WATER-RESOURCES REPORT NUMBER TWENTY-THREE

ARIZONA STATE LAND DEPARTMENT

OBED M. LASSEN, COMMISSIONER

GEOHYDROLOGY OF THE DATELAND-HYDER AREA

MARICOPA AND YUMA COUNTIES, ARIZONA

BY
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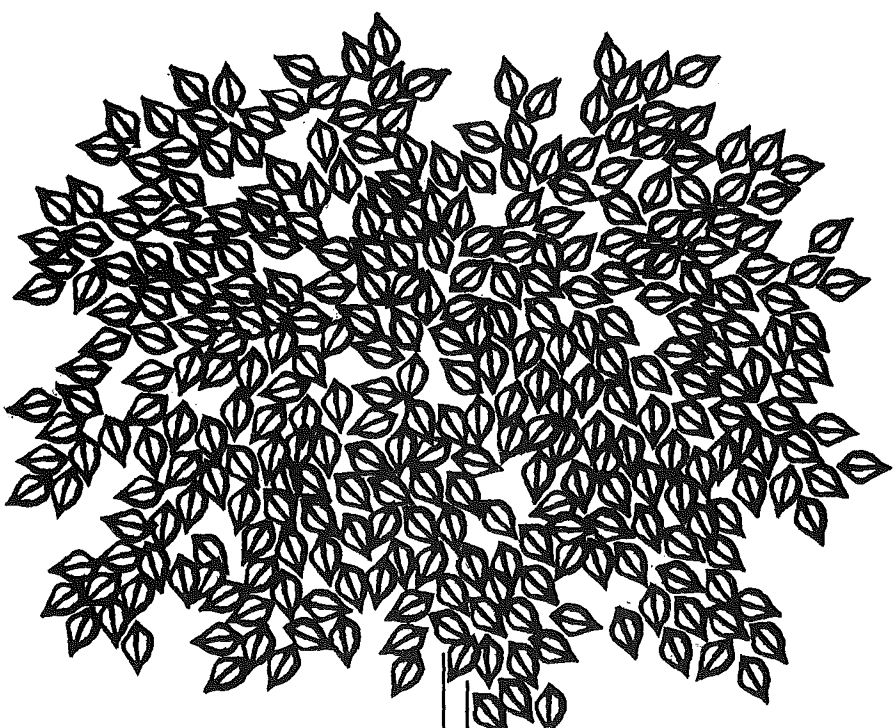

PREPARED BY THE GEOLOGICAL SURVEY
UNITED STATES DEPARTMENT OF THE INTERIOR

PHOENIX, ARIZONA
NOVEMBER 1965

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By

W. G. Weist, Jr.

ABSTRACT

The Dateland-Hyder area consists of 720 square miles in western Maricopa and eastern Yuma Counties, Ariz. The climate is arid and is characterized by very hot summers and mild winters; precipitation averages between 3 and 5 inches a year.

The valley fill is the only water-bearing unit in the area. The other units are the bedrock, which is composed of granite and schist, and the volcanic rocks, which are mostly lava.

The ground-water reservoir is recharged by precipitation, underflow, and excess irrigation water. Discharge occurs by underflow, pumping from wells, and evapotranspiration. In general, the water levels in the area slowly are declining.

The average specific capacity of the irrigation wells is 42 gallons per minute per foot of drawdown. This indicates a coefficient of transmissibility of about 71, 000 gallons per day per foot. It is estimated that the first 100 feet of saturated material contains about 5, 000, 000 acre-feet of available ground water. Additional development of ground water for irrigation is possible in most of the area.

Chemical analyses of 27 water samples collected from wells in the Dateland-Hyder area show that the water is of a sodium chloride nature. In general, the water is acceptable for domestic and stock purposes, although the fluoride content is generally high, and the amount of dissolved solids frequently exceeds the recommended limit. Because of the high to very high sodium and salinity hazards, the water is classified as acceptable to poor for agricultural use. However, because much of the soil is sandy, the water can be used successfully for irrigation if proper irrigation practices are followed. Several of the water samples analyzed contained excessive amounts of boron and lithium.

INTRODUCTION

Purpose and Scope of the Study

Groundwater is a major natural resource and is the only dependable source of water in the Dateland-Hyder area. It is necessary to understand the occurrence and movement of ground water in the area in order to utilize fully the available supply. In January 1963 the U.S. Geological Survey, in cooperation with the Arizona State Land Department, began an investigation of the ground-water resources of the Dateland-Hyder area. The objectives of the study were to determine the location of large supplies of ground water, how much is currently being used, and the advisability of increasing the development of the ground-water reservoir. Most of the work was done under the general supervision of H. M. Babcock, Arizona district chief, Water Resources Division.

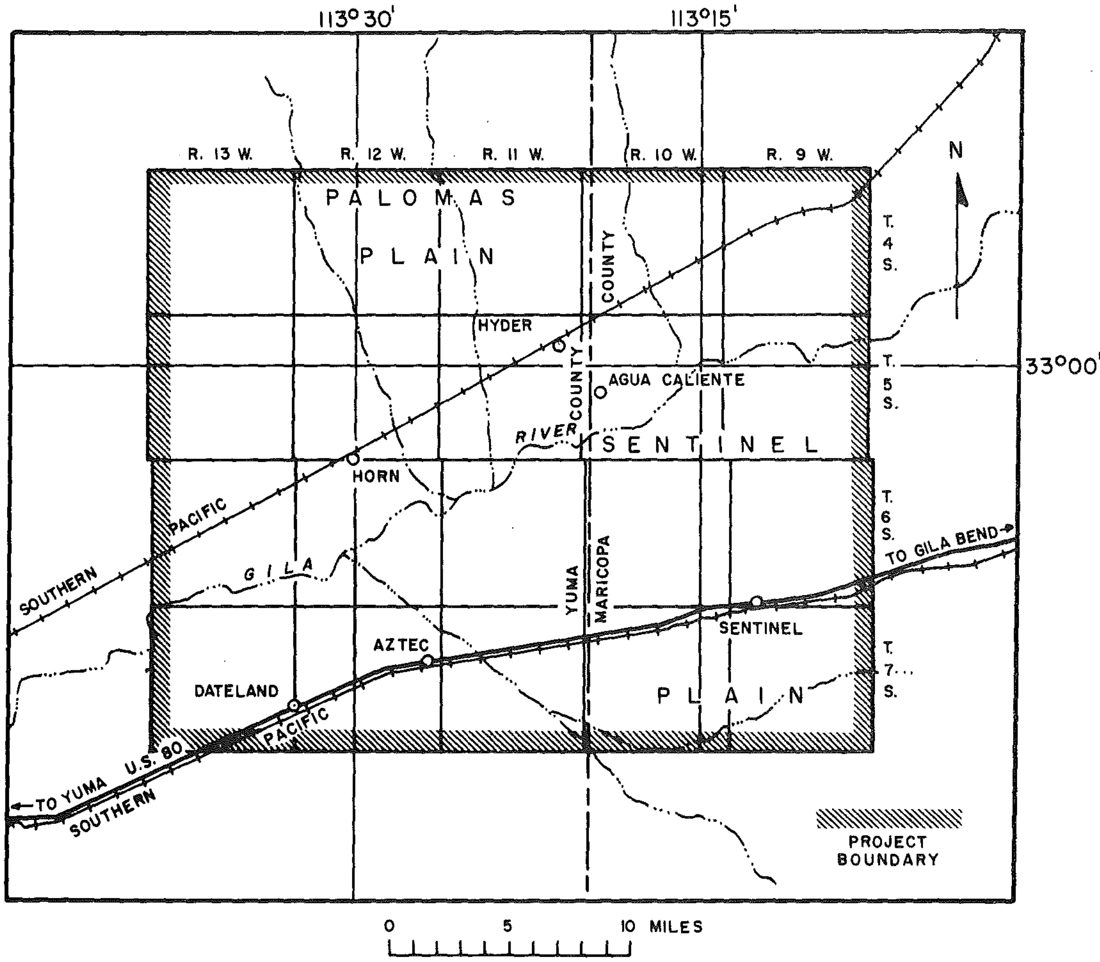
Location of the Project Area

The Dateland-Hyder area is in western Maricopa and eastern Yuma Counties (fig. 1) and includes all of Tps. 4-7 S., Rs. 9-13 W. The area comprises about 720 square miles and includes part of the Palomas Plain; parts of the Palomas, Tank, Face, and Oatman Mountains; part of the Aztec Hills; most of the Sentinel lava flow; and all the Baragan and Agua Caliente Mountains. All drainage is tributary to the Gila River, which flows from northeast to southwest across the area. The maximum altitude, more than 1,900 feet above mean sea level, is in the Palomas Mountains; the minimum altitude, about 350 feet, is at the Gila River where it flows west out of the area.

Except in the mountains, the area generally has a gently sloping surface that is dissected in varying degrees by washes. A prominent terrace occurs along the Gila River in the eastern part of the area where lava flows have formed a protective cap, which caused the development of a 40- to 80-foot escarpment.

Climate

The climate of the Dateland-Hyder area is arid and is characterized



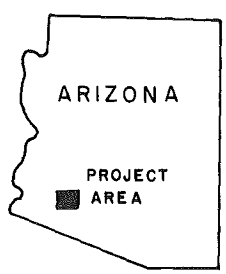


Figure 1. --Location of the report area.

by hot summers and mild winters—temperatures below 20°F are unusual (fig. 2). Short-term records of precipitation show an average of 3.33 inches of precipitation a year at Dateland and 4.96 inches a year at Sentinel (table 1).

Method of Study

Fieldwork was done intermittently in 1963 and the early part of 1964 by P. W. Johnson. The author did intensive fieldwork in the summer of 1964, and additional data were collected by F. E. Arteaga and R. S. Stulik during 1964-65.

Data were collected from all large-capacity wells in the area (table 3). (See appendix for tables 3, 4, 5, and 6.) Where there were no large-capacity wells, data were collected from stock and domestic wells. Drillers' logs for 56 wells and test holes are given in table 4. Water samples were collected from 27 wells for chemical analysis, and the results of these analyses are given in table 5.

The geology of the north half of the area was mapped previously by Armstrong and Yost (1958). The geology of the south half was mapped on aerial photographs during this study. All the data were transferred to the base map and spot checked in the field; the final map is of a reconnaissance type. Figure 3 shows the well-numbering system used in Arizona.

Previous Investigations

No comprehensive report on the geohydrology of the Dateland-Hyder area has been published to date (1965). Published reports on parts of the area or adjacent areas include those by Ross (1922, 1923), Bryan (1925), Wilson (1933), and Armstrong and Yost (1958). Unpublished reports on parts of the area or adjacent areas include those by Babcock, Brown, and Hem (1947), Babcock and Kendall (1948), Halpenny and others (1952), Johnson and Cahill (1954), and Cahill and Wolcott (1955). The unpublished reports are available for consultation in the offices of the Water Resources Division of the Geological Survey in Tucson and Phoenix, Ariz. Chemical analyses of water samples from selected wells in the area have been published by the University of Arizona Agricultural Experiment Station (Smith and others, 1963).

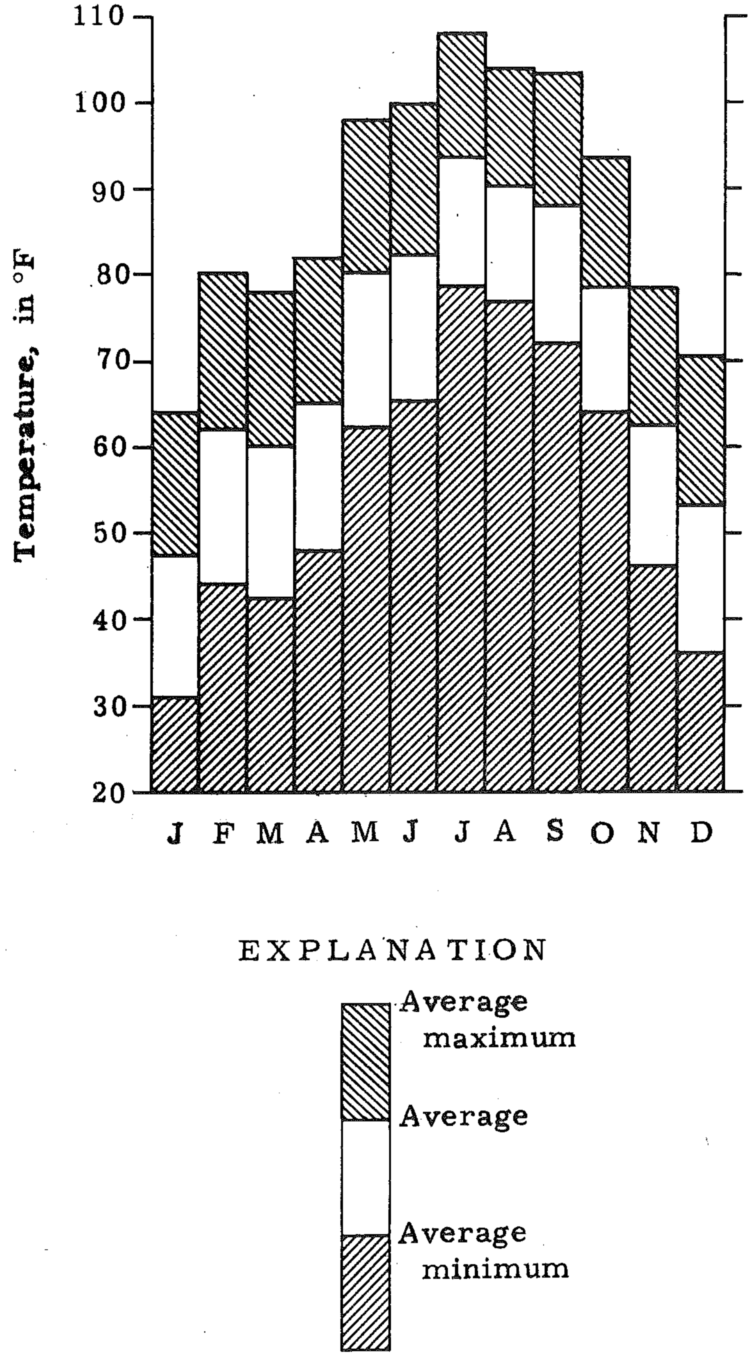
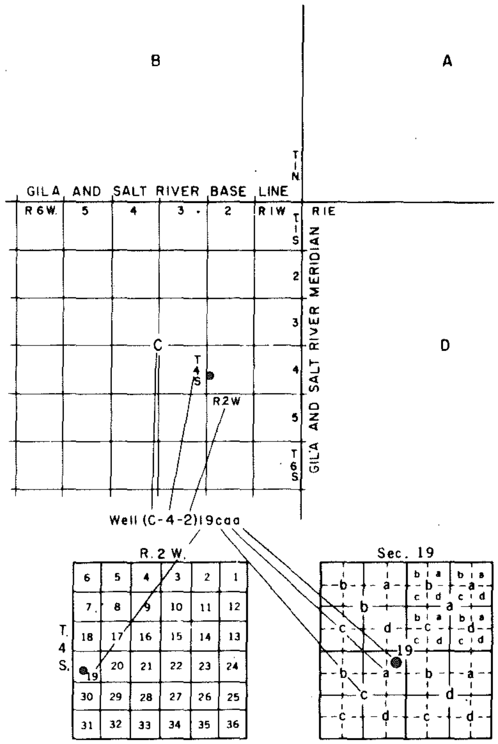


Figure 2.--Average maximum, average minimum, and average temperatures at Dateland, 1963.



The well numbers used by the Geological Survey in Arizona are in accordance with the Bureau of Land Management's system of land subdivision. The land survey in Arizona is based on the Gila and Salt River meridian and base line, which divide the State into four quadrants. These quadrants are designated counterclockwise by the capital letters A, B, C, and D. All land north and east of the point of origin is in A quadrant, that north and west in B quadrant, that south and west in C quadrant, and that south and east in D quadrant. The first digit of a well number indicates the township, the second the range, and the third the section in which the well is situated. The lowercase letters a, b, c, and d after the section number indicate the well location within the section. The first letter denotes a particular 160-acre tract, the second the 40-acre tract, and the third the 10-acre tract. These letters also are assigned in a counterclockwise direction, beginning in the northeast quarter. If the location is known within the 10-acre tract, three lowercase letters are shown in the well number. In the example shown, well number (C-4-2)19caa designates the well as being in the NE$\frac{1}{4}$NE$\frac{1}{4}$SW$\frac{1}{4}$ sec. 19, T. 4 S., R. 2 W. Where there is more than one well within a 10-acre tract, consecutive numbers beginning with 1 are added as suffixes.

Figure 3. --Well-numbering system in Arizona.

Table 1.--Annual precipitation at Dateland and Sentinel

Year	Precipitation (inches)	
	Dateland	Sentinel
1950	----	1.41
1951	----	7.10
1952	----	5.51
1953	2.81	3.18
1954	----	5.46
1955	----	6.39
1956	.58	2.23
1957	3.91	----
1958	----	3.40
1959	5.17	9.93
1960	1.80	----
1961	3.79	----
1962	3.27	----
1963	5.28	----
Average	3.33	4.96

Acknowledgments

The cooperation of the residents of the area is gratefully acknowledged. Special thanks go to C. R. Amavisca and Roy Higgenbottom, local residents, who ungrudgingly gave of their time to discuss the area with the author.

GEOLOGY

The geologic units in the Dateland-Hyder area can be divided readily into bedrock (granitic and schistose rocks), volcanic rocks, and valley-fill deposits (fig. 4). These units are discussed briefly below. Those interested in more detailed discussions of the geology are referred to the earlier reports mentioned under "Previous Investigations."

Armstrong and Yost (1958, p. 19) also mapped a conglomerate that they assigned tentatively to the Tertiary Period in the Palomas and Tank Mountains. The conglomerate was not studied during this investigation, and its effect on the occurrence of ground water in the area is not known. However, it probably does not carry water.

Bedrock

Bedrock is exposed only in parts of the Tank and Palomas Mountains and in the Aztec Hills. These rocks are Mesozoic in age (Wilson, 1960) and were raised above the rest of the area by faulting, which probably occurred prior to the start of Tertiary time. Part of the bedrock was covered by Quaternary lava flows, which partially have been eroded away. Further uplift of the bedrock in these areas probably occurred after the extrusion of the lava flows.

In the Dateland-Hyder area the Tank Mountains are composed chiefly of schistose rocks, which form low rounded hills that generally follow the west to northwest strike of the rocks. In places the schist is intruded by medium-grained granitic rocks. The southeastern part of the Palomas Mountains contains medium-grained grayish-white granite. A small outcrop of fine-grained well-laminated schist is exposed in the southeastern part of the mountains. The Aztec Hills are composed chiefly of coarse- to medium-grained pink and white granitic rocks and dark-olive-green to black diorite. The bedrock in all these areas is cut by faults and dikes of pegmatite and schistose rocks. The bedrock crops out over about 25 square miles of the area.

The bedrock is not known to yield water in the area. Small supplies of water may be available from highly fractured or jointed zones. Prospect holes and other depressions in the rocks collect and hold rainwater for short periods.

Volcanic Rocks

About 220 square miles of the Dateland-Hyder area is covered by Quaternary volcanic rocks, principally lava. Interbedded with the lava flows are smaller amounts of tuff and agglomerate. According to Armstrong and Yost (1958, p. 14), the lava can be divided into an older series of light-colored acidic and intermediate lava and a younger series of dark basic

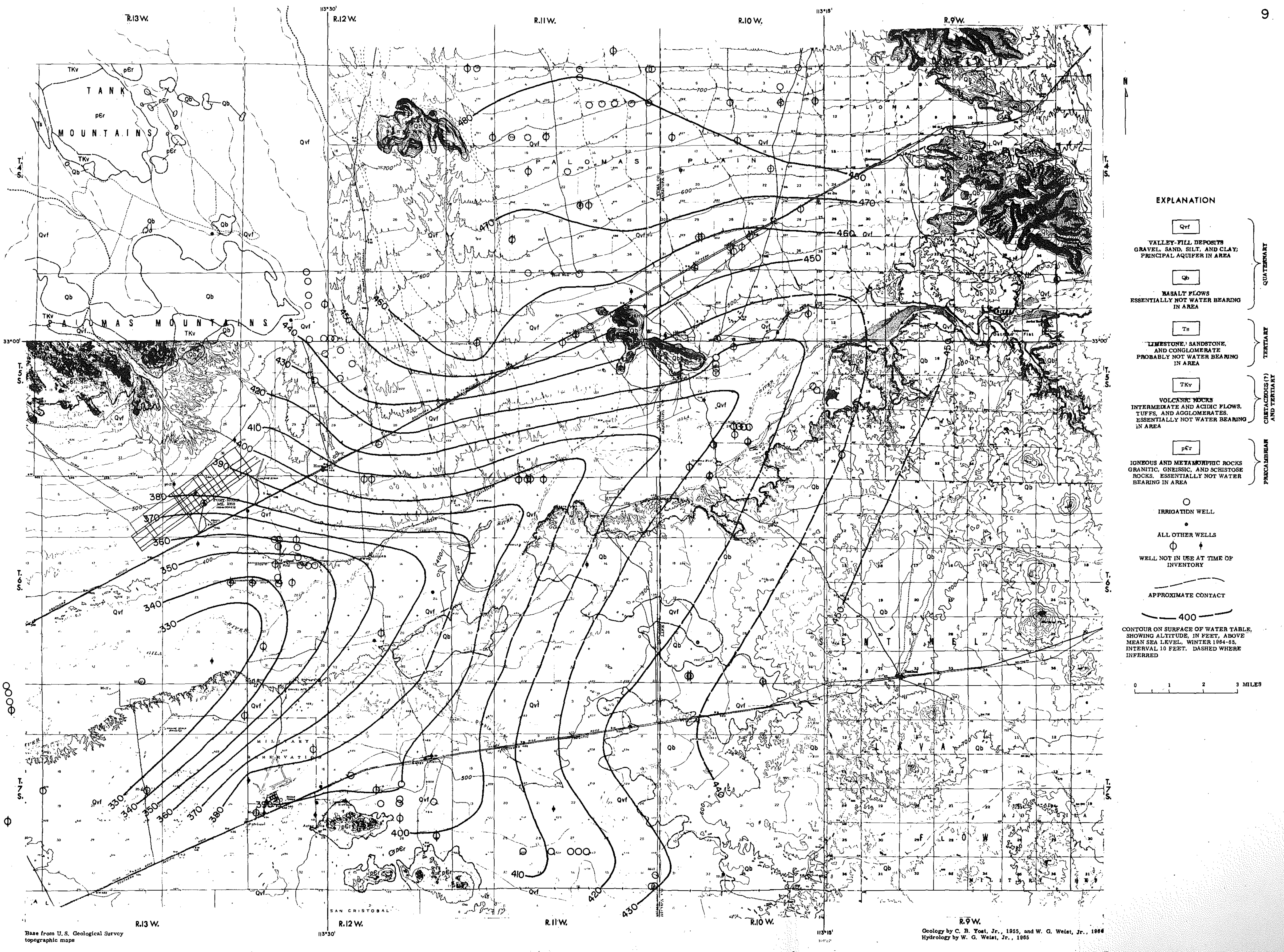


FIGURE 4.--MAP OF THE DATELAND-HYDER AREA, ARIZONA, SHOWING GEOLOGY, LOCATION OF WELLS, AND CONTOURS ON THE WATER TABLE, WINTER 1964-65.

rocks. The greatest extent of volcanic rocks forms the Sentinel lava flow in the southeastern part of the area. The Face, Oatman, Baragan, and Agua Caliente Mountains are composed almost entirely of lava, and considerable amounts of volcanic rocks are found in the Palomas and Tank Mountains.

The volcanic rocks are not known to yield water in the Dateland-Hyder area. The lava flows may contain some water in holes and tubes formed as the lava cooled or in fractures, but it is not possible to predict the location of such occurrences. Some of the interbedded sediments may contain small amounts of water.

Valley-Fill Deposits

The valley-fill deposits in the Dateland-Hyder area are similar to those in other basins in southern Arizona. They are composed chiefly of various mixtures of clay, silt, sand, and pebbles and contain some cobbles and boulders. The deposits usually are unconsolidated or loosely cemented, but in places some beds are well cemented. The valley-fill deposits cover all the area except where bedrock or volcanic rocks are exposed and underlie much of the volcanic rock.

A study of the available drillers' logs (Armstrong and Yost, 1958, table 4; table 4) indicates that the valley-fill deposits can be subdivided into an upper, middle, and a lower unit in most of the area. The upper unit consists mostly of sand and gravel, but some clay and silt are interbedded or mixed in the unit. This unit extends 200 to 380 feet below the land surface. In many places the unit is overlain by a few feet of fine-grained deposits or soil. Below this coarser facies is the middle unit, which consists of 250 to 750 feet of fine-grained material—mainly clay and silt and occasional thin beds of sand and gravel. The lower unit, composed of coarse sand and gravel, extends from the base of the middle unit to the bedrock. The thickness of this unit varies widely because the bedrock surface is very irregular. The lower unit tends to have more cemented zones than the other two units and in places may have undergone some deformation (Ross, 1922, p. 191).

There are many exceptions to this subdivision, however. For example, well (C-6-12)19bba penetrated only 62 feet of the upper coarse facies before entering the clay facies. The well was still in clay at 1,352 feet when drilling was stopped. Most of the wells near the Gila River penetrated a thinner section of the upper unit than wells in other locations. In places the valley-fill deposits are interbedded with lava flows.

In most of the area the surficial material of the valley-fill deposits is sandy silt and clay. In many places, especially north of the Gila River, there are elongate areas covered by a thin layer of dark gravel. According to Ross (1922, p. 190), these residual floors of gravel or desert pavement are caused by the wind blowing away the surface silt. The southwestern part of the area is covered, in part, by low sand dunes. The dunes are as much as 15 feet high, and most of them are stabilized by vegetation.

Except near the mountains, none of the wells in the area penetrated to bedrock, and the thickness of the valley-fill deposits is not known. Well (C-5-12)4cdd was still in sand and gravel when drilling was stopped at 1,690 feet.

The valley-fill deposits are the only known source of ground water in the Dateland-Hyder area. Domestic and stock wells can be developed almost any place where these deposits occur, and in many areas they yield sufficient water for irrigation. The middle clay unit usually does not yield much water to wells; however, in places where it contains appreciable amounts of coarser material it does yield water.

GROUND-WATER RESOURCES

Occurrence and Movement of Ground Water

Large supplies of water can be obtained from thick sequences of saturated sand and gravel in the valley-fill deposits. Although the individual beds in the valley-fill deposits are lenticular and discontinuous, they appear to be connected hydrologically—the water level in the wells forms a fairly uniform plane. In some places, as in well (C-5-10)28dab, the water is under artesian pressure. The water probably is confined by a thick clay sequence, but it may be confined by interbedded lava flows. At least two wells in the area are known to flow part of the time (table 3). The depth to water ranges from less than 20 feet along the Gila River to nearly 300 feet below the land surface along the north edge of the area.

The altitude of the ground-water surface is shown by contour lines on figure 4 for those areas where sufficient data were available. The contours were drawn from depth-to-water measurements made in the winter of 1964-65. Ground water in the Dateland-Hyder area generally flows toward the Gila River and thence downstream.

Recharge.--The amount of water recharged to the ground-water reservoir in the area is not known, but it probably is slightly less than the amount withdrawn because the water level is slowly declining in most of the area (fig. 5). The ground-water reservoir is recharged mainly by infiltration of runoff through stream channels and from ground-water underflow. A minor amount of recharge comes from infiltration of irrigation water where the water table is shallow.

Precipitation on the valley floor probably contributes little or no recharge to the ground-water reservoir because most of the precipitation is lost to the atmosphere by evaporation and transpiration. During heavy rains some of the precipitation leaves the area as streamflow, and a lesser amount percolates downward through the soil, replenishes the soil moisture, and eventually reaches the water table. In a streamflow study in Queen Creek in Pinal County, Babcock and Cushing (1942, p. 52) found that from February 12, 1940, to March 18, 1941, about half the total runoff was recharged to the water table. However, because Queen Creek is closer to the mountains than the stream channels in the Dateland-Hyder area, the sediments in the Dateland-Hyder area are finer grained, and the amount of recharge from runoff probably is less. The amount of recharge that reaches the water table depends on the permeability of the surficial materials, dryness of the soil, type of vegetation, shape and slope of the land surface, depth to the water table, and several other factors.

Ground-water flow into the area is chiefly from the north and southeast. A small amount of underflow occurs along the channel of the Gila River. No data are available on the saturated thickness and permeability of the water-bearing materials; therefore, it is not now possible to calculate the amount of underflow into the area.

The amount of recharge from irrigation depends mainly on the amount of water applied, the condition of the soil at the time the water is applied, and the type of crop under cultivation. If the soil is very dry, the water applied is used to satisfy the soil-moisture requirements, and little if any will reach the water table. Once the soil-moisture requirements are satisfied, excess irrigation water will infiltrate slowly to the water table; the amount and rate of infiltration depend on the vertical permeability of the sediments and the depth of the water table. In some areas the water table is so deep that recharge from irrigation is negligible.

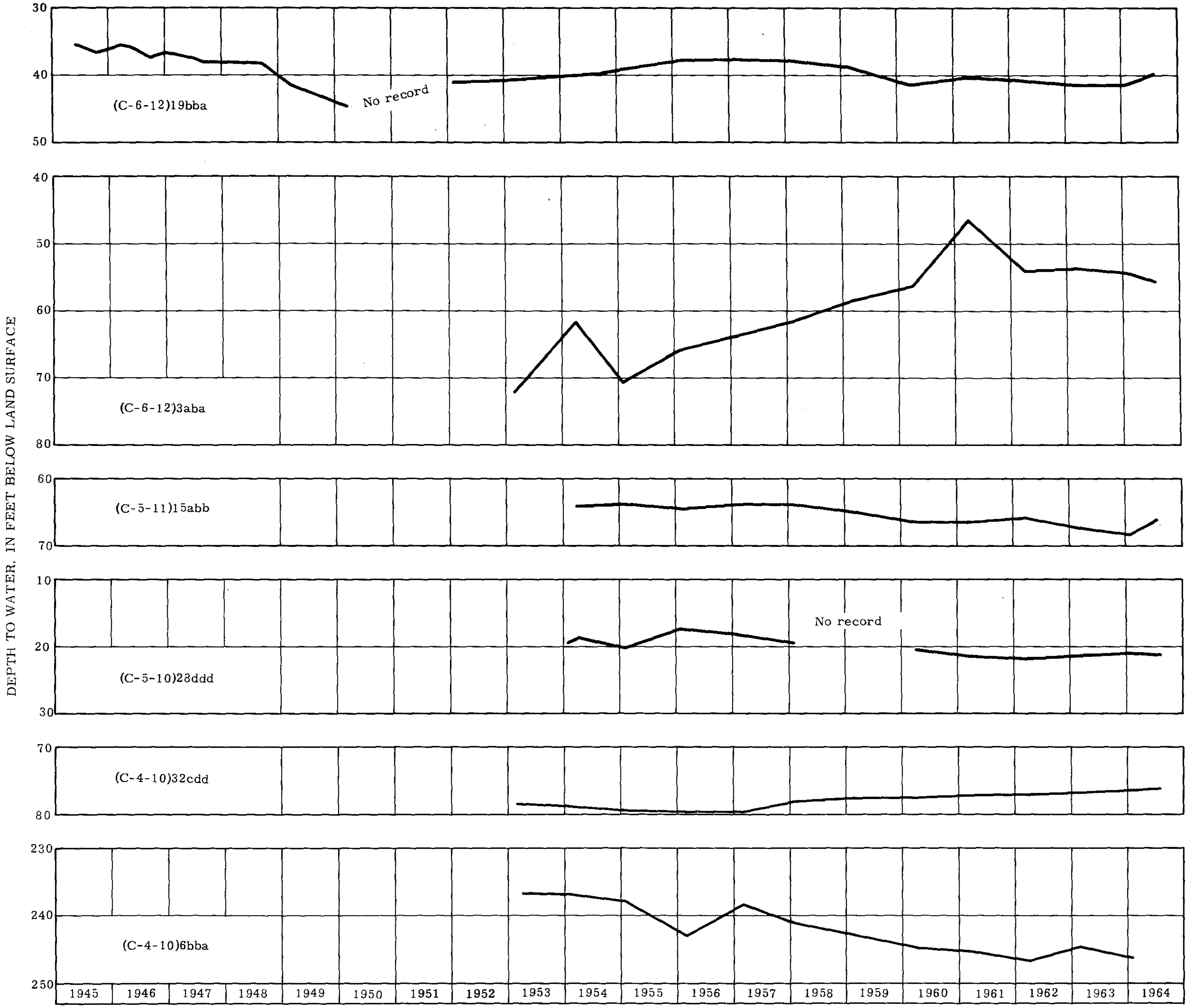


Figure 5.--Hydrographs of selected wells.

Discharge.--Water is discharged from the ground-water reservoir in the Dateland-Hyder area chiefly by underflow out of the area and by pumping from wells. Where the depth to water is quite shallow along the Gila River, some discharge occurs by evapotranspiration.

Discharge by underflow occurs only along the west edge of the area south of the Palomas Mountains. No data are available to compute the amount of underflow leaving the area, but it probably is about equal to the amount of underflow moving into the area.

Fluctuations of the Water Level

Water levels have been measured annually in 18 observation wells in the Dateland-Hyder area since 1953 (table 6); records for a few wells extend back to 1945. In general, the records indicate that the water levels in 1964 are a few feet lower than they were in 1953.

Specific Capacity of Wells

Time did not permit making aquifer tests in the area, but aquifer characteristics frequently are indicated by the specific capacity of a well. Specific capacity is the discharge per foot of drawdown and generally is expressed as gallons per minute per foot of drawdown. For example, if a well yields 100 gpm (gallons per minute) with a drawdown of 10 feet, it has a specific capacity of 10 gpm per foot. Specific capacity is a function of time of pumping, thickness and hydraulic properties of the aquifer, and well construction. In general, a high specific capacity indicates a high coefficient of transmissibility of the aquifer. Theis (1935) introduced the term "coefficient of transmissibility," which is expressed as the rate of flow of water, at the prevailing water temperature, in gallons per day, through a vertical strip of the aquifer 1 foot wide extending the full saturated height of the aquifer under a hydraulic gradient of 100 percent. Thomasson and others (1960, p. 222), when working in the Sacramento Valley, described a method in which the specific capacity of a well multiplied by an empirical factor of 1,700 gives an approximate value for the coefficient of transmissibility. Their method gave values for transmissibility that were within 10 to 15 percent of the values obtained by aquifer tests. This relation probably is valid for the Dateland-Hyder area because the valley-fill deposits are similar to those in California valleys.

The yield and drawdown for selected wells in the Dateland-Hyder area are given in table 3. The specific capacities range from 3 to 150 gpm per foot; only six are 100 or more, and only eight are less than 10; most of the specific capacities are between 20 and 36. The average specific capacity is 42 gpm per foot, which indicates an average coefficient of transmissibility of about 71,000 gpd (gallons per day) per foot for the valley-fill deposits in the Dateland-Hyder area.

Storage

About 330,000 acres in the Dateland-Hyder area is underlain by unconsolidated material. This figure would be even higher if the area covered by the Sentinel lava flow were included. Generally, about 20 to 40 percent of the volume of unconsolidated alluvium consists of pore spaces; below the water table these pore spaces are full of water. Much of this water is available for pumping over a long period of time, although some will adhere to the surfaces of the grains or otherwise be trapped in the material. The percentage of water that will drain from a deposit by gravity compared to the total volume of the deposit is called the specific yield. The specific yield of valley-fill deposits normally ranges between 10 and 25 percent. Assuming an average specific yield of 15 percent, the first 100 feet of saturated material in the Dateland-Hyder area contains nearly 5,000,000 acre-feet of available ground water. The total amount of available water in storage is unknown because the thickness of the valley-fill deposits is unknown. However, further development of water for irrigation probably can take place in most of the area without seriously affecting the existing wells.

Utilization

Information was collected for 180 wells (fig. 4, table 3), including all the irrigation wells in the area and a few wells outside the area. At the time of this study, 74 of the wells were used for irrigation, 3 were used for public supply, 23 were used for domestic or stock purposes, and the rest were not in use.

The principal development of ground water for irrigation has taken place since 1950. Only six of the large-capacity wells for which the date of completion is known were finished prior to 1951. From 1951 to 1954, 30 large-capacity wells were completed. Development has been sporadic since that time—17 wells were completed from 1959 to 1961, and 13 wells were completed from 1963 to 1964.

Most of the irrigation wells are 16 to 20 inches in diameter and yield an average of about 1,500 gpm. Table 2 shows the maximum, minimum, and average well yields and may indicate in a general way the most favorable areas for further development.

Many of the wells that were not in use at the time of this study were completed in the past few years and have not been put into production. Most of these wells probably will be in use by 1966. A considerable number of older unused wells demonstrate some of the problems involved in obtaining suitable supplies of ground water for irrigation in the area. Some of these wells were abandoned because they did not yield sufficient water. It is possible, however, that if these wells are deepened, additional water will be found, and the wells could be put into production. A few of the wells are not in use because, when pumped, they yield an excessive amount of fine sand. This condition can be overcome either by the installation of properly designed well screens to keep out the sand or by drilling deeper and casing off the strata of fine sand. Some wells were abandoned because the water is too highly mineralized. Modern agricultural practices may make it feasible to use this water, or if the water is confined to one or two zones, it can be cased off, as has been done in some of the newer wells.

CHEMICAL QUALITY OF THE GROUND WATER

Chemical analyses were made of water samples from 27 wells (table 5). An additional 70 analyses are available from earlier reports (Armstrong and Yost, 1958, table 5; Smith and others, 1963). A comparison of the earlier analyses with the analyses made in this study shows no significant change in the quality of water since 1954. Field measurements of conductivity and temperature were made in many of the wells in the summer of 1964. The multiplication of these conductivity values by 0.6 gives an approximate value of the total dissolved solids in the water. The dissolved-solids content of the samples analyzed ranges from 398 to 9,630 ppm (parts per million).

In all but one of the 27 samples analyzed, sodium and chloride ions made up more than half the dissolved solids. In water from shallow wells near the Gila River, the sodium and chloride ion content is great enough to give a salty taste to the water.

Table 2.--Yields of irrigation wells, Dateland-Hyder area, Arizona

Location		Number of wells1/	Well yields		
Township	Range		Maximum2/ (gpm)	Minimum (gpm)	Average (gpm)
4 S.	10 W.	5	4,100	830	2,050
4 S.	11 W.	13	2,200	750	1,450
5 S.	10 W.	5	1,800	600	1,150
5 S.	12 W.	15	3,500	800	1,450
6 S.	12 W.	9	1,900	330	1,000
7 S.	11 W.	6	2,500	1,400	1,800
7 S.	12 W.	5	2,500	950	1,750

1/ The number of wells for which data are available; see table 3 for a complete listing of irrigation wells.

2/ Quantities are approximate because methods used for obtaining discharge measurements have some inherent inaccuracies. Values include reported, estimated, and 1964 measured discharges.

Definition of Terms

A few terms used in a discussion on quality of water may convey a variety of meanings and, as an aid to clarity, are defined below.

Parts per million (ppm) is a unit that expresses the concentration of constituents on a weight-to-weight basis, usually in milligrams of constituent per kilogram of solution.

Equivalents per million (epm) is a unit that expresses the concentration of chemical constituents in terms of chemical equivalence and more closely describes the composition of a water and the relations of ions in solution.

Specific conductance is a measure of the capacity of the water to conduct an electric current and is expressed as micromhos per centimeter at 25°C. It is directly related to the concentration of ions in solution:

$$\text{Specific conductance} \times (0.65 \pm 0.10) = \text{ppm of dissolved solids.}$$

Sodium-adsorption-ratio (SAR) is a measure of the suitability of the water for irrigation and involves the adsorption of sodium from water by a soil.

Soft water, according to Collins, Lamar, and Lohr (1934, p. 17-18), is water having a hardness of 60 ppm or less. Water having a hardness between 61 and 120 ppm is considered "moderately hard"; that having a hardness between 121 and 180 ppm is "hard"; and that having a hardness greater than 180 ppm is "very hard."

Factors Affecting Water Quality

The chemical quality of ground water differs from place to place and is the result of several interdependent factors. The most important factors are physical and chemical properties of the material through which the water moves, source and amount of recharge, and direction of ground-water movement. Regional patterns of chemical quality do exist, but the quality of the water from each well is influenced more by local conditions. In general, water from the shallower wells near the Gila River is more highly mineralized than water from deeper wells or wells farther from the river.

Suitability of the Water for Use

Water in the Dateland-Hyder area is used for domestic, stock, and irrigation purposes. It is doubtful that water will be put to any other use in the foreseeable future.

Domestic use.--Because the residents are dependent on ground water for their domestic supply, this is the primary use of water in the Dateland-Hyder area. However, the amount of water used for domestic supplies is not as large as that used for irrigation. Water for domestic use should be clear, colorless, of reasonable temperature, and free of objectionable odor, taste, and disease-causing micro-organisms. The U. S. Public Health Service (1962) has established quality standards for culinary water used in interstate commerce, and the American Water Works Association has adopted these standards as recommended limits for public water supplies. The limits for some of the chemical constituents are listed below. Chemical substances should not be present in a water supply in excess of the following recommended limits if other more suitable supplies are available.

Constituent	Concentration (ppm)
Iron (Fe)	0.3
Manganese (Mn)	.05
Chloride (Cl^-)	250
Sulfate (SO_4^{--})	250
Fluoride (F^-)	1/
Nitrate (NO_3^-)	45
Dissolved solids	500

Although few permanently disabling diseases or harmful effects are attributable to the chemical constituents of water, concentrations that exceed these recommended limits may render a water undesirable for domestic use. Excess chloride imparts a salty taste to the water. A fluoride concentration of about 0.1 ppm has been shown to prevent dental cavities (Dean, 1936), but greater concentrations cause chronic fluorosis of bone tissue and teeth, which appears as mottled enamel in the teeth of children. Excessive nitrate is particularly hazardous to infants, causing methemoglobinemia or cyanosis. Excessive nitrate may be an indication of contamination from sewage, decaying vegetation, or fertilizers.

Hardness in water is manifested by the formation of soap curd or scum. It is caused principally by calcium and magnesium, although barium, strontium, aluminum, iron, and free acid, if present, contribute to hardness. Nine of the samples analyzed for this study were soft, and 11 were very hard.

Figure 6 shows the distribution of the fluoride concentration in the ground water of the Dateland-Hyder area. In general, the highest concentrations (more than 6.0 ppm) are found south of the Gila River and probably are associated with the Sentinel lava flow. Westward movement of the water

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1/ Latest recommendations (U.S. Public Health Service, 1962) give lower, optimum, and upper limits for fluoride based on the annual average of maximum daily air temperature. For the Dateland-Hyder area these limits are 0.6 ppm (lower), 0.7 ppm (optimum), and 0.8 ppm (upper). Concentrations of more than 1.4 ppm constitute grounds for rejection of the supply.

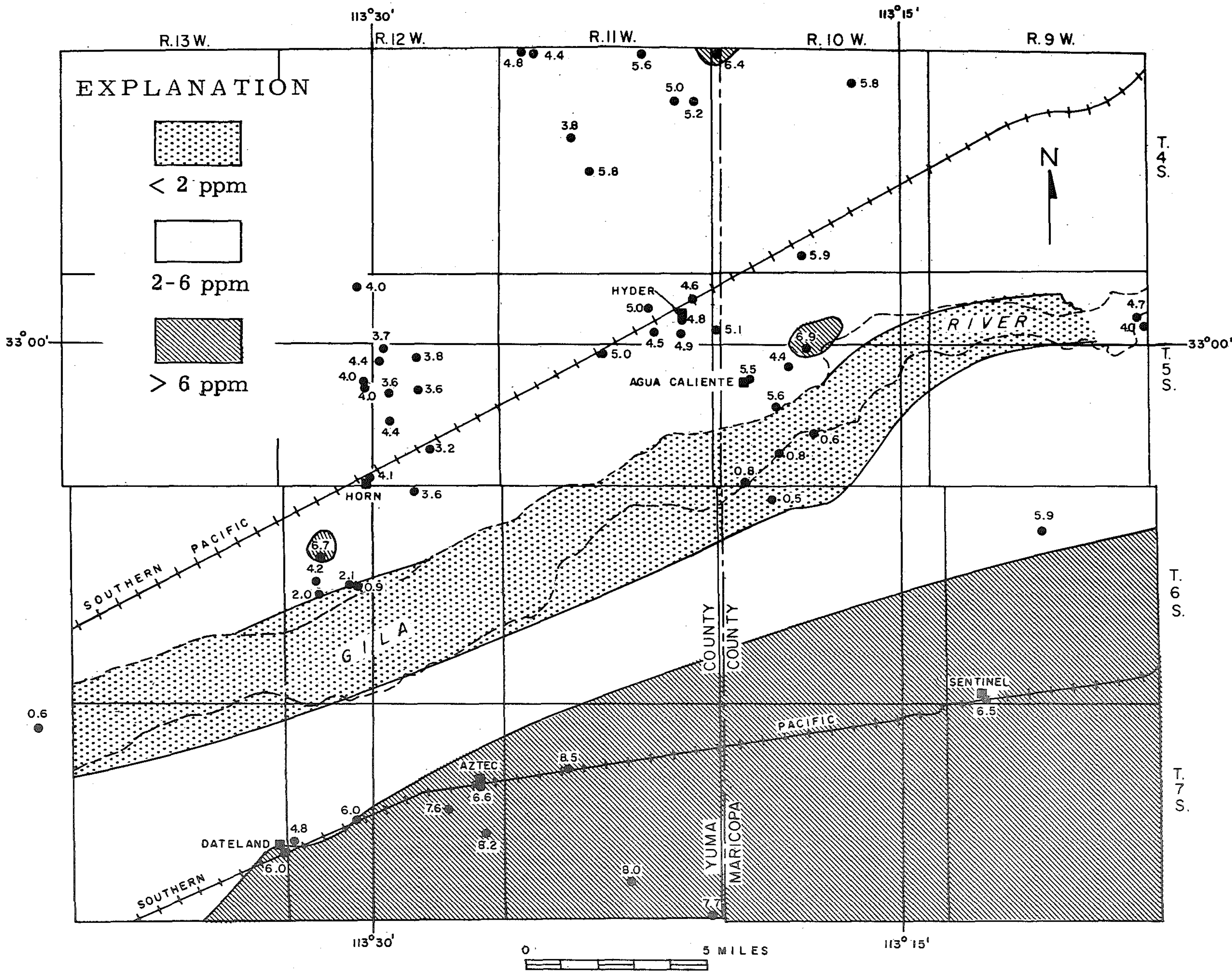

Figure 6.--Approximate distribution of fluoride concentrations in ground water.

has carried these high concentrations as far as Dateland. The lowest concentrations (less than 2.0 ppm) are found along the Gila River.

The distribution of dissolved solids in the ground water is shown on figure 7. Water along the Gila River contains the greatest amount (more than 2,000 ppm) of dissolved solids, and north and south of this area there is a zone containing 1,000 to 2,000 ppm. Water in the rest of the area contains less than 1,000 ppm of dissolved solids.

Stock use.--Although animals are able to tolerate water with a higher dissolved-solids content than man, water that meets the standards for domestic use should be used for maximum production of eggs, meat, and milk. Animals drinking highly mineralized water for prolonged periods may develop physiological disturbances, such as wasting, gastrointestinal disturbances, disease, and eventual death. Other effects are reduction in lactation and rate of reproduction.

The officers of the Department of Agriculture and Government Chemical Laboratories of Western Australia (1950) give the following threshold-salinity (dissolved-solids) concentration in water for poultry and livestock:

Animal	Concentration (ppm)	Animal	Concentration (ppm)
Poultry	2,860	Cattle, dairy	7,150
Pigs	4,290	Cattle, beef	10,000
Horses	6,435	Sheep, adult, dry	12,900

Water in Colorado that contains as much as 2,500 ppm of dissolved solids is acceptable for stock (McKee and Wolf, 1963, p. 113). Apart from total salt content, concentrations of certain salts, such as nitrate, fluoride, and salts of selenium and molybdenum, are toxic to animals even in low concentrations. The critical factor, however, is the total quantity of salts ingested, which depends on the daily water consumption and in turn depends on the water content of feed, the temperature and humidity, and the amount of exertion of the animal. Using Colorado's limit of 2,500 ppm of dissolved solids as a guide, most of the ground water in the Dateland-Hyder area is acceptable for stock use.

Irrigation use.--The suitability of water for irrigation is determined by the total salt concentration, ratios of certain salts, the chemical

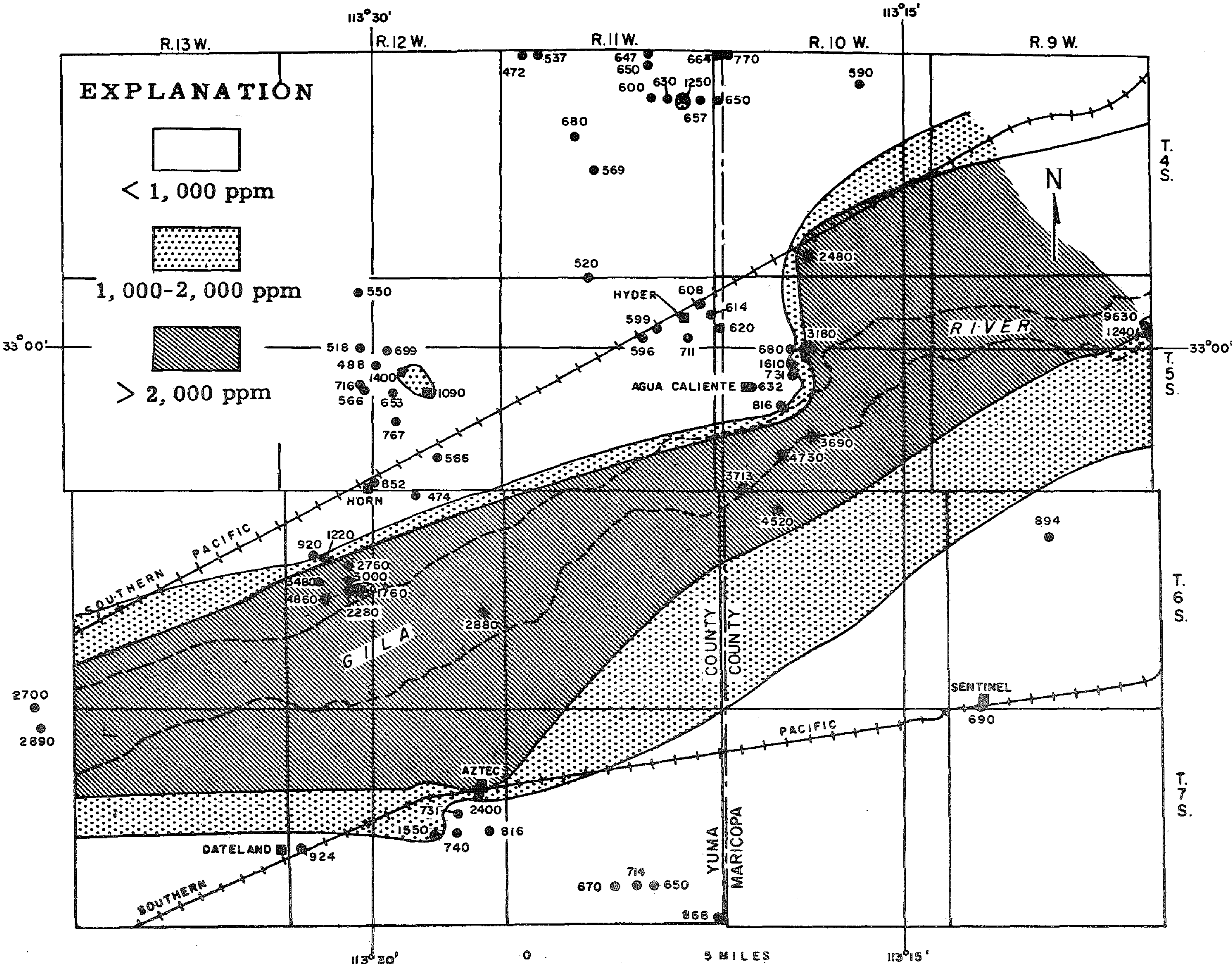

Figure 7.--Approximate distribution of total dissolved solids in ground water.

reactions between salts in the applied water and the soil, and the increase in salt concentration in the soil. Water rated "good" for irrigation may, when used with poor irrigation practices, cause deterioration and eventual destruction of the soil. Conversely, if sufficient quantities of poor-quality water are applied to well-drained soil, injurious concentrations of salt may be leached beyond the root zone. This practice, coupled with the proper use of soil amendments, would maintain good productivity with little damage to the soil. The calcium to sodium ratio in irrigation water is an important consideration because of ion-exchange reactions in the soil. Water that is high in sodium in relation to calcium will cause alkalinization of soils that contain silt, fine clay, or organic fractions and result in poor tilth. In general, the sodium concentration must comprise more than half of the soluble cations before exchange is significant. Most of the ground water in the Dateland-Hyder area is high in sodium, which presents a hazard when the water is used for irrigation.

The sodium hazard also is increased when the water contains a high concentration of bicarbonate ions. Calcium and magnesium tend to precipitate as carbonate, which increases the relative proportion of sodium in the water. Eaton (1950) defined the concept of residual sodium carbonate as the excess of bicarbonate over calcium and magnesium expressed as milliequivalents per liter. Water that contains less than 1.25 meq per l (milliequivalents per liter) is safe, that containing 1.25 to 2.5 meq per l is marginal, and that containing more than 2.5 meq per l is not suitable. Four of the samples analyzed during this study were classed as marginal, and the rest were classed as safe.

The U. S. Salinity Laboratory Staff (1954) has developed a method for rating irrigation water on the basis of salinity and sodium (alkali) hazards (fig. 8). When this rating is applied to the water analyzed for the Dateland-Hyder area, all the samples had a high to very high salinity hazard, and 20 of the 27 samples had a high to very high sodium (alkali) hazard (table 5). In general, this means that the water should not be used on soils with restricted drainage, salt-tolerant crops should be grown, and an excessive amount of water should be applied. An appreciable sodium hazard exists if the water is applied to fine-textured soil having a high cation-exchange capacity, especially under low-leaching conditions, and chemical amendments may be required. In the classification of irrigation water it is assumed that the water will be used under average conditions. Large deviations from average conditions may make it safe to use poorer quality water or unsafe to use good quality water.

Because of the increasing interest in crops of citrus and grapes in the area, the water samples were analyzed for boron and lithium content.

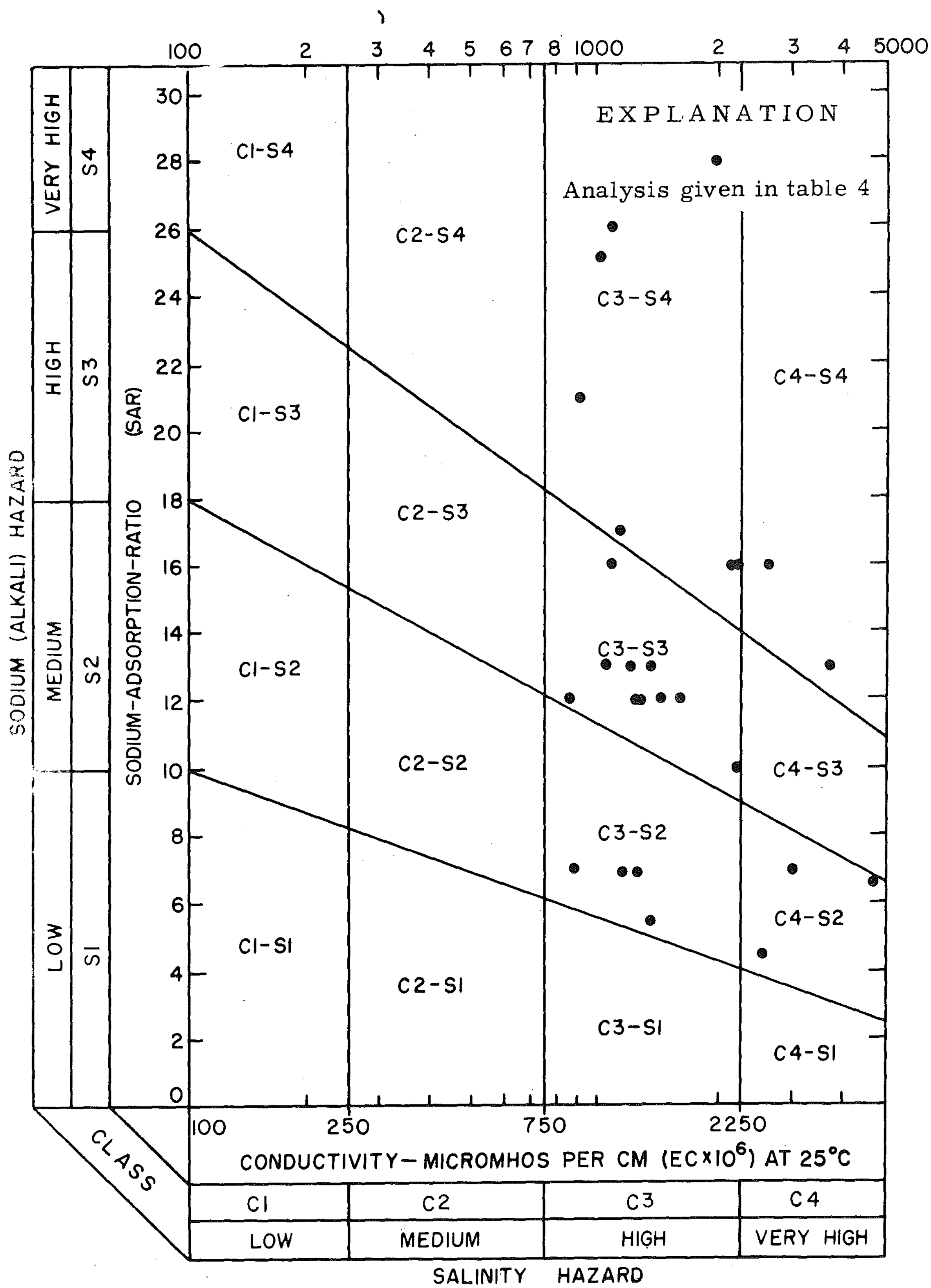

Figure 8.--Classification of irrigation water.

The boron concentrations ranged from 0.39 to 16 ppm—only four samples had boron concentrations of more than 2 ppm. In general, 14 of the samples were classed as acceptable for use on boron-sensitive crops. Lithium concentrations ranged from 0.4 to 3.8 ppm—six samples had lithium concentrations of more than 1.0 ppm. McKee and Wolf (1963, p. 210) reported that concentrations of lithium chloride of 1 ppm in the soil have caused symptoms of lithium toxicity.

APPENDIX — BASIC DATA

Table 3.--Records of selected wells, Dateland-Hyder area, Arizona

Location: See figure 3 for description of well-numbering system.
Depth of well: Measured depths are given in feet and tenths below land surface; reported depths are given in feet below land surface.
Type of casing: C, concrete; M, metal; W, wood.
Casing finish: OH, open hole; P, perforated; S, slotted.
Altitude: Altitudes were estimated from topographic maps.
Depth to water: Measured depths to water are given in feet and tenths below land surface; reported depths to water are given in feet below land surface.
Yield: E, estimated; M, measured; R, reported.

Type of pump and power: C, cylinder; Cf, centrifugal; J, jet; N, none; T, turbine; D, diesel engine; E, electric motor; G, gasoline engine; H, hand; P, propane engine; W, wind.
Use: D, domestic; I, irrigation; N, none; PS, public supply; S, stock.
Field conductivity: Specific conductance in micromhos at 25°C. Field conductivity x 0.6 = approximate dissolved solids.
Remarks: L, log of well given in table 3; LA, log of well available; L4, log of well given in Water Resources Report 4; WL, water-level measurements given in table 5; WS, chemical analysis of water given in table 4; WSA, chemical analysis of water given in Agricultural Experiment Station Report 217; WS4, chemical analysis of water given in Water Resources Report 4.

Location	Owner or user	Year completed (19-)	Depth of well (feet)	Casing record			Land-surface altitude (feet above mean sea level)	Water level		Yield (gpm)	Drawdown (feet)	Type of pump and power	Use	Temperature (°F)	Field conductivity	Remarks
				Diameter (inches)	Type	Finish (feet)		Depth to water (feet)	Date measured							
(C-3-11)36cbb	H. D. Molloham	'64	-----	20	M	-----	750	273.2	12/23/64	-----	-----	N, N	I	---	-----	Not yet in use.
((C-4-8)31ccc	Ray Hansen	-----	275	16	M	-----	515	57.2	8/ 6/64	-----	-----	N, N	N	---	-----	
(C-4-9)4cbb	C. R. Amavisca	'64	230	10	M	-----	673	181.3	7/22/64	-----	-----	C, G	S	---	-----	L.
10bcc	Andrea and Tomac	'53	190	-----	---	-----	628	168	/54	-----	-----	C, G	S	---	-----	
(C-4-10)2baa	Morrison, Metz, and Sills	'63	1,200	20-16	M	P 400-1,016	735	249.4	12/23/64	4,100 R	-----	T, P	I	---	-----	
3daa	do.	'55	451	16	---	-----	707	219.1	12/23/64	2,000 R	-----	T, E	I	92	990	L4, WS.
6bba	H. D. Mollohan	-----	1,000	16	---	-----	730	247.6	12/23/64	2,200 E	17 M	T, E	I	98	1,280	WL.
6bbb	do.	'61	455	14- 8	M	P 282-455	730	244.9	12/23/64	830 R	-----	T, E	I	95	-----	L4, WS4.
7bbb	do.	'62	642	16-12-9-5/8	---	OH 605-642	700	220.0	12/23/64	1,300 M	36 M	T, E	I	95	1,080	WS4.
9baa	Milton T. Smith	'53	628	16	---	P 200-628	687	208.3	7/ 8/64	-----	-----	T, N	N	---	-----	
10aaa	Oscar Kramer	-----	500	16	M	S 200-500	690	202.6	12/23/64	-----	-----	N, N	N	---	-----	L, WL.
11aaa	Bruce Church	-----	-----	-----	---	-----	692	207.1	12/23/64	-----	-----	T, E	I	---	-----	Not in use now.
16abd	John Flowers	'61	985	20-16	M	P 400-985	647	-----	-----	-----	-----	T, N	I	---	-----	Not yet in use.
18aab	Max Christiansen	-----	1,500	-----	---	-----	657	-----	-----	-----	-----	T, N	I	---	-----	Not yet in use.
20bbb	do.	'62	660	8	M	OH 656-660	622	143.1	12/10/64	-----	-----	N, N	N	---	-----	L.
22aba	do.	'53	500	16	M	P 140-412 OH 412-500	610	131.6	12/23/64	1,800 R	230 R	N, N	N	---	-----	L, WL.
24ccc	Pavlina Farms	-----	240	6	M	-----	568	96.6	7/ 7/64	-----	-----	N, N	N	---	-----	
26bad	do.	'56	270	16	M	-----	570	102.1	7/ 7/64	-----	-----	N, N	N	---	-----	
$32abb_1$	Williams	'51	176	20	M	P 65-176	558	104.6	7/ 9/64	400 R	86 R	N, N	N	---	-----	L4.
$32abb_2$	do.	-----	1,500	16	M	-----	555	101.7	7/ 9/64	-----	-----	T, E	N	---	-----	
32cdd	do.	-----	-----	18	M	-----	533	76.3	7/ 8/64	-----	-----	N, N	N	---	-----	WL.
33acc	do.	-----	700	18-20	M	-----	535	80.6	7/ 8/64	-----	-----	N, N	N	---	-----	
33adb	do.	-----	-----	20	M	-----	540	87.6	7/ 8/64	-----	-----	T, E	N	---	-----	

Table 3.--Records of selected wells, Dateland-Hyder area, Arizona—Continued

Location	Owner or user	Year completed (19-)	Depth of well (feet)	Casing record: Diameter (inches)	Casing record: Type	Casing record: Finish (feet)	Land-surface altitude (feet above mean sea level)	Water level: Depth to water (feet)	Water level: Date measured	Yield (gpm)	Drawdown (feet)	Type of pump and power	Use	Temperature (°F)	Field conductivity	Remarks
(C-4-10)33bda	Williams	'48	640	20	M	P 90-284 OH 284-640	543	88.0	1/ 5/65	710 R	-----	T, E	N	---	-----	L4, WS4.
34bbb	Pavlina Farms	'48	240	20	M	P 100-230	550	91.0	7/ 7/64	-----	-----	N, N	N	---	-----	L4.
(C-4-11)2bbb	Big Q Farms	'56	530	16	---	P 248-530	749	267.4	12/22/64	750 M	-----	T, E	I	101	1,020	WL, WS.
2bcb	do.	'56	530	16	---	P 244-530	740	259.5	12/23/64	1,400 E	-----	T, E	I	100	1,080	
5bbb	Leona Cochrane	'53	465	16	---	P 280-335, 398-448	768	280.6	5/ 8/55	1,400 M	14 R	T, E	I	103	850	L4, WS, WS4.
6aab	Garner Brothers Farm	-----	-----	16	---	-----	770	286.4	12/22/64	1,460 R	-----	T, E	I	100	-----	WS4.
11aba	Ray Hansen	'57	603	16	M	S 280-585	708	190	/64	750 M	-----	T, E	I	100	1,050	LA.
11bab	do.	'57	550	16	M	S 290-545	710	190	/64	1,500 R	-----	T, E	I	99	1,000	L.
12abb	do.	-----	1,229	-----	---	-----	700	222.8	12/23/64	1,600 M	-----	T, E	I	99	1,080	L, WS.
12bbb	John Badley	'53	415	16	M	S 216-241, 278-297, 345-385	708	221.2	3/24/53	1,000 E	-----	T, E	I	95	2,190	L4, WS, WS4.
15bbb	W. J. Falkenstein	'58	469	16	M	P 208-465	695	219.3	12/22/64	-----	-----	N, N	N	---	-----	L.
16abb	John Badley	'57	500	-----	---	-----	690	-----	-----	1,800 R	-----	T, E	I	---	-----	
16bbb	do.	'57	500	16	---	P 208-500	698	208	/57	1,500 R	10 M	T, E	I	86	-----	L, WS
17abb	Claude Jones	'57	500	16	---	P 220-500	708	231.3	12/22/64	-----	-----	T, E	I	---	-----	Not in use now.
21abb	Virgil Merrill	'64	1,375	-----	---	P 600-1,375	670	195.0	12/22/64	2,200 R	-----	T, E	I	90	840	WS, not yet in use.
22aba	Albers, Geig, and Garroto	-----	550	16	---	P 175-550	660	181.6	12/22/64	1,600 R	-----	T, E	I	---	-----	
26bab	Edwards and Porter	'53	330	20	M	P 245-265, 293-311	622	143.8	12/22/64	1,200 R	40 R	N, N	N	---	-----	LA.
26bbb	do.	'54	330	16	M	P 193-206, 299-311	625	146.6	12/22/64	1,200 R	45 R	N, N	N	---	-----	L.
33bbb	Kino Ranch	'63	1,090	20	M	P 200-308	616	150.3	12/22/64	1,800 R	40 R	N, N	I	---	-----	L, not yet in use.
(C-4-13)25cc	H. D. Mollohan	-----	-----	6	---	-----	-----	66.2	7/14/64	-----	-----	C, G	S	---	-----	
(C-5-9)6ddd	C. R. Amavisca	-----	34.8	42 - 6	C; M	-----	475	31.7	7/ 9/64	-----	-----	C, W	S	---	-----	
12aca	Ray Hansen	-----	150	-----	---	-----	510	-----	-----	550 E	-----	T, E	I	77	8,000 +	WS.
12acd	do.	-----	610	24-20	M	-----	510	19.3	8/27/54	675 E	-----	T, E	I, S	90	2,200	L4, WS, WS4.
(C-5-10)7cbc	J. C. Carpenter	-----	155	12	---	-----	512	55.9	1/19/54	-----	-----	T, E	D	83	-----	WS4.
7dcc	do.	-----	-----	6	M	-----	500	57.7	7/ 9/64	-----	-----	N, N	N	---	-----	

Table 3.--Records of selected wells, Dateland-Hyder area, Arizona—Continued

Location	Owner or user	Year completed (19-)	Depth of well (feet)	Casing record			Land-surface altitude (feet above mean sea level)	Water level		Yield (gpm)	Drawdown (feet)	Type of pump and power	Use	Temperature (°F)	Field conductivity	Remarks
				Diameter (inches)	Type	Finish (feet)		Depth to water (feet)	Date measured							
(C-5-10)10ddb	Andrea and Tomac	-----	-----	6	---	-----	460	26.6	7/ 9/64	-----	-----	C, W	S	---	-----	
11aca	Not known	-----	-----	120-10	W, M	-----	470	26.8	8/ 6/64	-----	-----	N, N	N	---	-----	
16abb	Anderson Development Co.	-----	72	20	---	-----	470	31.4	12/21/64	475 R	10 R	T, E	D	77	-----	WS4.
16abc	do.	-----	72	20	---	-----	460	29.9	12/21/64	1,000 R	-----	N, N	N	77	-----	
16bbb	do.	'60	1,268	20-18-14	---	P 844-1,268	480	18.2	12/21/64	1,450 M	178 M	T, E	I	114	1,130	L.
16cbb	do.	'54	72	20	---	-----	460	31.3	12/21/64	600 R	-----	T, E	I	91	-----	L4.
16cbc	do.	-----	-----	-----	---	-----	457	27.5	12/21/64	-----	-----	T, E	I	104	2,400	WS.
16ccb	do.	'54	72	-----	---	-----	454	26.9	12/21/64	1,000 R	-----	T, E	I	103	-----	L, WS4.
16ccc	do.	-----	-----	-----	---	-----	452	22.4	12/21/64	-----	-----	T, E	I	---	-----	
19aaa	J. Fuqua	'63	42	8	M	-----	460	10.6	7/12/64	-----	-----	Cf, E	D	100	1,180	
20dca	Scout Gray Eagle Camp	-----	42	6	---	-----	446	17	/64	-----	-----	C, H	D	92	-----	
23adb	J. A. McGann	'54	100	16	M	-----	465	21.5	7/21/64	-----	-----	T, G	I	---	-----	Not in use now.
23add	do.	'58	100	16	---	P 32-63 OH 63-100	470	31.5	2/18/65	-----	-----	T, G	I	---	-----	L, WSA, not in use now.
28daa	Caliente Farms	-----	290	18	M	-----	447	23.1	12/21/64	-----	-----	T, E	I	---	-----	
28dab	do.	'62	1,142	18-14	M	P 1,100-1,125	446	3.5	7/21/64	-----	-----	T, E	I	---	-----	Flows during winter.
28dba	do.	-----	104	16	---	-----	445	23.5	12/21/64	-----	-----	T, E	I	76	-----	WS4.
28dbb	do.	'59	133	20	---	P 20-133	445	21.2	12/21/64	-----	-----	N, N	N	---	-----	L.
28dcb	do.	'64	1,300	24-20	---	-----	447	-----	-----	-----	-----	-----	---	---	-----	Flows.
28ddd	do.	-----	104	18	M	-----	448	21.4	12/21/64	-----	-----	N, N	N	---	-----	WL.
32aaa	Fred Wertz	'52	112	16	---	P 35-108	440	18.7	12/21/64	1,800 R	20 R	T, E	I	---	-----	L, WS4, not in use.
32cbd	do.	'53	86	18	M	-----	438	20.6	7/21/64	2,400 R	20 R	N, N	N	---	-----	L.
32ddc	F. Krausse	'54	180	20	M	P 30-52	448	25.1	12/21/64	-----	-----	T, N	N	---	-----	
36aca	Not known	-----	700	16	---	-----	595	154.8	2/18/65	1,000 R	90 R	T, D	I	---	-----	L4, WL, not in use.
(C-5-11)1dbb	Southern Pacific Railroad	-----	373	16	M	-----	540	87.7	7/10/64	170 R	48 R	N, N	N	---	-----	LA.
1dcb	do.	'30	900	10-12	M	-----	538	87	/64	-----	-----	T, E	PS	89	990	LA, WS, supplies water for Hyder.
2bbb	B. Permenter	'59	1,000	20	---	-----	569	103.4	12/22/64	-----	-----	T, E	D, I, S	---	-----	L, WSA.
3bba	do.	-----	280.0	12	M	-----	573	106.3	12/22/64	-----	-----	N, N	N	---	-----	WL, "Hall well."
4abb	C. O. Stephens	'50	365	6	M	-----	580	115	/64	-----	-----	C, G	I	86	860	

Table 3.--Records of selected wells, Dateland-Hyder area, Arizona—Continued

Location	Owner or user	Year completed (19-)	Depth of well (feet)	Casing record			Land-surface altitude (feet above mean sea level)	Water level		Yield (gpm)	Drawdown (feet)	Type of pump and power	Use	Temperature (°F)	Field conductivity	Remarks
				Diameter (inches)	Type	Finish (feet)		Depth to water (feet)	Date measured							
(C-5-11)10dda	P. L. Porter	'53	510	16	M	-----	523	68.3	2/ 2/65	-----	-----	N, N	N	---	-----	L, WS4.
11cab	do.	'56	700	-----	---	-----	527	75.3	12/22/64	1,000 M	-----	T, E	D, I	98	930	WS.
12aaa	James Dunning	-----	262	6	M	-----	530	79.2	7/ 9/64	-----	-----	N, N	N	---	-----	WS4.
12cba	do.	-----	100	12	---	-----	550	67	/46	-----	-----	T, G	D	88	-----	WS4.
15abb	P. L. Porter	-----	-----	16	M	-----	515	66.1	7/10/64	-----	-----	N, N	N	---	-----	WL.
17bbb	H. D. Mollohan	-----	100.0	8	M	-----	535	65.7	2/ 2/65	-----	-----	C, W	S	---	-----	"Baragan's well."
(C-5-12)4bcb	Bruce Church	'53	370	20-16	M	P 145-250	-----	139.0	8/26/54	1,100 E	-----	T, E	I	88	460	L, WS4.
4cbc	do.	'59	310	16	---	-----	-----	144.0	12/24/64	1,300 E	65 R	T, E	I	86	600	
4cdd	do.	'64	1,680	20-12	M	P 400-1,680	-----	132.7	12/24/64	3,500 R	130 R	T, E	I	---	-----	L.
5aaa	do.	'59	715	16	M	-----	-----	162.4	12/24/64	900 E	-----	T, E	I	88	540	L4, WL.
8bdd	H. D. Mollohan	-----	99	6	M	-----	-----	122.7	7/13/64	-----	-----	C, W	S	---	-----	"Jim's well."
9bbb	Bruce Church	'59	560	14	M	-----	-----	139.5	12/24/64	800 E	52 R	T, E	I	88	500	L.
15cac	do.	'52	475	16	M	P 100-470	535	104	/52	1,500 M	-----	T, E	I	93	2,300	L, WS.
16aab	do.	'57	625	16	M	-----	560	113.5	12/24/64	1,400 E	63 R	T, E	I	90	800	L, WS, WS4.
16aba	do.	'61	644	14	M	-----	560	109.4	12/24/64	1,750 R	-----	T, E	I	100	740	WS4.
16acc	do.	'52	925	18-12-1/4	M	S 90-925	550	105.4	12/24/64	1,400 R	200 R	T, E	I	---	-----	L4, WS4.
16ada	do.	'52	505	20	M	P 115-500	548	104.3	12/24/64	1,400 E	-----	T, E	I	92	1,380	L.
16baa	do.	'63	742	20	M	-----	-----	127.2	7/30/64	800 E	-----	T, E	I	95	1,550	L4.
16bbb	do.	'63	457	16	M	-----	565	122.7	12/24/64	960 R	-----	T, E	I	98	520	WS4.
21aad	do.	'58	580	20	M	P 90-570	527	84.0	12/24/64	2,500 R	74 R	T, E	I	93	850	L, WS4.
21bbb	do.	'51	612	16	M	P 100-612	540	123.8	7/30/64	1,400 R	80 R	T, E	I	93	485	L4, WS.
21bbd	do.	'57	373	18	M	-----	535	104.8	12/24/64	1,250 E	-----	T, E	I	91	650	L4, WS4.
22acd	do.	'54	250	8	M	OH 200-250	520	76	/54	16 R	-----	T, E	D	---	-----	WS4, labor camp.
33cda1	Carter, Hickenbottom, and Kondora	'64	247	6	M	-----	465	60	/64	5 R	-----	T, E	D	88	840	WS.
33cda2	Southern Pacific Railroad	'54	152	8	M	-----	467	86	/64	-----	-----	C, E	D	---	-----	L4, WS4.
35bbb	Bruce Church	'53	486	-----	---	-----	477	51.5	2/18/65	-----	-----	N, N	N	---	-----	L, WS4.
(C-5-13)25ddc	Paul Pierce	'54	510	-----	---	-----	493	92.8	7/14/64	-----	-----	N, N	N	---	-----	
(C-6-9)5dcc	Walter Burdette	-----	-----	6	M	-----	625	72.0	7/21/64	-----	-----	C, W	S	---	-----	

Table 3.--Records of selected wells, Dateland-Hyder area, Arizona—Continued

Location	Owner or user	Year completed (19-)	Depth of well (feet)	Casing record			Land-surface altitude (feet above mean sea level)	Water level		Yield (gpm)	Drawdown (feet)	Type of pump and power	Use	Temperature (°F)	Field conductivity	Remarks
				Diameter (inches)	Type	Finish (feet)		Depth to water (feet)	Date measured							
(C-6-9)31dad	Madeline Morrison	'23	360	6	M	-----	690	300	/55	-----	-----	N, N	N	---	-----	LA.
32ccb	Southern Pacific Railroad	'17	1,030	11-5/8-9-5/8	M	-----	687	174.5	2/14/57	-----	-----	T, E	PS	---	-----	L, WS, supplies water for Sentinel.
(C-6-10)29cca	Walter Burdette	-----	131	6	M	-----	535	119.7	7/22/64	-----	-----	C, W	S	---	-----	
31dda$_1$	V. J. Lag	'60	750	16	M	S 257-574 OH 574-750	532	-----	-----	-----	-----	T, D	I	---	-----	L, not in use now.
31dda$_2$	do.	-----	-----	-----	---	-----	532	-----	-----	-----	350 R	T, E	I	---	-----	LA, not in use now.
34ccc	Walter Burdette	'61	1,250	20-16	M	S 150-1,225	571	126.4	3/12/65	-----	-----	N, N	I	---	-----	Not yet in use.
(C-6-11)4aba	A. T. Daniels	'53	267	16	M	P 42-267	420	27.0	7/10/64	-----	-----	T, E	I	---	-----	L, not in use now.
4bab$_1$	do.	-----	-----	16	M	-----	423	26.3	7/10/64	-----	-----	T, E	I	---	-----	Not in use now.
4bab$_2$	do.	-----	-----	20	M	-----	422	26.9	7/10/64	-----	-----	T, E	I	---	-----	Not in use now.
5aaa	do.	'53	603	20	M	P 45-603	419	24.2	2/ 2/65	-----	-----	T, E	I	---	-----	L, WL, not in use now.
15daa	H. D. Mollohan	-----	-----	6	M	-----	470	62.4	1/14/54	-----	-----	C, W	N	---	-----	
(C-6-12)3aba	Bruce Church	'52	505	24-20	M	P 100-500	455	55.6	7/10/64	-----	-----	N, N	N	---	-----	L4, WL.
3baa	do.	'53	800	20-16	M	S 40-700 OH 700-800	457	-----	-----	-----	-----	N, N	N	85	-----	L, WS4.
7bbb	Horn-Sturgis Gin	-----	103	8	M	-----	430	74.6	7/15/64	-----	-----	T, E	D	---	-----	L4.
7dda	Alfred C. Mueller	'61	1,620	18	M	P 64-200, 960-1,500	410	63.0	7/15/64	1,050 M	-----	T, E	I	82	1,900	L, WS.
7ddb	do.	'61	530	16	M	S 68-200 OH 220-530	408	64	/64	950 E	-----	T, E	I	82	1,540	LA.
8cda	do.	'64	-----	20	M	-----	410	59.0	7/15/64	-----	-----	N, N	I	---	-----	Not yet in use.
17baa	do.	'51	266	16	M	P 75-250	403	47.5	1/ 7/54	330 E	-----	T, E	I	80	4,600	L4.
17bda	do.	-----	-----	20	---	-----	395	-----	-----	1,900 M	-----	T, E	I	79	5,000	Surges.
17daa	do.	'51	206	20	M	P 65-190	395	35.9	1/ 7/54	1,050 M	90 R	T, E	I	76	2,900	L, WS.
17dab	do.	-----	-----	-----	---	-----	395	-----	-----	750 E	-----	T, E	I	76	3,800	WS4.
17dbb	do.	-----	175	20	---	P 50-80 OH 92-175	400	51.0	1/20/65	1,250 E	15 R	T, E	I	75	5,800	L4.
18aaa	do.	'61	220	16	M	P 64-200	405	61.9	7/15/64	-----	-----	N, N	N	---	-----	LA, not enough water for irrigation.
18dab	do.	-----	103.0	24	M	P 51-73	395	53.7	1/20/65	1,600 R	-----	N, N	N	---	-----	L4, WS4.
18ddd	do.	-----	116	20	---	-----	385	-----	-----	800 E	-----	T, E	I	75	6,800	WS.

Table 3.--Records of selected wells, Dateland-Hyder area, Arizona—Continued

Location	Owner or user	Year completed (19-)	Depth of well (feet)	Casing record			Land-surface altitude (feet above mean sea level)	Water level		Yield (gpm)	Drawdown (feet)	Type of pump and power	Use	Temperature (°F)	Field conductivity	Remarks
				Diameter (inches)	Type	Finish (feet)		Depth to water (feet)	Date measured							
(C-6-12)19aaa	Alfred C. Mueller	'41	125	24	M	P 44-67	388	41.3	1/ 7/54	1,000 R	10 R	T, E	I	75	6,300	L.
19bba	do.	-----	1,352	24	M	P 32-90	380	41.2	3/ 4/65	3,500 R	-----	N, N	N	---	-----	L, WL, backfilled to 100 feet. Water too highly mineralized.
20bab	do.	'51	270	16	---	P 70-255	385	41.0	7/15/64	-----	-----	N, N	N	---	-----	L.
24bda	Arizona Game and Fish Commission	'47	40	6	---	P 35-40	398	20.8	8/ 4/64	-----	-----	C, W	S	80	4,800	L.
27daa	Not known	-----	432	24	---	-----	397	11.0	12/20/45	2,600 R	26 R	N, N	N	---	-----	L.
27dbd	C. R. Amavisca	-----	-----	14	M	-----	398	29.8	8/ 4/64	-----	-----	C, G	S	---	-----	
30cdd	Not known	-----	-----	18	M	-----	375	25.0	7/20/64	-----	-----	T, E	D, I	---	-----	
(C-6-13)2bdd	C. R. Amavisca	-----	-----	-----	M	-----	485	101.8	7/14/64	-----	-----	N, N	N	---	-----	
2dca	do.	-----	-----	16	---	-----	465	89.3	2/ 2/65	-----	-----	T, P	I, S	---	-----	Pumps sand.
3aac	do.	-----	-----	6	M	-----	520	135.8	7/11/64	-----	-----	T, E	D	---	-----	
11dcc	Not known	-----	-----	48 - 8	C, M	-----	423	67.9	7/15/64	-----	-----	N, N	N	---	-----	
24abb	Alfred C. Mueller	-----	111	24	M	P 45-110	385	44.7	7/15/64	1,800 R	-----	N, N	N	---	-----	LA.
33ddd	James Girand	-----	75	-----	---	-----	360	-----	-----	-----	-----	T, N	N	76	-----	L.
35ada	do.	-----	100	24	M	-----	370	26.5	8/ 3/64	-----	-----	C, W	N	---	-----	L.
(C-7-10)32daa	E. L. Sisson	-----	300	8	M	-----	570	127.1	7/22/64	-----	-----	C, W	N	---	-----	
(C-7-11)12bca	K. P. Schaming	-----	222	8	M	P 120-140	527	91.7	3/ 3/65	-----	-----	N, N	N	---	-----	L.
21dad	C. L. Stephens	'64	650	10	M	-----	512	123.8	7/23/64	-----	-----	N, N	D	---	-----	Not yet in use.
27cdd	do.	'64	590	16	M	-----	532	-----	-----	2,100 M	71 R	T, E	I	89	1,100	WS.
27dcd	do.	'60	615	20	M	P 245-534 OH 543-615	540	100	/60	2,000 R	150 R	T, E	I	---	-----	L.
27ddd	do.	'60	678	20	M	P 265-603 OH 610-678	543	115	/60	1,400 E	150 R	T, E	I	94	1,090	L.
28ccc	do.	'61	-----	16	M	-----	529	-----	-----	1,400 E	150 R	T, E	I	86	1,120	
28ddd	do.	'61	-----	16	M	-----	528	148.9	7/23/64	2,500 R	50 R	T, E	I	---	-----	
36daa	E. L. Sisson	'51	546	20	---	-----	548	122.5	3/ 3/65	1,500 R	53 R	T, E	I	---	-----	L.
36ddc	do.	-----	-----	-----	---	-----	560	130.8	3/ 3/65	-----	-----	T, E	I	---	-----	WS.
36ddd	do.	-----	-----	-----	---	-----	563	129.3	3/ 3/65	-----	-----	T, E	I	---	-----	
(C-7-12)8ddd	Sun Country Acres	-----	-----	20	M	-----	448	76.2	7/24/64	-----	-----	N, N	I	---	-----	Not yet in use.

Table 3.--Records of selected wells, Dateland-Hyder area, Arizona—Continued

Location	Owner or user	Year completed (19-)	Depth of well (feet)	Casing record: Diameter (inches)	Casing record: Type	Casing record: Finish (feet)	Land-surface altitude (feet above mean sea level)	Water level: Depth to water (feet)	Water level: Date measured	Yield (gpm)	Drawdown (feet)	Type of pump and power	Use	Temperature (°F)	Field conductivity	Remarks
(C-7-12)13baa	H. P. Johnson	-----	180	6	M	-----	495	99.1	3/ 3/65	-----	-----	N, N	N	---	-----	WL.
13bbd	Southern Pacific Railroad	'56	658	10	M	P 590-644	495	105	/56	-----	-----	T, E	PS	92	3,600	WS, WSA, supplies water for Aztec.
14dcc	Kern McKenzie	'52	507	20	M	P 100-415 OH 415-507	495	90	/52	2,400 E	100 R	T, E	I	92	1,180	L, WS.
15cbc	Welton Crosby	-----	800	24	M	-----	472	106.9	1/30/64	2,500 R	-----	T, D	I	---	-----	
18ccb	John T. Sharrit	-----	2,000	12	M	-----	440	58.1	3/ 4/65	-----	-----	N, N	N	---	-----	L, WL.
19cca	Harris Farms	'50	678	20	M	P 500-666	448	90	/50	1,400 R	67 R	T, E	D, I	92	1,520	L, WS, WSA.
19cda	do.	'27	605	16	M	P 493-580	450	79.0	7/24/64	1,800 R	-----	N, N	N	---	-----	L.
20dda	do.	'52	140	8	M	-----	485	110.8	7/23/64	-----	-----	N, N	N	---	-----	L, WSA.
21bba	J. D. Breckenridge	-----	140	6	---	-----	470	75	/64	-----	-----	J, E	D	---	-----	
21bcc	J. W. Reed	-----	126	6	M	-----	478	81	/64	-----	-----	J, E	D	---	-----	LA.
22aab	George Woo	-----	-----	20	M	-----	495	140.3	8/ 4/64	-----	-----	N, N	N	---	-----	
22add	do.	-----	-----	-----	---	-----	510	-----	-----	-----	-----	T, E	D, I	88	2,580	
23bda	do.	'63	600	-----	---	-----	510	167.7	7/23/64	-----	-----	T, E	I	---	-----	
23bdd	do.	-----	-----	-----	---	-----	512	-----	-----	950 E	-----	T, E	I	90	1,230	
23cdd	Douglas White	-----	-----	16	M	-----	523	169.8	7/23/64	-----	-----	N, N	N	---	-----	
24bdd	Howard P. Johnson	-----	495	16	---	-----	510	118.2	8/23/56	1,500 E	-----	T, E	I	90	1,300	L, WS.
25acc	do.	'52	407	20	M	S 150-186 OH 196-407	530	167.6	4/ 2/65	500 R	175 R	N, N	N	---	-----	L.
(C-7-13)1ddd	James Girand	-----	168	18	M	-----	430	88.2	3/ 4/65	-----	-----	N, N	N	---	-----	L, WL.
22bbb	J. G Brown and associates	-----	855	20	M	P 150-190 OH 446-855	417	84.0	3/12/65	-----	-----	N, N	N	---	-----	L, WL.
(C-7-14)1bbc	Texas Hill Farms, Inc.	-----	198	16	M	-----	344	51.2	8/ 3/64	-----	-----	T, E	I	---	-----	
1bcc	do.	-----	98	-----	---	-----	345	27.8	8/16/56	1,150 M	-----	T, E	I	78	4,500	WS.
1cbc	do.	'64	600	20-12	M	-----	346	-----	-----	-----	-----	N, N	I	---	-----	Being drilled.
2aaa	do.	-----	98	20	M	-----	344	45.2	8/ 3/64	1,100 E	-----	T, E	I	76	4,500	
23ddd	Not known	-----	-----	5	M	-----	400	145.6	3/12/65	-----	-----	N, N	N	---	-----	
24aaa	Anderson	'63	-----	16	---	-----	409	-----	-----	-----	-----	T, D	I	---	-----	

Table 4.--Selected drillers' logs of test holes and wells, Dateland-Hyder area, Arizona

	Thickness (feet)	Depth (feet)
(C-4-9)4cbb		
Rock and sand	50	50
Red clay	150	200
Sand and gravel	30	230
TOTAL DEPTH		230
(C-4-10)10aaa		
Surface soil	5	5
Sand and gravel	15	20
Caliche	63	83
Sandy clay	87	170
Clay, hot	25	195
Sand	25	220
Sandy clay	20	240
Sand, clay streaks	55	295
Clay, streaks of sand	38	333
Clay	18	351
Clay, some sand	23	374
Clay	126	500
TOTAL DEPTH		500
(C-4-10)20bbb		
Caliche	50	50
Silt	150	200
Clay, hard, layers of sandstone	60	260
Silt and fine sand	30	290
Silt and clay	30	320
Clay	20	340
Fine sand	8	348
Silt	22	370
Hard silty clay	160	530
Silt	30	560
Clay and gravel	30	590
Clay	34	624
Clay, sand, and gravel	16	640
Sand and gravel	20	660
TOTAL DEPTH		660
(C-4-10)22aba		
Surface gravel, no water	28	28
Clay	113	141
Fine sand, small amount of water	8	149
Clay	25	174
Sand, more water	24	198
Clay	13	211
Sand, water	36	247
Clay	16	263
Sand, black, lots of water	39	302
Clay	79	381
Sand	6	387
Clay	73	460
Sand	7	467
Clay	33	500
TOTAL DEPTH		500
(C-4-11)11bab		
Sand gravel fill	218	218
Pea gravel and coarse sand, water	42	260
Sandy clay	60	320
Coarse gravel	29	349
Clay	91	440
Pea gravel	33	473
Sandy light clay	77	550
TOTAL DEPTH		550
(C-4-11)12abb[1/]		
Coarse sand and gravel, mostly volcanic material, subrounded; contains some caliche; contains some clay from 60 to 90 feet	90	90
Fine quartz sand, coarse volcanic gravels, and clay, partly cemented	30	120

	Thickness (feet)	Depth (feet)
(C-4-11)12abb—Continued		
Clay, sand, and gravel	36	156
Coarse gravel and some quartz sand	37	193
Coarse subrounded gravel; contains some rounded sand from 225 to 256 feet	63	256
Clay and sand	63	319
Rounded volcanic sand	31	350
Clay and subrounded sand	31	381
Coarse subangular volcanic gravel	31	412
Quartz sand and subrounded volcanic gravel	30	442
Volcanic sand and gravel	65	507
Coarse volcanic gravel	30	537
Coarse sand, subrounded	186	723
Fine subrounded sand	31	754
Clay with stringers of sand and gravel	31	785
Sand and gravel with clay stringers	32	817
Coarse sand and gravel, subrounded volcanic material	31	848
Fine rounded volcanic sand; contains some well-rounded quartz sand from 880 to 910 feet	94	942
Fine volcanic gravel	94	1,036
Fine gravel with stringers of clay	32	1,068
Fine gravel	31	1,099
Fine subrounded gravel and fine well-rounded quartz sand	93	1,192
Fine sand	37	1,229
TOTAL DEPTH		1,229
(C-4-11)15bbb		
Sandy clay	205	205
Gravel, water	44	249
Light clay	34	283
Sand and coarse gravel	31	314
Clay	98	412
Boulders, coarse sand	29	441
Light clay	28	469
TOTAL DEPTH		469
(C-4-11)16bbb		
Silt, sand	11	11
Sandy clay	203	214
Gravel, marble size, water	28	242
Sandy clay	54	296
Coarse gravel, water	46	342
Sandy clay	98	440
Gravel, marble size, water	53	493
Red clay	7	500
TOTAL DEPTH		500
(C-4-11)26bbb		
Gravel, sandy fill	108	108
Sandy clay	40	148
Fine sand, some water	33	181
Sandy clay	70	251
Gravel, pea size, water	12	263
Sandy clay	33	296
Gravel, marble size, water	13	309
Red clay	21	330
TOTAL DEPTH		330
(C-4-11)33bbb		
Clay base conglomerate	25	25
Mountain-type sand	3	28
Conglomerate	3	31
Conglomerate sand, clay base	26	57
Silty clay from small rocks	80	137
Fine sand, clay layers	9	146
Fine red and black sand	3	149
Fine red and black sand; contains few small mountain gravels	47	196
Clay and sandstone floaters	47	243
Silt and sand	9	252
Less silt, good mountain gravel	14	266
Cemented sand and gravel	5	271

Table 4.--Selected drillers' logs of test holes and wells, Dateland-Hyder area, Arizona—Continued

	Thickness (feet)	Depth (feet)
(C-4-11)33bbb—Continued		
Loose sand and gravel	17	288
Fine packed sand and silt	3	291
Sand, gravel, clay base	17	308
Silt	3	311
Sand, gravel, sandstone, firm	6	317
Clay	2	319
Silt	14	333
Hard red clay	3	336
Silt	11	347
Hard red clay	7	354
Sand	7	361
Silt, clay, few gravels	12	373
Silt and sand	36	409
Silt, few gravels	5	414
Silt and clay layers	22	436
Mountain-type gravel	6	442
Silt and clay	13	455
Loose silt, sand	28	483
Silt, sand, clay	6	489
Hard clay	1	490
Sand, few gravels	17	507
Clay	3	510
Layers of sand, silt, conglomerate; contains a few gravels	82	592
Good mountain gravel	13	605
Clay	3	608
Silt, sand	20	628
Layers of silt, sand	20	648
Fine conglomerate	51	699
Sand	15	714
Layers of silt, clay	65	779
Bentonite	77	856
Layers of clay, silt, sand, caliche, all dry	74	930
Black bentonite	9	939
Packed coarse sand	43	982
Decomposed rock	16	998
Loose rock formation	53	1,051
No record	39	1,090
TOTAL DEPTH		1,090
(C-5-10)16bbb		
Surface sand	20	20
Gravel and sand	20	40
Clay with gravel streaks	140	180
Clay	60	240
Sticky clay	220	460
Clay with thin gravel streaks and fine silt	360	820
Clay with sand and gravel streaks	80	900
Gravel and clay	20	920
Malpais, contains streaks of clay from 920 to 980 feet, streaks of sand from 1,100 to 1,150 feet, and good round gravel and sand from 1,150 to 1,240 feet	340	1,260
Granite	8	1,268
TOTAL DEPTH		1,268
(C-5-10)16ccb		
Silt	15	15
Coarse sand	10	25
Quicksand	5	30
Gravel, water-bearing	20	50
Clay	22	72
TOTAL DEPTH		72
(C-5-10)23add		
Silt	31	31
Gravel and sand, water	26	57
Clay	21	78
Gravel sand	8	86
Clay	14	100
TOTAL DEPTH		100
(C-5-10)28dbb		
Silt	18	18
Sand and rock, water at 21 feet	39	57
Sandy clay	27	84
Sand	2	86
Clay	47	133
TOTAL DEPTH		133
(C-5-10)32aaa		
Soil	18	18
Quicksand	8	26
Gravel and boulders	44	70
Brown clay	13	83
Streaks of sand and gravel	29	112
TOTAL DEPTH		112
(C-5-10)32cbd		
Silt	17	17
Boulders and sand	31	48
Silt	32	80
Clay	6	86
TOTAL DEPTH		86
(C-5-11)2bbb		
Topsoil	3	3
Caliche	17	20
Gravel, sand, $\frac{1}{2}$ inch	10	30
Yellow sandy clay	32	62
Gravel, 2 inches	14	76
Yellow clay	5	81
Gravel and sand, 1 inch, water at 92 feet	12	93
Yellow clay	184	277
Sandstone	3	280
Yellow clay	143	423
No record	255	678
[Rest of log by Turner and Associates]		
Fine medium-grained quartz sand and clay	12	690
Mostly clay with a little fine sand	15	705
Sand and gravel	95	800
Sand and gravel, volcanic, dark-gray	160	960
Sand and gravel, volcanic, reddish-gray	40	1,000
TOTAL DEPTH		1,000
(C-5-11)10dda		
Soil	8	8
Conglomerate	14	22
Clay and sand, mixed	12	34
Gravel, water at 94 feet	74	108
Clay	52	160
Gravelly clay	40	200
Clay	20	220
Gravelly clay, water	6	226
Clay	239	465
Clay, cinders	10	475
Cinders	35	510
TOTAL DEPTH		510
(C-5-12)4bcb		
Decomposed granite and gravel	110	110
Solid granite and gravel	35	145
Sand and $\frac{1}{4}$-inch gravel	95	240
Granite conglomerate, hard	20	260
Granite wash, $\frac{1}{4}$ inch	20	280
Granite conglomerate	20	300
Granite wash, $\frac{1}{4}$ inch	40	340
Large gravel, water	20	360
Granite conglomerate	10	370
TOTAL DEPTH		370

Table 4.--Selected drillers' logs of test holes and wells, Dateland-Hyder area, Arizona—Continued

	Thickness (feet)	Depth (feet)
(C-5-12)4cdd[1/]		
Silt, sand, gravel, and boulders, cemented by lime; volcanic, rhyolite, quartz, quartzite. Becomes finer and contains some epidote below 20 feet	60	60
Gravel cemented by caliche; mostly lava and tuff; contains some quartz, granite, and schist. Becomes more rounded and smaller below 110 feet	60	120
Mostly rounded sand and gravel; quartz, lava, and epidote	170	230
Sand and gravel, angular to rounded lava and quartz, some tuff	70	300
Sand and gravel, subangular to rounded; lava and quartz; contains some granitic rock below 340 feet	110	410
Mostly angular gray-brown volcanic sand and gravel; contains some rounded finer material; quartz, red and white granite. Becomes coarser from 420 to 480 feet, finer from 480 to 560 feet. Contains some basalt below 490 feet	150	560
Moderately well-rounded sand and pea gravel with some fine material; mostly acidic lava and quartz with some granite	70	630
Quartz and granite sand and gravel with some rhyolite. Becomes finer and contains calcareous clay balls below 670 feet	70	700
Silt, sand, and gravel, some red clay; mostly acidic volcanic material with some granitic and metamorphic material	80	780
Volcanic sand with some silt, dark gray to white	10	790
White tuff with some gray rhyolite	30	820
Silicified tuff	10	830
White, gray, and pink tuff; contains some perlite from 840 to 860 and 870 to 900 feet, biotite from 860 to 870 and 980 to 1,040 feet, crystalline quartz below 940 feet, and gray and brown rhyolite from 1,050 to 1,060 feet	230	1,060
Gray and brown rhyolite with some white tuff and biotite	120	1,180
Brown volcanic rocks with some brown clay and tuff	10	1,190
Brown clay with thin layers of sand and pea gravel (volcanic and quartz)	20	1,210
Brown dacite and red clay, weathered, angular, lots of quartz; becomes grayish below 1,320 feet; contains cinders below 1,330 feet; becomes darker and coarser below 1,350 feet	260	1,470
Gray and red acidic volcanic conglomerate, very hard (3 to 7 feet per hour)	30	1,500
Sand and gravel, pale-green to reddish-gray; rhyolite and andesite	20	1,520
Rhyolite conglomerate, pale-green to reddish-brown; becomes lighter in color below 1,610 feet	110	1,630
Moderately cemented light-gray rhyolite sand and gravel	50	1,680
Red and pale-green volcanic conglomerate	10	1,690
TOTAL DEPTH		1,690
(C-5-12)9bbb		
Topsoil	4	4
Cemented rocks	6	10
Clay and gravel	110	120
Gravel; contains clay	110	230
Conglomerate and clay, hard	150	380
Granite, decomposed	40	420
Malpais boulders	140	560
TOTAL DEPTH		560
(C-5-12)15cac		
Soil	5	5
Sand and rock	20	25
Sandy clay	15	40
Sand, brown	40	80
Clay, white	23	103
Water sand	7	110
Sandy clay	20	130

	Thickness (feet)	Depth (feet)
(C-5-12)15cac—Continued		
Sand	39	169
Gravel	3	172
Sand	6	178
Sandy clay	5	183
Sand, fine	4	187
Sand, coarse	8	195
Sand	25	220
Clay	25	245
Sandy clay	10	255
Sand; contains clay streaks below 265 feet	40	295
Clay and sand	5	300
Clay	5	305
Sand	10	315
Sand and clay	5	320
Clay, becomes sandy from 325 to 350 and from 355 to 360 feet	55	375
Sand	5	380
Sand and clay	20	400
Sand	15	415
Clay	5	420
Coarse sand	15	435
Sand	23	458
Sandy clay	7	465
Clay	10	475
TOTAL DEPTH		475
(C-5-12)16aab		
Gravel	30	30
Clay	100	130
Malpais gravel and clay	270	400
No record	225	625
TOTAL DEPTH		625
(C-5-12)16ada		
Soil	3	3
Sand and gravel	17	20
Sand and clay	45	65
Sand, show of water	5	70
Sand and clay	45	115
Sand, water	15	130
Sand and thin layers of clay	90	220
Coarse sand	10	230
Sand and clay	15	245
Hot mud	10	255
Sand and thin layers of clay	25	280
Clay	5	285
Sandy clay	5	290
Gravel	30	320
Sand and gravel	38	358
Sand	7	365
Sandy clay	10	375
Sand	20	395
Sandy clay	5	400
Sand and gravel	20	420
Sand and clay	10	430
Sand and gravel	10	440
Sand and clay	5	445
Sand	15	460
Sandy clay	20	480
Sand	6	486
Clay	4	490
Sand	15	505
TOTAL DEPTH		505
(C-5-12)21aad		
Volcanic ash	4	4
Gravel	66	70
Clay	90	160
Sand	150	310
Clay	10	320
Sand	40	360
Clay	30	390
Sand	180	570

Table 4.--Selected drillers' logs of test holes and wells, Dateland-Hyder area, Arizona—Continued

	Thickness (feet)	Depth (feet)
(C-5-12)21aad—Continued		
Clay	10	580
TOTAL DEPTH		580
(C-5-12)35bbb		
Soil	3	3
Rock and gravel	27	30
Sandy clay	15	45
Rock and gravel	5	50
Sandy clay	65	115
Sand	3	118
Sandy clay	17	135
Clay	5	140
Sandy clay	30	170
Sand and silt	15	185
Clay	20	205
Sandy clay	25	230
Coarse gravel	6	236
Sand and clay	9	245
Sandy clay	45	290
Muddy sand	12	302
Coarse gravel	8	310
Sandy clay	10	320
Sand and gravel	5	325
Sandy clay	45	370
Coarse sand and gravel	12	382
Red clay	3	385
Clay	15	400
Sandy clay	48	448
Tough clay	4	452
Sandy gravelly clay	30	482
Tough clay	4	486
TOTAL DEPTH		486
(C-6-9)32ccb		
Soil	20	20
Yellow clay	22	42
Lava	2	44
Malpais boulders	26	70
Solid rock	15	85
Clay and boulders	5	90
Lava	16	106
Malpais boulders and clay	34	140
Malpais	36	176
Clay, water rose to 180 feet	44	220
Sand and gravel	10	230
Heavy clay	74	304
Sand and clay	36	340
Boulders and sand	14	354
Clay	561	915
Rock	25	940
Clay	40	980
Gravel	15	995
Rock	11	1,006
Porous rock, water	8	1,014
Clay	6	1,020
Rock	10	1,030
TOTAL DEPTH		1,030
(C-6-10)31dda$_1$		
Hard rock	45	45
Clay and gravel	30	75
Clay	25	100
Sandy clay	21	121
Sand and gravel	54	175
Caliche	10	185
Clay and gravel	70	255
Sand and clay	60	315
Clay	195	510
Sandy clay	240	750
TOTAL DEPTH		750

	Thickness (feet)	Depth (feet)
(C-6-11)4aba		
Silt	23	23
Gravel	25	48
Clay	16	64
Quicksand	14	78
Clay	22	100
Gravel and clay	23	123
Sand and clay	97	220
Large gravel and clay	20	240
Clay	27	267
TOTAL DEPTH		267
(C-6-11)5aaa		
Soil	19	19
Gravel and sand, water at 26 feet	30	49
Clay	15	64
Quicksand	14	78
Clay	19	97
Quicksand	29	126
Sticky clay	28	154
Clay and fine sand, mixed	50	204
Clay	26	230
Quicksand	4	234
Hard packed clay	20	254
Fine sand	18	272
Gravel, sand, and clay, mixed	21	293
Clay	310	603
TOTAL DEPTH		603
(C-6-11)36ddd [2/]		
Soil	2	2
Hard clay and gravel	13	15
Black rock, hard	19	34
Clay	1	35
Blue rock, hard	21	56
Rock clay	5	61
Clay	12	73
Sandy clay	158	231
No record	20	251
Sand and clay	67	318
Sand and sheets	37	355
Sand and shells	21	376
Sand and clay	35	411
Sand	31	442
Sandy clay	236	678
Hard sand	43	721
Sandy clay	29	750
TOTAL DEPTH		750
(C-6-12)3baa		
Surface sand and gravel	80	80
Sandy clay	120	200
Sand	15	215
Sandy clay	90	305
Fine sand	25	330
Sandy clay	60	390
Fine sand	15	405
Sandy clay	95	500
Fine sand	30	530
Sandy clay	70	600
Fine sand	25	625
Sandy clay with lots of fine sand	75	700
Clay with very little sand	100	800
TOTAL DEPTH		800
(C-6-12)7dda		
Soil	28	28
Sand	5	33
Conglomerate	12	45
Clay with streaks of sand	15	60
Coarse gravel with fine sand	140	200
Sandy clay	20	220
Clay	740	960

Table 4.--Selected drillers' logs of test holes and wells, Dateland-Hyder area, Arizona—Continued

	Thickness (feet)	Depth (feet)
(C-6-12)7dda—Continued		
Small gravel with fine sand	160	1,120
Decomposed granite, soft	300	1,420
Decomposed granite, hard	200	1,620
TOTAL DEPTH		1,620
(C-6-12)17daa		
Silt soil	4	4
Sandy clay	14	18
Clay, soft	24	42
Gravel	32	74
Clay	10	84
Sand, mucky	11	95
Clay	2	97
Sand, mucky	17	114
Clay, tough	32	146
Mucky sand and clay layers	46	192
Clay, tough	14	206
TOTAL DEPTH		206
(C-6-12)19aaa		
Topsoil, very sandy	38	38
Sand, gravel, river boulders	28	66
Lots of sand, some clay	20	86
Sandy clay	22	108
Clay	17	125
TOTAL DEPTH		125
(C-6-12)19bba		
Clay	37	37
Coarse gravel	25	62
Yellow clay	49	111
Soft clay	220	331
Hard sticky clay	238	569
Very sticky brownish-yellow clay with occasional streaks of caliche	336	905
Red sticky clay	39	944
Brown clay, very sticky	126	1,070
Sticky clay with very little showing of gravel	12	1,082
Brown sticky clay	21	1,103
Sticky clay and caliche	28	1,131
Hard clay and caliche	37	1,168
Brown sticky clay	147	1,315
Hard clay and caliche	10	1,325
Brown sticky clay	27	1,352
TOTAL DEPTH		1,352
(C-6-12)20bab		
Sandy clay	33	33
Gravel	38	71
Clay	1	72
Sand	4	76
Clay	148	224
Shells and sandy clay	46	270
TOTAL DEPTH		270
(C-6-12)24bda		
Silt and sand	13	13
Adobe dirt	1	14
Small rock, sand, and gravel	13	27
Good river rock, sand, and gravel	13	40
TOTAL DEPTH		40
(C-6-12)27daa		
Soil	8	8
Sand	14.8	22.8
Sand and boulders	15.8	38.6

	Thickness (feet)	Depth (feet)
(C-6-12)27daa—Continued		
White clay	2	40.6
Cemented gravel	4	44.6
Sand	4.1	48.7
Cemented gravel with streaks of sand	16	64.7
Clay	8.8	73.5
Cemented gravel; contains soft streaks from 84.5 to 110 feet, clay from 110 to 123 feet	49.5	123
Soft clay; contains hard streaks from 131 to 145 feet	22	145
Clay	105	250
Sand, water-bearing	32	282
Sand, shale, and clay	150	432
TOTAL DEPTH		432
(C-6-13)33ddd		
Black soil	1	1
Sand	7	8
Silt	2	10
Blue mud	2	12
Sand	24	36
Free gravel	29	65
Clay	10	75
TOTAL DEPTH		75
(C-6-13)35ada		
Valley soil	10	10
River sand	18	28
Very hard cement gravel	6	34
Cement sand	1	35
Coarse tight wash gravel	2	37
Very hard cement gravel	2	39
Coarse tight wash gravel	12	51
Small gravel	8	59
Clay	41	100
TOTAL DEPTH		100
(C-7-11)11bcc[2/]		
Soil	1	1
Hard sandy clay	4	5
Sand and gravel	30	35
Clay	5	40
Hard sand and fine gravel	60	100
Clay	2	102
Hard sand and streaks of clay	64	166
Sand	16	182
Sandy clay	28	210
Clay and fine gravel	13	223
Sandy clay; contains streaks of sand below 385 feet	386	609
TOTAL DEPTH		609
(C-7-11)12bca		
Soil	1	1
Clay	6	7
Lava rocks	29	36
Sand	2	38
Clay	6	44
Coarse sand	9	53
Sand rock	3	56
Clay	31	87
River sand	22	109
Sand	6	115
Clay and sand	3	118
Clay	50	168
Clay and sand	39	207
Clay	3	210
Sand	3	213
Sand rock	1	214
Clay	4	218
Sand	4	222
Clay at 222 feet		
TOTAL DEPTH		222

Table 4.--Selected drillers' logs of test holes and wells, Dateland-Hyder area, Arizona—Continued

	Thickness (feet)	Depth (feet)
(C-7-11)23aaa[2/]		
Sand and gravel	24	24
Clay	2	26
Sand	10	36
Gravel	4	40
Clay	7	47
Sand	51	98
Clay	15	113
Hard sand	5	118
Clay	5	123
Sand	62	185
Sandy clay	27	212
Sand	9	221
Clay	66	287
Sand and streaks of clay	21	308
Sandy clay	295	603
Sandy clay and streaks of sand	97	700
TOTAL DEPTH		700
(C-7-11)27dcd		
Topsoil	15	15
White clay	15	30
Sand	60	90
Sticky clay	45	135
Sandy clay	40	175
Sticky clay	20	195
Clay	25	220
Sandy clay	25	245
Sand	35	280
Tight sand	25	305
Sticky clay	30	335
Sandy clay	60	395
Sticky clay	35	430
Sandy clay	20	450
Sticky clay	20	470
Sandy clay	30	500
Sand	10	510
Mountain rock, hard	105	615
TOTAL DEPTH		615
(C-7-11)27ddd		
Topsoil	20	20
White clay	20	40
Clay	50	90
Fine sand	220	310
Sandy clay	60	370
Fine sand	20	390
Sandy clay	120	510
Sticky clay	20	530
Gravel	42	572
Sand	18	590
Clay	15	605
Hard sharp gray rock	73	678
TOTAL DEPTH		678
(C-7-11)36daa		
Sandy clay	20	20
Sand, caves	15	35
Sandy clay	20	55
Sand	10	65
Red clay	50	115
Sandy clay	10	125
Clay	30	155
Sand, seep	5	160
Clay	30	190
Sandy clay	23	213
Sand, water rose to 110 feet	5	218
Clay, sticky, slow drilling	162	380
Sand and clay, becoming sandier	25	405
Sandy clay	55	460
Sand and clay, some water	15	475
Sand, stands	15	490
Sand rock	12	502
Sand, stands	10	512
Sand with clay balls	8	520
Conglomerate, some quartz rock	7	527
(C-7-11)36daa—Continued		
Coarse sand, good water	8	535
Quartz ledge	5	540
Sand, water	2	542
Quartz rock, drilled 2 feet in one day	4	546
TOTAL DEPTH		546
(C-7-12)14dcc		
Sandy soil	7	7
Sand	23	30
Coarse sand	37	67
Brown clay	12	79
Coarse sand	3	82
Brown clay	59	141
Clay with a few sand streaks	94	235
Sand and clay streaks	90	325
Coarse gravel with a few clay streaks	90	415
Hard sand	21	436
Granite	2	438
Hard sand	6	444
Granite	2	446
Hard sand and granite streaks	61	507
TOTAL DEPTH		507
(C-7-12)18ccb		
Sand	3	3
Caliche	5	8
Sandy yellow clay	79	87
Sand, water-bearing	35	122
Yellow clay and gravel, water-bearing	604	726
Red lava, porous	509	1,235
Blue shale, shale oil showing	15	1,250
Red lava, porous; contains streaks of hot gray shale	445	1,695
Blue shale, oil showing	25	1,720
Red lava, porous; contains streaks of hot shale	280	2,000
TOTAL DEPTH		2,000
(C-7-12)19cca		
Clay	12	12
Gravel	113	125
Sand	10	135
Clay and gravel	383	518
Gravel, very sharp	132	650
Clay and gravel	28	678
TOTAL DEPTH		678
(C-7-12)19cda		
Sandy loam	3	3
Clay	26	29
Sand	36	65
Gravel, dry	9	74
Clay	18	92
Sand, water at 92 feet	18	110
Clay	6	116
Quicksand	18	134
Clay	326	460
Sand rock	7	467
Clay	16	483
Heavy boulders, gravel	97	580
Conglomerate	25	605
TOTAL DEPTH		605
(C-7-12)20dda		
Sand and gravel	43	43
Clay	47	90
Sand and clay, water	20	110
Sand and gravel, clear	20	130
Clay and gravel	10	140
TOTAL DEPTH		140

Table 4.--Selected drillers' logs of test holes and wells, Dateland-Hyder area, Arizona—Continued

	Thickness (feet)	Depth (feet)
(C-7-12)24bdd[1/]		
Granitic sand, slightly calcareous, well-rounded	160	160
Granitic sand, very calcareous, well-rounded; contains some clay from 180 to 200 feet	80	240
Sand and gravel, slightly calcareous, granitic and schistose material	40	280
Sand, calcareous, granitic and schistose material; contains some clay	40	320
Sand, granitic and schistose material	175	495
TOTAL DEPTH		495
(C-7-12)25acc		
Soil	4	4
Caliche	12	16
Loose sand	44	60
Sandy clay	80	140
Quicksand	10	150
Sandy clay	15	165
Milky crushed rock, not heavy, hard; contains small breaks below 196 feet	242	407
TOTAL DEPTH		407
(C-7-13)1ddd		
Sandy loam	4	4
Caliche clay	4	8
Sand	3	11
White clay	2	13
(C-7-13)1ddd—Continued		
Sand and pea gravel	25	38
Cemented gravel	9	47
Free gravel	2	49
Fine sand	2	51
Coarse sand and a lot of pea gravel	20	71
Hard cemented gravel	2	73
White clay	1	74
Red clay	1	75
Clean free gravel	1	76
Fine sand with streaks of red clay, water at 92 feet	16	92
Red clay; water	3	95
Muddy sand with streaks of soft red clay	10	105
Clean sand, some small gravel	6	111
Cemented gravel	1	112
Heavy free gravel	30	142
Hard red clay	20	162
Clay, not so hard	6	168
TOTAL DEPTH		168
(C-7-13)22bbb		
Soil	10	10
Sand and gravel	140	150
Clay and little gravel	620	770
Clay with streaks of sandstone	8	778
Clay	22	800
Very sticky clay	55	855
TOTAL DEPTH		855

1/ Log by Turner and Associates.

2/ Test hole.

Table 5.--Chemical analyses of ground water, Dateland-Hyder area, Arizona

[Analyses in parts per million, except as indicated. All samples were collected from August 3 to 7, 1964. Classification of irrigation water: S, sodium hazard; C, salinity hazard. (See fig. 8.)]

Well location	Depth of well (feet)	Temperature (°F)	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Lithium (Li)	Dissolved solids (calculated)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium-adsorption ratio (SAR)	Specific conductance (micromhos at 25°C)	pH	Classification of irrigation water
(C-4-10)3daa	451	92	19	5.1	0	206	......	93	5	131	164	5.8	7.7	0.41	0.40	590	12	0	97	25	1,040	8.6	C3-S4
(C-4-11)2bbb	530	102	61	16	1.0	201	......	70	16	118	186	5.6	7.0	1.0	.48	647	44	0	90	13	1,080	9.0	C3-S3
5bbb	465	103	50	29	1.2	148	5.3	108	0	86	146	4.4	13	.47	.44	537	77	0	79	7.3	896	8.0	C3-S2
12abb ...	1,229	100	56	10	1.0	215	......	84	13	118	192	5.2	4.7	.99	.48	657	29	0	94	17	1,100	8.9	C3-S4
12bbb ...	415	95	49	81	5.8	350	9.7	88	0	132	557	5.0	17	1.2	.95	1,250	226	154	76	10	2,240	7.5	C3-S3
16bbb ...	500	86	40	65	2.7	165	5.0	96	0	94	240	3.8	17	.39	.59	680	173	94	66	5.5	1,180	8.1	C3-S1
21abb ...	1,375	90	80	5.9	.6	178	......	84	31	90	126	5.8	9.9	.64	.40	569	17	0	95	19	892	9.3	C3-S4
(C-5-9)12aca ...	150	77	34	808	210	2,440	22	534	0	1,400	4,420	4.7	4.5	16	3.8	9,630	2,880	2,440	64	20	14,900	7.1	C4-S4
12acd ...	610	90	19	46	.2	403	2.0	12	8	274	478	4.0	1.7	2.0	.92	1,240	116	92	88	16	2,180	8.9	C3-S4
(C-5-10)16cbc ...	......	104	42	67	4.1	489	4.6	110	0	392	482	4.4	67	3.7	1.1	1,610	184	94	84	16	2,600	7.8	C4-S4
(C-5-11)1dcb	900	89	36	4.3	.4	210	2.1	81	12	111	178	4.6	8.3	.77	.44	608	12	0	96	26	1,030	9.0	C3-S4
11cab ...	1,000	98	44	12	0	196	......	79	6	110	178	4.5	8.7	.76	.44	599	30	0	93	16	1,020	8.8	C3-S3
(C-5-12)15cac ...	475	93	46	182	31	248	10	118	0	144	587	3.8	91	.79	1.0	1,400	580	484	47	4.5	2,450	7.6	C4-S2
16aab ...	625	90	45	45	6.2	178	6.6	123	0	118	194	3.7	41	.46	.60	699	138	37	72	6.6	1,160	7.2	C3-S2
21bbb ...	445	93	47	47	7.4	185	9.3	124	0	97	238	4.0	19	.46	.62	716	148	46	71	6.6	1,230	8.0	C3-S2
33cda[1] ..	247	88	39	11	1.6	159	3.6	104	3	75	144	4.1	11	.42	.48	503	34	0	89	12	852	8.5	C3-S3
(C-6-9)32ccb ...	1,030	......	40	22	1.2	214	3.0	80	0	151	204	6.5	6.6	1.8	.62	690	60	0	87	12	1,180	8.1	C3-S3
(C-6-12)7dda	1,620	82	60	30	9.0	386	2.4	228	0	230	368	6.7	12	1.7	.88	1,220	112	0	87	16	2,030	8.0	C3-S4
17daa ...	206	76	37	152	60	389	8.0	266	0	270	707	.9	.4	.82	1.1	1,760	624	406	57	6.8	3,050	7.1	C4-S2
18ddd ...	116	76	39	305	129	1,280	......	343	0	988	1,920	2.0	26	3.3	1.8	4,860	1,290	1,010	68	16	7,770	7.1	C4-S4
(C-7-11)27cdd ...	590	89	52	21	2.1	220	2.7	66	13	154	202	8.0	4.9	1.5	.60	714	61	0	87	12	1,190	8.9	C3-S3
36ddc ...	......	......	41	29	1.8	268	3.4	84	0	222	246	7.7	5.5	1.7	.65	868	80	11	87	13	1,460	8.1	C3-S3
(C-7-12)13bbd ...	658	92	27	156	9.0	635	5.8	87	0	940	550	6.6	18	3.5	1.5	2,400	426	354	76	13	3,650	6.8	C4-S4
14dcc ...	507	92	31	22	.7	232	3.1	72	0	167	224	7.6	6.0	2.0	.72	731	58	0	88	13	1,260	7.0	C3-S3
19cca ...	678	92	24	35	6.0	284	......	90	0	215	302	4.8	6.8	1.4	.60	924	112	38	84	12	1,610	7.3	C3-S3
24bdd ...	495	90	38	31	.9	249	5.0	88	0	205	232	8.2	1.3	1.9	.65	816	81	9	85	12	1,380	7.0	C3-S3
(C-7-14)1bcc	98	78	27	343	103	523	......	300	0	794	945	.6	2.2	.72	1.2	2,890	1,280	1,030	47	6.4	4,510	7.2	C4-S2

Table 6.--Measurements of the water level in observation wells, Dateland-Hyder area, Arizona

[In feet below land surface]

Well	Date	Water level
(C-4-10)6bba	3-24-53	236.50
	1-22-54	236.69
	3- 4-54	236.85
	1-25-55	[1]237.90
	2- 1-56	242.95
	2-15-57	238.25
	1-22-58	240.91
	2-12-59	242.70
	3- 3-60	244.83
	3-15-61	245.23
	3- 6-62	246.78
	2- 6-63	244.46
	1-29-64	246.13
(C-4-10)10aaa	2-14-57	198.43
	1-22-58	199.20
	2-12-59	200.55
	3- 3-60	201.31
	3-15-61	201.48
	3- 6-62	203.14
	2- 6-63	203.10
	1- 8-64	202.04
	7- 8-64	202.27
(C-4-10)22aba	1-19-54	129.45
	8-27-54	128.88
	2-14-57	129.09
	1-23-58	129.44
	2-12-59	129.58
	3- 3-60	129.93
	3-15-61	130.17
	3- 6-62	130.68
	2- 6-63	130.44
	1- 8-64	129.26
	7- 7-64	130.79
(C-4-10)32cdd	2-12-53	78.56
	1-19-54	78.87
	3- 4-54	78.89
	1-25-55	79.31
	2- 1-56	79.65
	2-15-57	79.84
	1-22-58	[2]78.12
	2-11-59	77.54
	3- 3-60	77.40
	3-15-61	77.13
	3- 6-62	76.89
	2- 6-63	76.83
	1-28-64	76.54
	7- 8-64	76.32
(C-4-11)2bbb	1-22-58	261.76
	2-12-59	263.79
	3- 3-60	264.59
	3-15-61	266.43
	3- 6-62	269.58
	2- 6-63	265.40
	7-29-64	271.21
(C-5-10)28ddd	1-13-54	19.38
	3- 4-54	18.85
	1-25-55	20.12
	2- 1-56	17.32
	2-15-57	18.14
	1-22-58	19.50
	3- 3-60	20.36
	3-14-61	21.55
	3- 6-62	21.75
	2- 6-63	21.22
	1-28-64	21.04
	7-21-64	21.39
(C-5-10)36aca	8-27-54	156.80
	2-14-57	154.13
	2-12-59	153.43
	3- 2-60	152.67
	3-14-61	153.70
	3- 6-62	154.26
	2- 6-63	154.09
	1-28-64	154.26
(C-5-11)3bba	3-24-53	99.05
	1-13-54	99.40
	3- 4-54	99.66
	1-25-55	99.85
	5- 8-55	100.00
	2- 1-56	100.90
	2-15-57	100.80
	1-22-58	101.48
	3- 3-60	103.51
	3-15-61	104.06
	2- 7-63	104.80
	1-29-64	106.65
	7-10-64	102.62
(C-5-11)15abb	3- 4-54	64.02
	1-25-55	63.70
	2- 1-56	64.30
	2- 1-57	63.58
	1-22-58	63.58
	2-11-59	64.89
	3- 3-60	66.22
	3-15-61	66.19
	3- 6-62	65.79
	2- 7-63	67.10
	1-29-64	68.18
	7-10-64	66.07
(C-5-12)5aaa	2- 1-57	148.16
	1-22-58	150.40
	2-11-59	155.01
	3- 8-62	158.00
	2- 7-63	157.83
	1-29-64	159.05
(C-5-12)16bab[3]	12-28-53	107.45
	3- 4-54	103.00
	1-25-55	108.35
	2- 1-56	107.15
	2- 1-57	109.26
	1-22-58	[4]119.05
	2-11-59	126.96
	3- 3-60	120.85
	3-15-61	106.90
	3- 8-62	[4]119.23
(C-6-11)5aaa	1-22-54	24.00
	8-25-54	31.71
	2- 1-57	25.98
	1-22-58	29.46
	2-11-59	30.55
	3- 3-60	28.88
	3-15-61	31.26
	3- 6-62	25.73
	2- 7-63	28.90
	1-29-64	29.89
	7-10-64	25.84

See footnotes at end of table.

Table 6.--Measurements of the water level in observation wells, Dateland-Hyder area, Arizona—Continued

Well	Date	Water level
(C-6-12)3aba	2-12-53	72.07
	3- 4-54	4/61.45
	1-25-55	70.15
	2- 1-56	65.52
	2- 1-57	63.68
	1-22-58	61.61
	2-11-59	58.46
	3- 3-60	56.23
	3-15-61	46.32
	3- 6-62	54.02
	2- 7-63	53.62
	1-29-64	54.13
	7-10-64	55.56
(C-6-12)19bba	5- 4-45	35.50
	10-24-45	36.50
	12-19-45	36.67
	3-26-46	35.80
	5-29-46	35.98
	9- 6-46	37.41
	12- 3-46	36.94
	2-11-47	36.99
	6- 4-47	37.17
	8-26-47	37.95
	9- 7-48	38.16
	3- 7-49	41.35
	3-16-50	44.86
	1-30-52	41.03
	2-12-53	40.84
	8-24-54	39.92
	1-25-55	39.10
	2- 1-56	37.70
	2- 1-57	37.64
	1-22-58	37.66
	2-11-59	38.79
	3- 3-60	41.30
	3-15-61	40.34
	3- 8-62	40.81
	2- 8-63	41.23
	1-29-64	41.31
	7-15-64	39.96
(C-7-12)13baa	5- 4-45	104.20
	10-24-45	104.39
	12-19-45	104.30
	3-26-46	104.33
	5-28-46	104.40
	9- 6-46	105.16
	12- 3-46	104.36
	2-11-47	104.40
	6- 4-47	104.36
	8-26-47	104.49
	3- 1-48	104.37
	9- 7-48	106.30
	3- 7-49	104.42
	11-11-49	104.49
	3-16-50	105.22
	2-21-51	104.44
	2-10-53	104.61
	3- 3-54	103.94
	1-25-55	103.98
	2- 2-56	103.42
	2-15-57	101.59
	1-22-58	101.05
	2-11-59	101.59
	3-15-61	100.45
	2- 8-62	100.35
	2- 8-63	100.48
	1-30-64	99.52
	7-23-64	101.29
(C-7-12)18ccb	5- 4-45	26.92
	10-24-45	24.99
	12-19-45	22.50
	3-26-46	25.05
	5-29-46	23.06
	9- 6-46	20.04
	12- 3-46	19.60
	2-11-47	20.67
	6- 4-47	18.70
	8-26-47	18.95
	3- 1-48	21.75
	9- 7-48	23.05
	3- 7-49	25.31
	11-11-49	18.89
	3-16-50	20.47
	2-21-51	18.32
	1-30-52	21.53
	2-12-53	25.60
	3- 4-54	23.70
	1-25-55	29.93
	2- 1-56	29.31
	2- 1-57	31.35
	1-22-58	31.82
	2-11-59	39.10
	3- 3-60	45.90
	3-18-61	48.83
	3- 8-62	53.69
	2- 8-63	55.99
	1-30-64	56.40
	7-24-64	59.55
(C-7-13)1ddd	5- 4-45	81.82
	10-24-45	82.10
	12-19-45	82.44
	3-26-46	82.67
	5-29-46	81.58
	9- 6-46	81.80
	12- 3-46	81.37
	2-11-47	82.82
	6- 4-47	81.90
	8-26-47	81.45
	3- 1-48	82.79
	9- 7-48	82.90
	3- 7-49	83.02
	1-25-55	84.59
	2- 1-57	83.85
	1-22-58	85.50
	2-11-59	85.42
	3- 3-60	83.10
	3-15-61	86.14
	3- 8-62	86.89
	2- 8-63	85.55
	1-30-64	87.72
	7-20-64	88.02
(C-7-13)22bbb	8-24-54	82.41
	2- 1-57	82.71
	1-22-58	82.82
	2-11-59	83.17
	3- 3-60	83.10
	3-15-61	83.25
	3- 8-62	83.22
	2- 8-63	83.41
	1-30-64	83.44
	7-20-64	83.55

1/ Pump installed.
2/ Well deepened.
3/ Destroyed.
4/ Pumping nearby.

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