Modeling Quarterly Review Meeting

August 9-10, 2016
CBPO Conference Room - The Fish Shack
410 Severn Avenue Annapolis, MD 21403
Event webpage: http://www.chesapeakebay.net/calendar/event/24232/

MINUTES: August 9

Phase 6 Watershed Model Schedule Update – Lee Currey, MDE and Dave Montali, WVDEP

Attachment A.1, *Attachment A.2*

- As a reminder, the Beta 3 webinar will be held over the coming weeks. Like the Beta 2 webinar preceding it (found under the projects and resources tab of the modeling webpage), it will cover changes between Beta versions and further outline the process of Phase 6 refinement.
- Over the next few months the Modeling Workgroup will continue providing feedback to support decision making, particularly in regards to climate change and the influence of Conowingo in setting targets. A series of schedule deadlines and goals were further outlined in Lee's presentation of the Midpoint Assessment timeline as well as the timeline of deliverables set for the Modeling WG.
    - The final Phase 6 land cover land use is scheduled to be delivered to the Modeling WG by December 1, 2016.
    - A fatal flaw review period will also be built into the revised review period, and will occur in spring 2017.
    - April-May 2017 will be the time period in which the partnership fatal flaw review is expected to occur. There may need to be a better crystallization about what constitutes a fatal flaw. These changes are expected to not just be minor tweaks, but will encapsulate what the Modeling WG cannot live with in terms of the way in which the model impacts decision making
- Zoe Johnson asked whether the STAC Watershed Model (WSM) review will be separate from the STAC climate review.
    - Lew noted that an additional review may not be required if it was thoroughly covered by the other STAC reviews. However, the Modeling WG will remain flexible and keep this point on the list to see if it can be incorporated.
- The Modeling WG is trying to help decision makers better determine how an integration of climate change and Conowingo infill impacts can move the partnership towards allocation decisions.
- Review of the beta versions of the model greatly help to guide changes that the modeling team can implement with partnership input, and further input by members will continue to benefit the review process.
    - Alisha has already helped to provide some essential contributions and comments on the beta versions of the model.
- ACTION: The STAC comments and reviews will be added to the CBP Modeling Projects page as they are finalized.

Summary of Phase 6 Progress over the Last Quarter - Gary Shenk, USGS and Gopal Bhatt, PSU
Attachment B

- Gary set the stage and helped to provide the emphasis for the changes in the Phase 6 Beta 3 model, reviewing the different tasks and focuses of the Beta models.
- The Beta 2 documentation is on the Modeling WG's website, and documentation for Phase 6 Beta 3 is currently underway
- In Beta 2, the modeling team completed all the tasks outlined before in the flow chart of to-do items. Beta 3, on the other hand, was the first big calibration effort.
    - Calibration for Phase 6 is fundamentally different than calibration in previous phases, which used an automated method.
    - In Beta 3, and Phase 6 generally, the purpose of the calibration routine is to review and examine all of the different factors that are being used to put together the WSM and evaluate whether or not they make sense together, and whether individual pieces are causing specific problems when comparing monitored and modeled loads.
    - This new and different calibration process forces the modeling team to carefully consider each of these processes. Formerly, inputs were solely treated as inputs and rate parameters were altered in order to meet calibration standards. This revised process still incorporates pieces of the older method, but what can be done with rivers and other parameters is much more constrained, forcing a re-examination of all prior assumptions.
- This new calibration process (as well as the partnership) emphasized the need for a second look at average loads. These average loads are first developed by estimating total non-point source loads from monitoring stations. After obtaining those estimates, the average loads by sector are developed with the help of a multiple model approach (Phase 5.3.2, SPARROW, and CEAP).
    - Following these steps, the relevant WQGIT workgroups divided different loads up by sector based on their expert understanding.
- This was all put together in a stepwise fashion. All land loading rates seemed to be too high. This led the modeling team to the conclusion that the size of the "pie" of loads to distribute among land uses in Beta 2 was too large to begin with.
- The Modeling Team then went back to examine assumptions about the size of the overall amount of loads to be distributed, and the biggest assumption was that attenuation in rivers was the same as that used in Phase 5. A review of the literature and conversations with denitrification experts led to the conclusion that there is much less nitrogen processing in large rivers than was originally expected. This lessening of attenuation allowed for a reducing of the total loads that were to be subdivided, which in turn produced much more reasonable answers for land use loading rates.

Phase 6, Beta 3 Calibration – Gopal Bhatt, PSU and Gary Shenk, USGS
Attachment C

- Gopal introduced and reviewed updates to the model, comparisons with past versions of Beta models, the inclusion of rSAS, and results from the new methodology of Beta 3.

- Karl asked if the SPARROW run that was used had incorporated the new land uses derived from the land cover information that Peter Claggett provided.
    - Gary explained that the Modeling Team does expect to update SPARROW once the final land use is obtained. However, in setting the targets models were used that don't have the same precise inputs as Phase 6. Optimally, the updated SPARROW will be used but it could also be considered reasonable to use any version of SPARROW since none of the multiple models have the exact same inputs. If circumstances don't allow the use of the latest SPARROW model, then it won't be a fatal flaw.
- There were numerous new assumptions that helped to drive a more than doubled increase in AFO/CAFO loads. This change was a result of several different assumptions for Phase 6 loads that were used in Beta 3
    - States provided estimates of the percent of time animals spent in the barnyard which defines the AFO/CAFO load, e.g. if the animals spent 20% of their time in the barnyard, then 20% of the manure would be assigned to the AFO/CAFO load. The states are still revising these estimates.
    - New literature values showed greater N:P ratios, compared to Phase 5 (higher nitrogen values per pound of manure from AFO/CAFO operations).
    - Changes in BMP submissions from the states, which may have not had coverage for the animals for animal waste management storage systems.
    - There is also a panel studying animal waste management storage systems to provide a general idea as to how much of the manure from the barnyard can actually be lost in an effort to try and improve on Phase 6 assumptions.
- Other changes in phosphorus noted are likely driven by the settling of phosphorus in the rivers, instead of algal uptake. Overall, there is a decrease in river losses, which are driven by estimates produced from SPARROW.
- Karl asked if there were any estimates about how the mass balance loss in the Conowingo area compares to Phase 5.3.2.
    - Gopal noted that this is not the Phase 5 or Phase 6 model, rather this is directly examining WRTDS input and output and the resultant pass through factor. It is likely that there was a higher difference in the Phase 5 model, as there were higher attenuation rates.
    - Tom Sullivan asked whether this was based on an implicit assumption that WRTDS is a good application for the Conowingo gage.
        - From the standpoint of the Modeling WG, the approach outlined by Gopal follows a path using multiple lines of evidence. The approach uses Langland bathymetry, the Corps of Engineers' Lower Susquehanna River Watershed Assessment (LSRWA) report, the work produced by Gomez and Sullivan, and WRTDS estimates. Putting all these lines of evidence together can help to produce a more accurate assessment. This approach leans heavily on advice provided during the STAC Conowingo workshop.
- Lee emphasized that it is important to understand what is driving some of the decisions at the different monitoring stations, and there is a great deal to absorb in terms of the changes of the model.
    - Gary noted that SPARROW is only looking at overall attenuation, and not any particular process. There is still an under-constrained problem because of all these

processes, a big driver of which could be changes in seasonality as speciation and seasonality go into decision rules for river optimization. There will have to be a dialing back of denitrification to a further extent. Some of the un-optimized parameters were also reduced, specifically the production of benthic algae that was introduced in the Phase 4 model.

- Karl asked if the changes in settling would necessarily have management applications.
    - The planning target methodology depends upon the riverine delivery multiplied by the estuarine delivery. If the changes in delivery are similar everywhere and the same ordering of basins holds, then planning targets won't change. However, if there is a different spatial distribution of delivery then that will change the planning targets. The general point that Karl made is correct: the same set of BMPs will produce the same percentage reduction generally across the watershed.
- All simulations now have lag times in both the landscape and the HSPF representations of river simulation. UNEC is still being utilized for the watershed scale as rSAS necessitates significant computation efforts.
    - Gary noted that it may benefit the modeling team to keep UNEC for calibration runs while rSAS can be used as a discovery model to test questions for management, effects of climate change on lag times, etc.
    - The parameters for lag time specifications within UNEC are also being gathered from Ward Sanford's work.
- ACTION: Follow up with Gopal to determine an August date for the Beta 3 webinar.

Climate Workgroup Recommendations on Climate Change Impacts on Sea Level Rise and Tidal Wetland Loss – Mark Bennett, USGS
Attachment D

- Mark summarized the recommendations that emerged from both the STAC workshop in March 2016 as well as the recommendations provided by the Climate Resiliency Workgroup, which answered questions as to which variables are of greatest importance, what characteristics of the variables needed to be considered, among others.
- For 2025, the recommendation of climate impacts for study involved the use of historical trends to determine projections, which is really a 30 year projection from the starting point of 1995.
- There is a great deal of variability in models with multi-decadal oscillations, and it is important to examine longer term datasets that can help to explain anticipated future variability.
- Mark also provided a list of recommendations put forth by the Climate Resiliency Workgroup, which were developed with the assistance of Capt. Emil Petruncio, USNA, and Robert Kopp, Rutgers.
    - Both researchers emphasized a range of rising sea levels that could also help to capture interannual variability
- As to what the Modeling WG can do with a range of SLR scenarios, Lew suggested that the Modeling Team could take two scenarios and then interpolate as a stand-in for others due to time constraints. If the Modeling Team is then asked to further analyze the tradeoff for decision makers then that can be pushed, but runs of four separate SLR scenarios is unlikely to be completed.

- Mark suggested that it may be necessary to circle back to the larger Climate Resiliency Workgroup to get more input regarding such an interpolation strategy.
- Lee noted that the Climate Resiliency WG has done a great deal to help provide a great amount of specific recommendations and then asked what can be reasonably estimated with the use of these tools.
    - ACTION: Use this list in conjunction with the modeling team's schedule to determine what can and cannot be done given timeline constraints.

Climate Change Simulation Approach – Gopal Bhatt, PSU and Kyle Hinson, CRC
Attachment E

- Kyle presented an approach to simulating Climate Change within the WSM, using an ensemble of downscaled General Circulation Models (GCMs) to analyze changes to simulated flow, and loads in TN, TP, and TSS in both 2025 and 2050.
- Numerous issues were brought up related to the choice of models and methods for different time frames that were incongruous with recommendations provided by STAC in their 2016 workshop on this issue, for which a final report is soon to be released.
    - ACTION: Use long term trends determined from Karen Rice's (USGS) analysis of precipitation over the past approximately 90 years to evaluate the change in flow and loads in 2025.
    - ACTION: Follow up with Lee, Mark Bennett, Zoe Johnson, Lew Linker, and any other experts about the choice and method of implementing downscaled GCMs to determine changes by the year 2050.
    - ACTION: Explore the potential for drop-offs in BMP efficiencies resultant from anticipated changes in precipitation intensity.
    - ACTION: Further study the mechanisms that are producing dramatic increases in changes of loads, particularly with regards to enhanced wash-off and subsequent greater phosphorus and sediment loads.

Mass Balance Estimate for Ammonia Emission Controls – Gary Shenk, USGS-CBPO and Lew Linker, EPA-CBPO
Attachment F

- Gary introduced the topic and expressed that the Modeling Team is looking for weigh-ins from the Modeling Workgroup about how to handle the simulation of BMPs that affect the emission of ammonia.
- These were not treated in Phase 5, although there were previous discussions about the methodology. The Watershed Technical Workgroup is looking for the Modeling WG's recommendation, based on the three options outlined in Gary's presentation.
- The three options to deal with the outlined processes:
    - Credit can be applied everywhere to everyone within the Bay watershed.
    - Credit can be applied by county since atmospheric deposition is a county based dataset.
    - Credit the practice and individual who implemented the BMP.
- The cover and manure technologies both need these answers, but the question remains as to how the Modeling WG should propose doing it.

- The amount of manure coming down on crops is also affected by the BMPs. There's some reduction of nutrient volatilization that occurs on a farm. Some reduction means that some ammonia will be applied to the land and, subsequently, the Bay.
- ACTION: A decision to use the methodology of applying the overall effect directly to the BMP itself, a reasonable approach because of its very small impact on a very broad area, was agreed upon by the Modeling WG. A simple accounting approach seems reasonable since its impact is unlikely to even be seen or affect the model's calibration. The Modeling Team will sharpen the estimates as best they can, and will bring back refined numbers with the simplistic, more straightforward method.

Capping Potential Load Reductions in the Phase 6 Model – Matt Johnston, University of Maryland and Gary Shenk, USGS
Attachment G

- Matt asked whether or not the Modeling WG was supportive of an approach that involves limiting the potential efficiencies of upslope land use BMPs, in order to produce and return results back to the October quarterly meeting.
- Karl pointed out that the regulatory target language for stormwater emphasizes that flow should "be equivalent to flow from woods in good condition", meaning that the efficiencies of BMPs shouldn't be able to reach below the loading rates of forest although it does. What does the literature say?
    - The 85% efficiency is a carryover credit of past BMP panels which may have possibly been too optimistic.
    - The stormwater panel laid out how much could be treated per inch of volume, which were much lower than the initial estimate. However, states are still permitted to submit infiltration practices.
    - There is not a review possibility of returning to revise all of the BMPs that were determined previously. It is easier to simply cap all BMPs at a particular value that is a more reasonable estimate.
- The Modeling WG agreed that without fully understanding the context of the problem, it was difficult to provide any kind of solid recommendation.

Modeling Workgroup Membership Update – Lew Linker, EPA-CBPO
Attachment H

- Lew presented the outcomes of decisions that were made regarding modeling workgroup core values, decision making, and membership to the Modeling WG.
- Lew also outlined the membership of the Modeling WG currently, and proposed a list of recommended workgroup members based upon recent attendance at meetings and contributions to the workgroup. The Modeling WG agreed upon Lew's recommendations, and the members list will subsequently be updated.

MINUTES – AUGUST 10

WQSTM Calibration to the Phase 6 *Beta* 2 Loads – Carl Cerco, U.S. CoE ERDC
Attachment I.1, *Attachment I.2*, *Attachment I.3*, *Attachment I.4*, *Attachment I.5*

- Carl began by reviewing the numerous transmissions of watershed loads received from the Bay Program, and the ongoing efforts to calibrate the Water Quality and Sediment Transport Model (WQSTM) to those received loads.
- Carl first showed 10 year averaged loads from the Watershed Model (WSM), noting that a great deal more nitrogen, as well as additional phosphorus, was added to the WQSTM from updated WSM loads.
- While simulated mean differences are high for nitrate (the error statistic can be greatly distorted by outliers) the absolute mean difference values have actually decreased, suggesting improved model performance. This story holds true for some constituents but differs among others, such as dissolved inorganic phosphorus and total phosphorus.
- A more recent formulation of benthic nitrate simulation developed by Testa et al has been implemented and has helped to move the model closer to the observed values, although this new formulation isn't perfect in all areas.
- The difference in the proportion of nitrate is centered around the nitrogen loads coming from below the fall line that are still too high, which could greatly affect some of Carl's issues in calibrating the WQSTM.
    - As a reminder, the shrinking of the non-point source total amount of nitrogen is the mechanism that will bring down the load entering from the coastal plain.
    - ACTION: Before providing Beta 3 loads to Carl, a further look will be given to load speciation below the fall line as well as reduction in overall loads.
- Nitrification consumes oxygen

Progress in the Simulation Shallow Water Processes and Tidal Wetlands – Carl Cerco, U.S. CoE ERDC
Attachment J

- Carl emphasized that it is beyond our resources to do a complete wetlands biogeochemical model. However, there is an objective for the development of a simplified module that includes process like burial, respiration, denitrification, and possibly primary production among others that will help to capture processes related to the source, sink, or exchange of matter in the water column.
- Part of the process involves multiplying a settling velocity by the particle concentration in the water column and the area of the wetland. The calibration task then lies in determining the settling velocities such that observations and hot spots, as well as observed water column concentrations, are respected.
- Carl also reviewed the comparison between modeled and observed data for shallow water focus areas and their associated calibrated parameters, noting that there are several poorly calibrated shallow water locations.
- A more in-depth look at the Bush River was given where, absent more phosphorus, the calibration won't come close to the observed values.

    - Carl noted that the saving grace could be salinity, using a kind of sediment diagenesis phosphorus sorption that could be washed off in summer saline flows. Jim Fitzpatrick suggested that Carl could also make an aerobic layer partition coefficient a function of salinity as well.
- Model results also suggest that there may be errors in the minimum diffusivity being set too low. Ping, Jim Fitzpatrick, and Carl Friedrichs recommended that a modification of minimum diffusivity in upper layers may help to adjust the problems found with the vertical exchange.

WQSTM Sensitivity Scenarios – Lew Linker, EPA - Ping Wang, VIMS - Richard Tian, UMCES
Attachment K

- Lew outlined the motivation and results of tests of nutrient load sensitivities and limitations within the WQSTM, and reviewed fixes made to previous concerns with deep channel simulated dissolved oxygen.
- Lee asked about the driver of differences in model responses seen in areas like the Chester River, where the model reacted in a way that was expected with load reductions. It is important to try to identify what the most sensitive drivers are that we should be aware of, whether they are a result of revised loads and denitrification procedures or the inclusion of wetlands.
- Norm Goulet asked if, when reducing nitrogen for Beta 3 in the coastal plain, the modeling team is focusing on trying to match estimator values.
    - Lew outlined that the modeling team has WRTDS as one of its main aiming points for the calibration, and plans to produce model estimates within +/- 10% of WRTDS loads. Carl Cerco is calibrating to these WRTDS loads at the RIM stations, but is receiving more varied values from the coastal plain.

Nutrient Limitation Assessment – Richard Tian, UMCES – Ping Wang, VIMS
Attachment L

- Richard outlined the origins of nutrient limitation and determination of its application in the WQSTM, as well as the different spatial distributions of nutrient limitation throughout the Bay at different monitoring stations. A comparison of different nutrient species' limiting ability can help to guide our understanding of the ability to increase DO.
- Carl Cerco expressed his approval, and noted that it would be interesting to look at the trends in nutrient loading that are apparent in concentration data.
- Karl Berger asked why a trend toward more nitrogen limitation compared to phosphorus was evident, but no easy answer was immediately evident. Gary noted that by examining river input stations, many trends in phosphorus have been reversed. At the next STAC meeting, there will be a discussion about diverging changes in nutrient inputs
    - Hydrology does not affect any impacts on these differences, as the 1991-2000 run washes them out because of its representative hydrology.

Lower Susquehanna River Impoundment Modeling Studies – Jim Fitzpatrick and Mark Velleux (HDR)
Attachment M

- Mark provided updates of changes in the hydrodynamic and sediment transport simulations, the goal of which is to resolve some of the remnant channel changes while providing a grid that allows simulations to be run rapidly. At this point, sediment transport simulations from 2008-2014 can be run in approximately six hours.
- Efforts to better classify the relationships between clastic sediments and shear stresses within the reservoir were also reviewed.
- The plan for a utilization of this model is to first develop rating curves, similar to what West consultants did for upstream reservoirs, and then provide them to the Bay Program where they can be utilized for WSM calibration.
- Jim asked about updates of WQSTM sensitivities to G fractions of nutrients, but Carl noted that there have been no updates since the last presentation of species breakouts.

MEETING ATTENDANCE

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