



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION III  
Chesapeake Bay Program Office  
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Dr. Chris Pyke, Chair  
Scientific and Technical Advisory Committee  
US Green Building Council  
2101 L Street, NEW Suite 500  
Washington, DC 20037

Dear Dr. Pyke:

Thank you for the opportunity to respond to the STAC Hydrodynamic Workshop recommendations and to also address the specific recommendations of your October 21, 2011 and January 18, 2012 letters. We note that STAC has also recommended the application of multiple models in the Chesapeake Bay Program (CBP) in its *Review of the LimnoTech Report, "Comparison of Load Estimates for Cultivated Cropland in the Chesapeake Bay Watershed"* and that we've responded to that recommendation in my letter of December 21, 2011. In addressing the Hydrodynamic Workshop recommendations, this letter expands on the broader application, beyond watershed modeling, of multiple models in the Chesapeake Bay Program as you have requested.

In addition, the National Research Council's (NRC) review of the Chesapeake Bay Program recommended establishing a Chesapeake Bay Modeling Laboratory, which implicitly calls for the development of multiple Chesapeake Bay models. The NRC recommendations in particular will require broader consideration by the larger State and Federal agencies of the Chesapeake Bay Program and will take place later this year.

We recognize that the field of watershed, atmospheric, and estuarine environmental modeling is active, dynamic, and expanding rapidly. This will bring change and opportunity in how we do environmental modeling in the Chesapeake Bay Program. While there is broad agreement by EPA and the Management Board with the recommendations of the Hydrodynamic Model Workshop, we also recognize the regulatory nature of the Chesapeake TMDL and our specific State and Federal responsibilities, schedules, and priorities that can, in some contexts, create difficulties in the implementation of a multiple model approach.

The National Research Council's recommendations, which are further backed by the recommendations from the Hydrodynamic Modeling Workshop panel to *form a modeling laboratory in order to support multiple CBP models*, requires Bay Program-wide deliberation on how multiple models could be applied in a regulatory TMDL framework. The role of multiple models in the CBP will need to be resolved at both the technical and management levels. In addition, the resources

required, and the actual institutional sponsorship that could support multiple models also needs to be considered by all the Bay Program partners. We expect to begin this Bay Program-wide consideration of the role of multiple models in April 2012 after completion of deadline sensitive work on initial Phase II Watershed Implementation Plans by the Program partners.

### **Specific responses to the five key workshop recommendations**

#### ***Workshop Recommendation 1. Use multiple models to provide better confidence in model output and uncertainty estimates.***

We agree that a community of scientists and engineers actively using operational models of the Chesapeake watershed and estuary is a superior approach that provides for greater collaboration opportunities and useful comparisons among various models. The Chesapeake Bay hydrodynamic modeling community (using ROMS, CH3D, FVCOM and other models) and the watershed modeling community (using HSPF, SPARROW, and SWAT) are furthest along with the application of multiple models in the Chesapeake Bay Program.

In the watershed too, multiple models are being used and accepted as part of management decisions in the Chesapeake Bay Program. An example is the use of SPARROW by the State and Federal agencies throughout the watershed to assist in nutrient and sediment BMP targeting. Another example is in the application of the findings of the SPARROW Model in spatial differences in the rate of denitrification in Chesapeake rivers which was ultimately incorporated into the Phase 5.3.2 Watershed Model. The Chesapeake SWAT application is another example of the multiple CPB watershed models.

The fact that the watershed and hydrodynamic modeling communities are furthest along in the application of multiple models may be due in part to a unique characteristic shared by both the watershed and hydrodynamic models. Both modeling communities have model applications that are operationally upstream of estuarine water quality simulations that must rely on inputs from the watershed and hydrodynamic models. An estuarine water quality simulation is calibrated partly in response to the watershed and hydrodynamic model inputs. Accordingly, multiple models in water quality are more complex and difficult because of the multiple potential inputs that could potentially be used. The case of living resource models that rely on water quality models as their base are necessarily even more complex in a multiple model context. This is a key point because the assessment of the Chesapeake TMDL water quality standards of DO, chlorophyll, and water clarity ultimately requires an *integrated modeling system* including watershed, hydrodynamic, water quality, living resources, and airshed models. Marginal improvements in a single component of the model system have to be considered within this larger context.

Model modularity (discussed in Workshop Recommendation 4) may address some of these challenges and could be part of the next logical step in implementation of multiple models in the Chesapeake Bay Program.

***Workshop Recommendation 2. Use open source community models so that many modelers can sift through the model to find different computational approaches and errors. Using open source models would also increase the confidence in the models among the scientific community.***

We also fully agree with this recommendation. The Chesapeake Bay Program has been an early adopter of open source, public domain models and all of the TMDL models used by the CBP are open source and public domain as will be any future modeling system receiving CBP support. We would be pleased to work with STAC to improve accessibility to the model and its source code.

***Workshop Recommendation 3. Allow the scientific community to evaluate the skill of all future models quantitatively.***

We fully concur and will support and provide for, within reasonable resource constraints, any and all quantitative assessments of aspects of CBP model skill, and agree that this assessment could be part of the criteria for model selection.

The specific recommendation in your October 21, 2011 letter that ***any future hydrodynamic/water quality model shall be selected through quantitative skill assessment and an independent peer review process*** will need to be considered in light of the larger needs of the Chesapeake regulatory TMDL models. As previously mentioned, a system of models from the watershed to estuary will be needed for the 2017 Mid-Point Assessment of the Chesapeake Bay Program, and any application of multiple models in the Bay Program will need to be used within this system for TMDL decision making utility. Taking precedent in all decisions regarding the suitability of specific models to apply in the Bay TMDL assessment will be management decision-making needs, and TMDL decision and model delivery deadlines of Bay Program State and Federal agencies implementing regulatory nutrient and sediment controls. Within this context, the CBP partners are committed to continuing to improve the accuracy, utility, and reliability of the modeling effort and in this spirit the role of multiple models in the Bay TMDL decision process will be carefully considered.

***Workshop Recommendation 4. Implement models in a modular fashion so they can be easily used and tested by modelers inside and outside the CBP.***

We fully agree with this recommendation. In July 2011 EPA agreed to work within the Community Surface Dynamics Modeling System (CSDMS) [http://archive.chesapeakebay.net/pubs/calendar/11636\\_07-12-11\\_Presentation\\_2\\_11259.pdf](http://archive.chesapeakebay.net/pubs/calendar/11636_07-12-11_Presentation_2_11259.pdf) to develop modular simulations of the watershed, hydrodynamic, and water quality models. A key first step will be modularity of the CBP watershed models to hydrodynamic and water quality simulations of the Chesapeake. We are working on a system that will more easily allow any estuarine hydrodynamic or water quality model to use outputs from the watershed model and look forward to making progress on this work in the coming year.

***Workshop Recommendation 5. Form a virtual Chesapeake Modeling Laboratory to enable the successful implementation of the recommendations above.***

Here timing is an issue. The application of multiple models in a TMDL regulatory context has yet to be resolved by the EPA or the CBP, and establishment of a Chesapeake Modeling Laboratory will require the full support and guidance of all the Chesapeake Bay Program partners. In addition,



funding to support CBP multiple modeling will likely need to come from multiple sources and agencies in a collaborative approach. These decisions will take careful deliberation by the Bay Program partners in 2012. The specific recommendation in your October 21, 2011 letter that ***STAC strongly encourages the EPA to direct a portion of its modeling funds each year to the modeling community to develop and run multiple hydrodynamic/water quality models*** needs to be considered in light of congressional budget decisions and competing demands and priorities.

Your letter of January 18, 2012 suggests a constructive avenue of approach, which is for the CBP to begin to introduce a multiple model assessment of shallow water modeling to refine our assessment of shallow water SAV/clarity and open water DO water quality standards. A demonstration project in a well monitored and characterized system like the Gunston Cove would serve as a prototype for the application and assessment of multiple models. The EPA is now examining the potential to fund a few prototype shallow water models this year. To move this forward, we would welcome STAC's assistance in implementing a prototype multiple modeling strategy involving both skill assessment and peer review for the identification of models that best match observations in the shallow water systems of Chesapeake Bay. Specifically, an open STAC workshop that would "identify (1) technical requirements for these models, (2) [identify, assess, and rank] potential model candidates, and (3) [develop] model inter-comparison requirements ... needed to ensure adequate skill assessment and peer review" in a test-case shallow water system would be welcome.

Please extend my gratitude to the workshop steering committee and participants for their time and effort in developing the Hydrodynamic Modeling Report. We remain appreciative of STAC's role in providing independent reviews and guidance for improving our management of the Chesapeake Bay TMDL and restoration effort.

Sincerely,



Nicholas A. DiPasquale  
Director