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Ground-water resources of Deer Valley Maricopa County, Arizona

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With a section on quality of water
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O. C. Williams, Commissioner

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PURPOSE AND COOPERATION

The ground-water resources of Deer Valley, in Maricopa County, Arizona, were first studied in 1941 by the United States Geological Survey, Department of the Interior. This work was done at the request of the War Department. In the fall and winter of 1948, a more detailed study of the Deer Valley area was made as a part of the State-wide investigation of ground-water basins, as provided by the Arizona Ground Water Act of 1945. This work was done on a cooperative basis between the Arizona State Land Department, O. C. Williams, Commissioner, and the United States Geological Survey. Field work was done by F. I. Bluhm and H. E. Skibitzke, engineers, and H. N. Wolcott, geologist, under the direct supervision of H. M. Babcock, engineer, and under the general supervision of S. F. Turner, District Engineer (Ground Water), of the Geological Survey. Water analyses were made by L. S. Hughes, chemist, under the general direction of J. D. Hem, District Chemist of the Geological Survey. Analyses of water from some of the wells in the area were made in earlier years by the Salt River Valley Water Users' Association, and these records were made available by the Association for use in this investigation. G. M. Hoskins, engineer, assisted in the preparation of tables and illustrations.

LOCATION

Deer Valley, with an area of approximately 40,000 acres, lies on the north edge of the Salt River Valley Project, north of the town of Glendale. The area considered in this report is bounded on the north by the Hedgpeth Hills, on the east by the Union Hills and the Phoenix Mountains, on the south by the Arizona Canal, and on the west by the New River.

Aerial photographs of the area on a scale of approximately 2 inches to the mile were used in preparing the base map. Levels were run to wells and elevations were determined to the nearest 0.1 foot.

CLIMATE

The Deer Valley area has a climate much the same as that of Phoenix, characterized by dry, hot summers and mild winters. The average annual precipitation at Phoenix is 7.78 inches, according to a 52-year record of the U. S. Weather Bureau. During 1947 the temperature ranged from 27° to 113° F., and the mean annual temperature was 69.7° F.

HISTORY AND DEVELOPMENT

Prior to 1940 there was relatively little agricultural development in Deer Valley and water was pumped mainly for domestic and stock use. In 1940 approximately 200 acres were under cultivation, supplied with water from one large irrigation well (no. 2612). Since 1940, under the impetus of high agricultural prices, development of the area has been rapid. By the end of 1948, 80 large irrigation wells had been completed to irrigate more than 21,000 acres. The principal crops raised are truck-garden vegetables, cotton, and alfalfa. Well locations and cultivated areas are shown on plates 1 and 2. As no surface-water supply is available, all the irrigation water has been derived from wells and the result has been a large depletion of the ground water in storage. Pumpage has increased from a little over 600 acre-feet in 1940, to 88,000 acre-feet in 1948. The total pumpage for the 9-year period was 266,000 acre-feet. Figure 1 shows the amount of water pumped each year and the decline of water level in the valley.

PREVIOUS INVESTIGATIONS

In the spring of 1941, H. M. Babcock and R. B. Morrison[1] made a reconnaissance survey of the area. Data compiled at that time have been used in this study in determining changes in water levels and pumpage.

GEOLOGY AND ITS RELATION TO GROUND-WATER SUPPLIES

PHYSIOGRAPHY

Deer Valley is a small reentrant on the north border of the Salt River Valley. The valley floor is an undissected plain which slopes upward from the Arizona Canal to the Hedgpeth Hills on the north (see pl. 1). Hard-rock slopes of the Phoenix Mountains and the Union Hills form the eastern border of the area, and the New River limits the valley on the west. Skunk Creek and Cave Creek, both of which are ephemeral streams, emerge into Deer Valley from the mountainous country to the north, and flow in shallow channels across the flat valley floor.

GEOLOGIC HISTORY

It is possible to draw only general conclusions as to the geologic history of the area prior to the Cretaceous period. During a long interval of erosion that preceded the Cretaceous period, the land surface, underlain by pre-Cambrian schists and granites, probably was reduced to low relief. In parts of the region the pre-Cambrian rocks may have been covered with Paleozoic or early Mesozoic marine sediments, although there is no evidence that such deposition actually occurred. If such sediments did accumulate in the area prior to the Cretaceous period, they were either removed by subsequent erosion or buried beneath an enormous thickness of later volcanic materials or alluvium.

Land movement of great magnitude accompanied the volcanic activity of the Cretaceous and Tertiary periods, and it was probably during these times that large structural troughs and ridges were formed in the pre-Cambrian basal rocks. Lava was ejected from the earth at numerous places, usually in the form of flows but occasionally by violent eruptions. Accompanying the many local disturbances resulting from vulcanism in the Cretaceous and Tertiary periods, there began a gradual but general subsidence of the land mass over the entire valley region, and a corresponding uplift of the country to the north and east. These divergent movements produced a great escarpment and a parallel belt of intensely faulted and broken formations along the zone of maximum displacement. The escarpment is now known as the Mogollon Rim. Erosion was greatly accelerated by the changes in land levels, and enormous quantities of alluvium were deposited in the valleys of the subsiding areas. Deer Valley, in common with adjacent areas, began to accumulate its deposits of valley fill, and the process of aggradation has continued intermittently to the present time.

Interruptions in the deposition of alluvium in the valley may have been due to climatic changes, to lava flows which temporarily diverted drainage from the area, or to periods of stability during which the land surface ceased to subside. During the interruptions, the sediments at or near the temporary level of the valley floor were consolidated and cemented. Layers and lenses of cemented sands and gravels have been encountered in many wells within the area. As alluvial deposition was renewed, the cemented sediments were buried beneath the more recent unconsolidated material which now constitutes the upper portion of the fill in Deer Valley (see fig. 2).

[1] Babcock, H. M., and Morrison, R. B., Ground water in Skunk Creek area, Maricopa County, Ariz.: U. S. Geol. Survey (confidential report to U. S. War Dept.), 1941.

Although lava flows form part of the valley borders on the north and east sides, there is no evidence to indicate that the entire valley floor was ever covered by lava. Quaternary basalt rests upon alluvial material in a few places along the margin of the valley but only a few wells in the valley have encountered volcanic materials. This could mean that lava entered the valley area as tongues following drainage depressions in the older alluvial surface.

During the Quaternary period, volcanic activity diminished and finally ceased, but land movement, both local and regional, continued. These later movements were for the most part gradual but they were of considerable magnitude and their effects are visible in the present topography of the area.

STRUCTURE

Block faulting and tilting have had an important effect upon the topographic forms in the Deer Valley area. These structural movements probably reached a maximum during the Tertiary period, but large-scale faulting has continued into fairly recent times, affecting the Quaternary lavas and sediments. Although of considerable magnitude, the faulting and tilting apparently have been gradual, and the tilted blocks are not greatly broken up. The strike of the major movements conforms with the general northwest structural trend in the region, but there are numerous northeast-trending cross faults.

No evidence of folding was observed in the area.

ROCK FORMATIONS

Pre-Cambrian rocks

Schist, granite, and gneiss of probable pre-Cambrian age constitute the basal formations in the Deer Valley area. These rocks form a portion of the valley border on the east side, and a small exposure of the granite occurs on the northwest side of the area. Elsewhere these formations are covered by sediments or by lava flows.

Schists, which form part of the Phoenix Mountains on the eastern border of the valley, are probably the oldest rocks in the region. They range in color from light gray or tan to dark gray or buff. They are commonly sericitic and thinly laminated, and, as they contain small areas of quartzite and slate, they are undoubtedly of sedimentary origin. The prevalent strike is to the northeast, and dips are usually within a few degrees of vertical. Weathering accentuates the laminations on the surface, but does not penetrate deeply. Consequently, the rocks are not permeable and are of very little importance as aquifers.

The granite that borders part of Deer Valley is a medium-grained gray variety, composed principally of orthoclase feldspar, quartz and biotite mica. It is noticeably but not excessively jointed, and is not generally deeply weathered. As the rock is practically impervious, except along joints or fracture planes, it is of slight importance as an aquifer.

The gneiss in the area was derived from the granite, and its lithological and water-bearing properties are the same as those of the parent rock. It has practically no value for storage or transmission of ground water.

Cretaceous and Tertiary rocks

Volcanic rocks

Lavas of probable Cretaceous and Tertiary age occur on the northwest, north, and northeast sides of Deer Valley. These rocks are predominantly basic or intermediate in character and consist of successive flows of basalt, andesite, and some dacite. Thin beds of white rhyolitic tuff occur in several places between the topmost flows, which are believed to be of Tertiary age, and the overlying Quaternary basalt, and no definite age designation can be given to these pyroclastic materials. They may mark the last eruptive outburst of the Tertiary period or they may be related to the red scoria and agglomerate that frequently form the basal member of the Quaternary volcanic rocks in the region.

No uniform stratigraphic succession could be determined in the Cretaceous and Tertiary lavas. The thicknesses of the flows are extremely variable, suggesting the probability that they were deposited upon very uneven surfaces during periods of frequent upheaval and distortion of the land surface. Quaternary basalt covered most of the older lavas but they have been exposed again by block faulting and tilting.

In general, the Cretaceous and Tertiary volcanic rocks are extensively jointed and are therefore subject to fairly rapid erosion and weathering. Some of these rocks would provide easy access to water from rainfall, but the total exposed area is not large and they are not important aquifers.

Sedimentary deposits

On the eastern border of Deer Valley a conglomerate is exposed which is definitely prevolcanic in age, possibly early Cretaceous. This conglomerate, which is not shown on the geologic map, plate 1, occurs on the east bank of Cave Creek in sec. 21, T. 4 N., R. 3 E. The conglomerate lies unconformably upon chlorite schist. The rocks in the conglomerate range from small pebbles to very large cobbles and consist of various metamorphic rocks and, occasionally, granite. Volcanic rocks are absent.

None of the material in the conglomerate shows much rounding, and most of it is angular, indicating a nearby source. Cementation ranges from moderate to firm, and the cementing material is calcareous. Zones of firm cementation, which follow old channels cut in the underlying schist, are suggestive of the former presence of springs in this locality.

The lower part of the alluvium that constitutes the valley fill in the Deer Valley structural trough is probably of Tertiary age. The character of the alluvium is unknown as there are no surface exposures, and no wells have penetrated the entire thickness of the valley fill.

Quaternary rocks

Volcanic rocks

Lava flows of Quaternary age cover a considerable area along the northern margin of Deer Valley, and they also form a few small, but conspicuous, isolated hills which rise out of the flat valley floor. Similar flows cover older metamorphic rocks and sediments in the Phoenix Mountains on the eastern edge of the valley. A maximum thickness of approximately 200 feet was observed in the latter locality, but the thickness usually is much less.

The flows are composed of dark-gray olivine basalt, which is generally vesicular. The basal member frequently is a thin layer of red scoriaceous basalt or agglomerate. The gray basalt readily acquires a surface weathering of shiny black "desert varnish," typical of the Quaternary lava flows in this region.

Jointing has been extreme, and the rock disintegrates rapidly along the joint planes. This gives the effect of enormous boulder heaps which maintain the outlines of the original flows. In spite of the extent of their disintegration, the Quaternary lavas are not good aquifers in this region. The rock fragments weather rapidly into clay which effectively prevents the downward percolation of water from rainfall. Wells drilled near the edge of some of the basalt hills have penetrated the lava and passed into cemented sediments underneath. None of these wells is known to have encountered water in any appreciable quantity in the volcanic rocks.

Sedimentary deposits

Several different types of sedimentary deposits are exposed in the Deer Valley area. Although the age of these deposits cannot be proved, they are believed to be Quaternary and are shown as such on the map (pl. 1).

Older Quaternary sediments.- One type of sedimentary deposit may be observed along the east face of a steep hill in sec. 18, T. 3 N., R. 3 E. This deposit consists of a series of firmly cemented fine gravels and sands which are overlain with apparent conformity by Quaternary scoria and basalt. The maximum thickness of the sediments at this locality is estimated to be approximately 200 feet. Where the base is exposed, the sediments are resting upon an eroded surface of pre-Cambrian schist.

The sediments are fairly well sorted, and the beds dip approximately 5° northwest toward Deer Valley. Particles of granite, metamorphic rocks, and lavas make up the aggregate. These sediments are lithologically identical with specimens of cemented sand and gravel that came from well 2559 (see fig. 2) at a depth of approximately 600 feet, and it is probable that the two occurrences are directly related. There is no way in which the age of these sediments can be definitely determined, but they are believed to be Pleistocene.

Another type of sedimentary deposit is composed of unconsolidated and unsorted materials, which form several prominent ridges along the east side of Deer Valley. The materials composing the deposits range in size from silt to boulders more than 5 feet in diameter, and consist mostly of schist, gneiss, quartzite, and granite, with minor amounts of various volcanic rocks. These ridges exhibit smooth crests which are strongly suggestive of stream terraces. However, the angularity of the materials that compose them would appear to exclude the postulate of stream transportation, and the origin of the ridges cannot be determined without further investigation.

One of the ridge deposits rests, with an erosional unconformity, upon Tertiary or Cretaceous basalt at the base of a prominent peak 2 miles north of Cactus (see pl. 1). This ridge extends southward almost to Cactus, then branches to the west, and terminates against hills of pre-Cambrian schist in the Phoenix Mountains. There is no basis upon which to assign a definite age to the sediments of the type described, except that they are probably older than Recent, but certainly not older than Tertiary. In the absence of definite information, they are assigned a Quaternary age in this report.

If sediments similar to the ridge deposits exist as valley fill beneath the surface of the later alluvium in Deer Valley, they should be good aquifers. Because of their limited area, they are of minor importance in the transmission of rainfall to underground storage.

Quaternary alluvium.- The most extensive sedimentary deposits in the area are the Quaternary gravels, sands, silts, and clays which form the flat valley floor and which extend to undetermined depths below the surface of the valley. These deposits contain the most productive aquifers. Those at the surface are mapped as "Quaternary alluvium" on plate 1. At depth the younger deposits pass into sediments probably equivalent in age to the "older Quaternary sediments" exposed at the edges of the valley, but the data are not adequate to show definitely the depth at which this occurs. Although there is no apparent uniformity or pattern in the occurrence of the clays, silts, or uncemented sands and gravels, a study of the logs of many of the wells in Deer Valley reveals the presence of cemented sand and gravel at depths in the neighborhood of 500 feet (see fig. 2). These cemented beds probably correspond to the older sediments found in the hills in sec. 18, T. 3 N., R. 3 E. They are not good aquifers.

The youngest Quaternary deposit is the Recent alluvium along the channels of Skunk Creek and Cave Creek. It is not shown separately from the rest of the "Quaternary alluvium" on plate 1. The coarse, unconsolidated, and unsorted sands and gravels making up the Recent alluvium afford an excellent opportunity for the penetration of surface water to underground storage. Unfortunately, however, water flows in these channels only at rare intervals, and usually for not more than a few hours at a time. It is, therefore, evident that the streams, except during periods of abnormal precipitation, contribute very little recharge to the ground-water reservoir in Deer Valley.

THICKNESS OF VALLEY FILL

As no deep wells have been drilled in Deer Valley, any statement as to the character of the sediments at depth, or as to the total thickness of the valley fill in the area, can be only speculative. However, by analogy with conditions in the nearby Salt River Valley and Paradise Valley, it may be inferred that the hard-rock floor of the valley trough would be found between 2,000 and 3,000 feet below the present surface of the alluvium. This depth would, of course, be variable.

Another inference would be that productive aquifers generally will not be found at depths below about 1,000 feet. Below that depth clays and cemented materials will probably predominate, and these materials would have little productive capacity.

GROUND-WATER RESOURCES

OCCURRENCE OF GROUND WATER

Ground water occurs in the clays, silts, sands, and gravels of the alluvial fill in the valley. The materials that compose the fill are not distributed with any uniformity, either vertically or laterally. They occur as discontinuous layers and lenses, and closely adjoining wells usually show little similarity in the materials encountered at any given depth. Table 1 shows records of wells, and table 2 shows logs of representative wells in the valley. Although the silts and clays are generally more porous than the sands and gravels, the pore spaces are so small that little or no water can be removed. Therefore, the gravels and sands are the most important water-bearing materials. The lenses and layers of sand and gravel are discontinuous but are interconnected. This is shown by the fact that the water in practically all wells in a given locality stands at a comparatively uniform level.

Most of the irrigation wells have been drilled to a depth of more than 500 feet, greatest depth reported being 1,186 feet. Depths to water range from approximately 150 feet near the Arizona Canal to more than 300 feet in the northern part of the area. In general, the depth to water increases northward, as the slope of the land surface is greater than the slope of the water table. The discharge from individual wells ranges from about 600 to 3,500 gallons a minute, and the drawdown ranges from 25 to 75 feet. The specific capacity of the wells ranges from 25 to 85 gallons a minute per foot of drawdown, with an average of about 50 gallons a minute. The average pumping lift in 1948 was about 270 feet.

MOVEMENT OF GROUND WATER

The movement of ground water is down gradient, perpendicular to the ground-water contours. The contours show that, prior to agricultural development, the movement was generally from east to west, approximately the same amount of water entering the valley as leaving it. The excessive lowering of the water levels during the past few years has changed the direction of flow so that by the end of 1948 water was moving into the area from practically all directions (see pl. 1).

To determine the amount of ground water moving into and out of the area, a pumping test was made on an irrigation well on the south bank of the Arizona Canal (well 2601-A). The coefficient of transmissibility, T, was computed by the Theis[2/] recovery method as 112,500 gallons a day for each section of the aquifer 1 mile wide for each foot per mile of hydraulic gradient. Assuming the effective thickness of the aquifer to be 1,200 feet, then the average coefficient of permeability, P, is equal to 112,500/1,200 = 94 gallons a day per square foot. The amounts of underflow entering and leaving the area were estimated by using the coefficient of transmissibility, the gradient of the water table, and various increments of border length, depending on gradient change (see section, "Underflow from adjacent area", beyond).

RECHARGE TO GROUND WATER

Recharge to the ground-water reservoir of the area is derived from (1) seepage from irrigation, (2) stream flow, (3) rainfall, and (4) underflow from adjacent areas.

Seepage from irrigation

Part of the water used for irrigation returns to the ground-water reservoir. Tests made in the Safford Valley[3/], Arizona, showed that about 25 percent of the water applied to the land was recharged to the ground-water reservoir. Because the soil of the Safford Valley is more sandy than that of Deer Valley, the rate of infiltration probably is less in Deer Valley. Although no tests were made in Deer Valley, it is believed that probably between 15 and 20 percent of the water applied to the land is returned to the ground-water reservoir. Therefore, it is estimated that the recharge from irrigation during the year 1948 was between 13,000 and 17,000 acre-feet.

2/ Theis, C. V., The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground water storage: Am. Geophys. Union Trans., pp. 519-524, 1935.

3/ Turner, S. F., and others, Water resources of Safford and Duncan-Virden Valleys, Ariz. and N. Mex.: U. S. Geol. Survey (mimeographed), p. 30, 1941.

Stream flow

There is little recharge to the ground-water reservoir from stream flow in the area, as water flows infrequently and only for short periods of time. There are no available records of the amount of stream flow for New River, Cave Creek, or Skunk Creek, but it is believed that the amount of recharge from these sources is small.

Rainfall

Little or no recharge to the ground-water reservoir occurs directly from precipitation. Tests in the Eloy area of the Santa Cruz Basin[4] and in the Queen Creek area of Pinal County showed that little or no recharge occurs from rainfall on the desert.

Underflow from adjacent areas

In 1941, prior to extensive agricultural development, the amount of ground water entering the valley as underflow was approximately equal to the amount of water leaving it. It is estimated from the 1941 contours that this amount was about 2,500 acre-feet. As a result of the subsequent rapid decline of the water levels in the valley, a large cone of depression has developed, and ground water is moving into the valley from practically all directions. It is estimated that in 1948 about 6,000 acre-feet of water entered the valley as underflow.

By 1941 continued seepage had built up a ground-water ridge under the Arizona Canal. Numerous wells were drilled along the south side of the canal and pumping from these wells had lowered the south side of the ridge, leaving a remnant north of and parallel to the canal, as shown by the contours for 1941. These contours also show that at that time there was ground-water movement from Deer Valley into the Salt River Project area. The amount of this underflow was estimated to be about 2,300 acre-feet. The ground-water contours for 1948 show that there is still a ground-water ridge but that it has been lowered and moved to the south by the heavy pumping in Deer Valley. Also, the direction of underflow has been reversed and water is now moving into Deer Valley (see pl. 1). The amount of ground water moving into Deer Valley from the Salt River Project area in 1948 was estimated to be about 2,000 acre-feet.

Underflow from the drainage areas of New River and Skunk Creek and from Paradise Valley accounts for most of the remaining ground water moving into the area. This was estimated to be about 4,000 acre-feet during the year 1948.

There is practically no underflow from Cave Creek into Deer Valley,[5] as stated in the following excerpt from a report on Paradise Valley:

> "The foundation of Cave Creek Dam probably rests upon impermeable bedrock and any underflow of Cave Creek at this place presumably would be forced to the surface. Inasmuch as no underflow has been observed it is probable that the underflow of Cave Creek follows some ancient channel to the east of the dam. Furthermore, at the places where Cave Creek flows west through the Phoenix Mountains, 2½ miles south of the dam, impermeable schist lies very

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4/ Turner, S. F., and others, Ground-water resources of the Santa Cruz basin, Ariz.: U. S. Geol. Survey (mimeographed), pp. 53-61, 1943.

5/ McDonald, H. R., Wolcott, H. N., and Bluhm, F. I., Ground-water resources of Paradise Valley, Maricopa County, Ariz.: U. S. Geol. Survey (mimeographed), p. 10, 1947.

near the surface, and this rock constricts the stream passage to an opening not more than 100 yards in width. This barrier should bring any remaining underflow of Cave Creek to the surface, but no surface flow appears at this place."

DISCHARGE OF GROUND WATER

Ground water is discharged from the area by pumping for irrigation and by natural means. Natural discharge is practically all by underflow out of the area, and very little, if any, occurs through transpiration.

Pumpage

All irrigation water for Deer Valley is furnished by wells. The discharge from wells ranges from 600 to 3,500 gallons a minute and averages about 1,700 gallons a minute. Pumping lifts ranged from about 200 to about 340 feet and averaged about 270 feet for the fall of 1948.

The amount of water pumped for irrigation for the years 1941-48 is shown in figure 1. The total for the 9-year period 1940-48, including 600 acre-feet in 1940, was about 266,000 acre-feet. The total amount of water pumped was computed as follows: Well discharges were measured by weir, current meter, trajectory method, or Pitot tube. The kilowatt-hour demand for each pump was measured. The average power required to lift 1 acre-foot of water 1 foot was computed to be 1.80 kilowatt hours. This figure, the average pumping lift each year, and the total power consumption were used to determine the amounts of water pumped. The pumpage of the one Diesel-powered pump was estimated on the basis of amount of land irrigated.

Natural discharge

In the spring of 1941, before any appreciable amount of pumping had been done, it was estimated that an average of 2,500 acre-feet of water flowed out of the area each year. In 1948, after several years of heavy pumping, it was estimated that only 400 acre-feet of water flowed out of the area. This outflow occurred along the west side.

The amount of ground water discharged by transpiration through vegetation is believed to be negligible, owing to the depth to water.

FLUCTUATIONS OF THE WATER TABLE

Water levels in the valley have been declining continuously since 1941. The average decline for the 8-year period 1941-48 was about 70 feet, with more than 20 feet of this occurring during the last year. This decline was caused by pumping water for irrigation. Figure 1 shows the relation between pumpage and average depth to water for the 8-year period. The curve shows a smooth downward trend of the water table. Measurements made during the last several years indicate a slight rise in water level after the end of each irrigation season when most of the pumps were shut off, but in no case did the water levels regain the level of the previous year.

Plate 2 shows the decline in water levels in Deer Valley for the period 1941-48. The greatest lowering was 100 feet, which occurred in a small area about 2 miles north of the Arizona Canal along the Black Canyon Highway.

SPECIFIC YIELD OF THE AQUIFER

The water-yielding capacity of a rock or soil when expressed in percentage of the total volume of the rock or soil may be called its specific yield[6]. An approximate calculation of the specific yield of the unwatered materials in Deer Valley was made in the present study. Changes in depth to water for the period 1941-48 were computed for the center of each section of land and the volume of material unwatered was computed. The total volume of material unwatered during the 8-year period was computed to be 2,160,000 acre-feet. The net contribution to the ground-water reservoir of the area, as underflow--total inflow, increasing from 2,500 to 6,000 acre-feet per year, minus total outflow, decreasing from 2,500 to 400 acre-feet--was estimated as 22,000 acre-feet during the same period. As the percentage of recharge to the ground-water reservoir from irrigation was not known, estimated maximum and minimum rates of recharge were used. The specific yield of the material was computed on the basis of the following equation:

$$Y_s = \frac{Q - R_i - R_u \times 100}{V}$$

Y_s = specific yield, in percent

Q = water pumped, 1941 through 1948 = 266,000 acre-feet

R_i = recharge from irrigation

R_u = underflow into area less underflow out of area = 22,000 acre-feet

V = volume of material unwatered = 2,160,000 acre-feet

Assuming a maximum recharge from irrigation of 25 percent of 266,000 acre-feet, or 67,000 acre-feet, then:

$$Y_s = \frac{(266{,}000 - 67{,}000 - 22{,}000)\ 100}{2{,}160{,}000}$$

Y_s = 8.2 percent

Assuming a minimum recharge from irrigation of 0 percent, then:

$$Y_s = \frac{(266{,}000 - 22{,}000)\ 100}{2{,}160{,}000}$$

Y_s = 11.3 percent

The specific yield is therefore between 8.2 and 11.3 percent. The recharge from irrigation probably is in the neighborhood of 15 percent and the specific yield would be about 9.4 percent.

QUALITY OF WATER

By

J. D. Hem

This discussion of the quality of ground water in Deer Valley is based on the analyses of samples collected from 43 wells between October 1945 and June 1946 and on analyses of samples collected from 16 of the same wells and two additional wells sampled in 1948. The analyses for 17 wells sampled in 1948 and the analyses for the same wells when sampled in 1945 and 1946 are included in table 3. The other analyses are not tabulated in this report.

6/ Meinzer, O. E., Occurrence of ground water in the United States: U. S. Geol. Survey Water-Supply paper 489, p. 51, 1923.

In general, ground waters in the northern part of the area are moderate in dissolved solids, concentrations being as low as 219 parts per million. The principal anion in these waters is bicarbonate. In some of the waters calcium is the predominant cation, but in others the concentrations of calcium, magnesium, and sodium are nearly equal. Concentrations increase noticeably toward the south, and along the Arizona Canal the concentrations of dissolved solids in ground waters usually fall in the range of 500 to 1,000 parts per million. The increase is mainly in chloride and in calcium, magnesium, and sodium. The quantities of nitrate usually were noticeably greater in the waters of higher mineral content. In general the waters occurring along the Arizona Canal resemble in chemical character the ground waters of large areas of the Salt River Valley.

Relation of quality of water to use

Most of the ground waters in Deer Valley may be rated as excellent to good for irrigation use, as classified by Wilcox[1] with respect to dissolved-solids content and percent sodium. Some waters near the Arizona Canal are less satisfactory for irrigation than those occurring elsewhere in the Deer Valley area but are similar in composition to waters used successfully for irrigation in many parts of the Salt River Valley.

The waters in the northern part of the area generally are moderately hard but are satisfactory for domestic use with respect to mineral content. Waters in the southern part of the area are rather highly mineralized and, because of the excessive hardness, are not entirely satisfactory for domestic use. None of the samples from the area that were analyzed for fluoride was found to contain as much as 1 part per million. Concentrations of more than 1.5 parts per million may cause permanent mottling of tooth enamel when the water is used continuously by young children. It is probable that excessive fluoride concentrations do not occur in waters of Deer Valley. Concentrations up to about 1 part per million are believed to inhibit tooth decay.

Relation of quality of water to source

The 43 available analyses for the samples of ground water collected in the area in 1945-46 and the 18 available analyses for 1948 were used to prepare the quality-of-water map, plate 3. The map shows by means of dashed isochlor lines the probable concentration of chloride in ground water of the area in 1945-46, and by solid isochlor lines the probable concentration in 1948.

A comparison of the analyses of samples taken in 1945 and 1946 with those of samples collected in 1948 shows that in 12 of the 16 pairs of samples the chloride concentration increased during the period. This increase in concentration is shown on plate 3 as a general shift of the isochlor lines toward the northeast, except locally at the southeast corner of Deer Valley, where three of the wells showing decreases in the period are located. The apparent increase in chloride content of the ground water in the southern part of Deer Valley, where most of the samples were collected, may be in part the result of seepage of excess irrigation water to the ground-water reservoir, or seepage from the Arizona Canal. However, because the water-table contours in plate 1 show a general slope of the water table toward Deer Valley from the Salt River Valley, and because the increases are most notable in the southern part of Deer Valley, it is likely that most of the increase in chloride is the result of inflow of ground water to Deer Valley from the adjacent Salt River Valley. Analyses of samples of ground water taken in the part of the northern

[1] Wilcox, L. V., The quality of water for irrigation use: U. S. Dept. Agr. Tech. Bull. 962, p. 26, 1948.

half of T. 2 N., R. 3 E. that is south of the Arizona Canal show that concentration of chloride in this area ranged from 284 to 506 parts per million in 1946.

The analysis for well 2664-A shows that water from this well is higher in chloride than other waters in the vicinity. The well is the deepest (905 feet) from which a sample was collected, and it appears possible that the water at this depth may differ somewhat in chemical character from waters found at shallower depths.

Analyses of a few samples of ground water in Deer Valley8/ were made in 1941. These scattered analyses indicate that in 1941 the waters containing 50 parts per million, or less, of chloride were generally found much nearer the Arizona Canal than in 1946. These data suggest that there may have been some movement of water of high-chloride content into Deer Valley during the period 1941 to 1946, as well as since 1946.

CONCLUSIONS

Deer Valley, with an area of approximately 40,000 acres, is an undissected plain lying on the north edge of Salt River Valley Project north of the town of Glendale.

In 1940 approximately 200 acres were under cultivation, supplied with water from one large irrigation well. By the end of 1948, 80 large irrigation wells had been installed to irrigate more than 21,000 acres.

Ground water occurs in discontinuous layers and lenses of the sands and gravels of the alluvial fill in the valley. Depths to water range from approximately 150 feet near the Arizona Canal to more than 300 feet in the northern part of the area. The average pumping lift in 1948 was about 270 feet. The average discharge of wells is 1,700 gallons a minute, and the average specific capacity is about 50 gallons a minute per foot of drawdown.

In Deer Valley, prior to agricultural development, the movement of ground water was from the east to the west, approximately the same amount of water entering the valley as leaving it. The excessive lowering of the water levels during the past few years has changed the direction of flow and now water moves into the area from practically all directions.

Ground water in the valley fill is derived from four sources: (1) seepage from irrigation, (2) stream flow, (3) rainfall, and (4) underflow from adjacent areas. In 1948 the recharge from irrigation was estimated to be between 13,000 and 17,000 acre-feet, and the underflow from adjacent areas was estimated to be about 6,000 acre-feet. There is little recharge from stream flow and from rain falling directly on the land.

Ground water is discharged from the area by pumping for irrigation and by natural means. The total amount of water pumped for irrigation increased from 600 acre-feet in 1940 to 88,000 acre-feet in 1948. Natural discharge occurs as underflow, which was estimated to be about 2,500 acre-feet in 1941 and 400 acre-feet in 1948.

Water levels in the valley have been declining continuously since 1941. The average decline in water levels for the 8-year period 1941-48 was about 70 feet, of which more than 20 feet occurred during the last year. The specific yield of the materials unwatered was calculated as about 9.4 percent.

Most of the ground waters in Deer Valley may be rated as excellent to good for irrigation use. Waters near the Arizona Canal are less satisfactory than those occurring elsewhere in the area.

8/ Babcock, H. M., and Morrison, R. B., Ground water in Skunk Creek area, Maricopa County, Ariz.: U. S. Geol. Survey (confidential report to U. S. War Dept., 1941).

The waters in the northern part of the area are satisfactory for domestic use, although generally rather hard. The waters in the southern part of the area are not entirely satisfactory for domestic use, as they are excessively hard and rather highly mineralized.

The ground-water contours and the isochlor lines shown on plates 1 and 3 indicate that there has been a movement of ground water from the Salt River Valley into Deer Valley in the past several years.

The continued lowering of the water levels in Deer Valley and the data on pumpage and on recharge and natural discharge show that the safe yield has been greatly exceeded.

Table 1.--Records of wells in Deer Valley area, Maricopa County, Arizona
(All wells are drilled unless otherwise noted in "Remarks" column)

Office number	Location	Owner	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (in.)
	T. 4 N., R. 3 E.						
1897	NW¼NW¼NW¼ sec. 19	Guy J. Stumpff	Thompson Bros.	1948	1,428.1	701	18
1898	SE¼SE¼NE¼ sec. 29	Ray Maurer	A. Stewart	1945	-	350	6
	T. 3 N., R. 3 E.						
1924	NE¼NE¼NW¼ sec. 5	Isabell-Hartner Ranches	-	-	1,363.3	-	20
1925	NE¼NE¼NW¼ sec. 6	H. D. Conner	Thompson Bros.	1948	1,352.7	880	20
1926	SE¼NW¼NE¼ sec. 7	V. P. Shufflebarger	Aubrey Lyon	1946	-	500	16
1927	SW¼SW¼NW¼ sec. 7	J. W. Mitchell	Lewis and McNeil	1920	1,319.9	218	6
1928	NE¼NE¼NW¼ sec. 17	Unknown	-	-	-	-	16
1929	SE¼NE¼NW¼ sec. 17	Unknown	-	-	-	-	20
	T. 3 N., R. 2 E.						
2551	SE¼SE¼SE¼ sec. 24	Charles Christopher	-	-	1,256.3	176	6
d/ 2553	NW¼NW¼NW¼ sec. 8	Am. Inst. of Foreign Affairs	Aubrey Lyon	1941	1,236.6	525	20
2554	NW¼NW¼NW¼ sec. 8	do.	-	1941	1,232.4	460	14
d/ 2555	NW¼SW¼SW¼ sec. 26	S.R.V.W.U.A.	-	1944	1,228.0	263	6
2556	NE¼NE¼NE¼ sec. 1	H. D. Conner	Thompson Bros.	1948	1,342.9	616	20
2556-A	NE¼NE¼NE¼ sec. 1	do.	-	-	1,344.3	282	6
2557	NW¼NW¼NE¼ sec. 1	do.	Thompson Bros.	1948	1,342.7	606	20

a/Measuring point usually was top of casing, top of pump base, or top of well curb.
b/T, turbine; C, cylinder; E, electric motor; G, gasoline; W, wind; H, hand; Q, diesel; number indicates horsepower.

Well records obtained by F. I. Bluhm and H. E. Skibitzke

Office number	Water level: Depth below measuring point (feet) a/	Water level: Date of measurement	Pump and power b/	Use of water c/	Temp. °F.	Remarks
1897	314.44	Nov. 5, 1948	None	N	-	
1898	270e/	May 1945	C,E	D	-	
1924	212.38	Sept.30, 1948	None	N	-	
1925	269.22	Dec. 20, 1948	T,E 200	I	-	See log.
1926	240e/	May 10, 1946	None	N	-	
1927	165e/ 196.0	Apr. 1941 Oct. 20, 1948	C,W	D	79	
1928	203.05	Dec. 20, 1948	T None	N	-	
1929	217.08	Dec. 20, 1948	None	N	-	
2551	101.9 155.26	Apr. 1, 1941 Nov. 5, 1948	None	N	-	
2553	171.32	Sept.30, 1948	T,E 60	P	-	
2554	87e/ 161.27	1941 Sept.30, 1948	T,E 75	P	-	Reported discharge, 750 gallons a minute with a drawdown of 21 feet in 1941.
2555	142.98	Sept.30, 1948	C,E	D	-	
2556	260	June 22, 1948	T,E 150	I	-	Discharge, 1,270 gallons a minute with drawdown of 70 feet, measured June 22, 1948.
2556-A	267.78	Nov. 17, 1948	None	N	-	
2557	260.89	Dec. 20, 1948	T,E 200	I	-	Reported discharge, 1,600 gallons a minute with a drawdown of 60 feet, using 150-hp. motor, Feb. 1948. Discharge, 2,160 gallons a minute with a drawdown of 85 feet, using 200-hp. motor, measured June 22, 1948.

c/ I, irrigation; S, stock; D, domestic; P, public supply; N, none.
d/ See table 3 for analysis of water from this well.
e/ Water level reported.

Table 1.-Records of wells in Deer Valley area, Maricopa County, Arizona-Continued

Office number	Location	Owner	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (in.)
	T. 3 N., R. 2 E.						
2558	SE¼SE¼SW¼ sec. 1	E. W. Michael	-	-	-	360	6
2559	NW¼NE¼NE¼ sec. 2	do.	E. R. Robison and Mason	1948	1,330.1	625	20
2560	NE¼NE¼SE¼ sec. 2	John M. Jacobs	Aubrey Lyon	1946	1,320.7	460	20
2561	NW¼NW¼SE¼ sec. 2	do.	-	-	1,315.4	-	20
2562	NE¼NE¼SW¼ sec. 3	W. J. Parks	-	1946	1,295.3	602	20
2563	NE¼NE¼NW¼ sec. 4	J. L. Quamme	Thompson Bros.	-	1,283.1	896	20
2564	SW¼SW¼NW¼ sec. 4	-	-	-	1,267.0	136	8
d/ 2565	NE¼SE¼SE¼ sec. 4	M. O. Best	C. W. Freelove	1946	1,280.4	556	20
d/ 2566	NE¼NE¼NW¼ sec. 5	Moore, Bennett, and Owen	do.	-	1,259.6	546	20
2567	NE¼NE¼SE¼ sec. 5	E. M. Smith	Roscoe Moss Co.	-	1,262.5	850	20
2568	NE¼NW¼NW¼ sec. 6	J. S. Francis and I. Moore	do.	1948	1,237.9	600	20
2569	NE¼NE¼SW¼ sec. 6	W. L. Varney	Thompson Bros.	-	1,237.7	741	18
2570	NE¼NE¼NE¼ sec. 7	H. Nelson	Anderson	-	-	195	6
2571	NE¼NE¼NW¼ sec. 7	E. C. Williams	-	-	1,228.4	-	-
2572	NE¼SE¼SE¼ sec. 7	D. B. Fortini	-	-	1,219	108	8

Office number	Water level: Depth below measuring point (feet) a/	Water level: Date of measurement	Pump and power b/	Use of water c/	Temp. °F.	Remarks
2558	160	March 1941	C,G	D	78	
2559	254.98	Dec. 21, 1948	None	N	-	
2560	253.58	Nov. 5, 1948	T,E 200	I	-	Discharge, 1,620 gallons a minute with a drawdown of 44 feet, measured Oct. 20, 1948.
2561	245	Sept. 3, 1948	T,E 200	I	-	Discharge, 2,230 gallons a minute with a drawdown of 30 feet, measured Oct. 20, 1948.
2562	229.3	Nov. 15, 1948	T,E 200	I	-	Discharge, 1,720 gallons a minute with a drawdown of 35 feet, measured June 25, 1948.
2563	214.50	Dec. 28, 1948	T,E 200	I	-	Discharge, 2,280 gallons a minute, measured Sept. 13, 1948. See log.
2564	133.45	Mar. 29, 1941	None	N	-	
2565	217.29	Dec. 30, 1948	T,E 250	I	-	Discharge, 2,520 gallons a minute with a drawdown of 33 feet, measured Sept. 13, 1948.
2566	193.13	Nov. 4, 1948	T,E 150	I	-	Reported discharge, 2,800 gallons a minute with a drawdown of 36 feet, Apr. 1942. Discharge, 1,770 gallons a minute, measured Oct. 19, 1948.
2567	204.7	Nov. 3, 1948	T,E 200	I	-	Discharge, 2,070 gallons a minute, measured Sept. 7, 1948. See log.
2568	169.50	Dec. 28, 1948	T,E 200	I	-	Reported discharge, 3,370 gallons a minute with a drawdown of 50 feet, Mar. 1948. Discharge, 3,120 gallons a minute, measured Sept. 9, 1948.
2569	167.09	Dec. 28, 1948	T,E 150	I	-	
2570	156e/	Sept. 1948	C,E 2½	D	75	
2571	162.40	Nov. 3, 1948	T,E 125	I	-	Discharge, 1,400 gallons a minute with a drawdown of 37 feet, measured Sept. 9, 1948.
2572	86.4	Mar. 31, 1941	None	N	-	

Table 1.-Records of wells in Deer Valley area, Maricopa County, Arizona-Continued

Office number	Location	Owner	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (in.)
	T. 3 N., R. 2 E.						
2573	NE¼NW¼SE¼ sec. 8	E. M. Smith	Roscoe Moss Co.	1946	1,239.2	825	20
2574	NE¼NE¼SW¼ sec. 9	J. A. Fain	-	1948	1,257.6	-	-
2575	SE¼SE¼SE¼ sec. 9	L. Collins	C. W. Freelove	1930	1,258.4	254	6
2576	NE¼NW¼NW¼ sec. 10	M. O. Best	Aubrey Lyon	1946	1,280.1	586	20
2577	NE¼SE¼ sec. 10	McElroy and Jaggers	-	-	1,277.1	-	20
d/ 2578	NE¼NE¼SW¼ sec. 11	do.	-	-	-	-	20
2579	SE¼SE¼SW¼ sec. 11	McElroy and Jaggers	-	-	1,285.1	-	20
2580	NE¼NE¼SE¼ sec. 11	John M. Jacobs	-	1947	1,302.0	-	20
2581	NW¼NW¼NW¼ sec. 12	do.	Aubrey Lyon	1941	-	593	20
2582	NE¼NE¼SW¼ sec. 12	do.	do.	1941	1,310.2	417	20
2583	SE¼SE¼NE¼ sec. 12	Unknown	-	-	1,318	205	8
2584	NE¼NE¼SE¼ sec. 12	Isabell-Hartner Ranches	Aubrey Lyon	-	1,317.8	395	20
2585	SW¼SW¼SE¼ sec. 12	do.	-	-	1,303.0	-	20
2586	NW¼SE¼SE¼ sec. 12	do.	Aubrey Lyon	-	1,309.9	596	20
2587	NW¼NW¼NW¼ sec. 13	John M. Jacobs	do.	1943	1,289.8	511	20
2588	NE¼NW¼NW¼ sec. 14	McElroy and Jaggers	-	1940	1,278.6	345	8

Office number	Water level: Depth below measuring point (feet) a/	Water level: Date of measurement	Pump and power b/	Use of water c/	Temp. °F.	Remarks
2573	180	Nov. 3, 1948	T,E 200	I	-	See log
2574	195.65	Nov. 3, 1948	T,E	I	-	
2575	120	March 1941	C,E 3/4	D	78	
2576	221.49	Nov. 4, 1948	T,E 200	I	-	Discharge, 1,820 gallons a minute with a drawdown of 37 feet, measured June 1948.
2577	220.43	Nov. 4, 1948	T,E 250	I	-	
2578	219e/	Jan. 9, 1948	T,E 200	I	-	Discharge, 2,020 gallons a minute, measured Sept. 14, 1948.
2579	-	-	T,E 200	I	-	
2580	-	-	T,E 200	I	-	
2581	173e/	June 1941	T,E 300	I	-	
2582	162e/ 261.94	Jan. 1942 Dec. 28, 1948	T,E 150	I	-	
2583	163.63	Apr. 1, 1941	None	N	-	
2584	165e/	June 1945	T,E 40	I,D	-	
2585	260.66	Dec. 28, 1948	T,E 100	I	-	Discharge, 560 gallons a minute, measured Sept. 3, 1948.
2586	206e/ 247.99	Jan. 1945 Dec. 28, 1948	T,E 100	I	-	Reported discharge, 800 gallons a minute, Jan. 1945. Discharge, 630 gallons a minute, measured Sept. 3, 1948.
2587	177e/	May 1943	T,E 150	I	-	Reported discharge, 2,400 gallons a minute, May 1943. Discharge, 1,480 gallons a minute, measured Sept. 14, 1948.
2588	136.85 229.74	Mar. 30, 1941 Nov. 17, 1948	T,E	D	-	

Table 1.-Records of wells in Deer Valley area, Maricopa County, Arizona-Continued

Office number	Location	Owner	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (in.)
	T. 3 N., R. 2 E.						
2589	NE¼NE¼SE¼ sec. 14	Isabell-Hartner Ranches	C. W. Freelove	1941	1,281	617	20
d/ 2590	NW¼NE¼SE¼ sec. 14	do.	Aubrey Lyon	1945	1,277	605	20
2591	SE¼NE¼ sec. 15	Fred Belsey	Vermouse	1928	-	165	6
2592	SE¼SW¼ sec. 15	J. E. Crawford	L. P. Wilson	1935	1,250	200	6
2593	NW¼SE¼ sec. 15	C. F. Alexander	-	-	1,259.1	200	6
2594	NE¼NE¼NE¼ sec. 16	Sands Trading Co.	Thompson Bros.	1947	-	685	20
2595	NE¼NE¼NW¼ sec. 16	do.	Thompson and Mason	1946	1,251.5	682	20
2596	SE¼SW¼ sec. 16	State School Land	-	-	-	110	8
d/ 2597	NE¼NE¼NE¼ sec. 17	E. M. Smith	Roscoe Moss Co.	1946	-	622	20
d/ 2598	SW¼NE¼NE¼ sec. 18	S.R.V.W.U.A.	Western Pipe and Steel	1941	1,216.4	450	20
2599	NE¼[illegible] sec. [illegible]	do.	do.	1941	1,[illegible].2	394	20
2600	NW¼NW¼NW¼ sec. 20	do.	-	-	-	-	20
2601	NW¼NW¼NW¼ sec. 21	do.	-	-	-	-	20
2601-A	NW¼NW¼SE¼ sec. 21	do.	Roscoe Moss Co.	1948	-	1,000	24
2602	NE¼NE¼NW¼ sec. 22	Isabell Hartner Ranches	Aubrey Lyon	1948	1,250.0	851	20

Office number	Water level: Depth below measuring point (feet) a/	Water level: Date of measurement	Pump and power b/	Use of water c/	Temp. °F.	Remarks
2589	135e/	July 21, 1941	T,E 200	I	-	Reported discharge, 2,400 gallons a minute, July 1941.
2590	190e/	June 26, 1945	T,E 200	I	-	Discharge, 1,810 gallons a minute, measured Sept. 3, 1948. Reported discharge, 2,400 gallons a minute, with a drawdown of 40 feet, June 1945.
2591	120e/	1940	C,W	D,S	79	
2592	104.17	Mar. 28, 1941	C,E 3/4	D	76	
2593	118.82	Mar. 30, 1941	C,G 5	D	78	
2594	166e/	Feb. 1947	T,E 150	I	-	Reported discharge, 2,200 gallons a minute with a drawdown of 33 feet, Feb. 1947. Discharge, 1,800 gallons a minute, measured Sept. 7, 1948.
2595	189.52	Nov. 3, 1948	T,E 150	S,I	-	
2596	90e/	Mar. 1941	None	N	-	
2597	138e/	Jan. 1946	T,E			
	173	Dec. 1948	150	I	-	
2598	84.40	Mar. 31, 1941				
	146.5	Oct. 18, 1948	T,E 150	I	-	
2599	84.51	Mar. 30, 1941				
	148.5	Oct. 20, 1948	T,E 150	I	-	
2600	70.5e/	June 1940	None	N	-	
2601	82.9e/	Mar. 1941	None	N	-	
2601-A	147.18	Nov. 1, 1948	T,E	I	-	See log
2602	196.96	Sept. 7, 1948	T,E 200	I	-	Discharge, 2,100 gallons a minute with a drawdown of 72 feet, measured Oct. 19, 1948. See log.

Table 1.-Records of wells in Deer Valley area, Maricopa County, Arizona-Continued

Office number	Location	Owner	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (in.)
	T. 3 N., R. 2 E.						
d/ 2603	NE¼NW¼NE¼ sec. 23	Isabell-Hartner Ranches	Aubrey Lyon	1942	1,274.2	597	20
2604	NE¼NE¼NW¼ sec. 23	do.	do.	1941	1,265.9	956	20
2605	SE¼SE¼ sec. 23	Unknown	-	-	1,258	-	18
2606	NW¼NE¼NE¼ sec. 24	E. R. Spear	C. W. Freelove	1944	1,277.5	550	20
2607	NW¼NE¼NW¼ sec. 24	do.	-	-	1,277.2	-	20
2608	NW¼NW¼SW¼ sec. 24	John M. Jacobs	Aubrey Lyon	1944	1,265.1	511	20
2610	SE¼SE¼S½ sec. 24	Charles Christopher	-	-	1,256	203	8
d/ 2611	NE¼NE¼NE¼ sec. 26	John M. Jacobs	Aubrey Lyon	-	1,260.4	501	20
d/ 2612	NE¼NE¼NW¼ sec. 26	do.	George Gerle	1941	1,257.6	585	20
2613	SW¼NW¼NW¼ sec. 26	do.	-	-	1,249.7	131.5	48
d/ 2614	NE¼NW¼NE¼ sec. 27	do.	Aubrey Lyon	-	-	677	20
2615	NW¼NE¼ sec. 27	Z. T. Pennington	-	-	-	180	6
2616	SW¼NW¼NW¼ sec. 27	S.R.V.W.U.A.	Western Pipe and Steel	1941	1,224.7	680	20

Office number	Water level: Depth below measuring point (feet) a/	Water level: Date of measurement	Pump and power b/	Use of water c/	Temp. °F.	Remarks
2603	133e/	March 1942	T,E 250	I	78	Reported discharge, 3,800 gallons a minute, Mar. 1942. Discharge, 2,620 gallons a minute, measured Sept. 3, 1948.
2604	119e/ 214e/	July 1941 Sept. 1948	T,E 250	I	-	Reported discharge, 4,000 gallons a minute, July 1941. Discharge, 2,000 gallons a minute, measured Sept. 3, 1948. See log.
2605	109.08	Mar. 31, 1941	None	N	-	
2606	172e/	Feb. 1944	T,E 200	I	-	Reported discharge, 3,000 gallons a minute with a drawdown of 70 feet, Feb. 1944.
2607	237.75	Dec. 28, 1948	T,E 200	I	-	Pumping lift, 272 feet, measured Sept. 3, 1948.
2608	168e/	Nov. 1944	T,E 200	I	79	Reported discharge, 2,800 gallons a minute, Nov. 1944. Discharge, 1,320 gallons a minute, measured Sept. 8, 1948.
2610	-	-	C,E 5	D	-	Water originally bottled and sold as Mountain Spring table water.
2611	99e/ 176.35	Oct. 1946 Dec. 29, 1948	T,E 200	I	79	Reported discharge, 3,000 gallons a minute, Oct. 1946.
2612	99.39 180.64	Mar. 31, 1941 Dec. 29, 1948	T,E 125	I	-	Reported discharge, 1,800 gallons a minute with a drawdown of 40 feet, Oct. 1941. Discharge, 1,240 gallons a minute with a drawdown of 43 feet, measured Oct. 19, 1948.
2613	95.30	Mar. 31, 1941	None	N	-	Dug well. Dry, Nov. 1948.
2614	132e/ 167.70	Nov. 1945 Dec. 1948	T,E 150	I	79	Reported discharge, 2,200 gallons a minute, Nov. 1945. Discharge, 1,250 gallons a minute, measured Sept. 7, 1948.
2615	80e/	March 1941	C,G 60	D	-	
2616	82.87 146.5	Mar. 29, 1941 Oct. 22, 1948	T,E 100	I	-	Reported discharge, 1,610 gallons a minute with a drawdown of 75 feet, Mar. 1941.

Table 1.-Records of wells in Deer Valley area, Maricopa County, Arizona-Continued

Office number	Location	Owner	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (in.)
	T. 3 N., R. 2 E.						
d/ 2617	NE¼SE¼ sec. 27	S.R.V.W.U.A.	Western Pipe and Steel	1941	1,226.7	420	22
	T. 4 N., R. 2 E.						
2651	NE¼SE¼NE¼ sec. 27	Frank Echenique	-	-	1,343.7	277	6
2651-A	NW¼SW¼ sec. 13	Carl Lundberg	-	1948	1,405	315	7
2652	NW¼NW¼NW¼ sec. 14	R. Draper and F. Busch	Thompson Bros.	1947	1,398.0	1,186	20
2653	NE¼NE¼NE¼ sec. 16	E. W. Michael	Carl Langford	-	-	452	20
2653-A	NE¼SE¼SE¼ sec. 18	Isabell-Hartner Ranches	Aubrey Lyon	1946	1,310.0	628	12
2654	NW¼SE¼NE¼ sec. 19	do.	-	-	-	-	20
2654-A	SW¼SW¼NW¼ sec. 19	do.	Aubrey Lyon	1946	1,276.4	672	20
d/ 2655	NE¼SE¼SE¼ sec. 19	Isabell-Hartner Ranches	-	-	1,276.0	-	20
2655-A	NW¼NW¼NW¼ sec. 20	do.	-	-	1,297.4	705	20
2656	SE¼SE¼SW¼ sec. 20	do.	Ted Rodney	1946	1,291.4	528	20
2656-A	NE¼NE¼NE¼ sec. 22	E. W. Michael	Harry R. Rilling	1947	1,370.2	370	20
2657	NE¼NE¼NE¼ sec. 24	Guy J. Stumpff	Jess Wardlow	1946	1,427	314	8
d/ 2657-A	NW¼SW¼ sec. 24	L. Kerr	Carl Langford	1947	1,393.8	460	20
2658	NE¼NE¼SE¼ sec. 24	Jack Rankin	-	1947	1,415.3	715	20
2658-A	NE¼SE¼SE¼ sec. 26	E. R. Spear	Aubrey Lyon	1948	1,361.9	750	20

Office number	Water level: Depth below measuring point (feet) a/	Water level: Date of measurement	Pump and power b/	Use of water c/	Temp. °F.	Remarks
2617	82.05 148.5	Mar. 31, 1941 Oct. 20, 1948	T,E 100	I	-	Reported discharge, 1,360 gallons a minute with a drawdown of 79 feet, Jan. 1941.
2651	217.40 248.98	Jan. 15, 1946 Nov. 5, 1948	None	N	-	
2651-A	291.18	Aug. 17, 1948	None	N	-	
2652	282.2	Nov. 15, 1948	T,E 500	I	-	Discharge, 3,550 gallons a minute with a drawdown of 42 feet, measured June 1948. See log.
2653	242e/	May 1947	T,E 200	I	-	Reported discharge, 1,600 gallons a minute, May 1947.
2653-A	206e/ 249.09	Mar. 1946 Dec. 30, 1948	None	N	-	
2654	-	-	T,E 50	I	-	Reported discharge, 750 gallons a minute, July 1946.
2654-A	161e/ 221.97	Apr. 27, 1946 Dec. 29, 1948	T,E 150	I	-	Discharge, 1,240 gallons a minute with a drawdown of 22 feet, measured Oct. 20, 1948.
2655	225.05 177e/	Dec. 29, 1948 Feb. 1946	T,E 100	I	-	
2655-A	223.06	Nov. 4, 1948	None	N	-	
2656	246.7	Nov. 4, 1948	T,E	I	-	
2656-A	240e/ 263.00	Feb. 1947 Nov. 5, 1948	T,E 200	I	-	
2657	283e/	Dec. 1946	C,E	I,S	-	
2657-A	26[illegible]e/ 287.0	Oct. 1947 Nov. 9, 1948	T,E 200	I	82	Discharge, 1,630 gallons a minute, measured Oct. 18, 1948.
2658	307.80	Nov. 5, 1948	T,E 200	I	-	Discharge, 950 gallons a minute, measured July 1948.
2658-A	267.35	Dec. 21, 1948	T,E 200	I	-	See log

Table 1.-Records of wells in Deer Valley area, Maricopa County, Arizona-Continued

Office number	Location	Owner	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (in.)
	T. 4 N., R. 2 E.						
2659	NE¼NE¼NW¼ sec. 26	Harry Robinson	Carl Langford	1947	1,366.7	520	20
2659-A	SE¼SE¼NE¼ sec. 27	J. M. Echenique	-	-	-	-	-
2660	NE¼NE¼SE¼ sec. 27	E. R. Spear	Aubrey Lyon	1948	1,340.1	677	20
2660-A	SE¼NE¼ sec. 28	E. Evans	-	-	1,365.7	279	6
2660-B	SE¼NE¼NE¼ sec. 29	Isabell Hartner Ranches	Aubrey Lyon	1946	1,303.0	549	20
2661	NE¼NW¼SW¼ sec. 29	do.	Ted Rodney	1946	-	634	20
2661-A	SW¼SW¼SW¼ sec. 29	do.	Thompson Bros.	1948	1,273.1	826	20
2662	SE¼SW¼NE¼ sec. 30	do.	Aubrey Lyon	1946	-	541	20
2662-A	NW¼NW¼NW¼ sec. 30	do.	Ted Rodney	1946	1,257.0	709	20
2663	NE¼NW¼NW¼ sec. 31	D. O. Essley	Thompson Bros.	1948	1,254.0	800	20
2663-A	NE¼NE¼NW¼ sec. 32	J. S. Francis and Ira Moore	do.	1948	1,283.2	836	18
2664	SE¼SE¼NW¼ sec. 32	do.	do.	1948	1,272.5	885	18
d/ 2664-A	NE¼NE¼NE¼ sec. 33	E. R. Spear	Aubrey Lyon	1947	1,311.0	905	20
2665	NE¼NE¼SW¼ sec. 33	do.	Thompson Bros.	1948	1,289.5	970	20

Office number	Water level: Depth below measuring point (feet) a/	Water level: Date of measurement	Pump and power b/	Use of water c/	Temp. °F.	Remarks
2659	239e/ 266.00	July 1947 Dec. 21, 1948	T,E 200	I	-	Discharge, 1,890 gallons a minute with a drawdown of 73 feet, measured June 1948.
2659-A	-	-	T,E 25	I	-	
2660	250	Dec. 21, 1948	T,E 200	I	-	Discharge, 1,940 gallons a minute, measured Sept. 13,1948.
2660-A	197e/	March 1941	C,W	D,S	-	
2660-B	187e/ 247.65	June 1946 Dec. 29, 1948	T,E 100	I	-	Discharge, 770 gallons a minute, measured Sept. 9, 1948.
2661	234.13	Dec. 29, 1948	T,E 200	I	-	Discharge, 1,240 gallons a minute, measured Oct. 20, 1948.
2661-A	213.47	Dec. 29, 1948	T,E 200	I	-	Discharge, 2,130 gallons a minute, measured Oct. 20, 1948.
2662	160e/ 224.50	Mar. 1946 Dec. 29, 1948	T,E 200	I	-	
2662-A	197.90	Dec. 29, 1948	T,E 150	I	-	Discharge, 1,350 gallons a minute, measured Sept. 10,1948.
2663	190.90	Dec. 28, 1948	T,E 200	I	-	Discharge, 2,220 gallons a minute, measured Sept. 9,1948. See log.
2663-A	18[illegible]e/ 220.78	Jan. 1948 Dec. 28, 1948	T,E 150	I	-	Reported discharge, 1,975 gallons a minute with a drawdown of 33 feet, Jan. 1948. Discharge, 1,460 gallons a minute, measured Sept. 9, 1948.
2664	172e/ 206.36	Jan. 1948 Dec. 28, 1948	T,E 150	I	-	Reported discharge 2,065 gallons a minute with a drawdown of 27 feet, Jan. 30, 1948. Measured discharge 1,530 gallons a minute, Sept. 9, 1948. See log.
2664-A	225e/ 236.03	July 1947 Dec. 28, 1948	T,E 200	I	84	Reported discharge, 2,240 gallons a minute with a drawdown of 80 feet, July 1947. Discharge, 1,130 gallons a minute, measured Oct. 18, 1948.
2665	203.5e/ 216.2	Apr. 16, 1948 Dec. 28, 1948	T,E 200	I	-	See log

Table 1.-Records of wells in Deer Valley area, Maricopa County, Arizona-Continued

Office number	Location	Owner	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (in.)
	T. 4 N., R. 2 E.						
2665-A	SE¼NE¼SE¼ sec. 33	E. R. Spear	Thompson Bros.	1947	1,297.1	921	20
2666	NE¼SE¼NE¼ sec. 34	do.	-	1948	1,323.6	-	20
2666-A	SW¼SW¼NE¼ sec. 34	do.	Aubrey Lyons	1947	1,314.2	734	20
2667	SE¼SE¼SE¼ sec. 34	Woolf and Norton	David B. Graham	1948	1,315.9	600	20
2667-A	NE¼NE¼NE¼ sec. 35	J. P. Cline	V. L. Jones	-	1,355.4	-	12
2668	NE¼NE¼NW¼ sec. 35	E. R. Spear	Aubrey Lyon	1948	1,345.1	650	16
2668-A	NE¼NW¼NE¼ sec. 35	do.	-	-	-	-	20
2668-B	NE¼NE¼NW¼ sec. 36	Combs	-	1948	1,367.4	-	20
2668-C	NE¼NE¼NW¼ sec. 36	do.	-	1948	1,373	-	20
	T. 4 N., R. 1 E.						
2805	NE¼NE¼S[illegible]¼ sec. 23	Isabell Hertner Ranches	Ted Rodney	1946	1,272.2	634	20
2806	NE¼NE¼NW¼ sec. 24	do.	do.	1946	1,291.1	714	20
2807	NW¼NE¼SE¼ sec. 26	E. A. Chatham	-	-	1,245.7	-	20
2808	NE¼NE¼NW¼ sec. 35	Art Bodine	-	1946	-	700	20
	T. 3 N., R. 1 E.						
2857	NE¼NW¼NW¼ sec. 1	Essley and Durby	-	1946	1,214.9	-	-
2858	NW¼NW¼NW¼ sec. 2	O. P. Johnson	C. W. Freelove	1945	1,204.6	428	20
d/ 2859	SE¼SE¼NE¼ sec. 12	S.R.V.W.U.A.	Western Pipe and Steel	1940	1,213.5	460	20

a/ Measuring point usually was top of casing, top of pump base, or top of well curb.
b/ T, turbine; C, cylinder; E, electric motor; G, gasoline; W, wind; H, hand; O, diesel; number indicates horsepower.

Well records obtained by F. I. Bluhm and H. E. Skibitzke

Office number	Water level: Depth below measuring point (feet) a/	Water level: Date of measurement	Pump and power b/	Use of water c/	Temp. °F.	Remarks
2665-A	214e/ 223.51	Dec. 1947 Dec. 28, 1948	T,E 200	I	-	Reported discharge, 3,370 gallons a minute with a drawdown of 41 feet, Dec. 1947.
2666	248.23	Dec. 21, 1948	T,E 200	I	-	Pumping lift, 277 feet, measured Oct. 18, 1948.
2666-A	211e/ 238.37	Dec. 1947 Dec. 28, 1948	T,E 200	I	-	Reported discharge, 2,800 gallons a minute with a drawdown of 69 feet, Dec. 1947.
2667	240e/ 245	July 1948 Dec. 30, 1948	T,E 200	I	-	Pumping lift, 272 feet, measured Sept. 14, 1948.
2667-A	262.73	Nov. 5, 1948	T,E 75	I,D	-	
2668	245e/ 258.98	May 1948 Dec. 21, 1948	T,E 200	I	-	Discharge, 1,960 gallons a minute with a drawdown of 61 feet, measured Sept. 14, 1948.
2668-A	264	Feb. 10, 1949	T,E 200	I	-	
2668-B	270.06	Dec. 21, 1948	T,E 200	I	-	
2668-C	274.11	Dec. 20, 1948	T,E 250	I	-	
2805	-	-	T,E 125	I	-	Discharge, 1,200 gallons a minute, measured Sept. 10, 1948.
2806	229.25	Dec. 29, 1948	T,E 200	I	-	Discharge, 1,360 gallons a minute, measured Sept. 10, 1948. See log.
2807	181.27	Nov. 4, 1948	T,E 200	I	-	Discharge, 2,700 gallons a minute, measured Sept. 10, 1948.
2808	-	-	T,E 200	I	-	
2857	142	Nov. 17, 1948	T,O	I	-	
2858	124e/	July 1946	T,E 75	I	-	Reported discharge, 1,600 gallons a minute with a drawdown of 22 feet, July 1946.
2859	80e/ 142.0	Oct. 1940 Oct. 18, 1948	T,E 100	I	-	Reported discharge, 1,650 gallons a minute with a drawdown of 71 feet.

c/ I, irrigation; S, stock; D, domestic; P, public supply; N, none.
d/ See table 3 for analysis of water from this well.
e/ Water level reported.

Table 2. - Logs of wells in Deer Valley area, Maricopa County, Arizona.

Driller's log of well 1925
H. D. Conner, owner
NE¼NE¼NW¼ sec. 6, T. 3 N., R. 3 E.

	Thickness (feet)	Depth (feet)
Silty sands, sand and boulders - - - - - -	150	150
Pea gravel - - - - -	100	250
Fine sand - - - - - -	50	300
Clay - - - - - - - -	30	330
Sand and gravel - - -	70	400
Sand, streaks of clay	40	440
Sand and gravel - - -	40	480
Clay - - - - - - - -	20	500
Sand and gravel, streaks of hard sand and gravel	380	880
TOTAL DEPTH - - - - -		880

Driller's log of well 2563
J. L. Quamme, owner
NE¼NE¼NW¼ sec. 4, T. 3 N., R. 2 E.

	Thickness (feet)	Depth (feet)
Clay, caliche, and sand	150	150
Sand and gravel - - -	95	245
Sand, gravel and streaks of clay - - - - - -	159	404
Sand, gravel and streaks of clay - - - - - -	20	424
Clay, sand and gravel	71	495
Clay, some sand and gravel - - - - - - -	222	717
Gravel and sand - - -	59	776
Clay - - - - - - - -	10	786
Sand, gravel, streaks of clay - - - - - - - -	110	896
TOTAL DEPTH - - - - -		896

Driller's log of well 2567
E. M. Smith, owner
NE¼NE¼SE¼ sec. 5, T. 3 N., R. 2 E.

	Thickness (feet)	Depth (feet)
Top soil - - - - - -	3	3
Caliche - - - - - - -	3	6
Clay, gravel and boulders	8	14
Cemented sand and gravel	6	20
Clay - - - - - - - -	126	146
Clay and gravel - - -	10	156
Clay - - - - - - - -	32	188
Silt sand and gravel	7	195
Clay - - - - - - - -	95	290
Sandy clay and gravel	35	325
Clay - - - - - - - -	525	850
TOTAL DEPTH - - - - -		850

Driller's log of well 2573
E. M. Smith, owner
NE¼NW¼SE¼ sec. 8, T. 3 N., R. 2 E.

	Thickness (feet)	Depth (feet)
Top soil - - - - - -	3	3
Cemented sand and gravel	3	6
Hard pan - - - - - -	5	11
Clay - - - - - - - -	79	90
Clay and gravel - -	6	96
Clay - - - - - - - -	44	140
Clay and gravel - -	6	146
Clay - - - - - - - -	24	170
Silt, sand and gravel 3"	20	190
Clay - - - - - - - -	41	231
Clay and gravel - -	22	253
Clay - - - - - - - -	436	689
Sandy clay, some gravel	91	780
Clay - - - - - - - -	45	825
TOTAL DEPTH - - - -		825

Driller's log of well 2601-A
S.R.V.W.U.A., owner
NW¼NW¼SE¼ sec. 21, T. 3 N., R. 2 E.

	Thickness (feet)	Depth (feet)
Top soil - - - - - -	3	3
Clay - - - - - - - -	5	8
Sand, gravel and boulders	20	28
Clay, gravel and boulders	38	66
Clay - - - - - - - -	46	112
Sandy clay and gravel	123	235
Clay and gravel - -	87	322
Clay, streaks of sandstone - - - - -	36	358
Gravel and sharp rock	12	370
Clay and gravel - -	134	504
Clay - - - - - - - -	36	540
Clay, sandstone, and gravel - - - - - -	80	620
Clay - - - - - - - -	30	650
Clay - - - - - - - -	265	915
Clay, streaks of sandstone every 4 or 5 feet	85	1,000
TOTAL DEPTH - - - -		1,000

Table 2. - Logs of wells in Deer Valley area-Continued

Driller's log of well 2602

Isabell-Hartner Co., owner

NE¼NE¼NW¼ sec. 22, T. 3 N., R. 2 E.

	Thickness (feet)	Depth (feet)
Top soil - - - - - -	10	10
Clay - - - - - - - - -	4	14
Boulders - - - - - - -	43	57
Clay - - - - - - - - -	7	64
Sand and gravel - -	52	116
Clay - - - - - - - - -	4	120
Sandy clay - - - - -	24	144
Sand and gravel - -	14	158
Clay - - - - - - - - -	25	183
Sand and gravel - -	2	185
Packed sand - - - -	25	210
Sandy clay - - - - -	32	242
Sand and gravel - -	4	246
Sand and gravel - -	20	266
Clay - - - - - - - - -	36	302
Sand and gravel - -	4	306
Clay - - - - - - - - -	8	314
Sand and gravel - -	8	322
Caliche clay with small streaks of gravel -	24	346
Sandy clay and gravel	48	394
Caliche and clay - -	16	410
Sandy clay and gravel	24	434
Clay and gravel - -	12	446
Sandy clay - - - - -	24	470
Red clay - - - - - -	36	506
Sand, clay and gravel	48	554
Sandy clay - - - - -	12	566
Red sticky clay - -	36	602
Sandy clay - - - - -	188	790
Packed sand - - - -	12	802
Clay - - - - - - - - -	16	818
Sticky clay - - - -	33	851
TOTAL DEPTH - - - -		851

Driller's log of well 2604

Isabell-Hartner Co., owner

NE¼NE¼NW¼ sec. 23, T. 3 N., R. 2 E.

	Thickness (feet)	Depth (feet)
Coarse gravel and boulders - - - - -	25	25
Cemented gravel - -	17	42
Coarse gravel - - -	44	86
Clay - - - - - - - - -	4	90
Cemented gravel - -	60	150
Sandy clay - - - - -	8	158
Coarse gravel - - -	6	164
Cemented gravel - -	12	176
Log of well 2604-Cont.		
Clay and gravel - - -	80	256
Cemented gravel - - -	8	264
Clay and gravel - - -	75	339
Cemented gravel - - -	47	386
Clay - - - - - - - - -	6	392
Cemented sand - - - -	6	398
Cemented gravel - - -	10	408
Clay and gravel - - -	41	449
Cemented gravel - - -	14	463
Clay - - - - - - - - -	43	506
Sandstone - - - - - - -	2	508
Clay - - - - - - - - -	86	594
Sandstone - - - - - - -	4	598
Clay - - - - - - - - -	236	834
Streaks of sandstone	28	862
Clay and sandstone -	78	940
Rock - - - - - - - - -	16	956
TOTAL DEPTH - - - - -		956

Driller's log of well 2652

R. Draper and F. Busch, owners

NW¼NW¼NW¼ sec. 14, T. 4 N., R. 2 E.

	Thickness (feet)	Depth (feet)
Sand, boulders and gravel - - - - - - -	200	200
Sand and gravel - - -	60	260
Sand, gravel, and streaks of clay - - - - - -	140	400
Conglomerate, streaks of hard clay, and gravel	245	645
Clay sand streaks - -	27	672
Sand, gravel, and clay	43	715
Sand, gravel, and clay streaks - - - - - -	102	817
Clay - - - - - - - - -	35	852
Sand and gravel - - -	20	872
Clay streaks gravel -	19	891
Gravel - - - - - - - -	46	937
Clay streaks - - - -	10	947
Gravel and clay - - -	37	984
Clay - - - - - - - - -	9	993
Gravel - - - - - - - -	36	1,029
Sand, clay streaks -	39	1,068
Gravel and clay streaks	59	1,127
Gravel with streaks of clay - - - - - - - -	59	1,186
TOTAL DEPTH - - - - - -		1,186

Table 2. - Logs of wells in Deer Valley area-Continued

Driller's log of well 2658-A

E. R. Spear, owner
NE¼SE¼SE¼ sec. 26, T. 4 N., R. 2 E.

	Thickness (feet)	Depth (feet)
Caliche - - - - - - - -	9	9
Boulders - - - - - - -	31	40
Clay - - - - - - - - -	10	50
Sand and gravel - - -	10	60
Clay - - - - - - - - -	40	100
Sand and gravel - - -	35	135
Clay - - - - - - - - -	50	185
Sand and gravel - - -	41	226
Clay - - - - - - - - -	16	242
Packed sand - - - - -	16	258
Clay - - - - - - - - -	4	262
Sand and gravel - - -	4	266
Packed sand and cement streaks - - - - - -	20	286
Sand and gravel - - -	6	292
Packed sand - - - - -	10	302
Cement sand - - - - -	16	318
Packed sand with cemented streaks of gravel -	72	390
Cemented gravel - - -	24	414
Clay and gravel - - -	44	458
Cemented clay and gravel	28	486
Cemented conglomerate	200	686
Cemented gravel - - -	16	702
Cemented conglomerate	16	718
Hard clay - - - - - - -	32	750
TOTAL DEPTH - - - - -		750

Driller's log of well 2663

D. O. Essley, owner
NE¼NE¼NW¼ sec. 31, T. 4 N., R. 2 E.

	Thickness (feet)	Depth (feet)
Surface sand and clay	30	30
Sand and boulders - -	103	133
Sand and gravel - - -	45	178
Sand and gravel, streaks of clay - - - - - -	203	381
Sand and gravel, streaks of clay - - - - - -	44	425
Sand and gravel - - -	140	565
Sand, gravel, streaks of clay - - - - - - - -	76	641
Sand and gravel - - -	145	786
Clay - - - - - - - - -	14	800
TOTAL DEPTH - - - - -		800

Driller's log of well 2664

J. S. Francis and Ira Moore, owners
SE¼SE¼NW¼ sec. 32, T. 4 N., R. 2 E.

	Thickness (feet)	Depth (feet)
Surface sand and clay	65	65
Clay streaks and sand	60	125
Sand and gravel - - -	55	180
Sand, gravel and streaks of clay - - - - - -	200	380
Clay and gravel - - -	60	440
Clay - - - - - - - - -	65	505
Gravel and sand - - -	75	580
Sand and gravel - - -	140	720
Streaks of clay and sand	25	745
Clay and gravel - - -	25	770
Sand and gravel - - -	30	800
Clay - - - - - - - - -	10	810
Sand and gravel - - -	30	840
Clay - - - - - - - - -	45	835
TOTAL DEPTH - - - - -		885

Driller's log of well 2665

E. L. Spear, owner
NE¼NE¼SW¼ sec. 33, T. 4 N., R. 2 E.

	Thickness (feet)	Depth (feet)
Silt and boulders - -	85	85
Sand and pea gravel -	165	250
Clay and sand streaks	32	282
Sand and gravel - - -	132	414
Sand and streaks of clay	176	590
Sand - - - - - - - - -	22	612
Sand and clay - - - -	243	855
Coarse sand and gravel	85	940
Hard black sand - - -	30	970
TOTAL DEPTH - - - - -		970

Driller's log of well 2806

Isabell-Hartner Co., owner
NE¼NE¼NW¼ sec. 24, T. 4 N., R. 1 E.

	Thickness (feet)	Depth (feet)
Sand and boulders - -	165	165
Sand - - - - - - - - -	10	175
Sand and clay - - - -	35	210
Sand - - - - - - - - -	15	225
Sand and clay - - - -	30	255
Sand - - - - - - - - -	29	284
Sand - - - - - - - - -	81	365
Sand and clay - - - -	349	714
TOTAL DEPTH - - - - -		714

Table 3. - Analyses of water samples from wells in Deer Valley, Maricopa County, Arizona
In parts per million except specific conductance and percent sodium
Well numbers correspond to numbers in table 1.

Well no.	Date of collection	Depth (ft.)	Specific conductance (micromhos @ 25°C.)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium
a/2553	Apr. 4, 1946	525	496	38	14	36	183	23	35	0.4	19	256	152	36
a/2553	Oct. 7, 1948	525	492	-	-	-	188	-	41	-	-	-	-	-
b/2555	Oct. 4, 1945	303	1,720	154	52	115	236	114	298	-	136	987	598	29
a/2555	Oct. 7, 1948	303	1,880	170	62	115	261	139	346	.1	102	c/1,100	679	27
b/2565	Apr.30, 1946	580	450	24	14	49	179	17	29	-	14	237	118	48
a/2565	Oct. 7, 1948	580	444	-	-	-	189	-	30	-	-	-	-	-
b/2566	June 14, 1946	550	428	24	13	47	183	14	20	-	25	235	114	47
a/2566	Oct. 7, 1948	550	413	24	12	49	189	20	19	.8	15	c/269	110	50
b/2578	May 1, 1946	500	426	31	14	34	166	7	29	-	21	219	135	35
a/2578	Oct. 7, 1948	500	425	-	-	-	172	-	32	-	-	-	-	-
b/2590	Apr.30, 1946	605	654	55	25	33	163	24	40	-	118	377	240	23
a/2590	Oct. 7, 1948	605	515	42	21	32	170	24	35	.2	58	d/330	192	27
b/2597	May 2, 1946	700	593	34	21	54	177	21	66	-	31	315	172	41
a/2597	Oct. 7, 1948	700	643	-	-	-	185	-	78	-	-	-	-	-
b/2598	Oct. 3, 1945	450	934	68	35	62	175	64	132	-	53	502	314	30
a/2598	Oct. 7, 1948	450	1,130	87	44	71	207	83	179	.4	53	e/651	398	28
b/2603	Apr.30, 1946	597	666	58	26	31	177	16	44	-	118	382	252	21
a/2603	Oct. 7, 1948	597	673	-	-	-	173	-	51	-	-	-	-	-

Table 3. - Analyses of water samples from wells in Deer Valley, Maricopa County, Arizona-Continued

Well no.	Date of collection	Depth (ft.)	Specific conductance (micromhos @ 25°C.)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium
b/2611	Apr. 30, 1946	501	893	88	29	33	140	58	132	-	62	472	338	17
a/2611	Oct. 7, 1948	501	815	-	-	-	154	-	126	-	-	-	-	-
b/2612	Apr. 30, 1946	585	698	65	23	33	169	21	72	-	74	373	256	22
a/2612	Oct. 7, 1948	585	647	-	-	-	174	-	67	-	-	-	-	-
b/2614	June 14, 1946	677	650	47	28	35	142	16	66	-	93	356	232	25
a/2614	Oct. 7, 1948	677	907	74	40	8.7	135	38	100	.2	157	f/514	399	5
b/2617	Oct. 4, 1945	420	1,050	76	44	56	152	35	148	-	143	578	370	25
a/2617	Oct. 7, 1948	420	1,180	90	50	56	148	45	183	.6	154	g/682	430	22
b/2655	June 14, 1946	780	450	26	11	58	227	9	13	-	17	248	110	53
a/2655	Oct. 7, 1948	780	464	-	-	-	217	-	21	-	-	-	-	-
a/2657A	Oct. 20, 1948	780	394	-	-	-	207	-	14	-	-	-	-	-
a/2664A	Oct. 20, 1948	370	704	30	17	87	148	31	119	.4	15	g/403	145	57
b/2859	May 23, 1946	460	930	84	26	66	166	63	148	-	59	529	366	31
a/2859	Oct. 7, 1948	460	1,070	-	-	-	183	-	173	-	-	-	-	-

a/ Analyzed by U. S. Geol. Survey
b/ Analyzed by Salt River Valley Water Users' Assoc.
c/ Contains 36 parts per million silica (SiO_2)
d/ Contains 34 parts per million silica (SiO_2)
e/ Contains 32 parts per million silica (SiO_2)
f/ Contains 30 parts per million silica (SiO_2)
g/ Contains 31 parts per million silica (SiO_2)

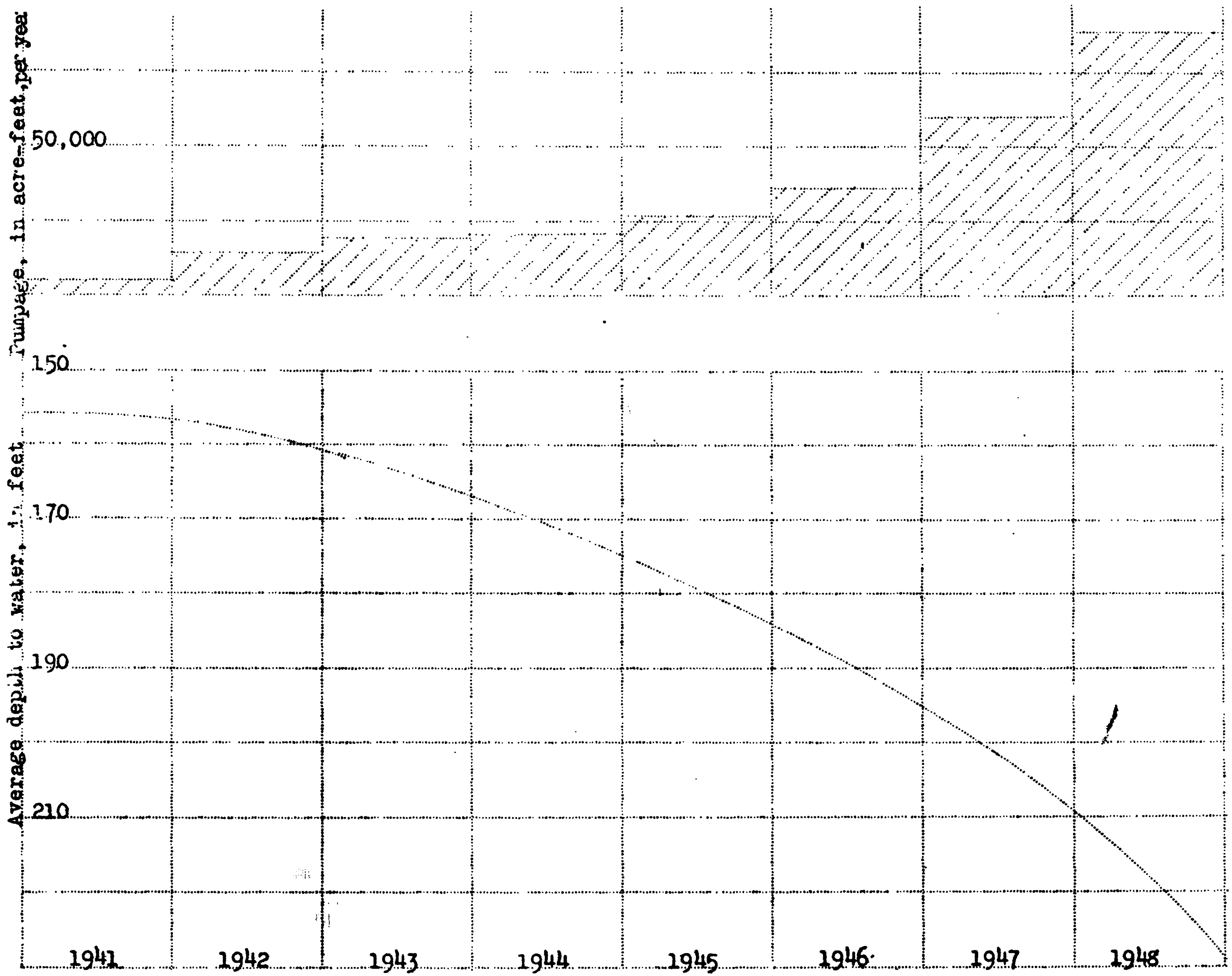

Figure 1.-Graph showing average depth to water and water pumped for irrigation in the Deer Valley area, Maricopa County, Arizona.

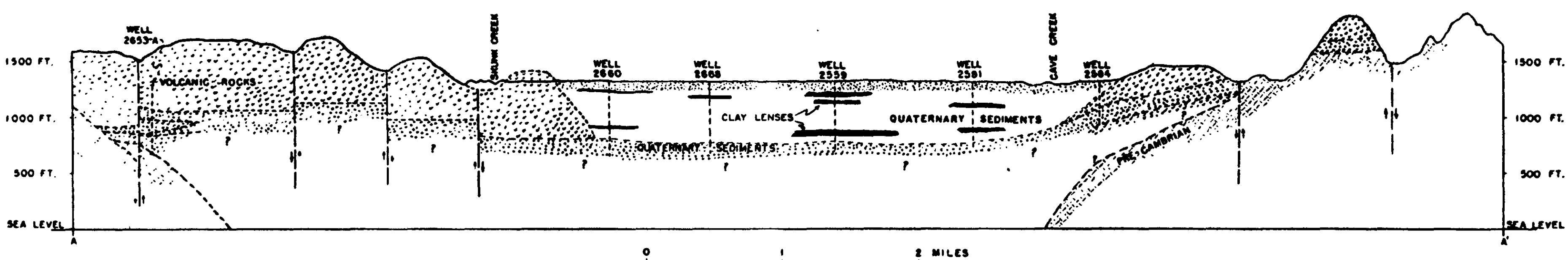

FIGURE 2 - HYPOTHETICAL GEOLOGIC SECTION ACROSS DEER VALLEY AT LINE A-A', PLATE I

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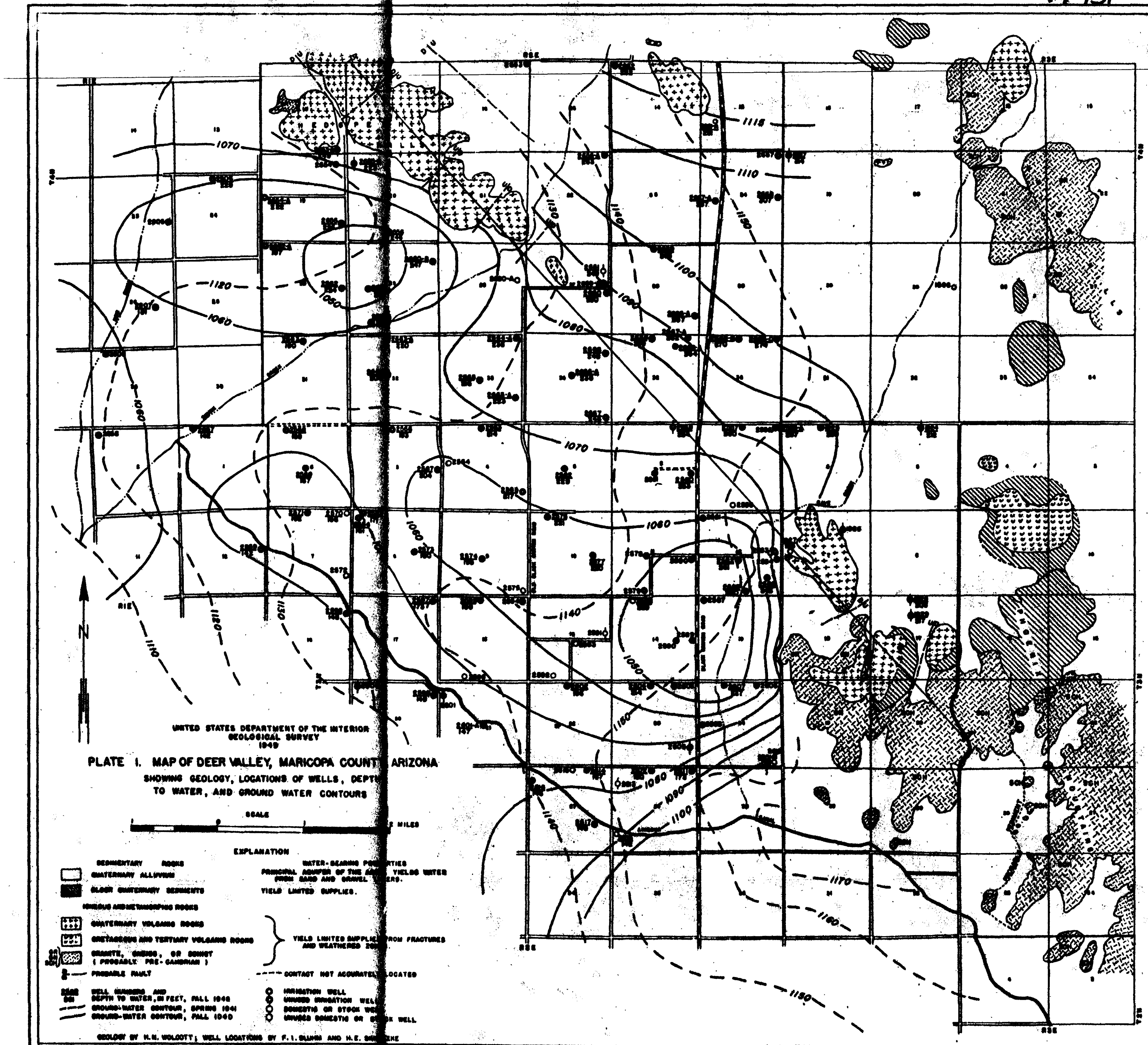

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
PLATE I. MAP OF DEER VALLEY, MARICOPA COUNT ARIZONA
SHOWING GEOLOGY, LOCATIONS OF WELLS, DEPT
TO WATER, AND GROUND WATER CONTOURS
SCALE
MILES
EXPLANATION
SEDIMENTARY ROCKS
QUATERNARY ALLUVIUM
OLDER QUATERNARY SEDIMENTS
IGNEOUS AND METAMORPHIC ROCKS
QUATERNARY VOLCANIC ROCKS
CRETACEOUS AND TERTIARY VOLCANIC ROCKS
GRANITE, GNEISS, OR SCHIST
(PROBABLY PRE-CAMBRIAN)
PROBABLE FAULT
WELL NUMBERS AND
DEPTH TO WATER, IN FEET
GROUND-WATER CONTOUR, SPRING 1941
WATER-BEARING P RTIES
YIELD LIMITED SUPPLIES.
YIELD LIMITED SUPPLI ROM FRACTURES
CONTACT NOT ACCURATEL LOCATED
IRRIGATION WELL
UNUSED IRRIGATION WELL
DOMESTIC OR STOCK W
1070
1060
1120
1110
1100
1090
1080
1130
1140
1150
1160
1170
1180
1118

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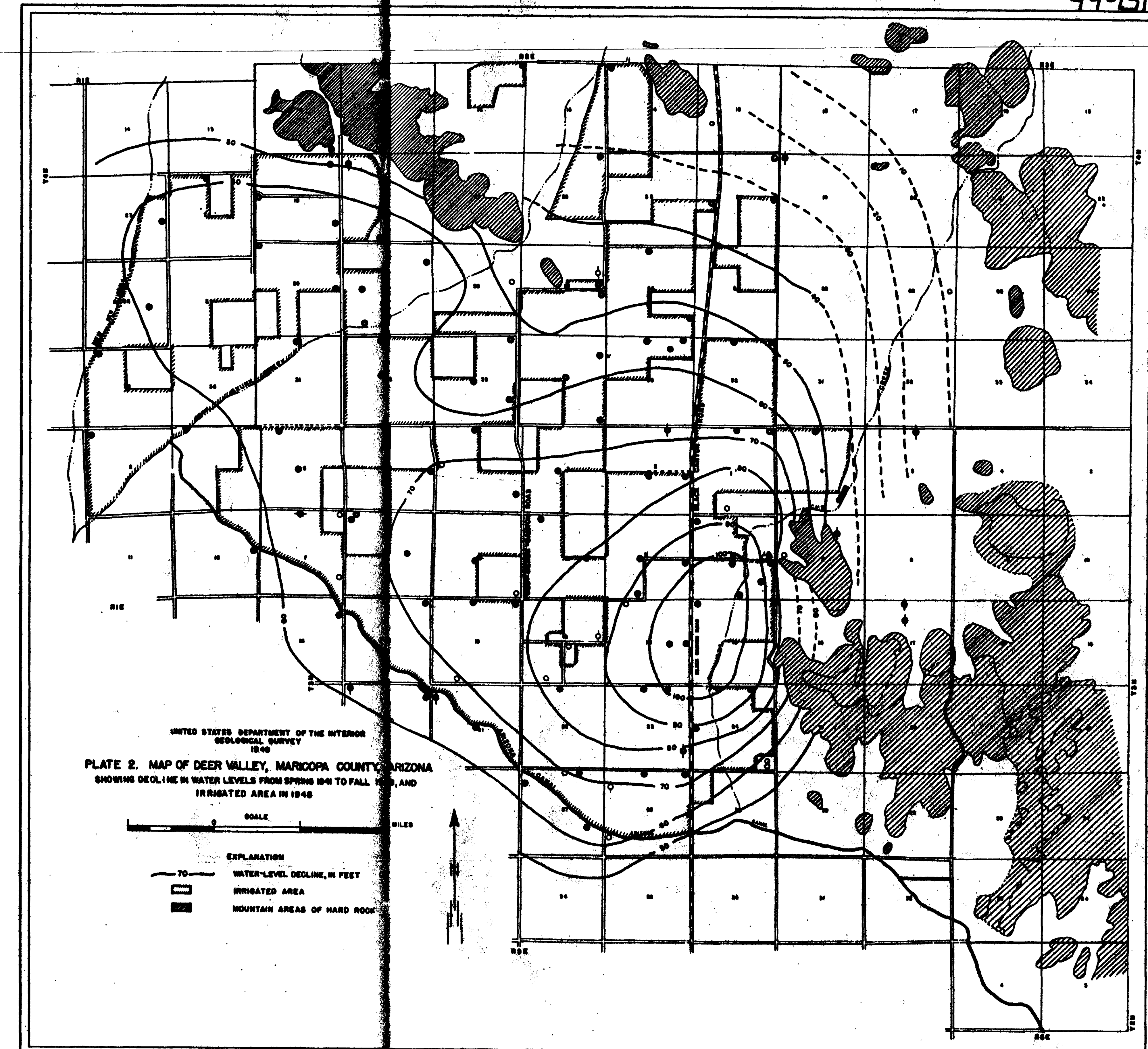
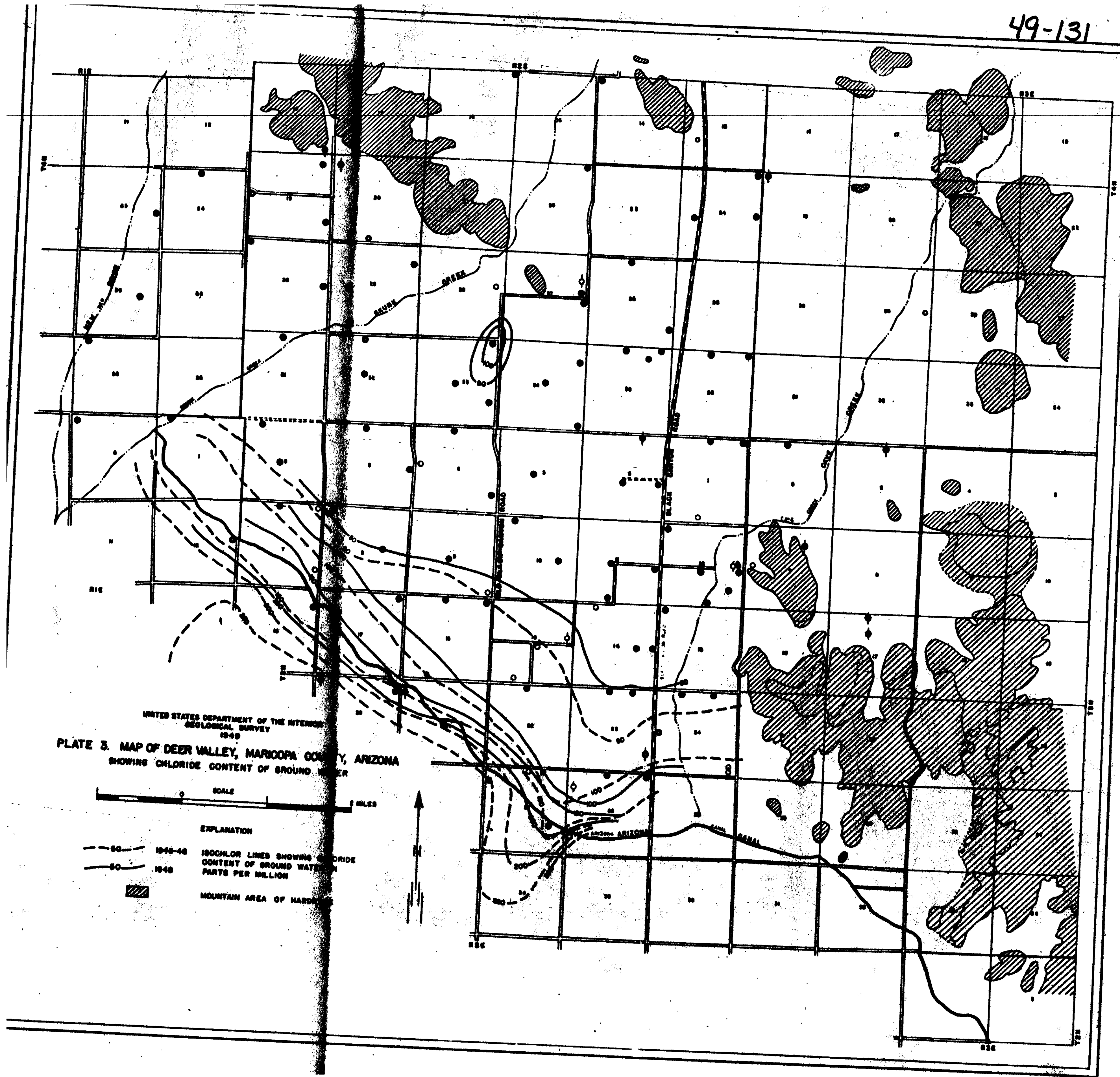


UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
1949

PLATE 2. MAP OF DEER VALLEY, MARICOPA COUNTY, ARIZONA
SHOWING DECLINE IN WATER LEVELS FROM SPRING 1941 TO FALL 19[illegible], AND
IRRIGATED AREA IN 1948


49-131
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
1949
PLATE 3. MAP OF DEER VALLEY, MARICOPA
ARIZONA
SHOWING CHLORIDE CONTENT OF GROUND
SCALE
2 MILES
EXPLANATION
1946-48
ISOCHLOR LINES SHOWING
CONTENT OF GROUND
PARTS PER MILLION
1949
MOUNTAIN AREA OF
BLACK CANYON ROAD
CREEK
ARIZONA CANAL
R1E
R2E
R3E
T4N
T3N