

Texas A & M University and U.S. Bureau of Reclamation
Hydrologic Modeling Inventory
Model Description Form
JULY 28, 2000

Name of Model: Water Rights Analysis Package (WRAP)

Model Type: Simulation of River Basin Management

Model Objective(s): WRAP simulates management of the water resources of a river basin, or multiple-basin region, under a priority-based water allocation system. The objective is to provide flexible generalized modeling capabilities for assessing hydrologic and institutional water availability/reliability for water supply, instream flow, hydroelectric power, and reservoir storage requirements (water rights). Basinwide impacts of water resources development projects and management strategies may be evaluated. The model is generalized for application to any river-reservoir-use system, with input files being developed for the particular river basin of concern.

Agency and Office: Texas Water Resources Institute, Texas A&M University System, College Station, Texas 77843-2118, <http://twri.tamu.edu>; and Texas Natural Resource Conservation Commission, Austin, Texas 78711-3087, <http://www.tnrcc.state.us>

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Model Structure or Mathematical Basis: Streamflow and reservoir storage are allocated to specified water use requirements during each month of a multiple-year hydrologic period-of-analysis. Streamflow frequency relationships and water supply reliability indices are determined from the results of the simulation.

Model Parameters:

Spatial Scale Employed in the Model: A river basin or multiple-basin region may be modeled. Spatial location and connectivity of all components of the river-reservoir-use system are represented by control points. The model is dimensioned for up to 3,000 control points, 3,000 diversion, instream flow, or hydropower demands, and 1,200 reservoirs.

Temporal Scale Employed in the Model: Monthly computational time step with no limit on the number of years in the hydrologic period-of-analysis.

Input Data Requirements: Two sets of simulation input data represent (a) hydrology and (b) water rights. The hydrology input data include: (1) sequences of monthly naturalized streamflows covering a multiple-year period-of-analysis for selected control point locations, (2) watershed parameters for distributing flows from gaged (known-flow) to ungaged (unknown-flow) control point locations, (3) channel loss factors, and (4) sequences of monthly net reservoir evaporation-precipitation rates. Water rights input data include: (1) water supply diversion and return flow, instream flow, and hydroelectric energy targets, (2) reservoir storage capacities and elevation-volume-area relationships, (3) hydroelectric power plant characteristics, (4) data specifying river/reservoir system operating rules, and (2) data defining priorities governing allocation of water among water rights.

Computer Requirements: Executable programs are distributed for use on desktop computers running MS-DOS/Windows operating systems. No special requirements.

Please see the HMI web page: <http://www.usbr.gov/hmi>
Forms are available in Text file, HTML, MS Word and WordPerfect formats
This effort is being conducted by River Systems & Meteorology Group: <http://www.usbr.gov/rsmg>

Model Output: The simulation model, called WRAP-SIM, outputs naturalized, regulated, and unappropriated streamflows, channel losses, reservoir storage content, reservoir evaporation-precipitation volumes, diversions and diversion shortages, hydroelectric energy generated and energy shortages, and instream flow shortages for each month of the multiple-year simulation for each appropriate control point, reservoir, and/or water demand. A post-simulation program, called TABLES, reads the simulation output file, computes frequency and reliability indices, and organizes the voluminous simulation results into a variety of user-specified tables. A pre-simulation utility, called WRAP-HYD, facilitates development of the naturalized streamflow and net evaporation-precipitation input data for WRAP-SIM.

Parameter Estimation / Model Calibration:

Model Testing and Verification:

Model Sensitivity:

Model Reliability:

Model Application / Case Studies: Pursuant to Senate Bill 1 enacted by the Texas Legislature in 1997, the Texas Natural Resource Conservation Commission (TNRCC), its partner agencies, and contractors are developing a statewide Water Availability Modeling (WAM) system during the period 1997-2001. The WAM system consists of the WRAP simulation model, WRAP input files for each of the 22 river basins of the state, various databases and data management software, and user interfaces. The objective is to provide a simulation model and databases that may be used throughout the water management community to support planning studies and both preparation and evaluation of water right permit applications. WRAP is the official model adopted by the TNRCC for administration of the water rights system and is used by various water management entities in the state for planning studies as well preparing permit applications. There has been some limited use outside of Texas. The model is applicable essentially anywhere.

Documentation: *Reference and Users Manual for the Water Rights Analysis Package (WRAP)*, by Ralph A. Wurbs, Texas Water Resources Institute Technical Report 180 prepared for the Texas Natural Resource Conservation Commission, First Edition August 1999, Second Edition August 2000.

Other Comments: The Texas Natural Resource Conservation Commission maintains the WRAP software, documentation, and input data files for river basins in Texas on their web site (<http://www.tnrcc.state.us>). The public domain software may be downloaded and freely copied. The Texas Water Resources Institute (<http://twri.tamu.edu>) distributes the software on diskette and the 300 page manual on paper in a three-ring binder for a \$35 handling fee.