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REPORT 153

DEVELOPMENT OF GROUND WATER IN THE EL PASO DISTRICT, TEXAS, 1963-70

By

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United States Geological Survey

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DEVELOPMENT OF GROUND WATER IN THE EL PASO DISTRICT, TEXAS, 1963-70

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ABSTRACT

Development of ground water in the El Paso district continued to increase from 1963 to 1970, but at a less rapid rate than in previous years. During this period, 82 wells were drilled for the following uses: Twenty-eight for municipal supply; five for industry; one for La Tuna Prison; one for Chamizal Park; seven for irrigation; one for domestic supply and stock; and 39 for observation of water levels and water quality. In 1963 the pumpage from deep wells was 78.3 mgd (million gallons per day); pumpage in 1969 was 90.2 mgd. The amount of water pumped for irrigation from deep and shallow wells ranged from 159.3 mgd in 1964 to 14.3 mgd in 1969. The amount of ground water pumped for irrigation depends in part upon the availability of surface-water supplies.

The increased pumpage of ground water has been accomplished by expansion of the existing well fields; consequently, water levels have declined steadily. Maximum declines during the period 1963-70 occurred in the Nevins field and city artesian area. In the Nevins field the maximum measured decline was 33.6 feet, and in the city artesian area, the maximum decline was more than 40 feet.

The recovery of water levels in the upper and lower valleys from 1964 to 1969 indicates that large quantities of ground water can be pumped during long periods of drought without seriously depleting the ground-water supply in the alluvium. In years when adequate amounts of surface water are available, recharge from surface water applied for irrigation is about 84,000 acre-feet in the lower valley, and at least 47,000 acre-feet in the upper valley.

Recharge to the Hueco Bolson is increasing. Recharge was computed to be 13.2 mgd from 1936 to 1942, and 34.7 mgd from 1963 to 1970. This increase in recharge has occurred in the artesian part of the bolson, and is derived from leakage from the alluvium that overlies the bolson deposits.

Approximately 7,500,000 acre-feet of fresh water is stored in the sediments in the bolson area, of which 6,800,000 acre-feet is in the mesa part of the bolson and 700,000 acre-feet is in the city artesian area. An estimated 3,400,000 acre-feet of slightly saline water, 1,000 mg/l (milligrams per liter) to 3,000 mg/l dissolved solids, is stored in the bolson deposits that adjoin and underlie the fresh-water zone. This water can be blended with fresh water to produce water that is suitable for public supply.

The amount of fresh water available (560,000 ac-ft) in the upper valley has remained essentially unchanged, because the rate of withdrawal is approximately equal to the rate of natural recharge (13.0 mgd).

In the mesa area, the increase in the chloride content of the water has not been serious; however, it is increasing in water from a few wells. Water from wells in the city artesian area has shown an increase in chloride content of as much as 175 mg/l in the last 10 years.

DEVELOPMENT OF GROUND WATER IN THE EL PASO DISTRICT, TEXAS, 1963-70

INTRODUCTION

Location and Extent of the Area

The El Paso district is in the extreme western part of Texas and includes all of El Paso County. Ciudad Juarez, Mexico is included in the report area, because this city and El Paso both pump ground water from the same aquifer. Pumping by Ciudad Juarez had no significant effect on the supply of water available in the Texas part of the bolson. Data were provided by the Superintendent, Ciudad Juarez Water Department.

In a previous report by Leggat (1962, p. 3), the El Paso district was subdivided into four general areas on the basis of ground-water development (Figure 17): (1) The mesa area; (2) the city artesian area; (3) the upper valley; and (4) the lower valley. The same designations are used in this report.

Purpose and Scope of the Investigation

This report is the tenth in a series of reports presenting information on ground-water development of the El Paso district. These reports have been prepared by the U.S. Geological Survey in cooperation with the Texas Water Development Board and the city of El Paso.

The purpose of this continuing investigation is to record the seasonal and annual variations in the amount of ground-water withdrawals; to determine the areal distribution of these withdrawals; to determine the relationship of the ground-water withdrawals to the changes in ground-water storage and to the quality of water in the ground-water reservoir; and to determine the amount of water that can be perennially withdrawn from the various aquifers without detriment to the water supply for irrigation.

This report updates the information on ground-water pumpage, changes in water levels, and changes in water quality during the period 1963-70. In addition, this report presents records for wells drilled during this period (Table 7), and presents information on the total water budget for the El Paso district.

Previous Investigations

The geology, geography, and climate of the area have been adequately described in several previous reports. The geology and its relation to the ground-water resources were discussed by Sayre and Livingston (1945), Knowles and Kennedy (1958), Leggat and others (1962), Leggat (1962), Davis (1965), and Leggat and Davis (1966). Additional data pertaining to ground water in the district have been published in reports by Scalapino (1949), Smith (1956), and Audsley (1959).

GROUND-WATER DEVELOPMENT AND PUMPAGE

Ground water in the El Paso district occurs chiefly in the unconsolidated deposits of the Hueco Bolson (mesa and city artesian areas), in the shallow alluvium of the El Paso Valley (lower valley area), and the lower Mesilla Valley (upper valley area, Figure 17).

Since 1963, the city of El Paso has drilled 25 municipal-supply wells, of which three are in the Airport well field, two in the city artesian area, nine in the Canutillo well field, six in the Nevins well field, and five east of the Airport well field and north of the escarpment.

In addition to the municipal-supply wells, the city of El Paso drilled 24 shallow (50 ft) observation wells in the upper and lower valley areas to measure water levels and to obtain water samples for chemical analyses.

The International Boundary and Water Commission drilled 11 shallow observation wells. These wells are measured every 3 months to study the effects on water levels of the concrete lining that was installed in the channel of the Rio Grande in the fall of 1968.

As the population of the El Paso district increases, ground water use from deep wells continues to increase.

The average daily pumpage of ground water for public supply, industry, and irrigation during the period 1963-69 is given in Tables 1-3. Pumpage from deep wells (includes Ciudad Juarez) increased from 78.3 mgd (million gallons per day) in 1963 to 90.2 mgd in 1969. In 1969, the city of El Paso pumped 50.5 mgd or about 56 percent of the total water pumped from deep wells (2.4 mgd was from shallow wells in the Upper Valley), and Ciudad Juarez pumped 19.8 mgd (Superintendent, Ciudad Juarez Water Dept., written commun.). Industry used 9.0 mgd; military establishments used 5.1 mgd; and irrigation used 5.8 mgd. The average daily totals from all wells are given in Table 4.

Table 1.—Average Daily Pumpage of Ground Water for Public Supply, 1963-69 (Millions of Gallons) 1/

YEAR	MESA AREA		CITY ARTESIAN AREA		UPPER VALLEY		LOWER VALLEY	TOTAL
	CITY OF EL PASO	MILITARY ESTABLISH-MENTS	CITY OF EL PASO	CIUDAD 2/ JUAREZ	DEEP AND MEDIUM AQUIFERS	SHALLOW AQUIFERS		
1963	25.9	5.4	8.3	13.7	11.6	7.1	0.4	72.4
1964	25.1	4.9	10.1	15.1	13.6	6.2	.4	75.4
1965	25.1	4.9	10.0	15.0	14.2	4.3	—	73.5
1966	20.8	5.1	7.5	15.0	14.2	3.1	—	64.7
1967	25.9	5.3	4.5	16.1	11.8	9.9	—	73.5
1968	26.0	5.4	10.0	17.6	10.4	4.0	—	73.4
1969	34.0	5.1	6.2	19.8	10.3	2.4	—	77.8
Total	182.8	36.1	56.6	112.3	86.1	37.0	0.8	510.7

1/ One mgd (million gallon per day) is equal to 1,120.95 acre-feet per year.

2/ Data furnished by superintendent, Ciudad Juarez Water Department.

Table 2.—Average Daily Pumpage of Ground Water for Industry, 1963-69 (Millions of Gallons)

YEAR	MESA AREA	CITY ARTESIAN AREA	UPPER VALLEY 1/	LOWER VALLEY	TOTAL
1963	2.1	6.2	2.4	—	10.7
1964	2.6	5.9	2.6	—	11.1
1965	3.0	5.9	2.4	—	11.3
1966	3.1	5.9	2.5	—	11.5
1967	3.6	5.2	2.7	—	11.5
1968	3.4	5.4	2.4	—	11.2
1969	3.3	5.7	2.8	—	11.8
Total	21.1	40.2	17.8	—	79.1

1/ Water pumped from shallow wells.

Table 3.—Average Daily Pumpage of Ground Water for Irrigation, 1963-69 (Millions of Gallons)

YEAR	MESA AREA	CITY ARTESIAN AREA	UPPER VALLEY 1/	LOWER VALLEY	TOTAL
1963	4.7	—	17.4	43.2	65.3
1964	5.7	—	37.5	116.1	159.3
1965	6.8	—	19.4	47.7	73.9
1966	5.5	—	10.7	20.7	36.9
1967	5.3	—	24.0	46.5	75.8
1968	4.6	—	17.4	8.9	30.9
1969	5.8	—	4.0	4.5	14.3
Total	38.4	—	130.4	287.6	456.4

1/ Water pumped from shallow wells.

Table 4.—Average Total Daily Pumpage of Ground Water, 1963-69 (Millions of Gallons)

YEAR	MESA AREA	CITY ARTESIAN AREA	UPPER VALLEY	LOWER VALLEY	TOTAL
1963	38.1	28.2	38.5	43.6	148.4
1964	38.3	31.1	59.9	116.5	245.8
1965	39.8	30.9	40.3	47.7	158.7
1966	34.5	28.4	30.5	20.7	114.1
1967	40.1	25.8	48.4	46.5	160.8
1968	39.4	33.0	34.2	8.9	115.5
1969	48.2	31.7	19.5	4.5	103.9
Total	278.4	209.1	271.3	288.4	1,047.2

Pumpage by Ciudad Juarez is cited for comparative purposes between the two water uses; it is not included in the computations relating the depletion of water stored in the Texas part of the Hueco Bolson.

Of the 50.5 mgd pumped by the city of El Paso in 1969, about 67 percent was from the mesa area, 20 percent from the upper valley area, and 13 percent from the city artesian area. The estimated average daily pumpage from deep wells in the El Paso district, 1906-69, is shown on Figure 1. The pumpage of ground water decreased considerably in 1966, when the city was able to obtain more return water from the Rio Grande. This return water is drain water returned to the river after the irrigation season.

In the mesa area, pumpage of ground water increased from 38.1 mgd in 1963 to 48.2 mgd in 1969. About 70 percent of the water pumped from the mesa area in 1969 was for municipal supply in El Paso.

Ground water pumped from the city artesian area ranged from 28.2 mgd in 1963 to 33.0 mgd in 1968. Pumping by Ciudad Juarez, the principal user of water from the city artesian area, increased from 13.7 mgd in 1963 to 19.8 mgd in 1969; the latter represents about 63 percent of the water pumped from the city artesian area. The amount withdrawn by the city of El Paso ranged from 10.1 mgd in 1964 to 4.5 mgd in 1967. Industrial use of water from the city artesian area decreased from 6.2 mgd in 1963 to 5.2 mgd in 1967.

Pumpage of ground water in the upper valley area varied considerably during the period 1963-69. The least amount of water pumped for public supply was 12.7 mgd in 1969, and the greatest amount was 21.7 mgd in 1967. Total pumpage for public supply from the shallow, medium, and deep aquifers in the upper valley area averaged 17.6 mgd during this period. Industrial use averaged 2.5 mgd.

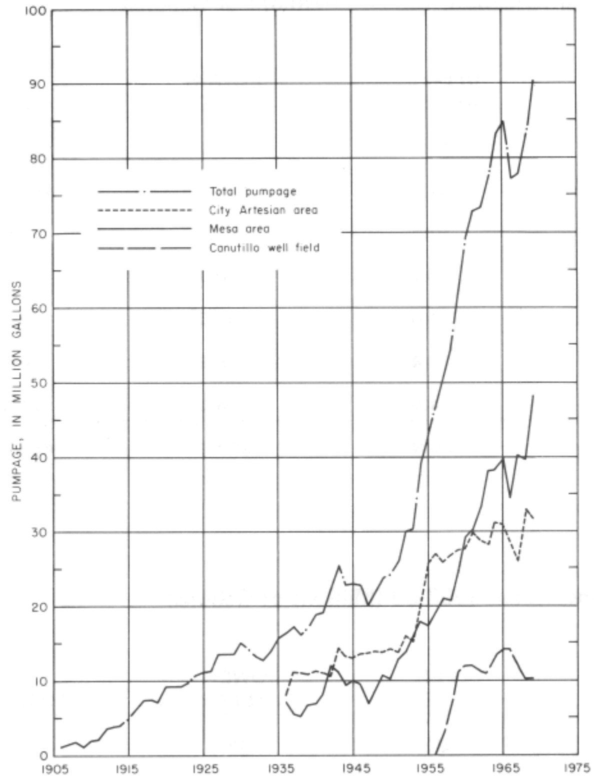

Figure 1.—Estimated Average Daily Pumpage From Deep Wells, 1906-1969

Irrigation is extensive in the upper and lower valley areas. Ground water is used to supplement surface-water supplies in most of the area, but there are about 1,500 acres for which there are no surface-water allotments and which are irrigated entirely with ground water. The amounts of water available for irrigation in the upper and lower valleys from surface-water sources during the period 1963-69 are as follows:

YEAR	SURFACE WATER ALLOTMENT (ACRE-FEET PER ACRE)
1963	2.00
1964	.32
1965	1.85
1966	2.50
1967	1.50
1968	2.00
1969	3.00

In 1964 surface water was applied to about 15,000 acres in the Mesilla Valley below Anthony, Texas, with the area about equally divided between Texas and New Mexico. The amount of ground water pumped varied inversely with the amount of surface water available. In 1964, when little surface water was available, 37.5 mgd of ground water was pumped for irrigation; but in 1969, when the surface-water allotment was adequate, only 4.0 mgd was pumped.

In the lower valley area where 45,000 acres in El Paso are irrigated, ground water is used to supplement surface water for irrigation. The amount of ground water pumped for irrigation ranged from about 116.1 mgd in 1964 to 4.5 mgd in 1969.

FLUCTUATIONS OF WATER LEVELS

Water levels in wells in the El Paso district fluctuate in response to natural causes such as changes in atmospheric pressure, amount of recharge, and evapotranspiration. Water levels are affected artificially by pumping from the aquifer. The fluctuations of the water table (top of the zone of ground-water saturation) indicate changes in the amount of water in storage in the aquifer. Minor fluctuations generally result from natural causes. Major fluctuations result from heavy pumping from the aquifer.

Water levels have been recorded in an extensive network of observation wells in the El Paso district since 1954. Measurements are usually made in January, so that the effects of seasonal pumping will be minimized.

Mesa Area

The fluctuation of water levels in most of the wells in the mesa area closely reflect the changes in rates of ground-water withdrawal. During the period 1963-69, the rate of withdrawal was fairly constant (about 39 mgd), except in 1966, when it decreased by about 5.0 mgd and in 1969, when it increased by about 9.0 mgd (Table 4). In general, most of the hydrographs of representative wells in the mesa area (Figure 2) show a fairly steady rate of water-level decline. The wells nearer the center of the areas of heavy pumping have declined at a faster rate than those at greater distances. The addition of new wells in the Nevins and Airport well fields caused the cones of depression to deepen and expand to the east and north.

The approximate declines in water levels during the periods 1963-70 in the mesa and city artesian areas are shown on Figure 3. The approximate altitudes of water levels during January 1970 are shown on Figure 4. The maximum measured decline was 33.6 feet in well R-28, which is located near the Franklin Mountains. The greater decline in this well probably results from pumping of well R-88 and its proximity to the permeability barrier formed by the mountains. Actually, water levels may have declined as much as 40 or more feet in the city artesian area, as determined from the superimposing of maps showing the altitude of water levels in 1963 (not shown) and in 1970 (Figure 4).

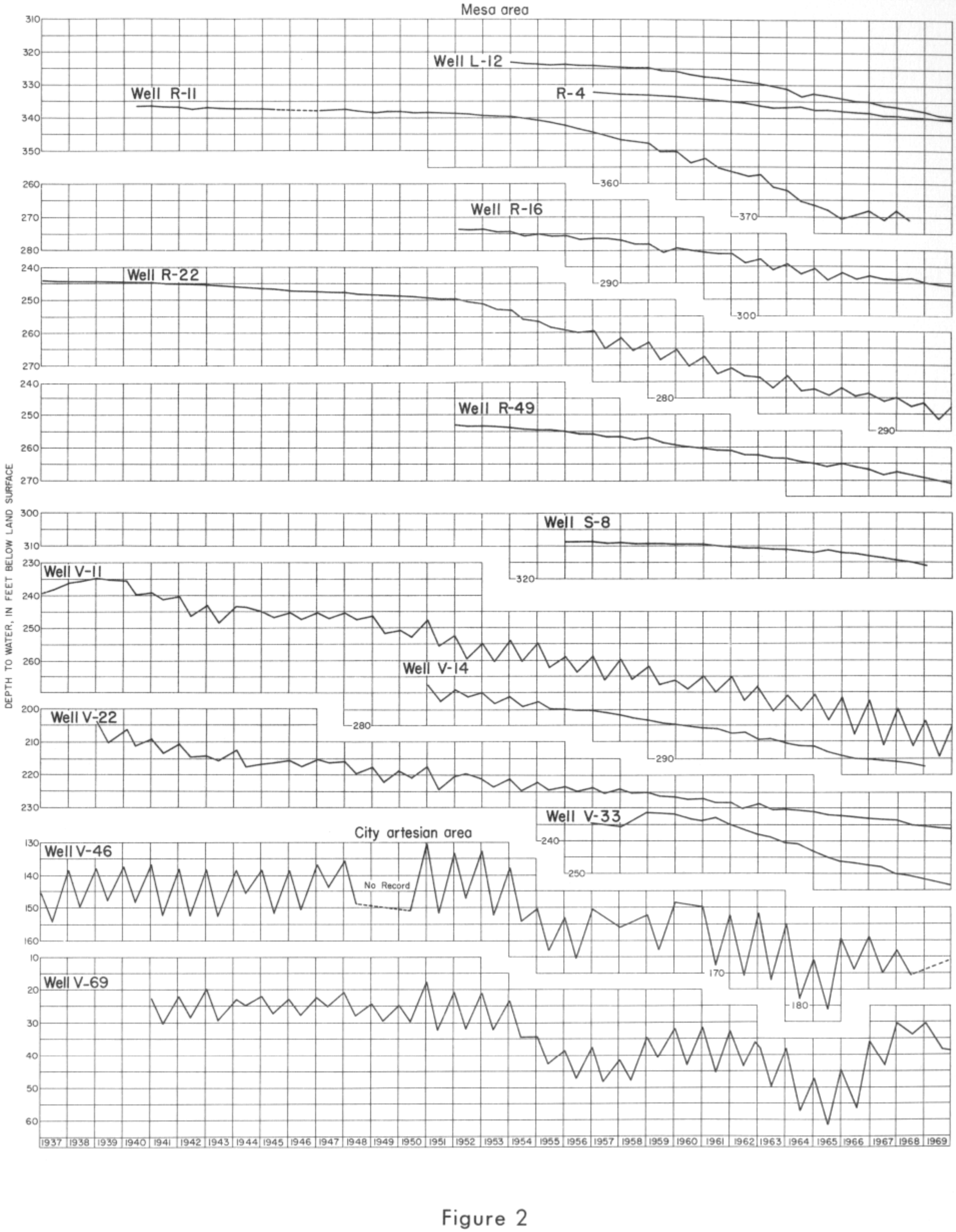

Figure 2

Hydrographs of Selected Observation Wells in the Mesa Area and City Artesian Area

During the period January 1963 to January 1970, a decline of 18.0 feet occurred in well V-42 in the Airport well field (Figure 5). The rate of decline in this well, which has increased greatly in the last 2 years (1968-69), reflects the pumping of the new city well V-165. A decline of 12.8 feet occurred in well R-62 (Figure 6), which reflects the gradual decline caused by pumping in the Nevins field. In 27 wells in the mesa area, the average water-level decline was 9.25 feet.

Water-level declines in the mesa and city artesian areas during the period 1903-70 are shown on Figure 7. The map was constructed by superimposing maps showing the altitude on the water table in 1903 (Figure 8) and 1970 (Figure 4). The largest declines, which were more than 60 feet, occurred in the older pumped part of the mesa area and extended southward to the city artesian area. In and near the Nevins field, which was developed fairly recently, the water levels declined more than 45 feet.

City Artesian Area

Water levels in the city artesian area respond more rapidly to changes in pumping rates than those in other areas. Seasonal fluctuations of 16 to 18 feet are not uncommon. The hydrographs of wells V-46 and V-69 (Figure 2) show that the water levels were the highest in 1951 and the lowest in 1965. The net decline was about 50 feet. Since 1965, the water levels have risen about 20 to 25 feet. This rise is accounted for by a decrease in pumping by El Paso.

In 1968, a study was made in the Chamizal Settlement area southeast of downtown El Paso to determine the effects of the water table resulting from relocating and lining the channel of the Rio Grande with concrete. The results (Leggat, oral commun., 1968) indicated that lining the channel would substantially reduce the recharge to the alluvium. As a result, the water levels could be expected to decline. The hydrographs of wells V-175 and V-176 (Figure 9) reflect this decrease in recharge; however, a part of the decline can be attributed to leakage of water from the alluvium to the underlying artesian aquifer in which the head has been lowered below the head in the alluvium. The extent of the decline resulting from lining the channel has reached at least as far as well V-177, V-178, and V-179 (Figures 17 and 9), but not as far as wells V-171 and V-172, which are downstream from the lined channel.

Upper and Lower Valley Areas

Changes in water levels in the alluvium of the upper and lower valley areas are directly related to the amount of surface water available for irrigation. Water levels are generally higher during the spring and summer months, because of recharge from the infiltration of surface water applied to the land and lower during the winter in response to the discharge of ground water to the drain and to the river. In years when the surface-water supply is insufficient and most of the water for irrigation is supplied by pumping ground water from the alluvium, the water levels in wells are lower in the summer and higher in the winter. These conditions are shown by the hydrographs of wells in Figure 10.

Water levels in the upper valley changed little during the period from January 1969 to January 1970. In 1969, the surface-water allotment was 3.0 acre-feet per acre; consequently, the water levels rose over most of the valley. The rise was as much as 6 feet in the shallow aquifer of the Canutillo well field, which reflected the near cessation of pumping in 1969 by the city of El Paso. In two small areas, however, a decline of about one-half foot occurred. One area is just north of Old La Union, and the other is in the southwestern part of the valley.

The relation of pumpage to the depth of water in observation wells in the Canutillo well field is shown on Figure 11. The hydrograph of well Q-86, in the shallow aquifer, shows that water levels were lowest in 1964, when surface-water supplies for the city of El Paso were reduced to 2.8 mgd. At this time, 6.2 mgd was pumped from the shallow aquifer.

The lower valley area is primarily an irrigated farming area with water availability and water-level fluctuations being very similar to those of the upper valley area. The hydrographs of several wells in the lower valley area are shown on Figure 10. During the period of 1963-70 water levels declined from 1964-65, but since then have generally risen and show only the normal seasonal fluctuations.

Water levels in the lower valley area changed little during the period January 1969 to January 1970. Along the east side of the valley from Ysleta to Fabens, the water levels declined a maximum of about 1.5 feet. This decline might have been caused by cleaning and deepening of the drains. The greatest changes were in the downtown area, where water levels declined as much as 11 feet, due in part to the lining of the channel of the Rio Grande, and in part to leakage of water from the alluvium to the artesian aquifer.

SIGNIFICANCE OF WATER-LEVEL CHANGES

The amount of material dewatered for the period 1963-70 in the water table part of the bolson was about 987,000 acre-feet. The volume of material affected by artesian head change in the artesian part of the bolson was about 355,000 acre-feet. The amount of water taken from storage was estimated to be about 148,400 acre-feet. During this period, approximately 420,000 acre-feet of water was pumped from the bolson; therefore, the recharge for the 7-year period was about

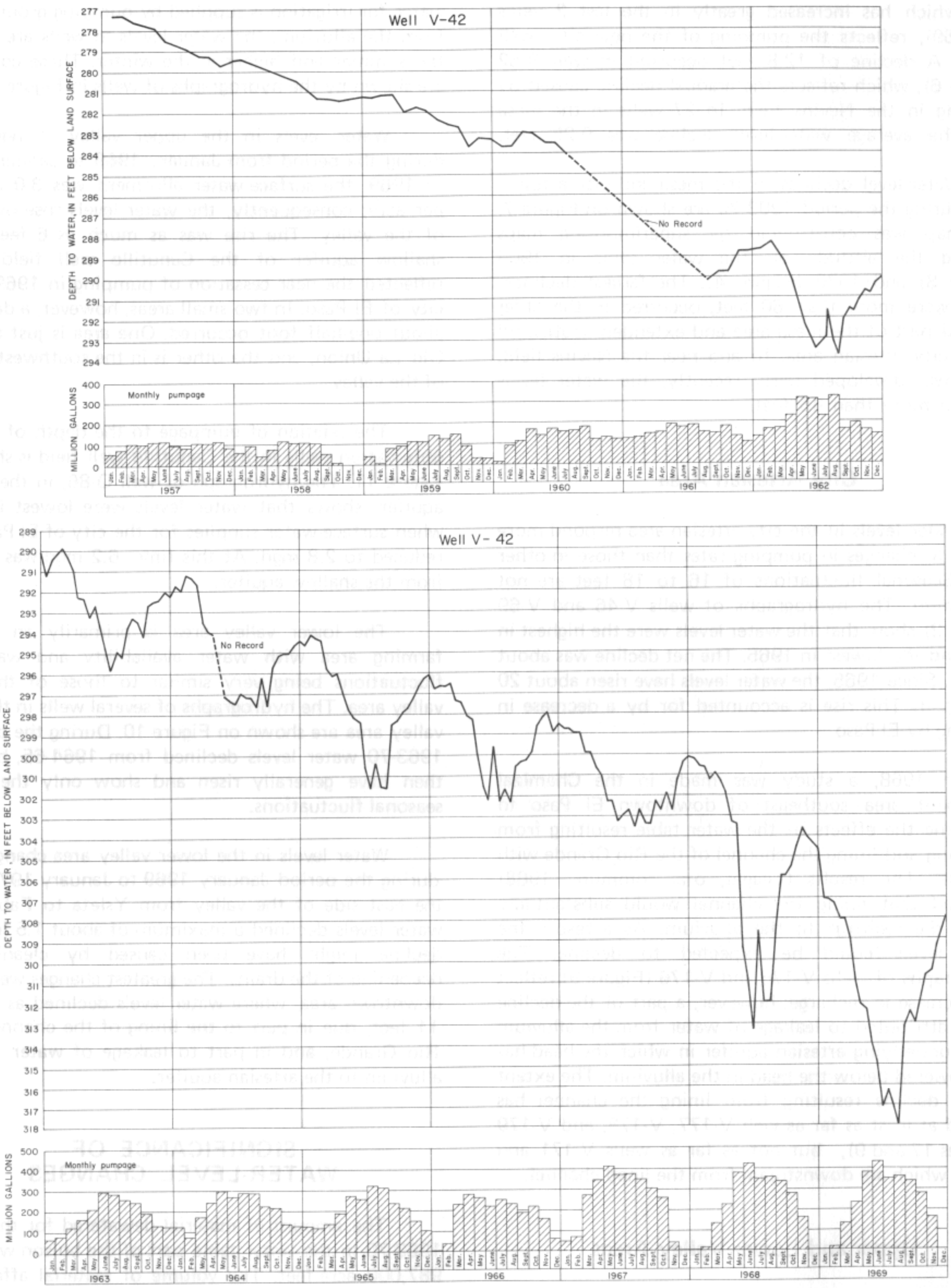

Figure 5

Relation of Pumpage to Depth of Water in Well V-42 in the Airport Well Field

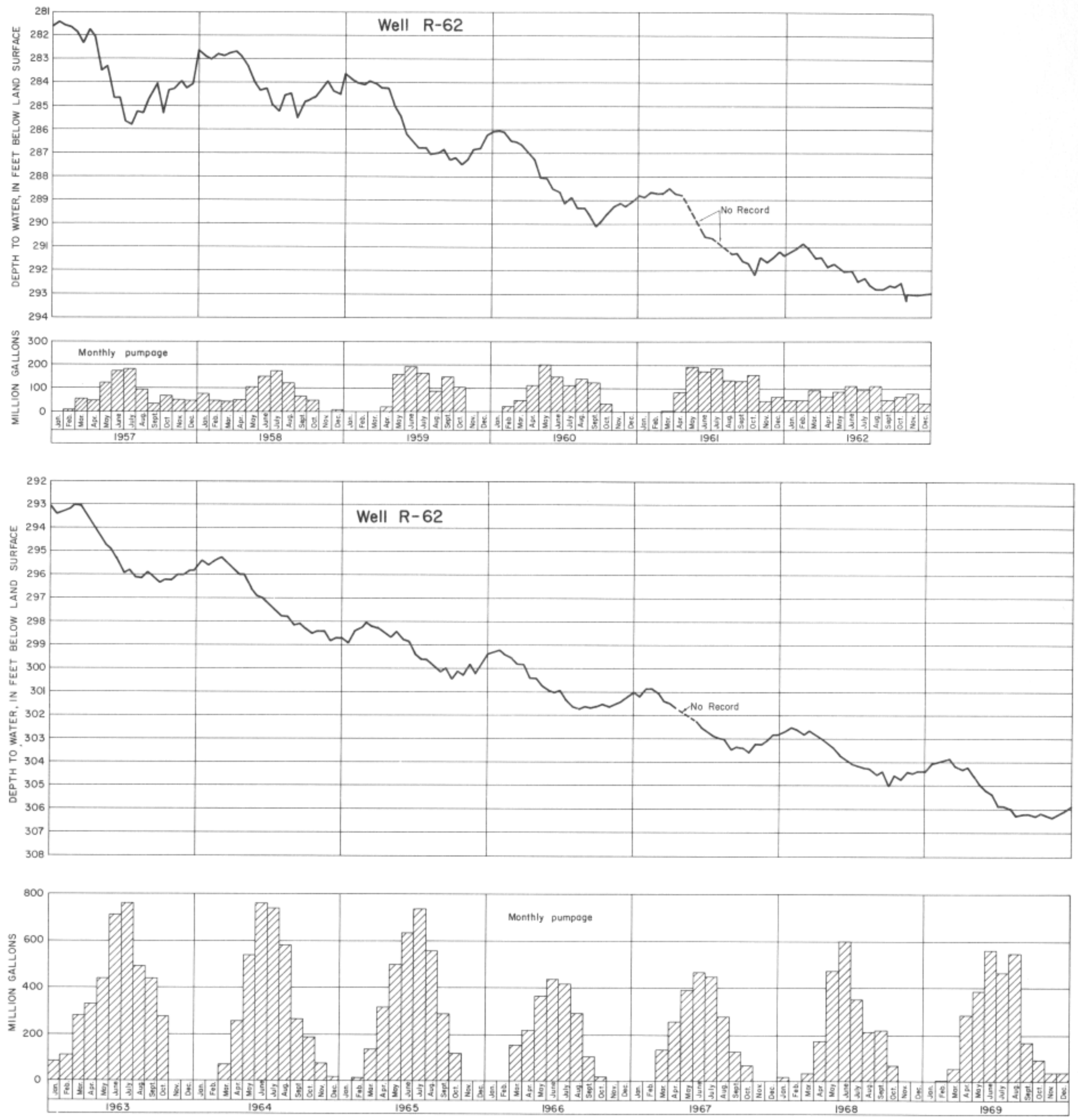

Figure 6

Relation of Pumpage to Depth of Water in Well R-62 in the Nevins Well Field

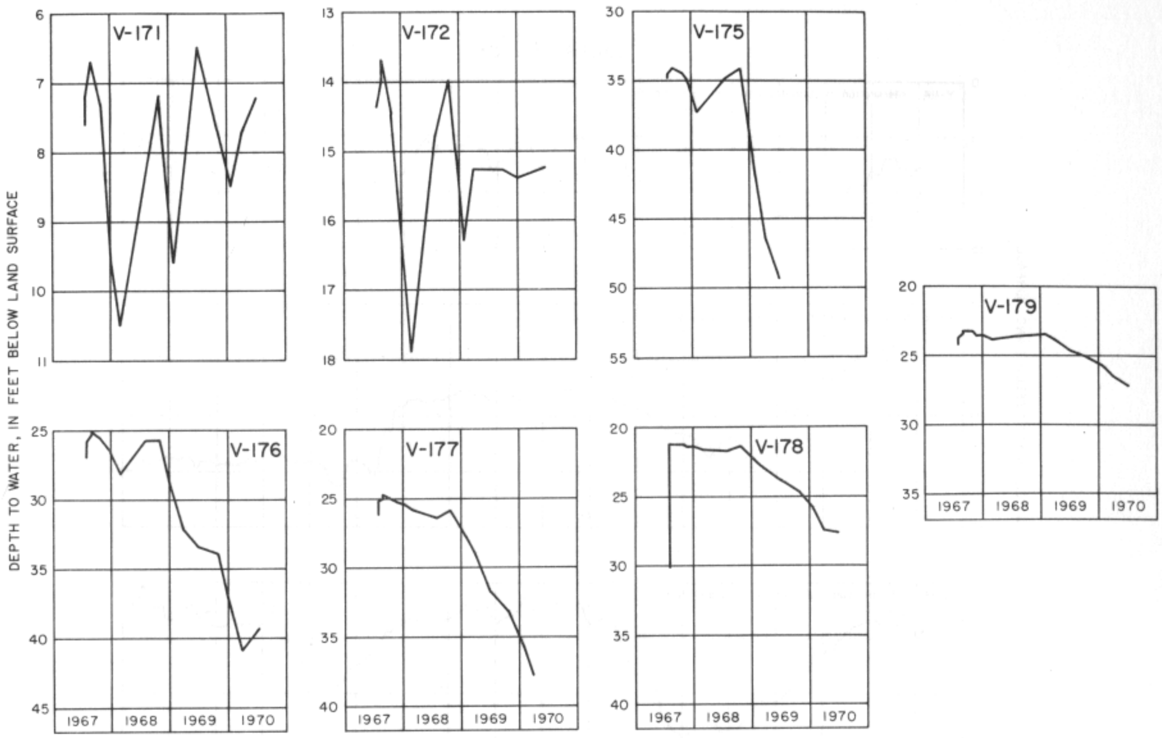

Figure 9.—Hydrographs of Observation Wells Maintained by the International Boundary and Water Commission in the Chamizal Zone

271,600 acre-feet, or 38,800 acre-feet per year (34.6 mgd).

The apparent increase in recharge can be attributed to several factors: (1) The cone of depression has intersected the point of natural discharge; (2) the cone of depression has intersected the recharge area, and (3) sufficient drawdown has occurred in the artesian zone to create a larger differential head between the water-table aquifer and the artesian aquifer, thus inducing a higher rate and greater area of leakage.

The data show a much larger decline in the artesian aquifer than in the water-table aquifer (Smith, 1956). Smith also reported, that before there was any pumpage from the artesian aquifer in the area, the head exceeded the head in the alluvial aquifer, and flow was from the deep aquifer to the alluvial aquifer. As the amount of pumping from the deep aquifer increased, the amount of upward flow decreased; and when the water level in the deep aquifer fell below the water level in the shallow aquifer, flow was reversed; and the shallow aquifer now supplies the deep aquifer.

At present, there is a fairly large area in which the head differential is more than 50 feet. This would mean that natural discharge from the artesian part of the bolson has ceased and a recharge area has been created. The water level in the alluvial aquifer has not declined as fast, because the alluvium is being recharged by leakage from the unlined part of the river channel.

In the industrial area, where there is sustained pumping from the artesian aquifer, the water quality has deteriorated. This deterioration probably is caused by leakage of saline water from the shallow aquifer to the deep aquifer; however, in some wells, the increase in salinity might be caused by leaking casings in poorly constructed wells. Also, the rapid decline of water levels in the alluvial aquifer in the downtown area indicates leakage to the artesian aquifer, because there is no pumping from the alluvial aquifer. The leakage probably has been occurring for several years, but the water-level decline in the alluvial aquifer did not occur until recharge from the river had been eliminated by lining the channel.

GROUND-WATER AVAILABILITY

The saturated thickness of the deposits containing fresh water in the Hueco Bolson in 1969 is shown on Figure 12. The volume of saturated material is at least 50,000,000 acre-feet.

By assuming a specific yield of 0.15 for the bolson deposits, 7,500,000 acre-feet of fresh water is in storage. Of this total volume, 6,800,000 acre-feet is available in

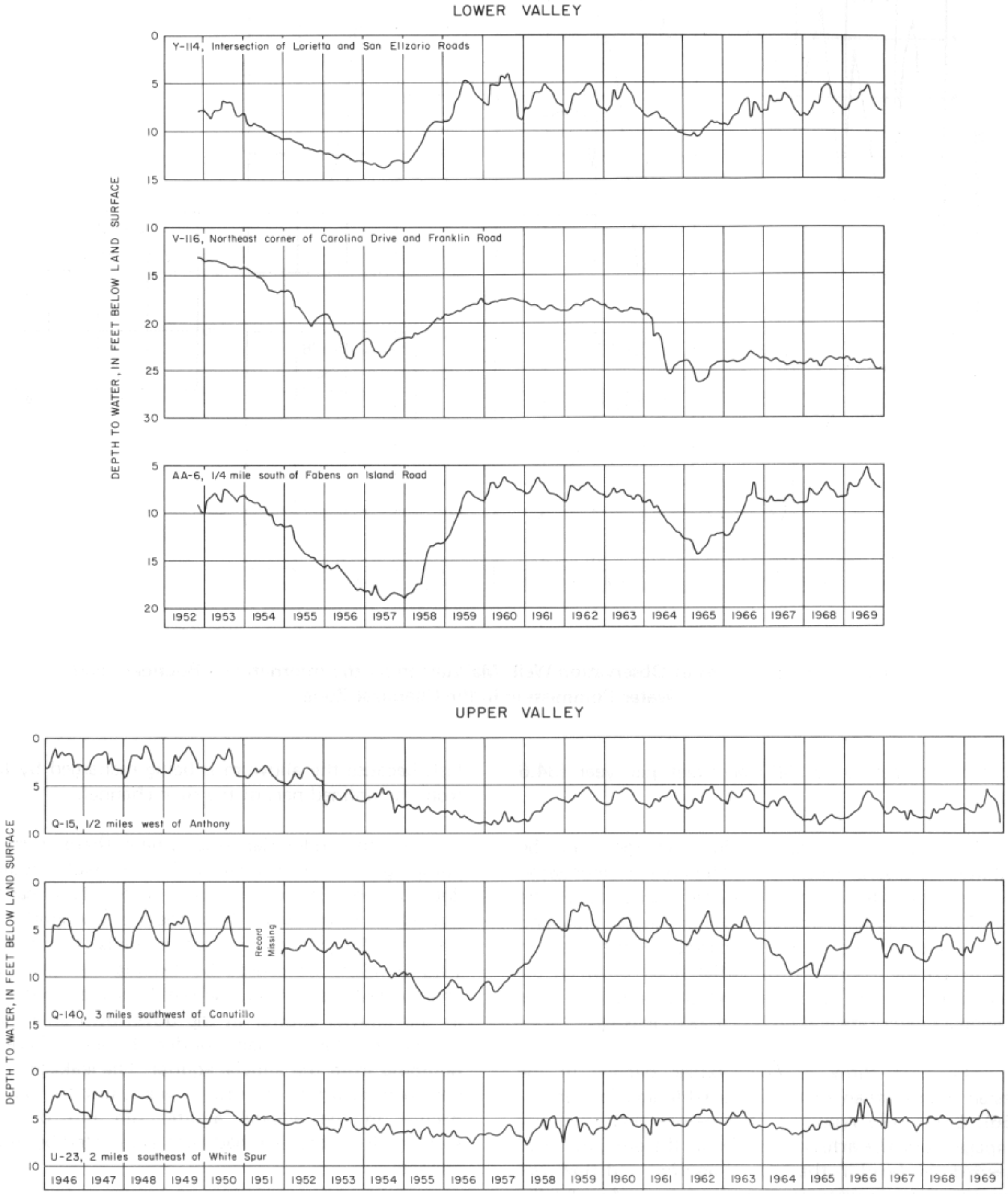

Figure 10

Hydrographs of Selected Wells in the Alluvium of the Upper and Lower Valley Areas

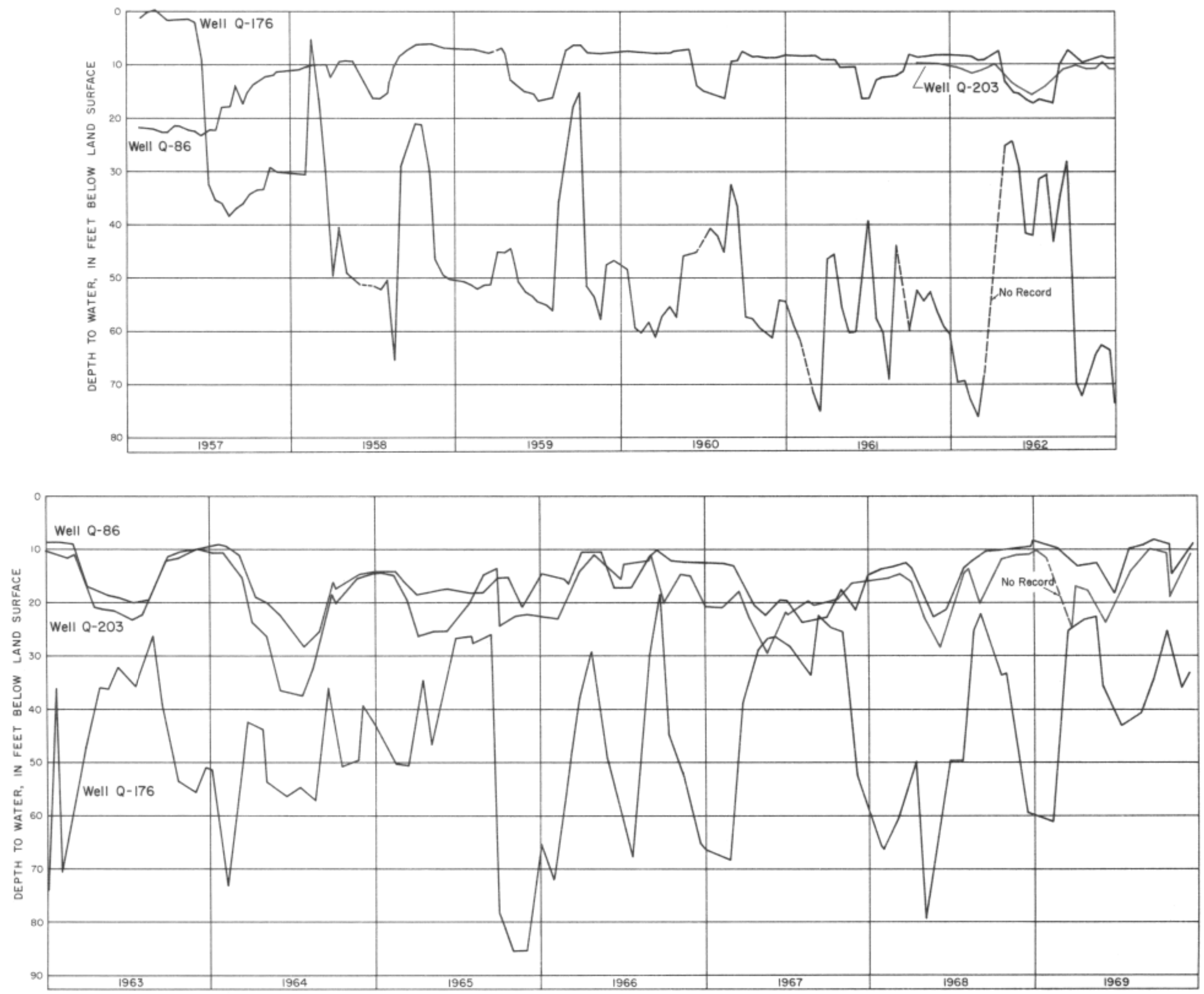

Figure 11

Hydrographs of Three Wells in the Canutillo Well Field

the mesa area and 700,000 acre-feet is available in the city artesian area.

Pumping of a large percentage of the available fresh water will result in salt-water intrusion. Data are not available to determine how much of the fresh water can be pumped before salt-water intrusion occurs, but it will probably be evidenced by a gradual deterioration in the water quality.

In addition to the large volume of fresh water available from the Hueco Bolson, about 34,000,000 acre-feet of material containing slightly saline water (1,000 to 3,000 mg/l dissolved solids) underlies and adjoins the fresh-water deposits. This water could be blended with the fresh water to produce water that is suitable for public supply.

Information available for the deep and intermediate aquifers in the upper valley area is from wells in the Canutillo well field. The hydrographs of several of these wells (Figure 10) indicate that when the wells are shut down for a period of time, the water level soon recovers. This indicates that the average annual withdrawal (14.2 mgd) is approximately balanced by the average annual recharge, which was estimated to be about 13 mgd (Leggat and others, 1962, p. 18). In addition to this perennially available supply, about 410,000 acre-feet of fresh water is stored in the two aquifers.

The alluvial deposits in the upper and lower valleys contain substantial quantities of water; the quality, however, ranges over wide limits. According to Davis (1967, p. 5), at least 18,000,000 acre-feet of saturated alluvium underlies those parts of the two valleys in Texas. Of this, about 12,000,000 acre-feet contains water having less than 2,500 mg/l (milligrams per liter) dissolved solids. Assuming an average specific yield of 15 percent for the alluvium, it is estimated that the volume of theoretically (but not necessarily economically) recoverable water having less than 2,500 mg/l dissolved solids is about 1.8 million acre-feet. Of this, 1.4 million acre-feet is in the lower valley, extending from El Paso to the El Paso-Hudspeth County Line, and slightly more than 400,000 acre-feet is in the upper valley. This estimate is based on the assumption that the aquifer is full, that is, the water levels are at the level of the bottom of the river and the drains.

Additional and at times, large volumes of ground water are potentially available from the alluvium in the two valleys, even when the aquifer is full. This water, which W. P. Meyer and J. D. Gordon (written commun., 1970) referred to as "potential ground-water recharge", is derived from the infiltration of irrigation water and from seepage losses in the canals and laterals; however, due to the fullness of the aquifer, a large part of the water is rejected and becomes drainflow. The volume of potential recharge available will range over wide limits, depending upon the availability of surface water for irrigation. A water-budget study for the lower valley indicated that the potential recharge to the alluvium from the infiltration of irrigation water and from canals and laterals amounted to 75,000 acre-feet in 1968, (W. R. Meyer and J. D. Gordon, written commun., 1970) and 84,000 acre-feet in 1969. The potential recharge in 1968 was roughly equivalent to 25 percent of the total inflow to the valley.

A summary of the water budget for the lower valley area during 1969 is given in Table 5. The imbalance of 34,600 acre-feet is probably caused by: (1) Leakage from the river to the shallow aquifer, which in turn leaks into the artesian aquifer; and (2) an unmeasured amount of water that is diverted to Mexico by pumps along the river and by the flow in a deep drain paralleling the river on the Mexican side.

The potential ground-water recharge in 1969 is represented by the sum of: (1) Drain flow (65,500 ac-ft); (2) loss to phreatophytes (13,000 ac-ft); (3) pumpage from the alluvium (5,000 ac-ft); and (4) the difference between ground-water inflow and outflow (700 ac-ft). Therefore, the potential ground-water recharge was approximately 84,000 acre-feet in the lower valley area, or about 1.55 acre-feet per acre of irrigated land. This amount is 53 percent of the water applied to land surface or 24 percent of the total amount of surface-water inflow to the area.

A similar budget study made in 1969 in the upper valley area revealed that ground-water recharge was at least 35,000 acre-feet. This total amount consisted of: (1) An increase in drain flow (21,240 ac-ft); (2) pumpage from the shallow aquifer (10,800 ac-ft); and (3) an increase in storage in the shallow aquifer (3,400 ac-ft). The amount of water pumped from the intermediate and deep aquifers (11,570 ac-ft) is not included in this calculation of recharge. Part of the water entering the ground-water reservoir was lost to phreatophytes that are abundant in parts of the area. During the summer months, the water table is within 5 feet of the surface, and some water is lost by evaporation.

The data reveal that most of the potential recharge leaves the lower end of the two valleys as drain flow; however, if the water table were lower than the river and drains, this water could be held in storage in the alluvium and could be pumped when needed.

Total recovery of the drain flow by pumping from the ground-water reservoir, although possible, is not advisable because of the unfavorable salt balance that would result.

WATER QUALITY

Fresh ground water is only a small part of the total amount of ground water in storage in the El Paso

Table 5.—Summary of the Water Budget for the Lower Valley Area During 1969

WATER-BUDGET ITEM	Q_i 1/ (ACRE-FEET)	Q_o 2/ + L 3/ + S 4/ (ACRE-FEET)
Surface-water inflow	308,900	
Ground-water inflow	2,800	
Precipitation	37,000	
Total	348,700	
Surface-water outflow		116,900
Ground-water outflow		2,100
Water used by crops		140,800
Water used by phreatophytes		13,000
Evaporation		46,600
Change in ground-water storage		3,200
Total		314,100
Water-budget imbalance		34,600

1/ Inflow.
2/ Outflow.
3/ Loss such as crop use, evaporation, and consumption by phreatophytes.
4/ Change in ground-water storage.

district. Fresh-water sands are usually underlain or adjoined by sands containing slightly saline water in the Hueco Bolson. The artesian area contains a section of fresh-water sands that are overlain and underlain by sands containing slightly saline water. In general, the salinity increases with depth.

In the mesa area, fresh water occurs in an irregular zone with a trough-like configuration in the shape of a "Y". One branch of the "Y" nearly parallels the Franklin Mountains, and the other branch parallels U.S. Highway 54.

The results of the chemical analyses of water samples made during the period 1963-70 are given in Table 6. Most of the chemical analyses were made to determine the changes in the chloride content of the ground water. When chemical changes are noted, the chloride content is usually the constituent showing the greatest change; therefore, it is used as an indicator of water quality.

Graphs showing the changes in chloride content of water from selected wells in the district are shown in Figure 13. Water samples were taken after the wells had been pumped for at least 20 hours to obtain a representative sample. The chloride content had varied considerably, but the overall change had not been large in most wells in the mesa area. However, as pumping continues and the cone of depression deepens and expands laterally, the movement of saline water to the wells may be accelerated.

The sands containing fresh water in the city artesian area occur between beds of sand that contain saline water; therefore, contamination of fresh water may occur from intraformational leakage or from leaking well casings.

Contamination is evident in wells V-94 and V-98, both of which are in an industrial area. The changes in water quality are causing problems for several industries, because their processes require water containing a relatively low chloride content.

The chemical quality of the water in the alluvium of the upper and lower valley areas varies considerably. The locations of wells, the depths, and dissolved-solids contents of the water in these areas are shown on Figures 14 and 15. The shaded parts of these maps show the areas where the dissolved-solids contents are more than 2,500 mg/l. In general, the water becomes progressively more mineralized toward the lower end of the valleys.

These maps show that water in the alluvium between El Paso and Socorro, Texas contains less than 2,500 mg/l dissolved solids. Between Socorro and the El Paso-Hudspeth County line, most of the water in the alluvium contains more than 2,500 mg/l dissolved solids.

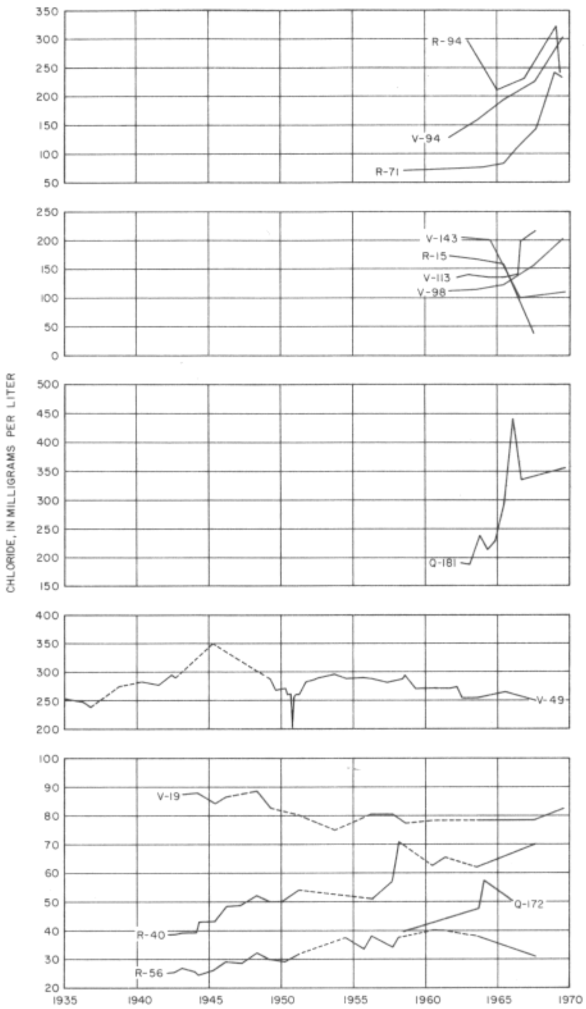

Figure 13.—Chloride Content of Water From Selected Wells in the El Paso District

In the area near Fabens, the improved water quality probably results from inflow from several arroyos entering the valley in this vicinity.

In the upper valley area, the water in the alluvium contains less than 2,500 mg/l dissolved solids, except in the extreme lower end of the valley. Most of the wells in the upper and lower valley areas are screened from the water level to the bottom of the well; therefore, the quality of the water pumped for irrigation is a composite of the water quality throughout the screened zone of the well.

SURFACE-WATER SUPPLY

Prior to 1943, most of the water pumped from the Rio Grande was for irrigation; however, a small amount was pumped from the river primarily for industrial use. In 1943, the city of El Paso installed a surface-water treatment plant with a capacity of 10 mgd; in 1950, the capacity of this plant was increased to 20 mgd.

The city of El Paso has a contract with the U.S. Bureau of Reclamation to divert waters from the Rio Grande as follows: (1) Water for farmland owned by the city; (2) leased water rights from owners of small tracts (2 acres or less); (3) surplus water in the river during irrigation seasons; and (4) return flow from the irrigation drains. The water for farmland owned by the city is available from March 1 to September 30, and the amount is based on water allotted per acre. Surplus water in the river results from storm runoff and lasts for short periods of time. The return flow from irrigation drains is available to the city, but the quality and quantity diminish after the irrigation season.

Surface water used by the city of El Paso is pumped from the American Canal treatment plant, located approximately 4 miles downstream from the American Dam. During the irrigation season, water in the American Canal is largely released from the Caballo Dam (in New Mexico); however, it contains return flow from irrigation drains in the upper Mesilla Valley. During the irrigation season, the water in the American Canal contains about 1.1 tons of dissolved solids per acre-foot; however, after the irrigation season, the water contains about 2.25 tons of dissolved solids per acre-foot.

The plant was not designed for treatment of water with a high concentration of dissolved solids; consequently, after the irrigation season, the surface water could not be used in the treatment plant, and operations ceased during the fall and winter months. Since 1966, the city has been using ground water from five wells near the treatment plant to blend with the saline water from the canal with the intention that usable water would be pumped by the treatment plant. This practice extended the usefulness of the plant and reduced the pumpage from deep wells to approximately 6.0 mgd.

The average daily diversions from the Rio Grande since 1943 are shown on Figure 16. These data do not include the water from the shallow wells in the Canutillo field, nor the water from the downtown wells that blend with the drain water.

FUTURE DEVELOPMENT

Although small additional surface-water supplies have been made available to the city of El Paso, ground water continues to be the most important source of supply, and the amount pumped is continuing to increase.

The city has explored all known fresh ground-water supplies in the Texas part of the Hueco Bolson and in the upper valley area. However, an additional 3,400,000 acre-feet of water containing 1,000 to 3,000 mg/l of dissolved solids is available in the sands directly underlying or adjoining the fresh-water body in the Hueco Bolson. Although the water is unsuitable for drinking because of the chloride content (usually

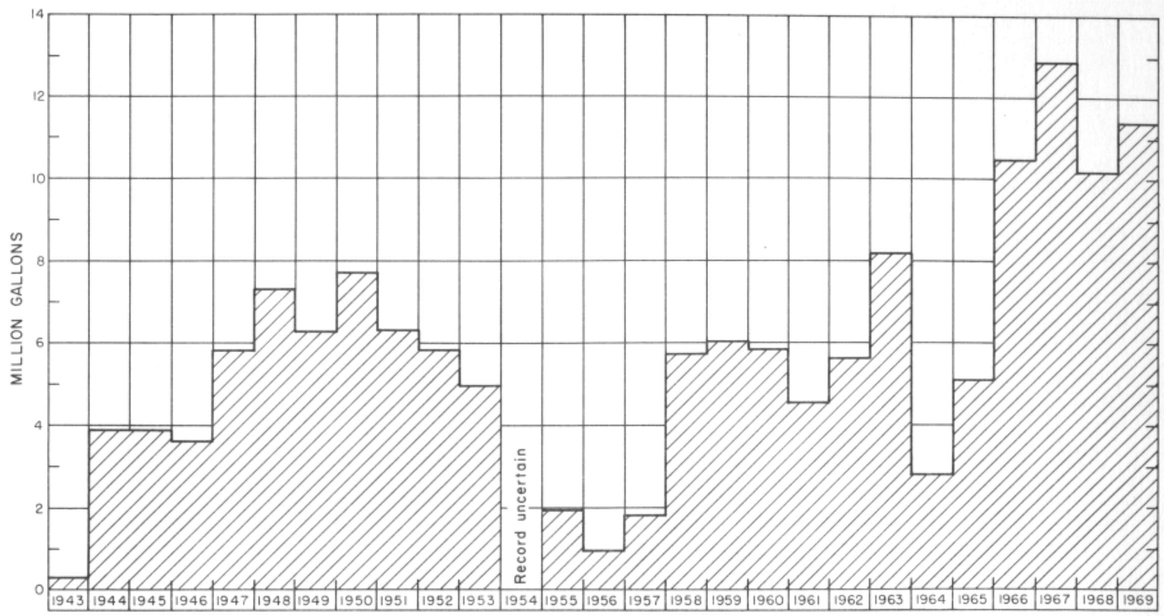

Figure 16.—Average Daily Diversions of Water From the Rio Grande for Municipal Use

exceeds 250 mg/l); it is satisfactory for either blending with water of better quality or for desalinizing. The upper and lower valleys contain water which is presently being discharged as drainflow, and if the water table could be lowered by pumping below the bottom of the river and drains, this water would remain in storage and available for development by the city. Much of this water is discharged as drain flow, but it could be retained in storage if the water table could be lowered below the river and drain.

REFERENCES CITED

Audsley, G. L., 1959, Records of wells and results of exploratory drilling in the El Paso Valley and Hueco Bolson southeast of El Paso, Texas: Texas Board Water Engineers open-file rept., 145 p.

Davis, M. E., 1965, Development of ground water in the El Paso district, Texas, 1960-63, progress report no. 9: Texas Water Comm. Bull. 6514, 34 p., 9 figs., 6 pls.

_____1967, Memorandum on availability of water having less than 2,500 ppm (parts per million) dissolved solids in alluvium of the Rio Grande near El Paso, Texas: U.S. Geol. Survey open-file rept., 6 p., 2 figs.

Knowles, D. B., and Kennedy, R. A., 1958, Ground-water resources of the Hueco Bolson, northeast of El Paso, Texas: U.S. Geol. Survey Water-Supply Paper 1425, 186 p.

Leggat, E. R., 1962, Development of ground water in the El Paso district, Texas, 1955-60, progress report no. 8: Texas Water Comm. Bull. 6204, 55 p.

Leggat, E. R., Lowery, M. E., and Hood, J. W., 1962, Geology and ground-water resources of the lower Mesilla Valley, Texas and New Mexico: Texas Water Comm. Bull. 6203, 195 p.

Leggat, E. R., and Davis, M. E., 1966, Analog model study of the Hueco Bolson near El Paso, Texas: Texas Water Devel. Board Rept. 28, 26 p., 13 figs.

Sayre, A. N., and Livingston, Penn, 1945, Ground-water resources of the El Paso area, Texas: U.S. Geol. Survey Water-Supply Paper 919, 190 p.

Scalapino, R. A., 1949, Ground-water resources of the El Paso area, Texas, progress rept. no. 6: Texas Board Water Engineers duplicated rept., 25 p.

Smith, R. E., 1956, Ground-water resources of the El Paso District, Texas, progress rept. no. 7: Texas Water Commission Bull. 5603, 36 p.

Table 6.--Chemical Analyses of Water From Wells in the El Paso District, 1963-70

(Analyses given are in milligrams per liter except specific conductance, pH, SAR, RSC, temperature and percent sodium.)

WELL	PRODUCING INTERVAL (FT)	DATE OF COLLECTION	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	TEMPERATURE	SILICA (SiO_2)	IRON (Fe)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM AND POTASSIUM		BICARBONATE (HCO_3)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (NO_3)	BORON (B)	DISSOLVED SOLIDS	HARDNESS AS $CaCO_3$	PERCENT SODIUM	SODIUM ADSORPTION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)
										Na	K											
R- 5	--	Apr. 7, 1965	--	8.25	--	--	0.02	80	8	--	--	--	325	560	--	--	--	1,227	232	--	--	--
R- 15	320- 360	July 18, 1963	805	7.0	--	--	--	--	--	--	--	132	--	166	--	--	--	--	120	--	--	0.00
R- 15	320- 360	June 24, 1965	818	--	--	--	--	--	--	--	--	--	37	158	--	--	--	--	--	--	--	--
R- 15	320- 360	July 11, 1967	762	7.8	74 °F	--	--	--	--	--	--	140	44	38	--	--	--	--	112	--	--	.05
R- 40	236- 853	Aug. 7, 1967	677	7.7	--	--	--	--	--	--	--	182	76	70	--	--	--	--	163	--	--	.00
R- 56	319- 909	Aug. 7, 1967	489	7.7	--	--	--	--	--	--	--	179	47	31	--	--	--	--	166	--	--	.00
R- 65	unknown- 280	Aug. 10, 1966	715	7.4	--	21	.14	63	36	30	20	248	83	45	0.7	13	0.05	416	306	17	0.7	.00
R- 67	503- 746	Aug. 5, 1966	1,940	7.2	79 °F	30	.00	68	16	274	7.8	77	29	532	.7	4.5	.06	1,000	238	71	7.7	.00
R- 70	330- 800	July 7, 1969	503	7.4	26.5°C	--	--	24	5.3	--	--	130	39	66	--	--	--	--	82	--	--	.49
R- 71	--	Apr. 14, 1964	--	8.1	--	--	.01	21	4	--	--	103	56	75	.5	--	--	267	69	--	--	--
R- 71	--	May 24, 1965	--	8.2	--	--	.03	24	3	--	--	156	62	80	.6	--	--	339	72	--	--	--
R- 71	--	Apr. 18, 1966	--	8	--	--	.03	42	10	--	--	90	97	105	.6	--	--	390	144	--	--	--
R- 71	--	Aug. 10, 1967	--	8	--	--	.014	56	8	--	--	90	128	140	.6	--	--	504	172	--	--	--
R- 71	--	Jan. 16, 1969	--	7.56	--	--	.12	96	29	105	--	101	142	240	.36	--	--	735	360	--	--	--
R- 71	--	Aug. 1, 1969	--	8.2	--	--	.03	90	22	108	--	100	121	230	.38	--	--	693	314	--	--	--
R- 80	--	May 16, 1961	487	7.2	82 °F	31	.00	17	5.6	78		141	44	46	1	6.5	--	298	65	72	4.2	--
R- 80	--	May 19, 1967	529	7.4	--	28	.01	19	5.4	86		160	48	49	1.4	3.5	--	324	70	70	4.4	1.23
R- 83	359- 810	Apr. 11, 1966	627	7.3	--	31	--	24	9	91		142	39	92	.9	5.3	--	362	97	--	--	--
R- 94	--	Sept. 1963	--	7.1	--	--	.0025	35.2	6.3	--	--	77	296	195	.064	--	--	463	114	--	--	--
R- 94	--	Apr. 23, 1965	--	7.2	--	--	.03	33	6	--	--	84	288	210	.08	--	--	474	106	--	--	--
R- 94	--	Sept. 8, 1967	--	8	--	--	.03	47	7	--	--	90	261	230	.07	--	--	559	146	--	--	--
R- 94	--	Jan. 22, 1969	--	7.95	--	--	.02	110	18	163	--	75	171	320	.5	--	--	874	350	--	--	--
R- 94	--	Aug. 1, 1968	--	8.20	--	--	.03	60	8	135	--	77	58	240	.52	--	--	595	184	--	--	--
R- 94	577- 602	Oct. 9, 1963	868	7.4	--	--	--	--	16*	--	--	104	--	191	--	--	--	--	102	--	--	.00
R- 94	682- 707	Oct. 10, 1963	1,210	7.2	--	--	--	--	21*	--	--	92	--	302	--	--	--	--	134	--	--	.00
R- 94	350- 670	Oct. 30, 1963	791	7.9	77 °F	30	.05	34	5.3	109	5.3	106	25	168	.8	4.9	.08	434	107	68	4.6	.00
R- 94	--	July 3, 1969	482	7.4	--	--	--	40	15	--	--	182	46	32	--	--	--	--	162	--	--	.00
R-101	374- 499	Aug. 1, 1966	570	7.2	79 °F	31	--	30	5.6	76	4.7	129	41	82	.7	4.8	.08	340	99	61	3.3	.13
R-102	--	Oct. 5, 1965	427	--	--	34	--	24	2.2	63		110	41	46	.8	6.4	--	271	69	66	3.3	.42
R-102	--	Oct. 6, 1965	722	--	--	33	--	31	.33	110		98	40	146	.7	3.5	--	416	94	72	4.9	0
R-102	--	Oct. 6, 1965	906	--	--	34	--	45	57	126		73	35	218	.6	4.5	--	505	136	67	4.7	0
R-103	1,095-1,120	Feb. 10, 1966	1,020	7.1	--	29	--	39	9.4	147		100	46	228	.4	2.5	--	550	136	70	5.5	0
R-103	330- 950	Mar. 16, 1966	488	6.9	80 °F	30	.02	21	4.9	68	6.0	130	35	55	.9	4.8	.10	290	73	65	3.5	.68

See footnote at end of table.

Table 6.--Chemical Analyses of Water From Wells in the El Paso District, 1963-70--Continued

WELL	PRODUCING INTERVAL (FT)	DATE OF COLLECTION	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	TEMPER-ATURE	SILICA (SiO_2)	IRON (Fe)	CAL-CIUM (Ca)	MAGNE-SIUM (Mg)	SODIUM AND POTASSIUM		BICAR-BONATE (HCO_3)	SUL-FATE (SO_4)	CHLO-RIDE (Cl)	FLUO-RIDE (F)	NITRATE (NO_3)	BORON (B)	DIS-SOLVED SOLIDS	HARD-NESS AS $CaCO_3$	PERCENT SODIUM	SODIUM ADSORP-TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)
										Na	K											
R-104	761- 786	Mar. 31, 1966	1,550	8.5	79 °F	31	2.2 ?	63	14	204	11	59	23	415	0.6	2.0	0.05	805	214	--	--	--
R-104	1,225-1,250	Apr. 4, 1966	18,100	6.4	80 °F	29	.11	1,270	186	2,600	23	41	668	6,360	--	--	.21	11,200	3,940	59	--	--
R-104	1,724-1,749	Apr. 8, 1966	31,000	6.4	80 °F	12	.22 ?	2,250	115	5,260	28	33	1,820	11,000	--	--	.25	20,500	6,090	65	--	--
R-104	2,167-2,182	Apr. 22, 1966	60,900	7.1	95 °F	20	.49	2,950	578	12,100	48	34	2,250	23,900	--	--	0	41,900	9,740	73	--	0
R-104	2,835-2,856	May 2, 1966	38,300	5.0	102 °F	14	.19	2,000	125	7,550	34	10	1,690	14,300	--	--	3.0	25,700	5,500	75	--	0
R-104	800- 820	May 23, 1966	1,400	7.3	79 °F	32	0	47	11	198	10	72	55	354	.6	2.5	--	747	168	70	6.6	0
R-104	686- 710	May 23, 1966	1,310	8.1	79 °F	24	.48	55	7.4	184	9.8	85	56	322	.6	3.2	--	704	168	69	6.2	0
V- 10	--	Nov. 4, 1964	483	7.4	80 °F	30	.09	17	6.2	79		168	52	30	.9	3.2	.15	301	68	72	4.2	1.40
V- 10	--	Dec. 15, 1965	506	--	--	30	.02	17	6.2	82		165	54	34	.9	4.5	--	310	68	72	4.3	--
V- 10	--	May 12, 1967	495	7.5	--	28	.02	18	5.6	81		160	56	34	1.2	3.5	--	311	68	72	4.0	1.26
V- 15	--	July 18, 1963	452	6.0	--	--	--	--	--	--	--	76	--	58	--	--	--	--	17	--	--	.91
V- 15	710- 750	June 24, 1965	548	--	74 °F	--	--	--	--	--	--	--	56	57	--	--	--	--	--	--	--	--
V- 15	710- 750	Aug. 11, 1967	528	7.4	75 °F	--	--	--	--	--	--	134	59	56	--	--	--	--	70	--	--	.80
V- 19	--	Oct. 23, 1957	--	7.85	--	--	< .02	30	8	--	--	224	100	80	1.5	--	--	490	110	--	--	--
V- 19	294- 867	July 17, 1967	757	7.9	80 °F	--	--	--	--	--	--	200	86	78	--	--	--	--	96	--	--	1.39
V- 19	294- 867	July 3, 1969	771	7.6	26.5°C	--	--	25	8.2	--	--	202	89	82	--	--	--	--	96	--	--	1.39
V- 21	--	May 16, 1961	825	7.1	--	33	.12	48	18	96		193	90	101	1.3	7.2	--	490	194	52	3.0	--
V- 21	--	May 12, 1967	827	7.2	--	30	.01	48	17	99		190	89	106	1.7	3.5	--	492	190	52	3.1	.0
V- 23	--	May 16, 1961	532	7.1	--	29	.00	38	13	52		167	48	46	1.1	8.2	--	317	148	43	1.9	--
V- 23	326- 774	Apr. 11, 1966	526	7.2	--	29	.00	38	14	49		177	43	42	1.1	6.3	--	309	151	41	1.7	--
V- 41	--	Oct. 23, 1957	--	7.9	--	--	< .02	31	19	--	--	208	82	62	1.2	--	--	427	170	--	--	--
V- 41	289- 752	July 29, 1966	667	7.5	79 °F	36	.00	24	7.4	104	9.9	196	80	57	1.0	5.8	.16	422	91	69	4.7	1.39
V- 45	562- 751	Aug. 8, 1967	891	7.6	--	--	--	--	--	--	--	179	54	156	--	--	--	--	130	--	--	.32
V- 49	465- 882	June 23, 1965	1,180	--	--	--	--	--	--	--	--	--	56	265	--	--	--	--	--	--	--	--
V- 49	465- 882	Aug. 8, 1967	1,180	7.9	--	--	--	--	--	--	--	171	64	250	--	--	--	--	232	--	--	.00
V- 56	403- 795	Oct. 26, 1965	729	7.2	--	29	.03	34	10	100	47	170	92	84	.7	.0	.09	439	128	62	3.8	.23
V- 59	294- 717	Oct. 13, 1965	968	--	--	--	--	--	--	--	--	212	163	108	--	--	--	--	288	--	--	--
V- 62	376- 401	Jan. 17, 1968	546	7.9	--	26	--	8.2	1.5	109	3.4	174	59	45	1.0	.0	--	339	26	88	9.3	2.32
V- 62	1,001-1,026	Jan. 19, 1968	33,100	6.4	--	31	--	2,260	476	5,220	54	40	989	12,900	--	--	--	22,000	7,600	60	--	.00
V- 62	300- 640	Feb. 16, 1968	734	7.9	26 °C	26	.01	34	7.6	110	4.2	200	104	64	1.2	.0	.11	449	116	66	4.4	.95
V- 69	350- 620	Aug. 30, 1968	1,040	7.8	--	27	.39	60	22	112	8.3	168	125	165	.4	.0	.10	603	240	49	3.1	.00
V- 71	20- 50	Apr. 30, 1968	35,300	7.2	--	--	--	940	404	--	--	492	4,240	11,400	--	--	--	--	4,010	--	--	--
V- 83	--	Apr. 5, 1962	--	7.9	--	--	< .03	21	6	--	--	--	62	110	1.2	--	--	436	76	--	--	--
V- 83	--	Aug. 21, 1963	--	8.5	--	--	.04	25	6	--	--	--	71	85	.8	--	--	436	87	--	--	--

See footnote at end of table.

Table 6.--Chemical Analyses of Water From Wells in the El Paso District, 1963-70--Continued

WELL	PRODUCING INTERVAL (FT)	DATE OF COLLECTION	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	TEMPER-ATURE	SILICA (SiO_2)	IRON (Fe)	CAL-CIUM (Ca)	MAGNE-SIUM (Mg)	SODIUM AND POTASSIUM		BICAR-BONATE (HCO_3)	SUL-FATE (SO_4)	CHLO-RIDE (Cl)	FLUO-RIDE (F)	NITRATE (NO_3)	BORON (B)	DIS-SOLVED SOLIDS	HARD-NESS AS $CaCO_3$	PERCENT SODIUM	SODIUM ADSORP-TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)
										Na	K											
V- 83	--	July 27, 1965	--	8.4	--	--	0.07	20	5	--	--	--	75	85	0.7	--	--	441	70	--	--	--
V- 83	256- 610	Aug. 1, 1966	725	7.5	78 °F	30	.02	22	4.6	116	5.9	146	73	102	.8	1.5	0.08	429	74	75	5.9	0.90
V- 83	--	Aug. 10, 1967	--	8.4	--	--	.009	22	4	--	--	--	87	110	.7	--	--	473	72	--	--	--
V- 83	--	Sept. 8, 1967	--	8.3	--	--	.009	22	4	--	--	--	87	110	.7	--	--	473	72	--	--	--
V- 84	--	Apr. 5, 1962	--	8.0	--	--	.02	20	8	--	--	--	77	130	1.1	--	--	469	80	--	--	--
V- 84	--	Jan. 11, 1963	--	8.4	--	--	.007	19	7	--	--	--	73	123	.6	--	--	505	78	--	--	--
V- 84	--	July 27, 1965	--	8.3	--	--	.01	20	5	--	--	--	75	130	.5	--	--	468	70	--	--	--
V- 84	--	June 22, 1966	--	8.1	--	--	.02	20	5	--	--	--	88	110	.3	--	--	478	72	--	--	--
V- 84	240- 555	Aug. 1, 1966	768	7.7	78 °F	30	.03	18	4.9	131	6.1	156	71	109	.9	2.8	.09	451	66	79	7.0	1.25
V- 84	--	Aug. 10, 1967	--	8.3	--	--	.013	26	1	--	--	--	83	105	.7	--	--	443	70	--	--	--
V- 91	--	July 23, 1962	--	7.9	--	--	.02	24	9	--	--	--	68	110	.5	--	--	479	98	--	--	--
V- 91	--	July 27, 1965	--	8.3	--	--	.06	24	8	--	--	--	73	135	.6	--	--	479	93	--	--	--
V- 91	--	Apr. 18, 1966	--	8.2	--	--	.05	27	13	--	--	--	84	130	.4	--	--	509	120	--	--	--
V- 91	430- 760	Aug. 1, 1966	819	7.8	78 °F	28	.00	25	7.2	132	5.1	166	70	125	1.0	.0	.11	476	93	74	6.0	.86
V- 91	460- 768	July 7, 1969	795	7.4	24.5°C	--	--	24	7.2	--	--	168	72	122	--	--	--	--	90	--	--	.96
V- 93	495- 982	July 29, 1966	940	7.5	79 °F	37	.00	31	9.0	144	10	190	97	129	1.1	5.0	.09	557	116	71	5.8	.80
V- 93	--	Aug. 14, 1969	946	7.4	--	36	--	30	9.8	149	11	180	97	140	1.0	3.2	.150	566	116	71	6.0	.64
V- 94	370- 600	June 23, 1965	1,050	--	81 °F	--	--	--	--	--	--	--	80	192	--	--	--	--	--	--	--	--
V- 94	450- 642	Aug. 1, 1967	1,110	7.6	81 °F	--	--	--	--	--	--	152	81	222	--	--	--	--	172	--	--	.00
V- 94	370- 600	July 21, 1969	1,340	7.2	22 °C	31	--	63	19	180		142	81	300	.7	.7	--	745	235	62	5.1	.00
V- 98	--	July 16, 1963	836	7.4	--	--	--	--	--	--	--	190	--	112	--	--	--	--	110	--	--	.91
V- 98	421- 619	June 23, 1965	906	--	--	--	--	--	--	--	--	--	92	120	--	--	--	--	--	--	--	--
V- 98	421- 619	Aug. 4, 1967	969	7.6	--	--	--	--	--	--	--	182	93	154	--	--	--	--	132	--	--	.34
V- 98	421- 619	July 11, 1969	1,120	7.5	29 °C	--	--	43	15	--	--	182	95	200	--	--	--	--	169	--	--	.00
V-101	--	July 23, 1962	--	8.0	--	--	< .03	17	13	--	--	--	97	60	1.0	--	--	375	95	--	--	--
V-101	--	June 14, 1964	--	7.9	--	--	.03	16	12	--	--	--	89	55	.9	--	--	344	89	--	--	--
V-101	380- 750	Aug. 1, 1966	614	7.5	79 °F	31	.00	22	5.4	94	7.1	153	70	66	.8	2.5	.11	375	78	70	4.6	.96
V-101	--	Sept. 8, 1967	--	7.9	--	--	.016	24	7	--	--	--	64	55	.9	--	--	362	88	--	--	--
V-109	--	July 23, 1962	--	8.3	--	--	.02	25	10	--	--	--	80	190	.7	--	--	544	104	--	--	--
V-109	--	July 27, 1965	--	8.2	--	--	.03	26	7	--	--	--	70	175	.7	--	--	472	94	--	--	--
V-109	450- 680	Aug. 1, 1966	942	7.7	78 °F	30	.06	26	7.1	153	5.3	161	68	165	.9	.0	.05	535	95	77	6.8	.74
V-113	--	Mar. 27, 1962	--	8.2	--	--	< .04	24	9	--	--	--	96	135	1.2	--	--	569	92	--	--	--
V-113	--	Jan. 11, 1963	--	8.3	--	--	.002	25	5	--	--	--	104	140	.8	--	--	607	82	--	--	--

See footnote at end of table.

Table 6.--Chemical Analyses of Water From Wells in the El Paso District, 1963-70--Continued

WELL	PRODUCING INTERVAL (FT)	DATE OF COLLECTION	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	TEMPERATURE	SILICA (SiO_2)	IRON (Fe)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM AND POTASSIUM		BICARBONATE (HCO_3)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (NO_3)	BORON (B)	DISSOLVED SOLIDS	HARDNESS AS $CaCO_3$	PERCENT SODIUM	SODIUM ADSORPTION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)
										Na	K											
V-113	--	June 14, 1964	--	8.2	--	--	0.03	28	7	--	--	--	97	135	0.7	--	--	657	99	--	--	--
V-113	--	July 27, 1965	--	8.2	--	--	.03	22	7	--	--	--	65	135	1.0	--	--	567	84	--	--	--
V-113	--	June 22, 1966	--	8.3	--	--	.03	20	10	--	--	--	80	140	.8	--	--	588	90	--	--	--
V-113	190- 316	Aug. 1, 1966	1,050	7.6	79 °F	29	.45	21	6.3	178	6.6	145	77	198	.9	1.8	0.09	591	80	--	--	--
V-113	--	Aug. 10, 1967	--	8.3	--	--	.024	26	4	--	--	--	104	215	1.2	--	--	644	81	--	--	--
V-138	--	July 16, 1963	1,270	7.2	--	--	--	--	--	--	--	168	--	270	--	--	--	--	236	--	--	--
V-138	317- 347, 353- 413	June 23, 1964	1,330	--	78 °F	--	--	--	--	--	--	--	94	270	--	--	--	--	--	--	--	--
V-138	317- 347 353- 413	July 31, 1967	1,300	7.8	78 °F	--	--	--	--	--	--	168	99	268	--	--	--	--	232	--	--	.00
V-141	320- 830	Aug. 14, 1969	496	7.9	--	30	--	16	5.8	78	7.5	162	56	32	.9	4.3	.110	311	64	70	4.2	1.38
V-142	--	Aug. 14, 1969	714	7.5	--	31	--	22	6.7	111	7.5	136	59	112	.7	2.1	.100	419	82	72	5.3	.58
V-143	330- 480	July 29, 1964	955	7.6	--	--	--	--	14 *	--	--	127	46	199	--	--	--	--	93	--	--	.22
V-143	330- 480	Aug. 29, 1966	701	7.9	--	27	.07	22	7.0	106	7.2	154	61	96	.7	2.2	--	405	84	71	5.0	.84
V-143	330- 480	Sept. 10, 1969	713	--	--	--	--	--	--	--	--	--	--	107	--	--	--	--	--	--	--	--
V-144	299- 618	Sept. 10, 1966	764	7.4	79 °F	29	.02	21	5.9	123	7.6	140	61	122	.8	1.8	--	441	77	76	6.1	.75
V-144	299- 618	Aug. 14, 1969	780	7.5	--	30	--	22	6.4	127	7.5	136	58	134	.7	1.6	.100	454	82	75	6.1	.60
V-150	--	Nov. 4, 1964	584	7.0	80 °F	32	.04	18	6.3	99		184	62	46	1.0	3.2	.18	358	71	75	5.1	1.60
V-150	315- 760	Dec. 16, 1965	609	7.0	--	32	.01	19	6.4	100		176	66	52	1.1	4.5	--	369	74	75	5.1	--
V-151	272- 550	Aug. 4, 1966	1,540	7.3	78 °F	31	.23	91	22	183	12	175	236	242	.6	18	--	924	320	54	4.4	0
V-153	100- 200	Aug. 1, 1966	3,410	7.4	66 °F	35	.14	92	40	625	9.2	400	514	612	--	.8	--	2,130	396	77	14	0
V-154	--	June 23, 1965	1,100	7.3	--	34	--	30	8.5	181		154	72	212	1.0	1.2	--	616	110	78	7.5	.32
V-154	530- 668	July 10, 1967	1,130	8.1	81 °F	--	--	--	--	--	--	148	69	235	--	--	--	--	122	--	--	.00
V-154	530- 668	July 11, 1969	1,170	7.9	28.5°C	--	--	36	8.8	--	--	148	66	246	--	.0	--	--	126	--	--	.00
V-156	60- 80	Aug. 5, 1966	2,380	7.3	70 °F	29	1.3	228	44	238	9.5	362	586	270	.6	.8	--	1,590	752	40	3.8	0
V-159	400- 700	Aug. 14, 1969	634	7.5	--	30	--	22	6.0	99	7.4	150	60	79	.8	2.6	.110	381	80	71	4.8	.87
V-161	67- 92	Mar. 10, 1967	1,100	7.9	--	39	.03	52	17	165	6.7	308	161	106	.7	.5	--	699	200	63	5.1	1.06
V-161	180- 205	Mar. 10, 1967	1,610	7.5	--	32	.10	112	43	158	8.9	186	274	268	.4	.5	--	988	456	42	3.2	0
V-161	75- 250	July 11, 1967	1,400	7.6	--	37	.01	86	32	168	8.9	304	299	172	.4	.0	.22	883	346	51	3.9	.00
V-161	75- 250	July 12, 1967	1,420	7.6	--	36	.05	86	32	170	9.2	301	226	174	.5	.0	.23	884	346	51	4.0	.00
V-161	75- 250	July 14, 1967	1,420	7.6	--	36	.05	86	32	170	9.2	301	226	174	.5	0	.23	884	346	51	4.0	0
V-162	764- 784	Apr. 5, 1967	600	7.7	--	29	--	19	5.7	98	11	166	66	59	.7	4.2	--	375	71	71	5.1	1.30
V-164	495- 520	Aug. 8, 1967	1,820	7.5	--	28	--	34	7.8	316	7.9	124	87	448	1.3	.5	--	992	117	84	13	.00
V-164	350- 480	Sept. 12, 1967	810	7.1	78 °F	29	.02	20	5.4	139	6.9	141	58	144	1.3	.8	.08	475	72	79	7.1	.87

See footnote at end of table.

Table 6.--Chemical Analyses of Water From Wells in the El Paso District, 1963-70--Continued

WELL	PRODUCING INTERVAL (FT)	DATE OF COLLECTION	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	TEMPER-ATURE	SILICA (SiO_2)	IRON (Fe)	CAL-CIUM (Ca)	MAGNE-SIUM (Mg)	SODIUM AND POTASSIUM		BICAR-BONATE (HCO_3)	SUL-FATE (SO_4)	CHLO-RIDE (Cl)	FLUO-RIDE (F)	NITRATE (NO_3)	BORON (B)	DIS-SOLVED SOLIDS	HARD-NESS AS $CaCO_3$	PERCENT SODIUM	SODIUM ADSORP-TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)
										Na	K											
V-166	572- 687	Apr. 10, 1968	944	7.7	26 °C	33	--	24	6.9	159	7.1	176	82	151	1.2	0.1	--	551	88	78	7.4	1.11
V-167	126- 151	Dec. 5, 1967	3,150	7.6	--	40	--	143	29	497	9.2	180	520	640	--	2.2	--	1,970	476	69	9.9	.00
V-167	641- 666	Dec. 6, 1967	1,070	7.4	--	25	--	65	18	120	7.9	150	106	195	.4	.0	--	611	236	51	3.4	.00
V-167	510- 730	June 21, 1968	1,320	7.2	26 °C	26	1.1	122	27	100	7.9	190	163	216	.4	.7	0.08	759	416	34	2.1	.00
V-183	20- 50	Apr. 25, 1968	1,270	7.3	--	--	--	78	17	--	--	242	238	124	--	--	--	--	264	--	--	.00
V-186	20- 50	Apr. 26, 1968	3,970	7.9	--	--	--	159	67	--	--	618	1,070	418	--	--	--	--	672	--	--	.00
V-187	290- 600	Mar. 3, 1969	680	8.0	--	--	--	17	4.4	--	--	168	79	74	--	--	--	--	60	--	--	1.54
V-189	105- 155	Aug. 1, 1968	1,300	7.6	--	29	--	103	30	114	10	212	238	162	.6	.3	.11	--	380	39	2.5	.00
W- 81	385- 485	Aug. 1, 1966	2,080	7.4	79 °F	29	.22	83	23	321	12	105	536	265	.8	212	.18	1,330	303	69	8.0	.00
W- 83	318- 337	July 20, 1967	877	7.4	--	32	--	17	2.1	159	7.2	134	147	102	1.6	.8	--	535	51	85	9.7	1.18
W- 83	438- 468	July 20, 1967	1,310	7.4	--	31	--	44	12	199	8.8	130	128	260	.8	2.2	--	750	160	72	6.8	.00
W- 85	20- 50	Apr. 2, 1968	3,030	7.5	--	--	--	188	59	--	--	304	836	378	--	--	--	--	712	--	--	.00
W- 86	20- 50	Apr. 22, 1968	4,570	7.6	--	--	--	187	58	--	--	452	1,080	720	--	--	--	--	705	--	--	.00
W- 87	20- 50	Apr. 18, 1968	2,520	7.4	--	--	--	26	8.9	--	--	228	620	282	--	--	--	--	102	--	--	1.71
Q- 3	--	May 29, 1969	1,120	7.8	21 °C	--	--	--	--	--	--	250	251	88	--	--	--	--	365	--	--	0.00
Q- 39	--	May 29, 1969	1,240	7.7	21 °C	--	--	88	18	--	--	270	254	107	--	--	--	--	286	--	--	.00
Q- 41	--	May 29, 1969	945	8.0	--	--	--	87	17	--	--	216	212	70	--	--	--	--	287	--	--	.00
Q- 47	--	Jan. 27, 1970	1,720	7.7	21 °C	--	--	150	27	--	--	314	436	166	--	--	--	--	485	--	--	.00
Q- 67	--	May 29, 1969	465	7.9	32 °C	--	--	9.5	.0	--	--	74	85	48	--	--	--	--	24	--	--	.74
Q- 71	45- 190	Jan. 27, 1970	5,840	7.8	25 °C	--	--	310	72	--	--	126	1,570	1,120	--	--	--	--	1,070	--	--	.00
Q- 82	63- 150	Oct. 23, 1967	1,280	7.6	70 °F	--	--	--	--	--	--	152	277	160	--	--	--	--	192	--	--	.00
Q- 83	59- 160	Oct. 23, 1967	1,190	7.8	71 °F	--	--	--	--	--	--	152	264	134	--	--	--	--	148	--	--	.00
Q- 86	100- 200	Aug. 24, 1966	2,440	7.6	--	37	.19	135	3.6	374	3.2	81	506	422	.2	.2	--	1,520	352	70	8.7	.00
Q- 90	76- 155	Oct. 23, 1967	2,130	7.6	71 °F	--	--	--	--	--	--	246	532	260	--	--	--	--	394	--	--	.00
Q- 91	73- 155	Oct. 23, 1967	680	7.1	70 °F	--	--	--	--	--	--	86	128	81	--	--	--	--	72	--	--	.00
Q- 99	0-1,321	Feb. 28, 1969	1,370	7.7	22 °C	--	--	46	15	--	--	314	284	107	--	--	--	--	176	--	--	1.62
Q-102	--	May 29, 1969	2,060	8.0	--	--	--	65	31	--	--	402	501	184	--	--	--	--	290	--	--	.80
Q-116	142- 78	Feb. 28, 1969	2,250	7.7	21 °C	--	--	167	38	--	--	458	597	194	--	--	--	--	573	--	--	.00
Q-122	41- 141	Feb. 28, 1969	1,680	7.7	21 °C	--	--	120	17	--	--	296	375	180	--	--	--	--	370	--	--	.00
Q-129	40- 150	Feb. 28, 1969	2,080	7.6	20 °C	--	--	105	18	--	--	362	430	241	--	--	--	--	336	--	--	.00
Q-135	--	May 29, 1969	1,950	7.9	19 °C	--	--	62	24	--	--	366	386	226	--	--	--	--	253	--	--	.94
Q-143	--	Feb. 20, 1969	1,540	8.1	23 °C	--	--	48	14	--	--	328	336	117	--	--	--	--	178	--	--	1.83
Q-165	52- 170	Oct. 23, 1967	2,090	7.6	70 °F	--	--	--	--	--	--	246	456	290	--	--	--	--	336	--	--	.00

See footnote at end of table.

Table 6.--Chemical Analyses of Water From Wells in the El Paso District, 1963-70--Continued

WELL	PRODUCING INTERVAL (FT)	DATE OF COLLECTION	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	TEMPERATURE	SILICA (SiO_2)	IRON (Fe)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM AND POTASSIUM		BICARBONATE (HCO_3)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (NO_3)	BORON (B)	DISSOLVED SOLIDS	HARDNESS AS $CaCO_3$	PERCENT SODIUM	SODIUM ADSORPTION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)
										Na	K											
Q-166	60- 194	Oct. 23, 1967	2,270	7.6	71 °F	--	--	--	--	--	--	206	556	332	--	--	--	--	468	--	--	.00
Q-167	37- 156	Oct. 23, 1967	2,280	7.5	69 °F	--	--	--	--	--	--	368	648	225	--	--	--	--	584	--	--	.00
Q-168	61- 200	Oct. 23, 1967	940	7.5	70 °F	--	--	--	--	--	--	177	221	78	--	--	--	--	219	--	--	.00
Q-169	62- 200	Oct. 23, 1967	985	7.5	71 °F	--	--	--	--	--	--	184	218	90	--	--	--	--	208	--	--	.00
Q-172	--	June 9, 1958	451	8.8	96 °F	34	0.00	3.6	.5	90	.6	65	80	39	1.3	0.0	0.13	291	11	94	12	--
Q-172	586-1,000	Sept. 25, 1963	489	8.3	95.5°F	--	--	--	2.2*	--	--	72	85	47	--	--	--	--	14	--	--	.90
Q-172	586-1,000	Feb. 6, 1964	572	9.0	96 °F	--	--	5.5	.1	--	--	68	103	57	--	--	--	--	14	--	--	.83
Q-172	586-1,000	Jan. 27, 1966	504	8.3	97 °F	--	--	--	--	--	--	73	87	50	--	--	--	--	14	--	--	1.05
Q-176	585-1,050	Aug. 23, 1966	422	8.4	--	34	.03	7.2	.2	78	1.8	72	78	32	1.0	.0	--	269	19	89	7.8	.87
Q-181	528-1,013	July 13, 1962	930	7.4	88 °F	37	--	42	2.3	144		62	102	190	.8	.0	--	548	114	73	5.9	--
Q-181	528-1,013	Feb. 13, 1963	936	7.5	88 °F	--	--	--	--	--	--	64	--	188	--	--	--	--	199	--	--	0
Q-181	528-1,013	Sept. 25, 1963	1,140	7.0	85 °F	--	--	--	25*	--	--	61	122	238	--	--	--	--	160	--	--	.00
Q-181	528-1,013	May 1, 1964	1,080	7.8	85 °F	--	--	--	23*	--	--	66	127	212	--	--	--	--	148	--	--	.00
Q-181	528-1,013	Nov. 23, 1964	1,130	7.7	86 °F	--	--	--	25*	--	--	70	141	228	--	--	--	--	165	--	--	--
Q-181	528-1,013	June 11, 1965	1,420	7.6	81 °F	--	--	--	33*	--	--	62	176	295	--	--	--	--	214	--	--	.00
Q-181	528-1,013	Jan. 27, 1966	1,970	7.0	--	--	--	--	--	--	--	58	244	440	--	--	--	--	336	--	--	0
Q-181	528-1,013	Aug. 26, 1966	1,570	7.5	85 °F	33	.02	88	6.0	213	4.4	62	186	335	.5	.2	--	895	240	65	6.0	0
Q-181	528-1,013	Sept. 8, 1969	1,570	--	--	--	--	--	--	--	--	--	--	355	--	--	--	--	--	--	--	--
Q-182	102- 202	Aug. 19, 1966	1,260	7.9	--	36	.04	38	5.7	217	6.7	182	188	180	.7	0	--	761	118	79	8.7	.61
Q-189	510- 900	Sept. 25, 1963	446	8.2	92 °F	--	--	--	2*	--	--	74	72	46	--	--	--	--	14	--	--	.93
Q-189	510- 900	Aug. 10, 1966	452	8.6	92 °F	20	.01	6.4	.2	87	1.1	60	72	46	.9	.2	--	252	17	91	9.2	.64
Q-203	445- 545	May 7, 1964	440	8.5	86 °F	--	--	--	2*	--	--	69	82	35	--	--	--	16	16	--	--	.98
Q-203	355- 545	Aug. 22, 1966	431	8.2	87 °F	35	0	7.5	.2	81	.9	80	74	36	1.0	0	--	275	20	90	7.9	.92
Q-203	200- 545	Sept. 9, 1969	429	--	--	--	--	--	--	--	--	--	--	40	--	--	--	--	--	--	--	--
Q-206	100- 200	Aug. 5, 1966	1,320	7.6	70 °F	32	.06	55	7.8	210	5.7	156	286	150	.5	0	--	825	170	72	7.0	0
Q-207	100- 200	Aug. 5, 1966	1,400	7.5	70 °F	35	.04	65	5.4	221	4.8	116	316	178	.4	0	--	884	186	72	7.0	0
Q-208	100- 200	Aug. 5, 1966	3,770	7.3	70 °F	35	.32	228	36	520	11.0	206	456	875	--	1.8	--	2,270	721	61	8.4	0
Q-209	100- 200	Aug. 10, 1966	1,410	7.3	70 °F	33	.25	70	14	206	4.6	211	292	150	.9	.2	--	876	234	65	5.9	0
Q-215	147- 189	Aug. 17, 1966	1,360	7.5	--	38	.04	43	26	178	23	164	119	265	1.4	.5	--	775	214	61	5.3	0
Q-216	146- 326	Mar. 11, 1966	1,150	7.4	80 °F	50	.02	31	3.1	205	5.7	166	160	170	.7	0	0	708	90	82	9.4	.91
Q-220	274- 558	Aug. 17, 1966	548	8	85 °F	33	.04	14	.4	98	2.6	108	96	46	.8	0	--	344	36	84	7.1	1.04
Q-221	1,063-1,088	Jan. 12, 1966	485	7.4	--	23	--	12	.5	89		110	79	36	.9	.2	--	295	32	86	6.8	1.16
Q-221	1,195-1,220	Jan. 13, 1966	2,320	7.4	--	28	--	46	2.7	453		90	576	305	2.9	.5	--	1,460	126	89	18	0

See footnote at end of table.

Table 6.--Chemical Analyses of Water From Wells in the El Paso District, 1963-70--Continued

WELL	PRODUCING INTERVAL (FT)	DATE OF COLLECTION	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	TEMPER-ATURE	SILICA (SiO_2)	IRON (Fe)	CAL-CIUM (Ca)	MAGNE-SIUM (Mg)	SODIUM AND POTASSIUM		BICAR-BONATE (HCO_3)	SUL-FATE (SO_4)	CHLO-RIDE (Cl)	FLUO-RIDE (F)	NITRATE (NO_3)	BORON (B)	DIS-SOLVED SOLIDS	HARD-NESS AS $CaCO_3$)	PERCENT SODIUM	SODIUM ADSORP-TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)
										Na	K											
Q-221	763-1,063	Aug. 18, 1966	430	8.3	90 °F	25	0.06	4.0	0.1	82	0.9	73	64	42	0.9	0	--	257	10	--	--	1.06
Q-226	--	Oct. 10, 1969	1,450	8	--	--	--	107	21	--	--	234	336	148	--	--	--	--	354	--	--	--
Q-227	--	Feb. 28, 1969	1,580	7.8	--	--	--	72	16	--	--	348	318	147	--	--	--	--	246	--	--	.79
Q-227	--	Oct. 10, 1969	1,280	8	--	--	--	82	17	--	--	276	268	115	--	--	--	--	274	--	--	.00
Q-230	20- 50	May 2, 1968	12,400	7.8	--	--	--	139	92	--	--	498	2,370	2,700	--	--	--	--	726	--	--	--
Q-231	20- 50	May 6, 1968	5,410	7.5	--	--	--	274	42	--	--	260	1,130	1,090	--	--	--	--	856	--	--	.00
Q-232	20- 50	May 8, 1968	1,500	7.5	--	--	--	121	23	--	--	244	336	163	--	--	--	--	396	--	--	.00
Q-232	10- 50	Dec. 18, 1969	1,220	7.8	19.0°C	--	--	84	17	--	--	252	266	108	--	--	--	--	280	--	--	.00
Q-235	20- 50	May 10, 1968	1,860	7.9	--	--	--	154	35	--	--	270	440	215	--	--	--	--	528	--	--	.00
Q-235	20- 50	Dec. 18, 1969	1,520	7.2	21 °C	--	--	128	26	--	--	256	360	155	--	--	--	--	426	--	--	.00
Q-236	20- 50	May 20, 1968	1,190	7.6	--	--	--	73	16	--	--	184	275	104	--	--	--	--	248	--	--	.00
Q-236	20- 50	Dec. 18, 1969	1,700	7.5	20.0°C	--	--	152	32	--	--	280	424	185	--	--	--	--	510	--	--	.00
Q-237	20- 50	May 13, 1968	4,470	7.7	--	--	--	290	76	--	--	532	1,280	600	--	--	--	--	1,040	--	--	.00
Q-237	--	Dec. 18, 1969	3,490	8.2	19.0°C	--	--	212	53	--	--	664	996	340	--	--	--	--	747	--	--	.00
Q-239	20- 50	May 28, 1968	4,380	7.9	--	--	--	80	83	--	--	264	992	668	--	--	--	--	541	--	--	.00
Q-240	20- 50	June 16, 1968	6,730	7.9	--	--	--	116	79	--	--	260	1,340	1,300	--	--	--	--	614	--	--	.00
Q-240	--	Dec. 18, 1969	7,260	8.0	22.0°C	--	--	146	94	--	--	340	1,500	1,440	--	--	--	--	751	--	--	.00
Y- 16	--	Sept. 6, 1956	2,560	7.8	66 °F	--	--	--	--	--	--	353	469	390	--	--	--	--	410	--	--	--
Y- 16	--	Dec. 8, 1969	2,300	7.9	21 °C	--	--	46	17	--	--	338	484	282	--	--	--	--	185	--	--	1.84
Y-217	--	Sept. 3, 1956	5,010	7.5	66 °F	--	--	--	--	--	--	378	864	1,120	--	--	--	--	1,340	--	--	--
Y-217	10	Dec. 17, 1969	1,740	7.4	20 °C	--	--	116	25	--	--	418	356	160	--	--	--	--	392	--	--	.00
Y-217	40	Dec. 17, 1969	1,990	7.9	20 °C	--	--	142	27	--	--	454	398	210	--	--	--	--	466	--	--	.00
Y-280	20- 50	Apr. 10, 1968	1,180	7.8	--	--	--	69	15	--	--	308	179	115	--	--	--	--	234	--	--	.38
Y-280	20- 50	Dec. 17, 1969	1,350	7.6	--	--	--	92	19	--	--	278	260	140	--	--	--	--	308	--	--	.00
Y-281	20- 50	June 3, 1968	1,920	7.9	--	--	--	112	20	--	--	340	418	190	--	--	--	--	362	--	--	.00
Y-281	--	June 7, 1968	--	8.1	--	--	.165	117	16	--	--	--	445	205	0	--	--	1,276	356	--	--	--
Y-281	10- 50	Dec. 17, 1969	2,940	7.6	20.5°C	--	--	233	47	--	--	438	672	420	--	--	--	--	775	--	--	.00
Y-282	20- 50	May 30, 1968	9,340	7.4	--	--	--	585	133	--	--	288	1,390	2,380	--	--	--	--	2,010	--	--	.00
Y-282	--	May 31, 1968	--	7.7	--	--	.009	775	37	--	--	--	1,417	2,550	< .01	--	--	6,849	2,090	--	--	--
Y-282	10- 50	Dec. 17, 1969	8,400	7.4	20.5°C	--	--	440	116	--	--	592	1,550	1,570	--	--	--	--	1,580	--	--	.00
Y-283	--	May 31, 1968	--	8	--	--	.017	261	18	--	--	--	895	527	0	--	--	2,651	726	--	--	--
Y-283	20- 50	June 5, 1968	3,690	7.7	--	--	--	216	39	--	--	216	900	520	--	--	--	--	700	--	--	.00

See footnote at end of table.

Table 6.--Chemical Analyses of Water From Wells in the El Paso District, 1963-70--Continued

WELL	PRODUCING INTERVAL (FT)	DATE OF COLLECTION	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	TEMPER-ATURE	SILICA (SiO_2)	IRON (Fe)	CAL-CIUM (Ca)	MAGNE-SIUM (Mg)	SODIUM AND POTASSIUM		BICAR-BONATE (HCO_3)	SUL-FATE (SO_4)	CHLO-RIDE (Cl)	FLUO-RIDE (F)	NITRATE (NO_3)	BORON (B)	DIS-SOLVED SOLIDS	HARD-NESS AS $CaCO_3$	PERCENT SODIUM	SODIUM ADSORP-TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)
										Na	K											
AA- 1	--	Sept. 5, 1956	3,880	7.5	65 °F	--	--	--	--	--	--	422	--	770	--	--	--	--	1,160	--	--	--
AA- 1	--	Dec. 9, 1969	2,890	7.5	19.5°C	--	--	222	39	--	--	484	622	400	--	--	--	--	714	--	--	0.00
AA- 24	--	Aug. 31, 1956	4,180	7.7	67 °F	--	--	--	--	--	--	298	--	1,010	--	--	--	--	1,220	--	--	--
AA- 24	44	Dec. 9, 1969	2,330	7.4	19.5°C	--	--	158	27	--	--	274	448	372	--	--	--	--	505	--	--	.00
AA- 24	16	Dec. 9, 1969	1,560	7.8	19.5°C	--	--	71	16	--	--	278	274	198	--	--	--	--	243	--	--	.00
AA- 24	10	Dec. 9, 1969	1,630	8.1	19.5°C	--	--	107	20	--	--	338	302	190	--	--	--	--	350	--	--	.00
BB- 33	--	Aug. 31, 1956	3,770	7.6	66 °F	--	--	--	--	--	--	355	--	750	--	--	--	--	870	--	--	--
BB- 33	40 -153	Dec. 9, 1969	2,780	7.7	20 °C	--	--	135	31	--	--	212	560	485	--	--	--	--	464	--	--	.0
V -168	25 - 50	Sept. 14, 1967	1,410	7.7	66 °F	23	--	94	20	189	8.6	332	268	141	0.8	0.2	--	908	317	56	4.6	.00
V -168	--	Sept. 19, 1967	--	8.1	--	--	0.866	100	15	--	--	--	265	148	.03	--	--	935	310	--	--	--
V -169	50.4- 52.8	July 20, 1967	2,140	8.2	68 °F	--	--	--	--	--	--	422	444	230	--	--	--	--	240	--	--	2.12
V -170	50.3- 52.2	July 20, 1967	1,180	8.0	67 °F	--	--	--	--	--	--	394	305	32	--	--	--	--	492	--	--	.00
V -171	49.7- 52.1	July 20, 1967	1,450	7.7	69 °F	--	--	--	--	--	--	368	202	166	--	--	--	--	352	--	--	.00
V -172	50.3- 52.7	July 20, 1967	1,040	7.8	68 °F	--	--	--	--	--	--	276	170	92	--	--	--	--	204	--	--	.44
V -173	50.3- 52.7	July 20, 1967	1,270	7.6	68 °F	--	--	--	--	--	--	344	168	142	--	--	--	--	308	--	--	.00
V -174	48.5- 51.5	July 20, 1967	1,890	7.9	69 °F	--	--	--	--	--	--	284	452	240	--	--	--	--	628	--	--	.00
V -175	48.8- 51.7	July 21, 1967	2,830	7.6	68 °F	--	--	--	--	--	--	252	660	450	--	--	--	--	785	--	--	.00
V -176	48.2- 51.2	July 21, 1967	2,390	7.8	69 °F	--	--	--	--	--	--	228	448	402	--	--	--	--	420	--	--	.00
V -177	46.1- 49.1	July 20, 1967	4,560	7.4	68 °F	--	--	--	--	--	--	247	1,260	840	--	--	--	--	1,750	--	--	.00
V -178	46.0- 49.0	July 21, 1967	7,920	7.7	67 °F	--	--	--	--	--	--	312	552	2,220	--	--	--	--	600	--	--	.00
V -179	48.4- 51.3	July 20, 1967	2,900	7.4	69 °F	--	--	--	--	--	--	332	764	395	--	--	--	--	880	--	--	.00

* Calcium and magnesium calculated as magnesium.

Table 7.--Records of Wells Drilled in the El Paso District, Texas, 1963-70--Continued

STATE WELL NO.	WELL	OWNER	DRILLER	DATE COM-PLET-ED	DEPTH OF WELL (FT)	DIAMETER OF WELL (IN)	ALTITUDE OF LAND SURFACE (FT)	WATER LEVEL: BELOW LAND-SURFACE DATUM	WATER LEVEL: DATE OF MEASUREMENT	METHOD OF LIFT	USE OF WATER	REMARKS
JL4904426	Q-208	City of El Paso Well 117	City of El Paso	1964	200	24 18	3,776.9	10.6 8.2	Oct. 21, 1964 Jan. 2, 1969	T,E	P	Casing: 24" Surface 0-80 18" Blank 0-100 18" Screen 100-200 Discharge 1,200 g.p.m.
JL4904428	Q-209	City of El Paso Well 118	City of El Paso	1964	200	24 18	3,764.4	8.2 5.0	Oct. 21, 1964 Jan. 21, 1969	T,E	P	Casing: 24" Surface 0-80 18" Blank 0-100 18" Screen 100-200 Discharge 1,065 g.p.m.
JL4904422	Q-205	City of El Paso Well 304	City of El Paso	1963	390	24 18	3,772.56	22.1	Mar. 6, 1963	T,E	P	Casing: 24" Surface 0-150 18" Blank 0-198 18" Screen 198-390 Discharge 2,500 g.p.m.
JL4904427	Q-210	City of El Paso Well 306	City of El Paso	1964	467	24 18	3,770.59	39.2	June 16, 1964	T,E	P	Casing: 24" Surface 0-220 18" Blank 0-230 18" Screen 230-461 Discharge 1,800 g.p.m.
JL4904116	Q-211	City of El Paso Well 308	City of El Paso	1964	279	24 18	3,777.87	25.4	July 13, 1964	T,E	P	Casing: 24" Surface 0-161 18" Blank 0-169 18" Screen 169-278 Discharge 1,225 g.p.m.
JL4904404	Q-212	City of El Paso Well 305	City of El Paso	1964	405	24 18	3,768.78	25.8	Aug. 24, 1964	T,E	P	Casing: 24" Surface 0-213 18" Blank 0-220 18" Screen 220-404 Discharge 1,600 g.p.m.
JL4904110	Q-213	City of El Paso Well 309	City of El Paso	1964	527	24 18	3,781.1	29.9	Sept. 17, 1964	T,E	P	Casing: 24" Surface 0-200 18" Blank 0-209 18" Screen 209-506 Discharge 2,100 g.p.m.
JL4904425	Q-214	City of El Paso Well 307	City of El Paso	1964	447	24 18	3,773.79	40.2	Oct. 5, 1964	T,E	P	Casing: 24" Surface 0-232 18" Blank 0-242 18" Screen 242-440 Discharge 1,500 g.p.m.
JL4904424	Q-207	City of El Paso Well 116	City of El Paso	1964	200	24 18	3,776.90	15.2	Oct. 21, 1964	T,E	P	Casing: 24" Surface 0-80 18" Blank 0-100 18" Screen 100-200 Discharge 825 g.p.m.
JL4904203	Q-215	Texas State Highway Department	Highway Department	1964	272	6	--	146	May 1964	T,E	P	--
JL4904117	Q-216	La Tuna Federal Prison	Layne-Texas	1964	452	18	--	90	Dec. 1964	T,E	D,P Irr	Casing: 18" Blank 0-146 18" Screen 146-336 Discharge 1,850 g.p.m.
JL4904432	Q-217	P.R.R. Stock Farm	W. Cass	1965	200	16	--	18	Jan. 1965	T,E	Irr	Casing: 16" Blank 0-100 16" Screen 100-200 Discharge 1,700 g.p.m.

Table 7.--Records of Wells Drilled in the El Paso District, Texas, 1963-70--Continued

STATE WELL NO.	WELL	OWNER	DRILLER	DATE COM-PLET-ED	DEPTH OF WELL (FT)	DIAMETER OF WELL (IN)	ALTITUDE OF LAND SURFACE (FT)	WATER LEVEL: BELOW LAND-SURFACE DATUM	WATER LEVEL: DATE OF MEASUREMENT	METHOD OF LIFT	USE OF WATER	REMARKS
JL4904705	Q-218	Charlie Dearman	W. Cass	1964	200	16	--	15	Jan. 1964	T,G	Irr	Casing: 16" Blank 0-50 16" Perforated 50-200 Discharge 2,000 g.p.m.
JL4903303	Q-219	Davis Greenwood	W. Cass	1965	80	16	--	13.2	Dec. 29, 1967	T,G	Irr	Casing: 16" Blank 0-35 16" Perforated 35-80 Discharge 1,400 g.p.m.
JL4912201	Q-230	City of El Paso	W. Cass	1968	50	1.5	--	10.3 10.4	May 6, 1968 Jan. 21, 1970	N	Obs	Slotted, gravel packed.
JL4912104	Q-231	City of El Paso	W. Cass	1968	50	1.5	--	10.1 8.3	May 16, 1968 Jan. 21, 1970	N	Obs	Slotted, gravel packed.
JL4904704	Q-232	City of El Paso	W. Cass	1968	50	1.5	--	4.5 5.2	May 16, 1968 Jan. 21, 1970	N	Obs	Slotted, gravel packed.
JL4904430	Q-235	City of El Paso	W. Cass	1968	50	1.5	--	7.2 5.8	May 16, 1968 Jan. 21, 1970	N	Obs	Slotted, gravel packed.
JL4904431	Q-236	City of El Paso	W. Cass	1968	50	1.5	--	7.2 7.2	May 23, 1968 Jan. 21, 1970	N	Obs	Slotted, gravel packed.
JL4904429	Q-237	City of El Paso	W. Cass	1968	50	1.5	--	7.8 8.3	May 16, 1968 Jan. 21, 1970	N	Obs	Slotted, gravel packed.
JL4904119	Q-239	City of El Paso	W. Cass	1968	50	1.5	--	14.6 13.9	May 28, 1968 Jan. 21, 1970	N	Obs	Slotted, gravel packed.
JL4912105	Q-240	City of El Paso	W. Cass	1968	50	1.5	--	6.8 6.5	May 20, 1968 Jan. 22, 1970	N	Obs	Slotted, gravel packed.
JL4912602	U-71	City of El Paso	W. Cass	1968	50	1.5	--	2.1 3.0	May 6, 1968 Jan. 21, 1970	N	Obs	Slotted, gravel packed.
JL4921101	V-168	City of El Paso	City of El Paso	1954	50	20	--	29.6 43.0	Mar. 26, 1968 Jan. 1, 1970	N	Obs	Recorder installed.
JL4913923	V-169	I.B.W.C.	Dickinson	1967	52.8	2	3,694.13	24.1 Destroyed	July 22, 1967	N	Obs	Sandpoint.
JL4921305	V-170	I.B.W.C.	Dickinson	1967	52.2	2	3,690.43	19.2 20.0	July 16, 1967 Jan. 26, 1970	N	Obs	3 ft Sandpoint.
JL4921306	V-171	I.B.W.C.	Dickinson	1967	52.1	2	3,684.24	7.6 8.5	July 17, 1967 Jan. 26, 1970	N	Obs	3 ft Sandpoint.
JL4921307	V-172	I.B.W.C.	Dickinson	1967	52.7	2	3,692.39	14.4 15.8	July 17, 1967 Jan. 26, 1970	N	Obs	3 ft Sandpoint.
JL4913812	V-173	I.B.W.C.	Dickinson	1967	52.7	2	3,695.10	17.7 Destroyed	July 17, 1967	N	Obs	3 ft Sandpoint.
JL4913712	V-174	I.B.W.C.	Dickinson	1967	51.5	2	3,698.06	19.0 Destroyed	July 20, 1967	N	Obs	3 ft Sandpoint.

Table 7.--Records of Wells Drilled in the El Paso District, Texas, 1963-70--Continued

STATE WELL NO.	WELL	OWNER	DRILLER	DATE COM-PLET-ED	DEPTH OF WELL (FT)	DIAMETER OF WELL (IN)	ALTITUDE OF LAND SURFACE (FT)	WATER LEVEL BELOW LAND-SURFACE DATUM	WATER LEVEL DATE OF MEASUREMENT	METHOD OF LIFT	USE OF WATER	REMARKS
JL4921102	V-175	I.B.W.C.	Dickinson	1967	51.7	2	3,710.92	34.9 50.0 + (dry)	July 20, 1967	N	Obs	4 ft Sandpoint.
JL4913713	V-176	I.B.W.C.	Dickinson	1967	51.2	2	3,709.16	25.9 38.3	July 22, 1967 Jan. 26, 1970	N	Obs	4 ft Sandpoint.
JL4913714	V-177	I.B.W.C.	Dickinson	1967	49.1	2	3,704.81	25.1 35.8	July 22, 1967 Jan. 26, 1970	N	Obs	4 ft Sandpoint.
JL4913715	V-178	I.B.W.C.	Dickinson	1967	49.0	2	3,704.82	21.4 25.8	July 22, 1967 Jan. 26, 1970	N	Obs	4 ft Sandpoint.
JL4913813	V-179	I.B.W.C.	Dickinson	1967	51.3	2	3,698.97	23.6 25.7	July 22, 1967 Jan. 26, 1970	N	Obs	4 ft Sandpoint.
JL4913811	V-180	City of El Paso	W. Cass	1968	50	1.5	3,695	19.0 20.0	Mar. 21, 1968 Dec. 2, 1969	N	Obs	Slotted, gravel packed.
JL4921303	V-181	City of El Paso	W. Cass	1968	50	1.5	3,685	9.2 7.8	Mar. 21, 1968 Dec. 9, 1969	N	Obs	Slotted, gravel packed.
JL4921304	V-182	City of El Paso	W. Cass	1968	50	1.5	3,682	12.0 11.2	Mar. 21, 1968 Dec. 9, 1969	N	Obs	Slotted, gravel packed.
JL4922108	V-183	City of El Paso	W. Cass	1968	50	1.5	3,678	7.4 7.0	May 2, 1968 Dec. 9, 1969	N	Obs	Slotted, gravel packed.
JL4922107	V-184	City of El Paso	W. Cass	1968	50	1.5	3,700	22.1 Destroyed	Apr. 10, 1968	N	Obs	Slotted, gravel packed.
JL4922106	V-185	City of El Paso	W. Cass	1968	50	1.5	3,700	27.2 Destroyed	Mar. 21, 1968	N	Obs	Slotted, gravel packed.
JL4913922	V-186	City of El Paso	W. Cass	1968	50	1.5	3,685	23.8 24.7	May 2, 1968 Dec. 8, 1969	N	Obs	Slotted, gravel packed.
JL4922501	W-85	City of El Paso	W. Cass	1968	50	1.5	3,670	8.9 8.3	Apr. 10, 1968 Dec. 8, 1969	N	Obs	Slotted, gravel packed.
JL4922502	W-86	City of El Paso	W. Cass	1968	50	1.5	3,665	10.1 9.9	May 2, 1968 Dec. 8, 1969	N	Obs	Slotted, gravel packed.
JL4922601	W-87	City of El Paso	W. Cass	1968	50	1.5	3,665	9.2 9.2	May 2, 1968 Dec. 8, 1969	N	Obs	Slotted, gravel packed.
JL4922203	W-88	City of El Paso	W. Cass	1968	50	1.5	3,670	10.9 10.2	Apr. 10, 1968 Dec. 8, 1969	N	Obs	Slotted, gravel packed.
JL4922803	Y-280	City of El Paso	W. Cass	1968	50	1.5	3,664	7.1 6.5	May 2, 1968 Dec. 8, 1969	N	Obs	Slotted, gravel packed.
JL4930303	Y-281	City of El Paso	W. Cass	1968	50	1.5	3,648	7.4 6.6	June 7, 1968 Dec. 8, 1969	N	Obs	Slotted, gravel packed.