Hydrologic Water Quality Modeling in Support of Watershed Based Planning Decision Support[1]

Research Need

HEC-HMS is extensively used by the Corps for watershed flow and sediment modeling in support of water management and water resource planning. The Corps needs a generalized next-generation watershed water quality modeling system, capable of simulating non-point source water quality (nutrients, dissolved oxygen, phytoplankton, and bacteria) and characterizing watershed-scale water quality impacts to improve water management for environmental and ecosystem benefits.

Project Objectives & Plan

The purpose of this project is to build new capabilities within the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS), in collaboration with ERDC Environmental Laboratory (ERDC-EL). This project will produce a new version of HEC-HMS with water quality modeling and analysis capabilities, simulating water temperature and general constituent transport for overland flow, streams, and reservoirs:

- The new software will integrate water quality into the hydrologic modeling process to improve water management for environmental and ecosystem benefits.
- Overland flow water quality capabilities will provide vital non-point source inputs for dedicated river and reservoir water quality models.
- Stream and reservoir capabilities will allow users to characterize watershed-scale water quality impacts.

These capabilities will be provided by a water quality engine and an expanded user interface, developed in close collaboration between HEC and ERDC-EL. The HEC-HMS user interface will support water quality model setup (including all necessary model parameters), water quality and meteorological data input, data visualization, analysis, and reporting requirements.

The updated HEC-HMS program, documentation, technical reports, and validation studies will be available from the HEC's and ERDC's web sites.

Payoff

Integrating watershed water quality modeling capabilities into HEC-HMS directly supports the Corps' high priority needs to assess project impacts and improve management of the watershed to meet environmental objectives, which range from endangered species protection to invasive species control, as well as to improve reservoir operations decision-making to meet downstream environmental requirements. The new HEC-HMS software will provide the Corps with integrated hydrologic and water quality capabilities, providing accurate non-point inputs for streams and reservoirs and extensive data visualization and reporting capabilities for analysis and decision support. The software will be intuitive, powerful, and easy to use, facilitating cost-effective, science-based environmental impact assessment and management. Furthermore, it will form the foundation for more extensive generalized watershed water quality modeling capabilities (e.g., nutrients, dissolved oxygen, bacteria, and phytoplankton) in the next major stage of development. The Corps is rapidly building real-time watershed-scale forecasting models across the nation, incorporating HEC-HMS and other models in the Corps Water Management System (CWMS). Through the CWMS implementation project, more than 200 watersheds will have HEC-HMS models constructed and ready for deployment over the next several years. The ability to add water quality to these watershed models and use them in CWMS for real-time decision support as well as planning studies provides an effective, efficient, and economical approach to addressing environmental requirements.

Products

Conference Presentations/Webinars/Workshops

Steissberg, T. (2017). Water temperature modeling workshop, Workshop. Hydrologic Engineering Center, Davis, California.

Project Activities

Literature review pertaining to temperature modeling as conservative, surrogate WQ model parameter; begin developing outline for software design document.

Models and Applications

HDF5 interface libraries were built that can be used with FORTRAN, .Net (Visual Basic and C#), and Java. These libraries provide a user-friendly interface for exchanging data with HDF5 files. These are general-purpose libraries that can be used by HEC-ResSim, HEC-RAS, HEC-HMS, and other programs to store and retrieve hydrologic and environmental data.

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[1]**Project Alias – Work Unit Documentation Title:** *Hydrologic Water Quality Modeling in Support of Watershed Based Planning Decision Support*