Watershed Management Optimization Support Tool (WMOST) v. 2
Integrated Water Management for Communities and Planning Authorities

EPA

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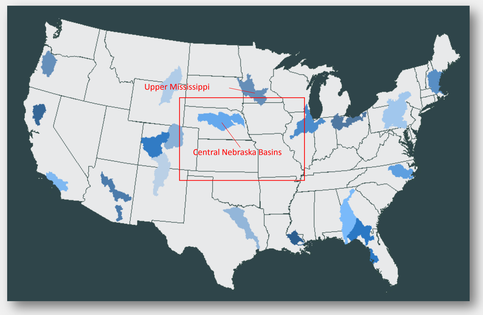
What is WMOST?

- Decision-support tool for integrated watershed and water resources management (stormwater, wastewater, drinking water, land conservation)
- Evaluates costs/benefits of green infrastructure (GI) solutions
- Cost-optimization given user constraints, e.g.,
  - Baseflows (drinking water supply, support fish populations)
  - Peak flows – minimize erosion, flooding costs

Hydrology Time Series Data Available for WMOST Inputs in EPA Region 7

EPA 20 Watershed Study Additions to WMOST database



Applications of Soil and Water Assessment Tool (SWAT) model

Example SWAT model applications in Region 7 States. A search of the SWAT online bibliography revealed 77 model applications in Kansas, 62 model applications in Iowa, 27 in Missouri, and 7 in Nebraska.

Reference	Watershed	Calibration	Validation
Arnold et al. 2000	Upper Mississippi River (incl. IA, MO)	1961-1980	1981-1985
Benham et al. 2006	Shoal Creek, MO	1999-2000	2001-2002
Benson et al. 2006	Long Branch, Upper Shoal Creek, Miami Creek, MO		
Benson et al. 2008	Small ag watersheds across Missouri	1997-2007	
Chaplot et al. 2004	Walnut Creek, IA	1991-1998	
Du et al. 2005	Walnut Creek, IA	1992-1995	1996-1999
Green et al. 2006	S Fork of the Iowa River, IA	1995-1998	1999-2004
Jha et al. 2004a	Mazuoketa River, IA	1981-1990	
Jha et al. 2004b	Upper Mississippi River	1989-1997	1980-1988
Jha et al. 2007	Racoon River, IA	1981-1992	1993-2003
Perkins & Sophocleous 1999	Lower Republican River, KS	1977-1994	
Secchi et al. 2007	13 watersheds, IA	varies	
Vache et al. 2002	Buck Creek and Walnut Creek, IA	varies	
Linard et al. 2009	Maple Creek, NE	1996-1997	

Future National Hydrologic and Water Quality System (HAWQS)

- National Watershed and Water Quality Assessment Tool
- SWAT-based
- Databases, interfaces and models to evaluate impacts of management alternatives
- Includes: sediments, pathogens, nutrients, BOD, dissolved oxygen, pesticides
- Supported by EPA Office of Water

Example Applications of WMOST

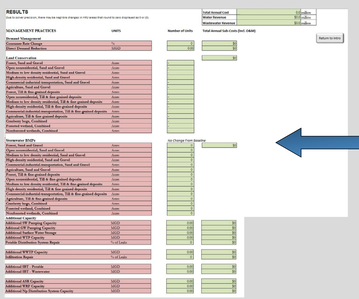
Case Study 1 (WMOST v1): Danvers/Middleton

- Ipswich River on American Rivers "Most Threatened Rivers" list due to excessive water withdrawals and interbasin transfers
- **History**:
  - Late 1800's, before the first sewers were built in Ipswich River communities, most water withdrawn from the watershed was returned as wastewater to the basin.
  - 2002: 80% of the total wastewater produced was exported out of the basin.
  - 50% of native riverine fish species extirpated
- **Objective**: Minimize cost to meet projected human demand and in-stream flow criteria
- **Goal**: Double target instream flow
- **Least cost management options**
  - Demand reduction
  - Fix leaks (drinking water, wastewater)
  - Increase local wastewater treatment
  - Green infrastructure (infiltration basins)
  - Aquifer Storage and Recharge
  - Water Reuse Facility

Case Study 2 (WMOST v2): Halifax

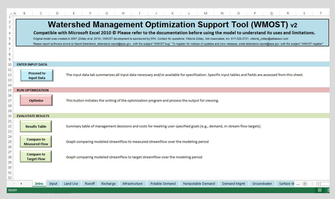
- Monponsett Pond: Water Quality, Water Supply and Flooding Issues
- **History**:
  - During historic droughts, state passed legislation allowing interbasin transfers from Monponsett Pond to another basin to serve another community 15 miles away
  - Water resource management is causing local flooding, loss of historic beaches, increased retention time in western basin and associated blue-green algal blooms
- **Objective**: Minimize cost to meet projected human demand as well as in-stream flow requirements for anadromous fish and downstream threatened ecosystems
- **Results**: System severely constrained
- **Least cost management options** selected for sustainable yield and minimized flooding
  - Demand reduction, reduction in interbasin transfers
  - Fix leaks (drinking water)
  - Green infrastructure stormwater BMPs a common least-cost solution in scenarios tested

Optimization Results



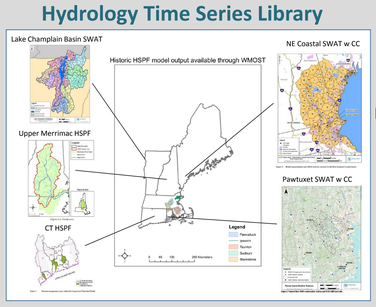
After the optimization step, the user is provided with a summary of optimal management choices and associated costs. Graphs are also provided for baseline validation runs and for comparison of target and model flows.

Main screen guides the user through the process

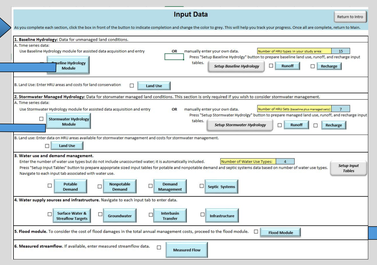


Previous runs of existing HSPF models using 50-year climate records used to generate unit runoff and recharge rate time series for wet and dry years. Alternatively, users can add their own time series from watershed models (HSPF, SWAT, etc). More time series for other regions will be added to the tool in the future.

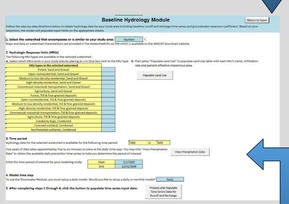
Hydrology Time Series Library



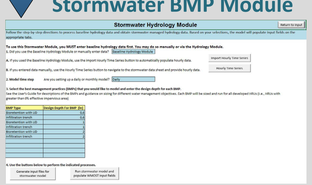
Buttons lead to different input tabs



Baseline Hydrology Module



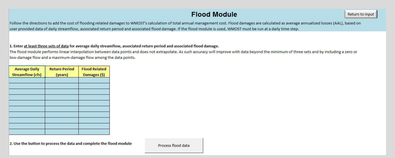
Stormwater BMP Module



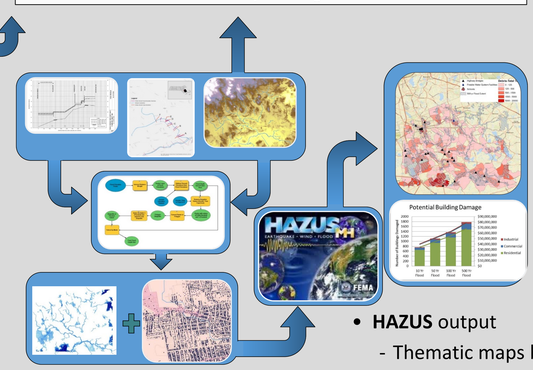
EPA SUSTAIN

WMOST interacts with the simulation module in EPA SUSTAIN to automatically route runoff time series through stormwater BMPs and estimate runoff reduction and recharge. Default BMP cost estimates are also imported from SUSTAIN. The future water quality module will use this mechanism to estimate reductions in nutrient, sediment, and metal loads.

Flood Module



The new flood module allows users to incorporate flooding risks and costs into cost-benefit analyses for green infrastructure



- **HAZUS** output
  - Thematic maps by census block
  - Infrastructure losses
  - Site-specific building losses

A protocol is provided for users to generate flood-cost curves for entry into WMOST using FEMA HAZUS software and publically available data from Flood Insurance studies.

Potential Contributions of WMOST in Region 7 States

- Kansas municipal Water Conservation Plans (WCPs)
- Evaluate strategies to maintain Minimum Desirable Streamflows (Kansas)
- Evaluation of aquifer recharge and water reuse options
- Drought planning
- Nebraska Integrated Management Plans for fully appropriated basins

Planned Future Directions

- **FY16**: Fall/winter: Water quality module, Spring/summer: CSO, Robust Decision Making for Climate Change modules; More hydro time series: Ches Bay, EPA 20 Watersheds Study
- **FY17**: Enhanced WQ (regional WQ-flow curves) module; GI Co-benefits module; link w nationwide SWAT (HAWQS)
- **FY18**: Multi-objective optimization; Scaling/linking across basins
- **FY19**: Synthesis of case studies
- **FY16-19**: Outreach/training: More case studies (diverse climates), Regional Tools Cafes; Technical support for urban partners (pending funding)

Contacts and Collaborations

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- Current Collaborators: Town of Halifax, MA; Monponsett Pond Watershed Association
- Example Users: MA Sustainable Water Management Initiative Pilot Communities, Univ of CT-Storrs