Reliability-Based Optimization for Managing Water Supply Operation

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ABSTRACT

Tampa Bay Water is the largest wholesale water supply utility in Florida serving the Tri-county area. In 1998 the agency entered into the Partnership Agreement with the Southwest Florida Water Management District to reduce pumpage. The water use permit required the agency to implement the Optimized Regional Operations Plan (OROP) that utilized optimization-simulation model to manage the agency's twelve interconnected wellfields and other surface water sources. The current deterministic model was formulated to maximize surficial aquifer system water-levels at key monitoring wells while satisfying various constraints including demands physical limits operating policy and groundwater flow model represented by the Unit Response Matrix (URM). The monitoring well also known as control point was intended to serve as surrogates to the environmental features to be protected such as wetlands and lakes. Currently the OROP monitoring well networks provides control for well and wellfield rotations.

In 2003 a multi-year multi-phase project for implementation of the second generation OROP using stochastic optimization was launched. The focus was to address the uncertainties associated with water demand forecasting the URM derived from an integrated hydrologic model (IHM) and forecasting of surface water sources availability. The selected reliability-based optimization approach finds a set of groundwater production rates surface water withdrawal rates and reservoir water inflow/outflow rates that maximizes the probability of meeting the groundwater level criteria. The formulation involves a system simulation model to represent the source-rotation/demand-delivery under physical and operating constraints and the Monte Carlo generated realizations of water demand surface water availability and URM. Realizations of water demand and surface water availability are linked to Monte Carlo simulations of climatic events. The formulation accounts for the adjustments of operation rates by well operators to meet the actual demands to utilize the the actual available surface water, and is solved using evoluationary algorithm.