# Simulated Effects of Proposed Ground-Water Pumping in 17 Basins of East-Central and Southern Nevada

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In keeping with the conceptual nature of the model, the simulation provides information about the probable areas that may be affected, the general magnitude of possible water-level declines or other effects, and the general period of time over which changes may be expected to occur. Prediction of specific, detailed water-level changes throughout the area would require that effects of the proposed pumping be superimposed on the effects of existing and other anticipated future pumping. That was beyond the scope of this analysis.

The second assumption was that storage values used for transient simulations for the upper layer were based on the predominant aquifer material in each cell, determined from surficial maps. This distribution may not be totally correct because the material may be different at depth in the zone of saturation. Storage coefficients in the upper layer also assume dewatering of the sediments.

Rock and deposit types were divided into three categories—basin-fill materials, carbonate rocks, and other consolidated rocks. Distribution of these units is shown by Prudic and others (1993, fig. 15). Average values for storage coefficients in layer one were assigned to each of these materials. For basin-fill material, a value of 0.1 was assigned on the basis of average values of specific yield used in U.S. Geological Survey reconnaissance evaluations of ground-water resources in most basins of the study area. For carbonate rocks, a value of 0.05 was assigned on the basis of an average porosity value of 0.047 determined from geophysical logs of five wells in the Coyote Spring Valley area (Berger, 1992, p. 18). For other rocks, a value of 0.01 was assigned on the basis of a range of values for fractured rocks given by Snow (1979, table 1).

The storage coefficient for the lower layer was estimated on the basis of the probable average porosity of the rocks present (0.01 to 0.05), the effective thickness of aquifer material (probably between 5,000 and 10,000 ft), the bulk modulus of elasticity of water ($3 \times 10^5$ lb/in$^2$), and the bulk modulus of elasticity of the solid skeleton of the aquifer (for limestone, about $4.8 \times 10^6$ to $5.4 \times 10^6$ lb/in$^2$; Krynine and Judd, 1957, table 2.5). The following equation from Lohman (1972, p. 9) was used to estimate the coefficients:

$$S = \theta \gamma b \left( \frac{1}{E_w} + \frac{C}{\theta E_s} \right) , \qquad (1)$$

where $S$ is storage coefficient (dimensionless);
$\theta$ is porosity, as a decimal fraction;
$\gamma$ is specific weight per unit, 62.4 lb/ft$^3$ ÷ 144 in$^2$/ft$^2$ = 0.434 (lb/in$^2$)/ft;
$b$ is thickness, in feet;
$E_w$ is bulk modulus of elasticity of water;
$C$ is a dimensionless ratio, which may be considered unity in an uncemented granular material; in a solid aquifer, such as limestone with tubular solution channels, $C$ is apparently equal to porosity; and
$E_s$ is bulk modulus of elasticity of the solid skeleton of an aquifer.

Estimates of storage values based on the above numbers ranged from $7.6 \times 10^{-5}$ to $1.2 \times 10^{-3}$. For purposes of this report, the storage coefficient for the lower layer was set at the midrange of these values, $6 \times 10^{-4}$, for the entire layer. The data set for storage values used in the model is listed in appendix 1.

The third major assumption used in the model is from the previous steady-state model and concerns the lower layer. The individual basin-fill aquifers underlying the various ground-water basins can be adequately described in the upper layer as a series of high-transmissivity zones (the basin-fill valleys) separated from each other by low-transmissivity zones (the intervening mountain ranges). The lower layer represents the distribution of carbonate-rock aquifers in the system in a limited way that may affect the calculated drawdowns in that layer.

The fourth and final assumption was that all input values used in the conceptual steady-state model remain constant during the transient simulations. No changes were made to transmissivity, leakance, recharge, or the other input data sets described by Prudic and others (1993) and Schaefer (1993).

## RESULTS OF SIMULATIONS

### Simulation of Conditions Prior to Proposed Pumping

The steady-state conditions simulated by Prudic and others (1993) represent a conceptualization of ground-water flow in the carbonate-rock province of the Great Basin before ground-water pumping within the province commenced. Figure 2 shows the general distribution of simulated steady-state heads (water