

## **Extension of Streamgage Network toward Digital Watershed Development**

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The streamflow gage network is at the base of the infrastructure of any digital watershed that is supposed to provide reliable, dynamic, online streamflow and water quality information for watershed management. According to the National Research Council's report 'Envisioning the Agenda for Water Resources Research in the Twenty-First Century' – "*The end-of-century trend of investing fewer and fewer dollars in data-gathering efforts – the declining number of stream gages is but one example – will need to be reversed if availability of streamflow information is to be adequately characterized.*" This project is to develop a scientifically-based approach for streamgage network optimization, which particularly aims to connect streamgage infrastructure needs and design to watershed management policy and decision making outcomes.

The task for streamgage network optimization is to decide the density and location of gages and the concomitant link to reliability of water management decisions. The key is to quantify the information gain from the extended network, which can be related to decision information. For example, with a certain level of extension, how much drought or flooding damage will be potentially reduced? As a beginning of such research, this project will focus on the development of the relation between network optimization and model reliability. Model reliability is used as a surrogate for water management policy decisions as models are often used as decision support tools for such endeavors and model reliability is inversely related to the "cost" of bad decisions. Thus the information gain is specified as the improvement of model reliability; and network optimization is defined as a multi-objective optimization problem to maximize the information gain and to minimize the cost. The goal of this project is to provide a portfolio to establish the optimal network of streamflow gages with consideration of model reliability, cost, as well as the existing infrastructure. Specific objectives are:

1. Establish a watershed streamflow simulation for a case study watershed, which will be based on U.S. Geological Survey Illinois Water Science Center's (USGS-IWSC) previous and ongoing work
2. Develop a consistent framework to integrate the model calibration/verification and streamflow gage network optimization, which will allow assessing the relation between model reliability and streamflow gage investment
3. Test the method on the Salt Creek watershed in Northeastern Illinois
4. Demonstrate the possible expansion of the method for sensor network design and overall digital watershed development under the framework of AISIS.

This project will involve USGS-IWSC staff and graduate research assistants, as well as the PIs.