CHANGES IN DEPTH TO WATER TABLE AND DIRECTION OF GROUND WATER FLOW 1902–1979

INTRODUCTORY STATEMENT

The depth to the water table, which is the upper surface of the ground water, has gradually increased beneath the Tempe Quadrangle from 1902 to about 1947. After 1947, the rate of lowering of the water table has become faster, and the contours of that surface have become complex.

The flow of ground water occurs from areas where the water table elevation is higher toward areas where it has a lower elevation. Until 1947, the ground water movement in the Tempe Quadrangle was generally westerly toward the Salt River channel (figs. 1-4). After 1947, the ground water movement has become complex (figs. 5-7). In addition, the repeated floods along the Salt River have resulted in modifications of the rate of drop in the water table in the Tempe Quadrangle (figs. 8 & 9).

The water levels used for these interpretations were measured in production wells, which usually had been pumped during the season of heavy water demand, generally May to October. Measurements were generally taken after the pumping stopped; however, the water levels in the wells may not have completely returned to the regional level.

DRAWDOWN

A slow but steady drawdown of the ground water level occurred between 1902 and 1947 in the Tempe Quadrangle. The elevation of the water table declined in a widespread, gradual manner (figs. 1-4). In 1947, a minor depression in the water table was evident in the southeast part of the quadrangle (fig. 4); this deepened 50 feet more (15 m) by 1955 (fig. 5). In 1955, indications were first noted that a complex depression 70-100 feet deep (21 to 30 m) was forming in the northeast part of the quadrangle (fig. 5). By 1957, the northeast and southeast depressions in the water table were deeper, and evidence signaled a drop in the water table west of Tempe Butte. The Salt River Project apparently stopped mapping the ground water table annually in 1960, but the U.S. Geological Survey published maps of the 1976 ground water conditions in the lower Salt River Valley (Laney and others, 1978; and Ross, 1978). Those maps show that the water table dropped 50 to 100 feet more (15 to 30 m) between 1957 and 1976 (fig. 7). The water table in the depressions of the northeast and southeast were shown to have declined 150 to 200 feet (45 to 60 m) below their 1902 levels (fig. 8). There had been a sharp, accelerating rate of water table lowering in the northeast part of the quadrangle, with the deepest area centered slightly north of the Tempe Quadrangle (Cordy and others, 1978).

The depth below the surface to ground water in 1979 (fig. 8) indicates the accelerating drawdown which had occurred since 1976 in the northeast part of the quadrangle. Figure 8 also shows the rise in ground water elevation of the area from around Thomas Road south to Baseline Road, following the floodflows occurring along the Salt River between March 1978 and spring 1979.

RECHARGE BY FLOODWATERS

The answer to the commonly asked question, "does flood flow along the Salt River recharge the ground water reservoir (elevate the level of the water table) near the river?" is still unclear, at least within the Tempe Quadrangle. Examinations of the records of wells along Scottsdale Road (Rural Road) for 5 miles north and 3 miles south of the river does indicate a general raising of the water table in response to flows in the ordinarily dry river channel from 1934 to 1979 (figs. 8 & 9). However, it should be mentioned that when water is available on the surface in the river valley, water users usually turn off their pumps. With the pumps off, the water levels in the wells rise in response to the ground water returning into the dewatered cones of depression which had developed surrounding each pumping well. Therefore, abrupt rises in the water table associated with flood flows need careful evaluation.

The apparent recharge from the 1941 flood produced about 25 feet of rise (7.5 m) in the water levels of measured wells E through H (see fig. 9), located from 1 mile (1.6 km) north to 3 miles (4.8 km) south of the Salt River channel. The water level in all wells dropped significantly from 1942 to 1965, during which time no flows in the Salt River occurred.

The effect of the 1965-1966 flood on the ground water level is unclear because measurements in many wells had not been taken for almost 6 years prior to that flood. However, the water level in Well H rose 40 feet (12 m) within a period of a few months following the flood. Well A showed almost a 75 feet (22.5 m) rise in water level between measurements which were made within a year following the 1965-66 flood. The actual water table rise may have been greater, but cannot be confirmed because no measurements had been made for more than 5 years prior to the flood. The elevated water level in Well A may also indicate influence from other sources than floodflow along the Salt River. There may have possibly been recharge from flow in Indian Bend Wash, but that cannot be proven with the available data. Water levels in Wells B and D were not measured during more than 5 years prior to the 1965-66 flood, and Well C was measured only once during the 3 years following that flood. Therefore, recharge, or modifications to recharge in the three wells is unclear, nor can the data be compared with that for Well A.

The lengthy floodflow of February to May 1973 probably caused a rise of the ground water surface of about 25 feet (7.5 m) in Well F, approximately 3/4 mile (1.2 km) south of the river, but infrequent measurements of water levels before that floodflow make any influence in the other wells difficult to interpret. The wet year beginning with the March 1978 flood, through the flood of March 1979, appears to have greatly influenced the water levels of all wells. Water in the wells rose from 5 to 40 feet (1.5 to 12 m) during that year.

The north-south ground water profile through the Tempe Quadrangle (fig. 8) indicates, among other things, the response of the water table to the wet times of 1978 and 1979. It also possibly demonstrates the slow horizontal movement of ground water. From 1976 to 1979, the water table between Well D near McDowell Road and Well F near Broadway Road rose to near its 1957 level. However, the depression of the ground water level in the northeastern part of the quadrangle has continued downward at an accelerating rate. The raised water table or mound appeared in 1979 to extend from the river northward to between Wells B and C (fig. 8), and southward to between Wells G and H.

Recharge, if any, shown in the wells south of the Salt River, was probably influenced mainly by floodflows along the Salt River channel. The wells north of the Salt River, Wells A through E may have been recharged either by flow along the Salt, along Indian Bend Wash, or both. However, any influence on the northern wells by the floodflow of June 1972 along Indian Bend Wash can only be surmised, because water levels were not measured there during the period 3 to 5 years prior to the June 1972 flood.

For references, see reverse side.

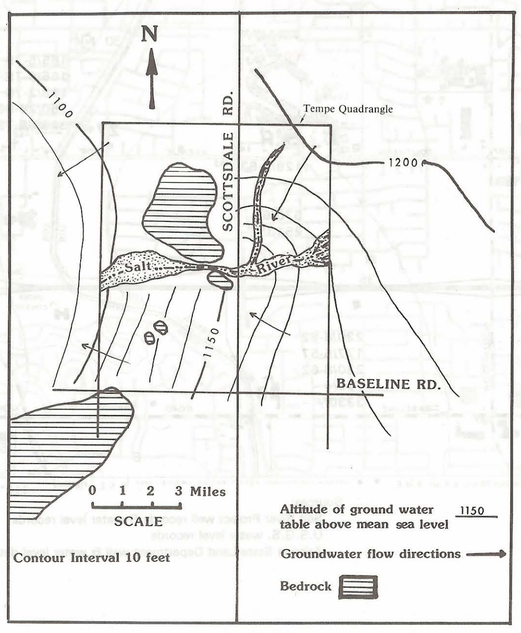

Fig. 1. 1902-1903 altitude of the ground water table in the Tempe Quadrangle and adjacent areas (modified from Salt River Project (SRP), 1903).

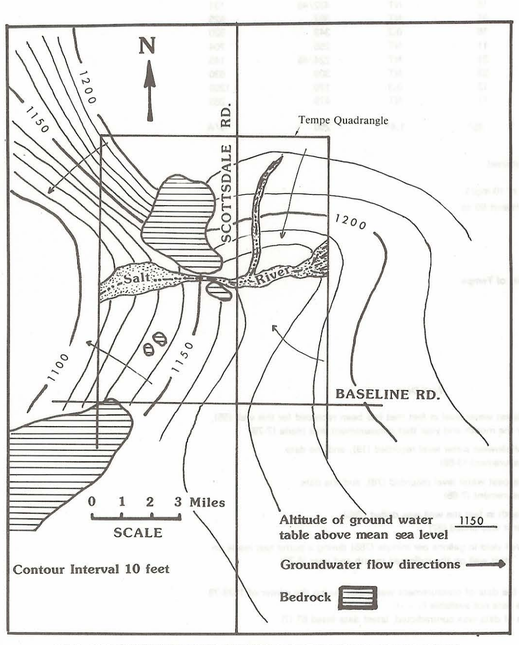

Fig. 2. 1922 altitude of the ground water table in the Tempe Quadrangle and adjacent areas (modified from SRP, 1922).

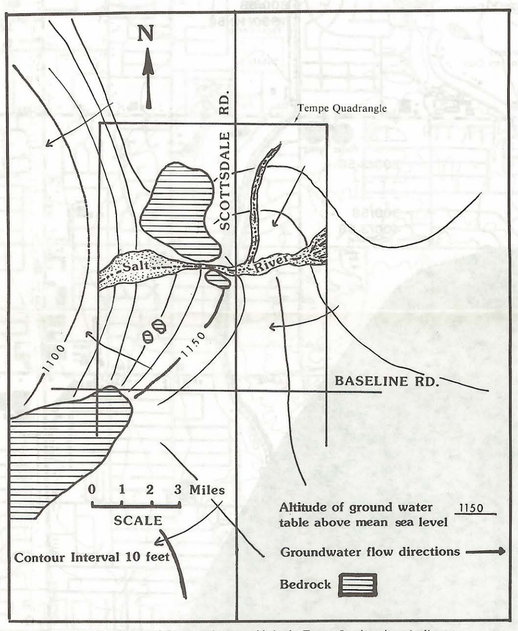

Fig. 3. 1942 altitude of the ground water table in the Tempe Quadrangle and adjacent areas (modified from SRP, 1942).

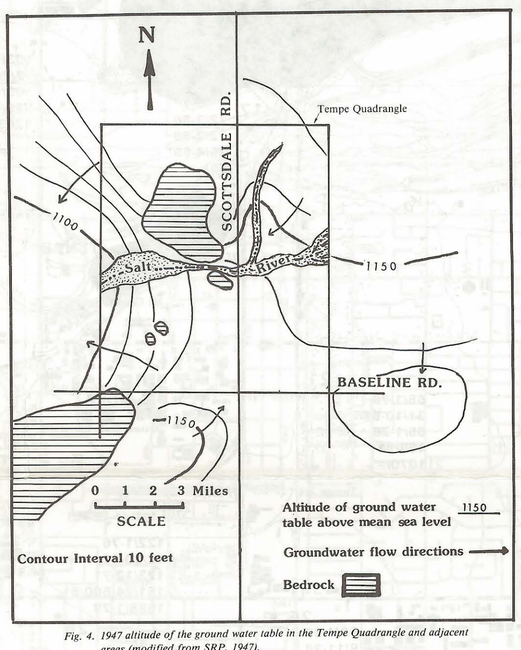

Fig. 4. 1947 altitude of the ground water table in the Tempe Quadrangle and adjacent areas (modified from SRP, 1947).

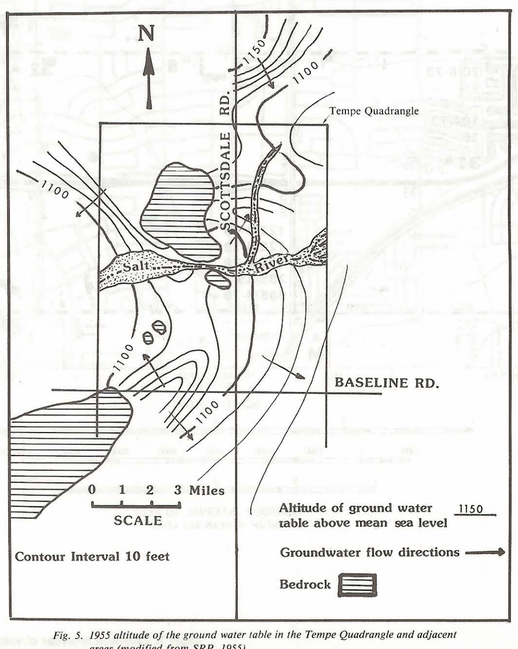

Fig. 5. 1955 altitude of the ground water table in the Tempe Quadrangle and adjacent areas (modified from SRP, 1955).

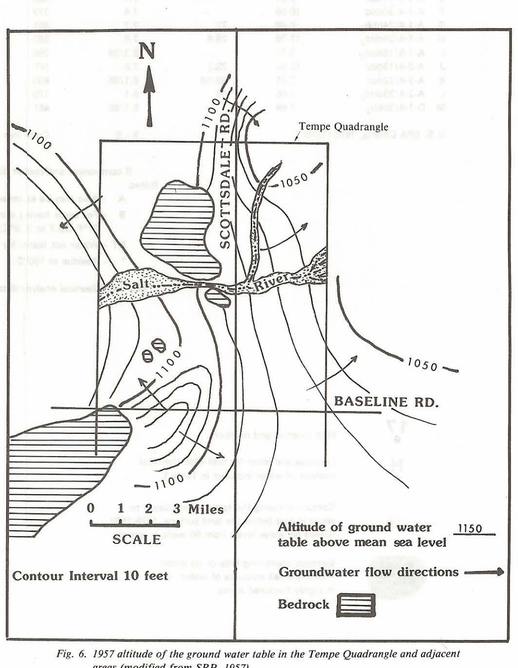

Fig. 6. 1957 altitude of the ground water table in the Tempe Quadrangle and adjacent areas (modified from SRP, 1957).

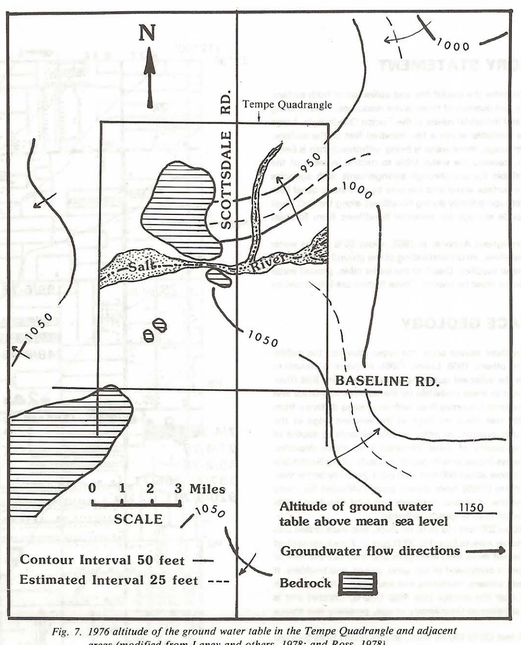

Fig. 7. 1976 altitude of the ground water table in the Tempe Quadrangle and adjacent areas (modified from Laney and others, 1978; and Ross, 1978).

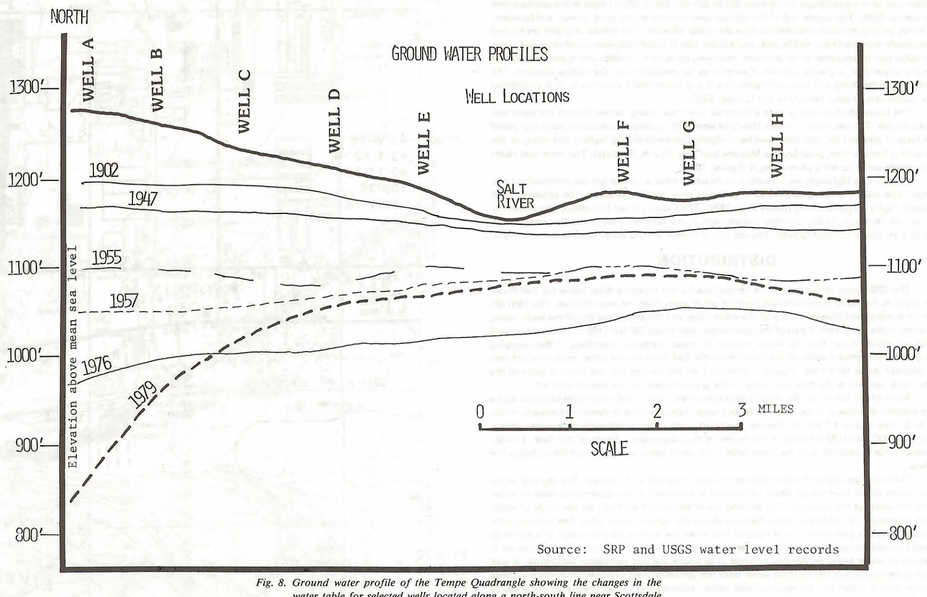

Fig. 8. Ground water profile of the Tempe Quadrangle showing the changes in the water table for selected wells located along a north-south line near Scottsdale Road (Rural Road). (Locations of the wells are indicated on the insert in Figure 9.)

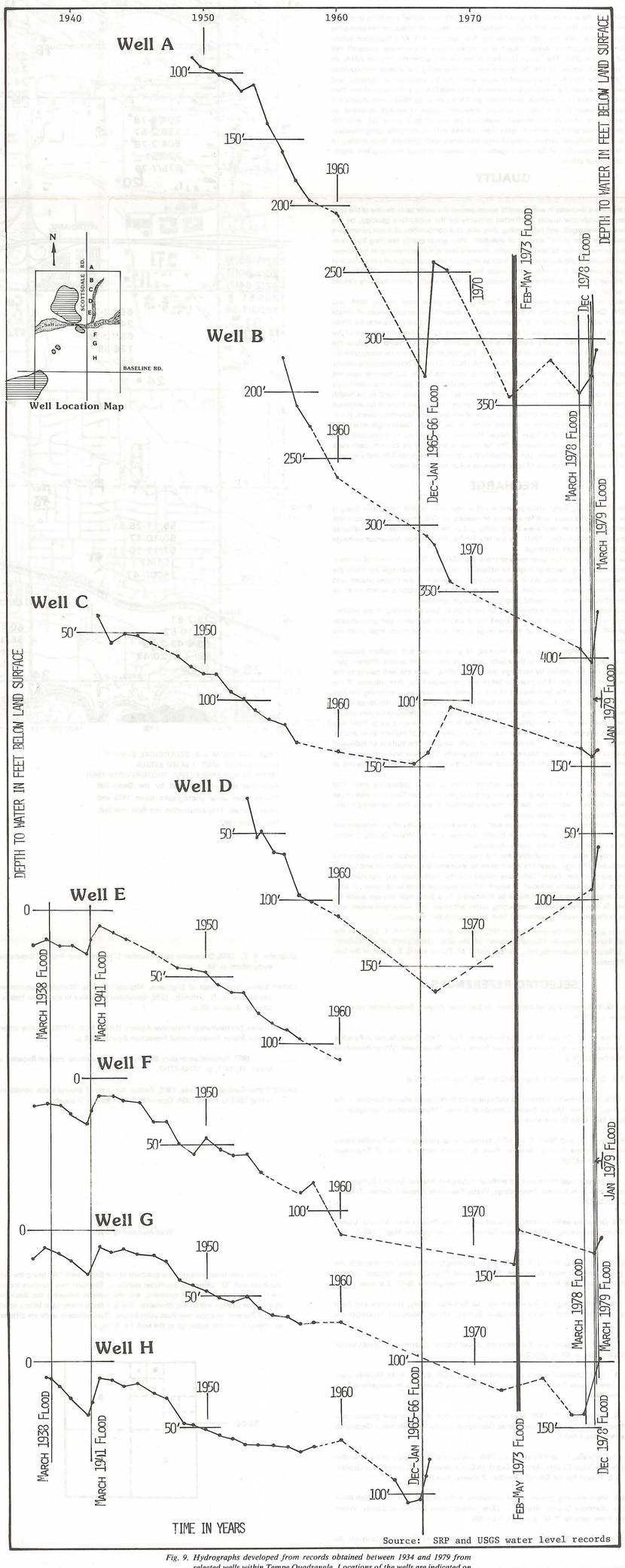

Fig. 9. Hydrographs developed from records obtained between 1934 and 1979 from selected wells within Tempe Quadrangle. Locations of the wells are indicated on the insert, above.