October 26, 2017

Vincent D. Furtado
Public Works Superintendent
Town of Fairhaven Public Works Department
5 Arsene Street
Fairhaven, MA 02719

Re: Massachusetts Estuaries Project New Bedford Harbor Report (2015)

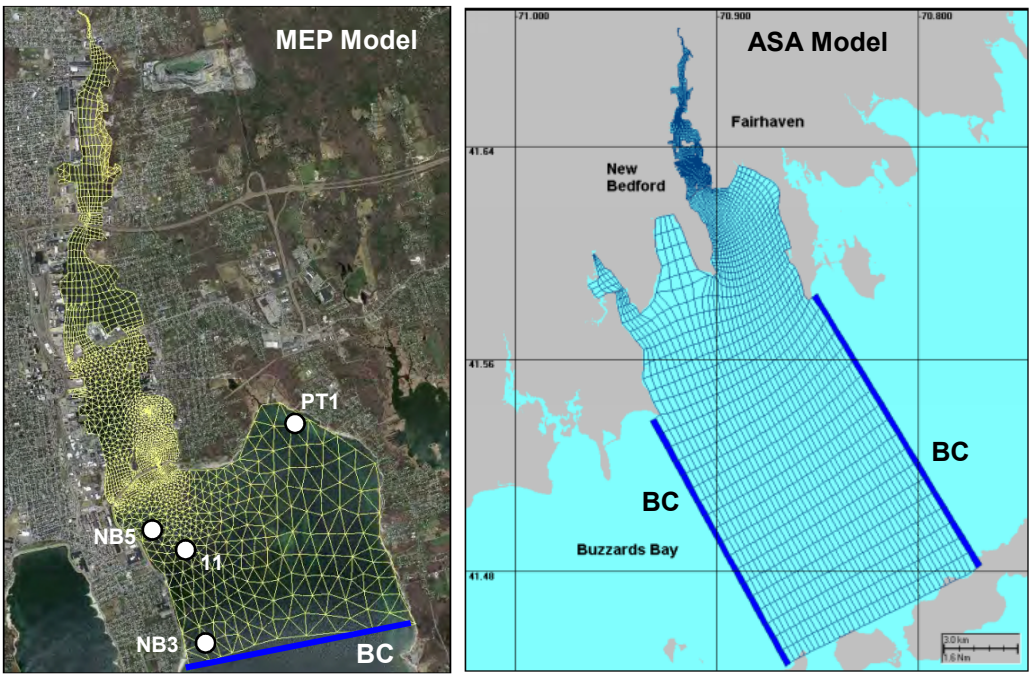
Dear Vinnie,

We have completed a preliminary review of the Massachusetts Estuaries Project (MEP) 2015 Updated Final Report titled *Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the New Bedford Inner Harbor Embayment System, New Bedford MA* (November 2015). We also completed a preliminary comparison between this 2015 Updated Final Report and the December 2008 Final Report. In addition, we reviewed modeling completed in the Acushnet River Estuary by ASA for the New England Interstate Water Pollution Control Commission (*Flushing Analysis in the Acushnet River Estuary, 2003*). Below are our preliminary observations and comments on the 2015 Updated Final Report.

- General observations on the embayment modeling are related to the location of the Buzzards Bay boundary condition (BC) and the data used to establish total nitrogen (TN) boundary conditions.

  The figure below presents the MEP model grid and boundary condition location (ending near Fort Rodman and Clarks Point) and the ASA model grid and boundary condition locations (east and west Buzzards Bay locations). The concern is that the MEP model grid boundary condition location is too close to New Bedford Harbor such that boundary condition TN concentrations assigned may have an undue influence on the model results in New Bedford Harbor. Boundary condition locations further offshore into Buzzards Bay like that used for the ASA modeling are more appropriate.

  In addition, the monitoring stations used to define the MEP model TN boundary conditions are too close to New Bedford Harbor and the hurricane barrier. The four stations used are presented in the MEP model figure below and are too close to New Bedford Harbor or other local nitrogen sources. TN monitoring data from Buzzards Bay would be more appropriate to use so that the model boundary condition does not reflect harbor or local sources but rather more open water TN levels.



- MEP model horizontal dispersion coefficients were calibrated based on the TN monitoring data in New Bedford Harbor. The typical method for calibrating dispersion coefficients is to use salinity as it is a truly conservative substance that is not impacted by watershed TN loadings. TN is not truly conservative as loss mechanisms can include denitrification and loss to the harbor sediments related to benthic fluxes. Sediment benthic nitrogen flux data presented in the 2015 Updated Final Report do indicate nitrogen flux into the sediments at certain locations in New Bedford Harbor. In addition, the ASA model used a calibrated horizontal dispersion coefficient of 0.02 m^2/s while the MEP model used a calibrated horizontal dispersion coefficient of 20 m^2/s in the main basins of the harbor. The impact of calibrating the MEP model dispersion coefficients to TN and the different dispersion coefficients used in the ASA modeling should be resolved.

- The MEP linked watershed-embayment model used different time periods for watershed TN loads, harbor tidal circulation and sediment benthic nitrogen fluxes. Watershed TN loads represented more of an annual loading to the harbor and were based on: land use information from 2005, 2009 and 2010; and long term average precipitation. Harbor tidal circulation represented a 7-day period starting on April 13, 2003 and higher spring runoff flows. Sediment benthic nitrogen fluxes were measured during July-August 2002 and 2012. It should be noted that benthic nitrogen fluxes vary as a function of temperature and are the highest during the summer when water temperatures are also high. This apparent mismatch of time periods for important watershed load, harbor tidal circulation and benthic nitrogen fluxes should be further evaluated to determine impacts on the model TN results and proposed TN allocations.

- Watershed TN loads presented in the 2015 Updated Final Report changed from those presented in the 2008 Final Report. Although the TN loads for different sources either

increased or decreased, the overall watershed TN load (including atmospheric deposition and benthic flux) increased from 351 kg/d (2008 Report) to 413 kg/d (2015 Report). One significant change made in the 2015 Report was to use a nitrogen attenuation of 15% instead of the 21% nitrogen attenuation used in the 2008 Report. The justification for using the lower nitrogen attenuation in the 2015 Report was a new analysis of the loading comparison data by excluding one year of load comparison data (2003-2004). Although this new analysis may be justified, the decreased nitrogen attenuation needed for calibrating the water quality model with the new watershed loads should be re-evaluated.

- Additional observations and comments relate to the MEP model calibration to measured salinity and TN concentrations in the harbor that could affect mixing and dilution of TN sources. For example, the MEP model tends to under-calculate observed salinity levels indicating that the right level of saltwater intrusion (and TN mixing) may not be well represented in the model. This could be a result of the mismatch of time periods for watershed loads, tidal circulation and benthic fluxes; or related to assigned dispersion coefficients and freshwater inflows to the harbor.

These preliminary comments and observations suggest that additional modeling improvements could be made to reduce the uncertainty in the overall analysis. Also, additional evaluations of source impacts (e.g., point source impacts to determine water quality based effluent limits) on TN levels in the harbor should be completed to assess attainment of the TN threshold of 0.5 mg/L at the sentinel location. Given that existing TN levels in the harbor are about 0.6 mg/L and the TN boundary condition assigned is about 0.4 mg/L this leaves only about 0.1 mg/L of TN to allocate between point and nonpoint sources. Given the uncertainty in the MEP analysis (watershed loads, nitrogen attenuation and time period mismatch) and limited room for TN allocations, an adaptive management approach to TN management in the watershed would be beneficial. This would allow incremental TN management to occur while continuing to monitor water quality improvements and attainment of the TN threshold.

If you have questions or comments on this preliminary review, please call.

Sincerely,
HDR Engineering, Inc.

Andrew J. Thuman, P.E. (NJ)
Vice President

cc: William Taylor (Pierce Atwood)

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