Oklahoma Comments on Model Selection Memo

January 10, 2011

Overall, we agree with the conclusions of the Memo. The Memo is well written with clearly articulated differences between candidate models. The comparison between the two lake models is particularly well researched in the framework of our project objectives. The following specific comments are provided to further improve the Memo. Some of the comments may be addressed in the Model Simulation Plan expected to be drafted soon.

1) The comparison between HSPF and SWAT on soil nutrient processes should be expanded to summarize the theories and mechanisms used by the two models in simulating pasture land with and without manure/poultry waste application. Pasture accounts for the majority of agricultural land use in the watershed. There are advantages of the SWAT model in simulating the growth and nutrient utilization of agricultural crops, including pasture grasses, due to the extensive crop database used in the model. HSPF, on the other hand, has the capability of simulating these crop processes with specific action modules. A more detailed description of these model specifics would add to the overall discussion of the pros and cons of the two widely used models.

2) It should have been discussed in the memo that HSPF offers the advantage/flexibility of simulating the effect of the Karst geology on the hydrology in parts of the watershed.

3) The discussion on HSPF's advantage in simulating the hydrology and nutrient loadings from urban lands should be expanded to provide more specifics.

4) A watershed model (GLEAMS coupled with a statistical phosphorus routing model) was developed by Dr. Bernard Engel of Purdue University for Oklahoma's Office of the Attorney General. ODEQ provided the model report to EPA during the data gathering phase of this project. The model had a focus on poultry waste application and its effect on phosphorus loading in the watershed. A brief review of the model, its input, and its conclusions would benefit the current modeling effort.

5) A two-dimensional hydrodynamic-water quality CE-QUAL-W2 model of Lake Tenkiller was developed by Dr. Scott Wells of Portland State University for Oklahoma's Office of the Attorney General. ODEQ provided the model report to EPA during the data gathering phase of this project. It seems that EFDC is a more comprehensive model than CE-QUAL-W2 due to the fact that EFDC is three-dimensional and has a sediment diagenesis module. Nevertheless, a review of this CE-QUAL-W2 model should be included in the Memo or the Simulation Plan. There are potential benefits of referencing to similar model parameters in the CE-QUAL-W2 model when developing the EFDC model for the lake.

6) Line 3, Para. 3, P. ii, change “compliance” to “impairment”.

7) Line 14, Para. 3, P. 1, add “darters and” before “bass”.

8) Last paragraph, P. 1, add description on Lake Tenkiller’s listings.

9) Figure 1.1, add Stilwell to the map. The city is one of the three significant point sources in the watershed on the Oklahoma side.

10) Figure 1.2., typo of the word “impairment” in the map legend.

11) Line 2, Para. 3, P. 5, White (2009) and Saraswat et al (2010) do not have the full citations in the Reference section of the report.

12) Second paragraph from the bottom on P. 14, in addition to water column DO criteria, surface DO criteria should be added. Please see *Implementation of Oklahoma's Water Quality Standards* OAC 785:46-15-5(b)(3) and (3) at http://www.owrb.ok.gov/util/rules/pdf_rul/2008_adopted/Chap46_2008.pdf.

13) Bullet points “b” and “d” on P. 13 seem to repeat one another. As written, the difference between them is not clear. They probably can be combined into one single point.

14) Last paragraph on P. 14. Since 2006, Oklahoma’s Water Quality Standards have had a specific criterion of 10 µg/L of Chlorophyll *a* for Lake Tenkiller (785:45-5-10(7), which translates into a TSI of 53, much lower than the “threatened by nutrients” criterion of 62 (http://www.owrb.ok.gov/util/rules/pdf_rul/RulesCurrent2010/Ch45.pdf). Therefore, we need to emphasize the direct simulation and interpretation of the Chlorophyll *a* data in the modeling effort, not the TSI.

15) First bullet point “3.” Contribution of *Cylindrospermopsis* to lake Chl-*a* levels can essentially be included as part of the Chl-*a* modeling. It would deviate from our project’s main goal of establishing nutrient TMDLs to achieve Chl-*a* compliance in the lake if extensive effort was made to simulate the effects of *Cylindrospermopsis* on other biota or study the control of *Cylindrospermopsis* through biomanipulation. Consequently, although it’s important to take *Cylindrospermopsis* into account in the lake model, it is not advisable to make *Cylindrospermopsis* a separate model evaluation endpoint.

16) Last sentence on P. 15. Change the sentence to “ … compliance with a surface dissolved oxygen, water column DO and Chlorophyll-*a* criteria”.

17) Second last line, Para. 1, P. 16, the "25 percent reduction" statement may be changed to "A percent reduction in phosphorus loading was determined for lake water quality to satisfy the target criteria." In general, quoting from the previous Tetra Tech EFDC study should be done in a way that only the capabilities of the model are illustrated not the specific results. Although this point is expressed earlier by the author in this particular section of the Memo, care needs to be taken in lengthy citations later on.

18) Bullet point "1.b." on P. 20, again, Oklahoma water quality standards require the direct use of the 10 µg/L Chl-*a* concentration.

19) Bullet point "4." under Section 3.4 on P. 20, please complete the two section references.

20) Bullet point "3.", P. 22, *see comment # 15) above.*

21) It is not easy to compare Figure 3.1 and 3.2. With only "model domains" illustrated, the figures give the impression that the two models are very similar while in fact their strengths are vastly different. Also, the three boxes at the lower center and lower right parts of the main box in Figure 3.1 have a background color that is not referenced in the legend. A table with side by side comparison of the two models should work better showing the different hydrodynamic, water quality, and biotic modeling capabilities.

22) Bullet point "4.", P. 28, it is conceivable that the current finished AQUATOX model can be expanded in the future to evaluate biomanipulation while EFDC is best suited to be revised in this project for a rigorous TMDL development.

23) Bullet point "5.", P. 28. Both EFDC and AQUATOX can represent three functional groups of water column algae as cyanobacteria (blue green algae), green algae, and diatoms. EFDC, through its cyanobacteria modeling module, is in fact fully capable of simulating the contribution of *Cylindrospermopsis* to lake Chl-*a* levels. Kinetic model parameters such as C/Chl-*a*, C/N, C/P, light and temperature dependence for growth, can be adjusted to reflect the particular bio- and physio-chemical preferences of *Cylindrospermopsis* growth and respiration. Field data needed for such parameterization (e.g., water temperature and lake Chl-a/TP ratios during *Cylindrospermopsis* blooms) has been collected through OWRB's lake monitoring programs. Therefore, it is simply incorrect to state that "only AQUATOX provides the capabilities needed to simulate the cyanobacterium *Cylindrospermopsis*" since EFDC can also represent cyanobacteria as a functional group of algae. Unlike EFDC, AQUATOX does, however, have the capability to include secondary and tertiary trophic levels to represent predation of algae groups by functional groups of zooplankton, fish and benthic organisms.