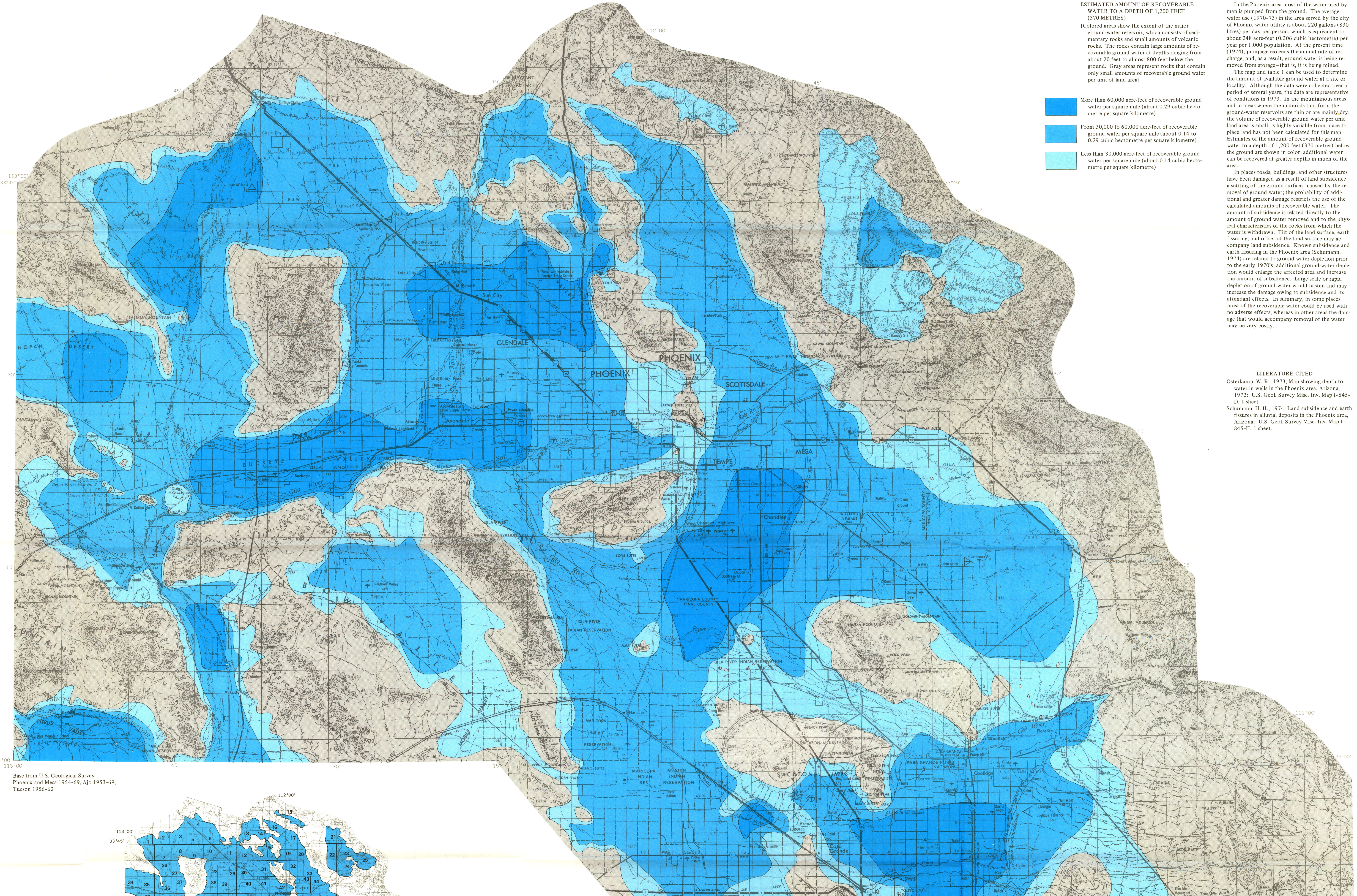
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

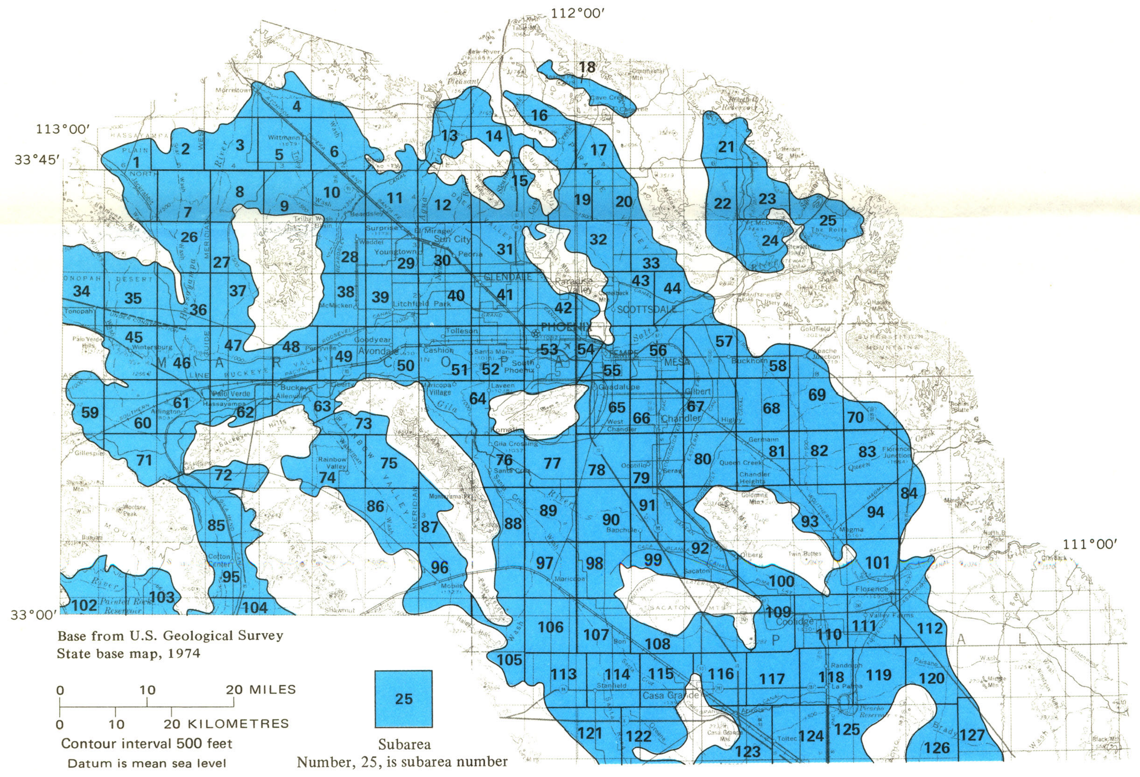
TABLE 1 – *Estimated amount of recoverable ground water in storage, Phoenix area*
(Recoverable ground water, in acre-feet)

Subarea Number (see index map for location)	Subarea Square miles	Water in upper 100 feet of saturated sediment	Water between land surface and 300 feet below land surface	Water between 300 and 700 feet below land surface	Water between 700 and 1,200 feet below land surface	Water between land surface and 1,200 feet below land surface
1	37.1	300,000	0	620,000	700,000	1,300,000
2	23.4	200,000	0	430,000	510,000	940,000
3	32.5	310,000	100,000	890,000	1,000,000	2,000,000
4	39.6	340,000	0	340,000	1,100,000	1,400,000
5	36.0	280,000	0	690,000	1,400,000	2,100,000
6	37.9	230,000	0	530,000	960,000	1,500,000
7	36.0	320,000	120,000	1,200,000	1,300,000	2,600,000
8	29.0	230,000	150,000	840,000	660,000	1,600,000
9	26.5	160,000	0	430,000	470,000	900,000
10	34.4	220,000	0	530,000	720,000	1,200,000
11	39.0	290,000	0	910,000	870,000	1,800,000
12	31.6	130,000	0	380,000	800,000	1,200,000
13	26.7	150,000	80,000	510,000	440,000	1,000,000
14	25.3	140,000	80,000	490,000	420,000	990,000
15	34.3	360,000	10,000	900,000	630,000	1,500,000
16	31.6	310,000	0	540,000	1,100,000	1,600,000
17	20.6	190,000	0	80,000	730,000	810,000
18	17.6	190,000	110,000	140,000	0	250,000
19	29.9	200,000	10,000	630,000	580,000	1,200,000
20	29.2	180,000	0	410,000	1,000,000	1,400,000
21	32.7	130,000	90,000	320,000	410,000	820,000
22	32.7	140,000	80,000	410,000	370,000	860,000
23	30.2	150,000	270,000	410,000	420,000	1,100,000
24	34.8	170,000	180,000	390,000	300,000	870,000
25	41.4	180,000	110,000	400,000	450,000	960,000
26	31.8	290,000	420,000	760,000	800,000	2,000,000
27	19.0	160,000	130,000	480,000	460,000	1,100,000
28	30.4	230,000	0	430,000	610,000	1,000,000
29	35.1	340,000	10,000	1,200,000	1,500,000	2,700,000
30	36.0	360,000	140,000	1,300,000	1,200,000	2,600,000
31	40.8	460,000	100,000	1,500,000	820,000	2,400,000
32	38.1	120,000	20,000	410,000	770,000	1,200,000
33	22.7	130,000	10,000	460,000	670,000	1,100,000
34	42.1	390,000	150,000	1,200,000	960,000	2,300,000
35	46.2	430,000	370,000	1,500,000	1,400,000	3,300,000
36	35.0	300,000	470,000	610,000	690,000	1,800,000
37	27.0	200,000	170,000	560,000	660,000	1,400,000
38	30.2	150,000	0	420,000	670,000	1,100,000
39	36.0	320,000	190,000	690,000	990,000	1,900,000
40	36.0	320,000	450,000	610,000	670,000	1,700,000
41	35.8	320,000	440,000	730,000	690,000	1,900,000
42	28.6	150,000	230,000	430,000	350,000	1,000,000
43	29.9	140,000	30,000	540,000	460,000	1,000,000
44	37.1	460,000	42,000	1,100,000	350,000	1,500,000
45	33.9	190,000	350,000	430,000	450,000	1,200,000
46	36.0	180,000	410,000	740,000	920,000	2,100,000
47	30.9	290,000	500,000	720,000	1,000,000	2,200,000
48	28.9	200,000	280,000	550,000	830,000	1,700,000
49	32.5	270,000	480,000	630,000	960,000	2,100,000
50	33.5	320,000	610,000	740,000	630,000	2,000,000
51	35.9	390,000	780,000	640,000	780,000	2,200,000
52	36.0	530,000	670,000	650,000	810,000	2,100,000
53	40.9	510,000	950,000	770,000	90,000	1,800,000
54	13.4	120,000	190,000	80,000	30,000	300,000
55	21.8	170,000	260,000	330,000	260,000	850,000
56	36.0	210,000	120,000	830,000	1,100,000	2,000,000
57	35.2	180,000	0	720,000	860,000	1,600,000
58	19.2	110,000	0	260,000	190,000	450,000
59	27.4	150,000	110,000	460,000	120,000	690,000
60	34.8	260,000	310,000	980,000	640,000	1,900,000
61	33.1	270,000	410,000	650,000	700,000	1,800,000
62	26.1	330,000	560,000	470,000	640,000	1,700,000
63	28.8	340,000	620,000	610,000	480,000	1,700,000
64	46.4	350,000	630,000	740,000	670,000	2,000,000
65	32.9	240,000	320,000	590,000	430,000	1,300,000
66	36.0	410,000	510,000	830,000	860,000	2,200,000
67	36.0	250,000	160,000	610,000	1,100,000	1,900,000
68	36.0	210,000	0	660,000	800,000	1,500,000
69	44.3	400,000	0	710,000	720,000	1,400,000
70	16.3	120,000	0	220,000	420,000	640,000
71	41.8	440,000	370,000	860,000	770,000	2,000,000
72	23.5	220,000	210,000	460,000	230,000	900,000
73	15.4	130,000	100,000	20,000	0	120,000
74	48.2	450,000	60,000	1,200,000	700,000	2,000,000
75	27.5	200,000	0	610,000	700,000	1,300,000
76	35.2	290,000	570,000	410,000	340,000	1,300,000
77	34.8	330,000	610,000	620,000	290,000	1,500,000
78	35.5	340,000	680,000	730,000	950,000	2,400,000
79	36.0	280,000	390,000	830,000	980,000	2,200,000
80	35.9	200,000	40,000	770,000	950,000	1,800,000
81	36.7	180,000	0	550,000	890,000	1,400,000
82	36.0	210,000	0	520,000	920,000	1,400,000
83	35.5	250,000	0	500,000	1,200,000	1,700,000
84	20.6	150,000	0	150,000	230,000	380,000
85	37.0	360,000	500,000	1,200,000	580,000	2,300,000
86	46.2	400,000	0	1,200,000	1,500,000	2,700,000
87	19.7	150,000	0	310,000	180,000	490,000
88	41.9	330,000	430,000	940,000	1,200,000	2,600,000
89	35.0	290,000	570,000	630,000	540,000	1,700,000
90	36.0	300,000	580,000	710,000	870,000	2,200,000
91	34.5	260,000	360,000	670,000	640,000	1,700,000
92	40.3	300,000	470,000	460,000	100,000	1,000,000
93	40.2	270,000	0	550,000	640,000	1,200,000
94	36.0	250,000	0	620,000	1,100,000	1,700,000
95	34.8	370,000	420,000	940,000	610,000	2,000,000
96	42.7	320,000	0	830,000	190,000	1,000,000
97	36.0	280,000	280,000	690,000	840,000	1,800,000
98	31.6	220,000	210,000	690,000	510,000	1,400,000
99	19.2	150,000	250,000	120,000	0	370,000
100	24.0	140,000	190,000	140,000	0	330,000
101	40.0	330,000	190,000	500,000	200,000	890,000
102	37.3	390,000	830,000	1,100,000	920,000	2,800,000
103	27.6	290,000	570,000	770,000	580,000	1,900,000
104	17.9	170,000	160,000	480,000	350,000	990,000
105	27.9	200,000	0	250,000	470,000	720,000
106	37.2	240,000	20,000	540,000	1,100,000	1,700,000
107	34.7	220,000	0	630,000	860,000	1,500,000
108	40.5	340,000	220,000	740,000	190,000	1,200,000
109	27.4	150,000	160,000	430,000	450,000	1,000,000
110	35.6	250,000	290,000	700,000	960,000	2,000,000
111	36.0	230,000	160,000	780,000	960,000	1,900,000
112	37.4	280,000	60,000	920,000	320,000	1,300,000
113	36.4	250,000	0	300,000	1,100,000	1,400,000
114	36.0	230,000	0	640,000	1,100,000	1,700,000
115	32.8	300,000	250,000	570,000	370,000	1,200,000
116	32.2	290,000	270,000	800,000	290,000	1,400,000
117	36.3	330,000	310,000	1,000,000	980,000	2,300,000
118	38.0	340,000	440,000	1,200,000	850,000	2,500,000
119	36.4	270,000	80,000	900,000	790,000	1,800,000
120	30.7	210,000	0	440,000	30,000	470,000
121	37.1	260,000	0	500,000	560,000	1,100,000
122	36.6	310,000	40,000	700,000	290,000	1,000,000
123	38.6	310,000	100,000	840,000	540,000	1,500,000
124	40.8	340,000	160,000	1,300,000	1,100,000	2,600,000
125	36.1	300,000	110,000	930,000	840,000	1,900,000
126	29.4	280,000	0	730,000	700,000	1,400,000
127	24.5	280,000	0	300,000	400,000	700,000

Table 1 gives the estimated amounts of recoverable ground water by depth zones for the subareas shown on the index map. The index map and table 1 are best used in conjunction with the map showing approximate depth to water (Osterkamp, 1973). The values given in the column entitled "Water in upper 100 feet of saturated sediment" are the estimated average amounts of water that could be pumped from a subarea with a resultant average water-level decline of 100 feet (30 metres). Similarly, the values given in columns "Water between land surface and 300 feet below land surface," "Water between 300 and 700 feet below land surface," and "Water between 700 and 1,200 feet below land surface" are estimates of the amount of water that could be recovered from these depths.

The amount of ground water stored in a subarea differs from place to place within the subarea. Estimates of amounts of water in storage at a specific site or in an area that is larger or smaller or that otherwise does not conform to the selected subareas can be made independently by using the data on the accompanying areal-distribution map as a guide. The index map and table 1 can be used to provide estimates of the amounts of water stored at the different depth ranges. All subarea boundaries are artificial boundaries selected for convenience in compilation and do not represent physical boundaries; for example, a well in the extreme northeast corner of subarea 79 will withdraw water from parts of subareas 66, 67, 80, and 79.





INDEX MAP SHOWING SUBAREAS LISTED IN TABLE 1

ESTIMATED AMOUNT OF RECOVERABLE WATER TO A DEPTH OF 1,200 FEET (370 METRES)

[Colored areas show the extent of the major ground-water reservoir, which consists of sedimentary rocks and small amounts of volcanic rocks. The rocks contain large amounts of recoverable ground water at depths ranging from about 20 feet to almost 800 feet below the ground. Gray areas represent rocks that contain only small amounts of recoverable ground water per unit of land area]

More than 60,000 acre-feet of recoverable ground water per square mile (about 0.29 cubic hectometre per square kilometre)

From 30,000 to 60,000 acre-feet of recoverable ground water per square mile (about 0.14 to 0.29 cubic hectometre per square kilometre)

Less than 30,000 acre-feet of recoverable ground water per square mile (about 0.14 cubic hectometre per square kilometre)

In the Phoenix area most of the water used by man is pumped from the ground. The average water use (1970–73) in the area served by the city of Phoenix water utility is about 220 gallons (830 litres) per day per person, which is equivalent to about 248 acre-feet (0.306 cubic hectometre) per year per 1,000 population. At the present time (1974), pumpage exceeds the annual rate of recharge, and, as a result, ground water is being removed from storage—that is, it is being mined.

The map and table 1 can be used to determine the amount of available ground water at a site or locality. Although the data were collected over a period of several years, the data are representative of conditions in 1973. In the mountainous areas and in areas where the materials that form the ground-water reservoirs are thin or are mainly dry, the volume of recoverable ground water per unit land area is small, is highly variable from place to place, and has not been calculated for this map. Estimates of the amount of recoverable ground water to a depth of 1,200 feet (370 metres) below the ground are shown in color; additional water can be recovered at greater depths in much of the area.

In places roads, buildings, and other structures have been damaged as a result of land subsidence—a settling of the ground surface—caused by the removal of ground water; the probability of additional and greater damage restricts the use of the calculated amounts of recoverable water. The amount of subsidence is related directly to the amount of ground water removed and to the physical characteristics of the rocks from which the water is withdrawn. Tilt of the land surface, earth fissuring, and offset of the land surface may accompany land subsidence. Known subsidence and earth fissuring in the Phoenix area (Schumann, 1974) are related to ground-water depletion prior to the early 1970's; additional ground-water depletion would enlarge the affected area and increase the amount of subsidence. Large-scale or rapid depletion of ground water would hasten and may increase the damage owing to subsidence and its attendant effects. In summary, in some places most of the recoverable water could be used with no adverse effects, whereas in other areas the damage that would accompany removal of the water may be very costly.

LITERATURE CITED

Osterkamp, W. R., 1973, Map showing depth to water in wells in the Phoenix area, Arizona, 1972: U.S. Geol. Survey Misc. Inv. Map I–845–D, 1 sheet.
Schumann, H. H., 1974, Land subsidence and earth fissures in alluvial deposits in the Phoenix area, Arizona: U.S. Geol. Survey Misc. Inv. Map I–845–H, 1 sheet.

SCALE 1:250 000

5 0 5 10 15 MILES

5 0 5 10 15 KILOMETRES

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100-FOOT INTERVALS
DATUM IS MEAN SEA LEVEL
1976 MAGNETIC DECLINATION VARIES FROM 13°30′ TO 13°00′ EAST

MAP SHOWING DISTRIBUTION OF RECOVERABLE GROUND WATER IN THE PHOENIX AREA, ARIZONA

By

W. R. Osterkamp and P. P. Ross

1976

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