-----Original Message-----
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Sent: Thu Sep 09 15:30:53 2004
Subject: Status of Charles River Eutrophication model.

Dear Group:

I am providing another update on the status of the Charles River Basin eutrophication model. Recoding of the model is complete and the model is undergoing testing and debugging. To refresh your memories I am including the description that I sent earlier explaining the reasons for needing to write additional code and the delays in finishing the model for the Charles. Writing new code and debugging the model is a time-intensive exercise and we want to be sure that the model is working properly before completing model calibration and validation for the Charles.

I plan to update you again and provide a timetable for reviewing the model and completing the TMDL once model testing is complete. I expect that will be in late September. Overall, it looks like we are about two months behind the schedule provided in my last message.

Please call or email me if you have questions. My number is 617 918-1537. As always, I am grateful for your patience with this project.

Mark

Background.

Hydrodynamic and water quality models of the Lower Charles River Basin have been developed and tested over the last year and a half, by Dr. John Hamrick of Tetra Tech, Incorporated and Richard Baker of Numeric Environmental Services, respectively. These coupled 3-dimensional, transient numerical models utilize the EFDC modeling framework. EFDC solves the governing hydrodynamic and water quality transport equations using a sigma-stretch coordinate system.

Vertical mixing predicted using EFDC has been found to be large, compared to levels suggested by historical salinity and water quality data available for the basin. This modeling problem is particularly evident during the summer months, when seawater intrudes into the basin at depth due to boat lockages at the Charlestown Dam. This results in a strong pycnocline near mid-depth and very low observed rates of exchange between surface and bottom waters. Extensive testing has been conducted using EFDC, in order to try to decrease vertical mixing to observed levels, with limited success. Based on the testing it has been concluded that the main source of artificial vertical mixing within the current EFDC application is due to its use of the sigma-stretch coordinate system. The sigma-stretch coordinate system utilizes the same number and relative thicknesses of individual vertical layers in each horizontal cell, regardless of total water depth. If two adjacent cells have much different total water depths, as is found in the Charles River Basin, the sigma coordinate formulation can result in excessive pumping of bottom water from the deeper cell to the shallower cell which is equivalent to excessive vertical mixing. Although progress was made in reducing the amount of salinity transported to the surface by this computational artifact, the transport of inorganic phosphorous to the surface layers still results in concentrations greatly exceeding observations.

In recognition of the need to accurately predict the low summertime vertical mixing rates observed within the basin for salt, heat and water quality constituents, Tetra Tech has commenced work on modifying the EFDC modeling framework to utilize a scaled height or Z-coordinate system which behaves similarly to a traditional Z coordinate system with fixed vertical layering. Use of the scaled Z-coordinate system will allow the model to more accurately predict the low vertical mixing rates observed within the basin, under existing summertime conditions.

Tetra Tech is presently working on these major model modifications.

Following conversion to the scaled Z-coordinate system, model testing and debugging, validation of the hydrodynamic and water quality model will be finalized within approximately 2-weeks.