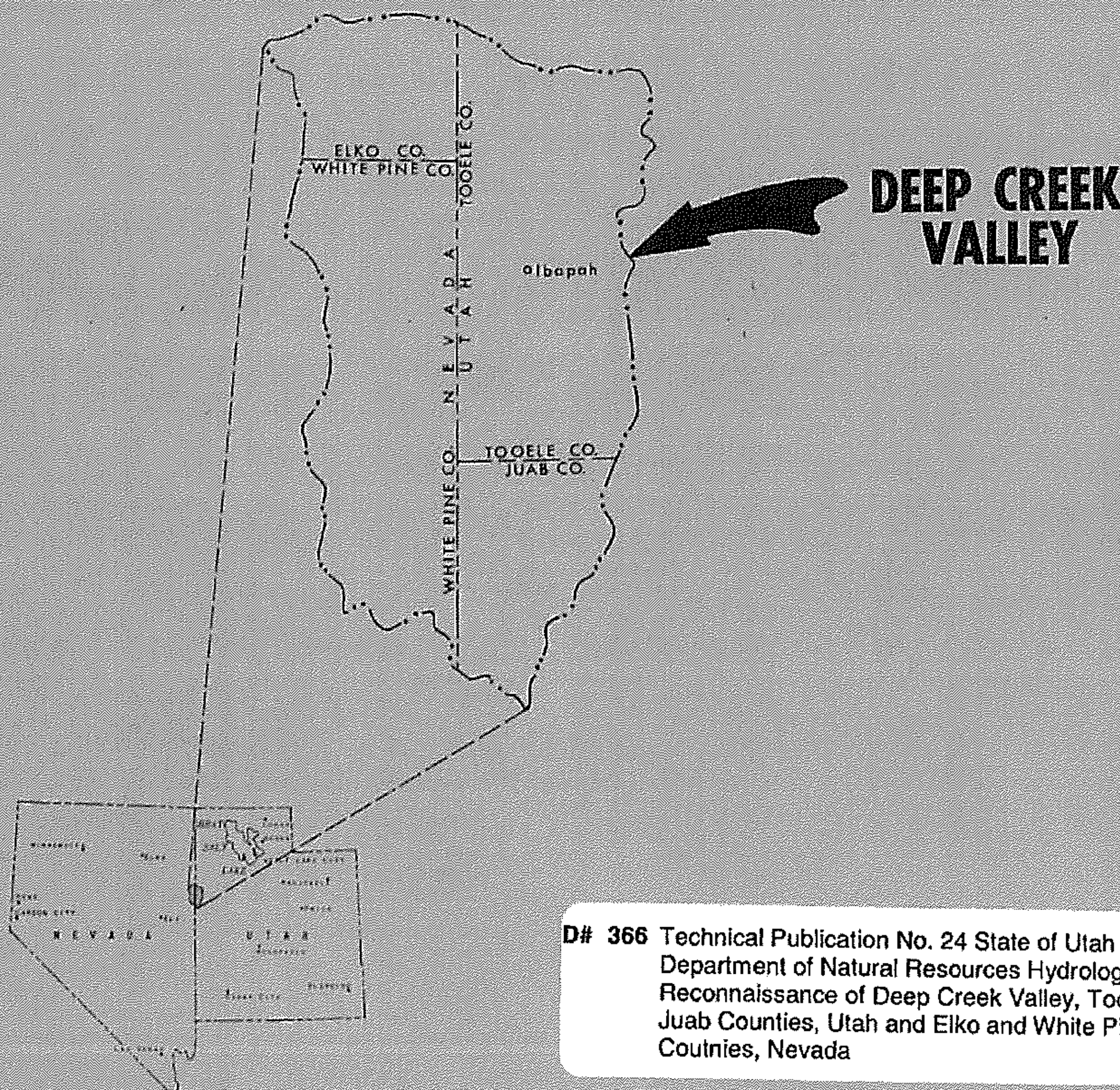
HYDROLOGIC RECONNAISSANCE OF DEEP CREEK VALLEY, TOOELE AND JUAB COUNTIES, UTAH, AND ELKO AND WHITE PINE COUNTIES, NEVADA



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HYDROLOGIC RECONNAISSANCE OF DEEP CREEK VALLEY, TOOELE AND JUAB COUNTIES, UTAH, AND ELKO AND WHITE PINE COUNTIES, NEVADA

by

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Outflow from the valley

The estimated average annual surface-water outflow from Deep Creek valley is about 2,000 acre-feet; about 1,000 acre-feet is upland runoff and 1,000 acre-feet is spring discharge, principally along the main channel of Deep Creek. This 2,000 acre-feet represents about 0.7 percent of the annual precipitation on the drainage basin.

Most streamflow is consumed in Deep Creek valley; but after thunderstorms, during periods of peak snowmelt, and during some winters, water flows out of the valley and northward to the Great Salt Lake Desert. Thunderstorms produce large ephemeral flows of a few hours duration; about 1,250 cfs (cubic feet per second) of water flowed past the crest-stage gage on Deep Creek as a result of a thunderstorm in August 1961. Melting snow and ice in the valley also cause a few large peak flows, but the flow is of slightly greater duration than flow from thunderstorms. Average winter outflow generally is on the order of 1 cfs but may be of several months duration in wet years.

Ground water

Source

Ground water in Deep Creek valley is derived entirely from precipitation that falls on the drainage basin, mostly on lands above 6,500 feet. Some of this water is lost directly by evapotranspiration, some infiltrates the consolidated rocks, and some collects in streams that discharge onto the adjacent permeable alluvial aprons. Of the water that infiltrates the rocks, much is lost by evapotranspiration after infiltration and a part eventually reaches the ground-water reservoir in the valley.

Only a small part of the precipitation that falls on lands below 6,500 feet reaches the ground-water reservoir, because the amount of precipitation is generally small and much of the water that infiltrates the soil is held in the soil and subsequently discharged by evapotranspiration. Precipitation on lands below 6,500 feet does recharge the ground-water reservoir when water from intense local storms falls on coarse-grained alluvium (Qag and Qgo on pl. 1), but recharge is least or nonexistent when water falls on fine-grained deposits (Qal and Tu on pl. 1).

Estimated average annual recharge

The annual ground-water recharge to Deep Creek valley was estimated by using a method described by Hood and Waddell (1968, p. 22). This method assumes that a fixed percentage of the average annual precipitation on the drainage basin enters the ground-water reservoir in the valley, and relates the quantity of recharge to the sum of quantities of water originating from precipitation in several isohyetal intervals. The amounts of precipitation were obtained for the isohyetal intervals shown in figure 2 by means of a planimeter, and the percentage of recharge from each of the isohyetal intervals was estimated on the basis of variations in geology and topography. Recharge percentage values are smallest where small quantities of precipitation fell on unconsolidated or semiconsolidated rocks with gentle slopes. Recharge percentages are greater in areas of moderate to high altitude—6,500-9,000 feet—where much of the Deep Creek Mountains is underlain by consolidated sedimentary rocks. The steep surface of these rocks rapidly delivers surface water to the permeable alluvial aprons at the edge of the valley. These rocks, moreover, may absorb a part of the precipitation which then percolates downdip through fractures and solution openings in the rocks and directly recharges the ground-water reservoir in Deep Creek valley. The largest recharge percentages are assigned to the highest parts of the Deep Creek Mountains—9,000-12,000 feet—where precipitation is greatest, the slope of the land surface is greatest, the soils are thin or missing, and the underlying rock is essentially impermeable. This area delivers surface water to recharge areas at the edge of the valley with the least initial loss.

The estimated average annual recharge to Deep Creek valley (table 7) is 17,000 acre-feet, or about 6 percent of the estimated 290,000 acre-feet of average annual precipitation on the drainage basin.

Table 7.—Estimated volumes of precipitation and ground-water recharge in the Deep Creek valley drainage basin

(Areas of precipitation zones measured from geologic and isohyetal maps, pl. 1 and fig. 2. Estimates of average annual precipitation are weighted for steeply sloping mountain areas.)

Precipitation zone (inches)	Area (acres)	Estimated annual precipitation		Estimated annual recharge	
		Feet	Acre-feet	Percentage of precipitation	Acre-feet
		Areas of Quaternary and Tertiary rocks			
8-12	131,000	0.83	109,000	0	0
12-16	55,900	1.13	63,000	3	1,900
16-20	2,000	1.46	2,900	8	200
20-25	1,000	1.83	1,800	12	200
Subtotal (rounded)	190,000		177,000		2,300
		Areas of Precambrian and Paleozoic consolidated rocks			
Less than 8	200	0.63	130	1	0
8-12	29,800	.83	25,000	2	500
12-13[1]	3,600	1.04	3,700	5	200
12-16	20,700	1.13	23,000	10	2,300
16-20	21,400	1.46	31,000	15	4,700
20-25	9,700	1.83	18,000	20	3,600
25-30	4,000	2.25	9,000	25	2,200
More than 30	1,200	2.61	3,100	30	900
Subtotal (rounded)	91,000		113,000		14,400
Total	281,000		290,000		17,000

[1] Estimated range of precipitation for northwestern part of drainage basin inside 12-16-inch isohyetal interval.

Occurrence and movement

Most of the ground water in Deep Creek valley is under artesian (confined) conditions. Drillers' logs of wells in the valley indicate that the permeable, water-bearing beds are intercalated with thick beds of clay (table 14). Thus, in most wells the water level is above the top of the permeable bed in which the water is found. Most wells in the valley are, therefore, artesian; but only three wells in the valley were known to flow in 1967. (See pl. 1 and table 13.) A few wells tap water under water-table (unconfined) conditions. Such conditions probably are prevalent beneath the alluvial fans adjacent to the valley, but the extent of water-table conditions is not known.

Artesian conditions in the valley are also indicated by the occurrence of springs which yield water that is warmer than the average annual air temperature. Water from Chadman Spring, (C-9-19)13cbc-S1, along the edge of the valley, and water from spring (C-9-19)33adc-S1 in the valley bottom have temperatures of 53° and 58°F (12° and 14°C), respectively, well above the average annual air temperatures of 46°F (8°C) at Ibapah. The relatively high temperature of the spring water indicates that the water probably is discharged from water-bearing beds several hundred feet below the land surface. Similar temperatures of water from shallow wells near the springs may indicate that a part of the well water is upward leakage from deep sources.

A reliable contour map of the ground-water surface in Deep Creek valley cannot be constructed because of the scarcity of well data away from the axis of the valley. Altitudes of the water surface in the wells indicate that the ground-water surface slopes generally northward in the same direction as the valley floor. In general, the ground water moves from the edges of the valley toward the axis and thence northward. The gradient of the ground-water surface along the axis of the valley is about 100 feet per mile, from the south end of the valley to the vicinity of Ibapah. The gradient of the ground-water surface is about 20 feet per mile from Ibapah to the north end of the valley. Although the gentler gradient in the northern part of the valley may be partly related to a thicker aquifer, the available data indicate that the gradient of the ground-water surface north of Ibapah is related to continuous ground-water discharge along the axis of the valley by evapotranspiration and springs.

Ground water in the consolidated rocks in the adjacent mountains can be inferred to move toward the valley because many of the consolidated rocks dip into the valley and because several springs discharge from bedrock. For example, spring (C-11-19)19caa-S1 issues from limestone and sustains the base flow of Spring Creek.

Information on water in the rocks beneath the valley is available only from the Gulf Refining Co. oil test 26/70-2cl. The water level in consolidated carbonate rocks encountered in this test is inferred from drill-stem test data to be about 800 feet below the land surface. The inferred altitude of that water level is 4,700 feet, which is below that of water levels in wells in the valley; but it is above the water level in well (C-7-19)9acc-1 and above the altitude of the floor of the Great Salt Lake Desert, both north of Deep Creek valley. Because there is no other potential discharge area for the deep-seated water in the consolidated rocks in Deep Creek valley, water that passes through the consolidated rocks moves to the area of the Great Salt Lake Desert. The amount of water moving in the rocks probably is small.

Storage

The subsurface geologic conditions within the Deep Creek valley drainage basin are not well enough known to provide an estimate of ground-water storage in the entire valley. An estimate was made for the valley flat and the immediately adjacent area, however, based on conditions inferred from water-level fluctuations and well logs.

Under natural conditions a ground-water system is in dynamic equilibrium; long-term average annual recharge and discharge are equal, and the amount of ground water in transient storage remains nearly constant. Withdrawal of water from wells in Deep Creek valley has not appreciably altered the natural balance. Comparison of water-level changes in observation wells with annual precipitation (fig. 6) shows that the ground-water levels generally follow precipitation changes.

Recoverable water in storage in the unconsolidated rocks is that part of the stored water that will drain by gravity from the ground-water reservoir as water levels are lowered and that water released when artesian head is lowered. In a water-table aquifer, the quantity of recoverable water is computed as the product of the specific yield of the ground-water reservoir, the saturated thickness, and the area.

Beds of permeable material in the unconsolidated rocks beneath Deep Creek valley have estimated specific yields of 20-30 percent, but the permeable beds are intercalated with thick beds of clay and amount to only about 20 percent of the saturated section. Because the clays are partly sandy and all the clay will yield some water by compaction, the maximum specific yield is estimated to be 10 percent for the entire saturated section. The valley flat and immediately adjacent areas of unconsolidated materials total about 50 square miles, or 32,000 acres. If 100 feet of saturated deposits in this area were dewatered, the estimated volume of water that would be recovered would be:

$$32{,}000 \times 0.1 \times 100 = 320{,}000 \text{ acre-feet}$$

or nearly 20 times the estimated average annual ground-water recharge. The storage figure of 320,000 acre-feet may be greater or smaller than the actual amount, because the ground-water reservoir may be more or less extensive than estimated.

Discharge

Ground water is known to discharge in Deep Creek valley by evapotranspiration, by pumpage from wells, and by outflow of unused spring discharge.

Evapotranspiration

Evapotranspiration in Deep Creek valley includes transpiration of water by both native and cultivated plants, evaporation from open bodies of water, and evaporation of water from the soil.