



Development of a Calibrated Watershed Model, Potomac River Basin

*A Cooperative Project between the U.S. Geological Survey (USGS),
the Interstate Commission on the Potomac River Basin (ICPRB),
the Maryland Department of the Environment (MDE), and the
U.S. Environmental Protection Agency Chesapeake Bay Program Office (CBP)*

Progress Report

January 1–March 31, 2004

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Project Description

Problem. Work performed by the National Water-Quality Assessment (NAWQA) Program Potomac River Basin study unit (1992-95) indicated that elevated concentrations of nutrients in surface and ground water in the basin often result from human activities such as manure and fertilizer application. A watershed model of the basin is needed to assess the effects of point and nonpoint nutrient and sediment sources on water quality in the Potomac River and its tributaries.

Objectives. The USGS is responsible for the following objectives: 1) compile necessary data for simulation of Potomac watershed processes, using the Hydrologic Simulation Program-FORTRAN (HSPF); 2) create necessary control files for HSPF simulation of the Potomac River Basin, following the framework developed by CBP for Phase 5 of the Chesapeake Bay Watershed Model (CBWM); 3) develop and implement innovative calibration procedures to improve HSPF model calibration; 4) calibrate an HSPF model for the Potomac River Basin; and 5) prepare reports on calibration and analysis of model results.

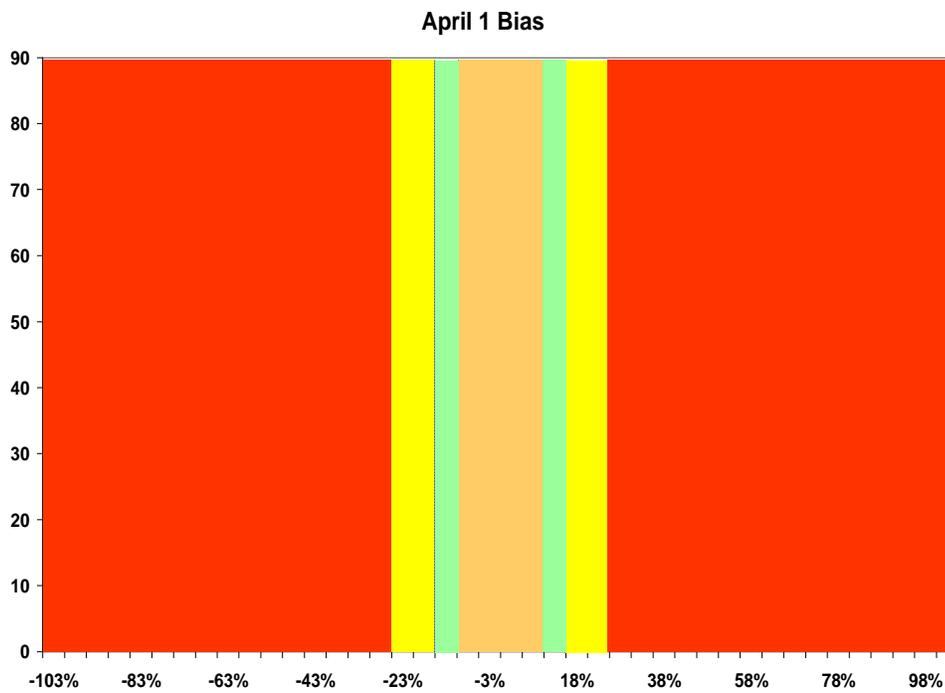
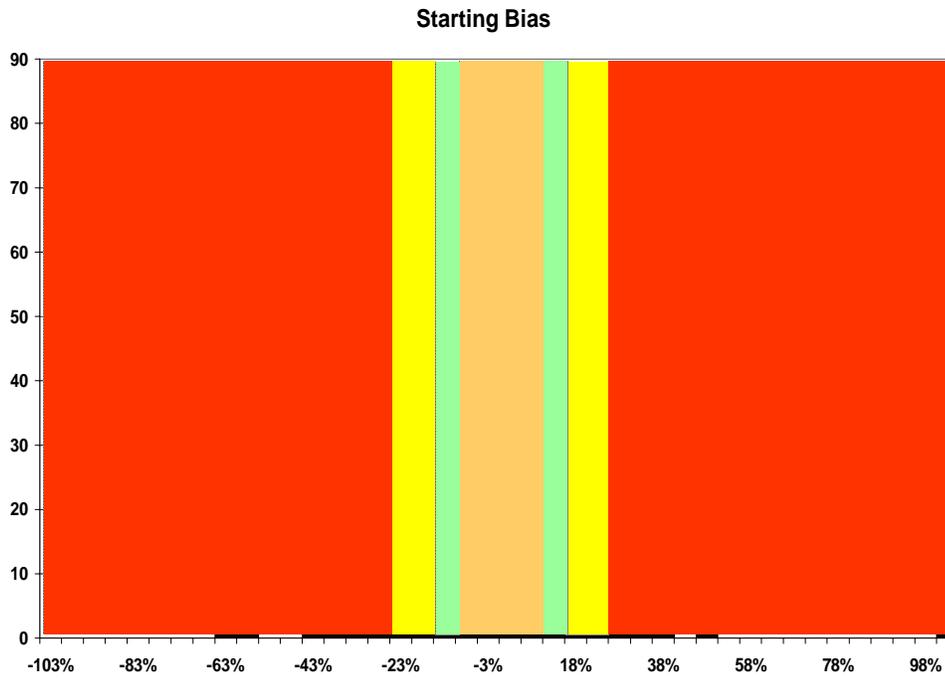
Benefits and relevance. The calibrated Potomac Watershed Model will allow resource managers to simulate the effects of land-use changes and best management practices on water quality and evaluate alternative approaches for correcting existing water-quality and water-quantity problems within the Potomac River Basin. The proposed study also meets several goals of the USGS Water Resources Division (WRD).

Approach and methods. The proposed study will involve the following tasks: 1) compilation of existing input data, development of model segmentation and network, processing of time-series data, and compilation of ancillary data and observational data for model calibration; 2) development of a model calibration strategy through implementation of existing software for general inversion and calibration of multi-parameter hydrological models; 3) calibration of hydrological and water-quality model (sediment and nutrients); 4) analysis of model results, including consideration of specific study questions; and 5) dissemination of calibrated model and preparation of final reports analyzing the model results.

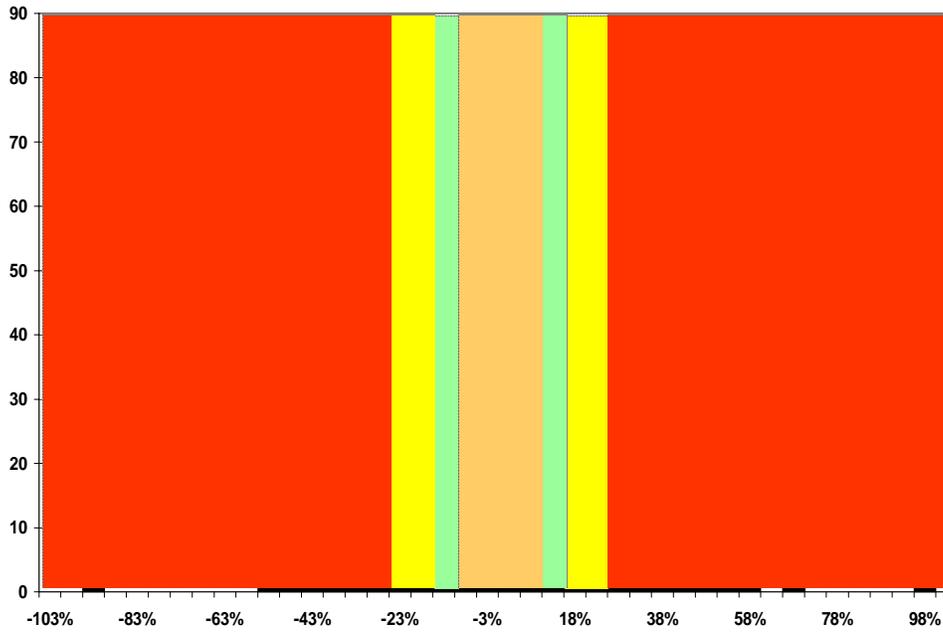
Progress During Reporting Period

During the past 6 months, effort was focused on hydrological calibration. Significant progress in calibration was achieved by the end of December. However, there were a number of issues of inconsistency and the entire basin was not complete at the time of the last progress report. By the end of March, 2004, hydrology was considered well enough calibrated to be approved by the CBP Modeling Subcommittee. A number of water-balance critical parameters were adjusted to minimize bias in the overall water balance (LAND_EVAP) and in the base flow (INFILT). Additional parameter adjustment (AGWR, IRC, KVARY, INTFW, UZSN, LZSN, others) was necessary to reduce bias in the separate baseflow and quick flow components, minimize seasonality in the residuals, and improve simulation of peaks. This has resulted in a model that is fairly accurate overall. Gary Shenk presented the general statistics of the initial and calibrated parameter estimates at the January and April CBP Modeling Subcommittee meetings.

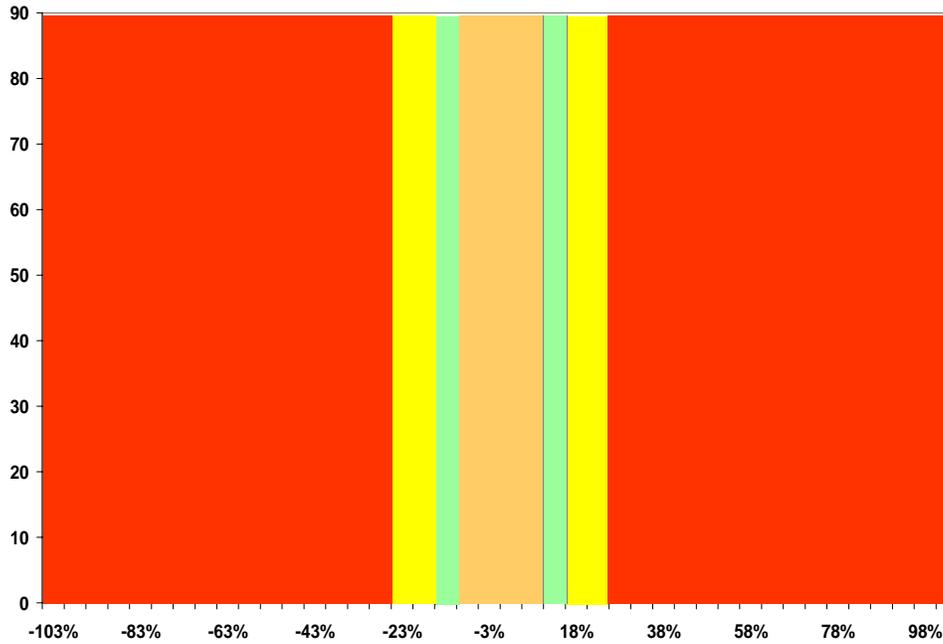
Initial and post-calibration frequency distributions for total bias (relative difference in total flow volume between simulation and observation), baseflow bias, quick flow bias, and daily and monthly (post-calibration only) Nash-Sutcliffe efficiencies are shown in the figures below.



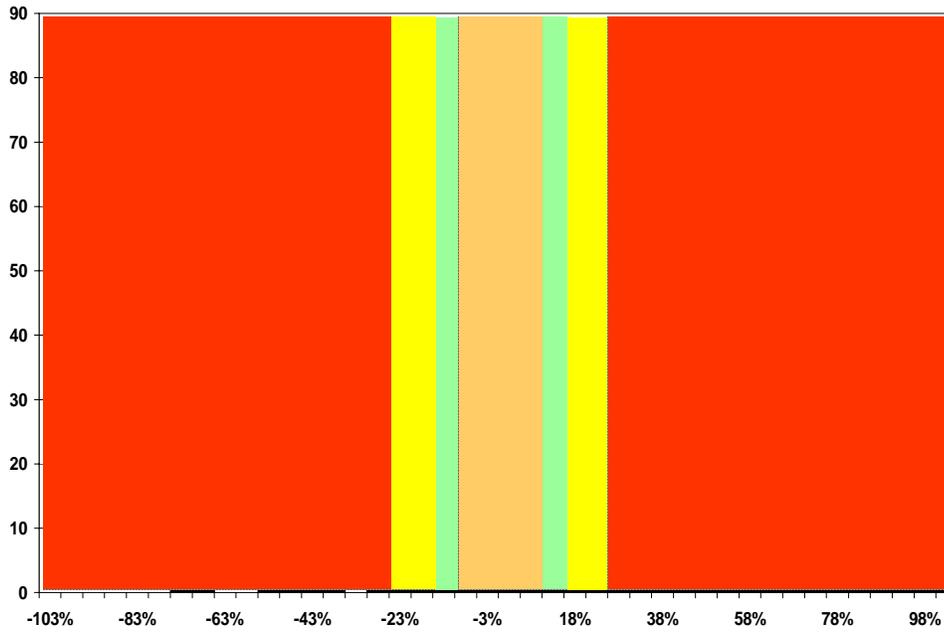
Starting Bstat



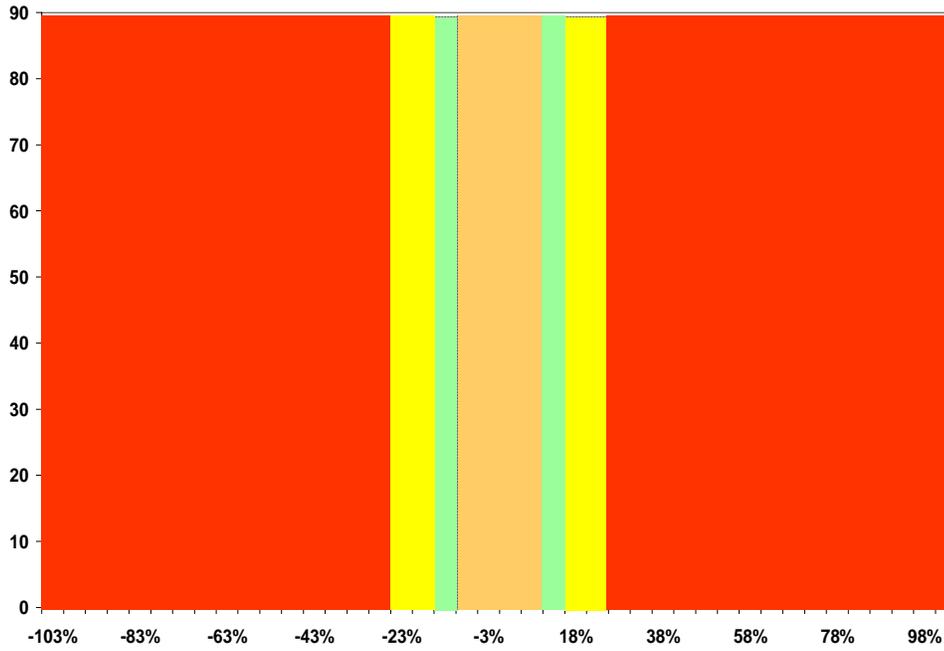
April 1 Bstat



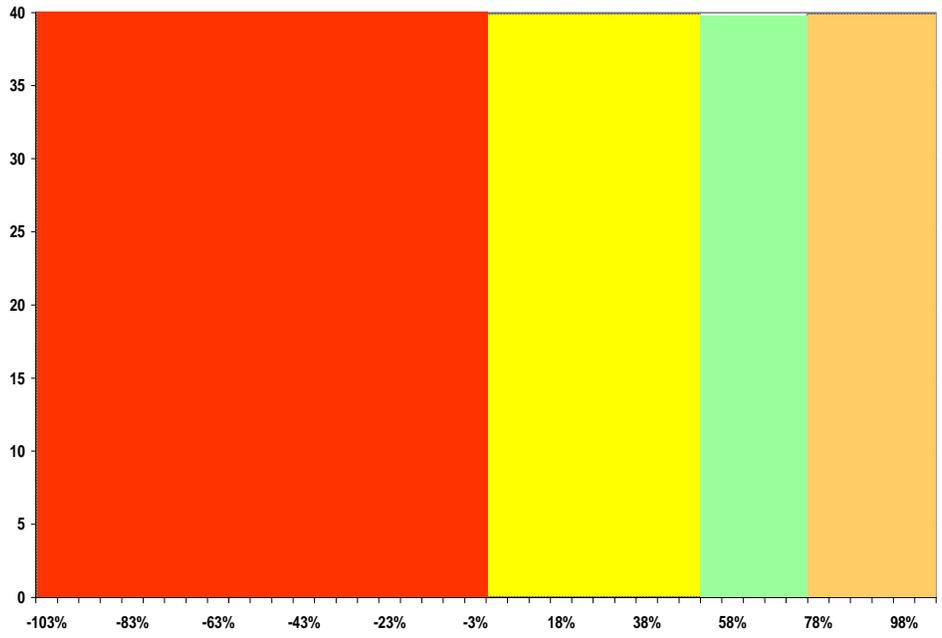
Starting Qstat



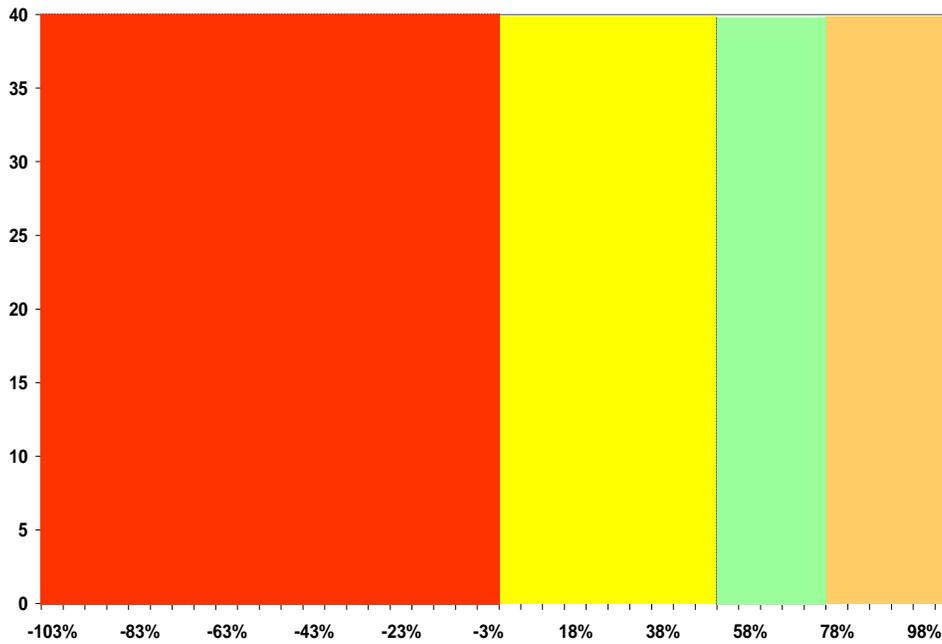
April 1 Qstat



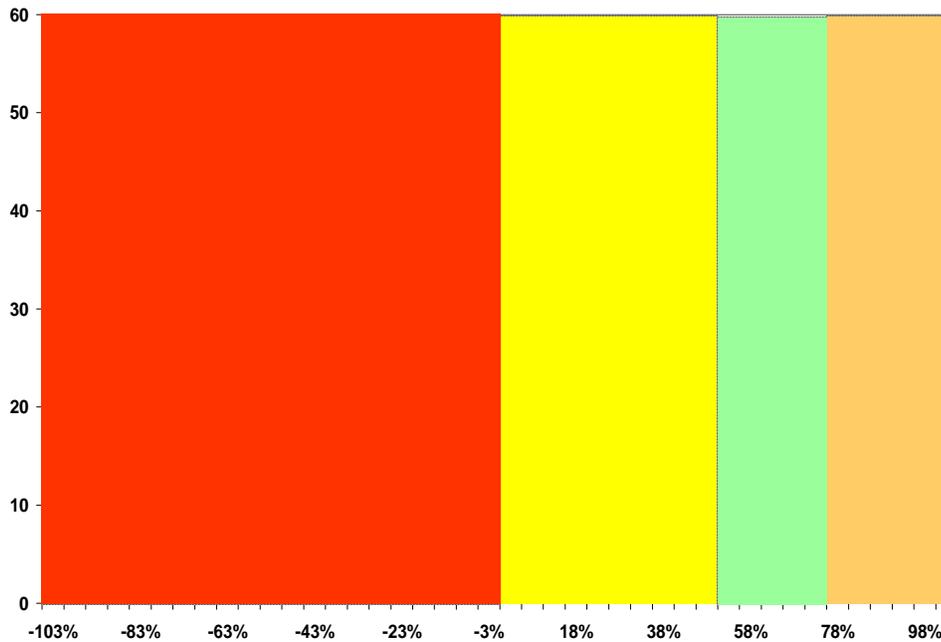
Starting Efficiency



Efficiency as of April 1



Efficiency of Monthly Flow as of Apr 1



Plans for Next Quarter

There are still a number of watersheds requiring minor parameter adjustment, F-table adjustment, or corrections to diversions. This will be accomplished over the next quarter. In addition, the precipitation model developed by Lauren Hay will be extended through calendar year 2002. This will provide a two-year window for model verification.

The second quarter of the current year will also begin sediment calibration. We have compiled the necessary data for calibration from existing USGS databases (which incorporate State and local jurisdiction data when appropriate). Sediment calibration is scheduled to be completed in June.