Modeling Surface Water Rights
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The Arbuckle-Simpson Aquifer contributes base flow to the Blue River, the Clear Boggy River and parts of the Lower Washita River watersheds. Pumping from the Arbuckle-Simpson Aquifer is expected to reduce base flows in these watersheds. The Oklahoma Water Resources Board issues permits for water use and administers water rights within the state of Oklahoma. In order to determine the potential impact of groundwater withdrawals on downstream permit holders, the Board contracted with Hydrosphere Resource Consultants of Boulder, Colorado, to develop a network model of surface water and water rights along the three watersheds. A network flow model is used to simulate the allocation of water to water rights according to priority.

Hydrosphere constructed the model to simulate the operation of all permitted water rights along the streams in priority. Over 190 water demands were represented, including 124 irrigators and 17 public water supplies. The model included 36 inflow points and 178 river reaches.

The model was constructed so that groundwater inflows could be adjusted using either specific time series data from outside sources, such as from the Arbuckle Simpson ground water model, or using basin-wide adjustments to the base flow. The model also allows the user to adjust the length of the growing season and the consumptive use of agricultural water users, which could vary with climate in the future.

Initial results from the modeling study indicate that shortages currently occur infrequently and for relatively short periods of time. Increased levels of pumping will reduce stream inflows and therefore the amount of water available to satisfy senior water rights and can be expected to increase or prolong shortages to senior water rights. One alternative to allow increased water use is the use of reservoir storage to supplement natural streamflows at times when shortages occur. Determining the precise amount and locations of the storage required depends on the pattern of depletions to the river caused by extractions from the aquifer.