



*The Wicomico River, top, and Whites Neck Creek, bottom, flow toward the Potomac River in Charles County, Md., on June 5, 2018. (Photo by Will Parson/Chesapeake Bay Program)*

## I. Introduction

For the past 35 years, the Chesapeake Bay Program (CBP) partnership has been committed to achieving and maintaining the water quality conditions necessary to support living resources throughout the Chesapeake Bay watershed. Building off these commitments and using the best scientific information available, the CBP partnership agreed to the nutrient and sediment allocations in the 2010 [Chesapeake Bay Total Maximum Daily Load \(TMDL\)](#), a historic and comprehensive pollution reduction effort in the Chesapeake Bay watershed, and the subsequent Phase II and Phase III planning targets.

The Bay TMDL identifies the necessary pollution reductions of nitrogen, phosphorus and sediment across the seven Bay watershed jurisdictions of Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia and the District of Columbia to meet applicable water quality standards in the Bay and its tidal waters. Reducing pollution is critical to restoring the Chesapeake Bay watershed because clean water is the foundation for healthy fisheries, habitats and communities across the region. All partners and source sectors must contribute substantial efforts to achieve our shared water quality goals.

The [Watershed Implementation Plans](#) (WIPs), developed by the seven Bay watershed jurisdictions, provide a roadmap for how the jurisdictions, in partnership with federal and local governments, will achieve the Phase III planning targets. As such, the WIPs collectively serve as the foundation of the management strategy for the 2017 WIP, 2025 WIP and Water Quality Standards Attainment and Monitoring outcomes.

The jurisdictions are expected to develop WIPs over three Phases. [Phase I and Phase II WIPs](#), developed and submitted to Environmental Protection Agency (EPA) in 2010 and 2012, respectively, describe actions and controls to be implemented by 2017 and 2025 to achieve applicable water quality standards. The Phase II WIPs build on the initial Phase I WIPs by providing more specific local actions.. As part of the accountability framework established in the Bay TMDL document, jurisdictions also establish short-term goals in the form of two-year milestones which are based on the WIPs and have been reported to EPA since 2011.

In 2019, the seven Bay watershed jurisdictions will develop Phase III WIPs that provide more information on what actions the jurisdictions intend to implement between 2018 and 2025. Based on a midpoint assessment of progress and scientific analyses that was completed in 2018, the Phase III WIPs will be developed so that by 2025 all practices are in place that are necessary to meet applicable water quality standards in the Bay and its tidal tributaries.

In conjunction with the implementation of the WIPs, the CBP partnership is engaged in an evaluation of water quality changes to explain progress toward meeting water quality standards and the Bay TMDL and to develop methods to assess incremental progress towards attaining water quality standards.

This evaluation includes assessing changes in nutrients and sediment in the Bay watershed and analyzing water quality trends in the estuary and tidal tributaries. In addition, the partnership will conduct selected assessments of factors affecting progress towards restoring water quality, habitat, fish and wildlife, and conserving lands, including the effects of management activities. Further incorporation and use of monitoring information to assess progress is critical to better understand how on the ground actions have an impact toward meeting the 2025 WIP outcome, particularly since monitoring assessments will ultimately determine when the jurisdictions' water quality standards are achieved.

## II. Goal, Outcome and Baseline

This management strategy identifies approaches for achieving the following goal and outcomes:



### **Water Quality Goal**

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

### **2017 WIP Outcome**

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

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### **2025 WIP Outcome**

By 2025, have all practices and controls installed to achieve the Bay's dissolved oxygen, water clarity/submerged aquatic vegetation and chlorophyll-*a* standards as articulated in the Chesapeake Bay TMDL document.

### **Water Quality Standards Attainment & Monitoring Outcome**

Continually improve the capacity to monitor and assess the effects of management actions being undertaken to implement the Bay TMDL and improve water quality. Use the monitoring results to report annually to the public on progress made in attaining established Bay water quality standards and trends in reducing nutrients and sediment in the watershed; as well as explanations for where progress is lagging or new science is changing our understanding of water quality responses.

## **Baseline and Current Condition**

### **Background**

In 2009, the Chesapeake Executive Council established the goal that all practices for a clean Chesapeake Bay be in place by 2025. The Bay TMDL document describes this goal, as well as the interim goal that practices be in place by 2017 to achieve 60 percent of the necessary reductions compared to 2009. However, the interim and final deadlines are those agreed to by the Executive Council, and not formally part of the TMDL itself. The baseline for the 2017 goal are the 2009 estimates of nitrogen, phosphorus and sediment loads (in pounds per year) in the Chesapeake Bay watershed. These estimates were obtained from the partnership's modeling tools that are calibrated to monitoring data and use implementation data collected from the seven Bay watershed jurisdictions. The year 2009 was established as the baseline year because it the last year for which pollution reduction progress was assessed prior to EPA establishing the Bay TMDL in 2010.

The Chesapeake Bay's tidal waters are divided into 92 segments, and each segment has up to five designated aquatic life uses which equates to a total of 291 designated uses. The CBP partners have endorsed an integrated approach that includes three primary pieces of information to measure progress toward water quality standards:

- Reporting of water quality management practices.
- Analyzing trends of nitrogen, phosphorus and sediment in the watershed.
- Assessing attainment of dissolved oxygen, chlorophyll-*a* and water clarity/SAV standards.

The integrated approach to quantify and explain water quality trends in the Bay and its watershed relies on monitoring information, enhanced BMP implementation data and use of several analytical tools (including statistical tools, CBP Watershed Model and estuary models, USGS SPARROW model and groundwater models). The measure of success for this integrated approach is to meet all applicable nutrient- and sediment-related water quality standards in the tidal Chesapeake Bay necessary to protect the designated uses for those 92 segments.

### **Progress to Date**

The WIPs identify how the seven Bay watershed jurisdictions are putting measures in place by 2025 that are needed to restore the Bay, and by 2017 to achieve at least 60 percent of the necessary nitrogen,

phosphorus and sediment reductions compared to 2009 levels. While the Chesapeake Bay partnership exceeded the 60 percent goals for reducing phosphorus and sediment, it fell short of the 2017 target for reducing nitrogen by 15 million pounds. The implementation of BMPs specifically in the agricultural and urban sectors will need to accelerate to close this gap.

As of 2017, based on the partnership’s modeling tool estimates, practices are in place to achieve 40 percent of the nitrogen reductions, 87 percent of the phosphorus reductions and 67 percent of the sediment reductions (compared to 2009 levels) that are necessary to attain applicable water quality standards in the Bay.

Attaining water quality standards is essential to other CBP goal areas including habitat and fisheries. Attaining the standards also provides substantial benefits for protection of human health, aesthetic and recreational uses. The Water Quality Standards Attainment and Monitoring Outcome will require the monitoring of water quality conditions to assess progress towards achieving applicable water quality standards in Bay and tidal water restoration to support aquatic living resources. Achieving those water quality standards is also a critical component of achieving many local water quality objectives and local TMDLs.

During the 2014-2016 status assessment, the partnership estimates that 40 percent of the Bay and its tidal waters were attaining applicable water quality standards—the highest value since data collection began in 1985. The long-term trend in water quality standards attainment is positive showing improvement in environmental health.

- For long-term water quality trends in nontidal rivers across the watershed, 50 percent of the nontidal network monitoring sites through 2016 showed improvements in nitrogen loads, 31 percent are degrading and the remainder are showing little or no change.
- About one third of monitoring sites showed improvements in phosphorus loads, 25 percent are degrading and the remainder are showing little or no change.
- Improvement for sediment loads was observed at 20 percent of monitoring sites, while 37 percent are degrading and the remainder are showing little or no change.

### III. Participating Partners

The following partners have participated in the development of this strategy.

- District of Columbia
- Delaware
- Maryland
- New York
- Pennsylvania
- Virginia
- West Virginia
- U.S Environmental Protection Agency
- Chesapeake Bay Commission
- U.S. Geological Survey

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- Other members of the partnership's Water Quality Goal Implementation Team

## Local Engagement

The Bay TMDL document, which describes an accountability framework including the 2017 and 2025 WIP outcomes, was developed through a highly transparent and engaging process. The outreach effort included hundreds of meetings with interested groups; two rounds of public meetings, stakeholder sessions and media interviews in all Bay watershed jurisdictions in fall of 2009 and 2010; a dedicated EPA website; a series of monthly interactive webinars; notices published in the Federal Register; EPA response to all TMDL comments; and a close working relationship with CBP committees representing citizens, local governments, and the scientific community. It was at the discretion of the Bay watershed jurisdictions to hold their own public meetings and public comment period for their respective WIPs, as these were state-developed documents.

A substantial portion of the nitrogen, phosphorus and sediment controls necessary to meet the Bay TMDL allocations is expected to be implemented at the local level by CBP partners including conservation districts, local governments, planning commissions, utilities and watershed associations. Outreach to a variety of local entities may help the CBP partners assess and determine the ideal scale at which implementation will be reflected in the CBP modeling tools and where appropriate, quantify local target loads within the WIPs. The partnership recognizes that individual jurisdictions may pursue somewhat different approaches to this local outreach.

The Phase III WIP local engagement strategies should provide a strong foundation for success: supported by sound science built on government leadership, strategic aligned federal-state-local priorities, strong networks, sufficient financial and programmatic capacity; and clear communication of roles and responsibilities.

EPA expects draft and final Phase III WIPs to include a detailed strategy of how each jurisdiction will engage its respective local partners in implementation of the jurisdictions' Phase III WIPs. After release of the final Phase III planning targets, the jurisdictions developed [local area planning goals](#) based on those planning targets.

## IV. Factors Influencing Success

The following are natural and human factors that influence the partnership's ability to attain this outcome:

### Implementation of Practices

These factors are related to the WIP outcomes, and include:

- 1. Continuing to sustain the capacity of governments and the private sector to implement practices**  
The state and local jurisdictions have described their capacity (funding, authorities and sustainability) to implement nitrogen, phosphorus and sediment reduction practices several times over the past two decades. These include the tributary strategies developed during the 1990s and again in the mid-2000s, and more recently, in the Phase I and Phase II WIPs and two-year milestones, which also include strategies to build capacity in order to achieve pollutant reductions.

Federal agencies and land holders have described their capacity (funding, authorities and sustainability) to implement nitrogen, phosphorus and sediment reduction practices through the programs they administer or on the lands that they control as part of [Executive Order 13508](#). These entities must continue to work towards strengthening and sustaining adequate capacity necessary to complete the efforts through the Phase III WIPs and future two-year milestones.

**2. Delivering the necessary financial capacity to implement practices and programs**

Both understanding and addressing the financial capacity needed to implement the Phase III WIPs and two-year milestones is an integral component to achieving the water quality goals in the Bay TMDL. The CBP partnership is focused on addressing these financial needs through:

- Quantification of existing and potential funding gaps, and the identification of new revenue sources and financing to address these gaps.
- Consideration of how costs might be reduced by more cost-effectively reallocating nutrient and sediment reductions among source sectors.
- Evaluation of BMP implementation and maintenance costs.
- Communication of funding needs to elected officials.

**Improved Technical Information**

These factors are related both to the WIP outcomes and Attainment and Monitoring Outcome, and include:

**1. Improving the identification of pollution sources and their contributions to nitrogen, phosphorus and sediment loads, including their dynamic interactions**

The sources and their respective contribution of loads listed in the Bay TMDL is currently represented through CBP [partnership models](#), [USGS SPARROW models](#) and supporting tidal and nontidal monitoring networks and research. As described in the Bay TMDL document (Chapter 4), the sources that are modeled by the partnership are based on U.S. Census Bureau and USDA Census data, federal and state permitting data, satellite imagery and additional data submitted by the seven Bay watershed jurisdictions. The CBP partnership will continue to incorporate additional/more recent local land use data, refining information on the transport of loads through the Bay watershed, and better predicting future impacts of population growth and climate change in the Bay watershed. Incorporating this information into the modeling tools will help to improve Phase III WIP and two-year milestone implementation.

**2. Develop a business strategy to sustain and grow monitoring programming that supports information needs**

It is necessary to sustain and grow the CBP monitoring program's capacity in order to meet the partnership's needs. Inflation, replacing aging infrastructure and lost partnerships have all put pressure on the existing monitoring program. The Scientific, Technical Assessment and Reporting (STAR) team and its workgroups have discussed gap-filling opportunities in meetings and Science and Technical Advisory Committee (STAC) workshops. Commitments to incorporating new partners, technologies and assessment protocols that leverage existing programming while adapting and

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enhancing approaches will be strategically necessary to sustain the monitoring capacity into the future. The [Water Quality Exchange and Water Quality Portal](#) can help share monitoring data amongst jurisdictions and their respective stakeholders.

**3. Supporting the use of new monitoring data sources having classified their integrity**

The partnership's monitoring program provides marginal support for assessing water quality standards attainment in the Bay and adequate, but not recommended, levels of monitoring in evaluating pollution inputs from the watershed to the Bay. By using data gathered by new monitoring sources, such as the volunteer networks and nontraditional partner efforts supported by the Chesapeake Monitoring Cooperative, the CBP can expand spatial and temporal resolution of decision-support assessments. In October 2018, the partnership signed a Memorandum of Understanding with the Chesapeake Monitoring Cooperative which recognized that these new data streams provide information valuable to product development that helps communication, management action targeting and regulatory level assessments with greater spatial and temporal coverage than has been achieved with our traditional investments.

**4. Quantifying the reductions from pollution control practices and verifying their continued performance**

The pollution reduction values associated with nitrogen, phosphorus and sediment controls that the CBP partnership has approved for use in the models are based on extensive literature reviews and expert panel recommendations. Through its technical source sector workgroups and expert panels, the [Water Quality Goal Implementation Team](#) (WQGIT) periodically refines these values based on new information and to account for innovative practices. The partnership is addressing the effectiveness and efficiency of practices by:

- Adopting principles to verify that reported practices are, indeed, in place and functioning as designed.
- Further quantifying the effect of variations in watershed properties (such as different types of soils) on controls.
- Quantifying changes in best management practices (BMP) performance over time.
- Evaluating the potential future impacts of climate change on BMP performance.

In addition, the Chesapeake Bay basin-wide BMP verification framework provides a structure by which the CBP partners will improve consistency through a collective analysis of the effectiveness and efficiency of various BMPs. Verification will be viewed as a [life cycle process](#), including initial inspection, follow up checks and evaluation of BMP performance.

**5. Enhancing the next generation of decision support tools (Phase 6)**

The CBP partnership has revised the watershed modeling system structure to enhance decision support and to improve accuracy, transparency and confidence. The [Phase 6 suite of decision support tools](#) has been refined in many ways, including the addition of 10 additional years of real-time water quality monitoring data, high-resolution land cover data, new data inputs from the agricultural community, additional BMPs and an approach to integrate multiple models into the Phase 6 decision support tools. Further incremental updates to the Phase 6 suite of modeling tools

will take place concurrently with the two-year milestone schedule beginning in late 2019, as approved by the Principals' Staff Committee (PSC). These incremental updates will include CBP-approved inclusion of new BMPs available for planning and reporting purposes, and incremental updates to land use information and optimization tools for cost-effective BMP planning.

**6. Ongoing Review and verification of historical implementation data submitted by the jurisdictions to the CBP partnership, confirming that BMPs are still in place and ensuring that accurate information is included in the modeling tools**

The jurisdictions Information on BMP implementation was [submitted](#) information on BMP implementation. The Chesapeake Bay Program Office (CBPO) reviewed this information to ensure maximum accuracy for:

- Calibrating the Phase 6 Watershed Model.
- Planning and reporting on future actions.
- Using monitoring data to assess impacts of past efforts, since understanding the factors affecting observed trends in water quality requires a clear understanding of what actions have been implemented over time.
- Assessing the critical period of 1993-1995.

Historical BMP implementation data submitted by the jurisdictions is available on [CAST](#) as annual progress. States may resubmit historical BMP implementation data if needed during two-year milestone periods, beginning in late 2019. Ongoing inspection and verification of historical implementation data will allow continued assessments of impacts of past efforts to enhance understanding of current conditions and efforts required to reach 2025 nutrient and sediment targets.

**7. Support the ongoing need for synthesis and communications of science findings and needs**

There is significant CBP partnership investment in updating the science that underpins advances in modeling, monitoring and management tools and assessments. Substantial publication efforts were initiated under the Bay TMDL's midpoint assessment. Synthesis and communication of science findings and needs will be linked to [data dashboard](#). Appropriate information, including presentations, will be posted to the [Integrated Trends Analysis Team](#) (ITAT) webpage and [Phase III WIP](#) webpage on chesapeakebay.net. While key products were provided, there is still a need for additional synthesis and communications of new findings to explain factors affecting water quality trends and linkages between sources and ecosystem response to support adaptive management.

**8. Consider co-benefits for the following selected set of CBP outcomes:**

- **Abundant Life:** Outcome for fish habitat, brook trout, wetlands, submerged aquatic vegetation, forest buffers, forest canopy, stream health.
- **Clean Water:** Outcomes for policy, as well as prevention and research.
- **Conserved Lands:** Outcomes for healthy watersheds and protected lands.
- **Climate Change:** Outcomes for adaptation and monitoring.



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- **Engaged Communities:** Outcome for public access.

The CBP will need to develop improved understanding of the potential benefits and risks for practices and policies to provide benefits to multiple outcomes. Existing technical tools, such as CAST, will have to be greatly expanded, and new tools may need to be developed, to provide the information decision makers can consider practices that provide benefits for multiple outcomes.

## **Response of Water Quality Conditions to Management Practices**

### **1. Understanding the factors affecting the ecosystem response to pollutant load reductions to focus management efforts and strategies**

Based on the current science and the associated CBP modeling system, the CBP partnership has projected that implementing practices for reducing nitrogen, phosphorus and sediment loads should achieve applicable water quality standards in the Bay. Improved understanding of the following elements could further enhance decision-making for the Phase III WIPs:

- The factors affecting the time it will take to see improvements (i.e., “lag times”) between implementation of practices and responses in water quality.
- Factors in addition to nitrogen, phosphorus and sediment pollutant load reduction that affect response of dissolved oxygen (DO), water clarity, SAV and chlorophyll.
- The relationships between water quality improvements and the recovery of habitat conditions for fish and shellfish populations.
- How population changes and economic influences impact restoration activities.
- The effects of climate change due to increased temperatures and sea level rise in the estuary.
- How increases in plant and animal biomass in response to improved water quality improves the assimilative capacity of the system for nutrients and sediment.
- Uncertainty associated with model projections.

### **2. Factoring in effects of climate change**

EPA and other partners are developing the tools to quantify the effects of changes in watershed flows, storm intensity and changes in hypoxia due to increased temperatures and sea level rise. Current efforts are to frame an initial future climate change scenario based on estimated 2025 conditions. The CBP partnership decided to incorporate these climate change considerations into the Phase III WIPs by including a narrative strategy that describes the state and local jurisdictions’ current action plans and strategies to address climate change and commit to adopting climate change targets by 2021. The current preliminary modeling estimates attributable to climate change by 2025 are roughly an additional 9 million pounds of nitrogen and 0.5 million pounds of phosphorus. Starting with the 2022-2023 milestones, the partnership will determine how climate change will impact BMPs included in the WIPs and address vulnerabilities in the two-year milestones.

### **3. Assessing the implementation potential of filter feeders for nutrient and sediment reductions**

Living resource restoration was not considered in the Bay TMDL because low filter feeder biomass was insufficient to influence water quality, and because of future biomass uncertainty due to harvest, disease and lack of habitat. Since then, significant oyster restoration has occurred and more is planned, as well as a recent resurgence of aquaculture in the Chesapeake Bay. The oyster model will be revised as necessary to incorporate aquaculture operations and additional oyster biomass brought about by restoration activities including sanctuaries. [Eight tributaries](#) in Maryland and Virginia have been selected for oyster reef restoration including development of a tributary restoration plan, construction and seeding reefs, and monitoring and evaluating restored reefs.

#### **4. Addressing the impact the lower Susquehanna dams have on the pollutant loads to the Bay, including changes over time**

The CBP partnership worked with the U.S. Army Corps of Engineers' Lower Susquehanna River Watershed Assessment (LSRWA) study and the STAR midpoint assessment work plan for the assessment of trapping capacity behind dams, especially the Conowingo, as well as greater representation of local impoundments and reservoirs throughout the Phase 6 Watershed Model. The partnership has developed a detailed Conowingo WIP framework to address how to reduce the level of impairment in the Chesapeake Bay due to Conowingo. A Conowingo WIP Steering Committee guides the development and implementation of the Conowingo WIP and financing strategy and will seek final approval of the Conowingo WIP document from the PSC.

The Conowingo WIP Steering Committee is composed of representatives from each jurisdiction and the assistance of a third party. EPA provides oversight in the development and implementation of the Conowingo WIP, evaluates and tracks the progress being made to reduce the additional pollution from the dam and provide technical and contractual support. [This approach](#) will give all the jurisdictions in the Chesapeake Bay watershed the chance to participate in this massive undertaking and contribute in putting conservation practices in place to help offset the nutrient and sediment pollution loads from the [Conowingo Dam](#).

#### **5. Addressing chlorophyll in the tidal James River**

The CBP partnership is working closely with the principal investigators of the James River chlorophyll-*a* criteria assessment to determine the criteria necessary in order to meet water quality standards in the James River. A [STAC peer review](#) for the James River chlorophyll-*a* criteria reevaluation was published in 2016. The partnership will support implementation efforts to reach the new James River chlorophyll-*a* criteria by providing ongoing modeling and monitoring support and other technical resources to support implementation.

## **V. Current Efforts and Gaps**

The CBP partnership did not meet its 2017 nitrogen target, but it continues to improve tracking, reporting and assessing the effectiveness of implementation actions. In addition, the Bay watershed jurisdictions are implementing BMP tracking, verification and reporting protocols and programs. As the CBP tracks partners' progress toward goals for cleaner waters, verifying that practices are being implemented correctly and are reducing nutrient and sediment pollution as expected will be critical in measuring success. EPA, the Bay watershed jurisdictions, local governments, the private sector and

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nongovernmental organizations use these data to inform accountability and adaptive decision-making and redirect management actions and resources.

Future specific management approaches to support tracking, reporting, assessment and verification include:

- Annual implementation progress reporting for inclusion in modeling tools and annual reporting on progress on programmatic milestones.
- Evaluation of BMP implementation and maintenance costs and actual nutrient and sediment reductions.
- Support for continued BMP implementation, tracking and reporting on agricultural loads.

The WIPs also evaluate the current legal, regulatory, programmatic, financial, staffing and technical capacity to deliver the implementation of reductions sufficient to achieve the target loads in the Bay TMDL. As part of their evaluation, the Bay watershed jurisdictions considered whether additional reductions could be achieved with existing capacity (funding, authorities and sustainability). The evaluation of existing capacity includes programs and rules, a comprehensive assessment of current point source permitting/treatment upgrade schedules and funding programs, nonpoint source control funding, existing permitting and incentive-based programs and regulations. Specific efforts include the use of the National Environmental Information Exchange Network (NEIEN) to seamlessly exchange information between existing federal, state or district databases and the suite of CBP decision support tools. Tracking data and models will be used, along with ambient monitoring data, to assess WIP and milestone commitments and progress.

The jurisdictions and EPA, through the WIPs and evaluations of the WIPs, respectively, identified gaps between their current capacity and the capacity they estimate is necessary to fully attain the interim and final nutrient and sediment target loads for each of the 92 segments of the Bay TMDL. Such gaps that the jurisdictions continue to address through the Phase III WIPs include:

- Financial capacity to oversee and implement municipal separate storm sewer systems (MS4s) and other stormwater programs.
- Financial, technical and regulatory capacity to deliver priority pollution reduction practices to priority watersheds.
- BMP tracking, verification and reporting programs.
- Financial capability to continue to maintain new and existing implementation practices.
- Specifically achieving the Phase III nitrogen planning targets by 2025 since the CBP partnership did not achieve the goal of 60% pollution reductions by 2017.

Necessary new capacity to address these issues includes additional incentives, new or enhanced state or local regulatory programs, market-based tools, technical or financial assistance and new legislative authorities. It also includes capacity from other federal agencies, local governments, the private sector and/or non-governmental organizations.

Through the Phase III WIP development and implementation processes, the Bay watershed jurisdictions are expected to discuss plans to work with federal, local, private sector and nonprofit partners to leverage capacity for achieving the Phase III planning targets. For specific WIP commitments, each jurisdiction's WIP is posted on its respective website:

- [New York State Department of Environmental Quality](#)
- [Pennsylvania Department of Environmental Protection](#)
- [West Virginia Department of Environmental Protection](#)
- [Maryland Department of the Environment](#)
- [Delaware Department of Natural Resources and Environmental Control](#)
- [D.C. Department of Energy and Environment](#)
- [Virginia Department of Environmental Quality](#)

**Water Quality Attainment and Standards and Monitoring:** There are several current efforts to address the water quality standards attainment and monitoring outcome. The CBP oversees the tidal and nontidal monitoring networks, which are used to (1) assess in tidal waters relative to established water quality standards and (2) measure nitrogen, phosphorus and sediment in the watershed to help determine if practices are reducing loads to the Bay and in the watershed.

The tidal monitoring network is a cooperative effort between EPA, Maryland and Virginia. The watershed monitoring is a partnership between USGS, EPA and all seven Bay watershed jurisdictions. The primary monitoring gaps include (1) more frequent measures and greater spatial resolution of dissolved oxygen and chlorophyll-*a* to assess criteria attainment, (2) expanding annual spatial coverage for water clarity acres assessments to the Bay-wide scale, and (3) more localized monitoring in watershed areas to assess effects of BMPs. The CBP water quality monitoring is coordinated through STAR and more information on the networks and efforts to address the gaps are in the Management Approach and Monitoring Progress sections of this document.

To support the Bay TMDL's midpoint assessment, USGS and the University of Maryland Center for Environmental Science (UMCES) provided leadership and worked with the STAR team to coordinate efforts of with multiple investigators on projects to assess and explain water quality conditions. Their objectives are to:

- Analyze water quality trends in the Bay and its watershed.
- Explain the factors affecting water quality trends in Bay and its watershed.
- Enhance CBP models using the improved understanding of trends.
- Inform management strategies to improve water quality.

Selected accomplishments for each objective include:

**Objective 1:** Developed new approaches to assess tidal trends using the General Additive Model (GAMs) techniques. Updated status and trends for the watershed using information from the CBP nontidal network and provided new analysis of estuary trends with the GAMs approach.

**Objective 2:** Conducted multiple studies and developed new approaches to better understand the factors affecting nutrient and sediment trends in the watershed. The findings are being summarized in several major synthesis products:

- Providing explanations of loads and trends at RIM sites to understand changes in waters reaching Chesapeake Bay.
- Describing the influence of Susquehanna reservoirs on loads and water quality in the Chesapeake Bay. There is a synthesis product on the understanding and implications of the

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Reservoirs on the Lower Susquehanna River.

- Explaining yields and trends at sites throughout the Chesapeake Bay watershed to support management decisions as part of the midpoint assessment.
- Reviewing sediment sources, transport, delivery and impacts in the Chesapeake Bay watershed to guide management actions.

The estuary investigators also conducted multiple studies which are being summarized in these syntheses products:

1. Estuarine water quality: Conceptual models and case studies of eutrophication and restoration.
2. Factors affecting Chesapeake SAV distribution and abundance.
3. Explaining estuarine water clarity trends: physical, biological and watershed influences.
4. Factors affecting changes in tidal Potomac River water quality.
5. Linking segment-scale patterns in water quality criteria attainment with station-scale water quality trends,
6. Tidal water quality trends: tributary summary reports.
7. STAC workshop report related to the meeting: “Integrating Recent Findings to Explain Water Quality Change: Support for the Midpoint Assessment and Beyond.”

**Objective 3:** The STAR team brought results forward on important watershed processes that were used to develop the Phase 6 Watershed Model. Some of the major findings included:

- Developing approaches to represent groundwater lag times into the watershed model.
- Improved information on transport of nitrogen and sediment (using the USGS SPARROW model).

Better simulating sediment from stream corridors

**Objective 4:** The USGS and UMCES established the Integrated Trends and Analysis Team (ITAT) under STAR to communicate findings to jurisdictions and science partners. The investigators also made multiple presentations to the WQ GIT and their work groups. The interaction helped the jurisdictions understand the technical findings, which will be used as they develop their Phase III WIPs.

Additional efforts were begun to summarize and communicate findings from the above objectives, specifically for informing management decisions during Phase III WIP development. A framework was developed for integrating, synthesizing and communicating the messages and conclusions from across the objectives at relevant geographic scales into locally meaningful storylines to demonstrate to managers how the information could be used to inform decisions. This storyline framework was presented to multiple groups within the CBP including the WQGIT, STAC, Citizens Advisory Committee and ITAT.

The CBP also developed Phase III WIP technical workshops to present the explaining trends work and storylines to jurisdictions and other entities involved in WIP development. The storyline framework is also being used to inform the tributary summary reports, and the Pennsylvania Department of

Environmental Protection is using it to generate county-level toolboxes for WIP development.

The CBP is currently developing an interactive web-based decision support tool that will allow users to access the data and the messages and conclusions generated and compiled from the above explaining trends objectives, and to utilize this information to inform management decisions. The tool is directed towards both technical and non-technical managers and environmental planners from the local to jurisdictional levels. The WQGIT is utilizing the storyline framework in a GIT-funded project to develop a portion of this web-based tool that will allow users to choose data and visuals to build their own storyline analysis and presentation for their area of interest.

In addition to the storyline framework, a story map is under development which aims to communicate the significance of local decisions in terms of impacts downstream in the estuary. The “Local Solutions, Big Impacts” story map can be used by local governments and planning jurisdictions to communicate how local water quality improvements ultimately lead to a cleaner Chesapeake Bay.

In addition to developing new methods for assessing tidal water quality trends using GAMs techniques, the CBP has begun developing new methods for:

- Assessing incremental progress towards water quality standards attainment.
- Assessing trends in estimated water quality standards attainment over time.
- Analyzing the spatio-temporal changes in estimated water quality standards attainment.

In 2017 the EPA CBPO published the sixth [Technical Addendum for Water Quality Criteria](#) to update the Bay-wide criteria assessment procedure factoring in new science. The 2017 addendum also documents the CBP’s development of a multi-metric water quality indicator using the water quality criteria attainment assessment results for dissolved oxygen, water clarity/submerged aquatic vegetation (SAV) and chlorophyll-*a*, to support public reporting of progress toward achievement of the jurisdictions’ Chesapeake Bay water quality criteria.

## VI. Management Approaches

The CBP partnership will work together to carry out the following actions and strategies to achieve the 2025 water quality goals. These approaches seek to address the factors affecting our ability to meet the goal and the gaps identified above.

### **Phase I WIPs, Phase II WIPs, Phase III WIPs and Two-Year Milestones**

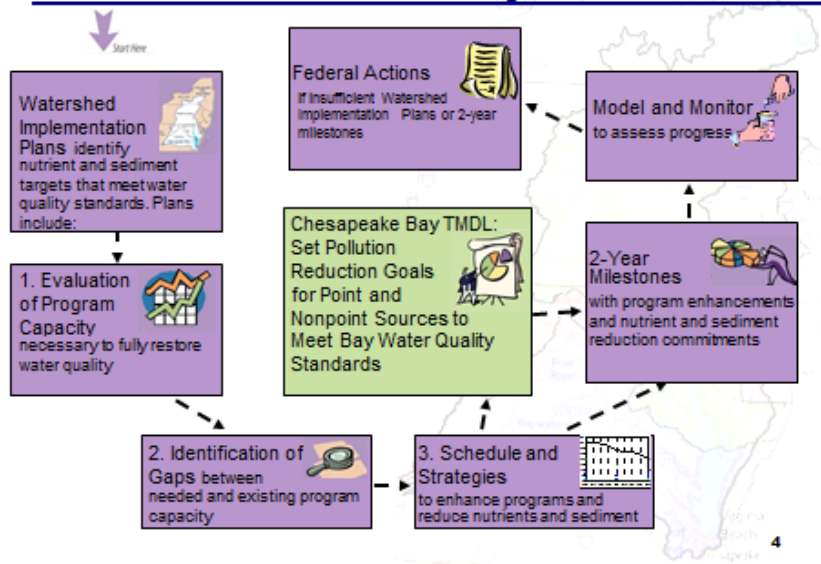
The overall management approach needed for reducing nitrogen, phosphorus and sediment are provided in the Bay TMDL document, the Phase I and II WIPs, and the accountability framework described in the Bay TMDL document and Executive Order 13508. The Phase III WIPs will describe how the seven Bay watershed jurisdictions, in collaboration with local partners and federal agencies, will refine, as necessary, the actions and controls that will be implemented between 2018 and 2025 to meet their final load reduction targets by 2025. Attainment of these goals across the watershed is expected to result in the achievement of all applicable nutrient- and sediment-related water quality standards in the Bay and its tidal tributaries.

## Chesapeake Bay TMDL Accountability Framework

The Bay TMDL is supported by a rigorous accountability framework to ensure cleanup commitments are established and met, including WIPs, short and long-term benchmarks (such as two-year milestones), a tracking and accountability system for jurisdictions' activities and federal actions that may be employed if jurisdictions do not meet their milestone and WIP commitments. Federal agencies are directed by Executive Order 13508 to consult with the seven Bay watershed jurisdictions to ensure that federal actions to protect and restore the Chesapeake Bay are closely coordinated with those actions by state and local jurisdictions in the watershed. The federal agencies have developed an Executive Order strategy to outline ways to accomplish that goal. EPA and other federal agencies, such as USDA, will also continue to develop water quality two-year milestones, and EPA will incorporate federal milestones efforts into the updated Milestone Guide.

Although the accountability framework is not part of the Bay TMDL, Sections 7 and 10 of the Bay TMDL document describe how the accountability framework helps provide reasonable assurance that the needed pollutant reductions will occur and how adaptive management can be used as a tool to implement those pollutant reductions within the accountability framework.

### Overview of Accountability Process



As part of its efforts to carry out the Bay TMDL accountability framework, EPA interacts with the jurisdictions directly and through the CBP's WQGIT and its associated source sector workgroups. The WQGIT workgroups are focused on supporting the reduction of nitrogen, phosphorus and sediment pollutant loads from key sources described in Section 4 of the Bay TMDL: wastewater, agriculture, urban storm water, septic systems, forests and air.

EPA also works with the jurisdictions and the WQGIT on issues associated with two-year milestones, offsets and water quality trading. The WQGIT is supported by the CBP STAR team, which contains the modeling and monitoring workgroups, and other goal implementation teams, as necessary. The CBP partnership's models are used to assist the jurisdictions in assessing different options for management

practices in the formulation of their WIPs and two-year milestone commitments.

### Enhancing Monitoring

To address limitations of the existing tidal monitoring program to obtaining measurements at temporal scales required to assess water quality standards, the CBP supported a Memorandum of Understanding that addresses the use of new data sources of known quality from citizen science groups and nontraditional partners. New data sources may enhance temporal data resolution at existing stations in the tidal monitoring network. However, these enhancements to data collections can also support greater spatial coverage that reduces uncertainty and improves estimates of water quality conditions.

Citizen science and nontraditional partner monitoring in the watershed is expected to assist in understanding local to regional-level spatial distributions of hot spots for nutrients, sediments, contaminants and biology that can be used to guide targeting for limited resources in managing restoration efforts. Incorporating new partners with advanced technology and related protocols for assessing Bay-wide scales of conditions at high resolution are further being pursued (e.g., NASA evaluations of satellite imagery for water clarity related measures). New science on monitoring (e.g., Bever et al. 2018) proposes alternative monitoring strategies that could be adopted if adequate in situ technology to obtain measurement profiles in the Bay in real time can be achieved. Pilot studies of such technology are being proposed and pursued through the GIT-funding process.

The CBP partnership conducts annual monitoring of river flow to the Bay to help explain yearly changes in DO, clarity/SAV, and chlorophyll-*a* conditions. Living resources monitoring is used to assess changes in populations of lower trophic levels (SAV and invertebrates) and fisheries (crabs, oysters and selected finfish species) that are dependent on habitat conditions. The CBP nontidal water quality monitoring program monitors nutrient and sediment at 115 sites in the watershed to help document and understand the factors affecting the response to management practices. Some of the enhanced monitoring efforts are mentioned below.

STAR, working with the WQ GIT and jurisdictions, is enhancing the monitoring to better documents changes in annual loads and their relations to responses in living resources. The efforts underway to improve monitoring programs include:

- Evolving the business strategy supporting the water quality monitoring program to sustain the work that provides existing outputs and target growth opportunities. Recognizing that the tidal monitoring program operates at marginal needs for water quality standards attainment assessments (USEPA 2003), and anticipated level funding future of monitoring, further work is needed to evolve monitoring strategies that support enhanced collection and analysis of tidal monitoring data to assess progress toward water quality standards.
- Maintain effort to incorporate continuous monitoring in nontidal tributaries and estuaries to better understand the nature and timeframe of estuarine responses to inputs. Recent monitoring has shown differences in short-term loadings from continuous monitoring that differ from those from current models. High frequency monitoring of inputs and the estuary will help better assess the timing and magnitude of responses in the estuary relative to watershed inputs.
- The STAR team is continuing efforts to better measure and explain progress toward water quality improvements. These efforts will generate and improve understanding of the factors



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affecting system response (the Bay and its watershed) to implementation of management practices. STAR (under the CBP Modeling Workgroup) is also pursuing with the Scientific and Technical Advisory Committee (STAC) approaches to reduce uncertainties for models. The STAR team will update to reflect work being done following the midpoint assessment. The Modeling Workgroup and Monitoring Workgroup will document continuing efforts to better measure progress. Additional efforts to enhance monitoring are described in the Monitoring Progress section of this document.

The CBP partnership also has a basin-wide reporting process for tracking implementation of management practices. Many of these monitoring and assessment activities are coordinated through and provided by the CBP's STAR team and partner science entities.

STAR is working with the WQGIT to develop an approach to integrate four key pieces of related water quality information to better assess and communicate progress towards meeting the goals of the Bay TMDL and associated water quality standards including:

- Reductions of nitrogen, phosphorus and sediment by source, jurisdiction and overall load reduction associated with the implementation of BMPs. These load reductions are estimates from the CBP models based on BMP implementation data submitted by the jurisdictions.
- Changes of in-stream nitrogen, phosphorus and sediment concentrations and loads as estimated by flow-adjusted trends of nitrogen, phosphorus and sediment. These estimates show long-term (25 year) and shorter term (10 year) changes by normalizing the annual effects of streamflow variability. The normalized estimates are based on monitoring data collected as part of the CBP nontidal water quality monitoring program.
- Attainment of Chesapeake water quality standards for dissolved oxygen, chlorophyll-*a* and water clarity/SAV standards. Attainment of these standards is based primarily on results from the CBP tidal water quality monitoring program.
- Changes in water quality and related parameters, including dissolved oxygen, chlorophyll-*a*, water clarity, nitrogen, phosphorus, and total suspended solids, across the CBP long-term tidal water-quality monitoring network. These estimates show long-term (up to 35-year) and shorter-term (most recent 10-year) changes by adjusting for seasonal cycles and variability in river flow or salinity.

### **Enhanced analysis**

The projects conducted leading up to the Bay TMDL's midpoint assessment to explain trends in the Bay and its watershed laid the groundwork for additional analyses that can enhance our understanding of factors affecting water quality and ecosystem responses to management actions. New and continued work in these areas will allow us to better track, assess and model change due to management efforts in the tidal waters and the watershed, and to better understand how these systems are connected.

STAR and ITAT will enhance and continue synthesis projects that utilize interdisciplinary teams to:

1. Explain change in water quality or ecosystem response in terms of management efforts or actions.
2. Employ statistical methods or models to assess and quantify interactions.

3. Analyze linkages between the watershed and the tidal water.
4. Communicate findings on management-relevant timeframes.

Some of the efforts for integrated synthesis include:

- Continued and enhanced development of metrics to assess change—such as GAMs for tidal water quality trends—including salinity or flow-adjustment and modeling predictors to analyze factors influencing tidal water quality trends.
- Analyses that compare monitoring results with model outputs to identify drivers of inconsistencies and assess the ability to account for these drivers to improve future models.
- Continued support of science to understand response times to watershed management. Continue and build upon current efforts to understand groundwater lag times for nitrogen, soil-phosphorus storage and release for phosphorus, and transport times for fluvial sediment.
- Using ITAT, continued engagement of the broader research partnership on synthesis analyses that continue to refine the science of estuarine response to watershed management. Work to ensure that the research communities and monitoring agencies more effectively utilize the data resources produced by the partnership.

### Phase III WIP and Two-year milestone Implementation

There are several other programmatic, management and implementation efforts underway to help achieve attainment of the water quality outcomes. By 2019, EPA expects the jurisdictions to develop Phase III WIPs that will describe the actions the jurisdictions will take to have all practices on the ground by 2025 to achieve their respective [Phase III planning targets](#).

To assist the jurisdictions in implementing the Phase III WIPs, the CBP partnership will work to:

- Develop enhanced understanding of BMP performance, siting and design under climate change conditions.
- Identify and provide technical assistance and funding to the Bay jurisdictions in Phase III WIP implementation.
- Support implementation of BMP verification programs.
- Continue to consider the co-benefits of management practices to address other *Watershed Agreement* goals and outcomes beyond water quality.
- Continue to maintain and update Phase 6 modeling tools, with PSC approval, to reflect advances in understanding and support jurisdictions' implementation planning and tracking.
- Work with the jurisdictions to coordinate place-based research activities and insights, while considering the spatial distribution of Phase III WIP implementation.
- Expand partnership collaboration and engagement, particularly at the local level.
- Share successful approaches among partners to help inform and support implementation efforts.
- Complete analysis of Conowingo and estuarine monitoring to support Conowingo WIP development.

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## Approaches Targeted to Local Participation

- Much of the implementation of the pollution reduction practices, as articulated in the Bay TMDL and the WIPs, will be carried out at the local level. This includes municipalities, counties, soil and water conservation districts, and local private sector groups and individuals. Therefore, management approaches should be designed to include timely dialogue with the responsible local agencies and other partners, taking into consideration funding and technical support required by these local partners as well as competing financial and resource demands.
- The Chesapeake Bay jurisdictions have developed [local planning goals](#) as part of the Phase III WIPs. Local planning goals are intended to enhance planning and implementation efforts at the local level. While there is flexibility in determining how local planning goals can be expressed (e.g., numeric and/or BMP implementation goals), they must be measurable and below the state-major basin scale.
- The CBP partnership will update the high-resolution land cover dataset every four years between 2018 and 2025, using state and local data from the jurisdictions. The collection of refined land use and land cover data for incorporation into the Phase 6 modeling tools is intended to improve the representation of urban, agricultural, federal and natural lands at the local scale. Trends in land use will be used to refine the future land use projections every two years through 2025. Local land use and growth projections will assist in local planning and implementation of practices to achieve the Phase III planning targets and two-year milestones.
- Further information is needed to fully understand and address local climate change impacts in the Chesapeake watershed. This will include assessing how climate change impacts affect Bay, tributary and local water quality standards. The CBP partnership will also collect and analyze local data to better understand implementation practice performance and resilience concerns under climate change conditions. Better understanding of implementation practice performance and resilience to climate conditions at the local level will assist in climate-smart implementation and programmatic design at the local level. The partnership will also develop techniques, collect data and perform studies through 2021 to better understand and predict impacts from climate change to Chesapeake watershed jurisdictions and local areas. Beginning in 2022, the partnership will assist the jurisdictions in applying new understandings of climate change impacts in implementation and programmatic practices through 2025.
- Recent investments by the CBP in citizen science and nontraditional partner monitoring efforts will help inform management and decision-makers with monitoring assessments, including the effects of management activities. The opportunity to expand the use of new data sources will provide key data for evaluating the work of the management strategies to understand the progress we are making, what gaps remain and what steps are needed to fill those gaps.

## Cross-Outcome Collaboration and Multiple Benefits

- State and local jurisdictions could target the implementation of actions that not only result in water quality benefits but address other impairments (e.g., bacteria or toxic contaminants), environmental problems (e.g., threatened or endangered species), safety concerns (e.g., flooding, infrastructure) and 2014 *Watershed Agreement* outcomes (e.g., wetlands, forest buffers) as well. In 2018, an action team was created to look at the co-benefits among these outcomes and the Phase III WIP. While co-benefits could be identified for the majority of the

2014 *Watershed Agreement* outcomes, the action team identified the top 12 that appeared to have a stronger link to the WIP, either through their ability to facilitate messaging or to enhance implementation of the WIPs. Using the results of a comprehensive report which qualitatively ranked BMPs available in the Phase 5.3.2 modeling tools according to their benefits developed by the CBP WQGIT and Habitat GIT, the action team created a series of two-page fact sheets for these 12 high-priority outcomes. They also included narrative descriptions from experts in the relevant GITs and workgroups on considerations for addressing these priority outcomes in Phase III WIP development, selection and siting of BMPs, and resources for additional decision-support tools and points of contact in each jurisdiction. The report, fact sheets and additional resources are available on [Phase 6 CAST](#).

The qualitative rankings are currently being incorporated into an interactive web-based tool, which will allow users to explore, rank, sort and filter scores across individual BMPs, *Watershed Agreement* outcomes and BMP sectors.

- The CBP partnership is currently developing an optimization tool for TMDL implementation purposes, but this tool could potentially capture a broader range of ecosystem benefits beyond water quality to help inform decision making in our restoration efforts. An effort will also identify barriers to pursuing such broader benefits as well as recommendations for how to address those barriers.
- The partnership is currently exploring the development of an ecosystem services framework for BMP selection, planning and implementation. This potential framework would provide additional decision support to state and local jurisdictions in addressing local concerns and goals through the TMDL implementation process.
- The Toxics Contaminant Workgroup (TCW) needs to identify and prioritize options for toxics mitigation to help inform policy and prevention strategies that have co-benefits with nutrient and sediment reductions. Both PCBs and mercury have widespread extent and severity and also cause fish consumption advisories, so they are being addressed first for mitigation options. For other contaminants and their mixtures, the TCW will use the information from previous approaches on landscape settings to identify and prioritize mitigation options. Work activities will include:
  - Study of mitigating contaminants in different landscape settings.
  - Determine the efficiencies of some management practices to reduce selected contaminants.
  - Explore the use of existing nutrient and sediment tools (such as CAST and watershed model) to address selected contaminants.
  - Interact with WQGIT teams on opportunities to achieve co-benefits between nutrient and sediment practice and contaminant reductions.

Share Information generated from the research strategy with the TCW and key workgroups of the WQGIT (Wastewater Treatment Workgroup, Urban Stormwater Workgroup, and Agricultural Workgroup) so they can consider options for mitigation impacts of toxic contaminants.

- The CBP will compile the list of science needs identified from Strategy Review System quarterly meetings and combine with the list of GIT science needs gathered by STAR. STAR, STAC and the

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WQGIT, using science prioritization, will analyze these needs in conjunction with the ongoing projects above and other current CBP projects to determine overlaps, gaps, and internal and external resources necessary and available. Final recommendations on science and resource prioritization will be brought to the Management Board for finalization.

Enhanced water quality monitoring will serve to support information needs of the Sustainable Fisheries GIT and its cross-cutting efforts (multiple benefits) with the Habitat GIT. Hypoxia negatively impacts water quality standards attainment, blue crab habitat, forage species (macroinvertebrates, fish and shellfish) distribution and abundance, fish habitat, fish and benthic macroinvertebrate community health, fishing success, nutrient cycling and oyster restoration siting. Reducing uncertainty in hypoxic volume estimates improves the power to detect change over time in response to management actions on shorter time scales than can be provided by present data collection strategies. Bottom measurement of temperature, salinity and dissolved oxygen were identified as needs from the recent STAC SAV, blue crab, oyster and climate workshops. Improved hypoxic volume resolution would improve habitat characterization needed to support the data being collated for developing Chesapeake Bay regional fish habitat health assessment per the 2018 STAC workshop findings and recommendations. Improved tracking of hypoxic habitat dynamics in space and time is also highlighted as a desired, cross cutting climate indicator per the 2017-18 climate indicators project by the Climate Resilience Workgroup. Further monitoring program improvements are being investigated to improve water clarity acres and chlorophyll-*a* assessments.

### **Communication & Outreach**

- The December 2017 STAC workshop, “Integrating Recent Findings to Explain Water Quality Change: Support for the Mid-Point Assessment and Beyond,” identified a number of recommendations for improving science communication and outreach to CBP partners. The CBP is currently following a number of these recommendations to provide enhanced in-person technical support, to provide technical support to more local entities such as counties or conservation districts (especially those with fewer technical resources), and to provide more consistent scientific and technical outreach to all jurisdictions.
- The CBP will improve access to its scientific and technical information by 1) developing an open data site that catalogs, standardizes, organizes and provides access to its datasets— including geospatial data—and its tools. This open data site will work in coordination with the existing CBP Data Hub, and 2) by incorporating scientific and technical information into web-based tools designed for users from different geographic resolutions and with different technical backgrounds. These tools may focus on data visualization or decision-support and will serve to provide access to information as well as guidance on using it. The Watershed Dashboard is an example of such a web-based tool.

Continued and more consistent scientific and technical outreach is necessary to provide managers the opportunity to incorporate science into their decision-making. Current outreach efforts surrounding Phase III WIP development should evolve in the future to 1) focus on WIP implementation support, 2) incorporate more cross-outcome technical outreach, and 3) align with management-relevant timelines such as the TMDL milestones.

## VII. Monitoring Progress

### 2025 WIP Outcome

*Practices:* Since 2010, the CBP partnership solicits BMP implementation data from the jurisdictions. The WQGIT Watershed Technical Workgroup is responsible for assisting jurisdictions in developing, understanding and submitting data through the NEIEN system. The CBP partnership is working with the jurisdictions and federal partners to improve verification of reported nutrient and sediment controls.

The WQGIT also adopted a protocol for reviewing the effectiveness of or BMPs based on an evaluation by expert panels and a review of the best available literature and data. Expert panels evaluating the effectiveness of BMPs are underway to inform the partnership as to whether it is appropriate or necessary to modify existing, or approve new, nutrient and sediment controls and how the implementation of those controls are accounted for by the CBP modeling tools.

*Modeled Loads:* The CBP partners use a suite of computer models to project pollutant loads and flow. The CBP modeling framework is designed to address questions of how Chesapeake Bay water quality will respond to changes in watershed and airshed management actions, which can inform decision-making for reducing pollution and meeting applicable water quality standards. These modeling tools are also used to track and quantify nutrient and sediment loads as WIP implementation progresses. The estimated modeled loads, together with relevant monitoring data, are used to track progress with achieving the 2025 WIP outcome. USGS and the Modeling Workgroup are currently enhancing techniques to better compare modeled nutrient and sediment load data with that of monitored loads.

The Modeling Workgroup, in collaboration with other CBP partners, enhanced and revised the watershed modeling system structure to improve transparency, accuracy and confidence, particularly through the incorporation of more refined local land use data.

### Water Quality Standards Attainment & Monitoring Outcome

The CBP has extensive tidal and nontidal monitoring networks, which are used to (1) measure nitrogen, phosphorus and sediment in the watershed; (2) assess conditions in tidal waters relative to established water quality standards; and (3) evaluate tidal habitat conditions and living resource populations and health.

Gaps in achieving the recommended levels of monitoring for complete water quality standards attainment assessments have been identified in the program. Nontidal network priorities need to be revisited for station densities and distribution. STAR and its workgroups are coordinating to address gaps and improve spatial and temporal resolution of the assessments. Analysis and synthesis of the watershed and bay monitoring results are essential to understanding and communicating changes through time that supports decision-making and adaptive management.

## VIII. Assessing Progress

The CBP accountability framework provides the foundation to assess progress towards the Bay TMDL and associated water quality standards. Enhanced knowledge of management practices and their effects will be used primarily to refine individual jurisdiction strategies to achieve the 2025 water quality goals.

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## 2017 and 2025 WIP Outcomes

EPA will assess the jurisdictions' progress toward reaching the Bay TMDL's ultimate nitrogen, phosphorus and sediment reduction goals at least biennially using the jurisdictions' two-year milestones commitments. Every two years, the jurisdictions are expected to identify and commit to implement specific pollutant-reduction controls and actions in each of their successive two-year milestone periods. Under the Executive Order, the federal government also has been committing to two-year milestones. EPA will measure progress annually by running implementation data collected from the jurisdictions through the CBP partnership's modeling tools.

When assessing two-year milestone commitments, EPA evaluates whether proposed actions, controls and practices would result in estimated loads at the jurisdiction scale that will put the jurisdiction on track towards meeting its 2017 and 2025 goals. EPA uses the reported BMP data and the Chesapeake Bay Watershed Model to assess the jurisdictions' progress towards meeting the Phase III planning targets. EPA also assesses the jurisdictions' and Federal Agencies' progress towards meeting its programmatic milestones (e.g., promulgation of new laws, implementation of regulations, policy development, permit issuance, compliance and enforcement commitments, etc.) at least biennially.

While the partnership exceeded the 60 percent goals for reducing phosphorus and sediment, it fell short of the 2017 target for reducing nitrogen by 15 million pounds. The implementation of BMPs specifically in the agricultural and urban sectors [will need to accelerate](#) to close this gap.

With the completion of the Bay TMDL's midpoint assessment, the WQGIT will no longer include workplan actions for the 2017 WIP outcome and instead focus efforts on achieving the 2025 WIP outcome.

## Water Quality Standards Attainment and Monitoring Outcome

The CBP partnership will evolve its business strategy to sustain existing water quality monitoring programs. Water quality monitoring programs support data and analysis for tracking Bay and watershed conditions and response to management progress. The business strategy further needs to target monitoring program enhancements to improve data coverage in space and time. Enhanced analysis and explanation of monitoring information was a key part of the Bay TMDL's midpoint

assessment. Further science synthesis and communication product development supports the CBP partners continued endorsement (PSC, May 2012) of an integrated approach that includes three primary pieces of information to measure progress toward meeting water quality standards:

- Documenting, tracking and reporting of water quality management practices.
- Analyzing trends of nitrogen, phosphorus and sediment in the watershed.
- Assessing attainment of dissolved oxygen, chlorophyll and water clarity/SAV standards.

An integrated approach is required to quantify and explain water quality trends in the Bay and its watershed, to understand the linkages between these systems and with ecosystems and living resources, and to assess the impact and results of management actions. This approach relies on monitoring information for water quality and living resources, enhanced BMP implementation data, the use of several analytical tools (including statistical tools, CBP Watershed Model and estuary models, USGS SPARROW model and groundwater models, GAMs tidal water quality trends models), and interdisciplinary synthesis efforts. The following activities will be coordinated through the CBP STAR team and interaction with the WQGIT:

- Analyze water quality trends in the Bay and its watershed.
- Develop and apply new methods for assessing and explaining change such as statistical analyses or models.
- Enhance acquisition of better spatial and temporal resolution monitoring data to fill gaps in measures necessary for assessing short duration dissolved oxygen criteria, improved resolution of chlorophyll-*a* patterns and expand the annual coverage of water clarity acres assessments.
- Analyze and explain the factors affecting water quality trends in Bay and its watershed.
- Analyze groundwater data. Groundwater data has been used in developing the Phase 6 model and used to help jurisdictions with Phase III WIP development.

## Lessons Learned

The development and review of the Strategy Review System (SRS) documents involved a collaborative process, with input from various members of the Water Quality Goal Implementation Team (WQGIT). Lessons learned from drafting the management strategy, work plan and logic table included the following:

1. There needs to be clarity on existing technical support, management strategies, gaps, needs, and metrics when proposing new actions or enhancing existing efforts.
2. It's important to ensure that WQGIT members are actively engaged and contributing throughout the entire development of the SRS documents.
3. Since the WQGIT has many contributing members for developing the SRS documents, it is helpful to track all changes and feedback in a very organized fashion.
4. In developing the SRS documents, it should be clear to all contributors of the documents that they are living documents that can be improved upon over time.
5. It is important for the work plan to address management strategies, gaps and needs that address what is covered in the Phase III Watershed Implementation Plans.



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- Analyze linkages between monitored water quality in the watershed and Bay, and between water quality and living resources.
  - Analyze the impact or influence of restoration and management efforts on water quality and living resources.
  - Enhance CBP models using the improved understanding of trends.
  - Inform management strategies to improve water quality and other outcomes.

## IX. Adaptively Managing

The partnership will use the following approaches to ensure adaptive management:

- In a dynamic environment like the Bay watershed, changes during the next seven years are inevitable. It may be possible to accommodate those changes within the existing Bay TMDL framework without the need to revise it in whole, or in part. The CBP partnership has committed to take an adaptive management approach to the Bay TMDL and incorporate new scientific understandings into the implementation planning in two-year milestones and in Phase III following the Bay TMDL's midpoint assessment. Future adjustments to WIPs and two-year milestones based on changing conditions and the availability of new information is consistent with the CBP's concept of adaptive management.
- The CBP partnership will continue to examine the following questions to address implementation challenges and opportunities, incorporate new data and scientific understandings and refine decision support tools and management strategies, as approved by the PSC, toward the achievement of the water quality outcomes in the 2014 *Chesapeake Bay Watershed Agreement*:
  - What progress had been made in implementing practices for the Bay TMDL?
  - What are the changes in water quality and progress toward applicable water quality standards?
  - Are there fundamental changes due to climate impacts or other factors that require reconsideration of the water quality standards that the Bay TMDL was originally based on?
  - What are we learning about the factors affecting water quality changes to better implement practices?
  - What refinements are needed in decision support tools, monitoring and science?
  - How do we make program decisions in a business strategy that sustains and grows monitoring programs to meet ongoing and growing CBP information needs under recognized economic constraints?
  - How do we best consider the combined impacts of land change and climate variability (storm events and long-term change) on nutrient and sediment loading and implications for the Bay TMDL?
  - What partnership actions can be taken to refine and simplify BMP verification protocols, and what support can the partnership provide to jurisdictions in addressing BMP verification and reporting needs?
  - How do we make the best implementation decisions under economic constraints at the state and local level?
  - How do we best target nutrient and sediment reduction practices to achieve the best outcomes?

- How do we better leverage resources?

## X. Biennial Workplan

A biennial work plan for the 2025 WIP outcome and the Water Quality Standards Attainment and Monitoring Outcome will be developed by April 2019. It will include the following information:

- Each key action
- Timeline for the action
- Expected outcome
- Partners responsible for each action
- Estimated resources

In 2008, the Chesapeake Executive Council charged the seven Bay watershed jurisdictions to develop a two-year milestone process for reducing their respective nitrogen, phosphorus and sediment contributions to the Chesapeake Bay and to track the pace of those reductions. [Two-year milestones](#) are short-term objectives under the Bay TMDL accountability framework used to assess progress towards restoration goals while allowing jurisdictions to flexibly adapt their WIPs to meet those goals.

Partnership-identified actions intended to advance understanding, programmatic and implementation support in the Bay jurisdictions' progress towards implementing the Phase III WIPs by 2025 will be included in the biennial workplan.