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

Monday, June 29
10:30 AM – 12:00 Noon
Session 4: Adaptive Management Decision Support Systems & Information Management Systems

1. From Ecohydrologic Observatories to Integrated Water Resources Management - Marian Muste, IIHR-Hydroscience & Engineering, Iowa City, IA

The emerging ecohydrologic observatories developed for supporting watershed-scale scientific investigations are taking advantage of the most recent advances in cyber-tools and methods (sensors, sensing networks, high-performance computing, communication technologies, GIS tools long with innovative data and simulation models). The last few years have demonstrated that today's cyberinfrastructure is sufficiently mature to aid quantifiable understanding of watershed water cycle processes and their interactions with the bio-geo-chemical and socio-economical activities dependent on them. The scales that can be tackled with the observatories approach those that are relevant to the decision-making process in water resources. In the last few decades, the water resources management community adopted the watershed approach that requires one to think about water resources development and management in the context of a larger system rather than a single project, and thus facilitates the search for comprehensive and integrated solutions to achieve objectives set by all concerned parties in the basin. By taking into account a multitude of water uses over a wide area as opposed to concentrating on a single use at ne project site, it becomes necessary to integrate a complex array of public values, institutional policies and priorities, regulatory procedures, planning criteria, public participation, and private sector business interests. The most difficult obstacle in implementing the integrated, comprehensive approaches is the lack of appropriate technology for the decision-making process. The paper presents emerging frameworks in watershed science and management. A description of the ecohydrologic observatory components is then provided to reveal their usage in supporting the decision-making process in water resources management. The paper demonstrates that by synergistically assembling a common cyberinfrastructure the scientist and managers can jointly benefit from high-fidelity, first-principles based, "information-centric" investigative and management approaches that enable to both advance our scientific understanding as well as to address watershed ecosystem changes, protect the environment, predict and prevent natural and human disasters through knowledge-based adaptive management. It is finally argued that, given that scientists and managers need robust information systems that have many overlapping components and functions, the time is ripe to coordinate and synergistically combine their efforts for mutual long-term benefits.

2. Bayesian Network Modeling for Adaptive Management to Control Estrogen Compounds from Swine CAFOs - Boknam Lee, Duke University, Durham, NC (co-authors: Kenneth H. Reckhow, Seth W. Kullman)

Natural steroidal estrogen hormones in wastes from swine Concentrated Animal Feeding Operations (CAFOs) have been arisen as potential pollutants to aquatic environments due to their adverse impacts on the reproductive biology of aquatic organisms. However, there is limited systematic knowledge regarding the concentration and fate of the estrogenic compounds throughout the swine facilities as well as potential release to the environment. To address this issue, a total estrogen budget model was constructed to characterize the behavior and composition of estrogens for one of swine CAFOs in North Carolina using a Bayesian network (BN) model. The BN model is superior to other modeling techniques due to its ability to use expert judgment to parameterize the model variables, while also taking into account uncertainty. In this study, experts' knowledge was solicited and incorporated into the preliminary development of the total estrogen budget BN model, and then new data sets of estrogen compounds collected in the study was used to update the model in an adaptive approach. Consequently, the Bayesian network model was used to describe the causal relationships as the values of probability for the

estrogen levels and activity with related to their physical, biological, and chemical processes from animal barns to the waste lagoon. In particular, this BN model will provide a mechanism to quantify the levels of three forms of estrogens and their activity throughout the swine facilities, while also helping to predict the overall contribution of estrogen compounds from each compartment of the system. Thus, we can utilize this model as the decision support system for the adaptive management to adjust the swine operations in order to reduce the release of estrogen compounds to the environment.

3. A GIS-Based Water Resources Supply Decision Support System For Santa Fe County , New Mexico - David Jordan, INTERA, Albuquerque, NM (co-author: Cindy Ardito)

INTERA worked with Santa Fe County, New Mexico, to develop a regional groundwater availability model and decision support system (DSS) to assist the County in evaluating potential well locations for groundwater supply sources to supplement surface water in a conjunctive use strategy. The groundwater availability model was used as part of a site suitability analysis DSS using multi-attribute utility theory (MAUT) to determine potential supply well locations. Using a geographic information systems (GIS) approach, the DSS identified potential supply well locations for the County that minimized impacts (and hence proximity) to existing supply wells, streams, and springs, while maximizing proximity to existing infrastructure, population centers, and areas of favorable geology and land ownership using a MAUT approach. As a final step, potential supply well locations were evaluated using the groundwater availability model to further refine the location alternatives to identify the most promising locations. This approach provided County decision-makers and the public with a structured, scientifically defensible, and unbiased method of identifying potential supply well locations.

4. Redevelopment of Water Resources Information System for Santa Clara Valley Water District - Nadeem Shaukat, DCSE, Inc, Richmond, CA

The Santa Clara Valley Water District (SCVWD) is the primary water resources agency for Santa Clara County, California. It acts not only as the county's water wholesaler, but also as its flood protection agency and is the steward for its streams and creeks, underground aquifers and district-built reservoirs. As the county's water wholesaler, the water district makes sure there is enough clean, safe water for homes and businesses. As the agency responsible for local flood protection, the water district works diligently to protect Santa Clara Valley residents and businesses from the devastating effects of flooding. SCVWD currently uses Water Resources Information System (WRIS) which was developed on the HP3000 platform in the early 1990’s to manage its water resources. Redevelopment of WRIS is a key project identified by the District's Information Systems Master Plan (ISMP). To satisfy the ever changing business requirements of the District and to remove the antiquated HP3000 system, SCVWD realized an urgent need to redesign WRIS and redeploy it on a current and supported technology platform. Major components of WRIS include well permit processing, well registration, and water production facility registration, managing water production and revenue collection, and storing and maintaining well related data. Phase 1 of the WRIS redevelopment project, which is already complete, provided the requirements for WRIS Redevelopment, a gap analysis between WRIS requirements and existing solutions at similar agencies, and a data consistency assessment on current WRIS and groundwater management data. As part of Phase 2, DCSE, Inc. is helping SCVWD for the WRIS Redevelopment to design, develop, and deploy the new WRIS. The overall objective for the WRIS redevelopment project is to create a new WRIS that will support District business needs based on an up-to-date technology platform that is adequately supported by selected hardware and software vendors. Moreover, the new system will be flexible enough to accommodate future growth and system expansion. The new WRIS will also enable users to perform current and new District business functions as efficiently and effectively as possible, and ensure the optimal flow of information in a manner that is flexible and cost effective.