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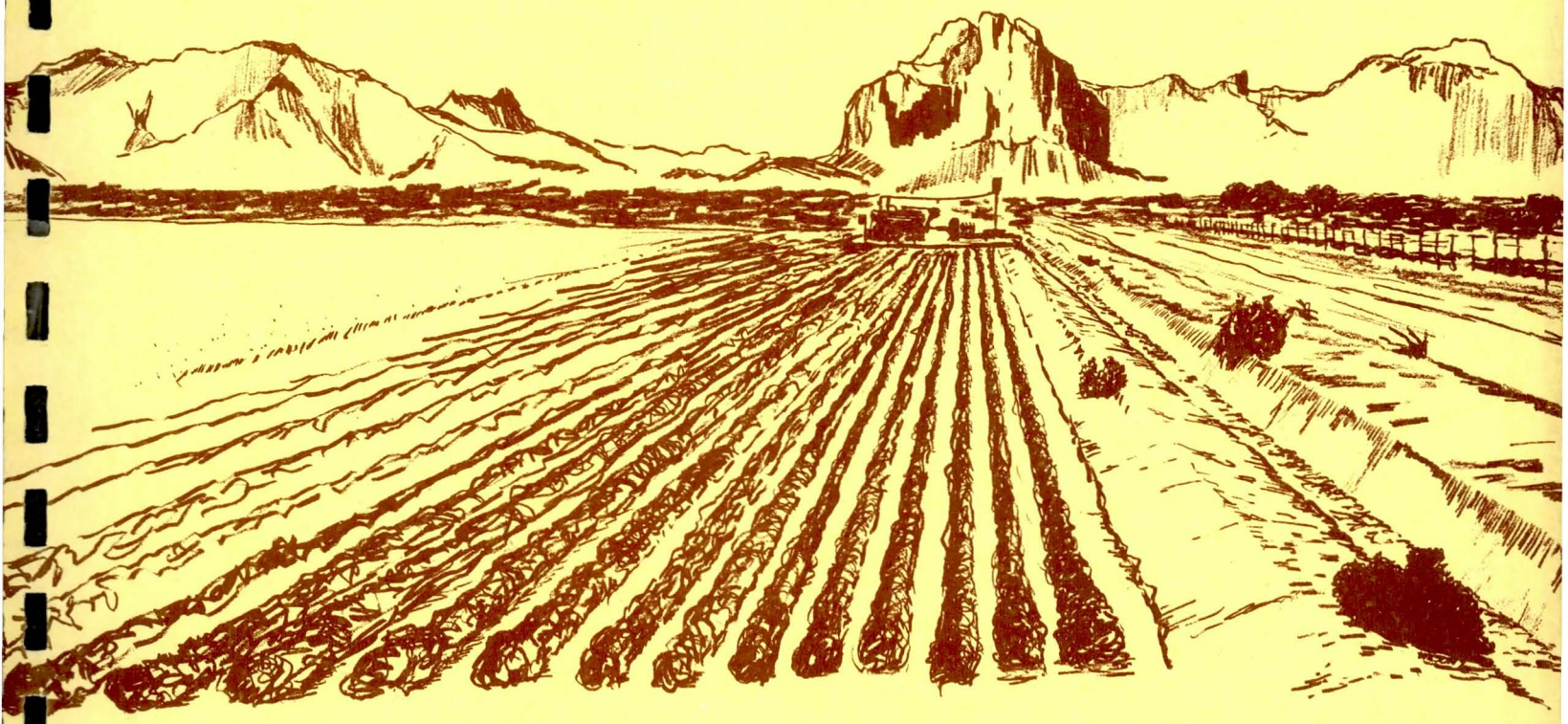
GROUND-WATER CONDITIONS IN THE HARQUAHALA PLAINS, MARICOPA AND YUMA COUNTIES, ARIZONA

BY E. E. DENIS



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No.

* 1. Pumpage and ground-water levels in Arizona in 1955, by P. W. Johnson, N. D. White, and J. M. Cahill: 69 p., 30 figs., 1956.

* 2. Annual report on ground water in Arizona, spring 1956 to spring 1957, by J. W. Harshbarger and others: 42 p., 18 figs., 1957.

* 3. Geology and ground-water resources of the Harquahala Plains area, Maricopa and Yuma Counties, Arizona, by D. G. Metzger: 40 p., 2 pls., 7 figs., 1957.

* 4. Geology and ground-water resources of the Palomas Plain-Dendora Valley area, Maricopa and Yuma Counties, Arizona, by C. A. Armstrong and C. B. Yost, Jr.: 49 p., 3 pls., 4 figs., 1958.

* 5. Annual report on ground water in Arizona, spring 1957 to spring 1958, by W. F. Hardt, J. M. Cahill, and M. B. Booher: 60 p., 19 figs., 1958.

* 6. Annual report on ground water in Arizona, spring 1958 to spring 1959, by W. F. Hardt, R. S. Stulik, and M. B. Booher: 61 p., 18 figs., 1959.

* 7. Annual report on ground water in Arizona, spring 1959 to spring 1960, by W. F. Hardt, R. S. Stulik, and M. B. Booher: 89 p., 22 figs., 1960.

* 8. Geology and ground-water resources of the McMullen Valley, Maricopa, Yavapai, and Yuma Counties, Arizona, by William Kam: 72 p., 17 figs., 1961.

9. Hydrologic data and drillers' logs, Papago Indian Reservation, Arizona, by L. A. Heindl and O. J. Cosner, with a section on chemical quality of the water by L. R. Kister: 116 p., 3 figs., 1961.

*10. Annual report on ground water in Arizona, spring 1960 to spring 1961, by N. D. White, R. S. Stulik, E. K. Morse, and others: 93 p., 32 figs., 1961.

*11. Annual report on ground water in Arizona, spring 1961 to spring 1962, by N. D. White, R. S. Stulik, and others: 116 p., 35 figs., 1962.

No.

*12A. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part I, Records of ground-water supplies, by G. E. Davis, W. F. Hardt, L. K. Thompson, and M. E. Cooley: 159 p., 3 figs., 1963.

*12B. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part II, Selected chemical analyses of the ground water, by L. R. Kister and J. L. Hatchett: 58 p., 2 figs., 1963.

12C. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part III, Selected lithologic logs, drillers' logs, and stratigraphic sections, by M. E. Cooley, J. P. Akers, and P. R. Stevens: 157 p., 3 figs., 1964.

12D. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part IV, Maps showing locations of wells, springs, and stratigraphic sections, by M. E. Cooley and others: 2 sheets, 1966.

12E. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part I-A, Supplemental records of ground-water supplies, by E. H. McGavock, R. J. Edmonds, E. L. Gillespie, and P. C. Halpenny: 55 p., 4 figs., 1966.

13. Desert floods—a report on southern Arizona floods of September 1962, by D. D. Lewis: 13 p., 18 figs., 1963.

*14. Basic ground-water data of the Willcox basin, Graham and Cochise Counties, Arizona, by S. G. Brown, H. H. Schumann, L. R. Kister, and P. W. Johnson: 93 p., 15 figs., 1963.

*15. Annual report on ground water in Arizona, spring 1962 to spring 1963, by N. D. White, R. S. Stulik, E. K. Morse, and others: 136 p., 47 figs., 1963.

16. Effects of ground-water withdrawal in part of central Arizona projected to 1969, by N. D. White, R. S. Stulik, and C. L. Rauh: 25 p., 7 figs., 1964.

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TO THE USERS OF GEOLOGICAL SURVEY HYDROLOGIC DATA:

Enclosed is a copy of the report entitled "Ground-water conditions in the Harquahala Plains, Maricopa and Yuma Counties, Arizona," by E. E. Denis. The report, prepared by personnel of the U.S. Geological Survey, has been published as Arizona State Land Department Water Resources Report No. 45.

The report includes discussions of the ground-water conditions and water-level trends in the Harquahala Plains and makes available hydrologic data that are useful in planning and studying water-resources development.

Sincerely yours,

H. M. Babcock
District Chief

Enclosure

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ARIZONA STATE LAND DEPARTMENT
ANDREW L. BETTWY, COMMISSIONER

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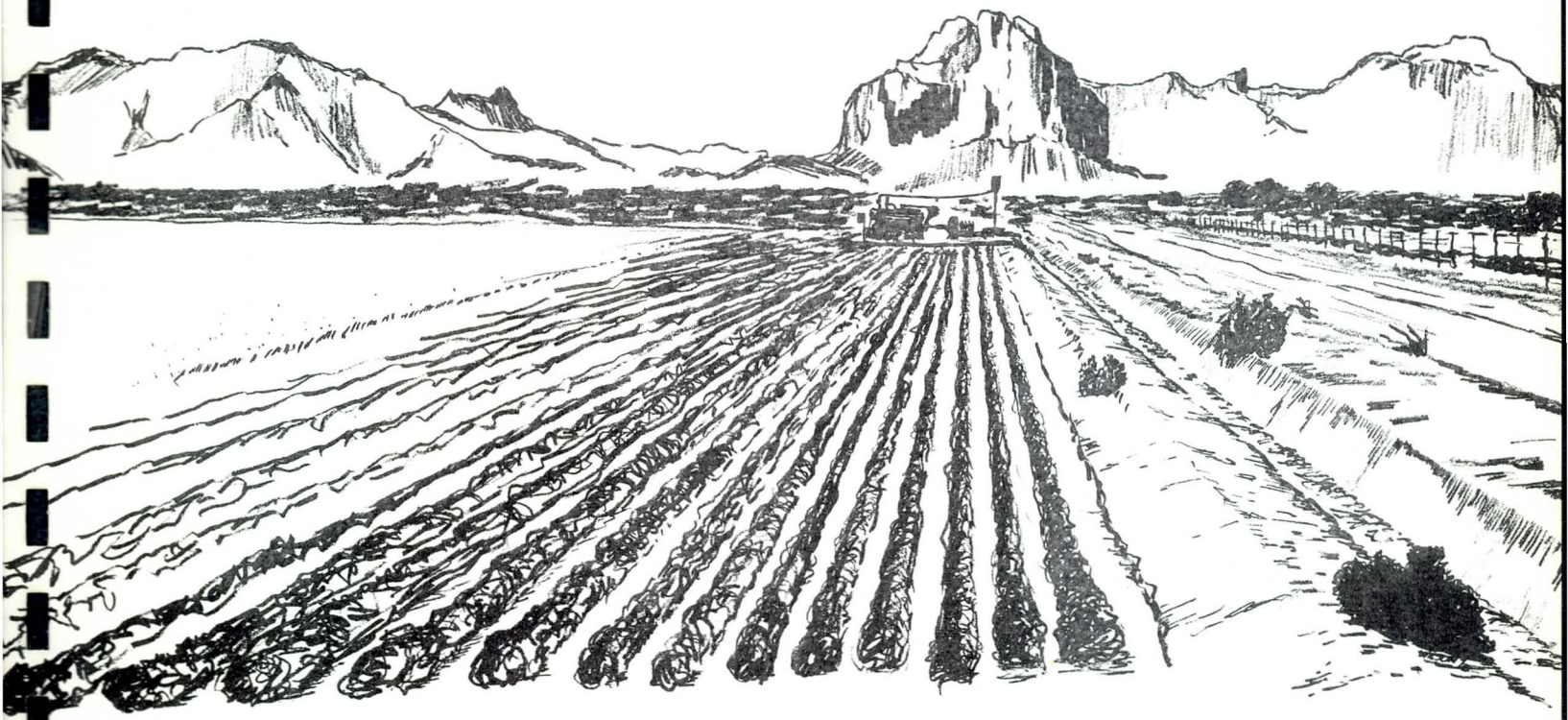
GROUND-WATER CONDITIONS IN THE HARQUAHALA PLAINS, MARICOPA AND YUMA COUNTIES, ARIZONA

BY E. E. DENIS



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PHOENIX, ARIZONA
APRIL 1971

CONTENTS

	Page
Introduction	1
Ground water	5
Volume of recoverable ground water	6
Chemical quality of the ground water	10
Summary	16
References cited	19
Appendix—Basic data	21

ILLUSTRATIONS

[Plates are in pocket]

PLATE 1. Map showing location of wells, cultivated areas, principal outcropping rocks, and change in ground-water levels from December 1963 to December 1966.

2. Map showing principal outcropping rocks, thickness of alluvial deposits, and depth to water in December 1966.

		Page
FIGURE 1.	Map showing area of report and Arizona's water provinces	2
2.	Sketch showing well-numbering system	4
3.	Map showing water-level contours and generalized flow pattern, December 1966	7

CONTENTS

Page

FIGURE 4. Graphs showing water levels in selected wells and estimated annual pumpage. 9

5. Map showing generalized zones of specific conductance and dissolved solids in ground water. 13

6. Diagram showing sodium and salinity hazard of ground water 15

7. Map showing fluoride content of the ground water . . . 17

TABLES

TABLE 1. Records of selected wells in the Harquahala Plains. 22

2. Drillers' logs of selected wells in the Harquahala Plains 32

3. Field determinations of temperature and specific conductance of water from selected wells in the Harquahala Plains. 40

4. Chemical analyses of water from selected wells in the Harquahala Plains 42

GROUND-WATER CONDITIONS IN THE HARQUAHALA PLAINS, MARICOPA AND YUMA COUNTIES, ARIZONA

By

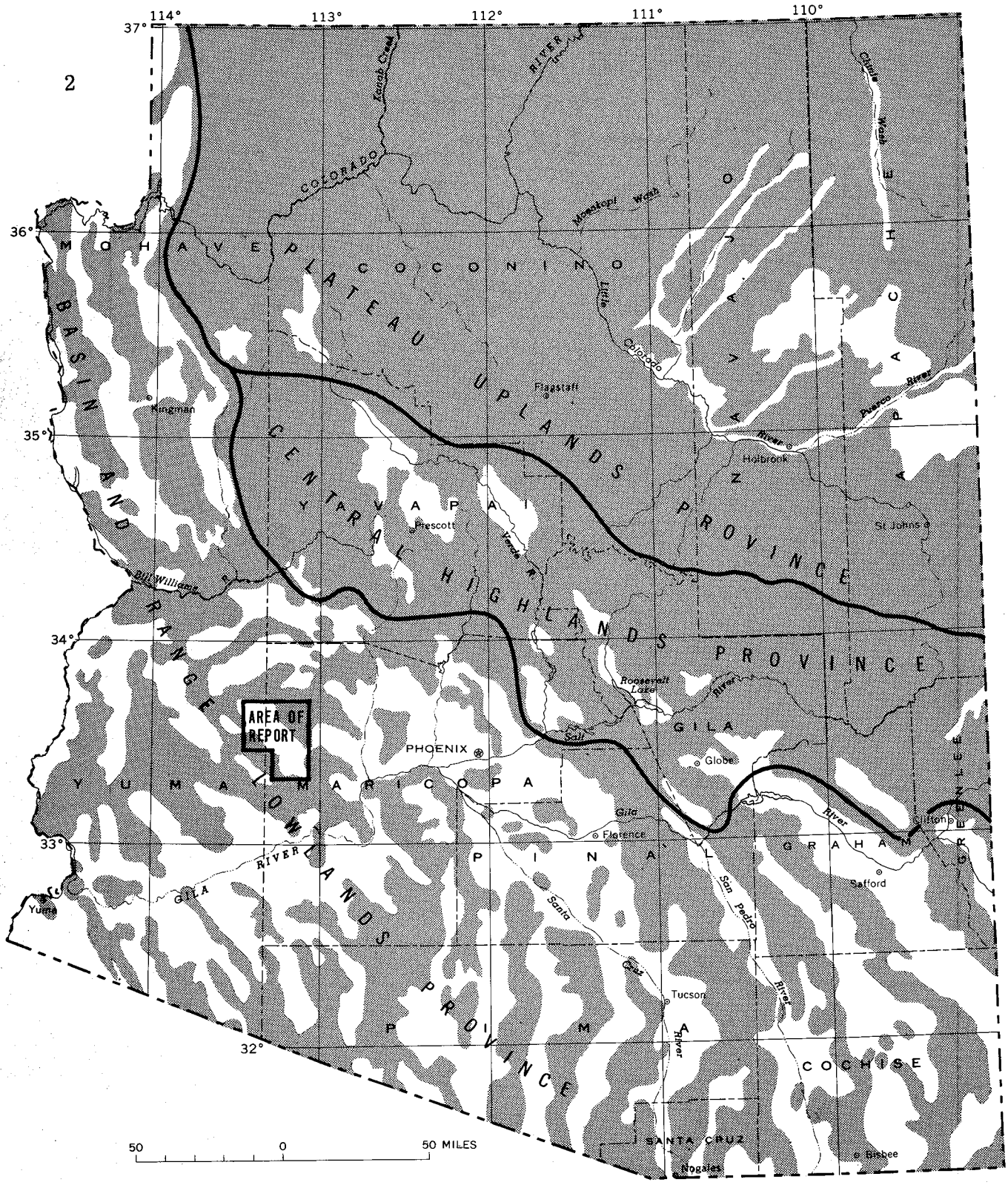
E. E. Denis

Introduction

The ground-water reservoir is the only dependable source of water in the Harquahala Plains (fig. 1), and it has been developed extensively in the last few years. Because the results of the ground-water development will have a direct effect on the overall economy of the area, it is essential to obtain a comprehensive knowledge of the factors that control the quantity and quality of the water stored in the ground-water reservoir. This report includes discussions of the ground-water conditions and water-level trends in the Harquahala Plains and makes available hydrologic data that are useful in planning and studying water-resources development.

As a part of the continuing ground-water program in Arizona, the U. S. Geological Survey, in cooperation with the Arizona State Land Department, O. M. Lassen, former Commissioner, and A. L. Bettwy, present Commissioner, collects and analyzes data on the occurrence and development of ground water in the State. For the most part, the data included in this report were collected as a part of the continuing program; however, some additional data were collected in November and December 1966. The study was conducted under the immediate supervision of H. M. Babcock, district chief of the Water Resources Division of the U. S. Geological Survey in Arizona.

The Harquahala Plains is in the Basin and Range lowlands water province in western Arizona and is about 60 miles west of Phoenix. The area is about 40 miles long and 13 miles wide and is bordered on the northwest by the Harquahala and Little Harquahala Mountains, on the northeast by the Big Horn Mountains, on the southeast by the Gila Bend Mountains, and on the southwest by the Eagletail Mountains (pl. 1). The valley floor slopes gently from the northwest to the southeast at a gradient of about 17 feet per mile along Centennial Wash. Centennial Wash is the main drainage in the basin; the wash is an ephemeral stream that joins the Gila River at the southeast end of the area.



Alluvial contacts by M. E. Cooley, 1967

EXPLANATION

ALLUVIAL DEPOSITS

CONSOLIDATED ROCKS

FIGURE 1.--AREA OF REPORT AND ARIZONA'S WATER PROVINCES.

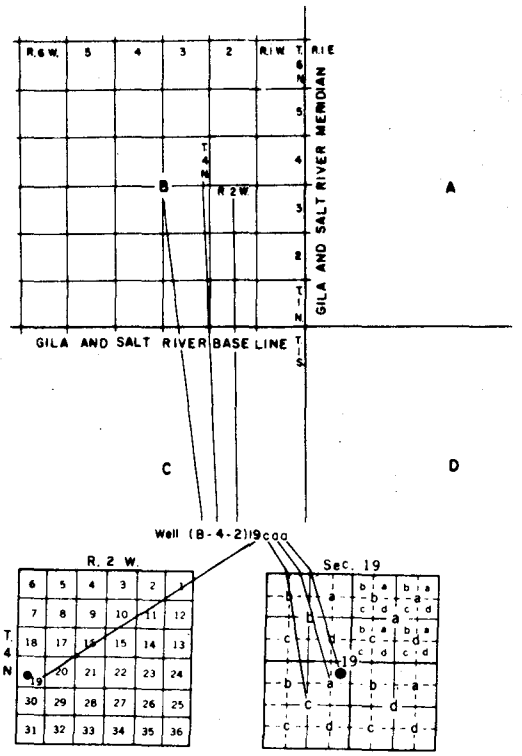
The climate in the Harquahala Plains is arid; during the 13 years of record at the Harquahala Plains No. 1 precipitation station in sec. 14, T. 2 N., R. 9 W., the average annual precipitation was only 6 inches (U.S. Weather Bureau, issued annually). Precipitation is inadequate for raising crops, and because there is no usable surface-water supply, it is necessary to pump ground water for irrigation.

The first large irrigation well was drilled in 1951; by 1954, about 7,000 acres of farmland was being irrigated with water from 20 wells, and by December 1963, about 33,000 acres of land was being irrigated with water from about 100 wells. In December 1966, 39,500 acres of land was under cultivation, and about 120 irrigation wells were in use. Most of the cultivated land is in the southeastern part of the area; about 2,000 acres is cultivated at the northwest end of the area, and the central part is undeveloped.

An inventory of irrigation wells was made in 1966; cultivated acreage was mapped from an aerial reconnaissance made in 1967 (pl. 1). Data for the wells—including date drilled, casing information, water levels, pumping data, and other information—are given in table 1 (see appendix). Other data in the appendix include drillers' logs of selected wells (table 2), field determinations of temperature and specific conductance of water from selected wells (table 3), and chemical analyses of water from selected wells (table 4). The well locations and cultivated acreage are shown on plate 1; all well locations are described in accordance with the well-numbering system used in Arizona, which is explained and illustrated on figure 2.

The author wishes to acknowledge the many people who provided useful information during this study. Special thanks are given to personnel of the Arizona Public Service Co., who provided data for use in computing the amount of ground water pumped in the area.

The geology and water resources of the Harquahala Plains have been described in several reports. The area is included in Ross' (1923) description of the lower Gila region, in which the characteristics of several wells were described. A comprehensive report by Metzger (1957) gives detailed descriptions of the geology and of the qualitative data concerning the ground water at the beginning of major ground-water development and a report by Stulik (1964) analyzes the results of several years of large-scale pumping.



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 (B-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 N., 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 2.--WELL-NUMBERING SYSTEM IN ARIZONA.

Ground Water

The occurrence of ground water in the Harquahala Plains is similar to that in many areas in the Basin and Range lowlands of Arizona. The principal water-bearing strata are the sand and gravel units in the alluvium that underlies the plains. In the developed southeastern part of the plains the alluvium is from less than 300 feet thick near the mountain fronts to more than 1,200 feet thick in the center of the developed area (pl. 2). One of the deepest wells in the area—2,010 feet deep—penetrated granite at a depth of 1,995 feet. Several wells bottom in the alluvium at depths of more than 1,500 feet. In general, the ground water in the Harquahala Plains occurs under water-table conditions, although artesian conditions may be present in places. In December 1966 the depth to water ranged from about 40 feet below the land surface near where Centennial Wash leaves the plains to 480 feet near the southeast end of the Eagletail Mountains (pl. 2).

Prior to significant ground-water development, the slope of the ground-water surface was from the northwest to the southeast. In 1954 ground-water movement was southeastward at a gradient of about 2 feet per mile (Metzger, 1957). As early as 1957, the withdrawal of ground water had reversed the direction of ground-water movement, and by 1963, the ground-water gradient was relatively steep; most of the ground water was moving toward a well-defined cone of depression centered near sec. 30, T. 2 N., R. 8 W., and some of the ground water was moving toward two small cones of depression in the southwestern part of the cultivated area (Stulik, 1964). Contours of the altitude of the water level in December 1966 (fig. 3) show that the three cones of depression have expanded and coalesced and that ground water is moving from all directions into a cone of depression that encompasses the entire cultivated area. The deepest part of the cone is at about the same location as in 1963 (fig. 3).

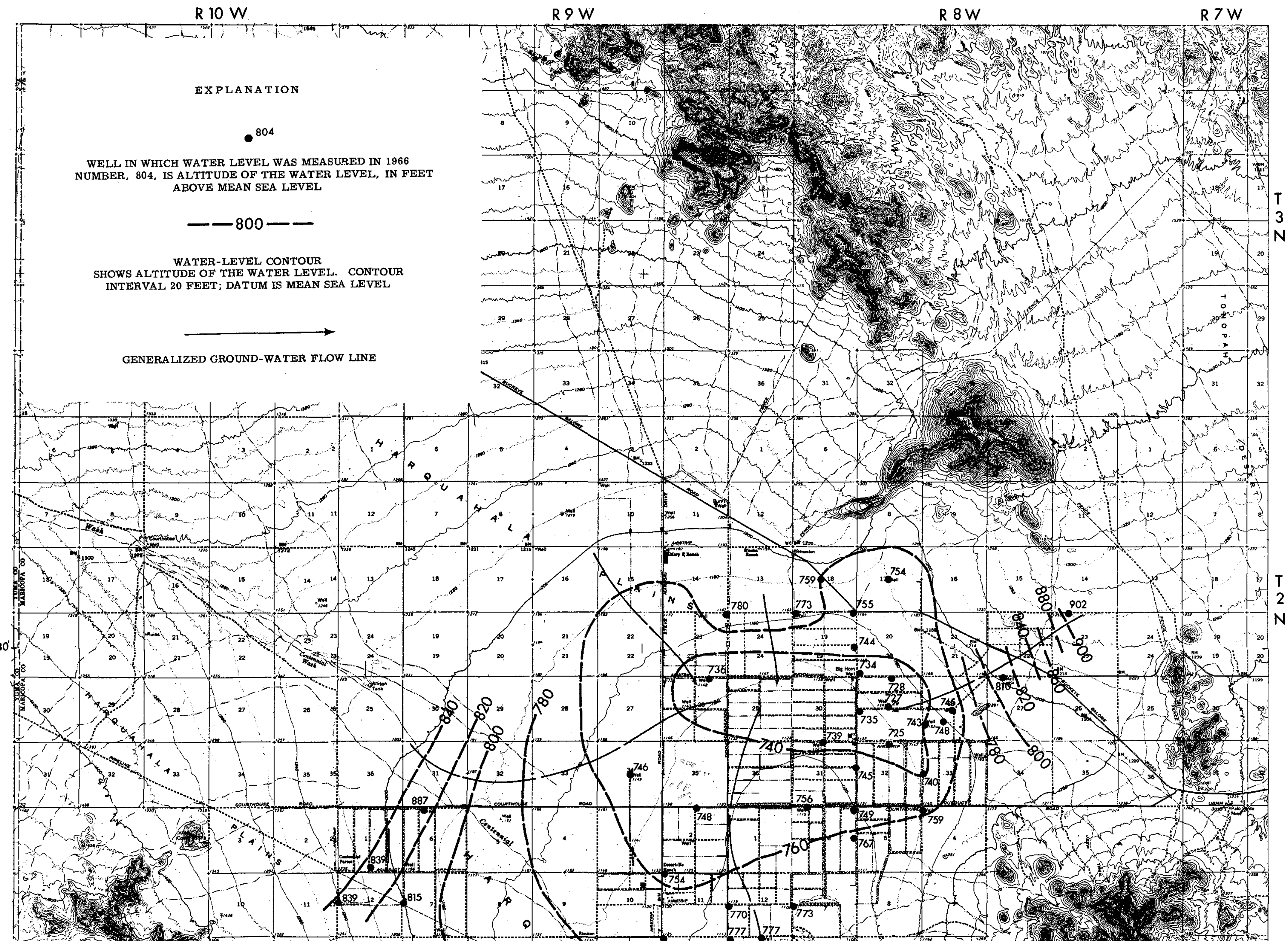
About 1,545,000 acre-feet of ground water had been withdrawn from the aquifer in the Harquahala Plains through 1966 (Cox and others, 1968). The withdrawal is greatly in excess of the replenishment to the ground-water reservoir and has resulted in large water-level declines in the cultivated area. From December 1963 to December 1966, the water level declined as much as 50 feet in a large part of the developed area (pl. 1). Water levels declined from about 20 to 30 feet at the southeast end of the area but only declined about 10 feet in the slightly developed area at the northwest end of the plains. The water level in a well in

sec. 11, T. 2 N., R. 9 W., was about 230 feet below the land surface when visited by Ross (1923) in 1917; in 1966 the water level near this well was more than 440 feet below the land surface. Figure 4 shows water levels in selected wells and the estimated annual pumpage of ground water in the Harquahala Plains from 1950 through 1967.

Volume of Recoverable Ground Water

Nearly all the water pumped in the Harquahala Plains comes from ground-water storage. In order to calculate the amount of water that can be withdrawn from the aquifer, it is necessary to determine the volume of material available for storage of the water and the storage coefficient of the aquifer. The storage coefficient of an aquifer is defined as the volume of water it releases from or takes into storage per unit surface area of the aquifer per unit change in head normal to that surface; therefore, it is a dimensionless ratio.

The thickness of the permeable alluvium and the depth to water in the southeastern part of the Harquahala Plains in December 1966 are shown on plate 2. The alluvium is less than 300 feet thick along the mountain fronts and more than 1,200 feet thick in the center of the area; the alluvium along the mountain fronts was not included in the computation of storage capacity because in this area most of the unit probably is above the water table. In places where the alluvium is from 300 to 700 feet thick, an average thickness of 500 feet was used in the computation, and, where the alluvium is from 700 to 1,200 feet thick, an average thickness of 950 feet was used. In the center of the area, where the alluvium is more than 1,200 feet thick, an arbitrary thickness of 1,200 feet was used in the computation; pumping from depths greater than 1,200 feet probably would not be feasible. The volume of saturated material was computed only for the southeastern part of the area, which comprises about 95,000 acres. Data are insufficient to compute the volume of saturated alluvium in the rest of the plains area. Using plate 2, it may be determined that the volume of permeable alluvium is about 85.2 million acre-feet in the southeastern part of the area. The 1966 depth-to-water contours show that 35.8 million acre-feet of the permeable alluvium is above the water table and, thus, is not saturated. Therefore, in December 1966 the volume of saturated alluvium was about 49.4 million acre-feet.



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0 1 2 3 4 5 MILES

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

FIGURE 3.--WATER-LEVEL CONTOURS AND GENERALIZED FLOW PATTERN, DECEMBER 1966, IN THE SOUTHEASTERN PART OF THE HARQUAHALA PLAINS.

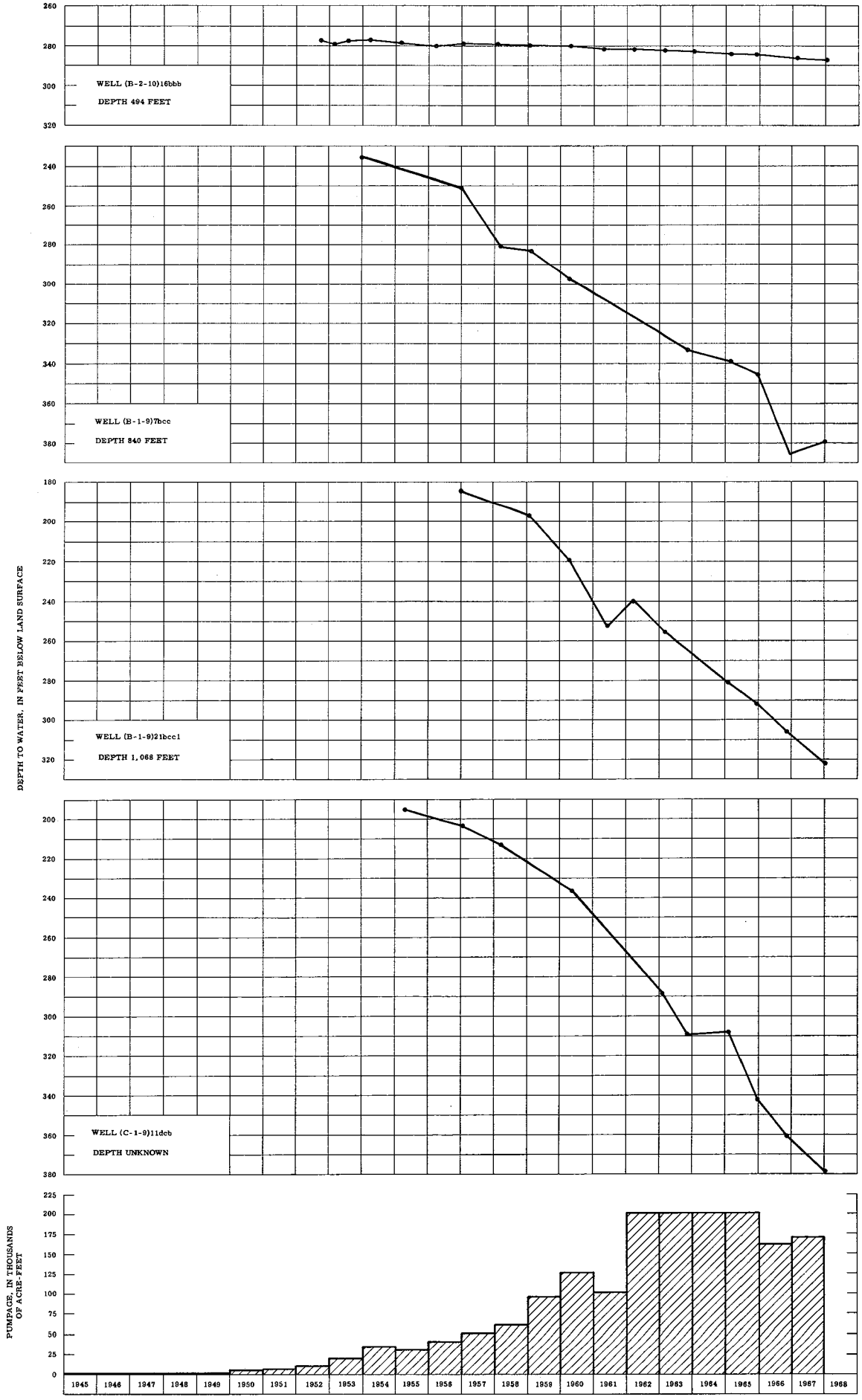


FIGURE 4.--WATER LEVELS IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN THE HARQUAHALA PLAINS.

The relation between the amount of ground water withdrawn and the resultant dewatering of the aquifer may be used to determine the storage coefficient of the aquifer, provided that natural inflow to the aquifer is of the same order of magnitude as natural outflow. At the present time (1967), this situation exists in the Harquahala Plains.

Using plate 1, which shows the change in water levels from December 1963 to December 1966, it may be determined that about 3.7 million acre-feet of sediments was dewatered in the Harquahala Plains as a result of the withdrawal of about 560,000 acre-feet of ground water. From these data, a storage coefficient of 0.15 was calculated for the aquifer. Using this value, the amount of water available from the aquifer can be computed. Based on the calculated volume of about 49.4 million acre-feet of saturated alluvium, about 7.4 million acre-feet of water can be pumped from the ground-water reservoir, within the limits previously described, assuming optimum effectiveness of the removal of water from storage.

Chemical Quality of the Ground Water

The amount and type of dissolved chemical constituents in water determine its suitability for use by plant and animal life. Therefore, the collection and analysis of water samples are an integral part of any water-resources study.

The Director of the U.S. Geological Survey has approved the change from the English to the metric system in reporting of water-quality data. Therefore, the water-quality data in this report are given in milligrams per liter (mg/l), degrees Celsius (°C), and micromhos at 25°C. The terms "parts per million" and "milligrams per liter" are practically synonymous for water containing as much as 5,000 to 10,000 mg/l of dissolved solids. The exact amount is dependent on the nature of the dissolved material. The Survey has set 7,000 mg/l dissolved solids as the point above which the difference in parts per million and milligrams per liter becomes significant. In order to convert data from one system to the other, a density factor must be applied to the analytical results of all water containing more than 7,000 mg/l of dissolved solids.

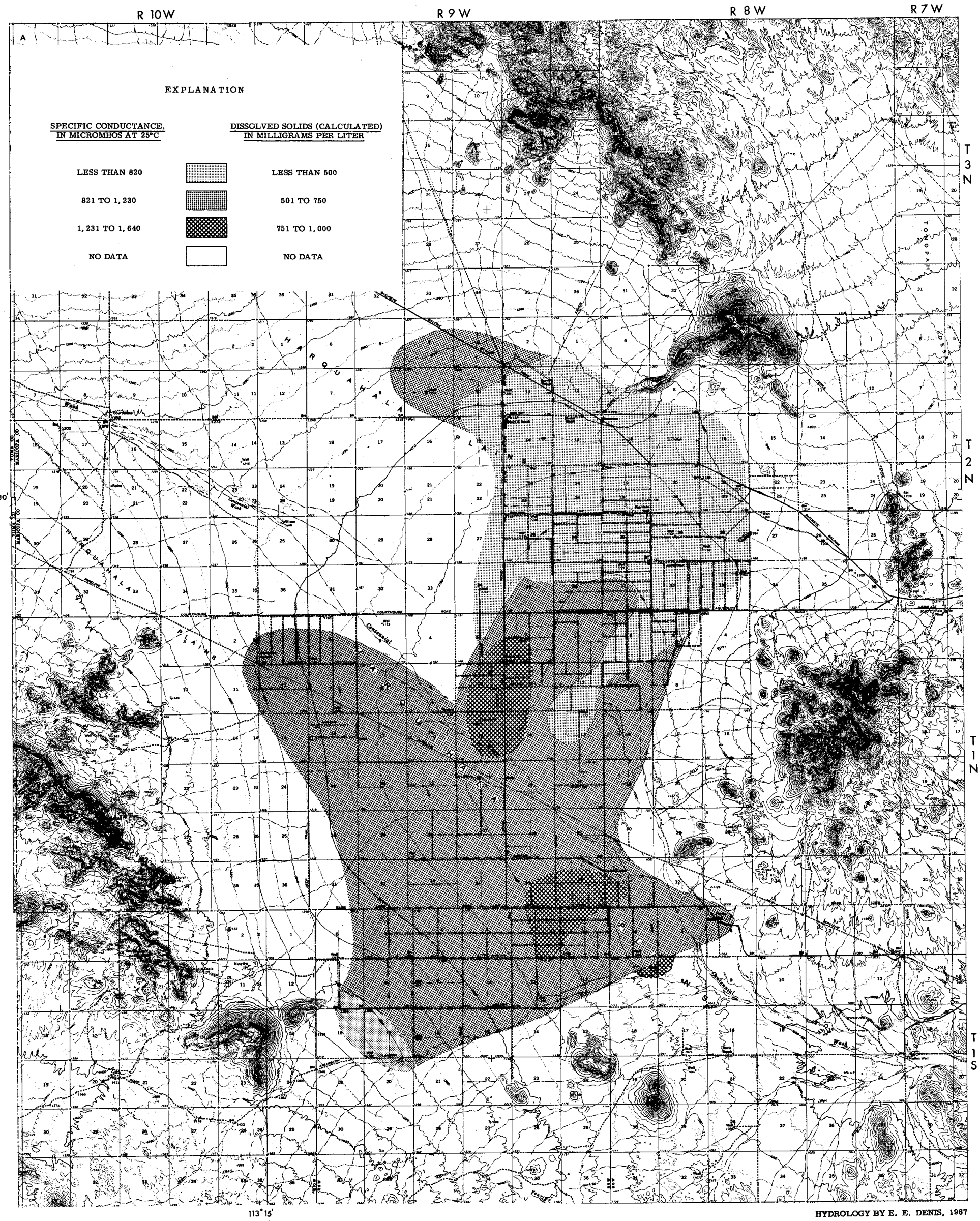
Temperature data given in tables 3 and 4 (see appendix) can be converted to degrees Fahrenheit (°F) by using the following:

°F	°C	°F	°C	°F	°C
32	0	63	17	94	34
33	1	64	18	95	35
34	1	65	18	96	36
35	2	66	19	97	36
36	2	67	19	98	37
37	3	68	20	99	37
38	3	69	21	100	38
39	4	70	21	101	38
40	4	71	22	102	39
41	5	72	22	103	39
42	6	73	23	104	40
43	6	74	23	105	41
44	7	75	24	106	41
45	7	76	24	107	42
46	8	77	25	108	42
47	8	78	26	109	43
48	9	79	26	110	43
49	9	80	27	111	44
50	10	81	27	112	44
51	11	82	28	113	45
52	11	83	28	114	46
53	12	84	29	115	46
54	12	85	29	116	47
55	13	86	30	117	47
56	13	87	31	118	48
57	14	88	31	119	48
58	14	89	32	120	49
59	15	90	32	121	49
60	16	91	33	122	50
61	16	92	33		
62	17	93	34		

Table 3 (see appendix) gives field determinations of temperature and specific conductance of water from selected wells, and table 4 gives laboratory determinations of the chemical constituents in the water. The specific conductance is a measure of the ability of the ions in solution to conduct an electrical current and is an indication of the amount of dissolved solids in the water. The relation between dissolved solids and specific conductance for most fresh water ranges from about 0.5 to 0.7, depending on the chemical composition of the water; in the ground water in the Harquahala Plains the dissolved-solids content, in milligrams per liter, is about 0.6 of the specific conductance. This factor was applied to the field determinations of specific conductance to calculate the dissolved-solids content for use in preparation of the map showing generalized zones of specific conductance and dissolved solids in ground water in the southeastern part of the Harquahala Plains (fig. 5). The map shows that the ground water in the northeast part of the developed area generally contains less than 500 mg/l of dissolved solids. In general, this coincides with the deepest part of the cone of depression caused by pumping of ground water and may indicate that the water at depth is of better quality. Data are insufficient to make direct comparisons of water from different depths at any specific location. Chemical analyses of water from wells in the Harquahala Plains indicate that the dissolved-solids content of the ground water ranges from about 500 to more than 1,000 mg/l (see table 4 in the appendix).

Much of the water sampled is classed as high in salinity hazard (fig. 6), according to the method of classification of irrigation water formulated by the staff of the U.S. Salinity Laboratory (1954). The water sampled ranges from low to very high in the sodium (alkalinity) hazard (fig. 6), but most of the water sampled is in the medium to high range. These factors could cause problems involving soil alkalinity or salinity, although none are apparent at the present time (1967). Proper management practices of draining and leaching may prevent the accumulation of harmful alkaline and saline salts in the soil.

The latest recommendations of the U.S. Public Health Service (1962, p. 8) give lower, optimum, and upper limits for the fluoride content in water for drinking purposes; the limits are based on the annual average of maximum daily air temperature. For the Harquahala Plains, these limits are 0.6 mg/l (lower), 0.7 mg/l (optimum), and 0.8 mg/l (upper). The average concentration of fluoride in drinking water should not be more than the appropriate upper limit, and concentrations of more than twice the optimum value constitute grounds for rejection of the supply.



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BASE FROM U.S. GEOLOGICAL SURVEY, 1:62,500 BIG HORN MOUNTAINS, 1961; CORTEZ PEAK, 1962; EAGLETAIL MOUNTAINS, 1962; AND LONE MOUNTAIN, 1961

FIGURE 5.--GENERALIZED ZONES OF SPECIFIC CONDUCTANCE AND DISSOLVED SOLIDS IN GROUND WATER IN THE SOUTHEASTERN PART OF THE HARQUAHALA PLAINS.

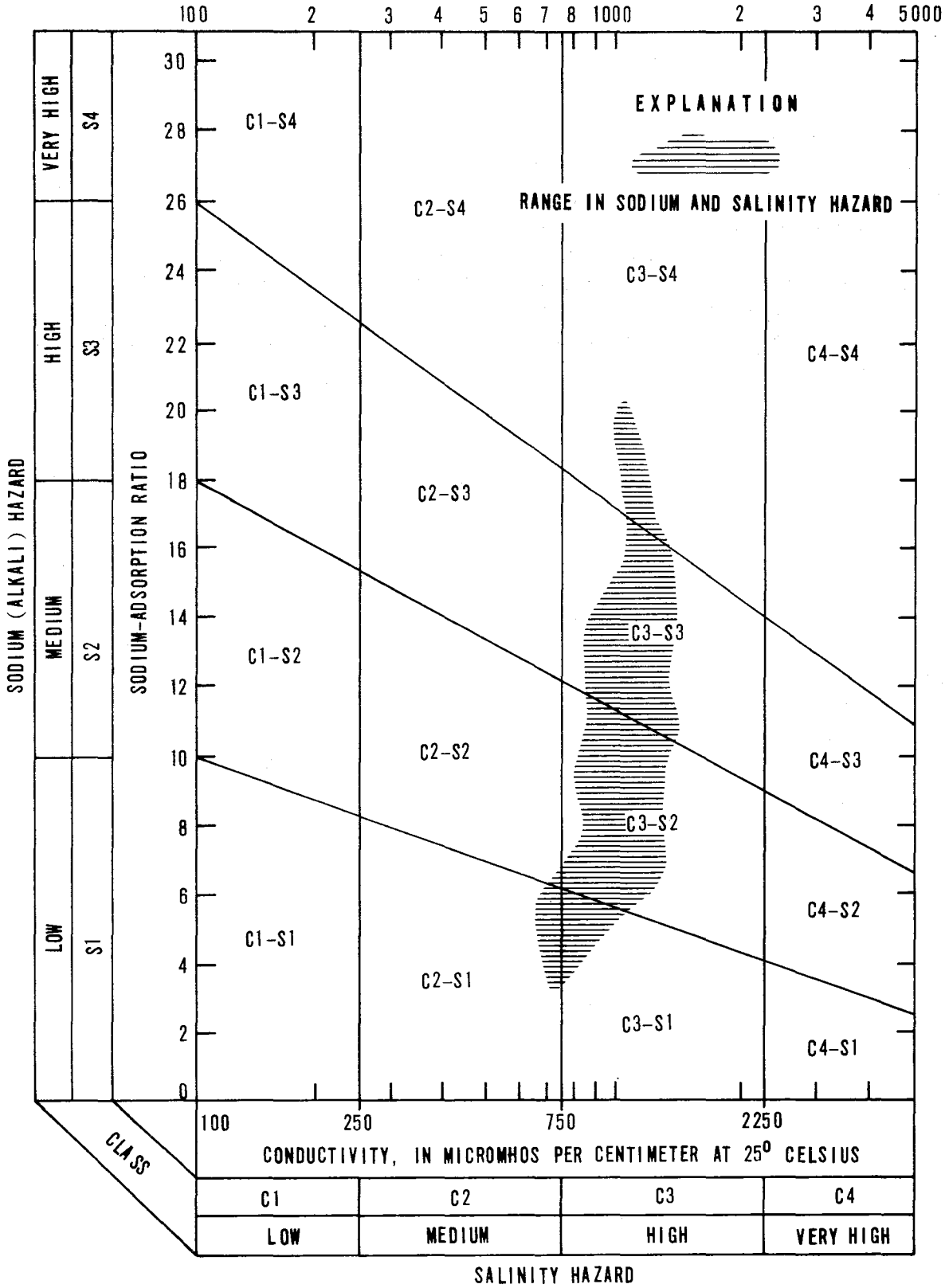


FIGURE 6.--SODIUM AND SALINITY HAZARD OF GROUND WATER. DIAGRAM ADOPTED FROM U.S. SALINITY LABORATORY STAFF (1954).

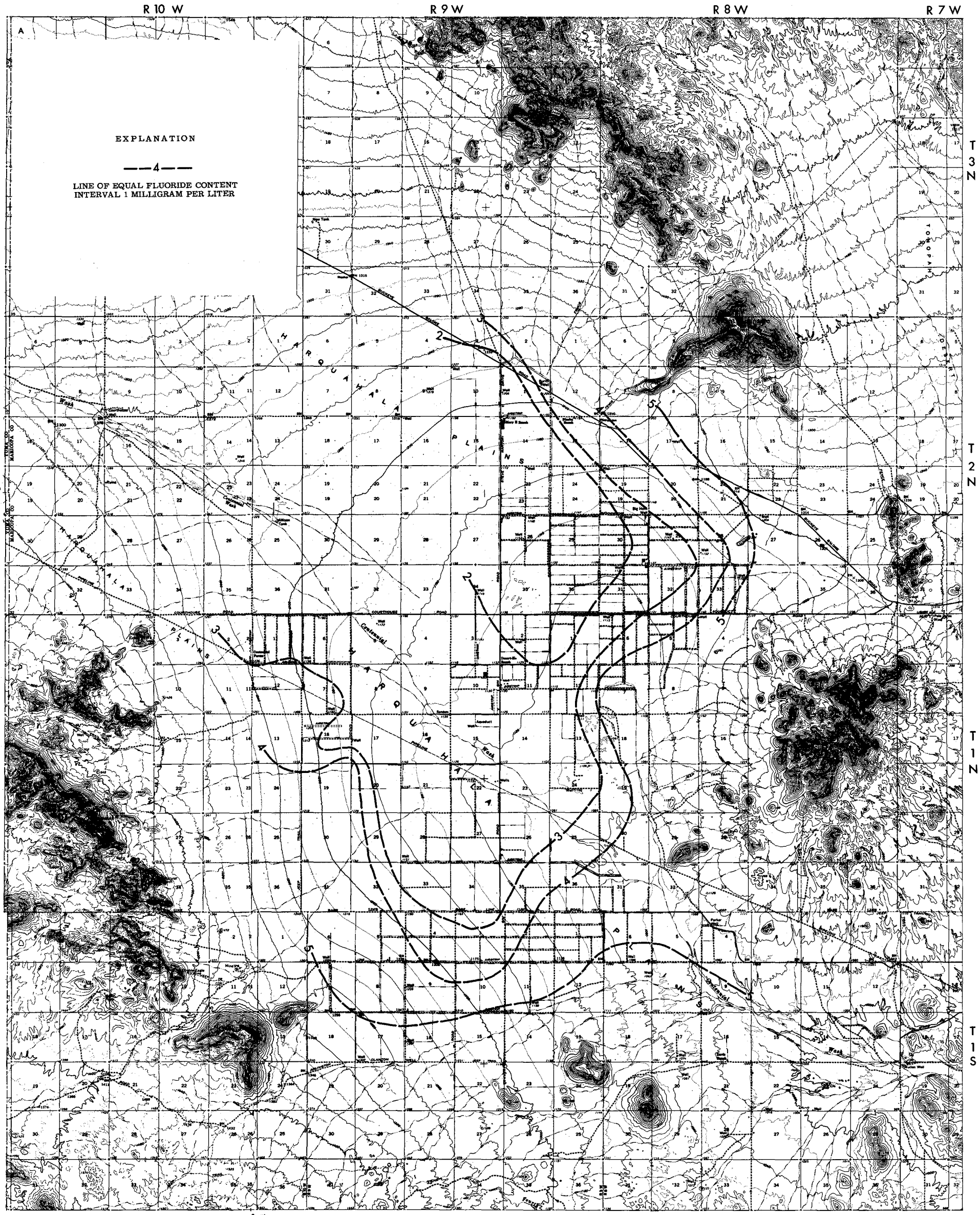
Fluoride concentrations in the water sampled in the Harquahala Plains range from 1.1 to 6.0 mg/l, and most of the water is not acceptable for drinking purposes (see table 4 in the appendix). The andesite and basalt that crop out in the mountains contribute large amounts of fluoride to the water, and the highest fluoride concentrations are in the water from the wells nearest the mountain fronts, particularly at the south end of the area (fig. 7). In the central part of the area it is probable that wells drilled to greater depths than the existing wells also will yield water containing large amounts of fluoride.

Summary

The climate in the Harquahala Plains is arid, and precipitation is inadequate for raising crops; therefore, the ground-water reservoir is the only dependable source of water for irrigation. The first large irrigation well was drilled in 1951; by 1954, 7,000 acres of farmland was being irrigated with water from 20 wells, and by December 1963, about 33,000 acres of land was being irrigated with water from about 100 wells. In December 1966, 39,500 acres was under cultivation, and about 120 irrigation wells were in use. Most of the cultivated land is in the southeastern part of the area.

From December 1963 to December 1966, the water level declined as much as 50 feet in a large part of the developed area. During this time, about 3.7 million acre-feet of sediments was dewatered as a result of the withdrawal of about 560,000 acre-feet of ground water. These data indicate a storage coefficient of about 0.15 for the aquifer. About 7.4 million acre-feet of water is available for withdrawal from the ground-water reservoir in the southeastern part of the Harquahala Plains.

Chemical analyses of water from wells in the Harquahala Plains indicate that the dissolved-solids content of the water ranges from about 500 to more than 1,000 mg/l. The fluoride concentrations in the water sampled ranged from 1.1 to 6.0 mg/l, and most of the water is not acceptable for drinking purposes. The highest fluoride concentrations are in the water from the wells nearest the mountain fronts.



BASE FROM U.S. GEOLOGICAL SURVEY, 1:62,500
BIG HORN MOUNTAINS, 1961; CORTEZ PEAK, 1962;
EAGLETAIL MOUNTAINS, 1962; AND LONE MOUNTAIN, 1961

HYDROLOGY BY E. E. DENIS, 1967

FIGURE 7.--FLUORIDE CONTENT OF THE GROUND WATER IN THE SOUTHEASTERN PART OF THE HARQUAHALA PLAINS.

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APPENDIX —— BASIC DATA

Table 1. --Records of selected wells in the Harquahala Plains

Well location: See page 4 for description of well-numbering system.
Perforated interval: OH, open hole.
Land-surface altitude: Determined from Geological Survey topographic maps.

Water level: R, reported.
Pumping data: R, reported; E, estimated.
Well log: X, driller's log of well included in table 2.
Chemical analysis: X, chemical analysis included in table 4.

Well location	Date completed (year)	Reported depth (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Water level		Pumping data			Well log	Chemical analysis	Remarks
							Feet below land surface	Date (month, year)	Yield (gpm)	Pumping level (feet below land surface)	Date (month, year)			
(B-1-8)4bbb	1960	1,000	16	507	200- 507 OH 507-1,000	1,142	350.0 382.8	10/63 11/66	--------	----------	--------	X	--------	
6aaa	1958	759	20	650	----------	1,117	308.3 367.6	11/63 12/66	--------	448.1	12/66	X	X	
6add	----------	----------	----------	--------	----------	1,115	348.3	12/66	--------	----------	--------	------	--------	
6baa	----------	----------	----------	--------	----------	1,118	272.8	4/62	--------	----------	--------	------	--------	
6bba	----------	600	16	600	300- 600	1,115	305.0 359.3	11/63 12/66	894	423.6	9/67	------	--------	
6bbb	1954	600	18	--------	----------	1,117	149.8	4/55	--------	----------	--------	------	--------	Destroyed, 1963.
6bdb	----------	650	----------	--------	----------	1,112	298.1 352.6	11/63 12/66	--------	----------	--------	------	--------	
7aaa	1963	775	20-16	775	600- 775	1,111	----------	--------	1,700	----------	11/66	------	--------	
7aab	----------	----------	----------	--------	----------	1,110	----------	--------	--------	----------	--------	------	--------	
7adc	----------	----------	----------	--------	----------	1,102	329.0	11/63	--------	444.3	9/67	------	--------	
7cbb	1958	800	20	600	300- 600 OH 600- 800	1,100	276.1 327.3	11/63 12/66	781	----------	9/67	X	X	
19abb1	----------	----------	16	--------	----------	1,086	119.1 130.7	6/55 8/57	--------	----------	--------	------	--------	
19abb2	----------	485	16	485	325- 485	1,086	150 R	7/58	1,660	216.8	9/67	X	--------	
19bcc	1957	700	20	675	165- 200 268- 300 330- 350 450- 665	1,086	198.0 295.3	6/61 11/66	786	366.8	9/67	X	X	
31ccc	----------	600	20	--------	----------	1,080	128.6 269.7	8/57 11/66	--------	----------	--------	X	--------	
(B-1-9)1bbb	1957	1,536	20-16	1,536	400-1,536	1,123	292.7	4/62	2,000 1,900	---------- ----------	9/60 12/66	X	X	
2abb	1961	1,578	20	--------	----------	1,130	330.1 381.5	11/63 12/66	--------	492.4	9/67	------	--------	
2caa	1960	1,600	20-16	--------	----------	1,130	----------	--------	--------	----------	--------	------	--------	
5acb	----------	----------	----------	--------	----------	1,172	----------	--------	--------	----------	--------	------	--------	
6bab	----------	1,638	----------	--------	----------	1,190	263.4 302.6	7/57 12/66	--------	----------	--------	------	--------	
6ccc	1963	1,420	20-16	--------	400-1,420	1,196	319.3	11/63	1,350	----------	12/66	------	X	
7bcc	1953	840	20-16	840	360- 840	1,201	236.4 386.1	1/54 12/66	--------	----------	--------	------	--------	
7ccc	1964	1,700	20-16-12¾	1,700	800-1,700	1,205	----------	--------	1,660 1,270	460.9 ----------	11/66 9/67	X	--------	

Table 1. --Records of selected wells in the Harquahala Plains—Continued

Well location	Date completed (year)	Reported depth (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Water level		Pumping data			Well log	Chemical analysis	Remarks
							Feet below land surface	Date (month, year)	Yield (gpm)	Pumping level (feet below land surface)	Date (month, year)			
(B-1-9)7dcc	1953	915	20-16	915	360- 915	1,187	303.8 330.3	6/61 11/63	1,900 1,400	---------- ----------	9/58 11/66	------	X	
10bbb	1958	1,784	20-16-12	1,784	1,210-1,780	1,148	226.4 310.2	2/59 6/61	--------	----------	--------	X	---------	
11bbb	1957	980	20	--------	----------	1,130	192.4 375.9	8/57 11/66	2,410	331.9	7/58	------	---------	
12cbb	1958	1,500	20-16-12	1,500	850-1,500	1,115	180 R 344.9	1/58 11/66	2,250 2,280	259.2 ----------	9/58 9/67	X	---------	
13abb	1960	1,120	20-16	--------	----------	1,111	291.7 334.0	11/63 11/66	1,920	----------	9/67	------	---------	
13bbb	1964	1,307	20-16	1,300	600-1,300	1,113	264 R 336.2	1/64 11/66	1,890	470.0	9/67	X	---------	
14bbb	1957	1,216	20	1,216	600-1,216	1,125	186.8 355.0	8/57 12/66	--------	----------	--------	------	X	Abandoned.
15abc	1957	1,714	20-16	1,714	1,000-1,714	1,128	306.4 356.9	11/63 11/66	--------	416.7	9/67	X	---------	
16bdd	1965	2,483	18-14	2,483	1,306-2,483	1,140	332 R	11/65	2,232 R	----------	--------	------	---------	
17abb	----------	----------	----------	--------	----------	1,157	314	11/66	--------	----------	--------	------	---------	Perched water table.
17bba	1963	1,500	20	1,500	500-1,500	1,165	----------	---------	--------	----------	--------	X	---------	
17cbb	1958	1,495	20-16	1,495	945-1,495	1,173	326.2 374.5	11/63 11/66	2,080	----------	8/58	X	X	
17dbb	----------	----------	----------	--------	----------	1,158	359.7	11/66	--------	----------	--------	------	---------	
17dcc	1963	1,505	20-16	1,500	500-1,500	1,158	310.8 346.6	11/63 11/66	--------	----------	--------	------	---------	Abandoned.
18bcc	1958	1,500	20-12	1,500	350-1,500	1,212	360 R 384.2	7/59 11/63	--------	----------	--------	X	---------	
18ccc	----------	----------	----------	--------	----------	1,215	----------	---------	2,110	470.0	11/66	------	X	
20bbb	1952	900	20	--------	----------	1,175	202.6 373.6	12/52 11/66	668	416.7	9/67	------	X	
20ccc	1963	1,500	20	--------	----------	1,179	305.4 394.7	2/63 12/66	--------	----------	--------	------	---------	
21bcc1	1952	1,068	20	1,068	350- 825 900-1,058	1,147	179.4 305.9	12/52 11/66	--------	----------	--------	------	---------	Abandoned.
21bcc2	1953	1,033	20-16	1,033	400-1,033	1,147	178 R	5/53	2,390	----------	8/58	------	X	
21bcc3	1955	1,500	20-12	1,500	970-1,500	1,147	302.2 351.7	11/63 11/66	--------	----------	--------	X	---------	
21ccc	----------	----------	----------	--------	----------	1,152	305.9 355.1	11/63 11/66	--------	----------	--------	------	---------	
22ada	----------	----------	----------	--------	----------	1,112	319.3	12/66	--------	----------	--------	------	---------	

Table 1. --Records of selected wells in the Harquahala Plains—Continued

Well location	Date completed (year)	Reported depth (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Water level: Feet below land surface	Water level: Date (month, year)	Pumping data: Yield (gpm)	Pumping data: Pumping level (feet below land surface)	Pumping data: Date (month, year)	Well log	Chemical analysis	Remarks
(B-1-9)23bcc	1959	1,105	20-16	1,080	----------	1,112	226.8 267.7	6/61 11/63	--------	----------	--------	X	--------	
24caa	1958	1,000	20-16	1,000	----------	1,103	221.2 300.1	6/61 11/66	2,730 2,050	---------- 389.0	7/58 9/67	------	X	
24cbb	----------	----------	----------	--------	----------	1,103	----------	--------	--------	----------	--------	------	--------	
26acb	----------	267	10	--------	150- 249	1,103	125 R	9/53	--------	----------	--------	------	--------	Abandoned.
26bcb	1962	1,200	20	--------	----------	1,112	260.8 304.3	11/63 11/66	--------	----------	--------	------	--------	
26cbc	1952	1,015	20-16	1,015	371-1,015	1,115	143.2 310.8	10/52 11/66	3,000 1,870	254.3 397.4	9/58 9/67	X	X	
28ccc	1958	1,130	20-16	1,130	400-1,130	1,171	287.7 323.3	5/61 11/63	2,080 2,180	400.3 ----------	11/66 9/67	X	X	
28dcc	1953	1,030	20-16	903	348- 903	1,158	195 R 271.6	6/53 6/61	2,370 1,880	---------- ----------	8/58 11/66	------	X	
28ddd	1960	996	20-16	996	310- 996	1,145	298.6 348.1	11/63 11/66	2,660	----------	9/67	X	--------	
29bcc	1959	600	20	600	350- 600	1,183	335.0 384.1	11/63 1/67	--------	----------	--------	------	--------	
32ccc	1962	986	20-16	986	300- 986	1,216	368.0 418.7	11/63 11/66	-------- 2,340	---------- ----------	-------- 9/67	X	--------	
34ccc	----------	----------	6	--------	----------	1,163	----------	--------	--------	----------	--------	------	--------	
34dcc	1953	845	20-16	812	200- 812	1,153	186.4 307.0	1/54 11/63	3,060 2,710	---------- 392.4	8/58 11/66	X	X	
35dcd	1953	910	20-16	730	240- 573	1,117	174.6 268.2	8/57 11/63	2,280 1,920	217.3 ----------	8/58 9/67	X	X	
(B-1-10)1ccc	1953	918	18-12	777	340- 777	1,236	257 R	1/53	1,700 R	----------	1953	X	X	
1dcc	1953	800	20-16	800	384- 800	1,215	376.0	12/66	--------	----------	--------	------	X	
1ddc	1963	2,010	20-16	--------	400-	1,205	----------	--------	2,070	----------	12/66	X	X	
12bcc	1959	770	20	770	290- 765	1,242	290 R 403.2	6/59 12/66	--------	----------	--------	------	--------	
(B-2-8)17caa	1960	1,650	20	488	250- 488 OH 488-1,650	1,180	380.6 425.6	10/63 12/66	--------	----------	--------	X	--------	Abandoned.
17daa	1954	510	----------	--------	----------	1,193	220 R 299.7	1/54 2/59	930	----------	8/58	X	X	Abandoned.
18caa	----------	----------	20	--------	----------	1,186	248.4 426.6	8/57 12/66	619	----------	9/58	------	--------	
19aaa	1956	----------	----------	--------	----------	1,164	216.0 408.7	8/57 12/66	--------	----------	--------	------	--------	

Table 1.--Records of selected wells in the Harquahala Plains—Continued

Well location	Date completed (year)	Reported depth (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Water level		Pumping data			Well log	Chemical analysis	Remarks
							Feet below land surface	Date (month, year)	Yield (gpm)	Pumping level (feet below land surface)	Date (month, year)			
(B-2-8)19bbb	1956	----------	20	--------	----------	1,163	223.4 389.8	8/57 12/66	--------	----------	--------	------	--------	
19ccc	1962	1,610	20-16	1,610	401-1,610	1,138	----------	--------	--------	----------	--------	X	--------	
19daa	1959	1,190	20-16	1,190	260- 600 615-1,190	1,153	359.0 409.0	11/63 12/66	--------	----------	--------	X	--------	
20bcb	1963	450	8	450	350- 450	1,158	358.8	11/63	--------	----------	--------	------	--------	
20ccc	----------	----------	----------	--------	----------	1,145	----------	--------	--------	----------	--------	------	--------	
23baa	----------	1,650	16	--------	----------	1,260	306.6 314.8	11/63 2/66	--------	----------	--------	------	--------	
23bba	1960	1,752	16-12¾	1,752	----------	1,260	299.2 358.2	6/61 3/67	--------	----------	--------	------	--------	
27baa	1960 1963	---------- 868	---------- 16	-------- --------	---------- 340- 440	1,204 ----------	254.2 341.4	8/57 10/63	-------- --------	---------- ----------	-------- --------	------ X	-------- --------	 Deepened.
27bba	1963	1,120	16	420	320- 420 OH 420-1,120	1,204	354.8 393.6	10/63 12/66	--------	----------	--------	X	--------	
28caa	1957	700-800	16	--------	----------	1,165	395.0 420.1	9/63 12/66	--------	----------	--------	------	--------	
28cac	----------	----------	----------	--------	----------	1,158	410.1	12/66	--------	----------	--------	------	--------	
28ccb	----------	----------	----------	--------	----------	1,152	410.4	12/66	--------	----------	--------	------	--------	
28dcc	----------	----------	----------	--------	----------	1,158	240 R	9/52	--------	----------	--------	------	X	Abandoned.
29abb	1960	1,660	18-16	1,660	119-1,660	1,155	386.8 426.9	11/63 12/66	--------	----------	--------	X	--------	
29bdd	----------	----------	----------	--------	----------	1,147	364.2 419.6	11/63 12/66	-------- 1,290	---------- 460.0	-------- 9/67	------	--------	
29cbb	1963	900	20	786	320- 786 OH 786- 900	1,137	353.3 402.5	10/63 12/66	-------- 2,000 E	---------- ----------	-------- 12/66	------	--------	
30aaa	----------	----------	----------	--------	----------	1,144	410.5	12/66	2,520	535.9	9/67	------	X	Big Horn well (see Ross, 1923, p. 202).
30baa	----------	----------	----------	--------	----------	1,138	378.3	11/63	--------	----------	--------	------	--------	
31aaa	1957	1,218	20-16	1,218	416-1,218	1,127	188.0 343.9	7/58 10/63	2,170	----------	12/66	X	X	
31baa	1958	1,200	20-16	1,200	400-1,200	1,123	330.0 384.5	10/63 12/66	-------- 2,360	---------- 452.8	-------- 9/67	X	--------	
31daa	----------	----------	----------	--------	----------	1,120	373.6	12/66	1,850	425.5	9/67	------	--------	
32baa	----------	----------	----------	--------	----------	1,137	412.0	12/66	--------	537.7	9/67	------	--------	
32bba	1961	1,720	20	1,676	456-1,676	1,133	----------	--------	2,000	----------	12/66	------	X	Deepened from 840 feet.

Table 1. --Records of selected wells in the Harquahala Plains—Continued

Well location	Date completed (year)	Reported depth (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Water level		Pumping data			Well log	Chemical analysis	Remarks
							Feet below land surface	Date (month, year)	Yield (gpm)	Pumping level (feet below land surface)	Date (month, year)			
(B-2-8)32ddd	1961	----------	----------	--------	----------	1,140	----------	--------	4,400 R	----------	8/61	------	--------	
33aad	----------	----------	----------	--------	----------	1,165	345.6	11/63	20 E	367.6	12/66	------	--------	
33cbb	----------	----------	----------	--------	----------	1,143	352.1 403.1	10/63 11/66	--------	----------	--------	------	--------	
33dbb	----------	----------	----------	--------	----------	1,153	303.8	4/62	--------	----------	--------	------	--------	
(B-2-9)7abb	1952	1,692	20-16	1,692	400-1,692	1,260	294.8 300.1	12/63 12/66	--------	----------	--------	X	--------	Observation well. Abandoned.
9abb	1952	1,540	20-16	1,500	400-1,500 OH 1,500-1,540	1,233	----------	--------	1,970	486.7	12/66	X	X	
9dbb	----------	1,500	20-16	1,500	----------	1,219	----------	--------	2,060	486.1	12/66	------	X	
10abb	1957	1,500	20-16	--------	----------	1,223	236.2	1/57	2,110 1,470	---------- ----------	8/58 12/66	------	X	
10bbb	1953	1,300	20-16	1,300	----------	1,227	280 R	1/54	2,380	485.7	12/66	------	X	
11adb	----------	390	6	--------	----------	1,210	230 R	12/17	--------	----------	--------	------	X	Burnt well or Burned Place well (see Ross, 1923, p. 204). Well has been deepened, depth unknown.
11bbb	1952	1,500	20-16	1,355	275-1,355 OH 1,355-1,500	1,220	412.4	11/63	1,600	----------	8/58	X	--------	
11cbb	1960	1,505	20-16	1,505	400-1,505	1,206	441.6	12/66	--------	----------	--------	X	X	
13baa	1954	603	18	550	----------	1,197	245.8 395.4	1/54 11/63	1,530 1,150	---------- 474.0	8/58 12/66	X	X	
14bbb	1951	1,530	20-16	1,452	294-1,452 OH 1,452-1,530	1,192	----------	--------	2,440	----------	12/66	X	X	
16bbb	----------	----------	----------	--------	----------	1,215	385.9 453.3	12/63 12/66	--------	----------	--------	------	--------	
18abb	----------	----------	----------	--------	----------	1,235	235.1 235.2	12/63 12/66	--------	----------	--------	------	--------	
23aaa	----------	1,660	20-16	1,550	298-1,550 OH 1,550-1,660	1,167	357.7 387.4	12/63 12/66	--------	----------	--------	X	--------	
23abb	----------	1,506	20-16	1,506	250-1,506	1,169	195.5	12/63	--------	----------	--------	X	--------	
26aab	1959	----------	20-16	--------	----------	1,148	373.7 412.2	12/63 12/66	--------	----------	--------	------	--------	
26adc	----------	----------	----------	--------	----------	1,138	----------	--------	1,930	----------	12/66	------	--------	
26bbb	1958	1,820	20-16	943	700- 935 OH 943-1,820	1,153	225 R	12/58	--------	----------	--------	X	--------	
26bcc	----------	----------	----------	--------	----------	1,148	----------	--------	2,380	534.7	12/66	------	--------	

Table 1.--Records of selected wells in the Harquahala Plains—Continued

Well location	Date completed (year)	Reported depth (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Water level		Pumping data			Well log	Chemical analysis	Remarks
							Feet below land surface	Date (month, year)	Yield (gpm)	Pumping level (feet below land surface)	Date (month, year)			
(B-2-9)26bdd	----------	----------	----------	--------	----------	1,143	----------	--------	--------	----------	--------	------	--------	
34dbb	----------	----------	----------	--------	----------	1,149	402.8	12/66	--------	----------	--------	------	--------	
35cbb	1956	920	20-16	920	690- 900	1,142	291.4 288.9	12/63 2/65	--------	----------	--------	X	--------	
36bbb	----------	----------	----------	--------	----------	1,132	----------	--------	2,570	----------	9/67	------	--------	
(B-2-10)5abb	----------	----------	16	--------	----------	1,330	333.7	3/63	--------	----------	--------	------	--------	
9bbb	----------	----------	----------	--------	----------	1,300	----------	--------	--------	----------	--------	------	--------	
14dca	----------	----------	20	--------	----------	1,246	244.6 244.9	3/55 12/63	--------	----------	--------	------	--------	Abandoned.
16bbb	----------	494	6	--------	----------	1,278	277.5 283.2 286.8	9/52 1/64 3/67	--------	----------	--------	------	X	Courthouse well (see Ross, 1923, p. 206).
23bba	----------	----------	----------	--------	----------	1,248	249.3 250.3	4/55 12/63	--------	----------	--------	------	--------	
(B-2-11)22bcc	----------	----------	----------	--------	----------	1,535	----------	--------	--------	----------	--------	------	--------	
(B-3-9)31aad	----------	----------	----------	--------	----------	1,315	326.6 Dry at 336	9/52 12/66	--------	----------	--------	------	--------	Mosher well.
(B-3-10)9dca	----------	----------	----------	--------	----------	1,458	----------	--------	--------	----------	--------	------	--------	
(B-3-11)8cac	----------	554	----------	--------	----------	1,450	439.3	3/67	--------	----------	--------	X	--------	
16ddd	----------	----------	----------	--------	----------	1,405	397.9 402.0	9/52 3/67	--------	----------	--------	------	--------	Government well.
17bdc	----------	478	5	--------	----------	1,432	400 R Dry at 450	12/17 3/67	--------	----------	--------	------	X	Lone Mountain well (see Ross, 1923, p. 212).
18bbb	----------	----------	----------	--------	----------	1,455	----------	--------	--------	----------	--------	------	--------	
20bbb	----------	----------	----------	--------	----------	1,426	----------	--------	--------	----------	--------	------	--------	
34daa	----------	----------	----------	--------	----------	1,355	360.6	1/67	--------	----------	--------	------	--------	
(B-4-9)30aab	----------	----------	----------	--------	----------	1,767	----------	--------	--------	----------	--------	------	--------	Windmill, stock well.
(B-4-11)15adc	----------	----------	----------	--------	----------	1,655	----------	--------	--------	----------	--------	------	--------	Carmelita well.
(B-4-12)4bcc	----------	----------	----------	--------	----------	1,650	338.0 448.0	1/57 2/67	--------	----------	--------	------	--------	
4cca	1956	----------	----------	--------	----------	1,640	442.7 444.9	10/63 1/67	--------	----------	--------	------	--------	
5aaa	1958	730	22	--------	----------	1,670	372.2 403.7	10/63 1/67	--------	----------	--------	------	--------	
5daa	----------	----------	----------	--------	----------	1,638	452.2 449.3	10/63 1/67	--------	----------	--------	------	--------	
9acc	----------	----------	----------	--------	----------	1,625	404.5 419.7	10/63 1/67	--------	----------	--------	------	--------	

Table 1. --Records of selected wells in the Harquahala Plains—Continued

Well location	Date completed (year)	Reported depth (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Water level: Feet below land surface	Water level: Date (month, year)	Pumping data: Yield (gpm)	Pumping data: Pumping level (feet below land surface)	Pumping data: Date (month, year)	Well log	Chemical analysis	Remarks
(B-4-12)10ccc	----------	----------	----------	--------	----------	1,600	374.0	10/63	--------	----------	--------	------	--------	
14cbb	----------	----------	----------	--------	----------	1,582	352.8 362.7	10/63 1/67	235	504.7	9/67	------	--------	
23cad	----------	----------	----------	--------	----------	1,548	----------	--------	--------	----------	--------	------	--------	
24edc	----------	----------	----------	--------	----------	1,540	----------	--------	--------	----------	--------	------	--------	
25aca	1963	1,100	18	--------	----------	1,530	----------	--------	--------	----------	--------	------	--------	
25cba	----------	----------	----------	--------	----------	1,523	----------	--------	--------	----------	--------	------	--------	
(C-1-7)19baa	----------	26.75	----------	--------	----------	960	26.5	12/66	--------	----------	--------	------	--------	
19bbb	----------	----------	----------	--------	----------	960	----------	--------	--------	----------	--------	------	--------	Abandoned.
(C-1-8)4bbd	----------	200	6	--------	----------	1,060	92.7 95.7 Dry	10/52 1/54 12/63	--------	----------	--------	------	--------	Parker well.
4bda	----------	----------	----------	--------	----------	1,060	187.3 240.4	12/63 12/66	--------	----------	--------	------	--------	
6ccc1	1957	710	20	615	154- 160 300- 308 354- 358 392- 406 494- 506 546- 610 OH 615- 710	1,090	135.6 223.2 275.5	8/57 11/63 11/66	--------	----------	--------	------	X	
6ccc2	1959	800	20-16	800	225- 800	1,090	137 R	12/59	--------	----------	--------	X	--------	
6dcc	1959	----------	20	--------	----------	1,086	136.5 210.5 263.5	5/59 11/63 11/66	--------	----------	--------	------	--------	
8bcb	1960	800	20-16	800	225- 800	1,067	193.6 245.8	11/63 11/66	--------	----------	--------	------	--------	
13bdb	1954	235	16	--------	----------	990	38 R 117.8	-------- 12/66	--------	----------	--------	------	--------	
13cbb	1939	137	16-10	--------	OH	982	26 R 85.0	1939 12/66	--------	----------	--------	------	--------	
13dcb	1937	218	20	60	20- 60 OH 60- 218	975	21 R 74.8	1948 12/66	--------	----------	--------	------	--------	Observation well.
13dcd	1938	70	20	60	20- 60 OH 60- 70	975	17.1 63.0	3/46 12/66	--------	----------	--------	------	--------	
14abb	1938	195	20	100	50- 100 OH 100- 195	1,008	45 R	11/48	--------	----------	--------	------	--------	
14abc1	----------	226	20	69	----------	998	55 R 153.4	2/48 12/66	--------	----------	--------	------	--------	
14abc2	1948	225	20	70	20- 70 OH 70- 225	998	46.4	3/49	--------	----------	--------	------	X	

Table 1.--Records of selected wells in the Harquahala Plains—Continued

Well location	Date completed (year)	Reported depth (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Water level: Feet below land surface	Water level: Date (month, year)	Pumping data: Yield (gpm)	Pumping data: Pumping level (feet below land surface)	Pumping data: Date (month, year)	Well log	Chemical analysis	Remarks
(C-1-8)14adb	1954	708	20-16	517	150- 225 229- 287 304- 323 363- 397 416- 517 OH 517- 708	992	37 R 137.0	1954 12/66	---------	----------	--------	X	---------	
14add	----------	1,111	20	574	60- 570 OH 574-1,111	990	52 R	3/60	---------	----------	--------	------	---------	
14bbb	1966	1,200	----------	1,100	----------	1,010	147.6 163.0	3/64 12/66	---------	----------	--------	------	---------	
14ddd	1960	551	20	9	OH 9- 551	980	32 R	4/60	---------	----------	--------	X	---------	
16ccb	----------	----------	----------	--------	----------	1,055	----------	--------	---------	----------	--------	------	---------	
16ccc	1960	553	18	12	OH 12- 553	1,055	101 R 196.7	5/60 12/66	---------	----------	--------	------	---------	
16dcc	1956	585	18	160	70- 160 OH 160- 585	1,035	74 R 178.7	12/56 12/66	1,500	----------	1956	X	---------	
17acc	1954	200	8	--------	----------	1,074	100 R	1954	35 R	----------	--------	------	---------	
17dca	----------	----------	----------	--------	----------	1,060	----------	--------	---------	----------	--------	------	---------	
17dcb	1959	1,050	----------	uncased	----------	1,074	125 R	7/59	---------	----------	--------	X	---------	
20adb1	1936	240	12	--------	OH	1,061	91 215.5	1937 12/66	---------	----------	--------	------	---------	
20adb2	1953	550	15	--------	----------	1,061	----------	--------	---------	----------	--------	------	---------	
22bbb	----------	----------	----------	--------	----------	1,020	64.9	8/57	---------	----------	--------	------	---------	
22bbc	1948 1957	175 500	16 16-12	-------- 500	---------- ----------	1,020	57.8 138.4	3/54 12/66	--------- ---------	---------- ----------	-------- --------	------ ------	--------- ---------	 Deepened.
22bcc	----------	----------	36	--------	----------	1,020	55.9	3/46	---------	----------	--------	------	---------	
22cdc	----------	----------	----------	--------	----------	1,016	----------	--------	---------	----------	--------	------	---------	
23bcb	1958	365	20-12	315	250- 315 OH 315- 365	1,000	----------	--------	---------	----------	--------	------	---------	
23cbb	1958	360	----------	uncased	----------	1,000	----------	--------	---------	----------	--------	------	---------	
23cdc	----------	----------	----------	--------	----------	1,016	----------	--------	---------	----------	--------	------	---------	
27bbb	----------	----------	----------	--------	----------	1,020	----------	--------	---------	----------	--------	------	---------	
27bcc	----------	----------	----------	--------	----------	1,030	----------	--------	---------	----------	--------	------	---------	
28aad	----------	----------	----------	--------	----------	1,025	----------	--------	---------	----------	--------	------	---------	
28dbb	----------	----------	----------	--------	----------	1,028	----------	--------	---------	----------	--------	------	---------	
32add	----------	89	6	--------	----------	1,073	66.3 66.6	4/46 5/55	---------	----------	--------	------	---------	

Table 1. --Records of selected wells in the Harquahala Plains—Continued

Well location	Date completed (year)	Reported depth (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Water level: Feet below land surface	Water level: Date (month, year)	Pumping data: Yield (gpm)	Pumping data: Pumping level (feet below land surface)	Pumping data: Date (month, year)	Well log	Chemical analysis	Remarks
(C-1-8)33d	----------	----------	----------	--------	----------	----------	70	5/55	--------	----------	--------	------	--------	
34bcd	----------	----------	----------	--------	----------	1,058	87.2 111.7	4/60 3/67	--------	----------	--------	------	--------	
(C-1-9)1ccc	1957	1,006	20-16	1,006	250-1,006	1,126	264.3 340.0	11/63 5/66	2,480 1,180	---------- ----------	7/58 9/67	X	X	
2bcc	----------	366	16	--------	----------	1,151	203.9 310.6	8/57 11/63	-------- 1,480	---------- ----------	-------- 9/67	------	X	Well was deepened, date and depth unknown.
2ccc	----------	1,100	22-16	1,025	280-1,025 OH 1,025-1,100	1,160	214.8	8/57	-------- 1,870	389.8 413.7	12/66 9/67	X	X	
2dcc	----------	----------	----------	--------	----------	1,143	----------	--------	2,270 1,680	363.7 379.3	11/66 9/67	------	X	
3ccc	1959	----------	20	--------	----------	1,190	344.5 395.1	11/63 11/66	--------	----------	--------	------	--------	
3dcc	----------	1,205	22-16	1,205	637-1,205	1,175	227.0 380.8	8/57 11/66	2,500	----------	9/58	X	X	
4ccc	1957	825	20	--------	275- 820	1,220	271.1 424.1	8/57 11/66	1,810 2,280	---------- ----------	9/58 9/67	------	--------	
4dcc	----------	----------	----------	--------	----------	1,206	272.1 410.0	3/59 11/66	--------	----------	--------	------	--------	
5ccc	----------	----------	----------	--------	----------	1,248	414.1 449.5	11/63 11/66	--------	----------	--------	------	--------	
5dcd	----------	930	20	870	----------	1,230	285.0 388.3	8/57 11/63	2,170	----------	7/58	------	X	
6dcc	----------	640	----------	--------	----------	1,259	452.8	11/66	--------	----------	--------	X	--------	
7dcc	----------	600	16	563	OH 563- 600	1,296	488.5	11/66	1,950	552.5	9/67	------	--------	Deepened to 687 feet, June 1967.
8dcc	----------	----------	----------	--------	----------	1,265	----------	--------	--------	----------	--------	------	--------	
9bcc	1957	----------	20	--------	----------	1,236	276.9 387.9	8/57 11/63	1,775 360	313.9 ----------	7/58 9/67	------	X	
9ccc	1957	1,500	20-16	1,481	296-1,481 OH 1,481-1,500	1,247	296.4 444.0	8/57 11/66	--------	----------	--------	X	X	
10dcc	1959	775	20	--------	265- 720	1,200	268.1 402.7	3/59 11/66	--------	----------	--------	X	--------	
11ccc	----------	----------	----------	--------	----------	1,180	330.6 383.7	11/63 11/66	--------	----------	--------	------	--------	
11dbc	1958	830	20	--------	----------	1,158	118 R	3/58	2,630	----------	8/58	------	--------	
11dcb	1955	----------	16	400	250- 400	1,158	195.7 361.1	4/55 11/66	--------	----------	--------	------	--------	Originally drilled to 400 feet; has been deepened, depth unknown.

Table 1. --Records of selected wells in the Harquahala Plains—Continued

Well location	Date completed (year)	Reported depth (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Water level		Pumping data			Well log	Chemical analysis	Remarks
							Feet below land surface	Date (month, year)	Yield (gpm)	Pumping level (feet below land surface)	Date (month, year)			
(C-1-9)14ccc	1960	1,250	20-16-12	1,250	300-1,250	1,198	249 R 380.0	5/60 11/66	--------	----------	--------	X	--------	
14cdd	1963	1,066	16	1,066	300-1,066	1,183	----------	--------	--------	----------	--------	X	--------	
16cbb	1957	1,092	20	--------	----------	1,267	316.0 466.4	8/57 11/66	1,640	----------	9/67	------	X	
16ccc	----------	----------	----------	--------	----------	1,272	----------	--------	--------	----------	--------	------	--------	
16daa	----------	----------	6-8	--------	----------	1,225	263.5 Dry	4/55 11/66	--------	----------	--------	------	--------	Abandoned.
17ccc	1958	----------	----------	--------	----------	1,307	488.7	11/66	--------	----------	--------	------	--------	Abandoned.
17dcb	----------	----------	----------	--------	----------	1,288	427.5	11/63	--------	----------	--------	------	--------	Abandoned.
17dcc	1954	526	16	--------	375- 502	1,290	325.6 473.3	3/55 11/66	--------	----------	--------	X	X	
18acb	1962	893	20	--------	0- 559	1,305	495.0	11/66	--------	----------	--------	X	--------	
18cbb	----------	----------	----------	--------	----------	1,328	----------	--------	--------	----------	--------	------	--------	
18ccc	----------	----------	----------	--------	----------	1,340	----------	--------	--------	----------	--------	------	--------	
22bcc	----------	----------	----------	--------	----------	1,245	----------	--------	--------	----------	--------	------	--------	
23bcc	----------	----------	----------	--------	----------	1,205	380.3	11/66	--------	----------	--------	------	--------	
23bdc	1964	1,311	16	1,311	----------	1,197	336 R	10/64	--------	----------	--------	X	--------	

Table 2.--Drillers' logs of selected wells in the Harquahala Plains

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
(B-1-8)4bbb					
Silt and caliche	50	50	Cemented conglomerate	110	915
Clay and gravel	100	150	Broken sand and conglomerate	85	1,000
Rock	250	400			
Conglomerate	405	805	TOTAL DEPTH		1,000
(B-1-8)6aaa					
Surface silt and clay	80	80	Streaks of clay and sand	72	550
Sandy clay	40	120	Hard sand	83	633
Red sand	22	142	Gravel, soft, loose	17	650
Clay with small streaks of gravel	96	238	Coarse gravel	109	759
Sand and gravel	134	372			
Malpais and sand	63	435	TOTAL DEPTH		759
Clay	43	478			
(B-1-8)7cbb					
Clay	285	285	Clay	15	800
Soft sandy clay	15	300			
Clay with streaks of sand	400	700	TOTAL DEPTH		800
Gravel	85	785			
(B-1-8)19abb2					
Clay	185	185	Clay	125	460
Sand with streaks of clay	15	200	Gravel	25	485
Clay	125	325			
Gravel	10	335	TOTAL DEPTH		485
(B-1-8)19bcc					
Sand	28	28	Gravel	4	460
Clay	137	165	Clay with gravel	62	522
Gravel	3	168	Cemented layers with sand and gravel between		
Clay	100	268	layers	112	634
Sand	12	280	Clay with gravel	18	652
Clay	51	331	Cemented boulders with layers of sand and gravel	48	700
Gravel	14	345			
Clay	111	456	TOTAL DEPTH		700
(B-1-8)31ccc					
?	60	60	Well-rounded pea gravel and coarse sand. All		
Sandy silt, poorly-moderately rounded	10	70	volcanic	20	370
Caliche cemented sandy silt	20	90	Same but more fine sand and some silt	10	380
Sandy silt	50	140	Silty, volcanic, pea gravel	40	420
Sandy silt, sand grains 50 percent, lavas 50 percent,			Same as 380-420 but less silt	20	440
granitic, moderate rounding	70	210	Same as 380-420 but more silt	30	470
Moderately well-rounded sand and pea gravel,			Same as 380-420 but less silt	10	480
some silt	10	220	Same as 380-420 but more silt	10	490
Well-rounded sand and pea gravel, 75 percent			Same as 380-420 but less silt	10	500
volcanic in origin	50	270	Same as 380-420 but finer and more silt	60	560
Well-rounded sand and pea gravel, 90 percent			Sandy silt	10	570
volcanic in origin	40	310	Sand and gravelly silt	10	580
Same as 270-310 but more silt	30	340	Gravelly silt	20	600
Same as 310-340. Contained layer of caliche-					
cemented silt	10	350	TOTAL DEPTH		600
(B-1-9)1bbb					
Surface silt and sand	100	100	Clay with streaks of sand	33	1,138
Brown clay	500	600	Sand and gravel	82	1,220
Sand and gravel	88	688	Sandy clay	60	1,280
Sand and streaks of clay	48	736	Sand and gravel	256	1,536
Brown clay	14	750			
Sand, variegated	310	1,060	TOTAL DEPTH		1,536
Sandy clay	45	1,105			
(B-1-9)7ccc					
Surface silt and sand	220	220	Gravel with streaks of boulders	300	1,020
Clay with streaks of gravel	220	440	Sand and gravel	320	1,340
Fine sand	40	480	Good gravel with streaks of granitic boulders	360	1,700
Good gravel	100	580			
Good gravel with streaks of clay	140	720	TOTAL DEPTH		1,700

Table 2.--Drillers' logs of selected wells in the Harquahala Plains—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
(B-1-9)10bbb					
Mixture sand, clay, and gravel	180	180	Clay (red)	652	1,310
Sand and gravel—water at 180 feet	70	250	Sand and gravel—medium-size gravel	474	1,784
Clay and gravel	55	305			
Clay	155	460	TOTAL DEPTH		1,784
Clay and little gravel	198	658			
(B-1-9)12cbb					
Surface sand	50	50	Gravel and sand	350	1,500
Brown clay	775	825			
Variegated gravel and sand	255	1,080	TOTAL DEPTH		1,500
Brown clay	70	1,150			
(B-1-9)13bbb					
Sand	20	20	Clay and gravel	80	600
Sandy gravel	220	240	Gravel	707	1,307
Clay	83	323			
Clay and gravel	187	510	TOTAL DEPTH		1,307
Boulders	10	520			
(B-1-9)15abc					
Surface sand	100	100	Coarse variegated with small gravel	220	1,500
Brown clay with streaks of fine sand	780	880	Coarse sand, variegated with small gravel	214	1,714
Sandy clay	120	1,000			
Streak of clay and coarse sand	280	1,280	TOTAL DEPTH		1,714
(B-1-9)17bba					
Surface silt and sand	20	20	Clay with streaks of good variegated gravel	60	900
Fine sand and caliche	20	40	Clay and variegated gravel	40	940
Pea gravel	40	80	Boulders and gravel with streaks of clay	40	980
Coarse sand and gravel	60	140	Variegated gravel and boulders	120	1,100
Gravel with streaks of clay	40	180	Very good gravel with streaks of boulders	120	1,220
Gravel	40	220	Boulders with streaks of fair gravel	160	1,380
Clay with small streaks of sand	240	460	Same as above only finer	80	1,460
Very good gravel with streaks of clay	200	660	Tight fine sand and granitic boulders	40	1,500
Mostly clay with streaks of medium-size gravel	100	760			
Clay	80	840	TOTAL DEPTH		1,500
(B-1-9)17cbb					
Surface sand	20	20	Gray sand	60	1,320
Fine gray sand	220	240	Pea gravel with streaks of sand	160	1,480
Silty clay with streaks of gravel	420	660	Gray sand	15	1,495
Clay with light streaks of sand	280	940			
Sand with light streaks gravel	320	1,260	TOTAL DEPTH		1,495
(B-1-9)18bcc					
Topsoil	45	45	Hard sand	150	1,280
Clay	285	330	Dark shells and boulders	110	1,390
Fine sand and clay	240	570	Coarse sand	95	1,485
Sand and gravel	190	760	Cemented sand	15	1,500
Silty sand	150	910			
Gravel and boulders	220	1,130	TOTAL DEPTH		1,500
(B-1-9)21bcc3					
Surface sand	40	40	Coarse gravel with sand streaks	160	1,200
Streaks of gravel with clay	160	200	Fine sand and gravel with sand streaks	20	1,220
Clay and fine silt	300	500	Fine gray sand with gravel streaks	40	1,260
Clay with gravel streaks, fine silt	40	540	Gravel, coarse sand	140	1,400
Sand, with gravel streaks	160	700	Fine gray sand with gravel streaks	100	1,500
Gravel with clay streaks, fine silt	80	780			
Gravel and small boulders	60	840	TOTAL DEPTH		1,500
Clay with streaks of sand and gravel	200	1,040			
(B-1-9)23bcc					
Topsoil	5	5	Silt	430	815
Sand and rock	7	12	Gravel and rock	290	1,105
Clay	112	124			
Silt	66	190	TOTAL DEPTH		1,105
Clay	195	385			

Table 2.--Drillers' logs of selected wells in the Harquahala Plains—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
(B-1-9)26cbc					
Surface sand and clay	50	50	Red bed and sand, gravel	110	923
Clay and sand	290	340	Red bed and hard sand, gravel	92	1,015
Sand and rock, fine gravel	200	540			
Fine sand, small gravel	89	629	TOTAL DEPTH		1,015
Hard sand, small gravel	184	813			
(B-1-9)28ccc					
Surface sand and gravel	40	40	Decomposed granite with sand and malpais streaks	320	960
Sand and gravel	100	140	Gray sand with gravel streaks	60	1,020
Clay	160	300	Malpais with sand and light gravel streaks	110	1,130
Clay with light streaks gravel	80	380			
Gravel with sand streaks	120	500	TOTAL DEPTH		1,130
Gray sand streaks malpais	140	640			
(B-1-9)28ddd					
Surface sand	65	65	Variegated sand and boulders	550	850
Sand and gravel	55	120	Hard fine gray sand	146	996
Brown clay with streaks of fine sand	40	160			
Brown clay with streaks of fine silty sand	140	300	TOTAL DEPTH		996
(B-1-9)32ccc					
Surface silt and sand	20	20	Same gravel with streaks of clay	207	694
Sand with streaks of caliche	40	60	Streaks of sand with some boulders	26	720
Sand and gravel with streaks of boulders	220	280	Same as above but fine and tighter	266	986
Boulders with streaks of boulders	40	320			
Very good pea-size well-rounded gravel	167	487	TOTAL DEPTH		986
(B-1-9)34dcc					
Surface clay	25	25	Sand, with streaks of hard shell	15	583
Sand, gravel, and clay	123	148	Sand, with streaks of very hard shell	45	628
Sand and gravel	37	185	Sand and gravel	55	683
Clay	10	195	Sand and gravel	97	780
Sand and gravel	135	330	Sand	32	812
Sand	61	391	Red shale	33	845
Sand and gravel, with a little clay	89	480			
Sand and gravel	88	568	TOTAL DEPTH		845
(B-1-9)35dcd					
Topsoil	30	30	Sand, gravel with streaks of clay	85	605
Shale and sand	92	122	Gravel and clay	95	700
Sand	18	140	Clay	114	814
Sand and clay	110	250	Rock and clay	61	875
Sand and gravel, with streaks of clay	75	325	Red bed and thin shells of red rock	21	896
Sand, gravel, and shale	75	400	Red bed	14	910
Sand and gravel	60	460			
Sand and red shale	60	520	TOTAL DEPTH		910
(B-1-10)1ccc					
Topsoil	3	3	Clay, small streaks sand	88	708
Hard sand	23	26	Hard sand	12	720
Country rock	148	174	Boulder bed	2	722
Sandy clay—firm	21	195	Hard sand	48	770
Sandy clay—firm	17	212	Looser sand	5	775
Sand	123	335	Sand, granite	17	792
Loose sand	20	355	Boulders	1	793
Sand, streaks yellow clay	21	376	Granite gravel	73	866
Sand, clay	34	410	Granite gravel	52	918
Sand	50	460	Granite at 918 feet.		
Sand, streaks of clay	70	530			
Sand	90	620	TOTAL DEPTH		918

Table 2.--Drillers' logs of selected wells in the Harquahala Plains—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
(B-1-10)1ddc					
Surface(?)	45	45	Sand	35	1,481
Sand and gravel	108	153	Hard sand	39	1,520
Sand and small boulders and gravel and streaks of clay	32	185	Sand	48	1,568
Sand and clay	309	494	Sand and gravel	52	1,620
Gravel	94	588	Sand	54	1,674
Sand and some clay	216	804	Gravel	21	1,695
Gravel	112	916	Sandy clay	17	1,712
Sand and some gravel probably cemented	96	1,012	Sand, gravel (quartz)	75	1,787
Gravel	109	1,121	Gravel, with streaks of clay	30	1,817
Hard sand	52	1,173	Sand and gravel with streaks of clay	102	1,919
Gravel	39	1,212	Gravel with streaks of hard sand	43	1,962
Sand	27	1,239	Sand in hard streaks	33	1,995
Gravel	91	1,330	Malpais and quartz	15	2,010
Hard sand	50	1,380	TOTAL DEPTH		2,010
Gravel	66	1,446			
(B-2-8)17caa					
Silt and caliche	150	150	Broken conglomerate, water bearing	250	1,150
Dry gravel	75	225	Sandy conglomerate, water bearing	250	1,400
Conglomerate—water	263	488	Clay, streaky conglomerate	250	1,650
Malpais	262	750			
Conglomerate, water bearing	150	900	TOTAL DEPTH		1,650
(B-2-8)17daa					
Surface sand and clay	85	85	Red sand rock and small boulders	20	420
Sand streaks and clay	135	220	Boulders and gravel	30	450
Surface water sand	5	225	Red sand, rocks, and boulder	20	470
Streaks of sand, clay, and gravel	55	280	Malpais boulder and gravel	40	510
Small boulders and cement gravel	20	300			
Hard rock and big boulders	20	320	TOTAL DEPTH		510
Malpais boulder and gravel	80	400			
(B-2-8)19ccc					
Surface silt and sand	20	20	Gravel and boulders with streaks of clay	260	1,020
Gravel and caliche	80	100	Red and black malpais boulders with streaks of gravel	590	1,610
Clay with streaks of gravel	200	300			
Gravel with streaks of boulders	200	500			
Very good coarse well-rounded gravel	260	760	TOTAL DEPTH		1,610
(B-2-8)[illegible]daa					
Topsoil	10	10	Clay, gravel, and small boulders	135	825
Sandy clay with narrow streaks of hard sandstone. Seepage water at approximately 90 feet; water level at 250 feet	240	250	Malpais rock with broken strata	125	950
			Broken malpais rock with stratas of red sticky clay	240	1,190
Sandy clay and some gravel	440	690	TOTAL DEPTH		1,190
(B-2-8)27baa					
Loam and caliche	215	215	Layers of white clay (sticky) and layers of red clay with volcanic rock	48	868
Basalt	80	295			
Red cemented conglomerate	430	725	Hard formation, red in appearance, at 868 feet.		
Layers of white clay and conglomerate	75	800			
Cemented volcanic deposit	20	820	TOTAL DEPTH		868
(B-2-8)27bba					
Loam and caliche	300	300	Black volcanic rock	52	1,052
Hard black rock	165	465	Red clay	51	1,103
Cemented conglomerate, small streaks of sandstone, about 1 inch thick with 6-inch layers of sand underneath	535	1,000	Gravel with some clay	17	1,120
			TOTAL DEPTH		1,120
(B-2-8)29abb					
Surface sand and silt	20	20	Small variegated gravel	40	880
Clay with streaks of gravel	160	180	Red clay with layers of volcanic formation	260	1,140
Brown clay	100	280	Coarse variegated sand embedded with boulders	110	1,250
Gravel with some boulders	240	520	Red clay embedded with boulders	110	1,360
Black volcanic formation with some rounded gravel	120	640	Small variegated sand	300	1,660
Coarse black volcanic sand and gravel	70	710			
Hard red clay embedded with black volcanic gravel	130	840	TOTAL DEPTH		1,660

Table 2. --Drillers' logs of selected wells in the Harquahala Plains—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
(B-2-8)31aaa					
Surface sand	20	20	Malpais	80	1,000
Sand with streaks of gravel	240	260	Sand	120	1,120
Gravel with streaks of loose sand	220	480	Gravel with thin streaks of clay	98	1,218
Very light streaks of clay with sand and gravel	80	560			
Sand and gravel	280	840	TOTAL DEPTH		1,218
Sandy clay, with streaks of hard sand	80	920			
(B-2-8)31baa					
Surface sand	20	20	Malpais and gravel	90	1,000
Sand with streaks of gravel and clay	240	260	Sand	80	1,080
Sand with streaks of loose gravel	50	310	Hard brown clay	40	1,120
Alternating streaks of clay and sand	170	480	Variegated sand and gravel	80	1,200
Sand with light streaks of clay	80	560			
Sand and streaks of gravel	292	852	TOTAL DEPTH		1,200
Sandy clay	58	910			
(B-2-9)7abb					
Clay	1,380	1,380			
Sand	312	1,692	TOTAL DEPTH		1,692
(B-2-9)9abb					
Clay	98	98	Sand—water sand	310	1,160
Sand (some water)	32	130	Clay and streaks of sand	220	1,380
Clay—water sand	440	570	Hard sand	160	1,540
Sand—water sand	35	605			
Clay and sand rock—water sand	245	850	TOTAL DEPTH		1,540
(B-2-9)11bbb					
Surface sand	90	90	Brown clay	45	745
Brown clay	310	400	Sand	75	820
Sand and small gravel	100	500	Good sand	340	1,160
Brown clay	10	510	Bluish-colored malpais	280	1,440
Small gravel	50	560	Malpais embedded in red clay	60	1,500
Brown clay	15	575			
Gray sand	125	700	TOTAL DEPTH		1,500
(B-2-9)11cbb					
Surface sand and clay	80	80	Coarse sand, red and black	240	1,360
Brown clay	80	160	Sand with streaks of clay	60	1,420
Brown clay with sandy streaks	300	460	Variegated sand	85	1,505
Coarse sand and streaks of clay	120	580			
Variegated sand and gravel	400	980	TOTAL DEPTH		1,505
Tight fine sand	140	1,120			
(B-2-9)13baa					
Sand and gravel	90	90	Sand and gravel	25	445
Hard sand, some gravel	60	150	Cemented conglomerate	10	455
Very hard dry sand and clay	40	190	Hard sand and gravel	30	485
Sand, clay, and coarse gravel	35	225	Clay	2	487
Coarse sand, streaks of clay	70	295	Conglomerate	4	491
Clay	5	300	Clay, sand, and gravel	10	501
Sand and clay	12	312	Cemented conglomerate	3	504
Dry clay, hard	31	343	Sand and gravel	10	514
Clay and gravel	21	364	Coarse gravel	36	550
Water gravel and coarse sand	16	380	Boulders, gravel	50	600
Malpais, hard boulders	3	383	Hard lava	3	603
Wash gravel	22	405			
Cemented sand and clay	15	420	TOTAL DEPTH		603
(B-2-9)14bbb					
Surface sand and clay	94	94	Hard sand	190	1,250
Sand, streaks clay	134	228	Sand, streaks conglomerate with clay streaks	100	1,350
Sand, clay, streaks of gravel	232	460	Hard brown sand, shells, conglomerate	99	1,449
Sand and gravel	80	540	Hard shale, streaks sand and shells	31	1,489
Streaks sand, clay, gravel	120	660	Very hard brown sand	50	1,530
Cemented sand, boulders	180	840			
Hard sand, streaks conglomerate, small boulders	140	980	TOTAL DEPTH		1,530
Hard sand, streaks hard clay	80	1,060			

Table 2.--Drillers' logs of selected wells in the Harquahala Plains—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
(B-2-9)23aaa					
Surface sand	20	20	Sand and gravel	160	1,380
Sand and gravel	140	160	Fine sand with malpais streaks	40	1,420
Fine sand with light streaks of clay	180	340	Fine sand	80	1,500
Sand and gravel with streaks of clay	280	620	Coarse gravel with streaks malpais	40	1,540
Gravel with malpais streaks	140	760	Malpais	120	1,660
Sand and gravel	180	940			
Malpais with sand streaks	280	1,220	TOTAL DEPTH		1,660
(B-2-9)23abb					
Surface sand and gravel	20	20	Fine gray sand with light streaks malpais	220	1,120
Fine sand with streaks of gravel	40	60	Fine gray sand with gravel and malpais	80	1,200
No sample	60	120	Very fine gray sand	60	1,260
Clay with gravel and sand streaks	380	500	Sand with gravel streaks	120	1,380
Sand and gravel with streaks of malpais	180	680	Gravel with sand and malpais streaks	126	1,506
Gravel with sand streaks	60	740			
Malpais with gray sand streaks	80	820	TOTAL DEPTH		1,506
Gravel with clay and sand streaks	80	900			
(B-2-9)26bbb					
Topsoil	25	25	Red sticky clay	3	1,045
Clay and gravel	35	60	Black rock and gravel	5	1,050
Red sticky clay	65	125	Clay, some small gravel	100	1,150
Sandy clay	80	205	Sticky clay	70	1,220
Red sticky clay	17	222	Gravelly clay	13	1,233
Sandy clay	8	230	Sticky clay	11	1,244
Clay	200	430	Hard gravel	12	1,256
Sand, little water	7	437	Clay, gravel	19	1,275
Clay	13	450	Sticky clay	46	1,321
Sand, clay and water 100 feet in hole	7	457	Black gravel and sand	5	1,326
Clay	17	474	Sticky clay	25	1,351
Hard sand	8	482	Hard sand	14	1,365
Red sticky clay	68	550	Clay	96	1,461
Clay	101	651	Red shale	13	1,474
Sand	4	655	Clay	61	1,535
Sandy clay	63	718	Gravelly clay, hard	55	1,590
Sand and water	7	725	Clay	105	1,695
Clay	25	750	Black sand	3	1,698
Sandy clay and gravel	208	958	Clay	86	1,784
Red clay	22	980	Black sand (lava)	3	1,787
Sandy clay, gravel	33	1,013	Clay	23	1,810
Composed black rock and gravel	4	1,017	Black sand, hard (lava)	10	1,820
Clay and gravel	13	1,030			
Black granite and gravel	12	1,042	TOTAL DEPTH		1,820
(B-2-9)35cbb					
Topsoil	5	5	Rock	10	705
Sand and gravel	11	16	Clay with gravel—some water	185	890
Clay	159	175	Gravel with large rocks—good water	30	920
Gravel—first water	33	208			
Clay with some mica	472	680	TOTAL DEPTH		920
Sand and gravel—some water	15	695			
(B-3-11)8cac					
Soil	12	12	Cemented clay and gravel	20	530
Cemented clay and gravel	98	110	Sand and gravel	12	542
Hard cemented clay and gravel	160	270	Cemented clay and gravel	12	554
Very hard cemented clay and gravel	120	390			
Cemented clay and gravel	50	440	TOTAL DEPTH		554
Very hard cemented clay and gravel	70	510			
(C-1-8)6ccc2					
Sandy loam, caliche	20	20	Intermittent streaks clay with streaks of sand, gravel, conglomerate	620	800
Sandy clay	110	130			
Small gravel and sand	50	180	TOTAL DEPTH		800

Table 2. --Drillers' logs of selected wells in the Harquahala Plains—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
(C-1-8)14adb					
Topsoil	7	7	Clay and shale, conglomerate	20	450
Hardpan	9	16	Boulders, quartz, malpais rock	70	520
Malpais sand	4	20	Hard conglomerate, streaks of sand	95	615
Silt, sand, hard streaks	65	85	Blue malpais rock and boulders	93	708
Gravel, sand, boulders	100	185			
Gravel, sand, boulders	175	360	TOTAL DEPTH		708
Malpais rock, quartz rock	70	430			
(C-1-8)14ddd					
Sandy soil	6	6	Clay and rock	75	420
Sandy clay	19	25	Loose rock	5	425
Clay and rock	15	40	Clay and rock	75	500
Rock	10	50	Very hard rock and volcanic ash mountain top at 500		
Loose rock. First water 60 feet	85	135	feet. Had samples run by geologist	27	527
Clay and rock	140	275	Volcanic ash and rock	24	551
Loose rock	55	330			
Clay and rock	10	340	TOTAL DEPTH		551
Hard rock	5	345			
(C-1-8)16dcc					
Surface fill (soil)	35	35	Red malpais, alternate layers red conglomerate	95	440
Red conglomerate (cemented), little water in hole	50	85	Very good water-bearing gravel	12	452
Alternate layers rock and water gravel and sand.			Hard rock (red and black). This formation seems		
Lots of water in hole	25	110	to have faults or crevices at various intervals	133	585
Red malpais	110	220			
Hard red rock and lava-looking rock	125	345	TOTAL DEPTH		585
(C-1-8)17dcb					
Soil	2	2	Red clay and rock	45	365
Caliche	13	15	Brown clay and rock	150	515
Red clay and rock	114	129	Hot red clay and rock	115	630
Loose rock (water)	1	130	Red clay	190	820
Red clay and rock	50	180	Red clay and rock	25	845
Loose rock (water)	1	181	Red clay	40	885
Red clay and rock	24	205	Rock and clay (water)	20	905
Loose rock (water)	5	210	Brown and red clay	75	980
Red clay and rock	50	260	Brown clay and rock	35	1,015
Loose rock (water)	2	262	Gray clay	2	1,017
Red clay and rock	18	280	Loose rock (water)	18	1,035
Loose rock (water)	3	283	Red clay	8	1,043
Red clay and rock	17	300	Gray clay and rock	7	1,050
Loose rock (water)	12	312			
Red clay and rock	3	315	TOTAL DEPTH		1,050
Loose rock (water)	5	320			
(C-1-9)1ccc					
Surface sand	20	20	Gravel with light clay	80	860
Very fine gray sand, streaks clay	160	180	Malpais with streaks of sand	40	900
Fine gray sand	100	280	Small malpais boulders with clay streaks	80	980
Decomposed granite with malpais streaks	160	440	Clay with light streaks of gravel, malpais	26	1,006
Red clay streaks with gravel	180	620			
Fine gray sand with streaks of malpais	160	780	TOTAL DEPTH		1,006
(C-1-9)2ccc					
Surface sand	20	20	Sand and gravel	140	720
Sand and gravel	40	60	Small gravel and sand with streaks of malpais	80	800
Gravel with malpais streaks	20	80	Gravel and clay (very red)	160	960
Gravel and clay	80	160	Sand and gravel, small streaks malpais	65	1,025
Decomposed granite, streaks of gravel and clay	120	280	Malpais with clay streaks	75	1,100
Gravel and clay	120	400			
Decomposed granite with gravel	80	480	TOTAL DEPTH		1,100
Fine sandy clay streaks	100	580			
(C-1-9)3dcc					
Surface sand	20	20	Fine gravel with clay streaks	220	760
Sand, gravel	180	200	Sand and gravel	240	1,000
Very fine gray sand with clay streaks	60	260	Coarse gray sand	205	1,205
Sand, clay with gravel streaks	160	420			
Very fine silt and gray sand with clay streaks	120	540	TOTAL DEPTH		1,205

Table 2. --Drillers' logs of selected wells in the Harquahala Plains—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
(C-1-9)6dcc					
Sandy clay	326	326	Clay	18	596
Coarse water gravel	55	381	Coarse gravel	21	617
Clay	37	418	Clay	12	629
Good gravel	34	452	Hard rock	11	640
Clay	83	535			
Rock	43	578	TOTAL DEPTH		640
(C-1-9)9ccc					
Surface sand	20	20	Coarse gray sand and streaks malpais	260	1,280
Fine gray sand, streaks of clay	160	180	Fine gray sand with streaks of gravel	160	1,440
Decomposed granite with streaks of malpais	240	420	Decomposed granite with malpais	40	1,480
Gray sand and gravel with light clay streaks	140	560	Granite boulders with streaks of fine gray sand	20	1,500
Gray sand with fine malpais cuttings, light streaks clay	320	880	TOTAL DEPTH		1,500
Sand and gravel with small malpais boulders	140	1,020			
(C-1-9)10dcc					
Topsoil	6	6	Sand and gravel (water bearing)	15	453
Caliche	36	42	Clay with gravel	15	468
Gravel	5	47	Sand and gravel (water bearing)	12	480
Caliche	45	92	Clay with gravel	20	500
Gravel	8	100	Cemented layers with sand between	80	580
Cemented boulders	147	247	Clay with gravel	8	588
Caliche	35	282	Cemented layers with sand between; cemented layers ranged from 6 inches to 2 feet, with thin layers of sand between possibly water-bearing sand	116	704
Sand and gravel (water bearing)	16	298	Clay	71	775
Clay with gravel	30	328			
Cemented boulders	17	345			
Sand and gravel (water bearing)	85	430			
Clay with gravel	8	438	TOTAL DEPTH		775
(C-1-9)14ccc					
Caliche	15	15	Malpais	19	639
Clay, gravel, sand	185	200	Gravel, rock (water bearing)	116	755
Clay	25	225	Sand, gravel (water bearing)	145	900
(Fill) clay, gravel, sand, rock	320	545	Gravel, rock, sand (water bearing)	350	1,250
Malpais (hard), 1 foot per day	49	594			
Gravel, black sand	26	620	TOTAL DEPTH		1,250
(C-1-9)14cdd					
Caliche and rock	23	23	Boulders, malpais	25	640
Clay, gravel, and sand	37	60	Gravel, water-worn volcanics	426	1,066
Rock and clay, cemented	173	233			
Clay, sand	17	250	TOTAL DEPTH		1,066
Water-worn volcanic gravel	365	615			
(C-1-9)17dcc					
Surface soil	24	24	Caliche and boulders	55	285
Granite	3	27	Sand and gravel with streaks of clay	33	318
Gravel	8	35	Red bed	25	343
Shale	40	75	Water sand	11	354
Sand and gravel	24	99	Granite	10	364
Granite	60	159	Water sand	24	388
Caliche and gravel	6	165	Red bed	39	427
Granite boulders	10	175	Water sand	75	502
Sand and gravel	15	190	Red bed	24	526
Caliche and boulders	26	216			
Gravel	14	230	TOTAL DEPTH		526
(C-1-9)18acb					
Surface silt and sand	20	20	Very good coarse gravel	20	720
Boulders with streaks of gravel	200	220	Red clay with streaks of malpais and basalt boulders	173	893
Gravel with streaks of clay	90	310	Bedrock at 893 feet.		
Boulders with streaks of sand and gravel	90	400			
Boulders with streaks of well-rounded gravel	140	540			
Same as above, only finer	80	620	TOTAL DEPTH		893
Fine and tight sand and boulders (poor)	80	700			
(C-1-9)23bdc					
Topsoil	3	3	Malpais boulders	160	785
Gravel, some clay	132	135	Malpais with faults and soft streaks	275	1,060
Boulders, gravel	41	176	Red cinders and shale, some hard stringers	251	1,311
Gravel and clay, some boulders	114	290			
Clay and gravel	130	420	TOTAL DEPTH		1,311
Malpais fractures from 560 feet to 595 feet	205	625			

Table 3. --Field determinations of temperature and specific conductance of water from selected wells in the Harquahala Plains

Well location	Date measured (month, year)	Temperature (°C)	Specific conductance (micromhos at 25°C)
(B-1-8)6aaa	12/66	32	480
6bba	8/57	----------	1,060
	8/58	29	----------
	9/67	32	900
7aab	12/66	34	720
19abb2	9/67	31	840
19bcc	7/58	29	----------
	9/67	30	860
31ccc	8/57	30	1,300
(B-1-9)1bbb	12/66	33	700
6ccc	12/66	33	----------
7ccc	11/66	35	----------
	9/67	34	1,100
7dcc	8/58	36	----------
	11/66	34	----------
11bbb	8/57	----------	1,300
	7/58	33	----------
12cbb	9/58	33	----------
	9/67	33	890
13abb	9/67	31	800
13bbb	9/67	30	725
15abc	11/66	36	1,300
18ccc	11/66	31	----------
20ccc	12/66	34	1,300
24caa	7/58	29	----------
	9/67	29	870
26cbc	9/58	27	----------
	9/60	29	----------
	9/67	28	----------
28ccc	11/66	36	----------
	9/67	32	1,100
28dcc	11/66	31	----------
28ddd	9/67	29	1,100
32ccc	9/67	32	1,100
34dcc	8/58	28	----------
	11/66	29	----------
35dcd	9/67	27	1,200
(B-2-8)17daa	8/58	31	----------
18caa	9/58	32	----------
29bdd	9/67	36	810
30aaa	9/67	33	800
31baa	9/67	37	780
31daa	9/67	31	790
32bba	12/66	34	580
(B-2-9)9abb	12/66	33	----------
9dbb	12/66	34	----------
10abb	8/57	34	734
	12/66	33	----------
10bbb	12/66	33	----------
13baa	8/58	32	----------
	12/66	32	520

Table 3. --Field determinations of temperature and specific conductance of water from selected wells in the Harquahala Plains — Continued

Well location	Date measured (month, year)	Temperature (°C)	Specific conductance (micromhos at 25°C)
(B-2-9)14bbb	12/66	33	625
23aaa	12/66	31	840
26bcc	12/66	32	480
36bbb	9/67	31	800
(B-4-12)14cbb	9/67	28	1,400
(C-1-8)4bda	9/67	37	850
6ccc1	8/58	29	----------
	9/67	31	1,120
6dcc	9/67	30	1,190
(C-1-9)1ccc	9/67	33	1,140
2bcc	12/66	28	720
	9/67	34	800
2ccc	12/66	29	750
	9/67	29	1,170
2dcc	11/66	31	----------
	9/67	31	1,240
4ccc	7/58	26	----------
	9/67	27	1,100
5dcd	7/58	29	----------
7dcc	9/67	32	740
9bcc	7/58	27	----------
	9/67	29	975
11dbc	8/58	37	----------
16cbb	9/67	28	750

Table 4.--Chemical analyses of water from selected wells in the Harquahala Plains

[Analyses by U.S. Geological Survey. Results in milligrams per liter except as indicated. Dissolved solids: Dissolved solids represent sum of determined constituents in solution]

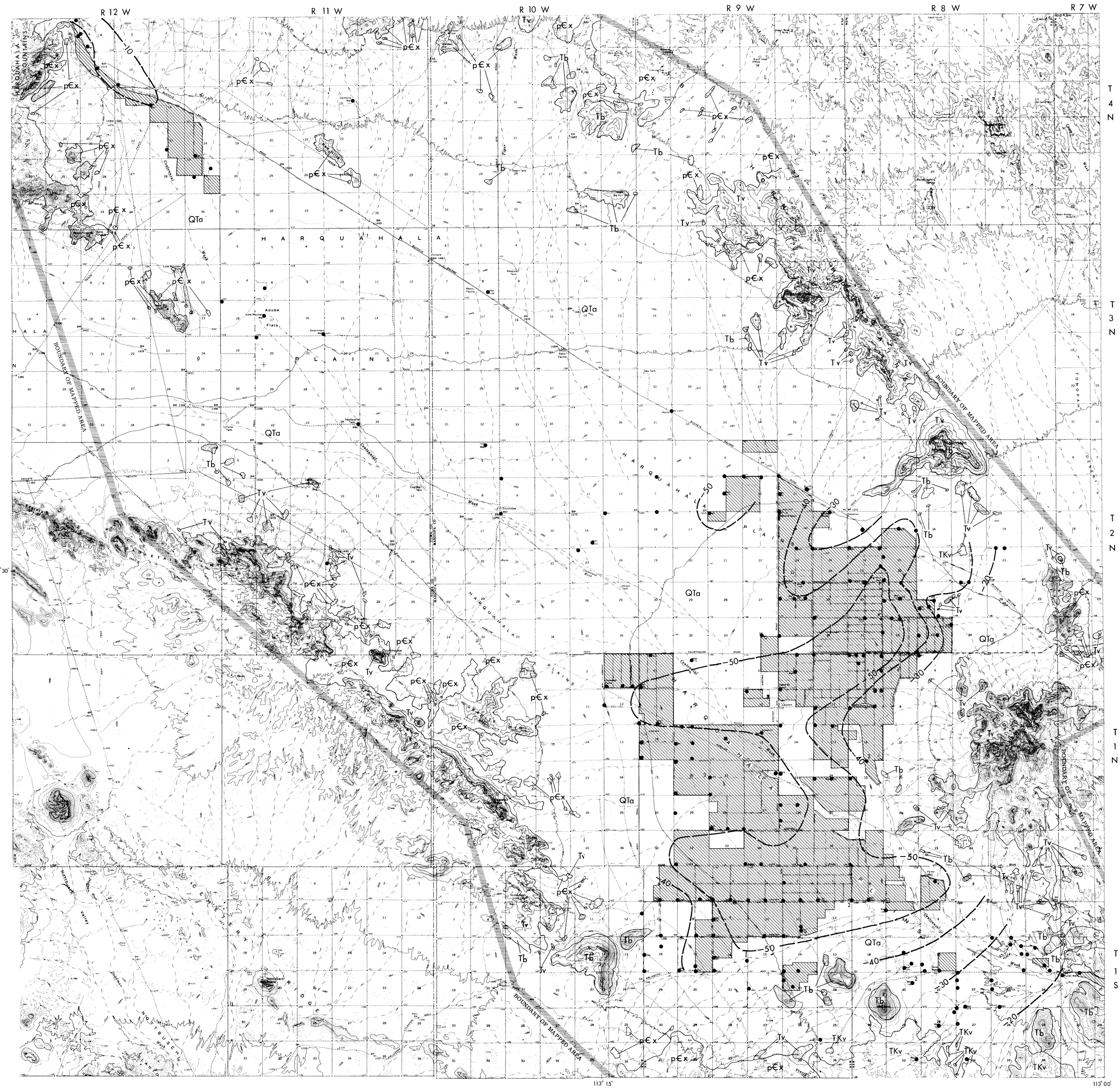
Well location	Date of collection (month, year)	Reported depth (feet)	Temperature (°C)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na + K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids: Milligrams per liter	Dissolved solids: Tons per acre-foot	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio (SAR)	Specific conductance (micromhos at 25°C)	pH	Remarks
(B-1-8)6aaa	12/66	759	32	91	0.02	31	10	144	114	40	94	119	3.1	------	------	------	120	0	-----	5.7	911	8.8	
7cbb	7/58	800	41	60	----	9.8	1.5	258	270	0	153	135	4.2	9.8	764	1.04	30	0	95	20	1,180	7.8	
19bcc	7/58	700	30	49	----	7.8	1.5	165	181	0	77	98	3.0	11	501	.68	26	0	93	14	874	7.2	
(B-1-9)1bbb	12/66	1,536	33	73	.04	34	9.0	168	156	0	228	83	1.6	------	------	------	122	0	-----	6.6	1,080	---	
6ccc	8/54	1,420	34	27	----	22	12	198	287	0	151	83	2.8	22	659	.90	104	0	80	8.4	1,060	---	
	12/66	1,420	-----	30	.03	30	11	199	298	0	150	102	3.2	------	------	------	120	0	-----	7.9	1,200	7.0	
7dcc	6/53	915	34	22	----	68	9.2	216	234	0	324	90	3.2	17	864	1.18	208	16	69	6.5	1,320	---	
	11/66	915	-----	27	.05	39	8.4	214	262	0	222	102	3.4	------	------	------	132	0	-----	8.1	1,220	7.0	
14bbb	8/57	1,216	30	130	----	27	.9	301	178	40	393	65	2.3	8.9	1,060	1.44	71	0	90	16	1,430	9.1	Boron, 0.69.
17cbb	7/58	1,495	36	30	----	16	8.1	202	286	0	122	93	2.8	16	631	------	74	0	86	10	1,010	8.1	
18ccc	12/66	--------	-----	26	.04	17	10	207	286	0	120	118	3.0	------	------	------	84	0	-----	9.8	1,110	7.1	
20bbb	6/53	900	32	27	----	19	7.6	206	270	0	145	92	4.8	16	650	.88	78	0	85	10	1,060	---	
	8/54	900	32	------	----	--------	-------	----------	293	0	-------	99	-----	------	------	------	-------	-----	-----	-------	1,100	---	
21bcc2	8/54	1,033	32	------	----	--------	-------	----------	253	0	-------	92	-----	------	------	------	-------	-----	-----	-------	997	---	
24caa	8/58	1,000	29	49	----	12	3.7	172	178	0	111	102	2.1	9.5	549	------	45	0	89	11	868	7.5	
26cbc	6/53	1,015	28	------	----	--------	-------	----------	229	0	-------	122	-----	------	------	------	-------	-----	-----	-------	1,030	---	
	4/55	1,015	28	22	----	9.5	7.4	205	231	0	117	121	2.6	13	612	.83	54	0	89	12	1,030	7.7	
28ccc	11/66	1,130	-----	33	.02	21	8.6	203	274	0	116	126	2.7	------	------	------	88	0	-----	9.4	1,120	7.0	
28dcc	8/54	1,030	31	------	----	--------	-------	----------	277	0	-------	130	-----	------	------	------	-------	-----	-----	-------	1,100	---	
	11/66	1,030	31	36	.02	17	7.2	206	260	0	112	130	2.7	------	------	------	72	0	-----	10	1,120	7.4	
34dcc	6/53	845	27	28	----	20	12	204	259	0	119	134	2.8	13	660	.90	100	0	82	8.9	1,100	---	
	11/66	845	29	38	.02	22	7.5	187	260	0	80	134	2.6	------	------	------	86	0	-----	8.8	1,090	7.4	
35dcd	6/53	910	26	23	----	16	10	273	355	0	142	152	4.0	14	809	1.10	81	0	88	13	1,260	---	
(B-1-10)1ccc	6/53	918	31	27	----	25	15	191	302	0	122	104	2.8	13	649	.88	124	0	77	7.4	1,070	---	
1dcc	6/53	800	33	------	----	--------	-------	----------	327	0	-------	98	-----	------	------	------	-------	-----	-----	-------	1,100	---	
1ddc	12/66	2,010	36	30	.05	27	6.9	214	284	0	150	116	3.4	------	------	------	96	0	-----	9.5	1,140	7.3	
(B-2-8)17daa	8/54	510	32	------	----	--------	-------	----------	141	0	-------	92	-----	------	------	------	-------	-----	-----	-------	691	---	Boron, 0.00.
	8/56	510	31	44	----	21	8.8	118	146	0	72	94	5.2	6.5	442	.60	88	0	74	5.5	711	8.2	
28dcc	9/52	--------	28	45	----	20	6.8	118	149	0	67	90	4.0	7.8	432	.59	78	0	77	5.8	693	---	
30aaa	12/17	--------	-----	4.5	.06	33	9.0	148	123	0	110	159	-----	1.6	527	------	119	-----	-----	-------	-------	---	From Ross (1923, p. 202).
31aaa	7/58	1,218	34	34	----	22	8.1	116	120	0	90	98	2.1	7.4	437	------	88	0	74	5.4	715	7.4	

Table 4. --Chemical analyses of water from selected wells in the Harquahala Plains—Continued

Well location	Date of collection (month, year)	Reported depth (feet)	Temperature (°C)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na + K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids: Milligrams per liter	Dissolved solids: Tons per acre-foot	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio (SAR)	Specific conductance (micromhos at 25° C)	pH	Remarks
(B-2-8)32bba	12/66	1,720	33	27	0.02	21	2.8	142	96	0	78	147	2.5	------	------	------	64	0	-----	7.7	861	6.9	
(B-2-9)9abb	9/52	1,540	34	36	----	28	16	124	162	0	119	59	1.4	17	480	0.65	86	0	76	5.8	710	---	
	7/53	1,540	34	------	----	--------	-------	----------	165	0	-------	61	-----	------	------	------	-------	-----	-----	-------	734	---	
	12/66	1,540	------	32	.02	30	14	110	156	0	146	63	1.3	------	------	------	132	0	-----	4.2	782	6.8	
9dbb	8/57	1,500	33	39	----	25	17	115	179	0	125	64	1.4	14	488	.66	132	0	65	4.3	824	7.1	
	12/66	1,500	34	43	.02	26	13	108	168	0	118	62	1.7	------	------	------	118	0	-----	4.3	788	7.1	
10abb	12/66	1,500	33	38	.02	31	13	117	150	0	93	114	1.8	------	------	------	130	0	-----	4.5	878	6.9	
10bbb	7/53	1,300	33	------	----	--------	-------	----------	153	0	-------	67	-----	------	------	------	-------	-----	-----	-------	732	---	
	12/66	1,300	33	112	.02	34	14	130	140	28	130	88	1.8	------	------	------	142	0	-----	4.7	882	8.7	
11adb	12/17	390	------	36	4.0	30	20	193	202	14	130	136	-----	75	746	------	157	-----	-----	6.7	-------	---	From Ross (1923, p. 205).
	9/52	--------	28	18	----	14	3.7	156	141	0	84	129	-----	4.2	478	.65	50	0	87	9.6	790	---	Has been deepened, depth unknown.
11cbb	12/66	1,505	------	35	.06	25	11	100	142	0	112	64	1.1	------	------	------	108	0	-----	4.2	715	7.0	
13baa	8/54	603	33	41	----	24	9.0	111	146	0	75	90	3.6	6.5	432	.59	97	0	71	4.9	686	---	
	12/66	603	32	44	.02	30	9.0	108	136	0	91	94	3.6	------	------	------	112	0	-----	4.4	767	7.1	
14bbb	7/52	1,530	32	38	----	28	15	104	152	Trace	115	73	1.4	9.2	459	.62	132	7	63	3.9	728	---	
	9/52	1,530	32	------	----	--------	-------	----------	150	0	-------	69	-----	------	------	------	-------	-----	-----	-------	709	---	
	3/55	1,530	32	41	----	25	21	98	154	0	111	78	1.3	8.9	460	.63	149	23	59	3.5	738	7.1	
	12/66	1,530	33	44	.02	32	12	142	144	0	143	117	1.9	------	------	------	128	10	-----	5.5	966	7.4	
(B-2-10)16bbb	3/55	494	26	17	----	11	14	169	286	0	78	73	2.8	32	538	.73	85	0	81	8.0	895	7.5	
(B-3-11)17bdc	12/17	478	------	36	.21	25	12	173	195	19	90	134	-----	16	657	------	112	-----	-----	-------	-------	---	From Ross (1923, p. 212).
(C-1-8)6ccc1	7/58	710	29	30	----	16	7.2	218	168	0	158	156	5.1	11	684	------	70	0	87	11	1,130	8.1	
14abc2	7/53	225	28	50	----	16	4.4	204	207	0	129	124	4.8	11	645	.88	58	0	88	12	1,030	---	
(C-1-9)1ccc	8/57	1,006	33	27	----	14	7.1	233	237	0	140	149	4.8	12	705	.96	64	0	89	13	1,190	7.6	
	11/66	1,006	------	26	.02	12	6.3	222	230	0	123	150	4.1	------	------	------	56	0	-----	13	1,190	7.4	
2bcc	4/55	366	26	28	----	13	11	239	293	0	125	154	-----	13	727	.99	78	0	87	12	1,220	7.6	
	11/66	--------	28	30	.03	14	11	210	246	0	120	147	2.0	------	------	------	82	0	-----	10	1,160	7.2	
2ccc	8/57	1,100	28	58	----	18	10	246	286	0	154	147	4.4	9.6	789	1.07	86	0	86	12	1,240	8.2	Boron, 0.74.
	8/58	1,100	28	------	----	--------	-------	----------	250	0	-------	150	-----	------	------	------	68	0	-----	-------	1,210	7.6	
	11/66	1,100	29	30	.02	15	7.9	230	264	0	128	149	3.9	------	------	------	70	0	-----	12	1,220	7.3	
2dcc	11/66	--------	------	34	.03	21	9.6	233	236	0	132	181	4.4	------	------	------	92	0	-----	11	1,350	7.5	

Table 4. --Chemical analyses of water from selected wells in the Harquahala Plains—Continued

Well location	Date of collection (month, year)	Reported depth (feet)	Temperature (°C)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na + K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids: Milligrams per liter	Dissolved solids: Tons per acre-foot	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio (SAR)	Specific conductance (micromhos at 25° C)	pH	Remarks
(C-1-9)3dcc	8/57	1,205	------	29	----	15	10	227	278	0	124	139	3.2	12	697	0.95	78	0	86	11	1,150	7.3	Boron, 0.56.
5dcd	8/57	930	29	40	----	28	11	179	154	8	139	143	4.4	9.3	638	.87	115	0	77	7.3	1,030	8.4	Boron, 0.74.
9bcc	7/58	--------	27	29	----	24	10	185	166	0	133	148	4.5	9.7	625	------	101	0	80	8.0	1,030	7.3	
9ccc	8/57	1,500	28	27	----	25	4.5	187	166	0	141	132	3.6	12	615	.84	81	0	83	9.0	1,020	7.5	Boron, 0.57.
16cbb	7/58	1,092	27	38	----	25	5.4	120	137	0	56	106	5.6	13	436	.59	84	0	76	5.7	834	7.7	
17dcc	8/56	526	------	30	----	27	4.0	144	136	7	102	100	6.0	15	502	.68	84	0	79	6.9	805	8.4	Boron, 0.00.



BASE FROM U. S. GEOLOGICAL SURVEY, 1:62,500
BIG HORN MOUNTAINS, 1961; CORTEZ PEAK, 1962;
EAGLETAIL MOUNTAINS, 1962; HOPE, 1961; LITTLE
HORN MOUNTAINS, 1962; AND LONE MOUNTAIN, 1961

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

GEOLOGY MODIFIED FROM METZGER (1957)
BY M. E. COOLEY, 1970; HYDROLOGY BY
E. E. DENIS, 1967

EXPLANATION

QUATERNARY

QTa — ALLUVIUM

TERTIARY

Tb — BASALTIC ANDESITE TO BASALT

Tv — YOUNGER RHYOLITE TO ANDESITE FLOWS AND TUFFS

CRETACEOUS

TKv — OLDER RHYOLITE TO ANDESITE FLOWS AND TUFFS

PRECAMBRIAN

pЄx — CONSOLIDATED ROCKS

CONTACT

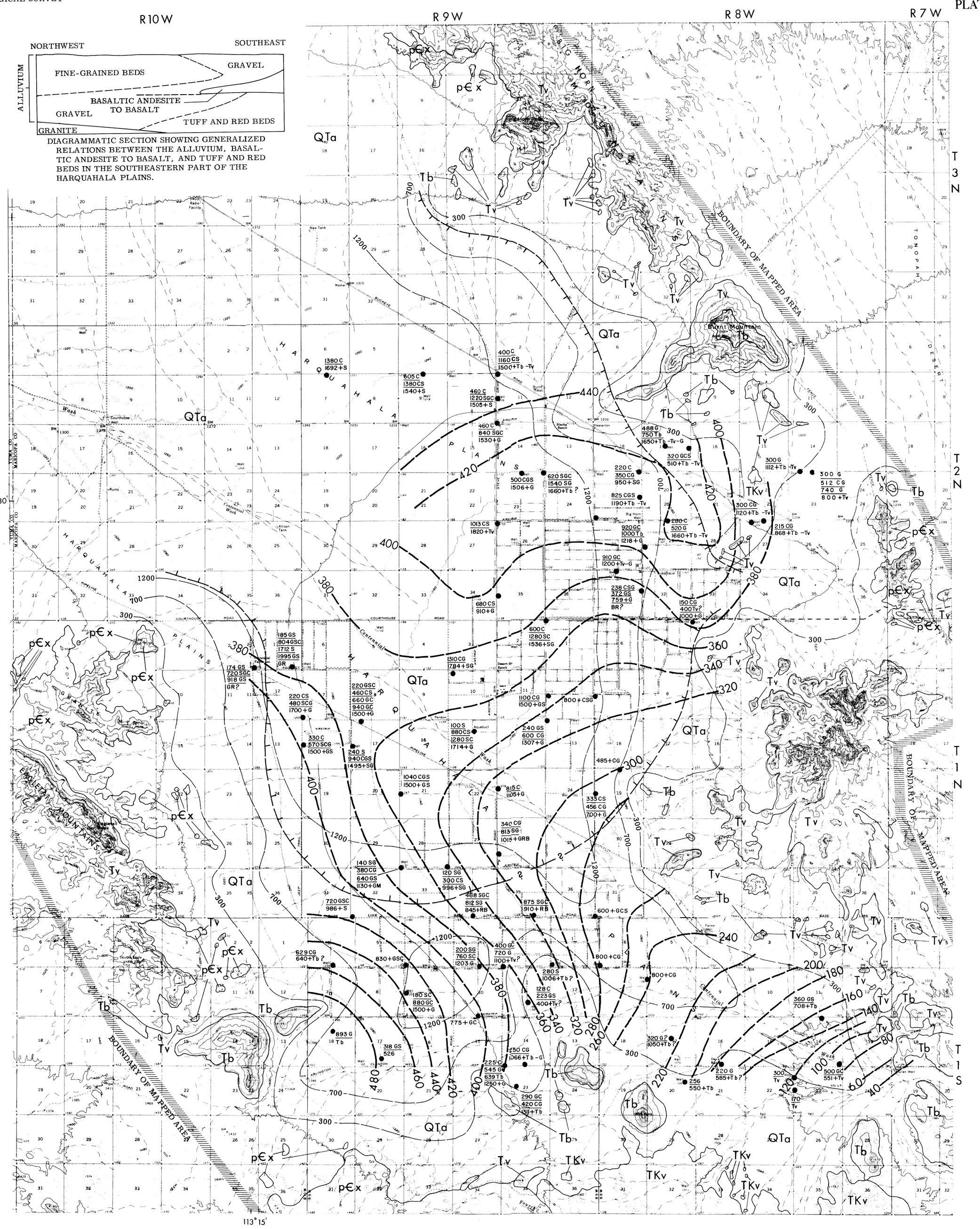
AREA UNDER CULTIVATION AS OF 1967
(BASED ON AERIAL RECONNAISSANCE IN 1967)

2
WELL
WELL DATA ARE GIVEN IN TABLE 1
(FIGURE, 2, INDICATES NUMBER OF WELLS AT THIS LOCATION)

40
LINE OF EQUAL CHANGE IN WATER LEVEL
INTERVAL 10 FEET

LOCATION OF WELLS, CULTIVATED AREAS, PRINCIPAL OUTCROPPING ROCKS, AND CHANGE IN GROUND-WATER LEVELS FROM DECEMBER 1963 TO DECEMBER 1966 IN THE HARQUAHALA PLAINS

DIAGRAMMATIC SECTION SHOWING GENERALIZED RELATIONS BETWEEN THE ALLUVIUM, BASALTIC ANDESITE TO BASALT, AND TUFF AND RED BEDS IN THE SOUTHEASTERN PART OF THE HARQUAHALA PLAINS.



BASE FROM U.S. GEOLOGICAL SURVEY, 1:62,500
BIG HORN MOUNTAINS, 1961; CORTEZ PEAK, 1962;
EAGLETAIL MOUNTAINS, 1962; AND LONE MOUNTAIN, 1961

0 1 2 3 4 5 MILES

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

SURFACE GEOLOGY MODIFIED FROM METZGER (1957) BY M. E. COOLEY, 1970; SUBSURFACE GEOLOGY BY M. E. COOLEY, 1970; HYDROLOGY BY E. E. DENIS, 1967

EXPLANATION

QTa — QUATERNARY

ALLUVIUM

THE ALLUVIUM CONSISTS OF SEVERAL UNITS COMPOSED OF DIFFERENT MIXTURES OF GRAVEL, SAND, SILT, AND CLAY. IN GENERAL, THE ALLUVIUM IS MADE UP OF AN UPPER SAND, GRAVEL, AND CLAY UNIT AND A LOWER GRAVEL UNIT. IN MUCH OF THE CENTRAL PART OF THE AREA THE UPPER UNIT INCLUDES MORE THAN 1,000 FEET OF CLAY AND SILT. THE GRAVEL IN THE LOWER UNIT INCLUDES MORE THAN ONE GRAVEL DEPOSIT AND PROBABLY IS STRATIGRAPHICALLY ABOVE AND BELOW THE BASALTIC ANDESITE TO BASALT UNIT. THE LOWER UNIT IS PENETRATED BY DEEP WELLS IN THE SOUTHERN PART OF THE AREA. THE ALLUVIUM IS THE MAIN AQUIFER IN THE AREA AND IS THE ONLY UNIT THAT YIELDS SUFFICIENT WATER FOR IRRIGATION WELLS

Tb — TERTIARY

BASALTIC ANDESITE TO BASALT

INCLUDES SOME LIGHT-COLORED WEAKLY CEMENTED SILICIC TUFF. WHERE PRESENT, THE UNIT IS FROM 50 TO MORE THAN 500 FEET THICK AND GENERALLY DIPS GENTLY VALLEYWARD. THE UNIT ESSENTIALLY IS NOT WATER BEARING

Tv — TERTIARY

YOUNGER RHYOLITE TO ANDESITE FLOWS AND TUFFS

THE FLOWS AND TUFFS ARE MORE THAN 2,000 FEET THICK IN THE EAGLETAIL AND BIG HORN MOUNTAINS. THE UNIT HAS BEEN STRUCTURALLY DEFORMED BY LARGE-SCALE FAULTING AND HAS LOCAL DISPLACEMENTS OF MORE THAN 1,000 FEET. THE UNIT IS NOT WATER BEARING EXCEPT WHERE IT HAS BEEN CUT BY FRACTURES; WHERE FRACTURED, IT YIELDS SUFFICIENT WATER FOR SMALL DOMESTIC AND STOCK WELLS

TKv — CRETACEOUS

OLDER RHYOLITE TO ANDESITE FLOWS AND TUFFS

THE UNIT CROPS OUT ONLY IN THE SOUTHERN PART OF THE AREA. IT IS HIGHLY DEFORMED BY STRUCTURAL MOVEMENT AND, IN PLACES, IS INTENSIVELY FRACTURED. WHERE FRACTURED, THE UNIT MAY YIELD SMALL AMOUNTS OF WATER TO STOCK OR DOMESTIC WELLS

p€x — PRECAMBRIAN

CONSOLIDATED ROCKS

THE SEDIMENTARY ROCKS ARE EXPOSED MAINLY IN THE NORTHERN PART OF THE AREA AND CONSIST OF SOME CONGLOMERATE OF PROBABLE MESOZOIC AGE AND LIMESTONE, SHALE, AND SOME SANDSTONE OF PALEOZOIC AGE. THE GRANITE AND SCHIST IS OF PRECAMBRIAN AGE. THE ROCKS ESSENTIALLY ARE NOT WATER BEARING; HOWEVER, WHERE HIGHLY FRACTURED, THE ROCKS MAY YIELD SMALL AMOUNTS OF WATER TO WELLS

CONTACT

290 GC
420 CG
1311 + Tb

WELL

NUMBER, 420, DENOTES GENERALIZED DEPTH, IN FEET, TO LITHOLOGIC ZONE OR UNIT PENETRATED. SYMBOL DENOTES MAIN LITHOLOGY OF ZONE OR UNIT:

- C = CLAY
- S = SAND
- G = GRAVEL
- RB = SHALY RED BEDS
- Tv = RHYOLITE TO ANDESITE
- Tb = BASALTIC ANDESITE, ANDESITIC BASALT, AND BASALT
- GR = GRANITE
- BR = BEDROCK
- + = PARTIALLY PENETRATED LITHOLOGIC ZONE OR UNIT

GENERALIZED LIMIT OF FINE-GRAINED BEDS

360

LINE OF EQUAL DEPTH TO WATER
INTERVAL 20 FEET, DATUM IS LAND SURFACE

300

GENERALIZED THICKNESS OF ALLUVIUM
INTERVAL, IN FEET, IS VARIABLE. SHOWS DEPTH TO TOP OF ESSENTIALLY NONWATER-BEARING ROCKS—VOLCANIC ROCKS, GRANITE, SCHIST, AND SHALY RED BEDS—THAT UNDERLIE THE ALLUVIUM

PRINCIPAL OUTCROPPING ROCKS, THICKNESS OF ALLUVIAL DEPOSITS, AND DEPTH TO WATER IN DECEMBER 1966 IN THE SOUTHEASTERN PART OF THE HARQUAHALA PLAINS

ARIZONA STATE LAND DEPARTMENT WATER-RESOURCES REPORTS
(Continued from inside front cover)

No.

17. Effects of ground-water withdrawal, 1954-63, in the lower Harquahala Plains, Maricopa County, Arizona, by R. S. Stulik: 8 p., 5 figs., 1964.

*18. Basic ground-water data for western Pinal County, Arizona, by W. F. Hardt, R. E. Cattany, and L. R. Kister: 59 p., 4 figs., 1964.

19. Annual report on ground water in Arizona, spring 1963 to spring 1964, by N. D. White, R. S. Stulik, E. K. Morse, and others: 60 p., 27 figs., 1964.

20. Hydrologic and drill-hole data, San Xavier Indian Reservation and vicinity, Pima County, Arizona, by L. A. Heindl and N. D. White: 48 p., 3 figs., 1965.

21. Basic hydrologic data for San Simon basin, Cochise and Graham Counties, Arizona, and Hidalgo County, New Mexico, by N. D. White and C. R. Smith: 42 p., 4 figs., 1965.

22. Bibliography of U.S. Geological Survey water-resources reports, Arizona, 1891 to 1965, compiled by the Arizona District, Water Resources Division, U. S. Geological Survey: 59 p., 1965.

*23. Geohydrology of the Dateland-Hyder area, Maricopa and Yuma Counties, Arizona, by W. G. Weist, Jr.: 46 p., 8 figs., 1965.

*24. Annual report on ground water in Arizona, spring 1964 to spring 1965, by N. D. White and others: 62 p., 22 figs., 1965.

25. An appraisal of the ground-water resources of Avra and Altar Valleys, Pima County, Arizona, by N. D. White, W. G. Matlock, and H. C. Schwalen: 66 p., 12 figs., 1966.

26. Basic hydrologic data of the Hualapai, Sacramento, and Big Sandy Valleys, Mohave County, Arizona, by J. B. Gillespie, C. B. Bentley, and William Kam: 39 p., 6 figs., 1966.

27. Basic ground-water data for western Salt River Valley, Maricopa County, Arizona, by William Kam, H. H. Schumann, L. R. Kister, and F. E. Arteaga: 72 p., 11 figs., 1966.

28. Anticipated changes in the flow regimen caused by the addition of water to the East Verde River, Arizona, by H. W. Hjalmarson and E. S. Davidson: 10 p., 3 figs., 1966.

29. Infiltration and recharge from the flow of April 1965 in the Salt River near Phoenix, Arizona, by P. C. Briggs and L. L. Werho: 12 p., 7 figs., 1966.

No.

30. Hydrologic conditions in the Douglas basin, Cochise County, Arizona, by N. D. White and Dallas Childers: 26 p., 9 figs., 1967.

31. Compilation of flood data for Maricopa County, Arizona, through September 1965, by L. L. Werho: 36 p., 1 fig., 1967.

*32. Annual report on ground water in Arizona, spring 1965 to spring 1966, by E. B. Hodges and others: 61 p., 22 figs., 1967.

33. Basic ground-water data for southern Coconino County, Arizona, by E. H. McGavock: 49 p., 4 figs., 1968.

34. Spring flow into the Colorado River—Lees Ferry to Lake Mead, Arizona, by P. W. Johnson and R. B. Sanderson: 26 p., 5 figs., 1968.

35. Ground water in Paradise Valley, Maricopa County, Arizona, by F. E. Arteaga, N. D. White, M. E. Cooley, and A. F. Sutheimer: 76 p., 15 figs., 1968.

36. Annual report on ground water in Arizona, spring 1966 to spring 1967, by C. J. Cox and others: 43 p., 30 figs., 1968.

37. Ground-water conditions in the Waterman Wash area, Maricopa and Pinal Counties, Arizona, by E. E. Denis: 23 p., 9 figs., 1968.

38. Annual report on ground water in Arizona, spring 1967 to spring 1968, prepared under the direction of H. M. Babcock, District Chief, Arizona District, Water Resources Division, U.S. Geological Survey: 54 p., 32 figs., 1969.

39. Hydrologic conditions in the Gila Bend basin, Maricopa County, Arizona, by R. S. Stulik and Otto Moosburner: 63 p., 10 figs., 1969.

40. Ground-water conditions in McMullen Valley, Maricopa, Yuma, and Yavapai Counties, Arizona, by P. C. Briggs: 31 p., 9 figs., 1969.

41. Ground-water conditions in the Ranegras Plain, Yuma County, Arizona, by P. C. Briggs: 28 p., 7 figs., 1969.

*42. Annual report on ground water in Arizona, spring 1968 to spring 1969, prepared under the direction of H. M. Babcock, District Chief, Arizona District, Water Resources Division, U.S. Geological Survey: 46 p., 33 figs., 1969.

43. Annual report on ground water in Arizona, spring 1969 to spring 1970, prepared under the direction of H. M. Babcock, District Chief, Arizona District, Water Resources Division, U.S. Geological Survey: 44 p., 30 figs., 1970.

ARIZONA STATE LAND DEPARTMENT WATER-RESOURCES REPORTS
(Continued from opposite page)

No.

44. Floods of September 1970 in Arizona, Utah, and Colorado, by R. H. Roeske: 20 p., 5 figs., 1971.

No.

45. Ground-water conditions in the Harquahala Plains, Maricopa and Yuma Counties, Arizona, by E. E. Denis: 44 p., 2 pls., 7 figs., 1971.