Modeling Workgroup Quarterly Meeting Minutes
April 22-23, 2015

CBPO Fish Shack
410 Severn Avenue Annapolis, MD 21403
Event webpage: http://www.chesapeakebay.net/calendar/event/22434/

MINUTES: April 22, 2015

Announcements and Amendments to the Agenda – Dave Montali, WVDEP – Lee Currey, MDE

- Recall that a Modeling WG decision was made in January regarding sensitivities, more information is being brought to the discussion by Bill Keeling.
- The Bay Program has three sessions to be held at CERF on climate change, multiple modeling, and emerging trends. Abstracts are due by 12 am ET May 1.
- Five workshops connected to the Modeling WG were approved by STAC. These include a workshop on climate change led by Mark Bennett and Zoe Johnson, a workshop on the Conowingo led by Lewis Linker, a workshop regarding uncertainty analysis that will be led by James Davis Martin, a comparison of shallow water models led by Marjy Friedrichs, and an optimization of model output, which is very strongly linked to uncertainty, which is also led by James Davis Martin
- Lewis introduced Jeremy Trombley, a PhD candidate at UMD who is working to describe the CBP modeling process and its interaction with decision making, governance, and environmental management from an anthropological perspective. Jeremy will be sitting in on meetings and conducting some interviews to attempt to get a sense of how the Modeling WG operates and study how decisions made in the workgroup propagate outward to decision makers.

Review of Modeling Workgroup Priorities – Lee Currey, MDE

Attachment A

- Lee reviewed the goals and schedule of the modeling WG, reviewing the "Build" year in 2015, the "Review" timeline through 2016, and the "Application" year of the models in 2017.
- Points of concern in the model that workgroup participants would like to emphasize during the review period are welcomed for discussion with the Modeling WG leadership.
- The CB Partnership will use these models to develop a Phase III Watershed Implementation Plan

Phase 6 Watershed Model Schedule – Gary Shenk, EPA/CBPO

Attachment B

- Gary reviewed the schedule of modeling tasks, and a status report of model inputs.

    - Atmospheric deposition data has fallen behind because of issues with funding sources, data is expected to be collected by late summer 2015.
- There are three different methods used to complete the temporal disaggregation model: PQUAL (which has no lag), UNEC, and RSAS (which incorporates hydrologic variability to attain mass balance).
- Until atmospheric deposition data is collected, the modeling team will continue to use patches of past data to fill the gap.

Phase 6 Model Land Use – Peter Claggett, USGS/CBPO

Attachment C

- Peter reviewed the classifications and the process of determining different land uses and land cover types that are to be delivered to the modeling team for Phase 6.
- Further discussions of extractive land uses are to be discussed at the Watershed Technical Workgroup meeting, including the two classifications of extractive defined by the PSC.
- Peter stepped through the set classifications of P6 land uses including impervious, natural, and agricultural land uses. These deliverables are the set land uses to be used within the model?
- A question was raised regarding the classification of mines as a point source type feature, which is something to be addressed by the land use group.
- STAC recommendations about reduction efficiencies for wetlands were also implemented, SPARROW may help to inform some of the wetlands data.
- The Chesapeake Conservancy is to provide one meter land cover data which is to be produced over the coming year with the University of Vermont. Data will have to be incorporated as it is received, as it is too difficult to bring in the data altogether beginning in May 2016.
- Virginia is doing their land use project with one meter data as well. The Chesapeake Conservancy may not be the group to also work with the land use data in VA since there are four proposed partners and the RFP has not yet been awarded.
- The Ag Census will be fixed in September, the Ag Land Uses are not expected to change.
- The Phase 6 Land Use Web Viewer is also being developed by the Land Use Workgroup.
- Having an understanding and a list of land use classes within the model could be helpful.
    - Even if the land uses are not used in the average calculation, it would be helpful to see the range and median of the literature values on these charts.
- It was noted that land uses cannot currently be further defined with loading factors, based on whether there may be a scientific loading rate or a management purpose for the land uses at this time.

Phase 6 Land Use Target Loads – Olivia Devereux, Devereux Consulting

Attachment D

- Olivia reviewed the calculation methods for the targets, the data needed to calculate the targets which includes the formulation of a global target, the relative rates for each of the

specific land uses within a sector, the acres being used for P6 land uses for an interim period until Peter finalizes the acres, the sensitivities, and some graph data generated as a first step.

- How do we adjust for changes if we are concerned about targets in the present sense?
    - The modeling team is concerned with the calculation of targets over the period 1985 to 2014 of the long term loads without any BMPs.
- Other steps bring in regional differences since SPARROW doesn't change between locations because it gets a region-wide regression coefficient.
- As a reminder, targets are calculated to figure out loads for the model to hit in the calibration process.
- CEAP differs from P532 in that its comparison is being done among farmland acres while P532 is doing a comparison by land segments.
- As a reminder, a decision was made not to use CEAP for urban loading rates.
- The difference between Urban TN loading for SPARROW and P532 may be attributed to SPARROW's use of NLCD in place of the land uses that were used by P532.
- Running SPARROW over a multitude of years and examining the coefficients could potentially provide some insight, suggested by Bill Ball.
- P532 has about 50% more urban land than SPARROW, which may help to explain the variability across LRSegs.
- The relative differences between each of the four categories are not the same between SPARROW and P532, which is an issue that may require further exploration.
- A goal in applying targets is not to develop global targets for each land segment. Rather, a base load is applied for a land use throughout the entire watershed. Then, a sensitivity is applied to alter the loading rates for each land segment based on the geographic location or whatever other factor there may be.
- Source sector workgroups provide information for Olivia's calculation of relative loading rates.
- Before going to the WQGIT, the modeling chairs and source sector chairs need to discuss why we are using global targets instead of source sector targets.
    - The Modeling WG needs to explain why global differences are important, how they're all equitable in terms of numbers, the reasoning for differences, and show how it integrates with the targets set by the different source sectors.

Virginia Analysis of Sensitivities – Bill Keeling, VADEQ

Sensitivity to Nitrogen Inputs – Richard Tian and Guido Yactayo, UMCES/CBPO

Attachment E, *Attachment F.1*, *Attachment F.2*

- Guido reviewed the motivation behind conducting sensitivity analyses and the further work being done, proposed by Bill Keeling.
- As a reminder, the sensitivity is used as a multiplier with the change in input, added to the average load.
    - For every extra pound in input, the regression slope provides a value for the export of nutrients in lbs/acre.

- Bill presented an in-depth analysis of the new approach to ensure that there is a consistent sensitivity assured in P6. Bill analyzed for scale or disproportionate response issues by land use and parameter.
    - The analysis began with an initial condition of the 1997 calibration year no-action scenario to eliminate the BMP effects that were included in Richard's previous multivariate analysis.
- Additional questions will be taken offline, once the prototype is out the spatial patterns will be re-examined.
- Richard reviewed his analysis completed by land segment for each input type, and presented a summary of the findings.
    - Most land segments were found to have a very linear response, and it was important to determine whether the spatial variations found could be described with environmental factors like latitude, land slope, and texture of subsoils.
- Comments and questions regarding further explanations of sensitivities should be sent to Lee, Dave, Gary, or Lew.
- The move from a multivariate to a univariate analysis demonstrated the reproducibility of the findings, and showed that the Modeling WG is on the correct path in determining sensitivities.
- The next conference call should include a discussion on land use mapping, more of Richard's sensitivity analysis work, and further explanations regarding the functions of urban numbers.
- **ACTION:** The modeling team will use the univariate approach to move forward and bring back analyses and results in the July quarterly.
- Guido reviewed the recommendations for the use of APLE, how it was implemented, and the phosphorus sensitivity analysis that was conducted using APLE.
- The modeling team is asking for the workgroup's approval of its chosen process for both the implementation of the model and the sensitivity analysis.
- Mehlich Phosphorus is problematic because it needs to be initialized in year 1 of the model simulation. APLE simulations will have to be run to more or less calibrate the initial Mehlich P number for 1985, APLE will track Mehlich P based on the input changes after that point. These simulations will need to be run in the WSM until the first Mehlich P value (provided in the year 2010) is obtained.
    - From Scenario Builder, APLE can be run continuously with fertilizer inputs.
- The Modeling Team needs to get sensitivities for P into the prototype being built for the July Quarterly Review, and make sure that there are no issues with the Modeling Workgroup in using APLE to determine phosphorus sensitivities.

Phase 6 Development Progress – Gopal Bhatt, PSU/CBPO

Attachment H

- Gopal reviewed progress made in the expansion of the simulation period to 2014, the incorporation of rSAS, and WSM calibration with revised (version II) SPARROW based L2W and S2R variances to account for small scale processes.

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- **ACTION**: The Modeling WG will meet with the Source Sector WG chairs to talk through the process of how targets are going to be set and take the consensus to the WQGIT.
- There was a decision made to move to a univariate approach instead of a multivariate approach in determining nutrient sensitivities.
- A prototype Phase 6 model will be brought back to the Modeling WG for the July Quarterly meeting.

Chester River Shallow Water Project Multiple Models – Harry Wang and Joseph Zhang, VIMS
Attachment I

- Harry presented an overview of SCHISM (Semi-implicit Cross-scale Hydroscience Integrated System Model) and some of its results. SCHISM is an improvement on the prior model SELFE, wherein the hydrodynamic and water quality processes are directly coupled.
- SCHISM is capable of using a very fine spatial scale on the order of ten to twenty meters, but can also run with a larger time step on the order of minutes.
- The new model also allows a mix of triangles and quadrilaterals for shallower channels and deeper channels, respectively.
- The stratification in the model is captured better with a z rather than a σ grid, which allows for variation in the layers as the depth of water in a cell changes.
- Future work with SCHISM may need to focus upon different wind data sources, as well as other data to better assess model performance.
- Harry also reviewed model performance times, showing that the shallow water model results can be obtained rapidly when the model is run in parallel.
- Questions of continuing to scale-up the model are currently under study. Potentially running processes with OpenMP may help to capitalize on shared memory which will also decrease processing time.

Full Representation of Diagenesis in WQSTM Sediments and Water Column – Carl Cerco, USACE
Attachment J

- Carl provided a background of the motivations behind the incorporation of bank nutrient loads and discussed the issues behind developing the bank loads.
- Carl also outlined the routing of the bank nutrient loads into the water column, introducing the prior methods utilized and the new methodology to account for all components of the loads.
- Bank loads for nitrogen are 1.3% of the watershed loads, meaning that they are nearly negligible. Phosphorus loads account for about 14% of the load, and makes up about 10% of the reactive phosphorus in the watershed load.
- In 1994 PIP was monitored during surveys, providing data that suggests the model is in the ballpark.

- The model is formulated correctly, allowing for multiple loads with different reactive fractions and the potential for resuspension.
- There is a relative dearth of guidance for partitioning loads, and some options for doing so were presented. Making these decisions may necessitate some sensitivity analyses and management decisions.
- There is interest in pursuing shoreline controls in place of watershed controls, and there may be regional differences in terms of reactive phosphorus. Iron bound phosphorous is more readily available than aluminum bound P, an issue which may necessitate the expertise of clay mineralogists, but also spatial data generally on the labile, refractory, inert, and PIP forms of P from Chesapeake shorelines is by-and-large absent. Options for partitioning the bank loads raise several questions including the validity of BMP nutrient reductions for shoreline loads. This issue could necessitate a decision by the WQGIT.
- A better approach may be to find out what the split is between G2 and G3, potentially somewhere between 20% or 100%.
    - Shifting between an 80-20 and a 100-0 G2/G3 split would necessitate changes in the reactivity of G3 within the water column.
- To what extent do bank loads vary with soil types?
    - This is unknown, we could better partition with better information. Bill Keeling is to contact the Virginia phosphorus index team to obtain more information on the Eastern Shore.

Refinements to the WQSTM Shallow Water Simulation – Carl Cerco, USACE
Attachment K

- Carl reviewed how the WQSTM responded to Phase 6 loads. The results were based on a new set of simulation years from 2002-2011 which can better incorporate the bulk of the shallow water data.
- A concern was raised about the potential need to rerun the hydrodynamics, which may no longer be adequate if the flows have changed substantially from the prior calibration. The hydrodynamics for CH3D are driven by daily averaged output flows for the WSM.
- But updating the CH3D hydrodynamics for scenario differences in flows, was found to be unnecessary because the WQSTM is sensitive to the nutrient load changes in the scenarios but insensitive to the scenario changes in flows.
    - An updated version, when available,will be sent to the shallow water teams to ensure that all groups are working with the same hydrodynamics.
- Further comparisons of more overlapping years will be completed by Carl Cerco, and the results will be shown to the Modeling WG for Carl's next presentation. For now, Carl is to move ahead with G2/G3 state variables for the years 2002-11.
- Decisions still need to be made about bioreactivity, recommendations and ideas will be brought back to the Modleing Workgroup.

Sediment Loads from Shoreline Erosion – Larry Sanford and Jia Gao, UMCES
Attachment L.1, *Attachment L.2*

- Jia presented a summary of her work in developing a comprehensive dataset of erosion rates, coastal morphology patterns, and wind field data which is interpolated from five stations around the Bay. Jia also reviewed her studies of erosion rates comparing natural (non-hardened) bank environments and marsh environments (as defined by the grid cells) around the upper Bay
- Further refinements in the implementation of statistical models are expected to help better determine patterns in the non-linear relationships of erosion around the bay.
- By integrating the mass erosion rate of the bank over time, it is possible to determine the instantaneous mass erosion rate. What questions remain involve the implementation of the shape function, which may be done immediately with a simple step function or cosine function to account for wave energy only impacting the bank at times in between low sea level or levels of inundation.
- Larry presented findings concerning the physical environment Susquehanna Flats, which is home to potentially the largest grass bed right at the mouth of the largest contributor of sediment to the Bay.
- No turbidity response was seen from hurricane Irene which had high wind speeds. A turbidity response was only seen in wind event following Tropical Storm Lee which deposited sediment onto the grass bed

Conowingo Infill Studies – Jeff Cornwell, UMCES
Attachment M

- There are currently people sampling flow events at the Conowingo Dam, and a large issue is determining when to send people to sample because of difficulties in predicting high flow events.
- Coring studies that are being taken behind the dam are moving forward as well.

Ammonia Emissions and Deposition in the Chesapeake Watershed – Mark Dubin, UMD/CBPO
Attachment N

- Mark presented efforts to develop Agricultural BMP guidelines, as well as a better determination of agricultural ammonia emissions and depositions.
- In the eyes of the Agricultural side of the partnership, CMAQ is considered to be lacking in its ability to capture localized deposition zones.
- John Rhoderick (Agriculture WG Co-Chair) emphasized that if water quality benefits are not stated within the model, the poultry industry has no incentive to apply any ammonia suppressants.
- Currently the model counts the nitrogen being applied from poultry litter to the land, but does not subtract the subsequent atmospheric release and deposition.
- Mark and John will propose to the Agriculture WG an external expert group to meet with the CMAQ group and return findings about the incorporation of localized deposition in Phase 6.

Phase 6 Model Sediment Delivery Ratios – Reid Christianson, CWP – Peter Claggett, USGS
Attachment O

- Peter discussed the problems of sediment delivery factors faced by Phase 5.3.2, and the proposed solution to develop relative sediment budgets for all catchments within each river segment.
    - Metrics to determine these sediment budgets were developed in Python using LIDAR data, and an evaluation of remotely sensed metrics with field data has proven very promising. Currently there is no LIDAR for about 1/3 of the watershed (primarily in WV and western VA).
- To complete the mass balance, the sediment delivery factors in RUSLE could be adjusted up and down with the analysis completed. Since the uncertainty of both methods is unknown, allowing both methods to vary will allow for greater consistency in stream source ratios (SSR) across the watershed.
- The Center for Watershed Protection is taking a mass balance approach as well and is also examining watershed characteristics like urban cover, forest cover, concentration of outfalls, etc.
    - The CWP is poised to start dumping watershed information into this effort, the collection of data has been a lengthy process.
- SSR will be a conservative measure because the upland end is represented by measured water samples from upland sites and multiplied by WSM flows.

Meeting Attendance

MEMBERS			
Currey	Lee	lcurrey@mde.state.md.us	MDE/Modeling WG Co-Chair
Montali	Dave	david.a.montali@wv.gov	WV DEP/Modeling WG Co-Chair
Linker	Lewis	linker.lewis@epa.gov	EPA/CBPO/Modeling WG Coord
Hinson	Kyle	khinson@chesapeakebay.net	CRC/CBPO/Modeling WG Staffer
Gladding	Steve	smgladdi@gw.dec.state.ny.us	NYSDEC
Keeling	William	william.keeling@deq.virginia.gov	VA DEQ
Mandel	Ross	rmandel@potomac-commission.org	ICPRB
Onyullo	George	george.onyullo@dc.gov	DDOE
Shenk	Gary	gshenk@chesapeakebay.net	EPA/CBPO
Wang	Harry	wang@vims.edu	VIMS
PARTICIPANTS			
Aburn	Tad	gaburn@mde.state.md.us	MDE
Amin	Vimal	vamin@mde.state.md.us	MDE
Ball	William	ballw@si.edu	JHU
Benham	Brian	benham@vt.edu	VT
Berger	Karl	kberger@mwcog.org	MWCOG
Bhatt	Gopal	gbhatt@chesapeakebay.net	Penn State/CBPO

Busch	Greg	gbusch@mde.state.md.us	MDE
Cerco	Carl	Carl.F.Cerco@erdc.usace.army.mil	USACE
Christianson	Reid	rdc@cwp.org	CWP
Claggett	Peter	pclagget@chesapeakebay.net	USGS
Cornwell	Jeff	cornwell@hpl.umces.edu	UMCES
Dalmasy	Dinorah	dinorah.dalmasy@maryland.gov	MDE
Devereux	Olivia	olivia@devereuxconsulting.com	DEC, Inc.
Dubin	Mark	mdubin@chesapeakebay.net	UMD
Friedrichs	Marjy	marjy@VIMS.edu	VIMS/STAC
Friedrichs	Carl	carl@VIMS.edu	VIMS
Gao	Jia	jgao@umces.edu	UMCES
Goulet	Norm	ngoulet@novaregion.org	Northern VA Regional Commission
Hanson	Jeremy	jchanson@vt.edu	VT/CBPO
Ibrahim	Mukhtar	mibrahim@mwcog.org	MWCOG
Johnston	Matt	mjohnston@chesapeakebay.net	UMD/CBPO
Katchmark	Whitney	wkatchmark@hrpdcva.gov	HRPDC
Mirsajadi	Hassan	hassan.mirsajadi@state.de.us	DE DNREC
Moriarty	Julia	moriarty@vims.edu	VIMS
Mulkey	Alisha	alisha.mulkey@maryland.gov	MDA
Murphy	Rebecca	rmurphy@chesapeakebay.net	UMCES/CBPO
Rhoderick	John	john.rhoderick@maryland.gov	MDA
Sanford	Larry	lsanford@umces.edu	UMCES
Sherwell	John	jsherwell@dnr.state.md.us	MDNR/PPRP
Smith	Sean	ssmith@dnr.state.md.us	MDNR
Sweeney	Jeff	jsweeney@chesapeakebay.net	EPA/CBPO
Tian	Richard	rtian@chesapeakebay.net	UMCES/CBPO
Tribo	Jenny	jtribo@hrpdcva.gov	HRPDC
Trombley	Jeremy	jmtrombley@gmail.com	UMD
Wang	Ping	pwang@chesapeakebay.net	VIMS/CBPO
Wang	Zhengui	wangzg@vims.edu	VIMS
Wilusz	Dano	dwilusz1@jhu.edu	JHU
Yactayo	Guido	gyactayo@chesapeakebay.net	UMCES/CBPO
Ye	Fei	feiye@vims.edu	VIMS
Zhang	Joseph	yjzhang@vims.edu	VIMS
Zhang	Qian	qzhang19@jhu.edu	JHU