

# **CBP Modeling Workgroup Response to PSC Requests for Further Analyses of the Bay's Assimilative Capacity and Future Tidal Deposition of Nitrogen Atmospheric Deposition**

**Briefing Paper for the WQGIT January 21, 2018**

## **Background**

At its December 19-20, 2017 meeting, the Principals' Staff Committee (PSC) agreed that the "draft Phase III Planning Targets for West Virginia and New York reflect the same adjustments provided during the establishment of the 2010 Chesapeake Bay TMDL allocations." The PSC also stated its commitment "to providing those same adjustments in the final Phase III Planning Targets."<sup>1</sup> Therefore, the revised draft Phase III Planning Targets approved by the PSC provide an additional one million pounds of nitrogen and 100,000 pounds of phosphorus to New York, and an additional two million pounds of nitrogen to West Virginia. The total draft Phase III planning target need for the Bay is 201.25 million pounds phosphorus and 14.17 million pounds phosphorus, which includes all the special case load allocations of three million pounds nitrogen and 100,000 pounds phosphorus.

The Chesapeake Bay Program Partnership's Modeling Workgroup, in coordination with the Water Quality Goal Implementation Team, conducted further analyses of the Bay's assimilative capacity and the projected tidal waters deposition of nitrogen atmospheric deposition. These analyses were directed towards determining the total nitrogen and phosphorus loads to the Bay's tidal waters which would still achieve all Chesapeake Bay water quality standards with the inclusion of a 6 percent restoration variance for Maryland's CB4MH Deep Channel segment.

In December 2017 and January 2018, additional Chesapeake Bay Water Quality and Sediment Transport Model scenarios were run by Chesapeake Bay Program Office staff to refine the Bay's assimilative capacity starting from the revised draft Phase III planning targets (201.25 million pounds of nitrogen and 14.17 million pounds of phosphorus) approved by the PSC. These scenarios were structured to incrementally increase the total nitrogen and phosphorus loads from the Susquehanna River and Potomac River watershed (from the proposed December 2017 draft target loads of 198.64 million pounds nitrogen and 14.07 million pounds phosphorus) and assess Bay water quality responses toward the draft Phase III planning targets of 201.25 million pounds phosphorus and 14.17 million pounds phosphorus, which includes all the special case load allocations.

In parallel, Chesapeake Bay Program Office staff worked with counterparts in EPA's Office of Air Quality Planning and Standards to determine if any additional pounds of

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<sup>1</sup> Language from the draft Principals' Staff Committee December 19-20, 2017 meeting summary of decisions and actions currently under review by the PSC chair.

nitrogen from implementation of Clean Air Act regulations beyond 2025 were available to the PSC for allocation to individual jurisdictions.

### **Detailed Assessment of Assimilation Capacity Results**

Based on running a full series of model scenarios, the estimated assimilative capacity of Chesapeake Bay factoring in the PSC's required condition of maintaining no more than a 6 percent nonattainment in CB4MH Deep Channel allows an increase of 500,000 pounds of total nitrogen and 50,000 pounds of total phosphorus from the Susquehanna River watershed, and 1 million pounds of total nitrogen from the Potomac River watershed. The total additional loads available from this assimilative capacity scenario analysis is 1.5 million pounds of nitrogen and 50,000 pounds of phosphorus. It is important to note that all loads estimated in this analysis are completely freely exchangeable among all basins and between nitrogen and phosphorus.

However, additional model scenarios based on atmospheric deposition of nitrogen to tidal water were specifically structured to evaluate incrementally higher allocation loads to the Susquehanna and Potomac, the two major river basins where New York and West Virginia, respectively, were located. The accompanying January 22, 2018 presentation to the WQGIT provides more details on the actual scenarios run and the resultant Chesapeake Bay water quality standards attainment responses to the incremental increases in nutrient loads.

### **Available Loads from 2030 Atmospheric Deposition to Tidal Waters**

In addition, an estimated additional reduction 800,000 pounds of total nitrogen (almost entirely comprised of nitrogen oxides or NO<sub>x</sub> load reductions) beyond EPA's atmospheric deposition to tidal waters load allocation of 15.7 million pounds total nitrogen is projected to be available in 2030. Two questions needed to be answered with regards to the use of these additional load reductions by the Partnership.

The first question is, given the atmospheric deposition load reductions are estimated to occur after 2025 (at which point there is only an estimated additional reduction of 100,000 pounds of total nitrogen beyond EPA's allocation), can the Partnership take credit for and allocate these additional pounds based on reductions that have not yet taken place? The answer is yes for two specific reasons.

The Partnership has a long history of crediting practices, treatment, technologies, and programs which have been implemented on the ground, but due to the nature of the means for reducing the nutrient and sediment pollutant load, the Bay may fail to see the benefit of the pollutant load reduction actions for many years, perhaps decades, due to lag times. A great example is a commonly applied practice of planting riparian forest buffers. There are decades of scientific findings demonstrating the riparian plantings effectively work to reduce nitrogen loads to local streams and rivers. However, once planted, the individual trees will take years to grow to heights and root zone depths at

which their effectiveness in reducing nitrogen loads matches the Partnership approved pollutant load reduction efficiency which is credited to the reporting jurisdictions. In the case of Clean Air Act implementation, there are corresponding lag times in emission/deposition reductions due to fleet turnover of all mobile sources including on-road, off-road, and marine, as well as ongoing reductions from the CAFE fuel standard and other regulations. So there is a direct parallel between implementation of Clean Water Act land-based BMPs and implementation of Clean Air Act regulatory programs, both of which can be tracked, verified, reported and credited under the Partnership's Bay TMDL accountability system. Both sets of implementation actions have recognized time lags between implementation and when Bay tidal waters received the reduced pollutant loads.

Chesapeake Bay Program Office staff followed up with EPA's Office of Air Quality Planning and Standards and confirmed that the state and federal Clean Air Act regulatory programs resulting in the estimated additional total nitrogen reductions were in place and being implemented prior to 2025. Two exceptions were noted. The emissions used in the 2030 scenario included estimated reductions from the Clean Power Plan, currently under review by EPA. However, these same emissions did not include reductions that will take place to achieve the 2015 National Ambient Air Quality Standards as the states have not developed implementation plans to reach the new 70 ppb standard. Recognizing that the emission reductions necessary to achieve the 2015 National Ambient Air Quality Standards will likely be higher than those estimated for the Clean Power Plan, these two exceptions should not influence the current 2030 estimated additional nitrogen load reductions to tidal waters.

The second question is, given these 2030 estimated additional nitrogen load reductions to tidal waters will be distributed across all of the Chesapeake Bay's tidal waters, not just in the upper Chesapeake Bay or the tidal Potomac River, how much of these estimated reductions can be reasonably allocated back upstream to New York and West Virginia (or other jurisdictions)?

The Chesapeake Bay Program Office's Modeling Team estimates that nitrogen atmospheric deposition loads to the tidal Bay have an influence on Bay hypoxia equivalent to a factor of 0.97 and 1.13 at the Susquehanna and Potomac fall lines, respectively. This means that for a reduction of each 100,000 pounds of nitrogen atmospheric deposition direct to the Bay's tidal waters below EPA's 15.7 million pounds of nitrogen atmospheric deposition to tidal waters allocation, the Partnership can decide to either increase loads at the Susquehanna River fall line by 97,000 pounds or at the Potomac River fall line by 113,000 pounds based on the nitrogen exchange rates between basins and tidal atmospheric deposition. Therefore, loads from the Susquehanna River could be increased by 776,000 pounds or loads from the Potomac River could be increased by 904,000 pounds.

The reason for relatedly high equivalent loads of nitrogen atmospheric deposition loads to tidal waters is that essentially most of the reductions in nitrogen load are from nitrogen oxides which are the preferred nutrient species for uptake by algae in the Bay. So even if the nitrogen atmospheric deposition loads to tidal waters are spread across the Bay's surface waters, they have a high relative impact on Bay dissolved oxygen conditions compared nitrogen loads from the watershed. In addition, the watershed nitrogen loads are composed of a variety of nitrogen species including organic forms of nitrogen which are less available for uptake by algae in the Bay and, therefore, have less impact on Bay water quality conditions.

### **Additional Nutrient Loads from Assimilative Capacity and Tidal Deposition of Nitrogen Atmospheric Deposition which can be Allocated**

The key findings from the above described analyses and scenarios are summarized as follows:

- The revised estimated assimilative capacity of Chesapeake Bay, factoring in the PSC's direction to maintain no more than 6 percent nonattainment in CB4MH Deep Channel allows an increase of 0.5 million pounds of total nitrogen and 50,000 pounds of total phosphorus at the Susquehanna River fall line, and 1 million pounds of total nitrogen at Potomac River fall line.
- All loads reductions at these major river basins' fall lines are completely freely exchangeable among all basins and between nitrogen and phosphorus.
- For a reduction of each 100,000 pounds of nitrogen atmospheric deposition direct to the Bay's tidal waters below EPA's 15.7 million pounds of nitrogen atmospheric deposition to tidal waters allocation, the Partnership can decide to either increase loads at the Susquehanna River fall line by 97,000 pounds or at the Potomac River fall line by 113,000 pounds. Therefore, loads from the Susquehanna River could be increased by 776,000 pounds or loads from the Potomac River could be increased by 904,000 pounds.

### **Three Options for Applying the Estimated Additional Nutrient Loads**

The Principals' Staff Committee committed to provide for additional 1 million pounds nitrogen and 100,000 pounds phosphorus for New York and 2 million pounds nitrogen for West Virginia at the Susquehanna and Potomac fall lines, respectively. While there are an infinite number of options for applying the estimated additional nutrient loads to New York and West Virginia special cases, three key options were examined. The first option applies all estimated additional nutrient loads to New York to entirely satisfy its special condition, with the remainder going to West Virginia. The second option applies all estimated additional nutrient loads to West Virginia to entirely satisfy its special condition with the remainder going to New York, while the third option apportioned the

additional nutrient loads equally among New York and West Virginia as shown in the table below.

**TABLE OF OPTIONS FOR APPLYING THE ESTIMATED ADDITIONAL NUTRIENT LOADS**

	<b>New York</b>	<b>West Virginia</b>
<b>Additional Nutrient Loads Committed to by the PSC</b>	1,000,000 N 100,000 P	2,000,000 N
<b>Option 1:</b> Fully address New York’s needs first, with the remainder going to West Virginia	1,000,000 N 100,000 P	1,180,000 N
<b>Option 2:</b> Fully address West Virginia’s needs first, with the remainder going to New York	420,000 N 50,000 P	2,000,000 N
<b>Option 3:</b> Apportioned equally between New York and West Virginia	890,000 N 25,000 P	1,520,000 N

**OPTION 1: ALL ESTIMATED ADDITIONAL NUTRIENT LOADS TO NEW YORK WITH THE REMAINDER TO WEST VIRGINIA**

Using the refined assimilation capacity estimates and the 2030 estimated freeboard below the allocation of atmospheric deposition to tidal waters, the New York special case of 1 million pounds nitrogen and 100,000 pounds phosphorus at the Susquehanna fall line can be fully satisfied. The West Virginia special case of 2 million pounds nitrogen at the Potomac River fall line be only partially fulfilled by a little more than half, or an estimated 1.18 million pounds nitrogen

**OPTION 2: ALL ESTIMATED ADDITIONAL NUTRIENT LOADS TO WEST VIRGINIA WITH THE REMAINDER TO NEW YORK**

Using the refined assimilation capacity estimates and the 2030 estimated freeboard below the allocation of atmospheric deposition to tidal waters, the West Virginia special case of 2 million pounds nitrogen at the Potomac River fall line can be fully satisfied. The New York special case of 1 million pounds nitrogen and 100,000 pounds phosphorus at the Susquehanna River fall line be only partially fulfilled by less than half or an estimated 420,000 pounds nitrogen and 50,000 pounds phosphorus.

**OPTION 3: ALL ESTIMATED ADDITIONAL NUTRIENT LOADS SPLIT EVENLY BETWEEN NEW YORK AND WEST VIRGINIA**

If the estimated additional nutrient loads are apportioned equally among New York and West Virginia, then the New York and West Virginia estimated shortfalls in the special case loads would both be a little more than half of the full special case condition with New York receiving 890,000 pounds of nitrogen and 25,000 pounds of phosphorus toward their special case and West Virginia receiving 1.52 million pounds of nitrogen towards their special case.

## **Current Status and Next Steps**

### **NEW YORK**

CBPO staff re-ran the allocations methodology using the Phase 6 suite of models factoring in a 1985 No Action base year (versus the same approach using the 2010 Phase 5 suite of models) and generated very similar additional nitrogen and phosphorus loads—1.14 million pounds total nitrogen and 100,000 pounds total phosphorus with the Phase 6 model suite—as provided to New York under the 2010 Chesapeake Bay TMDL—1 million pounds total nitrogen and 100,000 pounds total phosphorus with the Phase 5 model suite.

### **WEST VIRGINIA**

CBPO staff is in the process of working with West Virginia colleagues on correctly translating their Phase II WIP level of effort into the Phase 6 Watershed Model to more accurately determine how much additional pounds West Virginia needs to be fully consistent with what they received under the 2010 Chesapeake Bay TMDL.

### **ACCOUNTING FOR REMAINING SHORTFALLS**

Once the work with West Virginia is completed, CBPO staff will quantify how the remaining shortfalls illustrated in the three options above could be covered by spreading the remaining needed additional nutrient loads reductions across the remaining five jurisdictions following the Partnership's allocation methodology.