

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

Tuesday, June 30

1:30 PM – 3:00 PM

Session 23: Models Supporting Adaptive Management 1

1. Integrated Use of Watershed and Farm-Scale Models to Support Adaptive Management: Lake Champlain Basin, VT - Lula Ghebremichael, University of Vermont, Burlington, VT (co-authors: Mary C. Watzin, Russell F. Ford)

Lake Champlain exhibits eutrophication mainly due to continuing phosphorus (P) losses from upstream nonpoint source areas. To address this issue, a state-level P reduction goal has been set and an adaptive management (AM) approach is being undertaken aiming at assessing and identifying sources areas for P, and in exploring and implementing alternative best management practices (BMPs) to achieve water quality goals under typical conditions and in face of unexpected changes. To augment in the successful implementation of AM efforts on Lake Champlain Basin, this study employs a model-based approach to evaluate and quantify the benefits of various management strategies in controlling the P imbalance and P loss problems while maintaining or increasing the profitability of farms. The Soil and Water Assessment Tool (SWAT) and the Integrated Farming System Model (IFSM) were selected for this study. The SWAT will be applied on a 71 km² Rock River Watershed, which drains into the Lake Champlain, in an effort to identify source areas of P loss and evaluate environmental impacts of various BMPs. The IFSM will be employed on several Rock River Watershed dairy farms to assess economic and environmental impacts of various farm-level management strategies in the animal production part of the agricultural production, which won't be accounted using the SWAT model. IFSM includes an animal model, which represents P processes in cows, farm phosphorus inflows (in feed concentrates, minerals, and forage) and outflows (in milk, and crops and animals sold), and economic aspects of a farm system. Thus IFSM will estimate the economic and environmental effects of management scenarios at the farm scale, while SWAT will evaluate environmental effects at the edge of field and watershed outlet. Together, these tools will provide a comprehensive tool to support the AM process in assessing the potential for long-term, cost-effective, and permanent reduction of P loss from agricultural watersheds.

2. Incorporation of Water Quality Uncertainties into Stormwater Master Planning - Richard Wagner, CDM, Jacksonville, FL

A stormwater master plan study for Beaufort County, SC, included water quality data analysis and modeling designed to characterize watershed water quality, and to assess benefits of the County's requirements for Best Management Practices (BMPs). Receiving water analysis was limited to the major tidal rivers and creeks, focusing on fecal coliform bacteria. Historically, some areas have been restricted for shellfish harvesting, driving the County's interest in proper stormwater quality management. The receiving waters generally are subject to two standards for fecal coliform bacteria: (1) a geometric mean of 14/100 ml, and (2) no more than 10 percent of samples above 43/100 ml. Historical data at stations in the County were evaluated to develop relationships between the long-term geometric mean and the likelihood of meeting the standards. Each receiving water reach was assigned a level from A (expected to meet both standards for any 36-month period) to D (expected to exceed both standards in some 36-month periods). Receiving water segments were evaluated using the WASP water quality model. Input included average flow and geometric mean bacteria levels from each County subwatershed. The model was calibrated for existing conditions, first for tidal mixing based on modeled and measured salinity values, then for bacteria level through a first-order loss rate. Future conditions were evaluated to determine whether degradation (i.e., lower water quality level) would be predicted. Out of 139 segments, only 7 were expected to have degradation for future conditions. This may demonstrate the effectiveness of the County's BMP policies in controlling future development impacts. Sensitivity runs were conducted to evaluate "best case" and "worst case" conditions. "Best case" simulations (existing land use with BMPs on all development) identified locations that would benefit from existing development BMP retrofits, as opposed to locations that are influenced more by natural bacteria loads, limited tidal mixing, and/or limited bacterial loss rate. "Worst case" simulations (future land use with no BMPs) identified locations most sensitive to the

effectiveness of existing and future BMPs. These results were used to make recommendations for water quality monitoring of the most sensitive reaches and watershed area tributary to those reaches.

3. Development and Implementation of a Sequential Modeling Approach to Address the Complexity in Planning for Revised Operations for the Central and Southern Project in the Kissimmee Basin - Mark Abbott, AECOM, West Palm Beach, FL (co-authors: Christine Carlson, Guillermo Regalado)

The South Florida Water Management District is conducting a study to identify alternative water control structure operating criteria to achieve a more acceptable balance among the operating objectives of the Central and Southern Florida Project in the Kissimmee Basin (KB). The KB, located in Central Florida, includes the Kissimmee Chain of Lakes and the Kissimmee River and is the largest tributary to Lake Okeechobee. The initial phase of the project included a hydrologic assessment identifying water resource issues within and downstream of the basin and identified modeling tools, constraints, requirements, and strategy for the planning effort. The modeling strategy being applied in the study includes the sequential application of a suite of modeling tools to screen, formulate, and evaluate alternative operating criteria. The 'Screening Tool' is a fast-running water budget model. This model has been used to develop and modify operating criteria and has been applied in both small group settings and public workshops to solicit input and gain understanding of the hydrology and hydraulics and the system response to operating criteria changes. The 'Formulation Tool' is a hydraulic model of the Kissimmee Chain of Lakes and Kissimmee River. This model is being applied to refine the top performing alternative operating criteria from the Screening Tool and to identify the top performing alternatives for further evaluation. The 'Evaluation Tool' is a fully integrated hydrologic / hydraulic model representing the complete hydrology of the 2,300 square mile Basin. The top three alternative operating criteria promoted through both the screening and formulation levels will be evaluated with this tool to report on performance relative to the operating objectives of the study. Modeling results from the Evaluation Tool will be presented to Decision Makers to support their selection of a preferred alternative. This paper will describe the modeling tools, their calibration and verification, and their application in the formulation and evaluation of alternative operating criteria. Results from the testing and validation of the modeling tools will be presented to demonstrate the ability of these models to provide comparable results relative the performance metrics expressed as stage and flow in the Kissimmee Basin.

4. Regional Systems Dynamics Modeling for Adaptive Long-Term Water Supply Planning - Kelley Weaver, CDM, Carlsbad, CA (co-authors: Fakhri Manghi, Enrique Lopez-Calva,)

Water resources system models are useful tools for supporting strategic long-range water supply planning that needs to account for multiple performance considerations such as water reliability, economic feasibility, environmental impacts, and implementation issues. Several different potential supply and demand management alternatives, or combinations of projects, can be evaluated to assess overall water supply system performance of integrated resources such as groundwater, recycled water, and surface water. Western Municipal Water District (District), located in Southern California, provides both retail and wholesale services for the region. Many of the Districts' potential projects are large-scale regional projects which take years to implement, and the project need may be dependent on whether wholesale customers take action to develop their own local supply. To add complexity to planning decisions, many of the projects are subject to uncertainty. The District relies on imported water which is facing significant future increases in cost as well as uncertain reliability associated with drought, seismic, and regulatory conditions. Imported water is purchased from Metropolitan Water District (MWD) of Southern California, which in turn imports water from Northern California and the Colorado River. A detailed monthly water resources system simulation model was custom-developed using the commercial software STELLA to help the District continually re-define and adaptively manage mid- to long-term planning actions. The systems model included not only District-owned potential alternatives, but also local supply alternatives under consideration for implementation by its wholesale customers. Water sources modeled included multiple groundwater basins (including direct use, desalination, and conjunctive use projects), local and imported surface water (raw and treated), recycled water, and conservation. Accounting for increasing and fluctuating water demands, the systems model evaluates system reliability under various conditions including changing hydrology, peak day demands, imported water shortages, and emergency shutdown of MWD facilities. The systems model also accounts for the overall regional cost of water and water quality parameters. The model is intended to continually support regional planning decisions, and is a useful tool to adaptively manage the District's long-term water supply strategy as the actions of wholesale customers are determined in the future.