Discussion of the Elements of Research, Development, and Operations relative to a proposed Chesapeake Bay Modeling Laboratory

Restoration of the Chesapeake Bay and its watershed will call for the implementation of management practices requiring tremendous public and private investments. Prudent and effective decision making will need to be informed by models with the highest possible scientific backing and by models receiving a high degree of confidence from managers and stakeholders. Further, the model operations must be agile enough to quickly respond to requests for scenarios. To provide those involved with the restoration effort with the highest degree of responsiveness and confidence, the Modeling Lab Action Team (MLAT) has identified the following four essential functions of models for the Chesapeake Bay Program.

Operations Model operations are defined here as the rapid and automated development of scenarios. The Chesapeake Bay Program (CBP) Partnership currently runs 100-200 scenario builder and watershed model runs per year with a lesser number of land use change model and estuarine model scenarios. These scenarios support the TMDL, the WIPs, Progress runs, Milestones, ad-hoc questions from partners, and collaborations with university, state, or federal partners. Many of the person-hours involved in these scenarios are in the communication with partners about appropriate inputs and interpretation of the output.

Operational Development The modeling teams at the Chesapeake Bay Program Office (CBPO) perform a significant amount of programming and development work that supports the ability of the CBPO to efficiently run scenarios and to quickly respond to decisions made by the partnership. These generally are not to develop new models, but to enhance the abilities of the current models to incorporate new information, to run more efficiently, or to be calibrated more effectively. A few examples may be useful.

1. The scenario builder and watershed modeling teams are frequently asked to incorporate new types of BMPs. This can often be accomplished with a minimum of additional programming.
2. The partnership may also wish to investigate different algorithms for estimating manure application to cropland. This type of task involves software development or modification.
3. The watershed model is a vast system of small model runs with complex dependencies. Certain scenario-intensive tasks such as climate change investigations require a different parallel mode structure than a typical single scenario for optimal performance. Development and maintenance of multiple parallel methods is a significant task.
4. The partnership co-develops the automated calibration method for the watershed model through the modeling workgroup. Modifications to the calibration method can require extensive code modification.
5. Linkages among models require development and maintenance as models change or as scenarios change sources of loads.
6. The CBPO is frequently requested to provide inputs to other models. This requires a method to link the geography and data types.

Research-Oriented Development New models can be developed or old models can be modified to add new processes to the CBP modeling suite or to answer research questions. This type of model development consists of conceptual modeling, code development, testing, and model validation. To become a part of the CBP modeling suite, an input to the suite, or as a stand-alone model to answer a separable management question, the developed model must be implementable with available data and computing resources at a spatial scale relevant to

management. Care must be taken during the development process to adequately represent the scientific knowledge while producing a model that is appropriate to its intended purpose. .

Research Managers, modelers, academics, and other partners frequently ask questions that the current CBPO suite of models are not ideally equipped to answer. Two recent examples from the Scientific and Technical Advisory Committee (STAC) are how to incorporate lag times in the modeling and decision process and how to describe and integrate the effects of the spatial placement of land within a watershed. These questions are raised, but there is no current mechanism to get answers for watershed-related questions other than waiting for the scientific community to take these tasks independently. Historically, the estuarine model development has been informed by directed research sponsored by the US Army Corps of Engineers.

The discussions in the MLAT have revealed that the CBPO modeling teams are focused on operations and operational development with little time or resources developed to research or research-oriented development. Additionally, the MLAT feels that it is important that operations and operational development stay within the CBPO so that the current responsiveness to the partnership can be maintained. The MLAT sees an urgent need for a separate Chesapeake Bay Modeling Lab (CBML) that focuses on research and research-oriented development. It is clear that there must be very strong ties between the CBP, the CBPO modeling teams, and the CBML to guide the CBML in creating products that are responsive to management needs.

Key questions still to be discussed in MLAT
What would be the governance structure of the CBML?
Would the CBML be a physical location, a completely virtual lab, or a hybrid?
How would the CBML be funded?