Hydrologic Engineering Center (CEIWR-HEC)
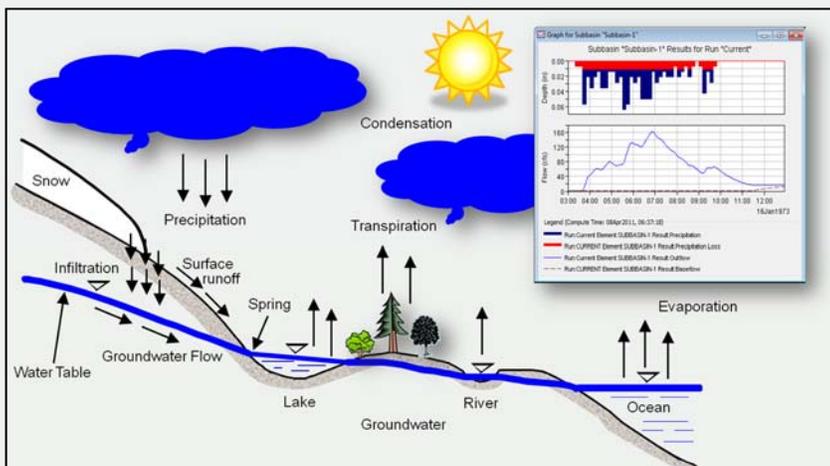# Hydrologic Modeling System (HEC-HMS)

U.S. Army Corps of Engineers (USACE)
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Description

The Hydrologic Modeling System (HEC-HMS) is designed to simulate the precipitation-runoff processes of den-dritic watershed systems. The software's design allows applicability in a wide range of geographic areas for solving diverse problems including large river basin water supply and flood hydrology, and small urban or natural watershed runoff. A model of the watershed is constructed by separating the hydrologic cycle into manageable pieces and constructing boundaries around the watershed o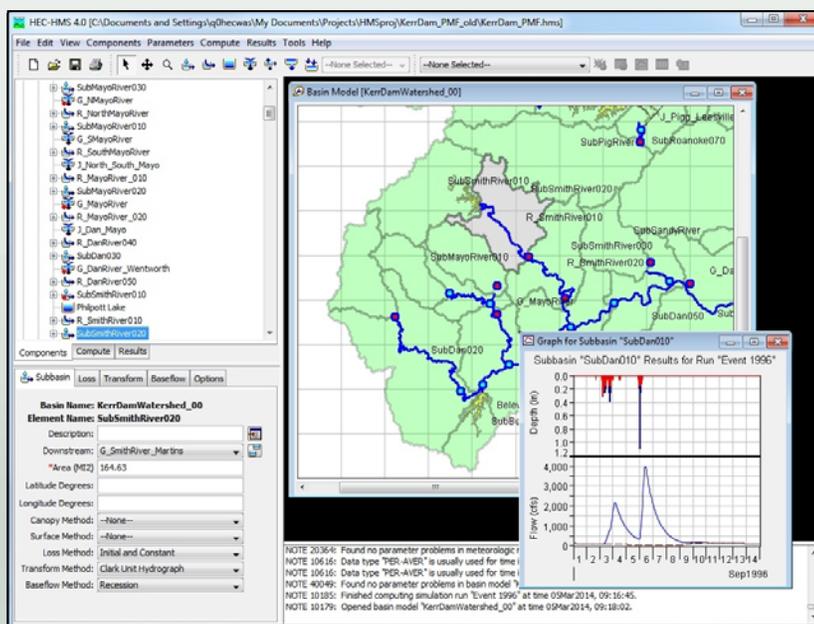f interest. In most cases, several model choices are available for representing each water pathway or energy input in the hydrologic cycle. Each mathematical model included in HEC-HMS is suitable in different environments and under different conditions. Making the correct choice requires knowledge of the watershed, the goals of the hydrologic study, and engineering judgment. HEC-HMS features a completely integrated graphical work environment including a database, data entry utilities, watershed map, computation engine, and results reporting tools.

Benefits

HEC-HMS combines tools for representing the hydrology of natural watersheds with tools for representing highly developed urban watersheds, plus engineered structures such as reservoirs, pump stations, and diversions. The software is one of the only hydrologic simulation products to place such an equal value on both natural and urbanized watersheds, and can handle watersheds with a mixture of development conditions. HEC-HMS also is one of the only hydrologic simulation tools to include both event and continuous simulation capabilities. This flexibility allows a watershed model developed for one purpose, to be repurposed with a minimal amount of effort. For example, a watershed model developed for real-time system operation can be easily employed for regulation purposes. A watershed model developed for estimating flood damage reduction benefits can be easily expanded to consider environmental restoration goals. Finally, the extreme modular concept of the underlying program components allows for mission flexibility in the future. The addition of new methods for representing infiltration, new reservoir outlet structures, or any other component of the hydrologic cycle can be accomplished quickly.

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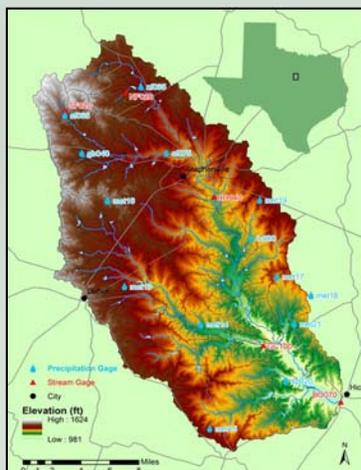**BUILDING STRONG®**

Relationship to USACE Business Lines

HEC-HMS is used in almost every mission area USACE, where hydrology is a component of the mission.

- **Flood and Coastal:** HEC-HMS is widely used to support the Flood and Coastal Business line. The software is one of the most widely utilized tools for estimating one percent flows for floodplain regulation. Furthermore, HEC-HMS is used in reconnaissance, feasibility, and design level studies for evaluating proposed alternatives and developing flow frequency curves for the risk-based design process. The software is used at all USACE Districts and Divisions performing a water management function, where HEC-HMS is used to make forecasts for short-duration floods as well as seasonal snowmelt runoff, so that reservoirs can be operated efficiently.

- **Environmental:** HEC-HMS is often used to perform continuous hydrologic simulations to estimate long-term flow regime statistics which indicate likely plant and animal health. The recent addition of land surface erosion, sediment transport, and nutrient simulation capabilities also will be useful for future environmental studies.

- **Navigation:** HEC-HMS is used to compute real-time upstream and lateral inflows to navigable rivers so that navigation dams and locks can be operated to maintain shipping. In a planning mode of analysis, HEC-HMS can be used to estimate long-term water supply available for lock operations.

Applications

HEC-HMS is used by all USACE District and Division offices to design and operate projects, regulate floodplain activities, and for other purposes. The Federal Emergency Management Agency (FEMA) has approved HEC-HMS for use in flood hazard mapping. The Federal Energy Regulatory Commission (FERC) accepts the software for hydropower licensing submittals. HEC-HMS is used by state and local governments for local or regional planning, by private architectural and engineering firms to conduct design work, and by university professors as a teaching tool. The software has been applied in watersheds as small as an elevated highway interchange to as large as 20,000 square miles. Hydrographs produced by HEC-HMS are used directly or in conjunction with other software for studies of water availability, urban drainage, flow forecasting, future urbanization impact, reservoir spillway design, flood damage reduction, floodplain regulation, and real-time systems operation.

Key Features

HEC-HMS includes a number of basic hydrology features as well as advanced simulation and analysis features:

- Precipitation
- Plant Evapo-transpiration
- Snowmelt
- Ground Surface Storage
- Soil Infiltration
- Surface Runoff
- Subsurface Baseflow
- Channel Routing with Losses
- Diversion Structures
- Reservoirs with Dam Failure
- Interior Flood Hydrology
- Storm Events
- Continuous Simulation
- Gridded Models
- Physically-based Models
- Automatic Parameter Estimation
- Flow Forecasting
- Depth-Area Analysis
- Monte Carlo Uncertainty
- Erosion and Sediment
- Nutrient Water Quality
- Probable Maximum Precipitation