Prepared in cooperation with the Las Vegas Valley Water District and the Nevada Division of Water Resources

New Regional Ground-Water Budgets for Nevada

- Field estimates of ground-water evapotranspiration (ET) have been made by the U.S. Geological Survey (USGS) at 12 sites in the Great Basin of Nevada and eastern California, on the basis of micrometeorological measurements. The estimates have led to development of relations between ET and vegetation cover as determined from Landsat satellite data.
- These relations then have been used to recalculate regional ground-water discharge by ET for a 16-valley study area in eastern Nevada. Recharge from precipitation also has been re-estimated for the study area, using the ET values and newly available information on mean annual precipitation. The new totals for discharge and recharge are about twice the quantities estimated during reconnaissance evaluations of the same valleys that began in the late 1940's.
- Application of this method statewide would provide an updated assessment of overall ground-water availability in the Nation's driest and fastest growing state.

Ground water is the main source of water supply throughout much of Nevada. In the topographically closed valleys of the region, ground-water recharge is from precipitation and from ground-water flow that originates in adjacent valleys. The principal mechanisms of ground-water discharge are ET by phreatophytes and ground-water flow to adjacent valleys.

W.D. NICHOLS, U.S. GEOLOGICAL SURVEY

Ruby Valley, Nev., July 1996. View southward from north of Franklin Lake. Ground-water evapotranspiration from valley may total almost 170,000 acre-feet (about 54 billion gallons) per year.

Beginning in the late 1940's, USGS reconnaissance studies, done in cooperation with the Office of the Nevada State Engineer, led to the development of ground-water "budgets" for many of the State's 232 valleys (fig. 1). The budgets were based largely on results of field studies in California and Utah to estimate ground-water ET that were published in 1912 and 1932. Any imbalance in the ground-water budget for a given valley was reconciled by assigning ground-water flow to or from the valley if an appropriate opposite imbalance existed in an adjacent valley. If ground-water flow could not be invoked, then the budget was either modified to achieve balance or was left unbalanced.

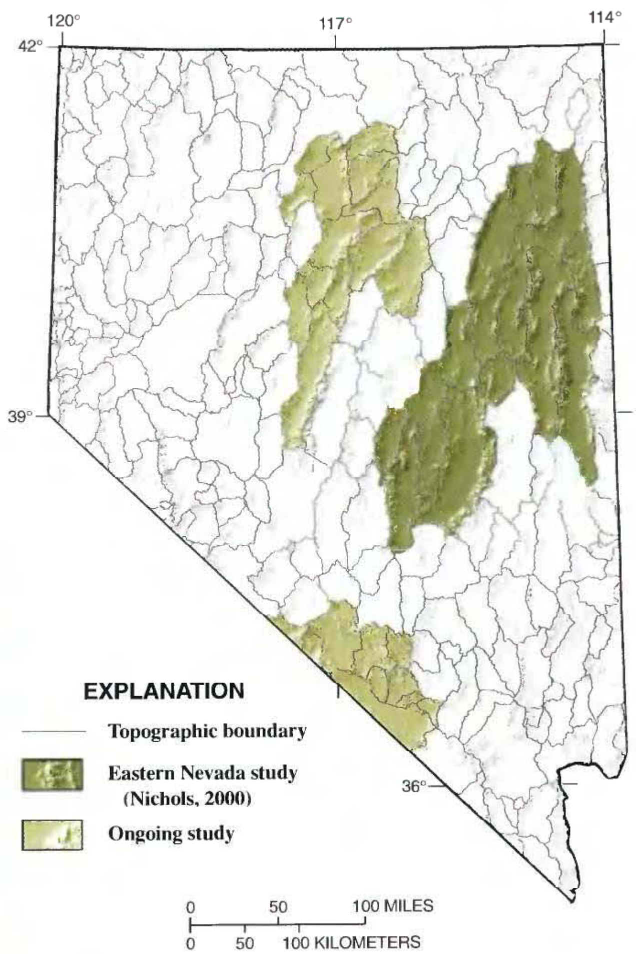

Figure 1. Nevada valleys and U.S. Geological Survey ground-water study areas.

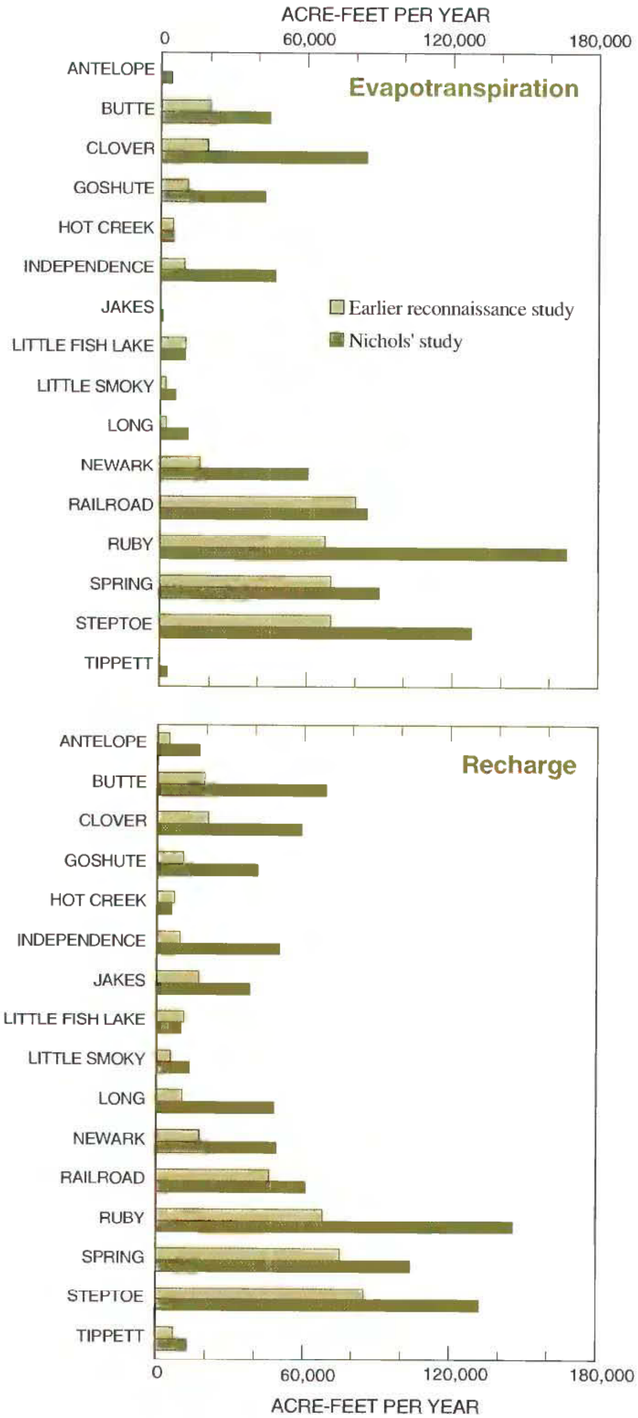

Figure 2. Estimated ground-water evapotranspiration and ground-water recharge from precipitation for 16 valleys in eastern Nevada (Nichols, 2000).

New USGS studies of ground-water ET in phreatophytic zones, employing micrometeorological methods at 12 field sites in Nevada and eastern California, have been used to develop a relation between ground-water ET and plant cover, as described by Nichols (2000, Chapter A). Then, field measurements of plant cover were correlated with a vegetation index, derived from Landsat data, that is sensitive to the sparse vegetation conditions which characterize the Great Basin (Nichols, 2000, Chapter B).

These tools have provided the means for estimating regional ground-water ET. A 15,000-square-mile study area that includes 16 contiguous valleys in eastern Nevada was selected (fig. 1), to compare new ET estimates with those of earlier reconnaissance studies (10 of the 16 valleys were among the first studied, in the mid-1900's). Ground-water ET was estimated for each valley, and ground-water recharge was calculated by using the ET data to determine recharge coefficients for application to newly available estimates of mean annual precipitation over the study area (Nichols, 2000, Chapter C). The resulting values for ground-water discharge by ET and recharge from precipitation (fig. 2) were used to develop a revised ground-water budget for each valley. Ground-water inflow or outflow to balance the budget for a given valley then was invoked in areas where it was suggested by earlier studies or where it is supported by available geologic and hydrologic information.

For the entire 16-valley study area, mean annual ground-water discharge by ET and recharge by precipitation are estimated at 788,000 and 855,000 acre-feet, respectively. Both totals are a little more than twice the previous reconnaissance estimates. The 67,000-acre-foot imbalance between total ET and total recharge is assumed to be recharge that leaves the study area as ground-water outflow. For most of the 16 individual valleys, the new estimates of ground-water ET and recharge were greater than the reconnaissance estimates; for two of the valleys, one or both of the new estimates were slightly less (fig. 2).

Traditionally, water managers in Nevada have used estimates of ground-water ET to determine the perennial yield of a valley, which is the amount of ground water that can be withdrawn and consumed each year for an indefinite period of time without overdrafting the ground-water resource. The new estimates presented by Nichols (2000) suggest that, for the entire study area, ground-water availability may be considerably greater than was estimated during the earlier reconnaissance appraisals.

In addition to the 16 valleys in eastern Nevada discussed by Nichols, updated estimates of ground-water discharge based on Landsat data are being developed by the USGS for valleys along the middle Humboldt River of north-central Nevada and in the Death Valley flow system of southern Nevada (fig. 1). Application of the method statewide would provide an updated assessment of overall ground-water availability in Nevada.

Reference Cited

Nichols, W.D., 2000, Regional ground-water evapotranspiration and ground-water budgets, Great Basin, Nevada: U.S. Geological Survey Professional Paper 1628, 82 p.

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