GEOCHEMISTRY AND ISOTOPE HYDROLOGY OF REPRESENTATIVE AQUIFERS IN THE GREAT BASIN REGION OF NEVADA, UTAH, AND ADJACENT STATES

REGIONAL AQUIFER-SYSTEM ANALYSIS

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ent of 0.12 ft/ft over about a 500-ft vertical interval exists between the basin-fill and carbonate-rock wells (Berger and others, 1988). This downward head gradient and the isotope value similar to that of average Sheep Range recharge (–93 permil) indicate that recharge from the Sheep Range probably flows primarily through the basin-fill aquifer in Coyote Spring Valley.

The basin-fill aquifer in Coyote Spring Valley is bound on the east by the carbonate rock of the northern Arrow Canyon Range and southern Meadow Valley Mountains. In this area, the carbonate rock that compose these mountains are exposed at land surface, and water in the basin-fill aquifer mixes with water in the carbonate-rock aquifers. This mixed water is observed at Muddy River springs. Water from a well (MX-6; fig. 17) completed in carbonate rock, about halfway between the east edge of the Coyote Spring Valley basin-fill aquifer and Muddy River springs, has a deuterium composition of –97 permil (pl. 2). This isotopic composition is similar to Muddy River springs (–98 permil) and is more evidence supporting the conceptual flow and mixing model: water in the Muddy River springs area is probably a mixture of Sheep Range recharge water and water from the carbonate-rock aquifers beneath Coyote Spring Valley. Using the average deuterium composition of Sheep Range recharge water (–93 permil) and Coyote Spring Valley carbonate-rock aquifer water (–101 permil) to determine the sources of water at Muddy River springs (–98 permil) results in a mixture of 38 percent (14,000 acre-ft/yr) Sheep Range water and 62 percent (22,000 acre-feet/yr) Coyote Spring Valley water.

Water in the carbonate-rock aquifers of Coyote Spring Valley (deuterium composition of –101 permil) can be from two sources, the White River flow system (deuterium composition of –109 permil) and the southern Meadow Valley Wash flow system (deuterium composition of –87 permil; pls. 1 and 2, figs. 16, 17). A mixture of 64 percent (14,000 acre-ft/yr) White River flow-system water and 36 percent (8,000 acre-ft/yr) southern Meadow Valley Wash flow-system water results in water isotopically the same as water in the carbonate-rock aquifers in Coyote Spring Valley.

In summary, water discharging from Muddy River springs is a mixture of 40 percent (14,000 acre-feet/yr) White River flow-system water, 38 percent (14,000 acre-ft/yr) Sheep Range water, and 22 percent (8,000 acre-ft/yr) southern Meadow Valley Wash flow-system water. The 14,000 acre-ft/yr contribution of White River flow-system water to Muddy River springs is significantly less than the 35,000 acre-ft/yr proposed by Eakin (1966) on the basis of water-level data and Maxey-Eakin recharge estimates (Maxey and Eakin, 1949) but is similar to recent estimates by A.H. Welch (U.S. Geological Survey, written commun., 1988) and Kirk and Campana (1990). Welch estimated 18,000 acre-ft/yr of underflow from Pahranagat Valley to Coyote Spring Valley on the basis of the isotopic compositions of empirically derived Maxey-Eakin recharge estimates for the entire White River flow system. Kirk and Campana (1990) calculated a contribution of 16,500 to 19,100 acre-ft/yr for three different flow scenarios for the White River flow system on the basis of Maxey-Eakin recharge estimates and water-level data with a discrete-state compartment model using deuterium to calibrate their models. These flow-system delineations are based on water-level data only, with no consideration of geologic or structural constraints on ground-water flow.

The Sheep Range contribution of 14,000 acre-ft/yr is significantly higher than the estimated 2,000 acre-ft/yr of Eakin (1966), 3,000 acre-ft/yr of A.H. Welch (written commun., 1988), and 5,000 to 6,000 acre-ft/yr of Kirk and Campana (1990). The greater contribution of Sheep Range water compared to previous studies is balanced by not including 6,000–9,800 acre-ft/yr of ground-water from Dry Lake Valley, north of Delamar Valley, because of geologic constraints to ground-water flow (Dettinger and others, 1995) and less underflow from Pahranagat Valley to Coyote Spring Valley. Geologic constraints on Sheep Range water flowing to the west and south, as previously discussed in the section titled "Geologic Framework," indicates that most of the recharge to the Sheep Range probably flows to the northeast toward the Muddy River springs area. The calculated contribution of 14,000 acre-ft/yr of Sheep Range water is higher than the empirical Maxey-Eakin recharge estimate of 11,000 acre-ft/yr, but the amount is reasonable if most of the recharge to the Sheep Range discharges at Muddy River springs. Winograd and Friedman (1972) also postulated, on the basis of deuterium data, that the Sheep Range may be a significant source of water discharging from Muddy River springs.

The 8,000 acre-ft/yr of ground water calculated to flow from the southern Meadow Valley Wash flow system to Muddy River springs agrees with previous estimates by Welch (8,000 acre-ft/yr) and Kirk and Campana (5,500–9,000 acre-ft/yr).

Ash Meadows Flow System

Springs at Ash Meadows discharge 17,000 acre-ft/yr at the distal end of the Ash Meadows flow system (Winograd and Thordarson, 1975). The average deuterium composition of the water from seven springs (the six largest discharging springs plus Scruggs Spring) is –103 permil (Winograd and Pearson, 1976;