American Water Resources Association
2009 SUMMER SPECIALTY CONFERENCE
Adaptive Management of Water Resources II
June 29 – July 1, 2009
Snowbird, UT

Wednesday, July 1
8:30 AM – 10:00 AM
SESSION 32: Models Supporting Adaptive Management 3

1. Flood Frequency and Debris Effects - Jason Lambert, RESPEC, Rapid City, SD

Selecting the magnitude of a design flood usually involves risk-based methods up to the 100 year flood, and for structures where loss of life or very severe economic loss is probable, the probable maximum flood (PMF) is used. A method was developed that uses both the 100-year flood and the PMF along with a hydraulic model that displays the floodplain zone for a given flood to analyze flood risk from streamflows that could be in the 500 to 5,000+ year range. On July 18, 2008, a major flood occurred on Pass Creek in the southwestern Black Hills of South Dakota. Floodway high-water marks were gathered from a field investigation and compared to the floodway extents predicted by a HEC-RAS model application of runoff from a 100-year flood and 50 percent of the PMF. The measured high-water marks from the flood event on July 18 indicated floodway extents that closely resembled those from 50 percent of the PMF. However, meteorological data and anecdotal evidence gathered suggested the amount of precipitation that actually fell over the watershed was much less than the amount used in the 100 year flood. During a field investigation 5 days after the flood, large amounts of debris were found in areas that would significantly constrict flow along Pass Creek. Cross sections of the floodway were surveyed and roughness coefficients were estimated at two uniform reach locations. Results from a Slope-Area Method analysis revealed a predicted flow rate at approximately 70 percent of the flow rate of the 100-year flood. However, the actual floodway extents more closely resembled a flood resulting from a much greater amount of precipitation. The large amounts of debris accumulation at various points along Pass Creek indicated constricted flow that resulted in increased floodway boundaries. From an investigation of the July 18, 2008, flood that occurred on Pass Creek, significant increases in floodway extents can result from considerable debris accumulation. Characteristics unique to the watershed can provide clues as to whether debris effects should be accounted for in floodplain modeling of that particular basin.

2. Applying COIN-OR Optimization Library to a Large Scale Water Transmission - Ming-Chin Jeng, DCSE, Inc., Aliso Viejo, CA (co-authors: Warren Hagstrom, Nem Ochoa, Stacie Takeguchi)

The Common Optimization INterface for Operations Research (COIN-OR) is an initiative to advance open source for the operations research community. It features tools for large-scale mixed-integer linear programming and combinatorial optimization. The optimization library has been integrated with a large scale optimization model to solve operational policies, to size future facilities, and in analyzing alternatives in the integrated resource plan. This model is a comprehensive resource and supply distribution system model which simulates and optimizes deliveries and storage of imported water through the water transmission system of Metropolitan Water District of Southern California (MWDSC). The model accounts for regionally coordinated local water supplies and storage of imported water in local groundwater basins and the hydraulic and storage constraints that limit the movement of water through the water transmission system. Specific model performance matrix and/or project accomplishments include: • Evaluate shortage patterns under different supply scenarios • Evaluate alternative water transfer options • Evaluate timing and sizing of facilities to enhance reliability • Evaluate emergency response management plans in the event of natural disasters • Allow for analysis of the hydroelectric recovery plants using historically derived imperial formulas • Allow for what-if type analysis where the impact of adding new facilities is to be evaluated. Alternatively, model the effect of facility shutdowns for maintenance purposes • Allow for specifying multiple time-step intervals to model the distribution system. For example, reservoir analysis may use monthly time interval while treatment plant analysis may need hourly time interval • Preserve the system mass balance while routing water from the supply sources to meet the demand points • Allow for a modular analysis (using “logical” cutoff points) of the distribution system by the Operations staff The preliminary results show that the COIN-OR provides efficient and easy to integrated optimization library to solve the large scale water transmission system.

3. Spatial Hydrologic Modeling using the Gridded Surface Subsurface Hydrologic Analysis (GSSHA) Model and the Watershed Modeling System (WMS) - Clark Barlow, Aquaveo LLC, Provo, UT

The Gridded Surface Subsurface Hydrologic Analysis (GSSHA) model is a 2D hydrologic model that can be used to model basic watershed rainfall/runoff processes. GSSHA can also be used to model more advanced watershed processes such as wetland hydraulics, sediment erosion/deposition, spatially varying precipitation (RADAR rainfall), long-term simulation, and groundwater flow. Recently, many advances have occurred in the availability and usability of tools for building and running spatially distributed (2D) hydrologic models. Traditional "lumped parameter" models only allow you to view the effects of changes in your watershed at the most downstream point of each sub-basin. 2D models afford better decision making capability since they allow you to view the effects of changes, such as a land use change or the addition of a wetland, at any point in your watershed. The Watershed Modeling System (WMS), a graphical user interface to several watershed models, allows you to set up a simple 2D hydrologic model with virtually the same amount of work that is required to set up a lumped parameter model. In this oral presentation, attendees will be introduced to the GSSHA model. They will also learn how to set up a GSSHA model using WMS. The WMS "Hydrologic Modeling Wizard" steps through the processes of downloading GIS data from the internet for any selected area, setting up a 2D grid, populating the grid with modeling parameters, running a GSSHA model, and viewing the output of the GSSHA model in a simple, easy-to-understand way.

4. Advances in Estimation of Reservoir-Release Transit-Loss: Combining Interactive Stream-Aquifer Modeling with Real-time Flow Data, Arkansas River from John Martin Reservoir to the Colorado-Kansas Stateline - Russell Livingston, Livingston Professional Services--Hydrologic Sciences, LLC, Golden, CO (co-author: Vivian Beal)

To protect surface-water rights along the Arkansas River in Southeastern Colorado the Arkansas River Compact and Colorado Water law require an accounting of natural water losses (transit losses) associated with the conveyance of water released from John Martin Reservoir in Colorado to the Colorado-Kansas Stateline, a distance of about 69 river miles. Previous methods to quantify reservoir-release transit loss have been based on steady-state stream-aquifer modeling and thus did not address continuous changes in the hydrologic system during the release period (which can be as much as several months), such as tributary inflows and ground-water gains or losses. A recent transit-loss investigation of this reach, done for the Arkansas River Compact Administration, resulted in the development of Transit Loss Application Program, or TLAP. TLAP consists of: • a series of Excel-based spreadsheets that are used to enter reservoir-release and antecedent-flow data, estimate river evaporation, prepare data for model computations, and summarize model output both in table and graphical formats, • a program that automatically inputs stream-flow and diversion data from a network of real-time data-collection platforms, • a calibrated and verified stream-aquifer model of the reach that is used to simulate the bank- and channel-storage effects on the reservoir-release hydrograph, and • macros that are used to calculate transit losses for various locations downstream of the reservoir. Computations are done for 22 modeled locations and at 4-hour time intervals for a period of 95 days. For time intervals up to any computational time TLAP uses historical real-time data for four main stem gaging stations, one tributary gaging station and eight diversions, while simulations for all future time intervals are based on the most recent real-time flow data at these locations. At each time step a mass-balance of observed and simulated flows is used to estimate ungaged surface-water and ground-water flows, and this information is used to improve the model computations. Thus TLAP’s simulated flows, and resultant estimates of transit losses, are improved as time moves forward during the release, providing detailed information that facilitates and improves reservoir-release administration and management