

**Texas A & M University and U.S. Bureau of Reclamation**  
**Hydrologic Modeling Inventory**  
**Model Description Form**  
August 22, 2007

**Name of Model:** Dynamic Watershed Simulation Model (DWSM)

**Model Type:** The DWSM is a physically based, event-based, distributed, and unsteady rainfall-runoff, soil/sediment erosion-transport, and agrochemical mixing-transport model. Details of only the rainfall-runoff (DWSM-Hydro) component are listed here. For the sediment and agrochemical components, contact the model developer.

**Model Objective(s):** To assess the environmental conditions of a watershed, such as flooding, upland soil and stream erosion, sedimentation, and contamination of water from agrochemical. To evaluate alternative land use and best management practice scenarios, implementation of which can help reduce the damaging effects of storm water runoff on water bodies and the landscape.

**Agency and Office:** Woolpert, Inc., 415 Port Centre Parkway, Suite 101, Portsmouth, VA 23704-4924, Tel: 757-398-6858, Fax: 757-399-6869, Email: [deva.borah@woolpert.com](mailto:deva.borah@woolpert.com)

**Technical Contact and Address:** Dr. Deva K. Borah, Woolpert, Inc., 415 Port Centre Parkway, Suite 101, Portsmouth, VA 23704-4924, Tel: 757-398-6858, Fax: 757-399-6869, Email: [deva.borah@woolpert.com](mailto:deva.borah@woolpert.com)

**Model Structure or Mathematical Basis:** Developed for small to medium sized agricultural and rural watersheds. Input mean areal breakpoint rainfall depths or distributed breakpoint rainfall depths from rain gages assigned to single or multiple overland planes as per Thiessen polygon. Simulates interception, infiltration, detention storage, and evaporation losses and routes the excess rainfall over overland surface and part of the infiltrated water through overland subsurface, and route the combined flow through channel segments, and through reservoir units, if any, from single or a consecutive series of rainfall events. Uses simple SCS runoff curve number procedure or a detailed interception-infiltration routine to compute time varying rainfall excess rates. Uses the analytical and an approximate shock-fitting solutions of the kinematic wave equations to route water over overland planes and through channel segments, a kinematic storage procedure to route subsurface flow through overland planes, and Puls or storage indication method to route water through reservoir units.

**Model Parameters:** Curve number (if SCS curve number procedure is chosen) or vertical saturated hydraulic conductivity (if interception-infiltration routine is chosen), and effective lateral saturated hydraulic conductivity for overlands. Manning's roughness coefficients for the overland planes and channel segments.

**Spatial Scale Employed in the Model:** The watershed is divided into a number of overland planes, channel segments, and reservoir units each having individual parameter and processes. Topography is the primary criteria. Soils and land uses are other factors for homogeneity, however, can be averaged with representative parameter values.

**Temporal Scale Employed in the Model:** Several days of rainfall events, time scale divided into constant time intervals ranging from few minutes to few hours.

**Input Data Requirements:** Area, length, average slope, Manning's roughness coefficient, effective lateral saturated hydraulic conductivity, and initial soil moisture of overland planes. If the SCS curve number method is chosen, the only other input for an overland is the curve number. If the interception-infiltration routine is selected, overland inputs also include canopy and ground cover fractions and storage capacities, average evaporation rate, vertical saturated hydraulic conductivity, and soil sorptivity. Channel inputs include lengths, average slopes, cross-sectional area-wetted perimeter power relation coefficients and exponents, and Manning's roughness coefficients. Reservoir input includes stage-storage-discharge tables. Breakpoint rainfall depth records at single or multiple rain gages.

**Computer Requirements:** PC running DOS. A 251-km<sup>2</sup> watershed divided into 78 overlands, 39 channels, and 2 reservoirs required 1.8 Meg. of Memory and 900 K of Disk space for running both the hydrology and sediment components for a period of 10 days with a 15-minute time step.

**Model Output:** Summary of total rainfall at each rain gage, watershed outflow volume, peak flow, and time to the peak flow. Summaries of areas, rainfall and rainfall excess depths, runoff volumes, and unit-width peak-flows in overland planes. Summaries of drainage areas, runoff volumes, peak flows and times to the peak flows for the channels and reservoirs. Time series of areal average rainfall intensity, watershed outflow, and outflows of selected channels and/or reservoirs at each time step, which can be used to develop hyetograph and hydrographs.

**Parameter Estimation / Model Calibration:** Initial values of the parameters are estimated based on observed conditions and literature values, which are adjusted by comparing the simulated runoff volume and hydrographs with as many observed data as available for a typical storm (calibration storm).

**Model Testing and Verification:** The model is run for as many observed storms as available, other than the one used for calibration, using the same input data and parameter values as the calibrated storm, except the rainfall intensities, and compared the simulated volume and hydrographs with the observed.

**Model Sensitivity:** Curve number, vertical and effective lateral saturated hydraulic conductivities, and Manning's roughness coefficients are sensitive parameters.

**Model Reliability:** Found reliable in case studies.

**Model Application / Case Studies:** Applied to various watersheds in the U.S. as part of research and practical projects, most are published in the literature.

**Documentation:** Partially documented and are available in the literature. Full documentation is in progress.

**Other Comments:** The model is fast and efficient, promising for large watersheds.