

INSIDE
 THIS ISSUE:

Comparing alternative methods 1

FTABLE generation method effects on in-stream bacteria 2

Recent Center Publications and Presentations 2

New staff joins Center 3

Update on Current Virginia TMDLs 3

Comparing alternative methods of simulating bacteria concentrations with HSPF under low-flow conditions

The hydrological Simulation Program-FORTRAN (HSPF) model is the primary tool used to develop bacterial impairment TMDLs for freshwater streams in Virginia. However, several TMDL reports have documented difficulty with simulating in-stream bacteria concentrations under low-flow conditions. Low flows are often associated with low-order, upland watersheds. During dry weather conditions, these streams frequently stop flowing. However, due to limitations with the application of HSPF, the model continues to predict very small flow rates when, in fact, no flow is occurring at the outlet and the flow within the reach is likely discontinuous (e.g., water collects in pools within the reach of the stream).

During these low-flow conditions, even small amounts of bacteria deposited directly in the stream result in simulated bacteria concentrations much higher than would realistically occur. In Virginia, a bacterial impairment TMDL must include load reductions sufficient to achieve zero violations of the single sample and geometric mean criteria associated with



Low flow stream conditions

the primary contact recreation standard. As a consequence, unrealistically high simulated in-stream bacteria concentrations are translated in the TMDL as bacteria source load reductions that might be greater than what is actually needed to improve water quality to meet the standard. To address this modelers have employed some unique methods to more accurately represent simulated bacteria concentrations at low flows.

This study used HSPF to compare three low-flow direct deposit (DD) simulation

approaches in two Virginia watersheds where bacterial impairment TMDLs were previously developed and where low-flow conditions had been encountered. The three low-flow simulation methods - Flow Stagnation (FS), DD Stage Cutoff (SC), and Stream Reach Surface Area (SA) - have all previously been used to develop TMDLs.

Results suggest that a combination of the SC and FS methods may be the most appropriate treatment for addressing unrealistically high concentrations simulated during low-flow conditions.

However, this combination must be used with caution as the FS method may increase the maximum simulated in-stream under specific circumstances. This re-

search provides a good basis for addressing low flow issues in TMDLs but additional research is needed to validate these methods so that those developing

TMDLs can choose an appropriate technique to accurately represent watershed conditions.

FTABLE generation method effects on in-stream fecal bacteria concentrations simulated with HSPF

The following is an abstract from a paper that will be published in early 2008 in Journal of the American Water Resources Association (JAWA).

Computer simulation models are used extensively for the development of Total Maximum Daily Loads (TMDLs). Specifically, the Hydrological Simulation Program-FORTRAN (HSPF) is used in Virginia for the development of TMDLs for bacteria impairments. HSPF estimates discharge from a reach using function tables (FTABLES). The FTABLE relates stream stage, surface area, and volume to discharge from a reach. In

this study, five FTABLE estimation methods were assessed by comparing their effect on various simulation outputs. Four "field-based" methods used detailed cross-sectional data collected via site surveys. A fifth "digital-based" method used digital elevation data in combination with the Natural Resources Conservation Service Regional Hydraulic Geometry Curves. Sets of FTABLES created using each method were used in simulations of in-stream bacteria concentration for a Virginia watershed. Several statistics relating to in-stream bacteria including long-term average concentration, die-off,

and the violation rate of Virginia's bacteria criterion were compared. The pair-wise Student's t-test was used for the comparison. The HSPF simulations that used FTABLES estimated from digitally-based data consistently produced significantly higher long-term average in-stream fecal bacteria concentrations, significantly lower in-stream fecal bacteria die-off, which is related to differences in residence time in the streams, and significantly higher water quality criterion violation rates.

Recent Center Publications and Presentations

Journal Publications:

- Benham, B.L., A. Braccia, S. Mostaghimi, J.B. Lowery, and P.W. McClellan. 2007. Comparison of best management practice adoption between Virginia's Chesapeake Bay basin and Southern Rivers watersheds. *J. of Extension* [On-line]. 45 (2).
- Hall, K.M., R.W. Zeckoski, K.M. Brannan, and B.L. Benham. 2007. FTABLE Generation Method Effects on Instream Fecal Bacteria Concentrations Simulated with HSPF. *JAWRA* (*accepted*).

Other Publications:

- Center for TMDL and Watershed Studies. 2007. Bacteria Source Load Calculator v2.0 Users Manual. BSE Document no. 2007-0002. Available online: http://www.tmdl.bse.vt.edu/uploads/File/pub_db_files/BSLUsersManual.pdf.
- Zeckoski, R., B. Benham, and C. Lunsford. 2007. Streamside Livestock Exclusion: A tool for increasing farm income and improving water quality. Virginia Department of Conservation and Recreation. Publication 442-766. Virginia Cooperative Extension. 18pp. Available online: http://www.tmdl.bse.vt.edu/uploads/File/pub_db_files/Stream%20brochure_final.pdf

Meetings and Presentations:

- Benham, B.L. and R.W. Zeckoski. 2007. Final Public Meeting for Indian Creek TMDL. September 17, 2007. Cedar Bluff, Virginia.
- Brannan, K.M. 2007. First public meeting for the Mill and Powhatan Creek bacteria TMDL, September 18, 2007. Williamsburg, Virginia.
- Brannan, K.M., S.M Kim and M. Ball. 2007. Second Technical Advisory Meeting for the Hardware River TMDLs June 6, 2007. Charlottesville, Virginia.
- Morris, S., R. Zeckoski and G. Yagow. 2007. Final Public Meeting for the Lick Creek TMDLs, July 16, 2007. Dante, Virginia.
- Yagow, G. 2007. Second Technical Advisory Meeting for N. and S. Fork Pound River TMDLs, August 29, 2007. Pound, Virginia.

New staff joins the Center

A familiar face in the Biological Systems Engineering (BSE) Department recently joined the Center's staff, bringing additional statistical and TMDL expertise to our team of watershed researchers and TMDL developers.

Karen S. Kline, who joined the Center this fall, earned her B.S. and M.S. in Agricultural Engineering at Virginia Tech. She completed her PhD in Agricultural Engineering at Texas A&M University in College Station, with an emphasis on statistical hydrology. After completing her

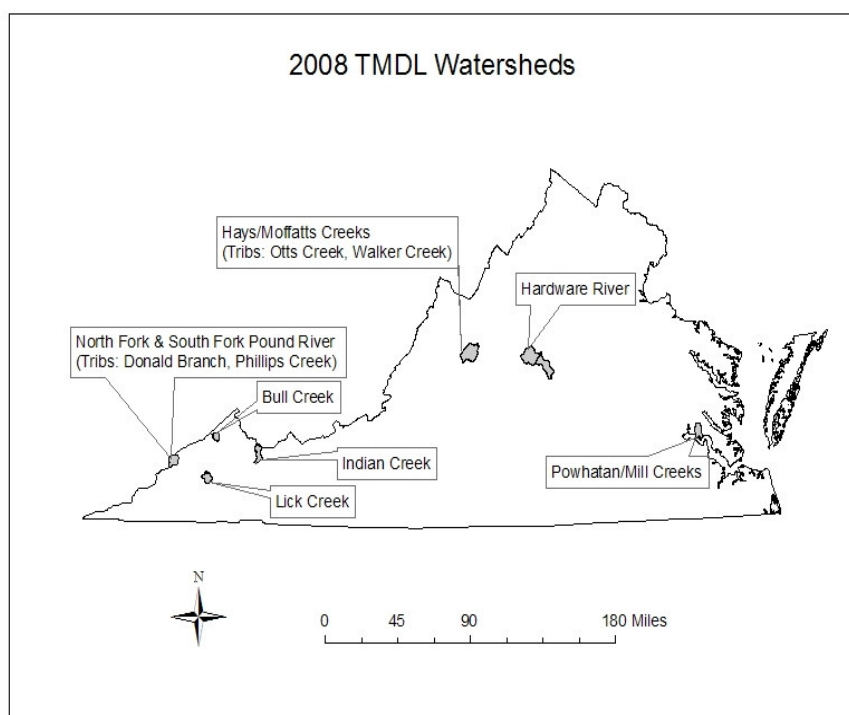
doctorate, Karen worked for the Biological Systems Engineering Department at Virginia Tech, where she provided statistical expertise in two watershed sampling and modeling projects.

Karen has over 10 years of experience in watershed and TMDL related projects. Her early work in the TMDL process included involvement with BSE's Polecat Creek, Nomini Creek, and Owl Run watershed projects. Karen has also been involved with a number of TMDL and implementation projects for the State of Virginia,

and she contributed to the Virginia Department of Conservation and Recreation's "Guidance Manual for Total Maximum Daily Load Implementation Plans."

As Kline explained, "I'm excited about returning to the academic setting to not only work on TMDL projects, but to continue to engage in research projects relating to water quality and watershed studies." Given her impressive range of TMDL, implementation, and statistical expertise, Karen will be a great asset to the Center.

Updates on current Virginia TMDLs



- Lick Creek bacteria and aquatic life (VA general standard) TMDLs (active and historical coal mining): Final comments addressed, awaiting submittal to EPA.
- Indian Creek bacteria TMDL: The final public meeting took place on September 17, 2007. The report is available for public comment.
- Hardware River bacteria TMDL. The final public meeting took place on September 13, 2007. The report is available for public comment.
- North Fork and South Fork Pound aquatic life (VA general standard) impairment (active and historical coal mining): Presented results of stressor analysis at the second TAC meeting on August 29, 2007. Discussions are underway with DEQ and EPA on the possibility of designating sulfate as one of the most probable stressors on two of the impaired segments.

- Hays/Moffatt Creeks bacteria TMDL: The watershed source characterization and hydrology calibration is underway.
- Powhatan/Mill Creeks bacteria TMDLs: The watershed source characterization and hydrology calibration is underway for this tidal influenced TMDL. HSPF and Tidal PRISM will be used to develop the allocations. The first public meeting took place on September 18, 2007.
- Bull Creek aquatic life TMDL (VA general standard) impairment (active and historical coal mining): Data is being gathered for the stressor analysis, the reference watershed comparisons, and for modeling purposes.