Watershed Analysis Risk Management Framework (WARMF)

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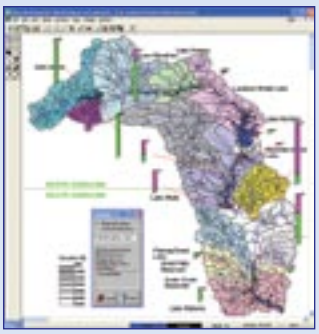
The Watershed Analysis Risk Management Framework (WARMF), developed by Systech Engineering Inc., is a distributed-parameter numerical model used to simulate watershed hydrology and pollutant transport, and to develop total maximum daily loads (TMDLs). The model output provides information on water quality of streams, tributaries, and lakes, given many non-point and point sources of pollution. WARMF rigorously simulates hydrology, including precipitation, evapotranspiration, infiltration, runoff, streamflow and routing, lake mixing and stratification, and groundwater flow. Pollutant transport applications have included: acid mine drainage, inputs from septic systems, bacterial pollution, dissolved oxygen, mercury loading and transport, sediment transport, periphyton in rivers, and algae in stratified reservoirs. WARMF includes software that helps stakeholders develop and evaluate water-quality management alternatives for a river basin. It guides users through a series of steps that help them understand their watershed and the relative impacts of various pollutant sources. The goal is to assist regulators and stakeholders in making informed decisions.

Some important advantages of WARMF are its ability to simulate nonagricultural problems and its physically based formulation. For example, its algorithms track the mass balance and geochemistry of constituents through soil layers rather than using specified soil concentrations, and it uses a dynamic water balance based on physical processes rather than empirical methods. The WARMF graphical user interface is more user-friendly than most watershed models with a similarly comprehensive formulation. Once set up, WARMF is a stand-alone tool that is easily distributed to stakeholders who may not have access to GIS software.

WARMF has a few weaknesses. It does not model deep groundwater aquifers or groundwater quality. In the TMDL module, if point source load reductions are desired, the algorithm will reduce all upstream sources by the same percent. The allocation of the individual point source reductions is then left to be determined by the stakeholders.

WARMF may be downloaded from the EPA Ecosystem Research Division TMDL Modeling Toolbox at no cost at *www.epa.gov/athens/wwqtsc/html/warmf.html*. WARMF has its own GIS system, but is compatible with EPA BASINS 3.1 and ArcGIS files. A WARMF user can use either of those programs to extract data (meteorology, land use, stream discharge, water quality, etc.), delineate watersheds, and generate necessary GIS files for input to WRAMF, and then proceed with model calibration and simulation.

Review of **WARMF**



Ease of Use:	
GUI:	
Output/Plotting:	
Documentation:	
Speed:	
OVERALL RATING:	

Application
Watershed Water Quality and Hydrology

Best Features
TMDL Tool

Worst Feature
Groundwater simulation

Rating System: Excellent — Poor

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