**DRAFT Discussion Paper for Applying the CBP Decision Framework to the TMDL Goal**

The Chesapeake Bay Program (CBP) Water Quality Goal Implementation Team (WQGIT) is working to reduce nitrogen, phosphorus and sediment (N, P, and S) in order to achieve water-quality standards in the tidal waters of the Chesapeake Bay and its tributaries. Many WQGIT activities relate to implementing the accountability framework within the Chesapeake Bay Total Maximum Daily Load (Bay TMDL), which draws significantly on adaptive-management principles. This discussion paper is an initial attempt to help the WQGIT apply the new CBP decision framework to the WQGIT’s activities and identify opportunities to improve information for decision making. The major steps of the CBP the decision framework are: articulating program goals, describe factors influencing goal attainment, assess current management efforts (and gaps), develop management strategy, develop monitoring program, assess performance, and manage adaptively.

***CBP Decision Framework Steps and Application for the Bay TMDL:***

**Articulate Program Goals:**

The WQGIT is using the decision framework to address the goals set by the Executive Council in 2009 and/or the Bay TMDL in December 2010:

*Restore water quality to achieve standards for DO, clarity, SAV, and chlorophyll-a in the Bay and its tidal waters by having all practices in place by 2025 that are necessary to reduce nitrogen, phosphorus, and sediment. Practices will be in place by 2017 that would achieve 60% of the necessary pollutant reductions compared to 2009.*

The CBP has conducted and used an extensive amount of science to support monitoring, modeling and research to develop the water quality standards and calculate the N,P and S load reductions needed to achieve the standards. The water quality standards are supportive of other goal areas including habitat (e.g., SAV) and fisheries (e.g., dissolved oxygen).

**Describe factors influencing goal attainment:** There are four major factors that would affect the ability of the CBP partners to achieve the goal:

* Understanding of ecosystem response to pollutant reductions and how its affected by other factors such as weather..
* Identifying the sources and amounts of N,P and S loads.
* Describing the methods (water quality practices and policies) to reduce N, P and S (refer to decision frameworks of WQGIT workgroups).
* The capacity to implement, as well as the implementation of the practices and policies (refer to decision frameworks of WQGIT workgroups).

Below is a brief summary for each factor and some of the uncertainties that need to be addressed to improve information for implementing the TMDL:

* Understanding of ecosystem response. The CBP has scientific knowledge to support the conclusion that implementing practices for reducing N, P, and S loads in rivers and achieve water-quality standards in the Bay. This understanding is based on the current science and the associated CBP modeling system. Better understanding of the following elements could further enhance decision-making: (1) the expected water quality improvements resulting from annual implementation of BMPs; (2) the factors affecting the time it will take to see improvements (i.e., “lag times” between implementation and responses in water quality); and (3) factors in addition to N, P and S reduction that affect response of DO, clarity, SAV, and chlorophyll (4) the relationship among water quality improvements and the recovery of habitat and fish populations (5) the effect of healthy habitats and fisheries on water quality.
* Identifying the sources and amounts of nitrogen and phosphorus and sediment loads. This is currently represented through CBP models, USGS SPARROW models, and supporting monitoring and research. As described in the Bay TMDL document, the sources that are modeled by CBP are based on U.S. Census Bureau and USDA Census data, federal and state permitting data, satellite imagery, and additional data submitted by watershed jurisdictions. …. Some topics to improve understanding and reduce uncertainty include incorporating additional local data, refining information on the transport of loads through the watershed and better predicting future impacts of population growth and climate change in the watershed.
* Methods to identify practices to reduce pollutants. The pollution reduction values associated with N, P and S controls that CBP has approved for use in the models are based on extensive literature reviews and expert panel recommendations. Some topics that would increase CBP’s understanding of the effectiveness and efficiency of practices include 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; change in BMP performance over time; and potential future impacts of climate change on BMP performance.
* Capacity to implement practices. The jurisdictions have described their capacity (funding, authorities, and sustainability) to implement N, P and S reduction practices several times over the past 2 decades. These include the tributary strategies developed during the 1990’s and, more recently, in the Watershed Implementation Plans (WIPs) and two-year milestones, which also included strategies to build capacity in order to achieve pollutant reductions.

 **Assess current management efforts (and gaps):** The overall management efforts needed for reducing N, P and S are provided in the Bay TMDL and elements of its accountability framework. The Bay TMDL, which was released in December, 2010 the identifies the necessary pollution reductions of N, P and S across the six states in the watershed and District of Columbia and sets pollution limits necessary to meet applicable water-quality standards in the Bay and its tidal rivers and embayments. The TMDL sets the Bay watershed allocations for N, P and S per year and their associated reductions from 2009 levels (see Table 1) and the section 6 of the TMDL. Section 6 of the TMDL also contains allocations for each jurisdiction and major river basin. Watershed Implementation Plans (WIPs) were prepared by during 2010 by the six Bay states and the District of Columbia on how to meet pollution allocations and played a central role in shaping the final TMDL.

**Table 1: Summary of Nitrogen, Phosphorus and Sediment Allocations for the Bay TMDL**

|  |  |  |
| --- | --- | --- |
| Parameter | Amount (pounds per year) | Percent Reduction |
| Nitrogen | 185.9 Million  | 25 |
| Phosphorous | 12.5 Million | 24 |
| Sediment | 6.45 Billion | 20 |

The Bay TMDL is supported by a rigorous accountability measures to ensure cleanup commitments are established and met, including short and long-term benchmarks, a tracking and accountability system for jurisdictions activities, and federal contingency actions that can be employed if necessary to spur progress. The accountability framework includes: WIPs, two-year milestones, EPA’s tracking and assessment of restoration progress, and as necessary federal contingency actions if the jurisdictions do not meet their commitments. The accountability framework, which is described in section 7 of the TMDL, is designed to provide reasonable assurance that the reductions in point and nonpoint sources will be achieved for the TMDL. The EPA developed an adaptive management framework in 2009 to help formulate the TMDL and Section 10 of the TMDL describes the use of adaptive management to implement the accountability framework.

To carry out the TMDL accountability framework, the EPA interacts with the jurisdictions through the CBP WQGIT and associated workgroups. The workgroups are focused on supporting the reduction of N, P, and S from key sources described in Section 4 of the TMDL: wastewater, agriculture, urban storm water, forests and air. The information from the workgroups has helped the jurisdictions prepare the Phase 2 WIPs, which provide more detail on practices to be implemented and actions needed to have all practices implemented by 2025 with 60 percent implemented by 2017. The WQGIT is supported by the CBP Scientific, Technical, and Analysis (STAR) team, which contains the modeling and monitoring workgroups. The suite of CBP models and supporting monitoring data which were used to help develop the N,P, and S allocations are discussed in section 5 of the TMDL. The models are also used to assist the jurisdictions in assessing different options for management practices in the formulation of the Phase 2 WIPs.

**Table 2: Overview of Major Sources Focus for TMDL and Associated WQGIT Workgroup**

|  |  |  |
| --- | --- | --- |
| Source | Issues Addressed | WQGIT Workgroup |
| Agriculture  | Concentrated Animal Feeding Operations (CAFOs), Manure, Biosolids, Chemical Fertilizer,  | Agriculture WG |
| Forest | Forest management | Forestry WG |
| Stormwater  | NPDES permitted stormwater, nonregulated stormwater runoff | Stormwater WG |
| Wastewater | Municipal and industrial treatment facilities, Combined Sewer Overflows, onsite systems | Wastewater WG |
| Nontidal (atmospheric) deposition | Power Plants, automatic emissions, industry,  | ? |
| Ocean |  | Modeling WG |
| Stream bank and Tidal Shoreline erosion |  | ? |
| Sediment Resuspension |  | ? |
| Wildlife |  | ? |
| Natural Background |  | ? |

Some gaps in the current TMDL accountability framework include:

* Ecosystem Response-The CBP needs to better explain the effect of BMPs on water-quality changes in the watershed and tidal waters. The jurisdictions would benefit from improved summaries of monitoring results and factors affecting changes in N’P, and S loads in the watershed and progress toward water-quality standards. This information would help with evaluation of 2-year milestones and assessment of the TMDL in 2017.
* Loads: There are gaps in assessing nonpoint source portion of N,P, and S loads at more local scales (county and townships). The Phase 2 WIPs provide more approaches for more local implementation of practices and would jurisdictions would benefit from improved information on local nonpoint sources of N, P, and S. Based on table 2, there are also no workgroups in the CBP WQGIT to address sediment and air sources.
* Practices. There are gaps associated with verification of “voluntary” BMPs have not have been reflected in the current suite of practices in the WIPs and improved tracking to ensure planned BMPs were implemented.
* Capacity –There are potential gaps in funding to implement some practices specified in the WIPs. For example, federal funding for the new Farm Bill and waste-water treatment plan upgrades may be reduced in 2013.

**Develop Management Strategy:**

The TMDL accountability framework provides a management strategy to implement the WIPs through the use of two-year milestones and provides for an evaluation period in 2017. The Phase 2 WIPs present the jurisdiction’s plans to implement practices to meet the TMDL goals for 2017 and 2025.The jurisdictions work with EPA to specify the amount of practices that need to be implemented every two years (milestones) to meet the goals of the TMDL. The jurisdictions have prepared their first TMDL milestones for 2012-2013 and will do so every two years. In addition to the 2-year milestones, the jurisdictions and EPA will have a more in-depth evaluate of progress in the 2017 to help with development Phase 3 WIPs and provides an opportunity revise the TMDL allocations based on watershed model changes and/or demonstration of reasonable assurance (see figure xxx for the accountability framework diagram).

The workgroups in the WQGIT are using the CBP decision framework to prepare more detailed approaches for supporting the implemention of practices in each source sectors listed in Table 2. Some of the considerations they are addressing include funding, government regulations, best availability technology, nutrient “trading”, operation and maintenance, and how to address future population growth in meeting and maintaining the N, P, and S allocations. The workgroups are also looking at needed improvements in data for reporting and analyses of practices for their respective source sectors.

Some steps being taken by STAR to support these management strategies include:

* Assess the potential to use multiple models and establish a modeling laboratory to provide information on more local distribution of N, P, and S loads. A STAR action team has been established to explore options for this activity and what can be accomplished in advance of the 2017 evaluation of the TMDL. The EPA and USDA are also using results from the USGS SPARROW model to identify “priority agricultural watersheds”, which are areas of high nutrient loading to the Bay, to focus water-quality practices.
* Improve verification of implementation of practices.
* Expand monitoring of N, P, and S in the watershed (see next section on monitoring)
* Prepare a report on lessons learned from BMPs and water-quality response to help improve decision making about implementation of practices.
* Provide improved information to focus management strategies to achieve water-quality response in different portions of the estuary that will provide greatest benefit to living resources.

**Develop Monitoring Program—**The CBP has existing monitoring programs, which are described in section 5 of the TMDL, used to monitor (1) N, P and S in the watershed, (2) conditions in tidal waters to assess water-quality standards in the estuary, and (3) tidal habitats and living resources. The CBP also has a reporting process for tracking implementation of management practices. Results from the monitoring and tracking programs are used to update indicators to help assess progress toward implementation of practices and water-quality improvements. Many of the monitoring and assessment activities are provided by the CBP Scientific, Technical Assessment, and Reporting (STAR) team and partner science entities. The CBP, through the STAC, conducted a review of its monitoring programs in 2009, to better align efforts with the anticipated needs of the TMDL and plans future evaluation to determine if changes need to be made to address the needs of the goal teams. Findings from all of the monitoring programs will need to be used to assess of potential improvements for CBP model simulations (by 2015) to help develop the Phase 3 WIPs by 2017. The key indicators and associated monitoring to assess progress toward the TMDL and associated water-quality standards include:

* Implementation of Restoration Efforts: Indicators for the reduction of N, P and S by source, jurisdiction, and overall load reductions. These indicators are based on BMP data submitted by the jurisdictions that are run through the CBP models to estimate progress toward load reductions.
* Changes in N, P, and Sediment: indicators of flow-adjusted trends of N, P and S. These indicators show long-term (25 year) and shorter term (10 year) changes in N, P, and S when annual effect of streamflow variability are removed. The indicators are based on monitoring data collected as part of the CBP nontidal network.
* Indicators of attainment of dissolved oxygen, chlorophyll-a, water clarity/SAV standards. These indicators are based primarily on results from the CBP estuary water-quality monitoring network.

There is additional monitoring and assessment to address the factors affecting annual loads, responses in living resources, and efforts underway to improve monitoring programs. These are summarized for each factor.

* System understanding: The CBP has annual monitoring of river flow to the Bay to help explain yearly changes in DO, clarity/SAV, and chorophyll-a conditions Additional living resources monitoring is used to assess changes in populations of fisheries (crabs, oysters, and selected finfish) that are dependent on DO conditions. Some improvements for monitoring and system understanding include:
	+ Continuous DO may be needed to better assess achievement of the standard.
	+ Monitoring of N, P and S in the watershed has been implemented but there is still a need to enhance small watershed monitoring and assessment to better evaluation BMP efficiency,
	+ Produce reports on lessons learned from BMPs and water-quality response.
* Loads: The CBP and USGS have the River-Input Stations to monitor and help assess annual loads of N, P and S to the Bay which are used to explain changes in estuary water-quality conditions. New techniques are being developed to better compare the N,P,and S load data to TMDL allocations.
* Practices. The CBP is implementing the National Environmental Information Exchange Network (NEIN) system for improved submission of BMP data from the jurisdictions and has a new reporting system—the Bay Tracking and Accounting System, or BayTAS - to help track implementation. The CBP is working with the jurisdictions and federal partners to improve verification of implementation of practices. The CBP also has planned on-going assessment of BMP efficiency based on literature reviews and is setting up expert panels modify existing, or approve new, BMPs which can be used in the CBP WSM.
* Capacity-The capacity to implement practices is being evaluated by EPA review of the WIPs, and future efforts to measure implementation progress relative to annual progress and 2-year milestones. This would be supported by improved tracking of BMPs implementation.

**Assess Performance—**The CBP accountability framework provides the foundation to assess performance toward the TMDL and associated water-quality standards. The established times in the accountability framework to assess performance include:

* **Assessment of Phase 2 WIPs (2011-2012).** EPA is working with the jurisdiction to assess if the Phase 2 WIPs to achieve the TMDL goals. This will be completed in 2012.
* **During the 2-year milestones.** In even years of the milestones, results of previous milestone are assessed and the next round of milestone commitments is assessed. In the odd years, there’s an interim report. All of the results are reported to the EC. This provides an assessment of performance to implement management practices and additional analysis to assess progress toward achieving changes in water-quality trends and standards.
* **2017 evaluation.** The evaluation will likely begin in 2015 includes development of Phase 3 of the WIPs, any potential modifications to the TMDL allocations based on changes to the WSM, and more in-depth assessment of water-quality and living resources changes.
* **2025 attainment of the TMDL**

**Manage Adaptively –**The CBP has employed managed adaptively since beginning to formulate the TMDL in 2009. During 2009-2010, the EPA and jurisdictions prepared and revised version of the Phase 1 WIP to help finalize the TMDL. The TMDL accountability framework, discussed in section 10 of the TMDL, provides the opportunities to manage adaptively from 2011 to 2025. Some specific steps where changes will be made include:

* Management changes are being made based on review of the Phase 2 WIPs.
* Changes will be made during formulation and assessment of each 2-year milestone.
* The 2017 evaluation will provide opportunity for larger changes in CBP models, TMDL allocations, and management strategies during develop of the Phase 3 WIPs.

Some general questions that will be addressed to make the needed management adjustments include:

* What progress had been made in implementing practices (annual progress runs and 2-year milestones)?
* What have we learned to better implement practices (summary document of lessons learned and need to have this done again prior to 2017 re-evaluation)?
* What are the changes in water quality and how does it inform implementation of practices (based on using monitoring data for annual updates of trends in N, P and S and water-quality standards in the Bay)?
* What improvements are needed in modeling, monitoring, and science (based on comparison of monitoring and modeling results and action team(s) to improve models for 2017 re-evaluation)?