Center for TMDL and Watershed Studies

CENTER FOR TMDL AND WATERSHED STUDIES

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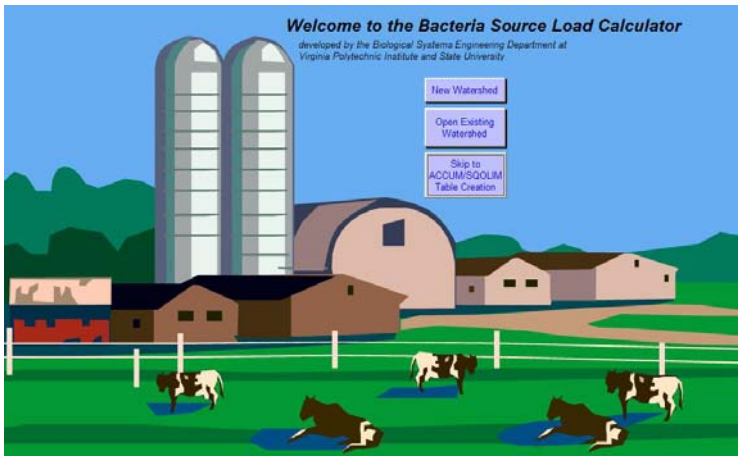
Bacteria Source Load Calculator Version 2.0 and User's Manual Released

INSIDE THIS ISSUE:

A new, enhanced version of the Bacteria Source Load Calculator (BSLC) software is now available, along with a recently published user's manual. The BSLC, developed by staff at the Center for TMDL and Watershed Studies, is designed to simplify the complex and time-consuming work involved in determining bacterial loadings necessary for input into many non-point source models including the Hydrological Simulation Program–FORTRAN model (HSPF). With new program features, such as allowing users to define in-stream defecation for specific days and species, BSLC users can more easily and accurately characterize the bacterial loads in watersheds.



Bacteria Source Load Calculator Opening Screen

The BSLC automates many of the source characterization steps, while providing a high level of consistency in data development and processing. The program is an especially useful tool when performing Total Maximum Daily Load (TMDL) studies, including developing allocation scenarios. The BSLC was developed using Visual Basic for Applications (VBA) in Microsoft Excel. The program's underlying methodology has been used in the development of 21 bacterial TMDLs in Virginia.

Version 2.0, released in February 2007, enables users to:

- input horse densities that vary by pasture type;
- analyze horse defecation in streams;
- separate in-stream defecation loadings for livestock (horse, sheep, and goats) from cattle direct deposits (previously all livestock contributions were lumped into one MUTSIN file);
- specify the number of lambs to be associated with each ewe (Version 1.0 used a default value of two ewes per lamb);
- use a calendar to specify the beginning and ending days for output to direct deposit tables, also known as multiple sequential input (MUTSIN) files;
- select the types of animals for MUTSIN output, significantly decreasing the run time of the program;
- output MUTSIN files by animal type only has been fixed, expanding the op-

tions (rather than just outputting MUTSIN files separately by animal type *and* subwatershed); and generate a MutImp.uci file that

◊ uses sub-watershed numbers in the file names (FILES block) and WDM timeseries numbers (EXT TARGETS block) instead of arbitrary increasing integers,

◊ works correctly if the user wants MUTSIN outputs by animal type, and

◊ only creates MUTSIN operations and EXT TARGETS linkages for the types of animals the user has selected.

The BSLC user's manual includes step-by-step instructions to direct users through the program and generate bacterial loads for a particular watershed.

The manual also features detailed information about each required user-generated input, as well as information regarding interpretation of raw data and results, in the appendices.

Visit the Center's website (www.tmdl.bse.vt.edu/outreach/C71/) to download the BSLC Version 2.0 and the user's manual.

Study identifies possible tools for automated HSPF calibration

For many people involved in developing TMDLs, 'calibration' is a four letter word.

The use of modeling programs to estimate water quality conditions has become commonplace. So too has the process of calibrating modeling parameters so that program outputs match observed data. Unfortunately, this calibration is usually done manually—a time-consuming, tedious process that is subject to user biases and, therefore, inconsistent results.

Researchers at the Center for TMDL and Watershed Studies may have found a better calibration solution. A recently published study, *Comparison of hydrologic calibration of HSPF using automatic and manual methods*, describes how using automated Parameter Estimation (PEST) software might be an effective and efficient alternative to manual calibration when using the popular Hydrological Simulation Program – FORTRAN (HSPF).

The study involved comparing parameter sets automatically calibrated with PEST to those generated with manual calibration aided by the use of the Expert System for the Calibration of HSPF (HSPEXP) software. PEST has been widely used in the field of groundwater modeling, but there have been very few applications of the program to surface water models.

HSPEXP, a decision support system, is currently the most widely used program calibrating the hydrologic component of HSPF. It guides users through the calibration process by offering advice based on expert users' experience.

In the past, research into the use of automatic calibration procedures usually focused on using a single overall objective function to measure performance of the calibrated model. Calibration based on a single performance measure, however, is often inadequate to properly measure the simulation of all the important characteristics of a hydrologic system. The strength of PEST is that it is a very flexible, model-independent program that can utilize multiple-objective functions in the calibration process. Center researchers developed multiple objective functions for use with the program—a significant advancement over past applications of the program to surface water modeling. Multiple objective functions include a number of different criteria describing different aspects of fit between model outputs and observed data.

Both the automatic and manual methods used observed data from a 5-year period (September 1985 to August 1990) for calibration and then an independent 4.5-year period (September 1990 to December 1994) for validation. The calibrated and validated results obtained from both calibration methods were compared using HSPEXP model performance criteria, goodness-of-fit measures (R^2; Nash-Sutcliffe efficiency coefficient, E; and RMSE), and base flow indices.

The automatic calibrated parameter set produced by PEST satisfied most of the HSPEXP model performance criteria and performed better than the manual calibration with respect to R^2, E, and RMSE for both the calibration and validation periods. The automation also eliminates user subjectivity and inconsistency problems. However, further research of the weights used in the objective functions is necessary to provide guidance when applying PEST to surface water modeling. Still, considering the results of this study, and the many possible applications of this automatic calibration method, researchers believe PEST offers a new frontier for improving the field of surface water modeling.

Citation:

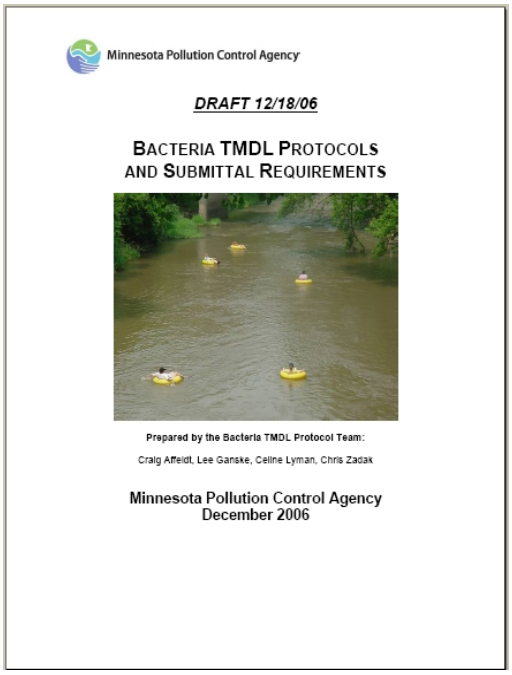
Kim, S.M., B.L. Benham, K.M. Brannan, R.W. Zeckoski, and J. Doherty. 2007. Comparison of Hydrologic Calibration of HSPF Using Automatic and Manual Methods. Water Resources Research 43. W01402, doi:10.1029/2006WR004883.

New Guidance Documents added to the TMDL Knowledgebase Clearinghouse

Eight new TMDL guidance documents have been added to the TMDL Knowledgebase Clearinghouse. The new material, published by state agencies in Connecticut, Florida, and Minnesota, are now accessible online at the Center for TMDL and Watershed Studies website www.tmdl.bse.vt.edu. The clearinghouse is a one-stop, searchable database with more than 370 TMDL-related documents and other resources from across the country, including research abstracts, guidance documents, and state summary reports.

The new additions to the clearinghouse database include Minnesota Pollution Control Agency (MCPA) TMDL protocols and submittal requirements for bacteria, dissolved oxygen, lake nutrients, and turbidity. MPCA also published a lake nutrient TMDL report developed by Limno-Tech that covers how states are addressing nutrient TMDLs for lakes where TMDL target loadings have been difficult to achieve. The report includes interviews with people involved in TMDL development in ten states—Arizona, California, Maine, Maryland, Michigan, Montana, New York, Vermont, Virginia, and Washington. The Florida Department of Environmental Protection also updated state protocols for the development of TMDL studies and implementation plans. The complete list of new documents is provided below.

The TMDL Knowledgebase Clearinghouse contains a summary of guidance documents available from all 50 states. Other resources include overviews of state TMDL programs, information on water quality impairments and TMDL development methodologies, and topical synopses of TMDL related technical and trade literature. The database is updated periodically to ensure the most up-to-date information is available.


Minnesota Pollution Control Agency

DRAFT 12/18/06

BACTERIA TMDL PROTOCOLS AND SUBMITTAL REQUIREMENTS

Prepared by the Bacteria TMDL Protocol Team:

Craig Affeldt, Lee Ganske, Celine Lyman, Chris Zadak

Minnesota Pollution Control Agency
December 2006

Bacteria TMDL Protocols and Submittal Requirements. Minnesota Pollution Control Agency, Draft December 2006.

Benchmarking Report: Site-Specific Approaches for Lake Nutrient TMDLs. Limno-Tech, Inc. drafted for Minnesota Pollution Control Agency, June 2006.

Determining the Probable Candidate Cause, Upper Naugatuck River TMDL Support Document. Connecticut Department of Environmental Protection, December 2004.

Dissolved Oxygen TMDL Protocols and Submittal Requirements. Minnesota Pollution Control Agency, Draft December 2006.

Lake Nutrient TMDL Protocols and Submittal Requirements. Minnesota Pollution Control Agency, Draft December 2006.

Percent Impervious Cover as a Surrogate Target for TMDL Analyses in Connecticut. Connecticut Department of Environmental Protection, December 2006.

TMDL Protocol version 6.0. Florida Department of Environmental Protection, June 2006.

Turbidity TMDL Protocols and Submittal Requirements. Minnesota Pollution Control Agency, Draft December 2006.

TMDL Implementation Planning Process Wins Award

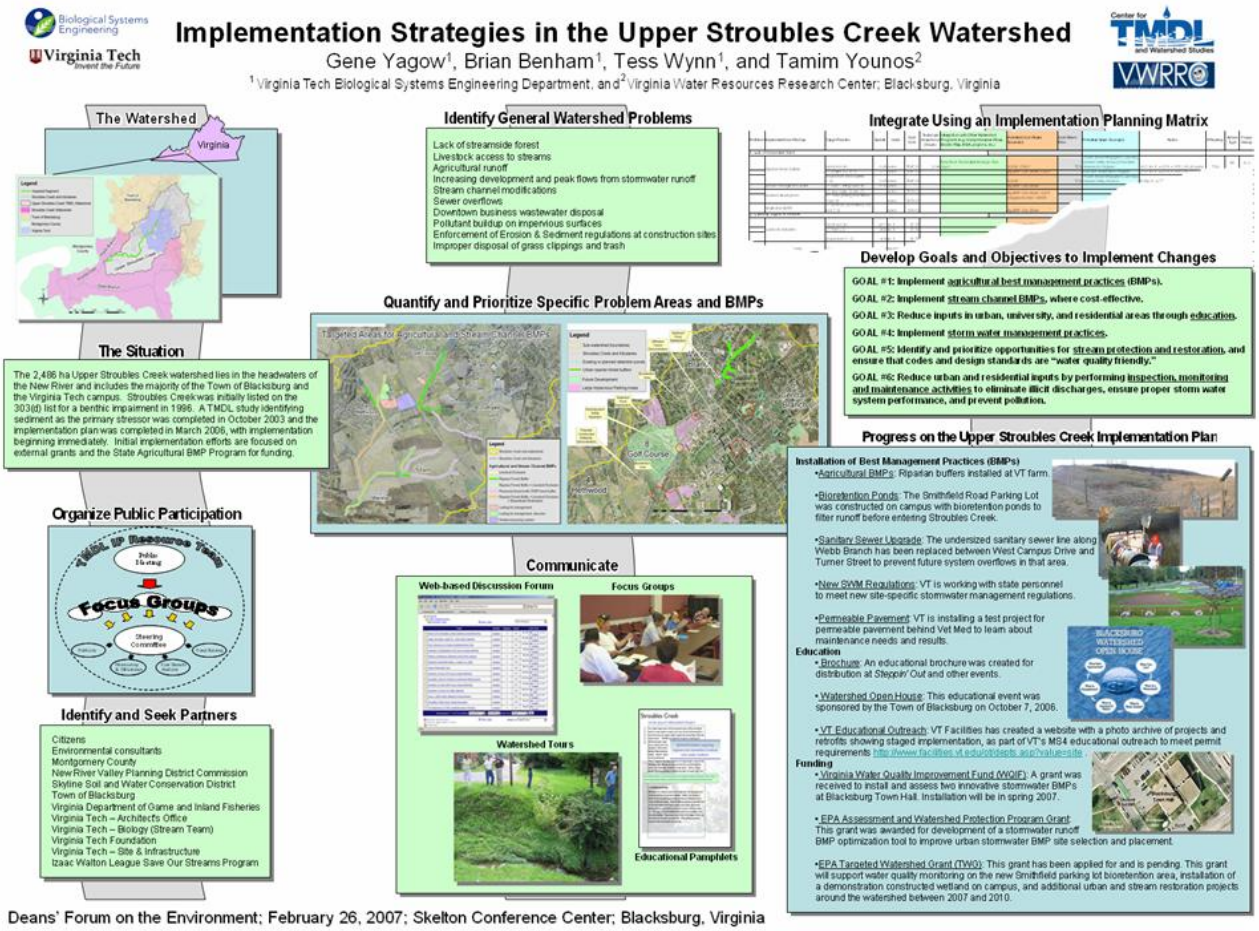
Much of the science and engineering invested in TMDL studies is in danger of being wasted, if TMDL implementation plans do not have adequate support from local stakeholders.

Center staff leading TMDL implementation planning for Stroubles Creek in Blacksburg, VA spent 11 months working with stakeholders. Their stakeholder (public) involvement efforts were highlighted in an award-winning poster presented during Virginia Tech's 2007 Deans' Forum on the Environment, held on February 26, 2007.

"The implementation planning process for this watershed included a lot more interaction with the working groups and the steering committee than in most other watersheds where this process has been completed," explained Gene Yagow, Research Scientist, Center for TMDL and Watershed Studies. "This was because of the unique characteristics of the watershed—highly urban, with the agricultural land owned primarily by Virginia Tech and the Virginia Tech Foundation, and lots of university people independently engaged in some aspect of watershed research."

An essential step in developing and carrying out a TMDL implementation plan is gathering input from a broad range of individuals, agencies, organizations and businesses with interest in and familiarity with local water quality needs and conditions. Watershed stakeholders are best suited to identify and resolve sources of water quality problems within their own communities. Public participation facilitates dialogue between local stakeholders and government agencies, encourages the commitment of resources for TMDL implementation, such as funding and technical support, and facilitates implementation of feasible solutions to water quality problems.

Yagow's poster highlighted the important organizational, communication, and educational strategies that were used to facilitate the public involvement process for



Award winning poster on the Stroubles Creek Implementation Strategies presented at Virginia Tech's Deans' Forum on the Environment.

Stroubles Creek. Such strategies included the formation of focus groups around agricultural/rural, urban/residential, and public works issues. Recommendations from the groups were refined by a steering committee, under the facilitation of a project support team. Informational meetings, public meetings, and watershed tours were part of the process.

The poster also presented some of the implementation progress that had been made since the implementation plan was completed and submitted for to the Virginia Department of Conservation and Recreation.

The Dean's Forum event showcased Virginia Tech's latest environmental research, activity, and expertise. The forum was designed to encourage awareness and foster synergy of research, education, and outreach efforts at the university in environment-related fields, including water quality and water quantity. The Center presented eleven posters at the forum—all accessible through the Outreach section of the Center's website: www.tmdl.bse.vt.edu/outreach .

Recent Meetings and Presentations

Hall, K.M., B.L. Benham, K.M. Brannan, and R.W. Zeckoski. Assessing Alternative Fecal Coliform Direct Deposit Modeling Approaches. Presented at the Fourth Conference on Watershed Management to Meet Water Quality and TMDLs (Total Maximum Daily Load) Issues: Solutions and Impediments to Watershed Management and TMDLs. March 11-13, 2007. San Antonio, TX.

Hall, K.M., R.W. Zeckoski, K.M. Brannan, and B.L. Benham. Comparison of HSPF Simulated In-Stream Fecal Bacteria Concentration Using FTABLEs Generated with Field Survey and Digital Data. Presented at the Fourth Conference on Watershed Management to Meet Water Quality and TMDLs (Total Maximum Daily Load) Issues: Solutions and Impediments to Watershed Management and TMDLs. March 11-13, 2007. San Antonio, TX.

Wolfe, M.L., B.L. Benham, F. Dukes, S. Morris, A. Collins, T. Borisova, and G. Yagow. TMDL implementation plan development for a rapidly urbanizing watershed in Northern Virginia. Presented at the Fourth Conference on Watershed Management to Meet Water Quality and TMDLs (Total Maximum Daily Load) Issues: Solutions and Impediments to Watershed Management and TMDLs. March 11-13, 2007. San Antonio, TX.

Yagow, G., B.L. Benham, M.L. Wolfe, C.D. Heatwole, and R.W. Zeckoski. Implementation Planning – Lessons Learned from 3 Watersheds in Virginia. Presented at the Fourth Conference on Watershed Management to Meet Water Quality and TMDLs (Total Maximum Daily Load) Issues: Solutions and Impediments to Watershed Management and TMDLs. March 11-13, 2007. San Antonio, TX.

Yagow, G. and R.W. Zeckoski. Second Technical Advisory meeting for the Lick Creek bacteria and aquatic ife (VA general standard) TMDLs. February 15, 2007 in Dante, VA.

Yagow, G. First public meeting and Technical Advisory Meeting for the North and South Fork of the Pound River aquatic life (VA general standard) TMDLs. January 30, 2007 in Pound, VA.

Zeckoski, R.W. First public meeting and Technical Advisory Meeting for the Indian Creek bacteria TMDL. February 22, 2007 in , Tazewell County, VA.

Zeckoski, R.W. and B.L. Benham. Water Quality and Economic Benefits of Livestock Exclusion from Streams: Experiences from Virginia. Presented at the Fourth Conference on Watershed Management to Meet Water Quality and TMDLs (Total Maximum Daily Load) Issues: Solutions and Impediments to Watershed Management and TMDLs. March 11-13, 2007. San Antonio, TX.

Recent Center 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. Extension [On-line]. 45(21). (April issue, in press).

Recent Center Publications (cont'd)

Kim, S.M., B.L. Benham, K.M. Brannan, R.W. Zeckoski, and J. Doherty. 2007. Comparison of Hydrologic Calibration of HSPF Using Automatic and Manual Methods. Water Resour. Res. 43. W01402, doi:10.1029/2006WR004883.

Kim, S.M., S.W. Park, J.J. Lee, B.L. Benham and H.K. Kim. 2007. Modeling and assessing the impact of reclaimed wastewater irrigation on the nutrient loads from an agricultural watershed containing rice paddy fields. J Environ. Sci. Heal. A. 42(3):305-315.

Kim, S.M., B.L. Benham, K.M. Brannan, R.W. Zeckoski, and G.R. Yagow. 2007. Water Quality calibration criteria for bacteria TMDL development. Applied Eng. Agric. 23(2): 171-176.

Updates on current Virginia TMDLs

Lick Creek: The second Technical Advisory Meeting for the Lick Creek bacteria and aquatic life (VA general standard) TMDLs took place on February 15, 2007 in Dante, VA. The hydrology and water quality calibration for the bacterial impairment has been completed and allocations are underway. The aquatic life impairment continues to progress with sediment and organic matter identified as the primary stressors. The modeling for existing and future loads and allocation scenarios is underway.

Indian Creek: The first Public Meeting and Technical Advisory Meeting for the Indian Creek bacteria TMDL took place on February 22, 2007. The hydrology calibration and animal source determination are underway.

Hardware River: The water quality calibration is nearing completion for the Hardware River Bacteria TMDL with allocations to follow.

NF and SF Pound River: The first public meeting for the North Fork and South Fork Pound aquatic life (VA general standard) impairment TMDLs took place on January 30, 2007. Data is being gathered on the North Fork and South Fork Pound River segments for the stressor analysis, the reference watershed comparisons, and for modeling purposes.

Center for TMDL and Watershed Studies

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The Center's mission is to conduct interdisciplinary research, teaching, and outreach to improve the integrity of the Nation's waters and watersheds by advancing the science, tools, and expertise available for developing, evaluating, and implementing watershed planning and management processes.