

Development of Fecal Coliform TMDL Protocols for Bass and Cinder Creeks on Kiawah Island

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REFERENCE: *Proceedings of the 2008 South Carolina Water Resources Conference*, held October 14-15, 2008, at the Charleston Area Event Center.

Abstract. The U.S. Environmental Protection Agency (EPA) Region 4, through a contract with Tetra Tech Inc., developed a methodology for a three-tiered approach for determining fecal coliform Total Maximum Daily Load (TMDL) for shellfish waters. The tiers ranged in complexity from a simple flow exceedance examination to a complex three-dimensional hydrodynamic and fate and transport model. The first tier is a mass balance approach based on the concentration of bacteria from source assessments and response sampling concentrations. The second tier uses a tidal prism spreadsheet model to account for the dilution and decay of bacteria. The third tier approach utilizes a multi-dimensional hydrodynamic model to simulate the water levels, currents, and salinity to simulate the retention time of an estuarine system. The tiers were used to examine at what point fecal coliform levels became unsafe to permit shellfish harvesting and how the results from each tiered approach compared. An estuary that includes Bass and Cinder Creeks on Kiawah Island was one of three estuaries used to develop and evaluate the fecal coliform TMDL methodologies.

Data to support the development of the three-tiered approach for Bass and Cinder Creeks was provided by The National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS). Researchers at NOAA's Center for Coastal Environmental Health and Biomolecular Research have been studying the fate and transport of bacteria from tidal ponds on Kiawah Island to the receiving shellfish waters of Bass and Cinder Creeks. The Tetra Tech study

was able to utilize four years of continuous water-depth data in four of the ponds and one creek, precipitation data from one site, flow rates from the ponds to the creeks, and discrete sampling data for dry and wet weather conditions. In addition to the water quality and hydrology data, NOAA had obtained detailed land-use and bathymetric data and had applied the 3-dimensional (3D) Environmental Fluid Dynamic Code (EFDC) model to Bass and Cinder Creek and the Stono River. To provide data to calibrate the EFDC model, hydrologists from the USGS instrumented two index-velocity sites on Bass and Cinder Creeks with continuous acoustic velocity meters and water-level sensors to compute a 30-day continuous record of tidal streamflows. In addition to monitoring tidal-cycles, streamflow measurements were made at the index-velocity sites, and tidal-cycle streamflow measurements were made at the mouth of Bass Creek and on the Stono River to characterize the streamflow dynamics near the ocean boundary of the three-dimensional model.

Comparison of the three-tiered TMDL approach for the three estuarine systems showed that there were greater reductions in fecal coliform loading using the Tier I and II approaches than the more complex Tier III approach (46 to 78 percent and 16 to 56 percent, respectively). Ultimately, the fecal coliform TMDLs for shellfish waters will need to be developed on a case-by-case basis with regard to available data, complexity of the water body, potential economic impact, and public health concerns.