensure the quality and quantity of tree stock will be available to meet ambitious tree planting goals.
- The need to fund, train and maintain a robust, well-trained workforce to meet scaled-up tree planting and maintenance needs.
- The lack of capacity and investment in programs varies widely across the watershed.

If off course, what is needed to accelerate progress?

- Implement Chesapeake Bay Program and jurisdictional action plans developed as a result of the recommendations from the 2023 Chesapeake Tree Canopy Funding & Policy Roundtable (expected completion date of summer 2023).
- Incorporate credits and incentives for forest and tree conservation and maintenance actions in the next (post-2025) Chesapeake Bay Total Maximum Daily Load implementation framework (in addition to planting).
- Invest in coordinated tree canopy workforce and nursery supply pathways to scale up implementation, with diversity, equity, inclusion and justice as the central focus.
- Expand tree canopy communication, outreach and training resources to help build local government and community support for tree conservation, maintenance and planting.
- Leverage the benefits of tree canopy for increasing climate resiliency in the watershed as the Chesapeake Bay Program addresses climate change effects.

Water Quality Goal

CHESAPEAKE BAY WATERSHED AGREEMENT

"Reduce pollutants to achieve the water quality necessary to support the aquatic living resources of the Bay and its tributaries and protect human health."

Photo by Will Parson/Chesapeake Bay Program

2017 Watershed Implementation Plans (WIPs) Outcome

Outcome

By 2017, have practices and controls in place that are expected to achieve 60 percent of the nutrient and sediment load reductions necessary to achieve applicable water quality standards compared to 2009 levels.

Status

Watershed Implementation Plans (WIPs), created by the seven Bay watershed jurisdictions as part of the Chesapeake Bay Program's Accountability Framework and serving (the Phase I WIPs) as a large part of the basis for the Chesapeake Bay "pollution diet" or Total Maximum Daily Load (TMDL), are instrumental in the restoration of tidal water quality and meeting the 2017 and 2025 WIP outcomes. Improving water quality will support other restoration goals and benefit human health.

While the Chesapeake Bay Program partnership has met its 2017 pollutant reduction targets for phosphorus and sediment, it fell short of its pollutant reduction target for nitrogen by 15 million pounds. According to the Chesapeake Bay Program's Watershed Model Phase 5.3.2, controls put in place in the Chesapeake Bay watershed between 2009 and 2017 lowered nitrogen loads 11%, phosphorus loads 21% and sediment loads 10%. This outcome was established as a midpoint assessment from the 2009 baseline and the 2025 goal described in the Bay TMDL. The 2017 WIP Outcome is considered to be complete.

What has helped achieve success since 2014?

- Completion of Phase I WIPs and Phase II WIPs in 2010 and 2012, respectively, that outlined steps the seven Bay watershed jurisdictions committed to take to reduce nitrogen, phosphorus and sediment from flowing into the Bay.
- The additional implementation and verification of best management practices, especially in the agricultural sector, following the Chesapeake Bay Program partnership adoption of a BMP Verification Framework in 2014.
- Additional resources and technical support allocated for state and local governments to implement the WIPs.]
- Steps taken to meet the wastewater sector's pollutant reduction goals a decade early.

What challenges have hindered progress?

- While this outcome is completed, challenges remain in reducing nitrogen loads, particularly from nonpoint sources.

What is needed to continue current trajectory?

- This outcome is completed.

2025 Watershed Implementation Plans (WIPs) Outcome

Outcome

By 2025, have all practices and controls in place to achieve applicable water quality (i.e., dissolved oxygen, water clarity/submerged aquatic vegetation and chlorophyll *a*) standards, as articulated in the Chesapeake Bay Total Maximum Daily Load.

Status

As of 2022, best management practices (BMPs) are in place to reduce 51% of nitrogen, 60% of phosphorus and 100% of sediment loads necessary for the Chesapeake Bay to attain applicable tidal water quality standards for dissolved oxygen, water clarity/submerged aquatic vegetation (SAV) and chlorophyll a. While management actions are sufficient to meet the sediment reduction target by 2025, they are not for the nitrogen and phosphorus reduction targets. Approximately 41 million pounds of nitrogen and 1.4 million pounds of phosphorus remain to be reduced. The 2025 WIP Outcome is off course and will not be met by 2025.

What has helped achieve success since 2014?

- The goal of reducing sediment loads to 18,587 million pounds annually was met as of 2021 due to the implementation of BMPs.
- An increase in federal funding from sources such as the Infrastructure Investment and Jobs Act is helping to expand BMP implementation and support the maintenance and growth of the Chesapeake Bay Program's long-term tidal and nontidal monitoring networks.
- Additional federal and state funding has helped to grow outreach opportunities and offer technical assistance for state and local entities throughout the watershed to fund nonpoint source BMP adoption and implementation.
- Enhanced financial and technical support for agricultural BMP implementation, tracking and reporting.
- Increased levels of engagement from local stakeholders to target resources and build capacity in meeting water quality goals, particularly in local waters.
- Continued efforts by local and state governments to reduce nutrient and sediment pollution from wastewater treatment facilities, regulated stormwater systems and nonpoint sources.

What challenges have hindered progress?

- New funding is often targeted to direct implementation and often does not address increased technical assistance, workforce development, inspection and maintenance needs to administer new funds or programs.
- Insufficient capacity to meet technical assistance and outreach needs across all sectors and levels of government.
- Climate change impacts that increase flow and pollution delivery above historic baseline conditions have impacted the amount of nitrogen and phosphorus that jurisdictions must reduce in order to meet their water quality goals. The reservoir located behind the Conowingo Dam reached trapping capacity much earlier than anticipated, resulting in additional nitrogen, phosphorus and sediment loads to the Bay during higher flow events compared with historic conditions of the Susquehanna River.

- Rising inflation rates led to substantial increases in costs for the materials and labor needed to implement, maintain and operate BMPs and monitoring networks.
- The COVID-19 pandemic impacted the ability to work directly with landowners and limited access to BMP implementation and verification.
- An outbreak of the avian flu in 2022 limited interaction with the agriculture community.

If off course, what is needed to accelerate progress?

- Define the vision for what represents an acceleration of progress above present rates.
- Greater focus on implementation and verification of nonpoint source practices and controls that result in on-the-ground nutrient reductions across the watershed to accelerate progress in agricultural and unregulated developed areas, and continuing to develop best practices ensuring all installed BMPs are captured and reported in appropriate jurisdictional tracking systems.
- Greater targeting of BMPs that are known to be more effective in reducing nutrient loads in areas that have the greatest impact. This likely includes better coordination around, and use of, existing targeting tools, as well as the evaluation of existing federal and state programs to improve efficiencies to better target and implement highly effective BMPs.
- Acknowledgement of programs that deliver high-quality results may improve awareness of strategies that already work effectively. However, new incentives and innovative approaches will be essential to accelerate the rate of progress above current levels, including: (a) improved coordination between implementation and monitoring partners/programs to understand how to adapt management approaches that increase efficiency to reduce nitrogen loads and restore water quality and living resources and (b) more discussion to promote success stories, share lessons learned and foster new innovative approaches (e.g., pay for performance).
- Continue to account for, and adapt to, using new data, analyses and science to increase the effectiveness of management efforts, such as creating new policies, developing effective incentive programs and actively pursuing adaptive management actions in timely, decision-making processes.
- Improve accounting for evolving climate change impacts and address the impacts that human growth and livestock increases have on our progress to achieving reduction goals.
- Government and non-government organizations implementing BMPs need support for workforce development, technical assistance, outreach, grant management, etc., in order to accommodate the increase in grant funding. The implementation of BMPs lags behind funding because there is a significant capacity gap in implementing projects.
- There is continual need to sustain and grow investments in monitoring networks to assess effectiveness of implementation, as well as the resulting impacts on nitrogen, phosphorus and sediment reduction targets, as well as the Bay response to dissolved oxygen, clarity/SAV and chlorophyll *a*.

Water Quality Standards Attainment and Monitoring Outcome

OUTLOOK ON COURSE

Outcome

Continually improve our capacity to monitor and assess the effects of the management actions being taken to implement the Bay TMDL and improve water quality. Use monitoring results to report annual progress being made in attaining water quality standards and trends in reducing nutrients and sediment in the watershed.

Status

The Water Quality Standards Attainment and Monitoring Outcome uses monitoring results to report annual progress made in attaining water quality standards for clean water goals defined by dissolved oxygen, water clarity (partly by underwater grass abundance) and chlorophyll a (a measure of algae growth) in the tidal waters of the Chesapeake Bay and its tidal tributaries; and status and trends in reducing nutrients and sediments delivered to the Chesapeake Bay from its surrounding watershed. During the 2019-2021 assessment period, an estimated 28.1% of the Chesapeake Bay and its tidal tributaries met clean water goals. Long-term monitoring results (1985—2022) reveal that the health of the Bay's water quality was estimated as achieving 25% of goal conditions in the mid-1980s and reached a high of 42% before the most recent decline, attributed to effects of pollution delivered with elevated river flows recorded in 2018, the highest on record since 1937, and additional high flows in 2019. In the watershed, less than 50% of the 123 non-tidal monitoring network stations show improving trends in the reduction of nitrogen and phosphorus loads for the period 2011-2020. The Chesapeake Bay Program has made significant new investments in monitoring infrastructure and analysis tools necessary to support water quality criteria assessments, but currently lacks the capacity to fully assess the attainment of tidal water quality standards. The Water Quality Standards Attainment and Monitoring Outcome is currently on course.

What has helped achieve success since 2014?

- The investment of Chesapeake Bay Program partners in retrieving, analyzing and communicating monitoring information. The prioritization of staff time also helped with these advances.
- *Enhancing the Chesapeake Bay Program Monitoring Networks* report and effort. The report outlined recommendations and provided cost estimates needed to address network gaps, data shortfalls, maintenance and enhancements of core networks, as well as development of new monitoring networks.
- Development of the Chesapeake Bay Program's Strategic Science and Research Framework to identify and assess short-and-long-term science needs of the partnership.
- The availability of robust, repeatable, approved and published data collection protocols, sound Quality Assurance/Quality Control procedures and associated documentation, and extensive data and metadata management to support the integrity of datasets.
- The work of the Chesapeake Monitoring Cooperative (CMC) in providing technical assistance to non-traditional monitoring partners that can be used to augment the state-collected datasets for regulatory assessments.
- Development of the tributary summaries to communicate changes in water quality patterns and factors affecting those changes to technical managers and planners.
- Progress in analyzing and communicating factors impacting water quality.

What challenges have hindered progress?

- Core monitoring funding did not adjust for inflation leading to reduced data collections.
- Historically, a lack of technological capacity to effectively collect the necessary water quality data across space, in sufficient temporal resolution, robust to Bay conditions and cost-effective, to create a full accounting of dissolved oxygen data necessary to assess water quality standards for the tidal Bay.
- A delay in in-person, streamside field audits due to the COVID-19 pandemic.
- A lack of complete criteria assessment protocols, that can be instituted in the near term, that make use of readily available continuous monitoring datasets.
- A lack of criteria assessment protocols that consider expanding impacts from climate change such as effects on dissolved oxygen saturation as a function of increased Bay water temperature.
- The use of watershed and Bay water quality monitoring results is limited in informing effective management decisions due to the time and effort it takes to accurately collect, process and analyze the data.
- Numeric thresholds for chlorophyll *a* that address aquatic life impacts presently only apply to seven of the 92 segments in Chesapeake Bay's tidal waters. An effective numeric translation of the narrative chlorophyll criteria based on harmful algal bloom characterization has not been developed by the partnership, even though states' water quality standards include this goal.
- Research and publications regarding new technologies are just beginning to address challenges that, once overcome, can support improved water quality assessment and tracking.
- *Enhancing the Chesapeake Bay Program Monitoring Networks: A Report to the Principals' Staff Committee* estimated that $5.4 million would be needed to fulfill the recommendations to enhance the Chesapeake Bay Program's core networks through a five-year period. High inflation and rising equipment prices have increased that number to over $6.8 million dollars. EPA, with contributions from NOAA and USGS have satisfied most of these recommendations for years one and two with the intent of utilizing IIJA funding to meet the recommendations for years three through five and maintain current capacity. Once IIJA funding is not available, which happens in year five, a new funding stream will be needed to support this highly valuable, robust monitoring network.

If off course, what is needed to continue current trajectory?

- Maintain support for development, testing and implementation of the new 4-dimensional (4D) interpolator, which will help assess dissolved oxygen criteria in the Bay.
- Developing, finalizing and approving new monitoring protocols that use newly available technologies including vertical water quality monitoring arrays, 4D interpolator, and satellite image data collection with Artificial Intelligence/Machine Learning algorithms supporting data access, image acquisition, data characterization and summary specifically for dissolved oxygen, SAV, chlorophyll *a* assessment.
- Support is needed for updated tidal Bay study design plans to chart the timing and location of deployments of new monitoring arrays and nearshore sensors.
- Greater support for analysis, dissemination and communication of reporting results and relevant lessons to diverse partners and audiences.

- Engage community science groups on monitoring that contributes to calibration and verification of aerial and satellite based SAV assessment, confirmation of harmful algal bloom locations and adds data supporting Bay health assessments of dissolved oxygen, temperature and salinity.
- Continued research is needed for characterizing harmful algal blooms with satellite-based resources in order to create effective translations of narrative chlorophyll a criterion into quantitative assessment criteria.

Toxic Contaminants Goal

CHESAPEAKE BAY WATERSHED AGREEMENT

"Ensure that the Bay and its rivers are free of effects of toxic contaminants on living resources and human health."

Photo by Will Parson/Chesapeake Bay Program

Toxic Contaminants Policy and Prevention Outcome

OUTLOOK OFF COURSE

Outcome

Continually improve practices and controls that reduce and prevent the effects of toxic contaminants below levels that harm aquatic systems and humans. Build on existing programs to reduce the amount and effects of polychlorinated biphenyls (PCBs) in the Bay and watershed. Use research findings to evaluate the implementation of additional policies, programs and practices for other contaminants that need to be further reduced or eliminated.

Status

The number of tidal segments in the Chesapeake Bay that are considered to be partially or fully impaired by toxic contaminants has seen an increase with each biennial data update from 2010-2018. In 2018, the estimate reached a high of 84%, but in 2020, the percentage saw a slight reduction. However, for the first time, the number included state-listed impairment for per-and-polyfluoroalkyl (PFAS). Chesapeake Bay Program partners are working to advance remediation efforts of polychlorinated biphenyls (PCBs) in local areas by expanding existing state programs to implement local Total Maximum Daily Loads (TMDLs). Despite these efforts, along with making upgrades to wastewater treatment plants and implementing land-based best management practices (BMPs), water quality in the Chesapeake Bay and its tidal tributaries continues to fall short of healthy standards. The Toxic Contaminants Policy and Prevention Outcome is off course.

What has helped achieve success since 2014?

- Municipal Separate Stormwater System (MS4) permits in some local areas in the watershed have begun to include requirements to identify and address PCB sources where there is a PCB TMDL.
- Ongoing sediment remediation activities in some parts of the watershed including the Anacostia, Patapsco and Middle rivers.
- The priority to upgrade wastewater treatment plants across the watershed.

What challenges have hindered progress?

- The lack of available staff time to participate in cross-jurisdiction PCB coordination.
- Studies on the efficiency of removing toxics through stormwater best management practices continue to be limited.
- The Bay TMDL does not include a requirement for WIP development to include co-benefits, including those related to toxic contaminant reductions.
- An appropriate method to link toxic contaminant BMP science with stakeholder planning tools has not been identified.
- The implementation of management actions under local TMDLs is limited and jurisdictions have to balance emphasis on PCBs with other pollutants of concern.
- Limited PCB monitoring data exists for unregulated and National Pollutant Discharge Elimination System (NPDES) regulated stormwater.

- The limited science and therefore lack of tools to estimate co-benefits of toxic contaminant removal with nutrient and sediment management actions limits progress.

If off course, what is needed to accelerate progress?

- The partnership needs to apply its collective expertise in pollutant based TMDLs to accelerate the reduction of bioavailable PCBs.
- An improved understanding of the presence of PCB s in biosolids is needed because of emerging information on the quantity that is being reapplied to the landscape through the application of biosolids.
- State and federal commitments to achieving PCB TMDLs needs to fall under an accountability and progress framework similar to that which is used for nitrogen, phosphorus and sediment.
- Jurisdiction coordination and sharing of best practices and interstate information is needed to advance PCB TMDLs.

Toxic Contaminants Research Outcome

OUTLOOK ON COURSE

Outcome

Continually increase our understanding of the impacts and mitigation options for toxic contaminants. Develop a research agenda and further characterize the occurrence, concentrations, sources and effects of mercury, polychlorinated biphenyls (PCBs) and other contaminants of emerging and widespread concern. In addition, identify which best management practices might provide multiple benefits of reducing nutrient and sediment pollution as well as toxic contaminants in waterways.

Status

Through cross-workgroup coordination, the Toxics Contaminants Workgroup has made significant progress on characterizing the occurrence, concentrations, sources and effects of mercury, PCBs and PFAS. Further projects are underway to characterize more regional occurrences and concentrations of other contaminants, such as pesticides. Recently, thanks to collaboration with stakeholders and the incorporation of local Total Maximum Daily Loads (TMDLs) into stormwater permits, progress has been made in addressing the impacts of mercury across the watershed, and other contaminants of interest at the local level. The workgroup has also improved understanding of the reduction of specific contaminants in response to some management actions, but further progress will require additional pollutant removal efficiency studies for stormwater BMPs. While this outcome lacks specific metrics for assessing progress, it has demonstrated increased understanding of the impacts and mitigation of a variety of toxic contaminants, along with established plans for further research, synthesis and information sharing. The Toxic Contaminants Research Outcome is on course and will be met by 2025.

What has helped achieve success since 2014?

- Research undertaken to understand per-and-polyfluoroalkyl substances (PFAS), microplastics and endocrine disrupting compounds in the Chesapeake Bay watershed.
- STAC workshops on emerging urban and agricultural contaminants including entire workshops on PFAS and microplastics in the Chesapeake watershed.
- Papers published by Chesapeake Bay Program partners (e.g., U.S. Geological Survey papers on PCBs in wastewater and biosolids, and occurrence of emerging contaminants in the Potomac and Shenandoah watersheds).

What challenges have hindered progress?

- The significant number of toxic contaminants that require research.
- The Bay TMDL does not include a requirement for WIP development to include co-benefits, including those related to toxic contaminant reductions.
- The limited science, and therefore lack of tools, to estimate co-benefits of toxic contaminant removal with nutrient and sediment management actions limits progress.
- Increased emphasis on PFAS has required some jurisdictions to reprioritize monitoring of other contaminants, such as PCBs.
- The absence of watershed-wide monitoring programs creates challenges with assessing status and trends regarding impact from toxic contaminants.
- Barriers to collaborative efforts with Chesapeake Bay Program GITs and workgroups that share interests with the Toxic Contaminants Workgroup exist due to the absence of watershed-wide prioritization of toxic contaminants. While the Toxic Contaminants Workgroup has made partial

success in partnering and collaborating with other workgroups, often these workgroups do not prioritize toxic contaminants in their work.

If on course, what is needed to continue the current trajectory?

- Allocation of federal and state resources to conduct research on sources, effects and allocation of monitoring dollars to measure occurrence and concentrations.
- Enhanced ability to communicate and engage the academic and monitoring communities on science-based questions the partnership needs answers to, and the resources needed to complete such research.
- Improved coordination across the partnership on the impact of toxic contaminants on the living resources of the Chesapeake Bay watershed.

Healthy Watersheds Goal

CHESAPEAKE BAY WATERSHED AGREEMENT

"Sustain state-identified healthy waters and watersheds recognized for their high quality and/or high ecological value."

Photo by Will Parson/Chesapeake Bay Program with aerial support by Southwings

Healthy Watersheds Outcome

Outcome
100 percent of state-identified currently healthy waters and watersheds remain healthy.

Status
The Healthy Watersheds Goal Implementation Team has developed the Chesapeake Healthy Watersheds Assessment framework to provide information on the current condition, level of protection and whether or not watershed catchments are potentially vulnerable or resilient. This helps jurisdictions to detect signals of change in state-identified healthy watersheds and beyond (provided the data to inform the assessment is updated over time). The Healthy Watersheds Outcome is currently uncertain.

What has helped achieve success since 2014?

- The development of new data and tools that help characterize and provide context for healthy watersheds, such as the Chesapeake Healthy Watersheds Assessment, Chesapeake Bay Phase 6 Land Use Viewer, Chesapeake Bay Watershed Data Dashboard, CBP Land Use/Land Cover Data Project, Land Use Methods and Metrics indicators on impervious cover and change, and the Chesapeake Bay Environmental Justice and Equity Dashboard.
- Projects that enhance focus on communications, such as the Chesapeake Forest Restoration Strategy, Conservation Land-Use Policy Toolkit and Resource Lands Assessment.
- Increasing knowledge at a local-scale through the development of such tools as the Local Government Guide to the Chesapeake Bay, Improved Technical Service Delivery to Landowners, Targeted Outreach for Green Infrastructure, Chesapeake Watershed Finance Intensive workshops, Maryland Healthy Watershed Assessment and the automation of Chesapeake Protected Lands data.

What challenges have hindered progress?

- The amount, type and way in which land use occurs is the biggest factor impacting healthy watersheds, particularly when it results in the loss, fragmentation or degradation of wetlands, forests and underwater grasses.
- A wide range of natural and human factors, such as climate change and invasive species.
- Ensuring local governments and decision-makers have the best available information—and understand it—to make land use decisions.
- Projects necessary for assessing the spectrum of watershed health and vulnerability on a Chesapeake Bay regional scale are in progress and are expected in late 2023.
- Lack of support, effective communication, coordination and leadership from Chesapeake Bay Program partners and the Healthy Watersheds GIT at the state and local level to protect healthy watersheds.
- The Healthy Watersheds GIT Coordinator has been leading a multiyear healthy watershed assessment effort due to limited state capacity to report whether we've lost or gained any healthy waters since the *Watershed Agreement* was signed.
    - Existing reporting through the integrated monitoring reports under section 305b and 303d of the Clean Water Act may help inform reporting and progress tracking.
    - It is the intent that the Chesapeake Healthy Watersheds Assessment be used as a proxy to determine the spectrum of watershed health and vulnerability and be updated regularly when new data is available.

- Measures to protect healthy watersheds vary across—and sometimes within—watershed jurisdictions.
- Meeting the Healthy Watersheds Outcome is dependent on the participation of related workgroups and their work/products.

If uncertain, what would need to be done before 2025 to classify as on course/off course and can this be done in that timeframe?

- Completion of the Chesapeake Healthy Watershed Assessment 2.0 in August 2023 and committing to update the assessment with the best available input data as available, and consider additional watersheds identified by the assessment, as healthy in addition to state-identified healthy watersheds, to augment state efforts.
- Continued development and application of the Land Use Method and Metrics Outcome and continued support for high resolution land use/land cover data.
- Investigation and development of indicator(s) related to watershed health and vulnerability.
- Update the Watershed Protection Map.
- Implementation of the Scientific and Technical Advisory Committee report, *Rising Watershed and Bay Water Temperatures—Ecological Implications and Management Responses*.
- Strengthen local commitment and capacity to understand the spectrum of watershed health and vulnerability and increase local capacity to protect healthy watersheds.

Stewardship Goal

CHESAPEAKE BAY WATERSHED AGREEMENT

"Increase the number and the diversity of local stewards and local governments that actively support and carry out the conservation and restoration activities that achieve healthy local streams, rivers and a vibrant Chesapeake Bay."

Photo by Will Parson/Chesapeake Bay Program

Stewardship Outcome

Outcome

Increase the number and diversity of trained and mobilized volunteers who have the knowledge and skills needed to enhance the health of their local watersheds. *

**In October 2022, the outcome was modified from the original language*.

Status

A quantitative target has not been established for the Stewardship Outcome. In 2021, a baseline indicator was developed using data from the 2017 Stewardship Index. Resources are now needed to prioritize programmatic efforts and build desired behaviors. The next survey to update the data is expected to be conducted in 2023 with data available in early spring 2024. Information on the extent of progress toward the Stewardship Outcome will be available after that analysis and comparison to 2017 data has been completed. If this shows an increase in stewardship, then the Outcome can be considered as on course, but it remains uncertain until this data is obtained.

What has helped achieve success since 2014?

- Multiple partners continue to implement on-the-ground stewardship activities, as well as launch regionally focused behavior change and social science projects.
- Efforts are underway to increase the capacity and application of social science approaches into the work of the Chesapeake Bay Program including the establishment of a new staff position to focus on social science.
- The launch of the Chesapeake Behavior Change website has enabled behavior change practitioners to learn more about behavior change methodology, access residential stewardship behavior adoption rates and learn more about stewardship campaigns in their watershed
- The partnership completed the *Enhancing Chesapeake Bay Partnership Activities by Integrating Social Science* report in 2023 which includes recommendations for fuller integration of social sciences within the partnership.
- Sharing stewardship data as an indicator for Chesapeake Bay health as part of the University of Maryland Center for Environmental Science Chesapeake Bay Report Card helps to bring attention to the importance of, and progress toward, stewardship within the watershed and highlights where we might focus attention to improve actions.

What challenges have hindered progress?

- It is necessary to collect information from stakeholders on their motivations, values and attitudes to design programs and policies that align with their needs, to be most effective. However, federal survey restrictions and financial constraints limit utilizing surveys to collect quantitative and qualitative data from stakeholders.
- The raw data collected in the Stewardship Index is too complex for most practitioners to use.
- More attention and resources are needed to focus on programmatic efforts and to get back on track with building desired behavior as guided by the standard ladder of engagement.
- Limited coordination with the Diversity Workgroup and other workgroups that rely on individual stewardship actions.

If uncertain, what would need to be done before 2025 to classify as on course/off course?

- Complete the second data collection of individual residential stewardship behaviors and data analysis to update stewardship indicators to show change in stewardship behaviors from 2017 to 2023.
- Increase capacity to implement social science assessment and build broader engagement in social sciences within the partnership by increasing funding for social science project implementation and additional social science staff expertise.
- Provide training and guidance resources, identify potential funding support and other means to build capacity among the partnership to engage in behavior change to advance goals that require individual action.
- Build relationships with trusted sources and behavior change practitioners that engage at the regional level, especially within localized environmental justice communities, to build their capacity to utilize effective behavior change campaigns.
- Continue to interact with other workgroups across the Chesapeake Bay Program that rely on individual actions to achieve outcomes.

Local Leadership Outcome

Outcome

Continually increase the knowledge and capacity of local officials on issues related to water resources and in the implementation of economic and policy incentives that will support local conservation actions.

Status

In 2022, a survey was distributed to local leaders across the Chesapeake Bay watershed and results showed that many officials have a solid understanding of watershed basics. However, many lack knowledge about water resource regulations, particularly at the federal level. Newly elected officials and those from smaller communities were the groups that indicated the greatest need for further knowledge and capacity on issues related to water resources. Since 2019, efforts by the Local Leadership Workgroup have engaged more than 2,000 local officials directly (through peer-to-peer learning exchanges, roundtable discussions and conference panels) and more than 20,000 indirectly (through newsletters, magazine articles and blogs). Additionally, over 900 local planners attended webinars and conference sessions, activating an additional network who can support the increase of local officials' knowledge and capacity. The Local Leadership Outcome is on course.

What has helped achieve success since 2014?

- The development of editable educational modules tailored toward issues relevant to local leaders.
- Enhanced partnerships with trusted sources, like local government associations, council of governments and local planner networks.
- The distribution and analysis of a baseline survey to expand understanding of local officials' knowledge and capacity for water resources.
- Expansion of peer-to-peer learning exchanges create an opportunity for experiential learning.

What challenges have hindered progress?

- Continued turnover of local officials makes engagement an ongoing challenge.
- Local governments lack the capacity to access state and federal funding.
- Existing local infrastructure was not designed to handle current and future climate change conditions, leaving local officials struggling to adapt.
- Labor shortages, capacity, supply chain issues and needed training are ongoing issues.

If on course, what is needed to continue current trajectory?

- Expanded use of editable educational modules, including tailoring at state and regional levels.
- Continued partnership with trusted sources, like local government associations, council of governments and local planner networks, with an additional focus on smaller, regional partners.
- Connecting local governments with technical assistance and capacity building opportunities.

Diversity Outcome

OUTLOOK OFF COURSE

Outcome

Identify stakeholder groups not currently represented in the leadership, decision-making or implementation of current conservation and restoration activities and create meaningful opportunities and programs to recruit and engage these groups in the partnership's efforts. *

**In January 2020, the outcome was modified from the original language.*

Status

The Diversity Outcome is off course in part due to a need for more timely, consistent and comprehensive analysis and tracking of diversity progress across the Chesapeake Bay Program. The current indicator is inward facing, looking at the makeup of the Chesapeake Bay Program staff and leadership. In 2016, 2019 and 2022, a diversity survey was disseminated to the partnership, with intent to continue every three years. The most recent survey experienced a larger pool of voluntary responses overall and indicated a slight increase in the percentage of respondents who self-identified as people of color in the Chesapeake Bay Program compared to previous years; however, the data shows no statistically significant change in racial or ethnic diversity among the three surveys, averaging slightly less than 15%. The Workgroup strives to improve accuracy of the measurement method including reviewing the survey tool as well as the process for collecting and analyzing the data.

Based on the most recent analysis, we have learned that individuals recruited to partnership roles in the last 10 years are twice as likely to be people of color than those who have been involved for 11 years or more. That the LGBTQIA+ population is more than twice as prevalent in the last five years' recruits as it was in older cohorts. Finally, female representation has increased over time; accounting consistently for more than half of participants recruited over the past 20 years.

A full understanding of outcome achievement requires the development of additional indicators that look at other important factors. Both the Diversity Outcome specifically, and the Stewardship Goal more broadly, include involvement of other stakeholders and members of the public in decision-making and carrying out conservation and restoration activities. Progress toward this key component has not been tracked using a numeric indicator, therefore additional metric(s) should be explored for the future, determining an effective methodology for measuring success toward the overall intent of the goal and outcome. The Diversity Outcome is off course.

What has helped achieve success since 2014?

- Development of the *Diversity, Equity, Inclusion and Justice (DEIJ) Strategy* and *Implementation Plan*.
- The signing of the *DEIJ Directive* by the Chesapeake Executive Council in 2020.
- Increasing awareness of stakeholder perceptions and needs through internal and GIT funded projects.
- Significant changes in DEIJ policy at the federal and state levels.
- Incorporation of a diversity question in the Strategy Review System materials that will ensure all GITs and workgroups are taking DEIJ considerations into account in their work.
- DEIJ considerations have been incorporated into funding opportunities through the Chesapeake Bay Program along with several other federal and jurisdictional grant programs. The Diversity Workgroup facilitated a series of workshops in 2023 to further share best practices among funders and to foster communication among funders and community-facing grant applicants.

- Establishment of several Memorandum of Understanding (MOUs) with Historically Black Colleges and Universities (HBCUs) in the region to provide ready means for working together on research, workforce development and other opportunities.
- Creation of the C-StREAM internship program with the Chesapeake Research Consortium, to encourage and support underrepresented students interested in environmental careers.
- In 2022, the Chesapeake Bay Program Governance Document was revised to provide more guidance on DEIJ considerations when making appointments to participate in the Program at various levels of responsibility.
- Ongoing training, workshops, webinars and peer guidance across the partnership.

What challenges have hindered progress?

- Turnover in staffing, leadership and membership of the Diversity Workgroup.
- The indicator is inadequate, relying on self-reporting and only measures part of the outcome.
- Survey results are not readily actionable due to lack of alignment with DEIJ Implementation Plan or a clear organizational structure where impact can be made.
- The Diversity Workgroup operates with limited resources, capacity and authority; inability to effectively track recruitment and retention data; and inability to address structural changes necessary to implement DEIJ best practices—especially regarding hiring practices and pathways. With no means for substantive influence on Chesapeake Bay Program partners' policies and operations, the Workgroup can only offer guidance.
- Lack of understanding and guidance about how underrepresented communities and organizations can participate in the Chesapeake Bay Program meaningfully and effectively, and what is appropriate within the structure of the partnership for engaging with community-based organizations.
- Chesapeake Bay Program partners lack experience and knowledge to incorporate DEIJ principles into their work.
- Disruptions and subsequent work life changes due to the COVID-19 pandemic.

If off course, what is needed to accelerate progress?

- Clarity on the functions of the Chesapeake Bay Program from leadership, along with a skilled analysis of opportunities for systemic change within the partnership to best include and amplify diverse voices and participants in Chesapeake Bay Program work.
- Commitment of action from Chesapeake Bay Program leaders on a short set of recommended high-impact DEIJ actions for beyond 2025 regarding hiring and other practices (to be identified).
- Built-in, ongoing guidance on DEIJ practices across the partnership—in the form of at least one position dedicated to serving as an internal "consultant" to help steer GITs and Workgroups, assure continual training for staff and partners and lead development of improved systemic processes.
- Coordinated demographic data collection from signatories and mandated employee surveys similar to the Federal Employee Viewpoint Survey.
- Reevaluation of Diversity Workgroup structure and capability to achieve desired outcomes within current limitations.
- Development of green job initiatives to develop/enhance DEIJ participation in the green economy (e.g., wetlands, planting crews, BMP inspections and maintenance).

Land Conservation Goal

CHESAPEAKE BAY WATERSHED AGREEMENT

"Conserve treasured landscapes in order to maintain water quality and habitat; sustain working forests, farms and maritime communities; and conserve lands of cultural, indigenous and community value."

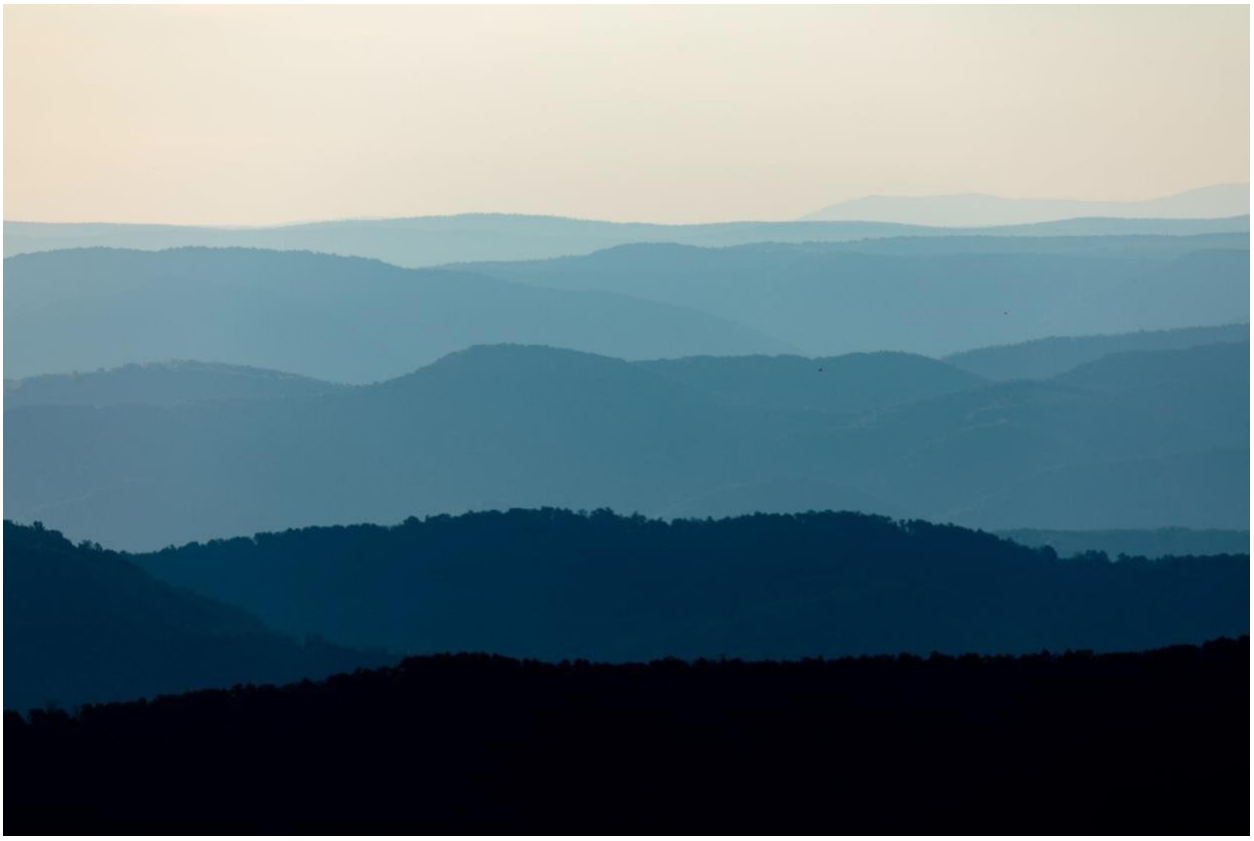

Photo by Will Parson/Chesapeake Bay Program

Protected Lands Outcome

OUTLOOK ON COURSE

Outcome

By 2025, protect an additional two million acres of lands throughout the watershed—currently identified as high-conservation priorities at the federal, state or local level—including 225,000 acres of wetlands and 695,000 acres of forest land of highest value for maintaining water quality.

Status

Through 2022, nearly 1.64 million of acres of land has been permanently protected across the Chesapeake Bay watershed since 2010. This marks an achievement of 82% of the Protected Lands Outcome target. In 2021 the Chesapeake Executive Council Directive No. 21-1: Collective Action for Climate Change called for protecting 30% of the watershed by 2030. This represents an additional 2.4 million acres above the 2025 goal. Work continues to strive for 30% as an ambitious target. The Protected Lands Outcome is on course and will be met by 2025.

What has helped achieve success since 2014?

- A strong and growing network of conservation-minded partners through the Chesapeake Conservation Partnership.
- Voluntary jurisdictional coordination with federal agencies on land conservation priorities has increased steadily with the implementation of Executive Order 13508: Chesapeake Protection and Restoration.
- Increased funding from the private sector, including donors, foundations and landowners, has presented an enhanced opportunity for stewardship. In recent years there has also been an increase in federal funding that supports land conservation.
- A rise in the protection of culturally valuable lands.
- Articulating conservation values through the lens of health, safety and welfare has helped to increase public support.

What challenges have hindered progress?

- Definitional, attitudinal and political messaging.
- Difficulties with the generational transfers of land ownership.
- Limited personnel and programmatic capacity to administer and manage funding for land conservation. The field is also experiencing organizational turnover and overall workforce development needs.
- Competition, on a nationwide scale, for federal and state funding for land conservation.
- As populations have increased, so have development pressures and competition from new transportation and energy infrastructure including industrial solar.
- Climate change has impacted ecologically and culturally significant places, as well as shifted native species patterns and contributed to land loss through erosion, flooding and increased precipitation.

If on course, what is needed to continue current trajectory?

- Managing and leveraging of diverse funding pools.
- Integration and coordination of conservation data.
- Maintaining the capacity level of conservation land trusts.
- Develop conservation actions through the two new Virginia Sentinel Landscapes designated in 2023.

Land Use Methods and Metrics Development Outcome

OUTLOOK ON COURSE

Outcome

Continually improve our knowledge of land conversion and the associated impacts throughout the watershed. By December 2021, develop a watershed-wide methodology and local-level metrics for characterizing the rate of farmland, forest and wetland conversion, measuring the extent and rate of change in impervious surface coverage and quantifying the potential impacts of land conversion to water quality, healthy watersheds and communities. Launch a public awareness campaign to share this information with local governments, elected officials and stakeholders. *

**In January 2020, the outcome was modified from the original language*.

Status

The Land Use Methods and Metrics Development Outcome developed an impervious surface cover indicator in 2023, describing the amount of the watershed that is covered by impervious surfaces, the changes in impervious cover time and the types of impervious cover that contribute most to land changes. The metrics described in outcome language will be reassessed in 2024 using data from 2021-2022. The Land Use Methods and Metrics Outcome is on course.

What has helped achieve success since 2014?

- Continued funding support for monitoring land use and land cover metrics.
- Development of the high-resolution land use and land cover datasets and change tool.
- Close coordination with other outcomes, workgroups and advisory committees.

What challenges have hindered progress?

- Translating the land use and land cover change data into a form that is understood and actionable for communities.
- Continually updating existing high-resolution land cover and land use datasets during each four-year remapping phase.
- The need for a methodology to quantify the impacts of changes in land use on communities and the environment.
- The current strategy for reducing the rate of land conservation through land use planning is passive and lacks sufficient incentives.

If on course, what is needed to continue current trajectory?

- Funding for a new cooperative agreement and Chesapeake Bay Program staff to continue robust land cover, land use monitoring and develop change products.
- Clear charge for the Land Use Workgroup and/or other appropriate workgroups to directly work with pilot communities (e.g., local governments) to develop meaningful uses for land use data in local planning and stormwater management.
- Direct communication with jurisdictions on how they can incentivize land use planning at the state level using land use data.
- Better identification of the cross connections with other outcomes.

Land Use Options Evaluations Outcome

Outcome

By the end of 2017, with the direct involvement of local governments or their representatives, evaluate policy options, incentives and planning tools that could assist them in continually improving their capacity to reduce the rate of conversion of agricultural lands, forests and wetlands as well as the rate of changing landscapes from more natural lands that soak up pollutants to those that are paved over, hardscaped or otherwise impervious. Strategies should be developed for supporting local governments' and others' efforts in reducing these rates by 2025 and beyond.

Status

This outcome is focused on developing and implementing strategies to increase the capacity of local governments and others to reduce land conversion of natural land cover types to impervious surfaces. Various efforts listed in the below section have helped this outcome to progress. However, with this qualitative outcome, there are challenges in assessing the degree to which efforts are helping to reduce the rate of land conversion, but the development of the local government engagement strategy and the communication of available land use data and tools are expected to lead toward meeting the outcome. The Land Use Options Evaluation Outcome is on course and will be met by 2025.

What has helped achieve success since 2014?

- Collaboration on projects and products with related workgroups.
- The number of non-governmental organizations that are focused on future land changes.
- Development of high-resolution land use/land cover and change products help to characterize the extent and rate of land use change.
- Existing policy drivers, such as the Bay TMDL and Executive Order 13508 Chesapeake Bay Protection and Restoration.

What challenges have hindered progress?

- Lack of coordination and clear communication with Chesapeake Bay Program partners in conveying the need and purpose in communicating and engaging with local planners.
- The need to continue to work with professional communicators and subject matter experts to translate data and analysis into materials and resources for those to utilize at the local and jurisdictional level to influence the rate of land conversion to development, especially considering population and land use change trends.
- Efforts to minimize future land change impacts are sometimes neglected given the need to reduce effects from existing land conversion.
- The need for better information on the benefits of land conservation and smart growth in language that is compelling for local governments and outlines the positive impacts on communities.
- Competition with economic development objectives.
- Local governments' need for technical assistance.
- Insufficient funding to complete the evaluation component of this outcome.

If on course, what is needed to continue current trajectory?

- An upcoming Goal Implementation Team funding project to help make land use and land use change data actionable and operational at the community level in areas vulnerable to habitat loss, will help engage with local and state organizations.
- Several obstacles remain in effectively communicating and illustrating the application of resources. While staff have been able to manage and champion land use resources, tools and information, there is more need to communicate how planning for and protecting stable hydrology will reduce erosion and its associated sediment and nutrients to downstream areas, including the Bay, while also reducing local flooding and improving drinking water quality and quantity. A more coordinated effort is needed, including:
    - A quantified cost analysis of the long-term economic effects of property damage from flooding along with increased drinking water treatment costs from altered hydrology due to land use change is needed so that people can get an idea of why this is important.
    - A benefit analysis of the preservation and restoration of green infrastructure such as floodplain connectivity and wetlands as well as recharge areas that protect and maintain stable hydrology and clean, full aquifers through time. Ultimately, our goal should be to inform land use planning and conservation decisions with information that will engender more sustainable decisions.
- Additional needs in communication, translation and engagement:
    - Translate, format, package and flow information through to trusted sources.
    - Determine how to effectively engage locals directly.
    - Improve how DEIJ and climate considerations are accounted for in the Land Use Options Evaluation Outcome.

Public Access Goal

CHESAPEAKE BAY WATERSHED AGREEMENT

"Expand public access to the Bay and its tributaries through existing and new local, state and federal parks, refuges, reserves, trails and partner sites."

Photo by Will Parson/Chesapeake Bay Program

Public Access Outcome

OUTLOOK ON COURSE

Outcome
By 2025, add 300 new public access sites, with a strong emphasis on providing opportunities for boating, swimming and fishing, where feasible.

Status
Between 2011 and 2022, partners have opened an average of approximately 20 sites per year, bringing the total of new public access sites in the watershed to 248. This marks a 83% achievement of the goal to add 300 new public access sites by 2025. The long-term data trend has been positive, but public access site development remains largely opportunistic. There are limited sources of dedicated funding for new access projects and the accomplishments of the past may not predict future trajectory. The Public Access Outcome is on course and will be met by 2025.

What has helped achieve success since 2014?

- The committed efforts of the jurisdictions, partners and members of the Public Access Workgroup has ensured progress of the public access goal thus far.
- The sharing of best practices and learning among workgroup members.
- The creation of programs and passage of legislation that highlights outdoor recreation and infrastructure investment has increased public awareness of the importance of public water access.
- A recent GIT funded project to understand the benefits and barriers to public access.

What challenges have hindered progress?

- Increased demand for public access sites has highlighted the need for increased ADA accessibility and resulted in the overuse and degradation of some sites, as well as delayed maintenance and construction at others.
- Creation of new sites is often delayed in favor of addressing a backlog of maintenance at existing sites.
- Funding for operations and maintenance of existing public access sites is limited and most federal and state grant programs require matching funds, which smaller jurisdictions struggle to secure.
- Inflation and supply chain issues have caused the cost of materials and labor to rise.
- Delayed maintenance and environmental impacts have negatively impacted some existing public access sites.
- The workgroup has limited influence to change available funding or budgets for projects.

If on course, what is needed to continue current trajectory?

- Continued commitment by the jurisdictions and federal agencies.
- The creation of 16 new sites per year would ensure that the 2025 target is met.
- To accelerate progress, additional funding, staffing and planning would be required.

Environmental Literacy Goal

CHESAPEAKE BAY WATERSHED AGREEMENT

"Enable every student in the region to graduate with the knowledge and skills to act responsibly to protect and restore their local watershed."

Photo by Will Parson/Chesapeake Bay Program

Student Outcome

Outcome

Continually increase students' age-appropriate understanding of the watershed through participation in teacher-supported meaningful watershed educational experiences and rigorous, inquiry-based instruction, with a target of at least one meaningful watershed educational experience in elementary, middle and high school depending on available resources.

Status

The Environmental Literacy Indicator Tool (ELIT) was distributed in 2015, 2017, 2019 and 2022 to collect data related to student participation in Meaningful Watershed Educational Experiences (MWEEs). The COVID-19 pandemic had a tremendous impact on K-12 education, and implications related to significant learning loss and social-emotional setbacks are still being felt across school districts. Data collection scheduled for 2021 instead took place in 2022 to assess where the region stands in the wake of these impacts on education systems. The status of the 2022 ELIT Report shows a decline in system-wide MWEEs across the board. The Student Outcome is off course.

- Twenty-seven percent of responding school districts in the watershed have a MWEE in place throughout the school system (system-wide MWEE) at the elementary grade level and 39% have some MWEEs (not yet system-wide). There has been a trend of progressive increases in the number of school districts reporting that no MWEEs were available in the elementary level (18% in 2015 to 39% in 2022).
- Twenty-eight percent of responding school districts in the watershed have system-wide MWEEs in place at middle school grade levels and 42% have some MWEEs (not yet system-wide). Since 2015, there has been a progressive decrease in the rate of system wide MWEEs (43% in 2015 to 42% in 2022).
- Twenty-two percent of responding school districts in the watershed have system-wide MWEEs in place at high school grade levels and 48% have some MWEEs (not yet system-wide).

What has helped achieve success since 2014?

- New tools have been developed to support school districts and environmental literacy providers (environmental educators not part of the school system who support school programming) in developing their understanding for designing and implementing MWEEs, including: the revised Educator's Guide to the MWEE, Environmental Literacy Model Tool and Environmental Literacy Audit Tool, a series of state-specific versions of the Facilitator's Guide to MWEE Training and a MWEE 101 and 201 online course with continued learning credits. Specifically, more than 1,600 educators have taken the MWEE 101 course.
- A community of practice for MWEE practitioners started in 2019 and has brought together educators for more than 30 conversations and webinars sharing best practices for MWEE implementation.
- Federal, regional and state grant programs have adopted the MWEE Guide and other key MWEE resources within their funding specifications (Notice of Funding Opportunities and Request for Proposals) which has strengthened understanding of MWEEs for the applicants and improved their proposed MWEE efforts.

- Biennial Environmental Literacy Forums have brought together nearly hundreds of practitioners to train on resources such as the Facilitator's Guide to MWEE Training and the District Environmental Literacy Planning Toolkit.

What challenges have hindered progress?

- Teacher and administrator turnover is a challenge and has been exacerbated by the exodus of teaching professionals during and after the COVID-19 upheaval of the educational system.
- COVID-19 impeded efforts to implement MWEEs with full fidelity and drew time and resources away from environmental education programming.
- COVID-19 also limited progress in working with other systems of influence including pre-service teacher programs, district and school administrator professional development and superintendent awareness and advocacy, among others, as competing challenges put a damper on our ability to attract the attention of those in educational leadership positions and higher education.
- Low availability of sustainable funding mechanisms to support MWEEs beyond grant funding.
- An increasing emphasis on math, reading and English language arts in elementary schools has diminished science and social studies education, which is where MWEEs often occur. This trend was exacerbated by COVID-19 when test scores revealed significant learning loss in these foundational subject areas.

If off course, what is needed to accelerate progress?

- Identification of an established program leader in each school district and community partnerships with environmental education providers (identified as a best practice 2022 ELIT report).
- Continued funding for NOAA's Bay Watershed Education and Training (B-WET) Program, Chesapeake Bay Trust's Environmental Education Grant Program and other state/regional funding to catalyze the development of MWEEs. Additionally, models of school districts identifying sustainable funding sources to support MWEEs long-term are needed.
- Activation of intra-state networks and non-formal partners in reaching districts that currently have no MWEEs or are not reporting on ELIT.
- Continued support from state leaders in elevating MWEEs, as exemplified by Pennsylvania in the re-write and explicit inclusion of MWEEs in their new learning standards regime.
- A renewed emphasis on aligning the environmental education community towards MWEE programming that directly meets the needs of school districts.

Sustainable Schools Outcome

OUTLOOK ON COURSE

Outcome
Continually increase the number of schools in the region that reduce the impact of their buildings and grounds on their local watershed, environment and human health through best practices, including student-led protection and restoration projects.

Status
Certified sustainable schools include public and charter schools within the Chesapeake Bay watershed that have been recognized as sustainable by the following programs: U.S. Green Ribbon Schools, National Wildlife Federation Eco-Schools USA (Bronze, Silver and Green Flag status), Maryland Green Schools, Pennsylvania Pathways to Green Schools and Virginia Naturally Schools. The most recent data from 2021, shows that 597 schools in the watershed are currently certified by one of these programs. This represents a 19% increase above the 2015 baseline of 501 schools. However, this data shows a decrease from the 2019 reporting. This is speculated to be due to lack of recertification paperwork being submitted during the COVID-19 pandemic and less project work being possible during prolonged school shutdowns.

While this outcome does not have a specific numerical target to meet by 2025, it is anticipated that the number of sustainable schools throughout the watershed will continue to exceed the 2015 baseline. The Sustainable Schools Outcome is on course.

What has helped achieve success since 2014?

- COVID relief funding provided additional grants to school districts to invest in outdoor learning infrastructure (e.g., Queen Anne's County Public Schools).
- Connecting sustainable school initiatives to Meaningful Watershed Educational Experience efforts to increase funding available to support projects.
- Connecting facilities managers to their curriculum specialist counterparts in school districts to better connect school operations to student learning.
- A subset of Environmental Literacy Workgroup members gathered to coordinate and share lessons learned at the regional level about sustainable school efforts. Post-COVID, reconvening of a rejuvenated Sustainable Schools team and recruitment of additional partners dedicated to the outcome.
- Connecting sustainable school conversations to emerging priorities around climate action in districts where this is a priority.

What challenges have hindered progress?

- Sustainability projects are not typically seen as necessary, and their implementation is continually slowed by competing priorities. Student involvement in such projects can be used to address the learning losses associated with the COVID-19 pandemic but are often seen as superfluous.
- The educational community was negatively impacted by the COVID-19 pandemic, which continues to affect school operations and staff turnover.
- In an effort to address the health concerns associated with the COVID-19 pandemic, previously reusable items (e.g., lunch trays and water bottles) were replaced with disposable versions, representing a setback to sustainable practices.

- Relative to other environmental literacy outcomes, the implementation of sustainable school actions has received somewhat limited workgroup attention, resulting in slower progress since the last reporting cycle. Those who provide most attention to these actions are more likely specialists representing green schools-type programs. Steps are being taken to remedy this, including the establishment of a reinvigorated Sustainable Schools team and the 2023 Environmental Literacy Leadership Summit will have sustainable schools as a main topic of focus.
- There are ongoing challenges involving states and counties that do not already have an interest in sustainable schools. As is the trend across the Chesapeake Bay Program, the vast majority of progress on sustainable schools has been achieved in relatively limited areas of Maryland and Virginia.

If on course, what is needed to continue current trajectory?

- Increase focus on "High Impact Actions" that will more dramatically reduce harmful effects to the environment. This includes, where possible:
    - Transitioning to clean energy to reduce greenhouse gas emissions.
    - Implementing environmentally beneficial landscaping techniques to reduce pesticide and fertilizer use.
    - Increasing tree canopy cover and natural grounds while reducing artificial surfaces to improve sustainability and stormwater infiltration, while reducing heat of play and learning areas.
- Focus the next biennial Environmental Literacy Leadership Summit, planned for fall 2023, on sustainable schools as the main topic. This will bring the topic to front of mind for stakeholders and provide a means for collaboration where best practices, success stories and critical information can be shared to advance the outcome.
- Actively increase involvement of facilities managers, who are best equipped to address the "High Impact Actions."
- Increasing Chesapeake Bay Program involvement in existing sustainable school organizations and efforts. Assist in the proliferation of existing and emerging sustainable school plans and best practices.
- Find new strategies to engage geographic areas that are currently underrepresented in sustainable school conversations.

Environmental Literacy Planning Outcome

Outcome
Each participating Bay jurisdiction should develop a comprehensive and systemic approach to environmental literacy for all students in the region that includes policies, practices and voluntary metrics that support the environmental literacy Goals and Outcomes of this Agreement.

Status
The Environmental Literacy Indicator Tool (ELIT) was distributed watershed-wide in 2015, 2017, 2019 and 2022 to collect data related to school district preparedness to implement environmental education. The COVID-19 pandemic had a tremendous impact on K-12 education and implications related to significant learning loss and social-emotional setbacks are still being felt across school districts. Data collection scheduled for 2021 instead took place in 2022 to assess where the region stands in the wake of these impacts on education systems. The percentage of Local Education Agencies (LEAs) scoring as well prepared to implement environmental education decreased slightly in 2022, down to 17% from a height of 20% in 2019. Previously, this indicator had shown steady increases from 2015 to 2019, however there remains an overall positive trend between the 2015 baseline and the current 2022 numbers.

In the watershed, the majority of responding LEAs (56%) are somewhat prepared to implement high quality environmental education and an additional 17% of districts are well prepared. Preparedness varied a great deal between the states with Maryland having majority of its districts scoring as well prepared (67%). Evidence for classifying this outcome as "on course" also lies in looking at jurisdictional trends in and outside of the watershed. Standards set at the state level impact preparedness at the regional level, and most states (Maryland, Virginia, and D.C.) are either holding steady or have continued to show positive trends. Pennsylvania, though showing a decrease in 2022, showed an overall increase in preparedness amongst LEAs that had also responded to the survey in 2019, indicating that new participation in the survey may be contributing to more unprepared LEAs in the latest results.
The Environmental Literacy Planning Outcome is on course and will be met by 2025.

What has helped achieve success since 2014?

- Aligned state efforts have been key to advancing environmental literacy. Major efforts include the incorporation of environmental literacy (including elements of the Meaningful Watershed Educational Experience framework) in the new Pennsylvania learning standards for science; the completion of a new Environmental Literacy Framework for Maryland; and the new Seal for Excellence for Science and the Environment in Virginia.
- The National Oceanic and Atmospheric Administration (NOAA), Pisces Foundation and Chesapeake Bay Trust have supported the development of strong, intentional environmental literacy networks in each state that works towards meeting state priorities, including the outcomes of the *Chesapeake Bay Watershed Agreement*. These state networks are connected at the watershed level through the Regional Outdoor Learning Network.
- The biennial Chesapeake Bay Environmental Literacy Leadership Summit allows education leaders from around the watershed to share environmental literacy planning successes and challenges from their respective states. The 2021 summit focused on the five dual themes of increasing climate education and ensuring equity in environmental education. One key to

success has been having a Principals' Staff Committee (PSC)-level state partner work with the Chesapeake Bay Program to host the event; this ensures alignment with state priorities.
- Development of the District Environmental Literacy Planning Toolkit which houses a set of materials and best practices to aid school district efforts to create equitable, sustainable and systemic environmental literacy programs.
- Biennial Environmental Literacy Forums that train environmental educators and school district leaders in key environmental literacy principles using new tools and guides.
- Development of state-specific guides, templates and examples for educator professional development, district level environmental literacy plans and MWEE programming.
- Training series with non-profit partners who serve as "network weavers" in the states, working with school districts to facilitate the development of environmental literacy plans and programming.

What challenges have hindered progress?

- The focus of administrators has been centered on the continued challenges related to Covid-19 recovery, including learning loss and social-emotional problems in students.
- Teacher and administrator turnover is a challenge and has been exacerbated by the exodus of teaching professionals during and after the COVID-19 upheaval of the educational system.
- COVID-19 limited district and school administrator professional development and superintendent awareness and advocacy, as competing challenges limited our ability to attract the attention of those in educational leadership positions and higher education.
- Lack of dedicated school district personnel focused on the development and implementation of environmental literacy programs.

What is needed to continue current trajectory?

- Identification of an established program leader in each school district and community partnerships with environmental education providers (identified as best practices in the 2022 ELIT report).
- Growth of state environmental literacy networks.
- Continued support from PSC-level state partners to work with the Chesapeake Bay Program to host the biennial Chesapeake Bay Environmental Literacy Leadership Summit.
- Sustained funding for the Chesapeake Bay Trust Environmental Education Grant Program, National Oceanic and Atmospheric Administration's Bay Watershed Education and Training (B-WET) Program, and related state funding programs to support school district efforts to develop and implement environmental literacy programming and fund program implementation.

Climate Resiliency Goal

CHESAPEAKE BAY WATERSHED AGREEMENT

"Increase the resiliency of the Chesapeake Bay watershed, including its living resources, habitats, public infrastructure and communities, to withstand adverse impacts from changing environmental and climate conditions."

Photo by Will Parson/Chesapeake Bay Program

Climate Adaptation Outcome

Outcome

Continually pursue, design and construct restoration and protection projects to enhance the resiliency of Bay and aquatic ecosystems from the impacts of coastal erosion, coastal flooding, more intense and more frequent storms and sea level rise.

Status

While new restoration and protection projects are being developed and implemented, metrics for tracking and measuring the success of these projects to enhance resiliency (e.g., carbon sequestration, flood reduction, shoreline protection, habitat preservation) to coastal climate change impacts have not yet been developed. Given the urgency demonstrated by climate change trends and projections, it is critical to establish metrics to measure resilience successes to both assess progress toward this outcome and inform future management decisions. Past efforts to track progress in improving resilience have been too broad in scope, and we still need research and methodologies that support metric development for measuring resilience effectiveness in both the short- and long-term. Currently, the Climate Resiliency Workgroup has narrowed the scope of their work to focus on nature-based strategies (e.g., living shorelines, tidal wetlands, forest buffers); the workgroup assists with bringing partners together to develop adaptation projects, targeting project locations using the best available data and connecting partners with funding for both project design and implementation. In their 2023-2024 Logic and Action Plan, the workgroup prioritized supporting efforts to identify strategies to track progress in enhancing resiliency of the Bay and aquatic ecosystems from climate change impacts, which includes learning how partners are defining resiliency and measuring the efficacy of nature-based strategies. The workgroup must define what it means to enhance resiliency through nature-based strategies and develop methods and metrics to track success of these strategies. The Climate Adaptation Outcome is off course.

What has helped achieve success since 2014?

- Executive Order 14008: *Tackling the Climate Crisis at Home and Abroad* and the requirement to develop federal agency climate resilience goals.
- Collaboration with other Chesapeake Bay Program GITs and workgroups on projects and efforts.
- Narrowing the scope of the outcome to focus on nature-based adaptation strategies (e.g., marsh migration, green/natural infrastructure).
- Federal, state, nonprofits and academic partners involved in the partnership are actively generating prominent climate change information through funding and implementing climate resilience research and projects.
- Many of the jurisdictions and federal agencies in the watershed have developed their own standalone climate change adaptation plans and resilience metrics or have established advisory bodies to guide efforts and oversee projects.
- Local governments and communities are employing new and creative strategies to further adaptation opportunities.

What challenges have hindered progress?

- There is a lack of understanding or agreement from stakeholders on what constitutes resiliency, including what key actions to take to support management approaches.
- A variety of stakeholders have differing goals, making it challenging to have adequate resources to facilitate meaningful connections across all groups.
- There is a lack of capacity and dedicated human capital to fill research gaps, translate science, develop proposals and manage projects, and incorporate climate change considerations into programs, plans, processes or projects.
- The ability of governments and institutions to respond to climate change is still limited by legislature, policy, regulations and other authorities.
- Since there is variability across the watershed in how different systems respond to resiliency efforts, it is challenging to develop consistent guidance.

If off course, what is needed to accelerate progress?

This outcome is currently categorized as off-course because the way it is currently written is unattainable to be met by 2025 and should be refined for beyond 2025. The following bullets will assist in narrowing the scope of the outcome so that it is trackable and manageable within the purview of the Chesapeake Bay Program's current natural resource goals, however we are recommending that the Beyond 2025 discussions focus on updating the outcome language to make it attainable:

- Establish common definitions, metrics and monitoring for climate adaptation to account for and evaluate the efficacy of restoration and adaptation projects related to natural resource goals. When appropriate, align metrics to the co-benefits of BMPs that count toward Bay TMDL nutrient and sediment reductions.
- Implement strategic targeting of adaptation projects based on maximizing benefits and persistence/longevity. Build in use of the Chesapeake Bay Environmental Justice and Equity Dashboard to prioritize vulnerable communities that are disproportionately affected by environmental, health and climate risks (e.g., abundant and pervasive fossil fuel toxic contamination of air, water, soil, urban heat islands, flooding and increased exposure to greater amounts and intensities of runoff).
- Explore options for a climate resilience adaptation clearinghouse for the Chesapeake Bay that would include educational fact sheets, training materials, planning and assessment tools, climate adaptation efforts and strategies currently in place, grant opportunities as a resource for various stakeholders (e.g., federal, state and local governments, non-profit organizations, academia) to promote and track climate adaptation work.
- Provide technical assistance, community engagement and capacity building to assist Bay partners in developing large-scale and/or high impact restoration and protection projects that can enhance resiliency of the Bay and aquatic ecosystems from coastal climate change impacts.
- Work with the Strategic Engagement Team to survey local governments on their perspectives, efforts, barriers and needs in addressing climate change and sea level rise.

Climate Monitoring and Assessment Outcome

OUTLOOK ON COURSE

Outcome
Continually monitor and assess the trends and likely impacts of changing climatic and sea level conditions on the Chesapeake Bay ecosystem, including the effectiveness of restoration and protection policies, programs and projects.

Status
Progress continues on assessing climate change trends related to physical changes, including temperature, precipitation and sea level rise, in connection with programs. The language in this outcome does not provide a target or goal to meet. Furthermore, climate change is an ever-evolving issue, with new challenges and opportunities presenting themselves continually. As such, the Climate Resiliency Workgroup is focused on continually exploring new ways to monitor and assess the trends and impacts of climate change and will be faced with new challenges and impediments to overcome, so that we can continue to provide the Chesapeake Bay Program and our partners with data and information to assist in building climate resilience. In order for the outcome to stay on course, these recommendations require review and implementation by their respective partner programs (e.g., state natural resource agencies, federal agencies, local governments). The Climate Monitoring and Assessment Outcome is on course.

What has helped achieve success since 2014?

- Collaboration between Chesapeake Bay Program GITs and workgroups on incorporating climate change considerations in addressing the impacts of climate change on water quality, habitats and living resource outcomes.
- The Chesapeake Bay Program has an abundance of environmental monitoring resources that provide data to track climate change impacts, with two climate change Indicators (i.e., total annual precipitation and average air temperature) regularly maintained and updated on Chesapeake Progress.
- The Chesapeake Bay Program Modeling Team, with advisory support from the Climate Resiliency Workgroup and STAC, incorporated climate change considerations and projections into the Chesapeake Bay Program's suite of modeling tools. The modeled outputs provide insights into climate change effects on nutrient and suspended sediment loads in the Bay and provide information on how to accommodate the projected changes. The jurisdictions utilized these outputs in the development of their Phase III Watershed Implementation Plans (WIPs) beginning in 2021.

What challenges have hindered progress?

- The scientific capabilities needed to estimate, project, model and monitor ecosystem changes and impacts as a result of climate change are complex and resource intensive.
- Climate change impacts are exacerbated by non-climate stressors such as land subsidence, land use change, development and growth.
- Climate change impacts vary across the watershed, presenting challenges in data consistency and comparability across the region.

- Differing rules and regulations across agencies and organizations make it difficult to share or provide open access to monitoring data.
- The development of a monitoring program to detect ecosystem changes and inform program and project responses is a complex undertaking.
- Lack of consistent long-term funding for indicator development and monitoring needs.
- Partnership support is needed to support all monitoring and assessment needs, including the commitment of technical analysts and long-term data providers to inform model improvements and climate change indicators.
- There is a lack of staffing resources to undertake resource-intensive data analysis to inform climate change indicators.
- A coordinated effort toward improving the integration of modeling and monitoring tools that include climate parameters and future climate change projections is needed to improve understanding of how climate change will impact habitat and living resource goals in the *Chesapeake Bay Watershed Agreement*.

If on course, what is needed to accelerate progress?

Increasing capacity to support the prioritized list of climate change indicators, which includes the development of several new indicators. These indicators are time and staff resource intensive (beyond the capacity of current staff), so it will be important to build partnerships with organizations that can commit to being long-term data providers and assist with the indicator analysis.

- Continue supporting existing, in addition to, expanding long-term monitoring networks to provide needed data to assess climate change trends and impacts to the Chesapeake Bay's ecosystems.
- Continue to work with Chesapeake Bay Program Modeling team to incorporate climate change into modeling efforts and collaborate with Chesapeake Bay Program living resource outcomes to connect these models with current and future efforts (e.g., assessing striped bass habitat and SAV under changing climate and water quality conditions).
- Optimize use of the indicators and available resources, through establishing the purpose of the indicator with potential end-users to make the level of effort worthwhile. This includes getting support from other workgroups in connecting the climate change indicators with relevant ecological impacts to natural resource outcomes.
- Ensure adequate dedicated climate staff support is in place to continue progress.