ANALYSIS OF GROUND-WATER DATA FOR SELECTED WELLS NEAR HOLLOMAN AIR FORCE BASE, NEW MEXICO, 1950-95

By G.F. Huff

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CONTENTS

FIGURES

FIGURES--Continued

Page

FIGURES--Concluded

Page

TABLES

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
foot	0.3048	meter
mile	1.609	kilometer
acre	4,047	square meter
gallons per minute	0.06309	liters per second
million gallons per year	3,785	cubic meter per year

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) as follows:

$$°F = (1.8 \times °C) + 32$$

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

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ABSTRACT

Ground-water-level, ground-water-withdrawal, and ground-water-quality data were evaluated for trends. Holloman Air Force Base is located in the west-central part of Otero County, New Mexico. Ground-water-data analyses include assembly and inspection of U.S. Geological Survey and Holloman Air Force Base data, including ground-water-level data for public-supply and observation wells and withdrawal and water-quality data for public-supply wells in the area.

Well Douglas 4 shows a statistically significant decreasing trend in water levels for 1972-86 and a statistically significant increasing trend in water levels for 1986-90. Water levels in wells San Andres 5 and San Andres 6 show statistically significant decreasing trends for 1972-93 and 1981-89, respectively. A mixture of statistically significant increasing trends, statistically significant decreasing trends, and lack of statistically significant trends over periods ranging from the early 1970's to the early 1990's are indicated for the Boles wells and wells near the Boles wells. Well Boles 5 shows a statistically significant increasing trend in water levels for 1981-90. Well Boles 5 and well 17S.09E.25.343 show no statistically significant trends in water levels for 1990-93 and 1988-93, respectively. For 1986-93, well Frenchy 1 shows a statistically significant decreasing trend in water levels.

Ground-water withdrawal from the San Andres and Douglas wells regularly exceeded estimated ground-water recharge from San Andres Canyon for 1963-87. For 1951-57 and 1960-86, ground-water withdrawal from the Boles wells regularly exceeded total estimated ground-water recharge from Mule, Arrow, and Lead Canyons. Ground-water withdrawal from the San Andres and Douglas wells and from the Boles wells nearly equaled estimated ground-water recharge for 1989-93 and 1986-93, respectively. For 1987-93, ground-water withdrawal from the Escondido well regularly exceeded estimated ground-water recharge from Escondido Canyon, and ground-water withdrawal from the Frenchy wells regularly exceeded total estimated ground-water recharge from Dog and Deadman Canyons.

Water-quality samples were collected from selected Douglas, San Andres, and Boles public-supply wells from December 1994 to February 1995. Concentrations of dissolved nitrate show the most consistent increases between current and historical data. Current concentrations of dissolved nitrate are greater than historical concentrations in 7 of 10 wells.

INTRODUCTION

Holloman Air Force Base is located in the Tularosa Basin in the west-central part of Otero County near Alamogordo, New Mexico (fig. 1). The base withdraws water from the Boles, San Andres, Douglas, Escondido, and Frenchy wells for domestic supply (figs. 2 and 3). Holloman Air Force Base is concerned about the future supply of potable ground water for domestic supply and other uses. The U.S. Geological Survey analyzed ground-water-level, ground-water-withdrawal, and ground-water-quality data for trends. This report was prepared in cooperation with Holloman Air Force Base.

Purpose and Scope

This report presents the analyses of ground-water-level, ground-water-withdrawal, and ground-water-quality data for trends that may affect the future availability of potable water for Holloman Air Force Base. The evaluation included assembly and inspection of data obtained from published reports and files of the U.S. Geological Survey and files of Holloman Air Force Base detailing ground-water levels in public-supply and observation wells and ground-water-withdrawal and ground-water-quality data for public-supply wells in the area of ground-water withdrawals by Holloman Air Force Base. Ground-water levels and selected ground-water-quality data were examined for temporal trends.

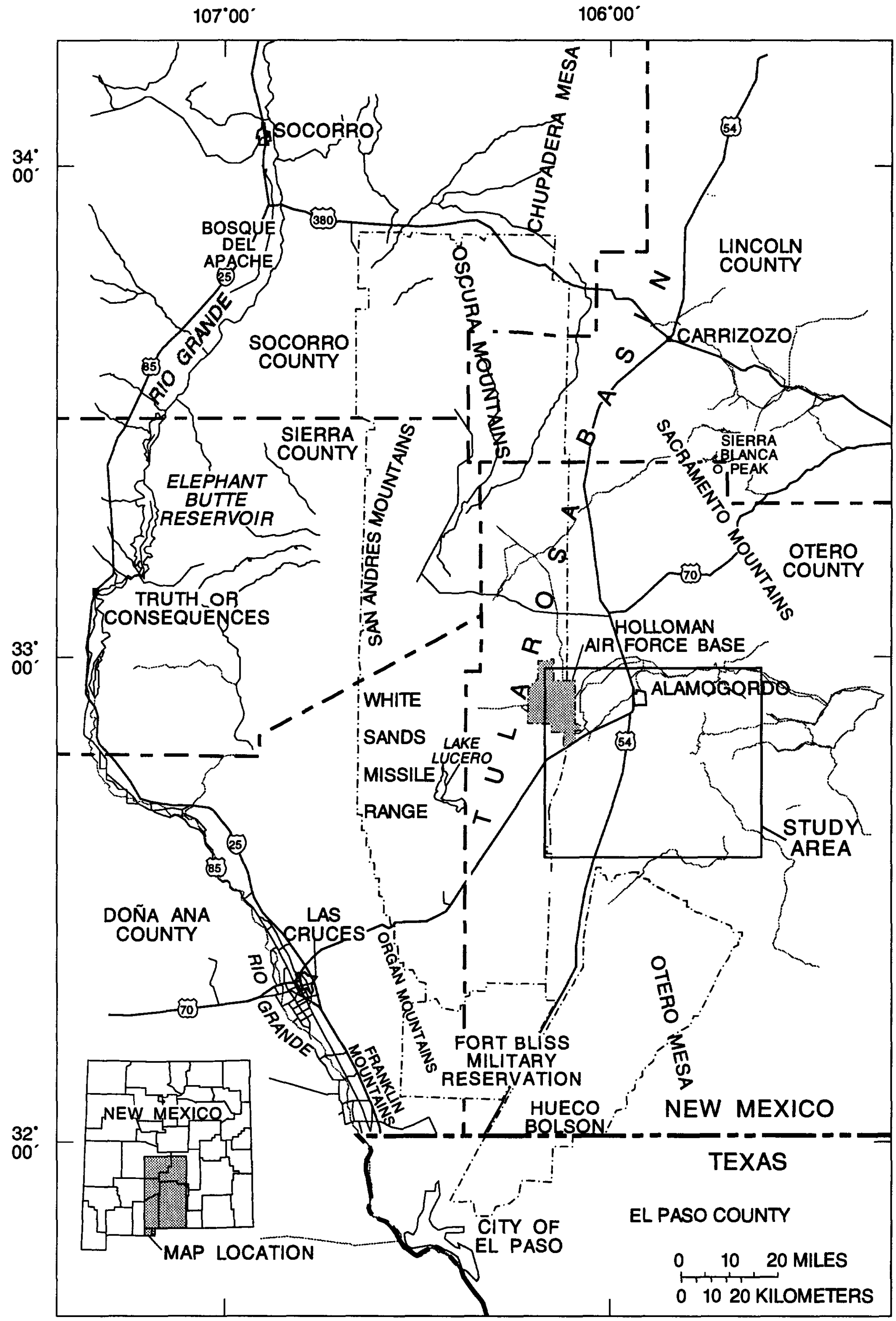


Figure 1.--Location of the study area.

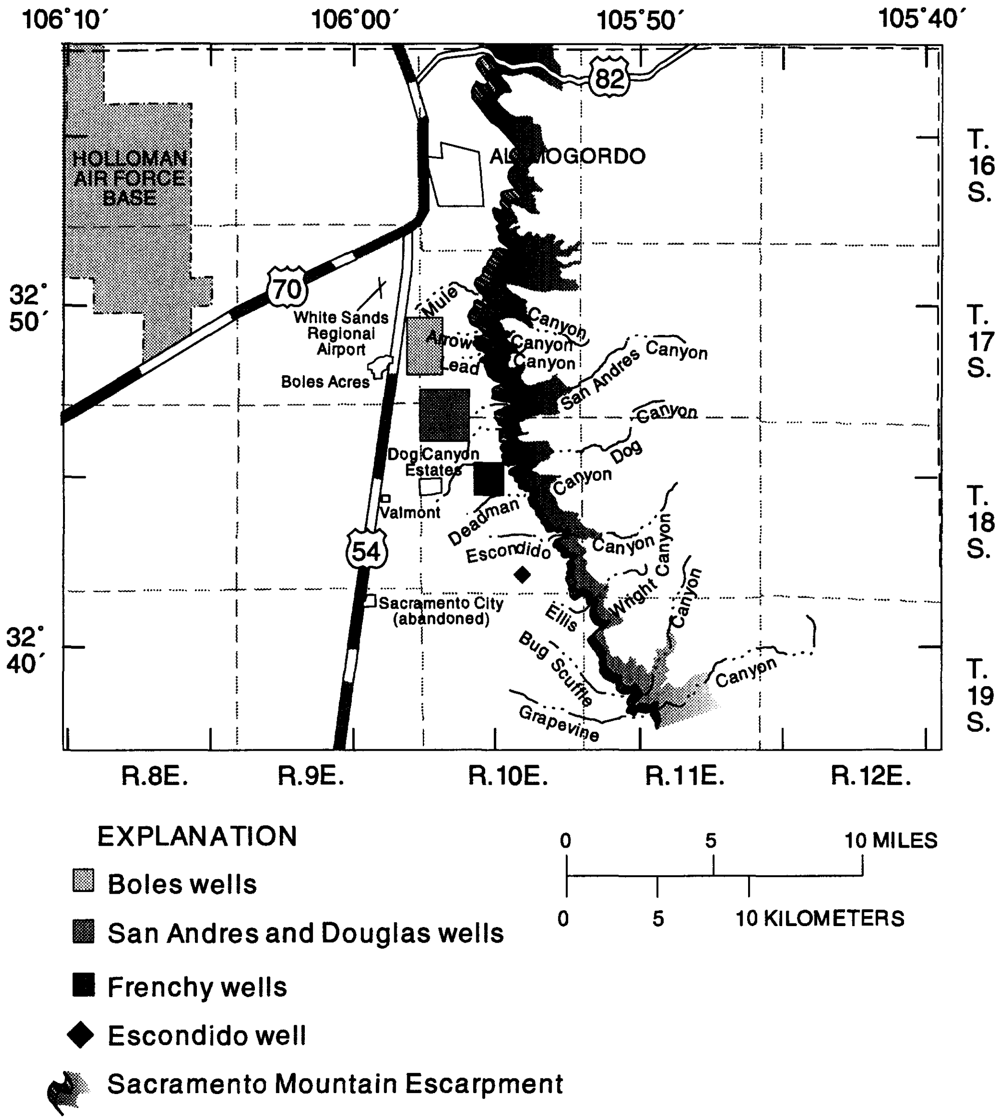


Figure 2.-Location of the Boles wells, San Andres and Douglas wells, Frenchy wells, Escondido well, and major canyons.

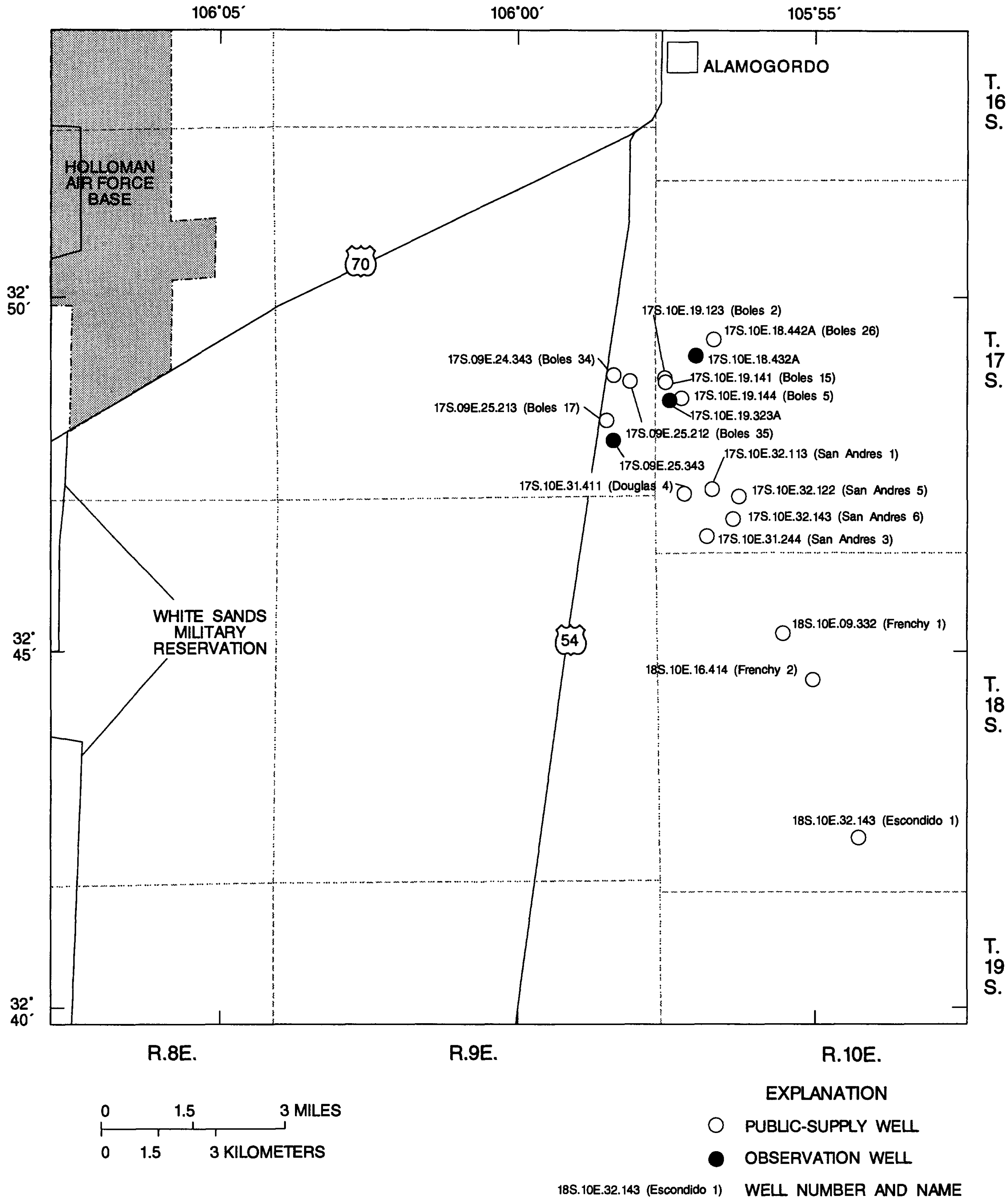


Figure 3.--Location of selected public-supply and observation wells near Holloman Air Force Base, New Mexico.

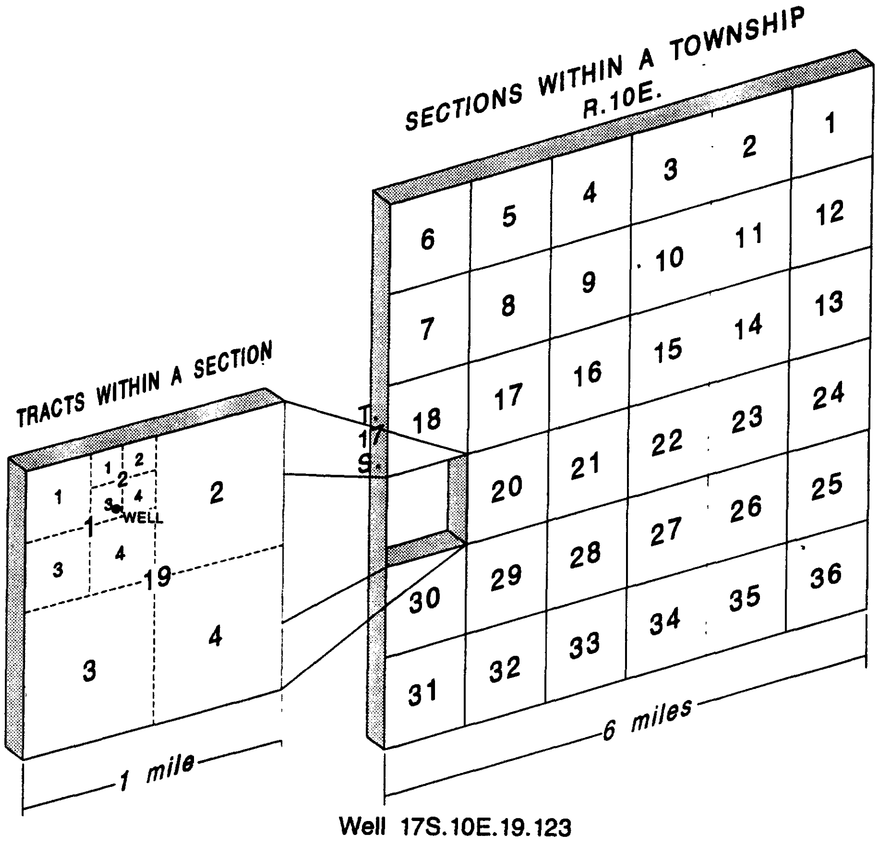


Figure 4.--System of numbering wells in New Mexico.

Well-Numbering System

Wells are located according to the system of common subdivision of sectionized land used throughout the State by the U.S. Geological Survey. The number of each well consists of four segments, separated by periods, that locate the well's position to the nearest 10-acre tract of land (fig. 4). The segments denote, respectively, the township south of the New Mexico base line, the range east of the New Mexico principal meridian, the section, and the particular 10-acre tract within the section.

The fourth segment of the number consists of three digits denoting, respectively, the quarter section or approximate 160-acre tract, the quadrant (approximately 40 acres in size) of the quarter section, and the quadrant (approximately 10 acres in size) of the 40-acre tract in which the well is located. For example, well 17S.10E.19.123 is located in the SW 1/4 of the NE 1/4 of the NW 1/4, section 19, Township 17 South, Range 10 East. If more than one well within the 10-acre tract has the same location number, the letter "A" is assigned to the second well, the letter "B" to the third well, and so on.

Previous Investigations

Ballance (1976) studied ground-water resources in the Holloman Air Force Base well-field area and discussed saline water that is present to the north and west of, as well as in a thin zone overlying, the area of freshwater in which the Boles, San Andres, and Douglas wells are located. Burns and Hart (1988) numerically simulated ground-water flow in a part of the southeastern Tularosa Basin, including the area of ground-water withdrawal by Holloman Air Force Base, and indicated water-level declines ranging from 26 to 60 feet from 1982 levels by the year 2001. Burns and Hart assumed ground-water withdrawal to be constant at 1981 rates. Estimated ground-water recharge from Mule, Arrow, Lead, San Andres, Dog, Deadman, and Escondido Canyons also was tabulated by Burns and Hart (1988).

Geohydrology of the Study Area

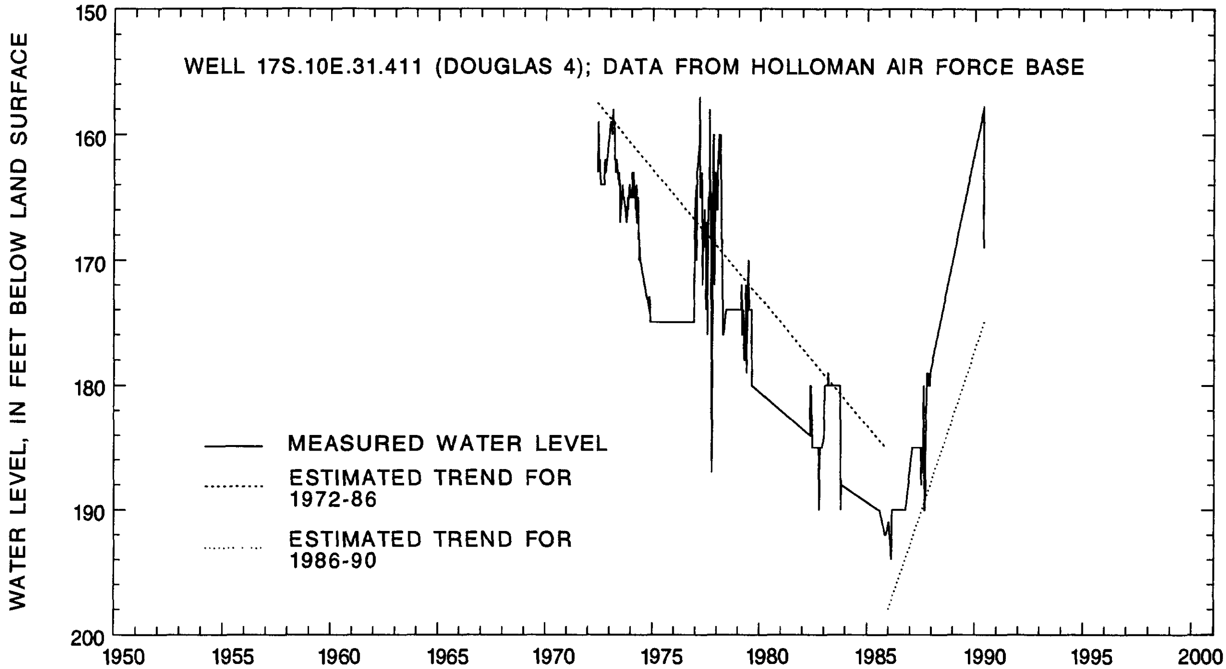
Unconsolidated sedimentary deposits of middle Tertiary to Holocene age, including alluvial-fan and basin-fill deposits, form the bolson aquifer in the central Tularosa Basin (fig. 1). The thickness of these unconsolidated sedimentary deposits ranges from 0 to 3,000 feet (Burns and Hart, 1988). Ground-water flow in the Tularosa Basin is generally to the south or southwest with the exception of westward to southwestward flow near the mouths of canyons cutting into the Sacramento Mountains. The Sacramento Mountains form the eastern boundary of the Tularosa Basin in the area of Holloman Air Force Base (fig. 1), and infiltration of runoff from the Sacramento Mountains is the primary source of recharge to the bolson aquifer. As a result, an area of freshwater in the bolson aquifer extends for 8 to 12 miles westward into the basin from the foot of the Sacramento Mountains, reaching depths as much as 1,200 feet below land surface (McLean, 1970). It is from this area of freshwater that Holloman Air Force Base withdraws water for domestic supply and other uses. More detailed information on the geology and hydrology of the central Tularosa Basin is presented in Hood (1958), McLean (1970), and Garza and McLean (1977).

ANALYSIS OF GROUND-WATER-LEVEL DATA

The results of statistical analyses of water-level data for selected Douglas, San Andres, Boles, Escondido, and Frenchy public-supply wells and observation wells near the Boles wells are listed in table 1 (all tables are in the back of the report). Water-level data were examined for temporal trends using techniques described by Hirsch and others (1982) and Hirsch and Slack (1984). A p-value shown in table 1 less than 0.1 indicates a statistically significant temporal trend in water-level data at the 90-percent confidence level. The magnitude of temporal trends was estimated for water-level data where p-values were less than this 0.1 value. A positive estimated trend indicates increasing water levels, and a negative estimated trend indicates decreasing water levels. Kendall's tau value is a measure of how well the estimated trend represents the measured data near the mid-point of the data set. Increasing agreement between the estimated trend and the measured data is indicated as the value of Kendall's tau approaches 1.0 for a positive trend and -1.0 for a negative trend.

Statistical analyses were performed on raw and log transformed data sets. In one data set (well 17S.09E.25.213, Boles 17), the p-values calculated on raw and log transformed data sets differed. However, both p-values were greater than 0.1, indicating the absence of a temporal trend at the 90-percent confidence level. For all other analyzed data sets, the p-values and Kendall's tau values calculated on raw and log transformed data sets were equal.

Statistically significant estimated temporal trends in water levels for selected wells are listed in table 1. Well 17S.10E.31.411 (Douglas 4) shows a statistically significant decreasing trend in water levels for 1972-86 and a statistically significant increasing trend for 1986-90 (fig. 5). Water levels in wells 17S.10E.32.122 (San Andres 5) and 17S.10E.32.143 (San Andres 6) (fig. 6) show statistically significant decreasing trends in water levels for 1972-93 and 1981-89, respectively. The calculated rate of water-level change in San Andres 5 is small (0.5 foot per year) and may be caused by scatter in water-level data rather than an actual long-term decrease in water levels. Wells 17S.10E.19.123 (Boles 2) and 17S.10E.19.144 (Boles 5) show statistically significant increasing trends in water levels for 1972-93 and 1981-90, respectively (fig. 7). The calculated rate of water-level change in well Boles 2 also is relatively small (0.7 foot per year) and may be caused by scatter in water-level data rather then a long-term increase in water levels. Water levels in well Boles 5 show no statistically significant changes for 1990-93. For 1961-85, well 17S.09E.24.343 (Boles 34) shows a relatively small (0.4 foot per year) statistically significant decreasing trend in water levels (fig. 8). The relatively low scatter in water-level data for well Boles 34 suggests that this decreasing trend, although relatively small, may be real. Decreasing trends in water levels in well 17S.10E.18.432A are shown for 1960-70 and 1970-86 (fig. 9). The rate of decrease for 1970-86 is relatively small (0.2 foot per year) but may be real based on the low scatter in water-level data for that period. For 1960-73, well 17S.10E.19.323A shows a statistically significant decreasing trend in water levels (fig. 9). Water levels in wells 17S.09E.25.343 and 18S.10E.32.143 (Escondido 1) (fig. 10) show no statistically significant changes for 1988-93 and 1987-93, respectively. Well 18S.10E.09.332 (Frenchy 1) shows a statistically significant decreasing trend in water levels for 1986-93 (fig. 11). Although not a statistically demonstrable trend, visual inspection of water levels in well 18S.10E.16.414 (Frenchy 2) shows a decline between 1990 and 1993 (fig. 11).



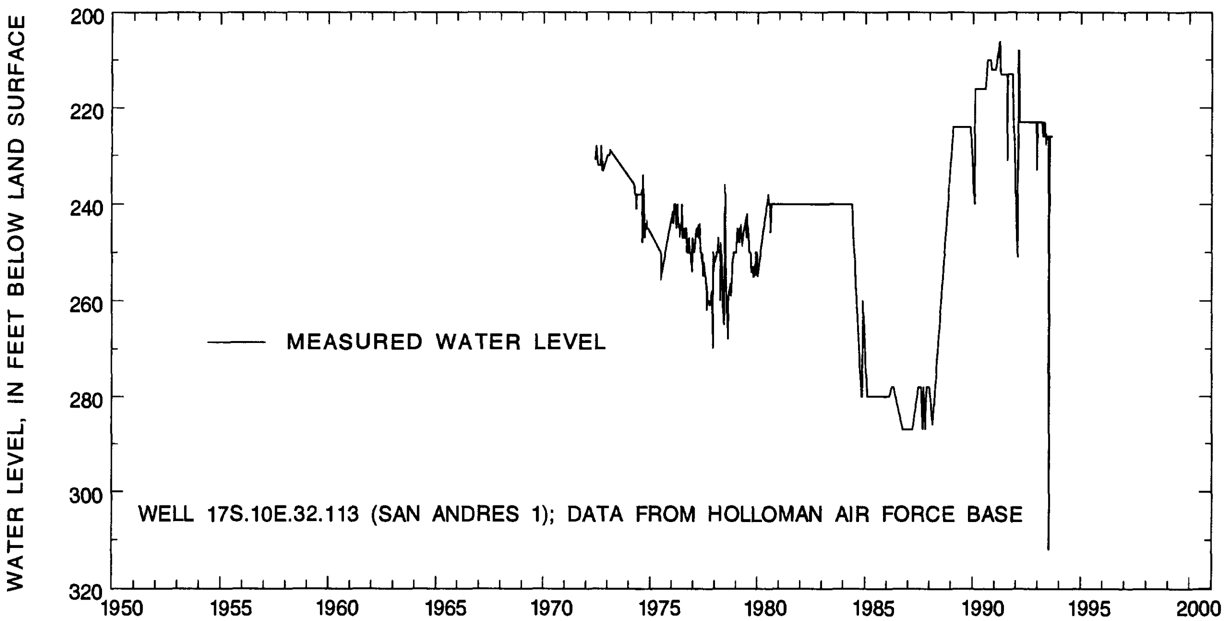
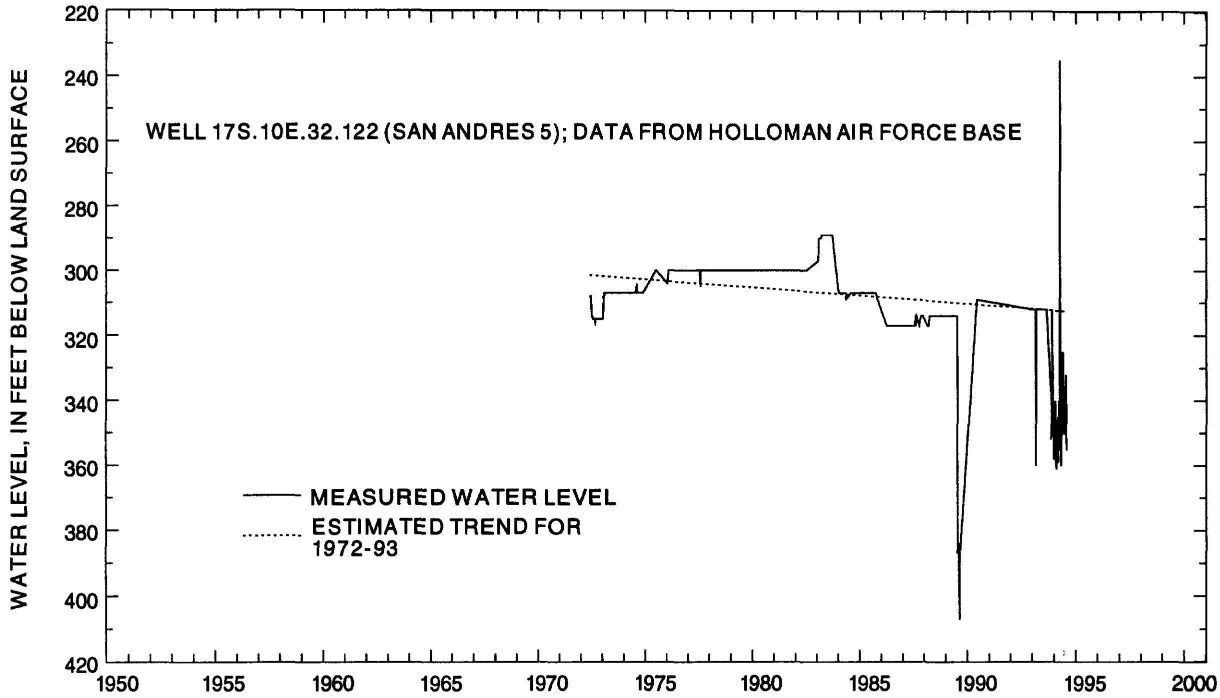


Figure 5.--Measured water levels and estimated temporal trends in water levels (if present) for well 17S.10E.31.411 (Douglas 4) for 1972-90 and for well 17S.10E.32.113 (San Andres 1) for 1972-93.



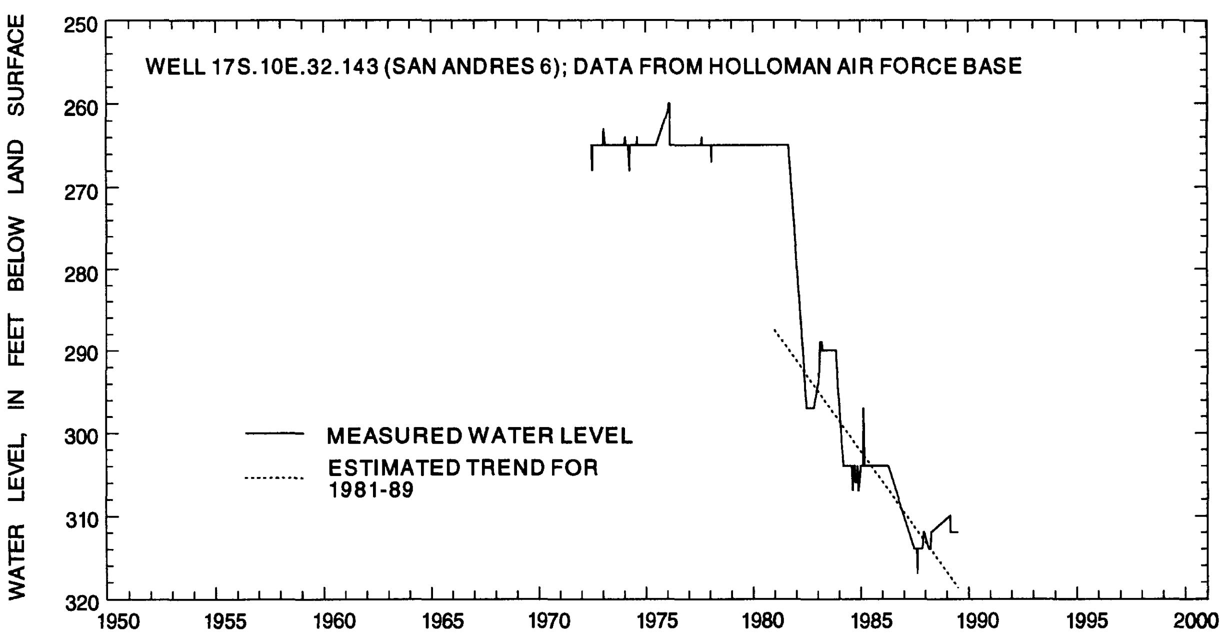
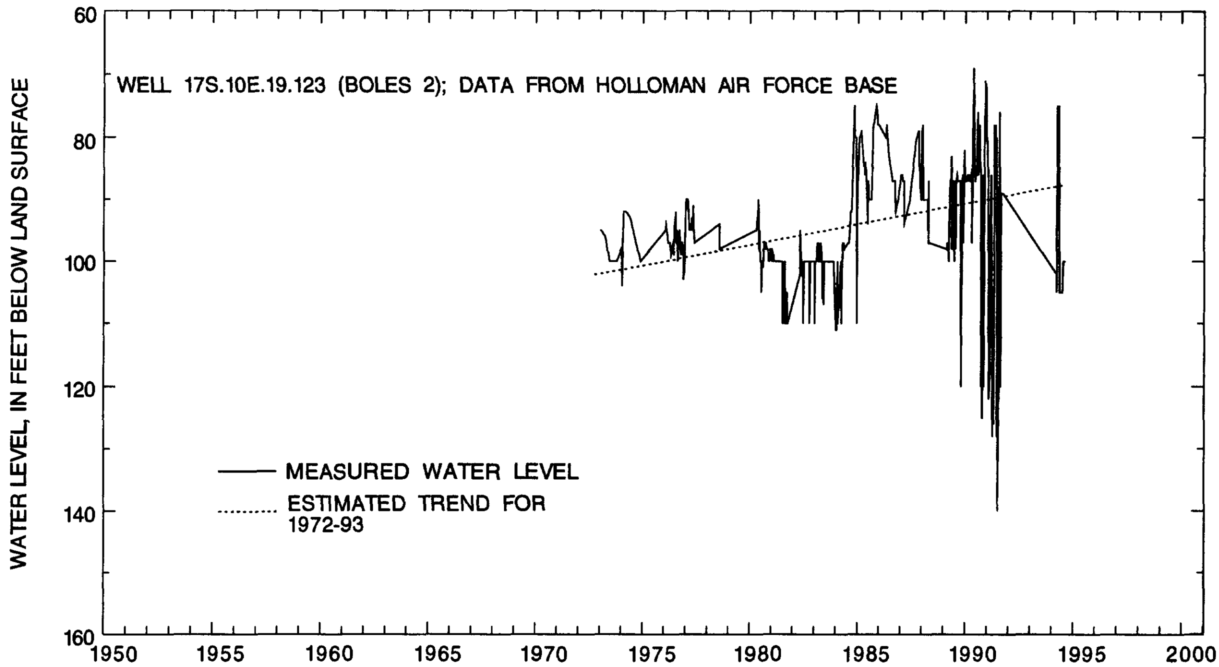


Figure 6.--Measured water levels and estimated temporal trends in water levels (if present) for well 17S.10E.32.122 (San Andres 5) for 1972-94 and for well 17S.10E.32.143 (San Andres 6) for 1972-89.



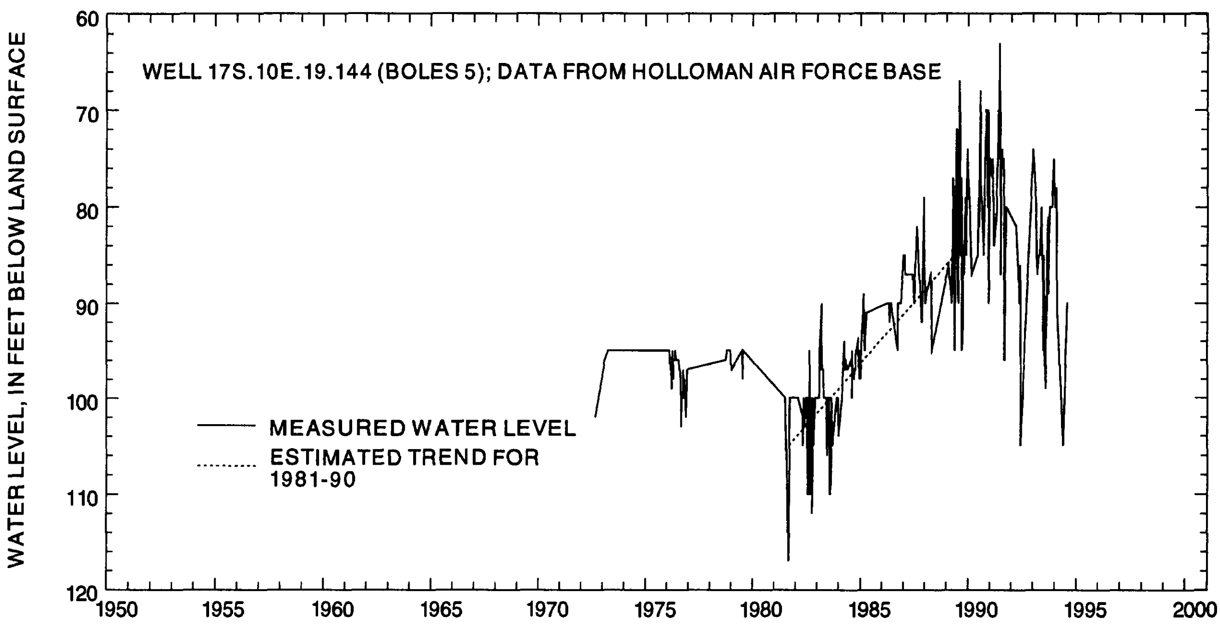
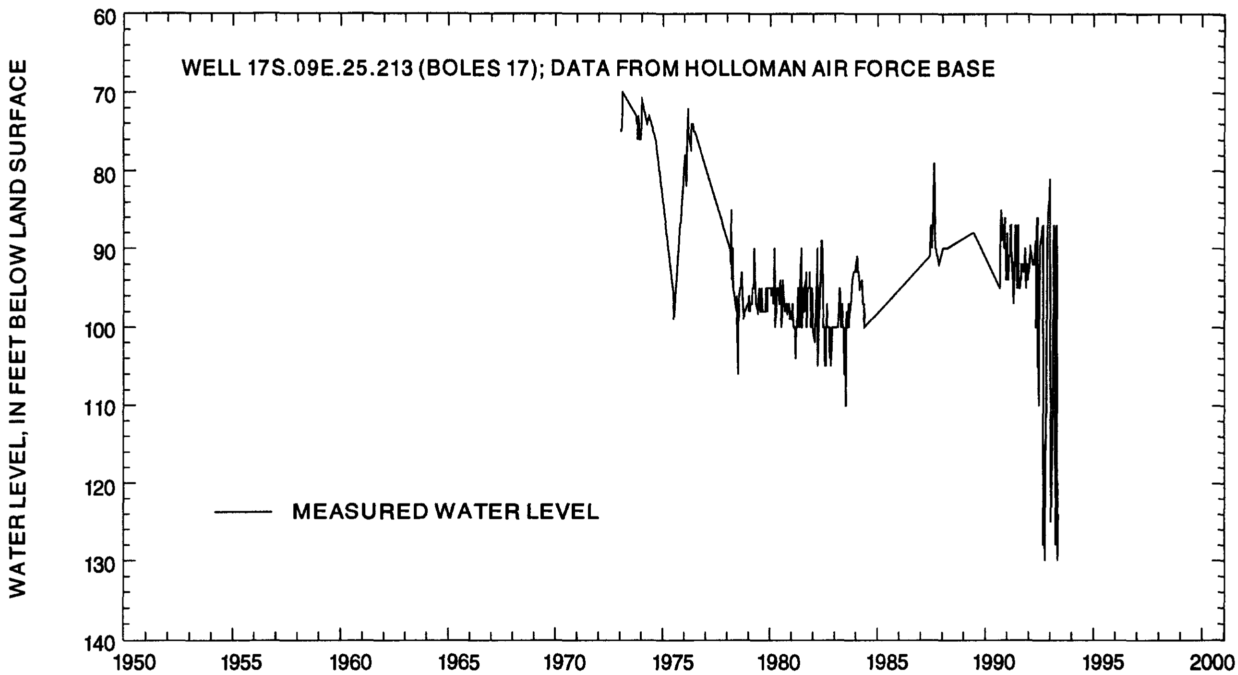


Figure 7.--Measured water levels and estimated temporal trends in water levels (if present) for well 17S.10E.19.123 (Boles 2) for 1972-94 and for well 17S.10E.19.144 (Boles 5) for 1972-94.



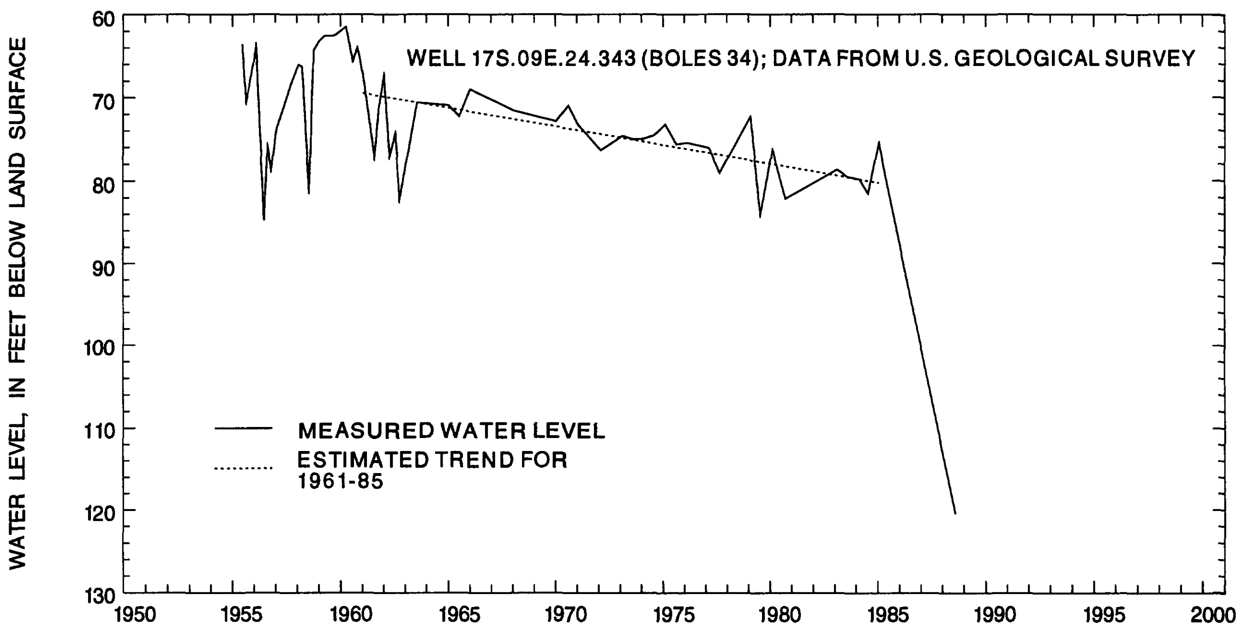
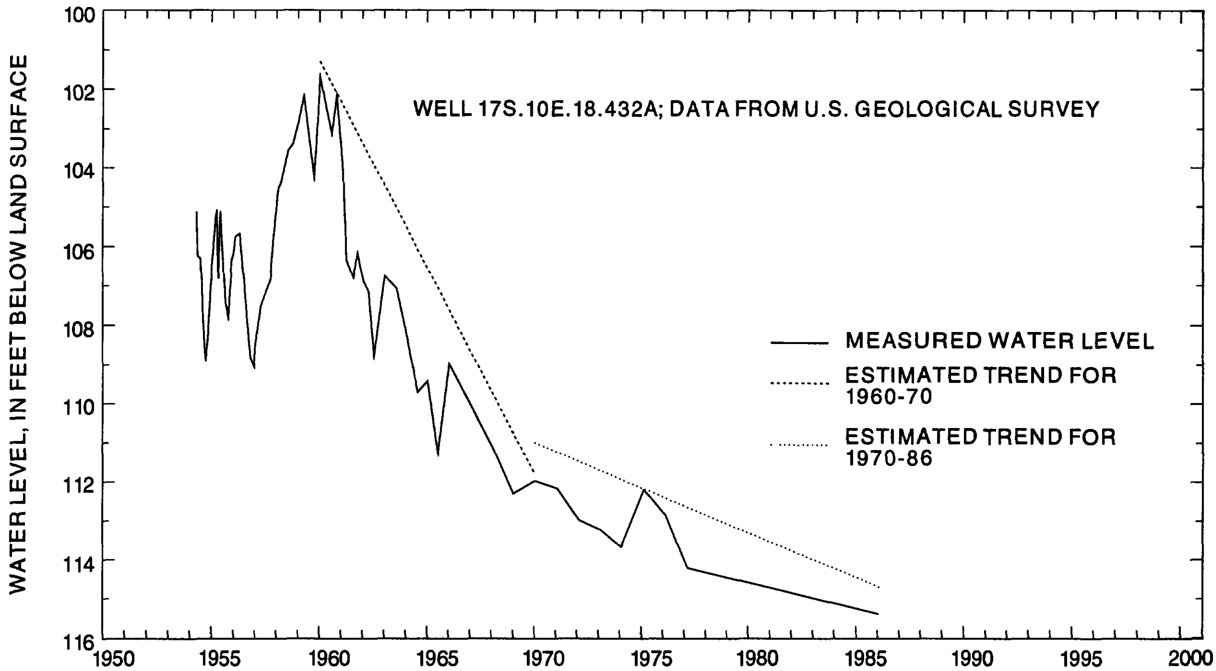


Figure 8.--Measured water levels and estimated temporal trends in water levels (if present) for well 17S.09E.25.213 (Boles 17) for 1972-93 and for well 17S.09E.24.343 (Boles 34) for 1955-88.



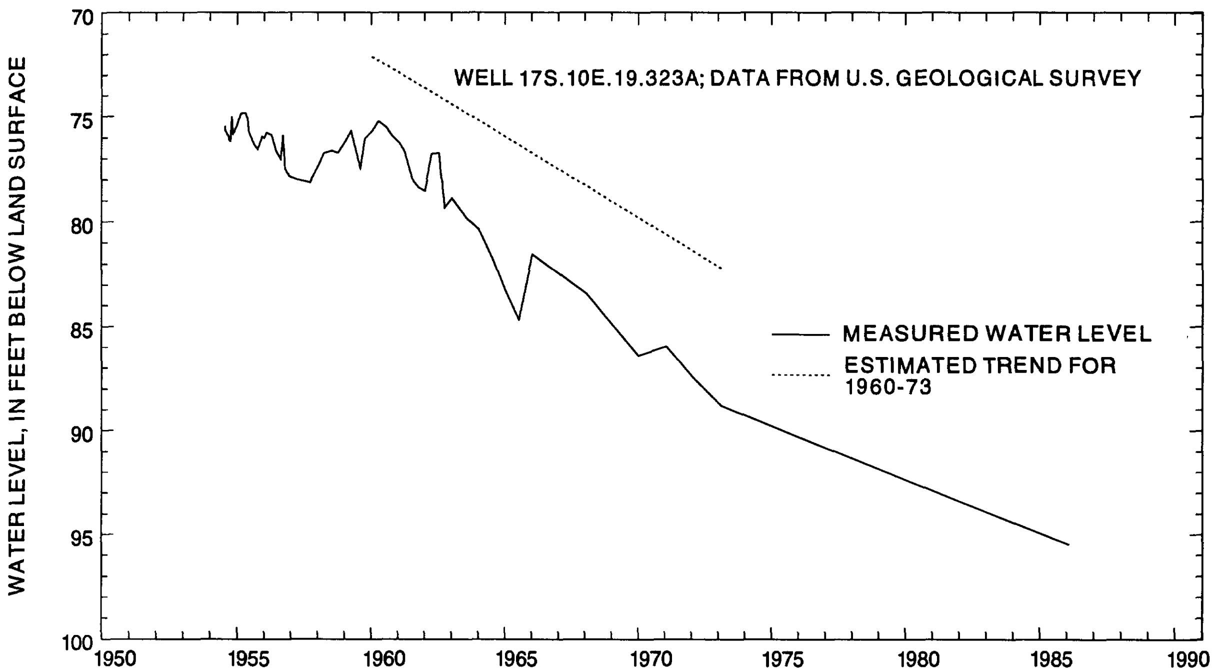
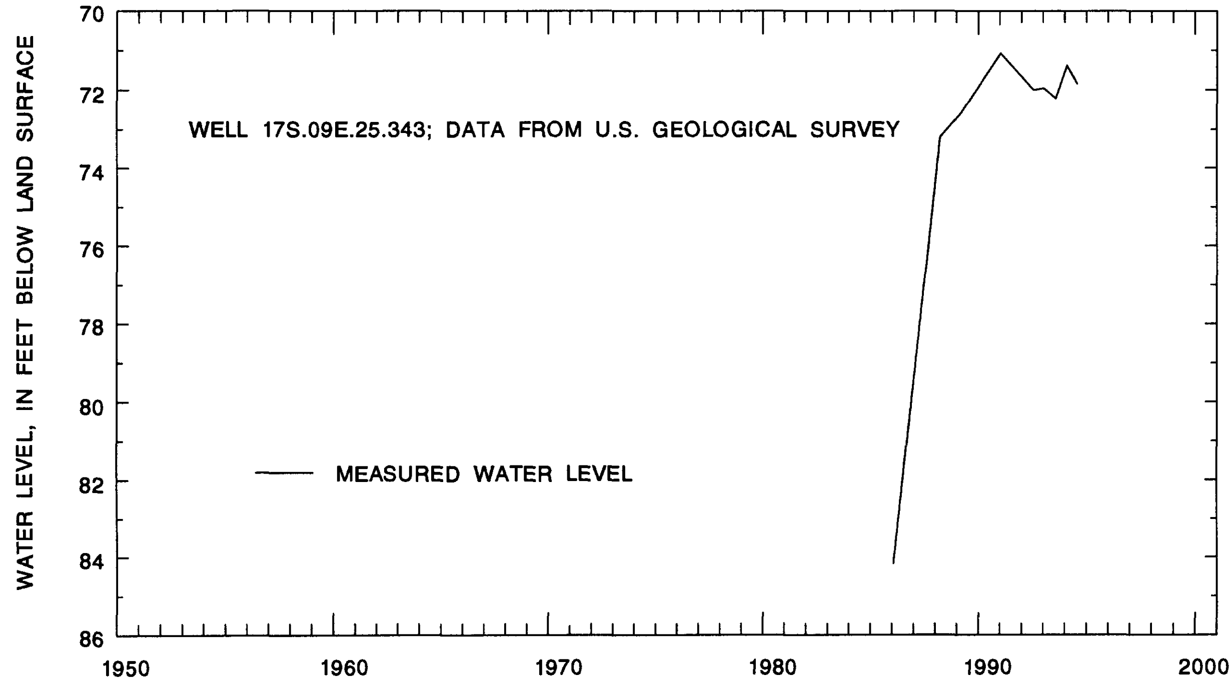


Figure 9.--Measured water levels and estimated temporal trends in water levels (if present) for well 17S.10E.18.432A for 1954-86 and for well 17S.10E.19.323A for 1954-86.



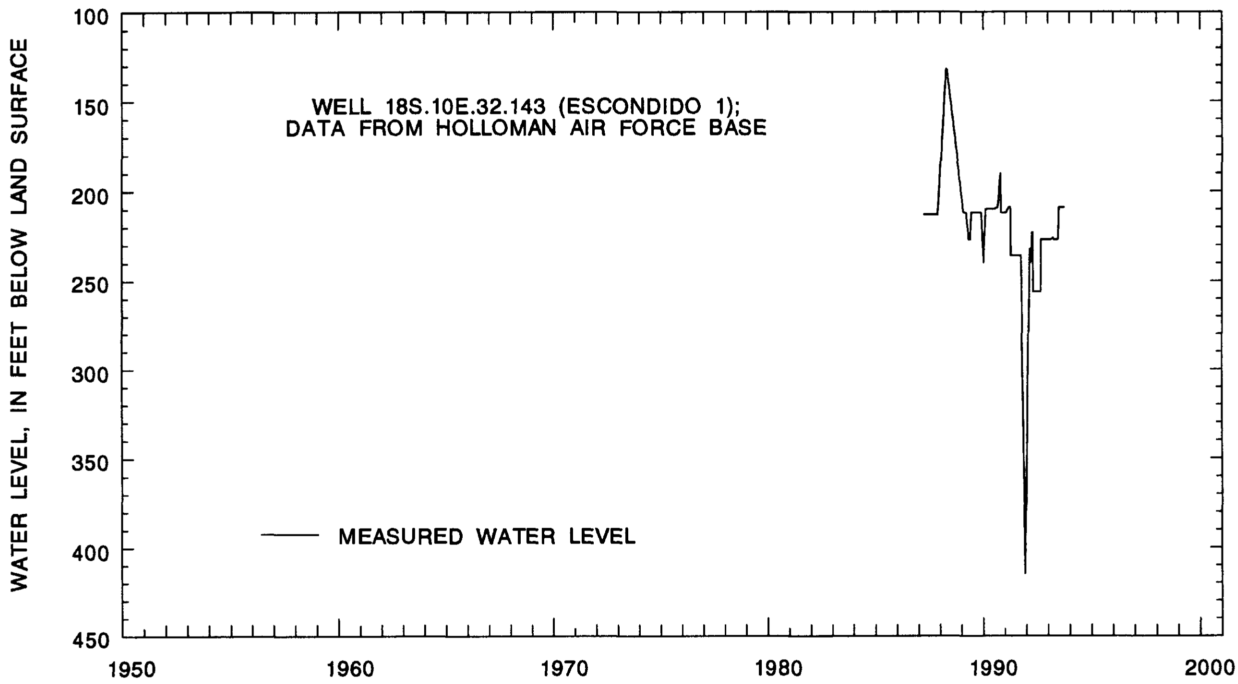
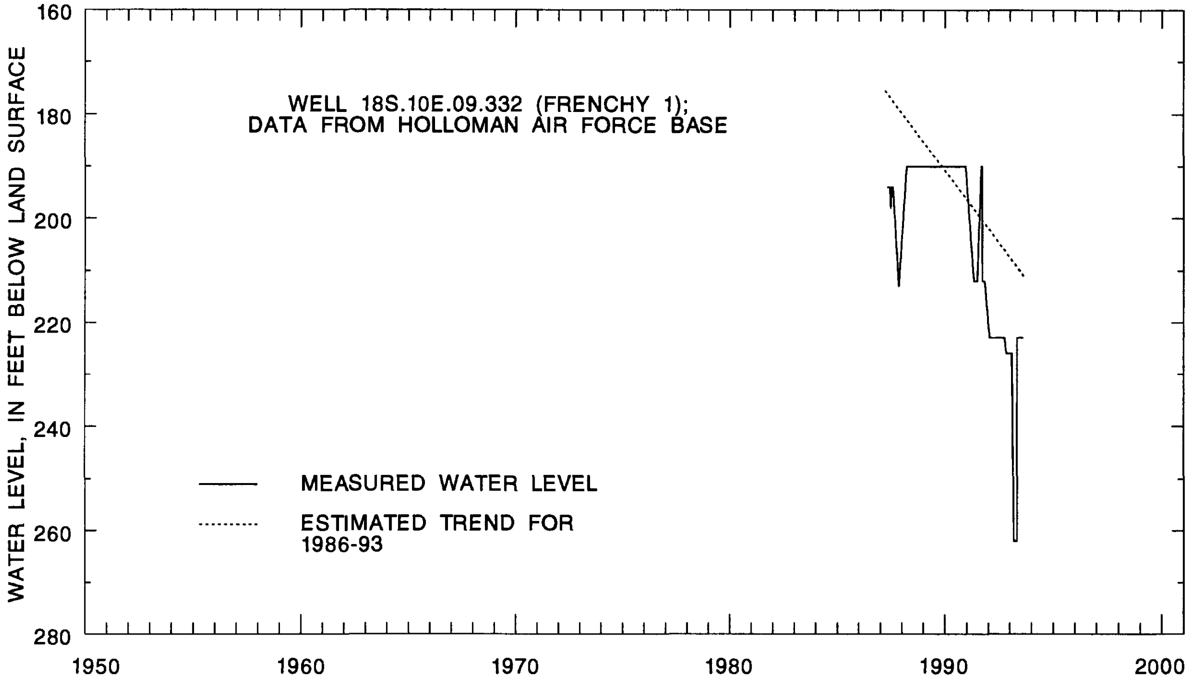


Figure 10.--Measured water levels and estimated temporal trends in water levels (if present) for well 17S.09E.25.343 for 1986-94 and for well 18S.10E.32.143 (Escondido 1) for 1987-94.



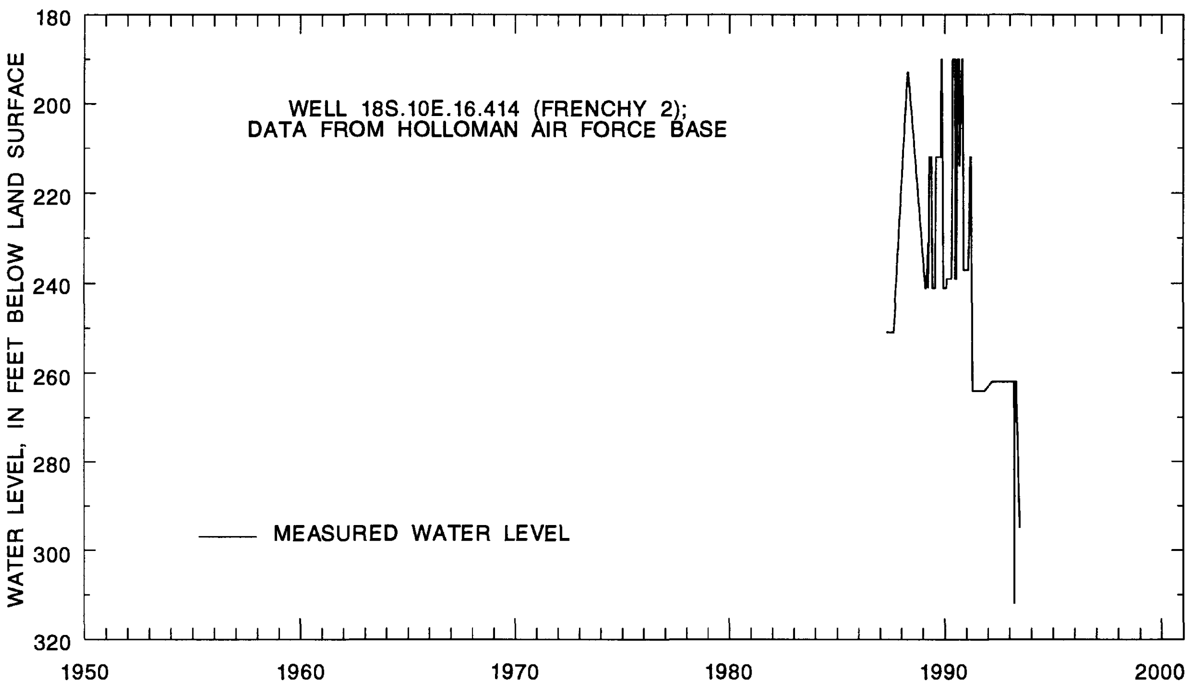


Figure 11.--Measured water levels and estimated temporal trends in water levels (if present) for well 18S.10E.09.332 (Frenchy 1) for 1987-94 and for well 18S.10E.16.414 (Frenchy 2) for 1987-94.

ANALYSIS OF GROUND-WATER-WITHDRAWAL DATA

Because ground-water withdrawals are combined for groups of wells, changes in water levels in any particular well may be difficult to relate to ground-water withdrawal. Rather, the ground-water withdrawals as presented may correlate to the overall rates of water-level change in an area surrounding a particular group of wells. Ground-water withdrawal from the various wells are compared to estimated ground-water recharge from associated canyons (fig. 2) as tabulated by Burns and Hart (1988).

Ground-water withdrawal from the San Andres and Douglas wells regularly exceeded estimated ground-water recharge from San Andres Canyon for 1963-87 (fig. 12). For 1951-57 and 1960-86, ground-water withdrawal from the Boles wells regularly exceeded estimated total ground-water recharge from Mule, Arrow, and Lead Canyons (fig. 13). Ground-water withdrawal from the San Andres and Douglas wells and the Boles wells nearly equaled estimated ground-water recharge for 1989-93 and 1986-93, respectively. For 1987-93, ground-water withdrawal from the Escondido well regularly exceeded estimated ground-water recharge from Escondido Canyon (fig. 14), and ground-water withdrawal from the Frenchy wells regularly exceeded total estimated ground-water recharge from Dog and Deadman Canyons (fig. 15).

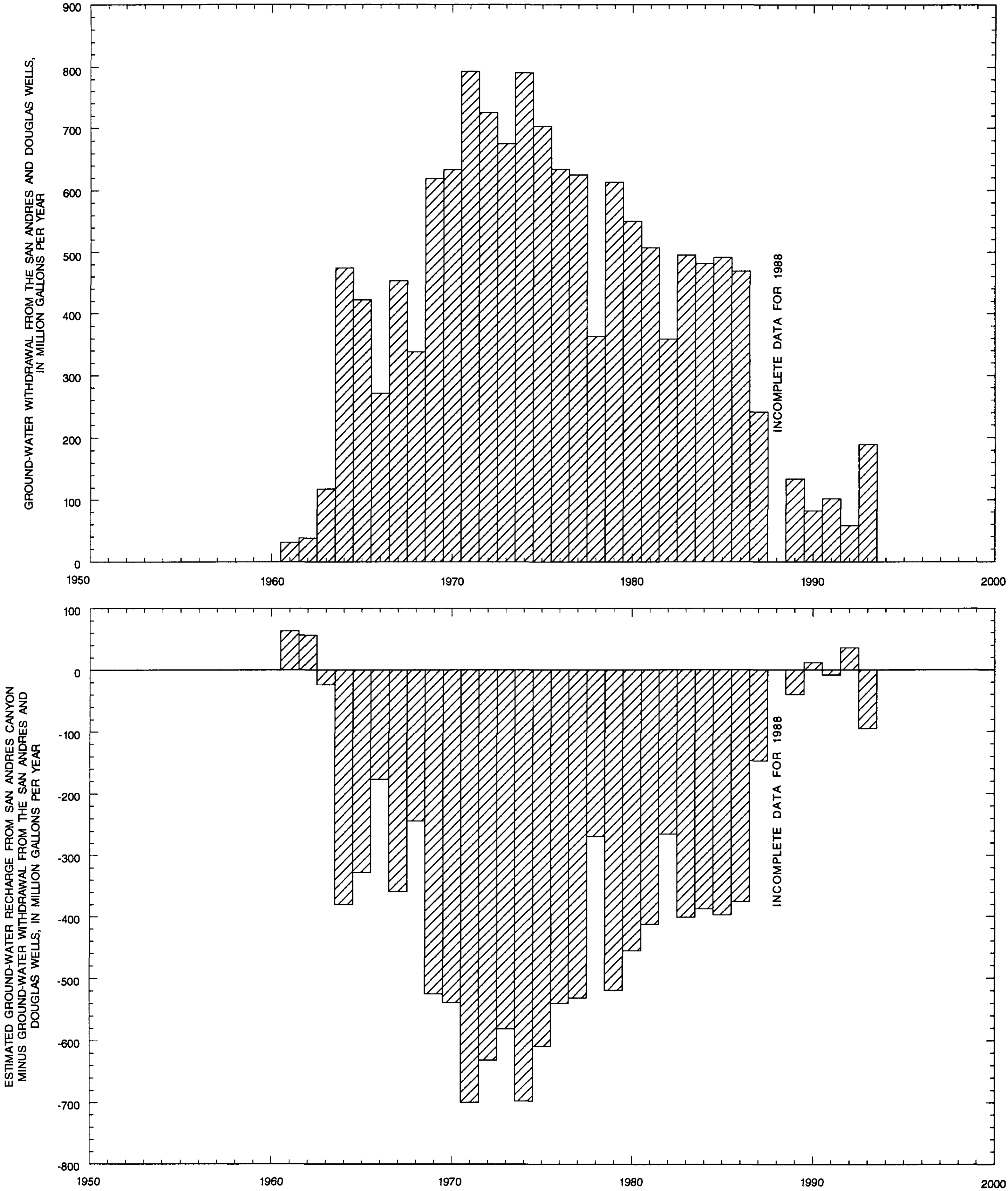


Figure 12.-Ground-water withdrawal from the San Andres and Douglas wells and estimated ground-water recharge from San Andres Canyon minus ground-water withdrawal from the San Andres and Douglas wells for 1961-93. (Ground-water withdrawal for 1961-81 and estimated ground-water recharge from Burns and Hart (1988). Ground-water withdrawal for 1982-93 compiled from records supplied by Holloman Air Force Base, New Mexico.)

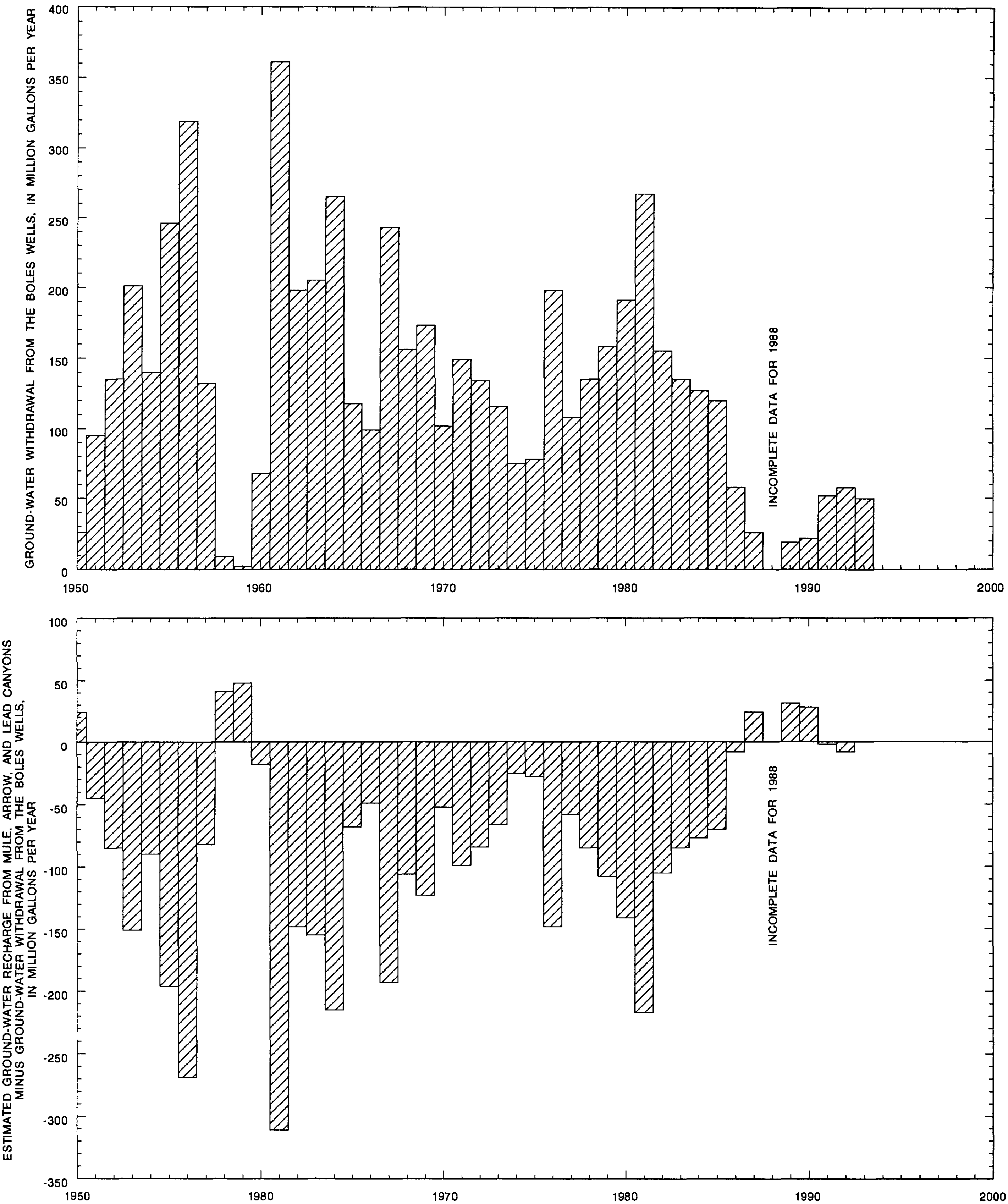


Figure 13.-Ground-water withdrawal from the Boles wells and estimated ground-water recharge from Mule, Arrow, and Lead Canyons minus ground-water withdrawal from the Boles wells for 1950-93. (Ground-water withdrawal for 1950-81 and estimated ground-water recharge from Bums and Hart (1988). Ground-water withdrawal for 1982-93 compiled from records supplied by Holloman Air Force Base, New Mexico.)

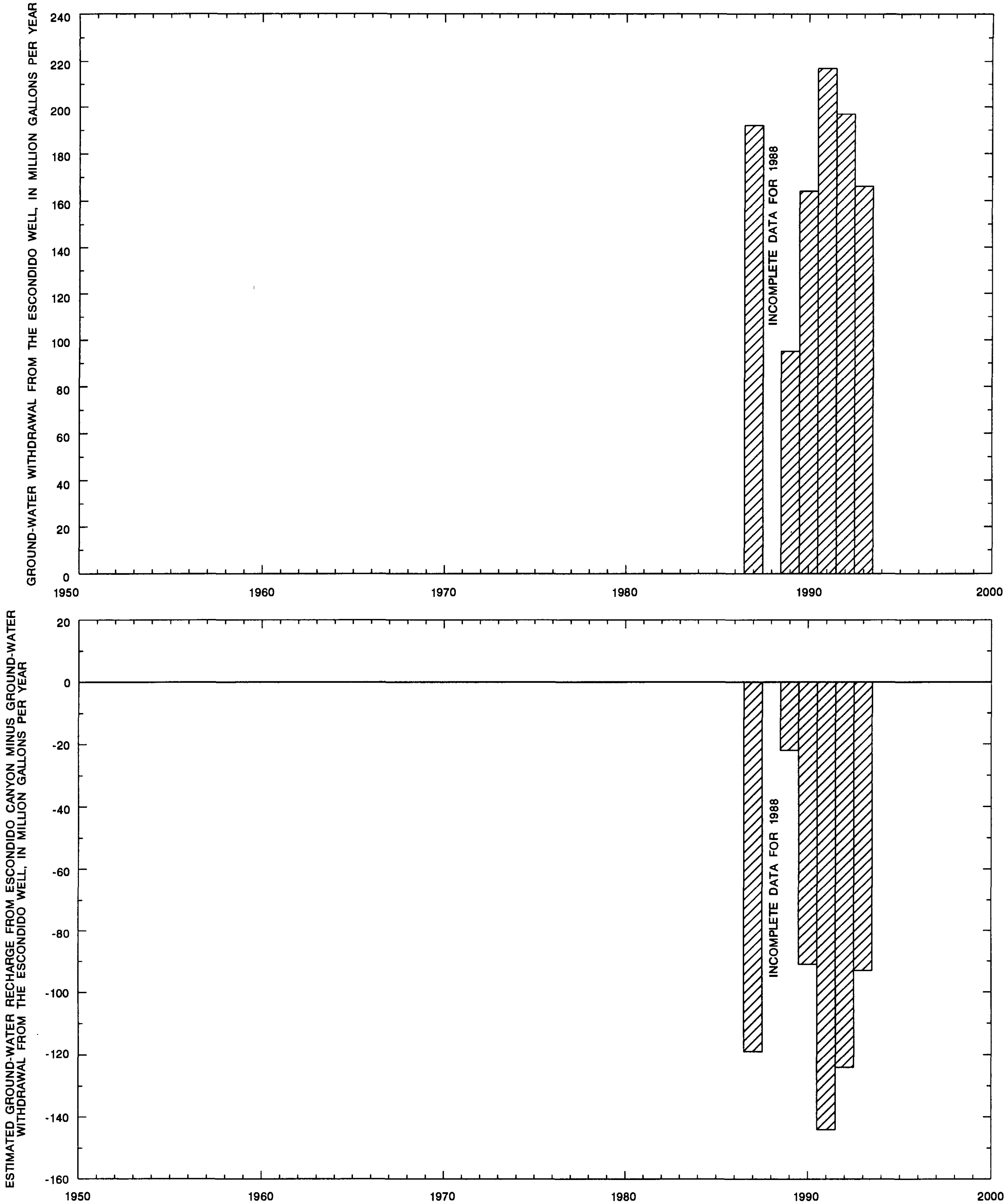


Figure 14.-Ground-water withdrawal from the Escondido well and estimated ground-water recharge from Escondido Canyon minus ground-water withdrawal from the Escondido well for 1987-93. (Estimated ground-water recharge from Burns and Hart (1988). Ground-water withdrawal for 1987-93 compiled from records supplied by Holloman Air Force Base, New Mexico.)

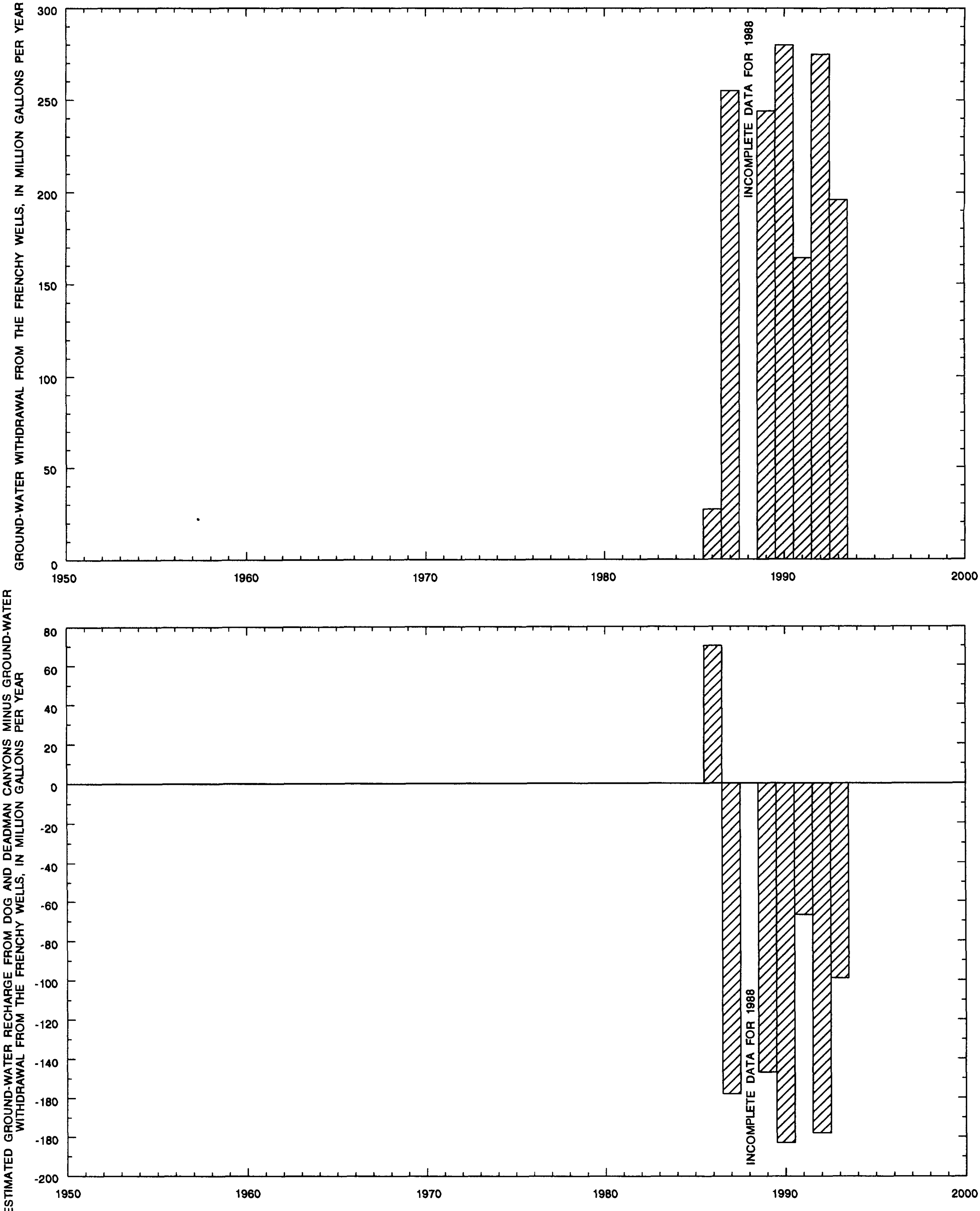


Figure 15.--Ground-water withdrawal from the Frenchy wells and estimated ground-water recharge from Dog and Deadman Canyons minus ground-water withdrawal from the Frenchy wells for 1986-93. (Estimated ground-water recharge from Bums and Hart (1988). Ground-water withdrawal for 1986-93 compiled from records supplied by Holloman Air Force Base, New Mexico.)

ANALYSIS OF GROUND-WATER-QUALITY DATA

Water-quality samples were collected by the U.S. Geological Survey from selected Douglas, San Andres, Boles, Frenchy, and Escondido public-supply wells from December 1994 to February 1995. Results of analyses on water-quality samples are listed in table 2. Concentrations of dissolved nitrate, dissolved chloride, dissolved sulfate, and dissolved solids in water-quality samples collected by the U.S. Geological Survey and data provided by Holloman Air Force Base were compared with historical water-quality data to evaluate the presence of temporal trends. No historical water-quality data were available for the Frenchy and Escondido wells. Concentrations of dissolved nitrate, dissolved chloride, dissolved sulfate, and dissolved solids as a function of time for selected Douglas, San Andres, and Boles public-supply wells are shown in figures 16-24.

Historical water-quality data are available for 1955-70; current data are for 1990-95. The 20-year (or greater) gap between historical and current water-quality data and the limited amount of current water-quality data would result in a tenuous statistical trend analysis. Therefore, water-quality data were examined by quantifying current concentrations as greater than, less than, or within the range of concentrations in historical data. The results of comparisons between historical and current water-quality data are summarized in table 3. Where concentrations of dissolved nitrite in current water-quality data (table 2) were less than 0.01 mg/L (milligram per liter), concentrations of dissolved nitrite plus nitrate (table 2) were considered equivalent to concentrations of dissolved nitrate for comparison with historical nitrate data. Concentrations of dissolved nitrite in current water-quality data greater than or equal to 0.01 mg/L were subtracted from concentrations of dissolved nitrite plus nitrate to calculate concentrations of dissolved nitrate. Calculated concentrations of dissolved nitrate were then used for comparison with historical nitrate data. Concentrations of dissolved nitrate have the most consistent increases of the constituents listed in table 3. Current concentrations of dissolved nitrate are greater than historical concentrations in 7 of 10 wells. In all wells considered in this study, current concentrations of dissolved nitrate are less than the maximum contaminant level of 10 mg/L for drinking water established by the U.S. Environmental Protection Agency (1994).

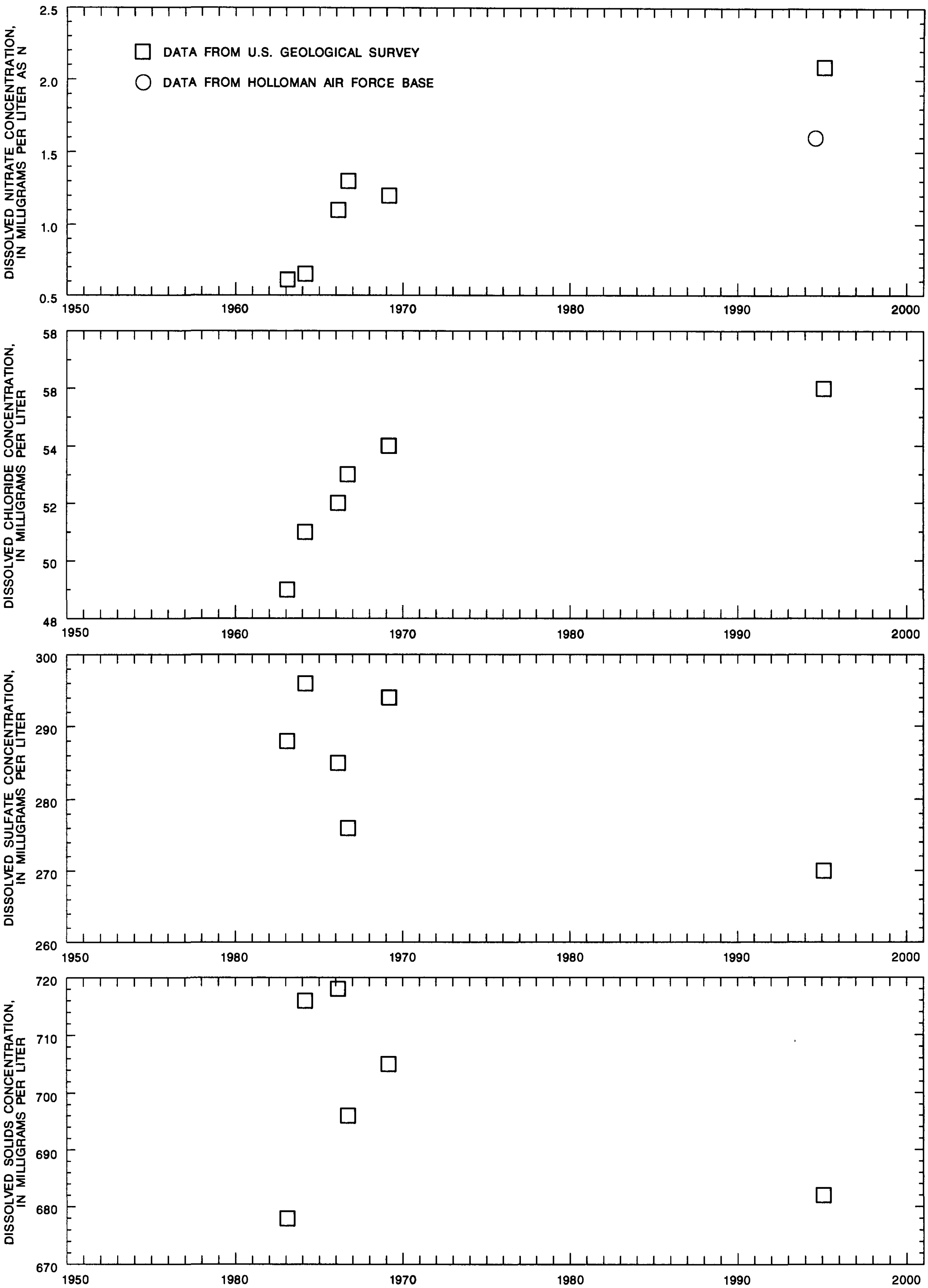


Figure 16.--Concentrations of dissolved nitrate, dissolved chloride, dissolved sulfate, and dissolved solids as a function of time for well 17S.10E.31.411 (Douglas 4) for 1963-95.

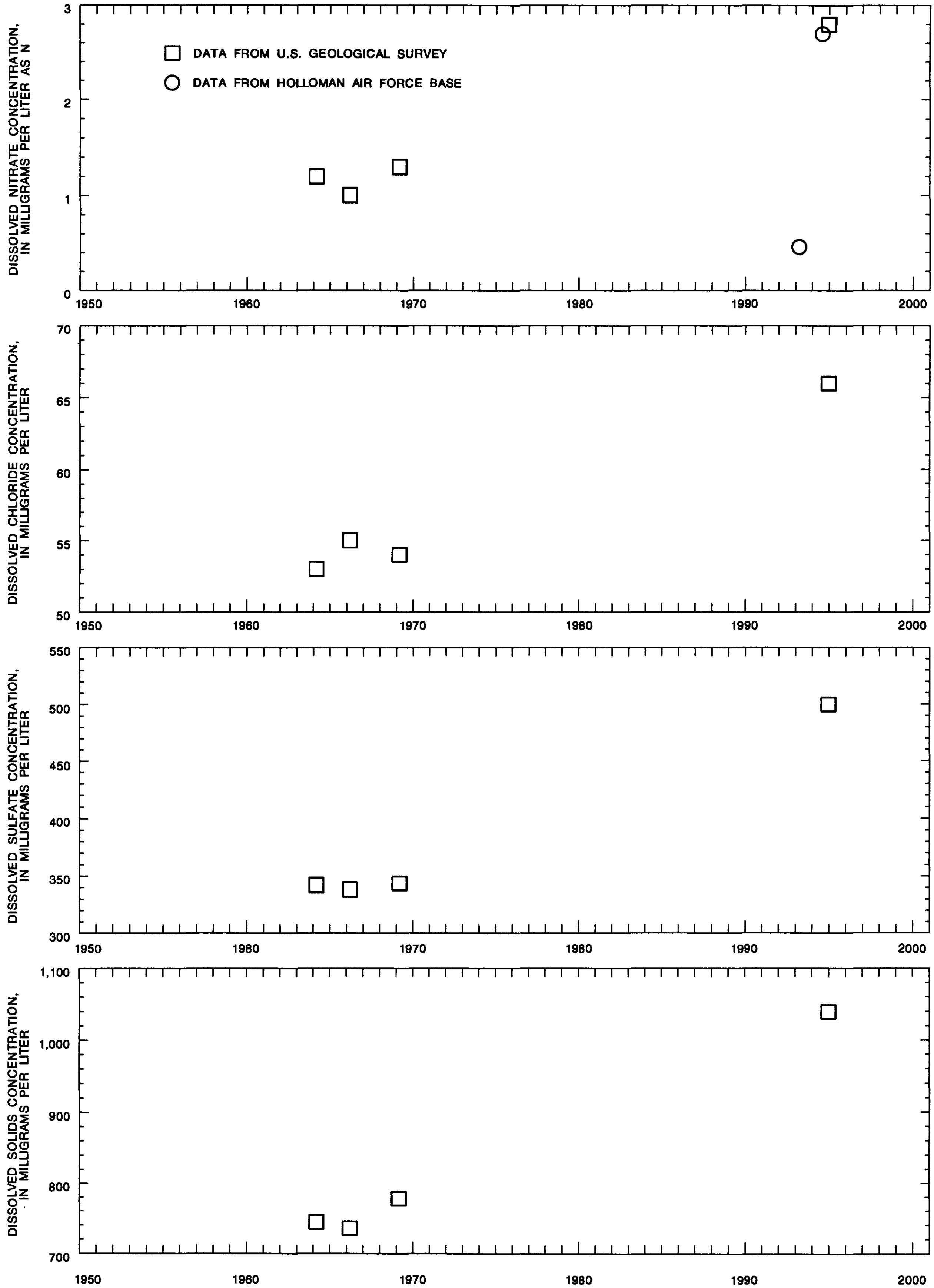


Figure 17.--Concentrations of dissolved nitrate, dissolved chloride, dissolved sulfate, and dissolved solids as a function of time for well 17S.10E.32.113 (San Andres 1) for 1964-94.

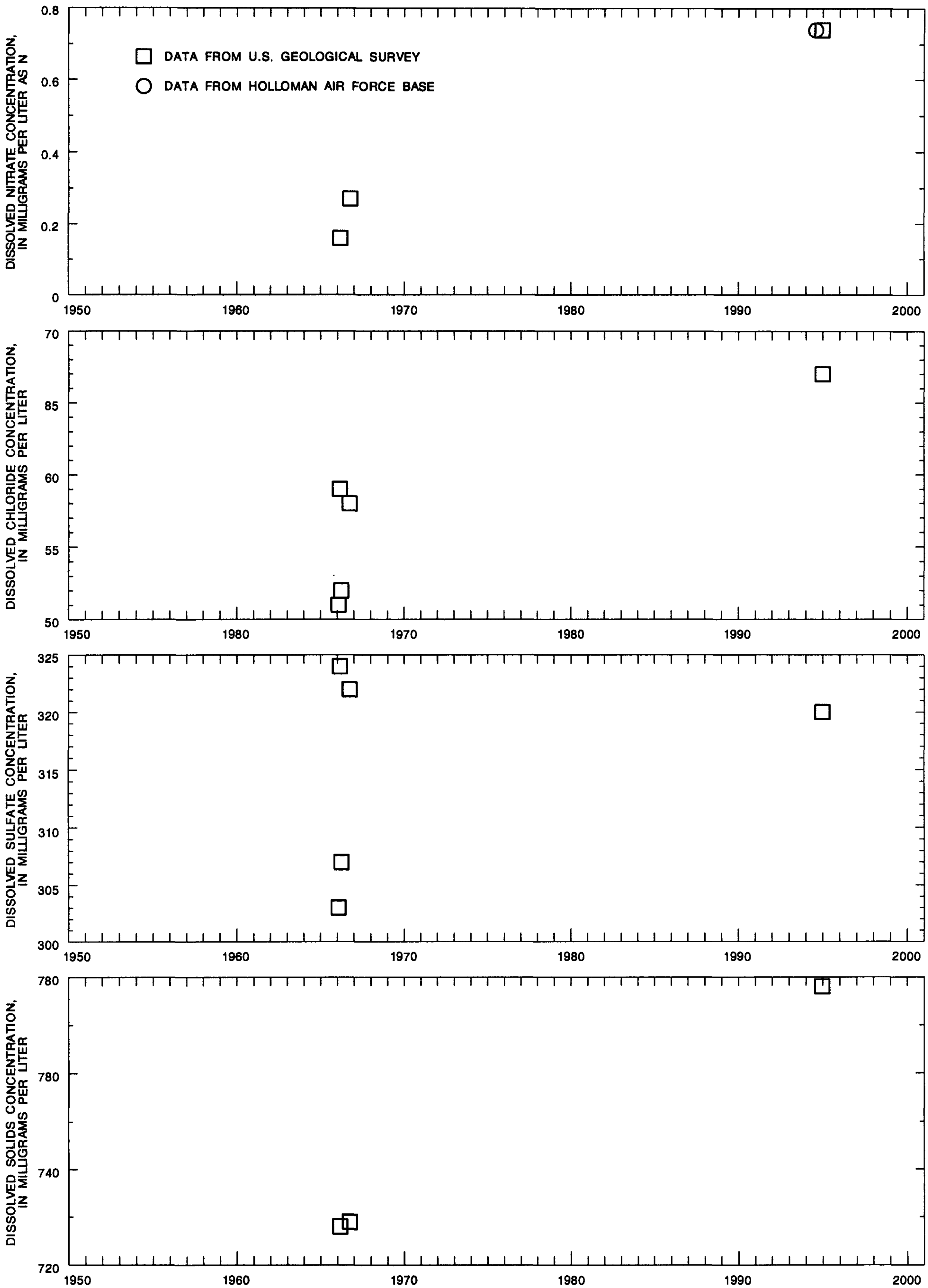


Figure 18.--Concentrations of dissolved nitrate, dissolved chloride, dissolved sulfate, and dissolved solids as a function of time for well 17S.10E.31.244 (San Andres 3) for 1966-94.

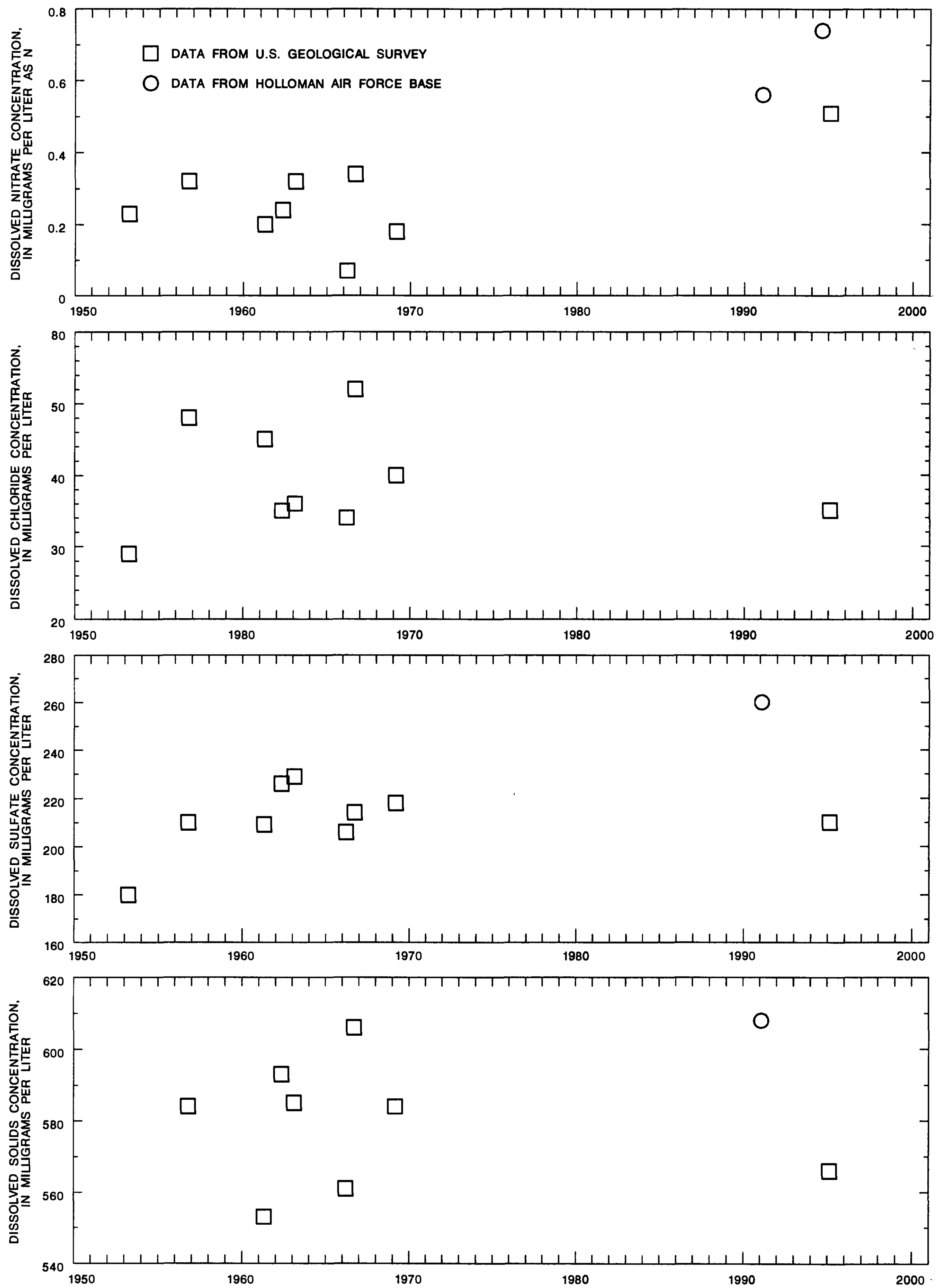


Figure 19.--Concentrations of dissolved nitrate, dissolved chloride, dissolved sulfate, and dissolved solids as a function of time for well 17S.10E.19.123 (Boles 2) for 1953-95.

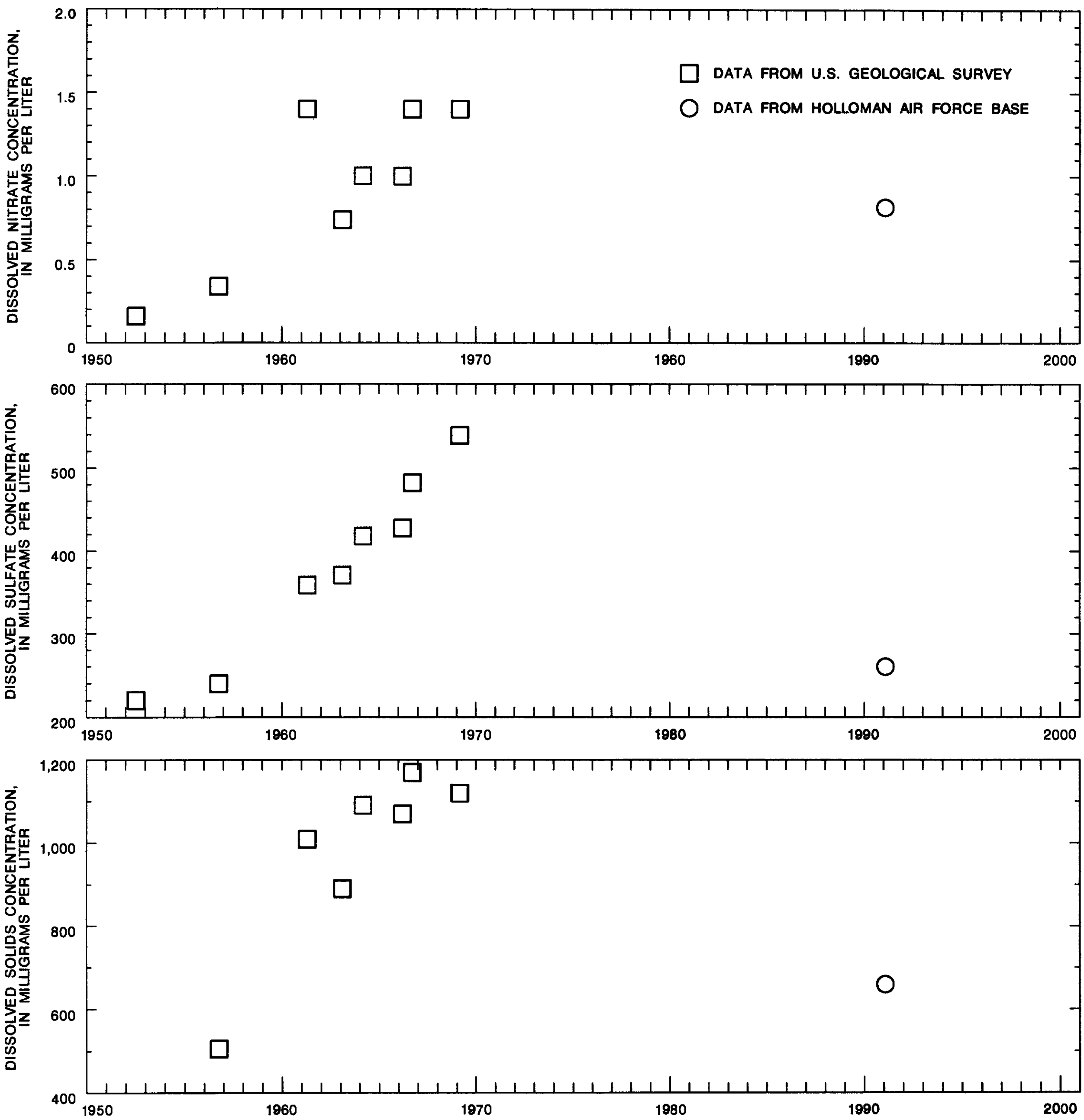


Figure 20.--Concentrations of dissolved nitrate, dissolved sulfate, and dissolved solids as a function of time for well 17S.10E.19.144 (Boles 5) for 1952-90.

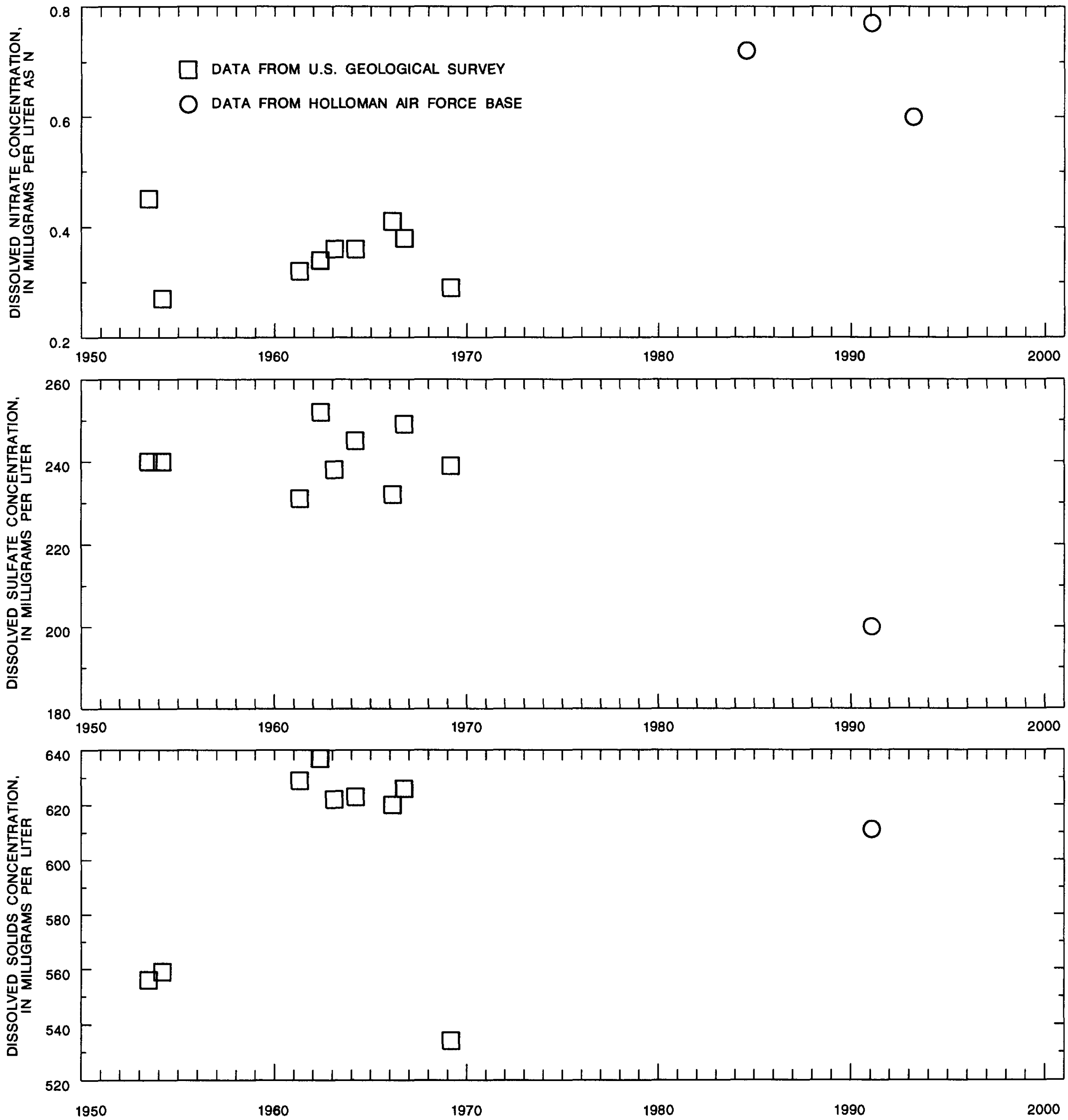


Figure 21.--Concentrations of dissolved nitrate, dissolved sulfate, and dissolved solids as a function of time for well 17S.09E.25.213 (Boles 17) for 1953-93.

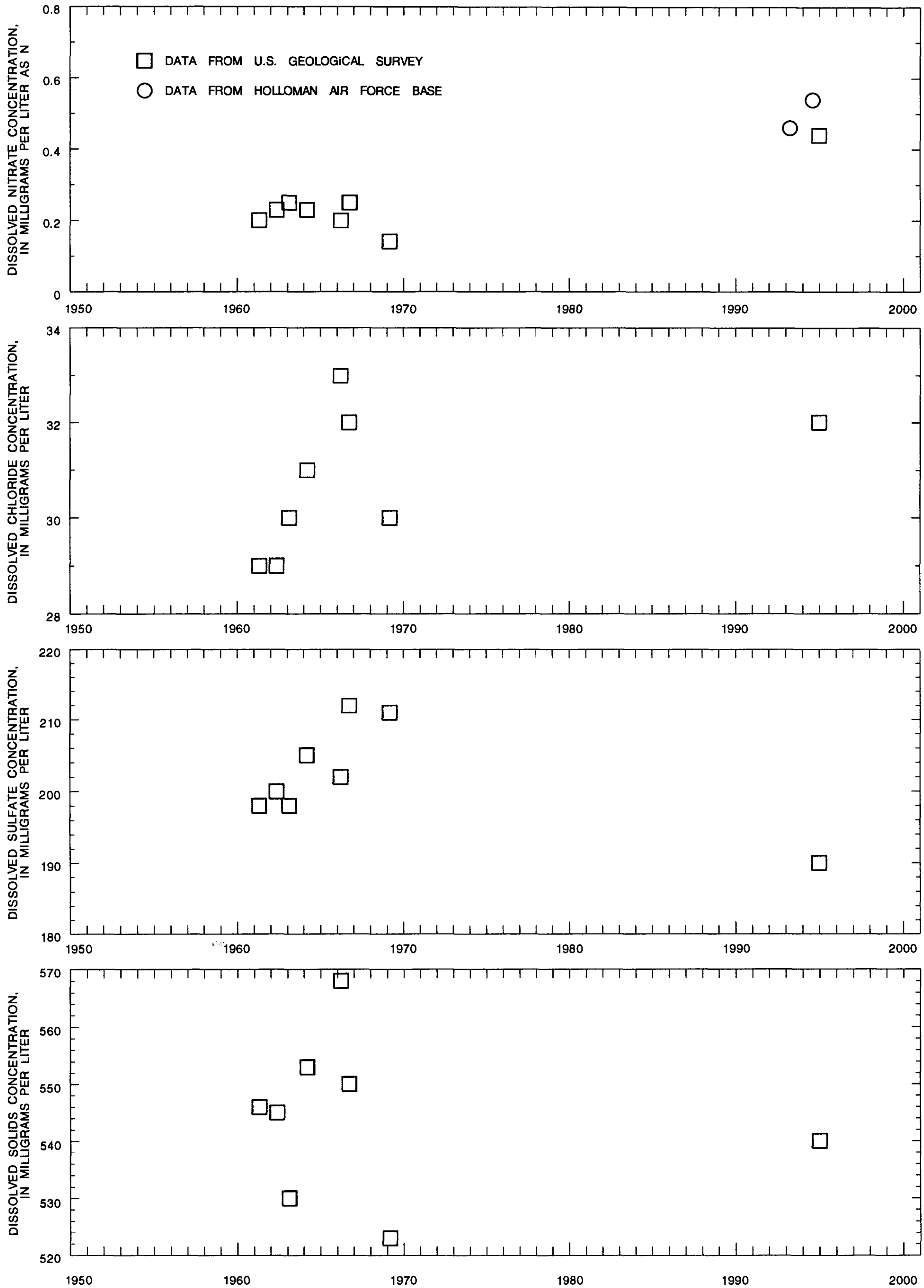


Figure 22.--Concentrations of dissolved nitrate, dissolved chloride, dissolved sulfate, and dissolved solids as a function of time for well 17S.10E.18.442A (Boles 26) for 1961-94.

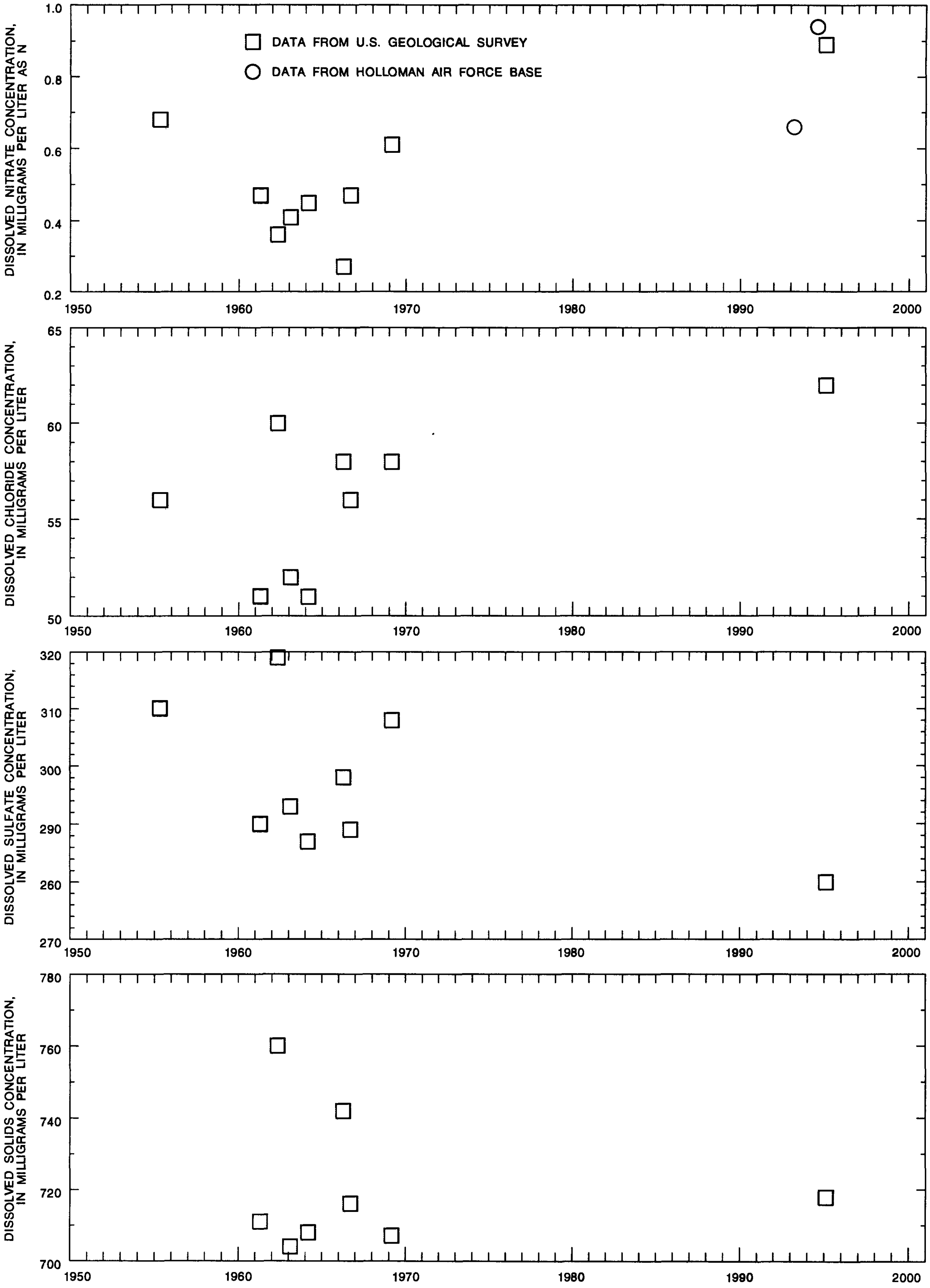
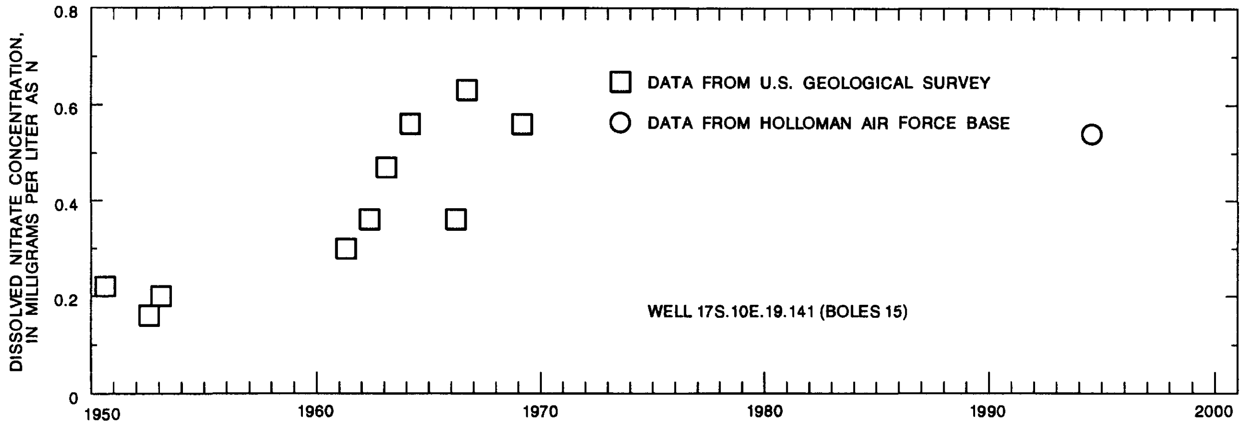


Figure 23.--Concentrations of dissolved nitrate, dissolved chloride, dissolved sulfate, and dissolved solids as a function of time for well 17S.09E.24.343 (Boles 34) for 1955-95.



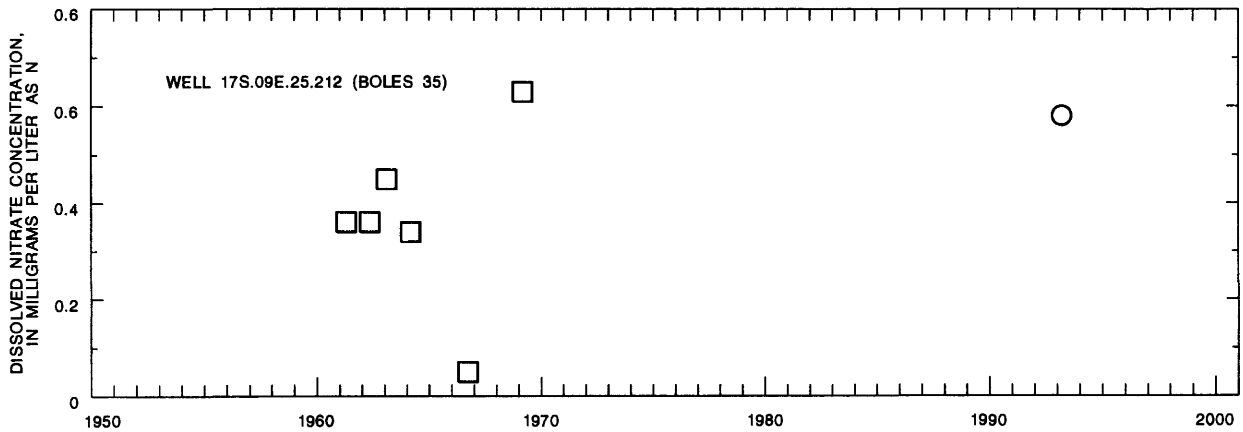


Figure 24.--Concentrations of dissolved nitrate as a function of time for well 17S.10E.19.141 (Boles 15) for 1950-94 and for well 17S.09E.25.212 (Boles 35) for 1961-93.

SUMMARY

Ground-water-level, ground-water-withdrawal, and ground-water-quality data were evaluated for trends. Data for well Douglas 4 indicate a statistically significant decreasing trend in water levels for 1972-86 and a statistically significant increasing trend in water levels for 1986-90. Water levels in wells San Andres 5 and San Andres 6 show statistically significant decreasing trends for 1973-93 and 1981-89, respectively. A mixture of statistically significant increasing trends, statistically significant decreasing trends, and a lack of statistically significant trends over periods ranging from the early 1970's to the early 1990's is indicated for the Boles wells and observation wells near the Boles wells. Data for well Boles 5 show a statistically significant increasing trend in water levels for 1981-90. Data for well Boles 5 and observation well 17S.09E.25.343 indicate no statistically significant trends in water levels for 1990-93 and 1988-93, respectively. Data for well Frenchy 1 indicate a statistically significant decreasing trend in water levels for 1986-93.

Ground-water withdrawal from the San Andres and Douglas wells regularly exceeded estimated ground-water recharge from San Andres Canyon for 1963-87. For 1951-57 and 1960-86, ground-water withdrawal from the Boles wells regularly exceeded total estimated ground-water recharge from Mule, Arrow, and Lead Canyons. Ground-water withdrawal from the San Andres and Douglas wells and the Boles wells nearly equaled estimated ground-water recharge for 1989-93 and 1986-93. For 1987-93, ground-water withdrawal from the Escondido well regularly exceeded estimated ground-water recharge from Escondido Canyon, and from the Frenchy wells regularly exceeded total estimated ground-water recharge from Dog and Deadman Canyons.

Concentrations of dissolved nitrate show the most consistent increases between historical (1955-70) and current (1990-95) data. Current concentrations of dissolved nitrate are greater than historical concentrations in 7 of 10 wells. Current concentrations of dissolved nitrate in all wells considered in this study are below the maximum contaminant level of 10 mg/L for drinking water established by the U.S. Environmental Protection Agency.

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Table 1.--Results of statistical analyses of water-level data for selected Douglas, San Andres, Boles, Escondido, and Frenchy public-supply wells and observation wells near the Boles wells

[Negative values of estimated trends indicate decreasing water levels; positive values indicate increasing water levels. Data from Holloman Air Force Base unless otherwise noted. --, no value computed. Well locations shown in figure 3]

Well location number and name	Time period of data analyzed	Raw data		Log transformed data		Estimated trend (feet per year)
		p-value	Kendall's tau value	p-value	Kendall's tau value	
17S.10E.31.411 (Douglas 4)	1972-86	0.0000	0.77	0.0000	0.77	-2.0
17S.10E.31.411 (Douglas 4)	1986-90	.0929	-1.0	.0929	-1.0	5.3
17S.10E.32.113 (San Andres 1)	1973-93	.1129	-.15	.1129	-.15	--
17S.10E.32.122 (San Andres 5)	1972-93	.0014	.28	.0014	.28	-0.5
17S.10E.32.143 (San Andres 6)	1981-89	.0000	.73	.0000	.73	-3.7
17S.10E.19.123 (Boles 2)	1972-93	.0015	-.31	.0015	-.31	.7
17S.10E.19.144 (Boles 5)	1981-90	.0000	-.85	.0000	-.85	2.6
17S.10E.19.144 (Boles 5)	1990-93	.1781	.34	.1781	.34	--
17S.09E.25.213 (Boles 17)	1978-93	.2607	-.14	.2614	-.14	--
17S.09E.24.343* (Boles 34)	1961-85	.0000	.65	.0000	.65	-.4
17S.10E.18.432A*	1960-70	.0000	.88	.0000	.88	-1.1
17S.10E.18.432A*	1970-86	.0165	.67	.0165	.67	-.2
17S.10E.19.323A*	1960-73	.0000	.93	.0000	.93	-1.0
17S.09E.25.343*	1988-93	.1833	-.54	.1833	-.54	--
18S.10E.32.143 (Escondido 1)	1987-93	.1368	.28	.1368	.28	--
18S.10E.09.332 (Frenchy 1)	1986-93	.0181	.43	.0181	.43	-5.7
18S.10E.16.414 (Frenchy 2)	1986-93	.1274	.32	.1274	.32	--

*U.S. Geological Survey data

Table 2.--Chemical analyses of water from selected Douglas, San Andres, Boles, Frenchy, and Escondido public-supply wells in the Holloman Air Force Base area

[deg. C, degrees Celsius; gal/min, gallons per minute; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than. All samples collected by U.S. Geological Survey and analyzed by Holloman Air Force Base. Well locations shown in figure 3]

Well location number and name	Date of sample	Altitude of land surface (feet)	Depth of well, total (feet)	Pump or flow period prior to sampling (minutes)	Well yield (gal/min)	Specific conduct-ance, field (µS/cm)	Specific conduct-ance, lab (µS/cm)	pH water, whole, field
17S.10E.31.411 (Douglas 4)	02-09-95	--	--	--	--	997	992	7.4
17S.10E.32.113 (San Andres 1)	12-21-94	4,212	370.00	--	450	1,390	1,410	7.5
17S.10E.31.244 (San Andres 3)	12-20-94	4,191	966.00	--	900	1,180	1,120	7.8
17S.10E.32.122 (San Andres 5)	12-20-94	4,298	995.00	--	975	1,090	1,200	7.5
17S.10E.19.123 (Boles 2)	02-08-95	4,161	240.00	--	--	835	838	7.5
17S.10E.18.442A (Boles 26)	12-21-94	--	--	--	--	--	805	7.5
17S.09E.24.343 (Boles 34)	02-08-95	4,140	255.00	--	--	1,030	1,040	7.5
18S.10E.32.143 (Escondido 1)	12-22-94	4,198	1,000	40	1,250	771	757	7.6
18S.10E.09.332 (Frenchy 1)	12-28-94	4,202	1,000	30	1,700	958	960	7.3

Table 2.--Chemical analyses of water from selected Douglas, San Andres, Boles, Frenchy, and Escondido public-supply wells in the Holloman Air Force Base area--Continued

Well location number and name	Date of sample	pH water, whole, lab (standard units)	Temperature, air (deg. C)	Temperature, water (deg. C)	Alkalinity (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Nitrogen, nitrite, dissolved (mg/L as N)	Nitrogen, NO_2+NO_3, dissolved (mg/L as N)
17S.10E.31.411 (Douglas 4)	02-09-95	7.7	24.5	23.0	167	98	44	43	1.9	0.010	2.10
17S.10E.32.113 (San Andres 1)	12-21-94	7.5	18.0	22.5	159	150	66	55	2.2	<0.010	2.80
17S.10E.31.244 (San Andres 3)	12-20-94	7.7	16.0	26.0	175	100	47	62	2.5	<0.010	0.740
17S.10E.32.122 (San Andres 5)	12-20-94	7.6	16.5	24.5	164	120	54	61	2.5	<0.010	0.600
17S.10E.19.123 (Boles 2)	02-08-95	7.7	18.0	20.5	180	89	37	30	1.2	0.010	0.520
17S.10E.18.442A (Boles 26)	12-21-94	7.6	20.5	21.0	180	88	34	29	1.4	<0.010	0.440
17S.09E.24.343 (Boles 34)	02-08-95	7.7	16.0	19.5	171	110	46	46	1.9	0.020	0.910
18S.10E.32.143 (Escondido 1)	12-22-94	7.7	17.5	27.0	195	59	30	54	2.7	<0.010	0.160
18S.10E.09.332 (Frenchy 1)	12-28-94	7.5	15.5	25.0	200	100	38	48	2.2	<0.010	0.370

Table 2.--Chemical analyses of water from selected Douglas, San Andres, Boles, Frenchy, and Escondido public-supply wells in the Holloman Air Force Base area--Concluded

Well location number and name	Date of sample	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)	Solids, residue at 180 deg. C, dissolved (mg/L)	Fluoride, dissolved (mg/L as F)	Bromide, dissolved (mg/L as Br)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (µg/L as Fe)	Manganese, dissolved (µg/L as Mn)
17S.10E.31.411 (Douglas 4)	02-09-95	56	270	682	0.50	0.15	21	<3	3
17S.10E.32.113 (San Andres 1)	12-21-94	66	500	1,040	0.40	0.19	20	11	3
17S.10E.31.244 (San Andres 3)	12-20-94	67	320	778	0.50	0.15	22	6	2
17S.10E.32.122 (San Andres 5)	12-20-94	66	360	858	0.60	0.15	21	<3	2
17S.10E.19.123 (Boles 2)	02-08-95	35	210	566	0.20	0.070	20	6	1
17S.10E.18.442A (Boles 26)	12-21-94	32	190	540	0.30	0.070	19	6	1
17S.09E.24.343 (Boles 34)	02-08-95	62	280	718	0.30	0.11	23	<3	5
18S.10E.32.143 (Escondido 1)	12-22-94	32	150	486	0.50	0.090	21	38	37
18S.10E.09.332 (Frenchy 1)	12-28-94	40	250	660	0.40	0.13	21	15	3

Table 3.--Comparisons between historical (1955-70) and current (1990-95) water-quality data for selected Douglas, San Andres, and Boles public-supply wells

[+, current concentrations greater than the range of concentrations in historical data; -, current concentrations less than the range of concentrations in historical data; 0, current concentrations within the range of concentrations in historical data; +/-, current concentrations both greater than and less than the range of concentrations in historical data; +/0, current concentrations both greater than and within the range of concentrations in historical data; N, no data available. Well locations shown in figure 3]

Well location number and name	Dissolved nitrate	Dissolved chloride	Dissolved sulfate	Dissolved solids
17S.10E.31.411 (Douglas 4)	+	+	-	0
17S.10E.32.113 (San Andres 1)	+/-	+	+	+
17S.10E.31.244 (San Andres 3)	+	+	0	+
17S.10E.19.123 (Boles 2)	+	0	+/0	+/0
17S.10E.19.144 (Boles 5)	0	N	0	0
17S.10E.19.141 (Boles 15)	0	N	N	N
17S.09E.25.213 (Boles 17)	+	N	-	0
17S.10E.18.442A (Boles 26)	+	0	-	0
17S.09E.24.343 (Boles 34)	+/0	+	-	0
17S.09E.25.212 (Boles 35)	0	N	N	N

*U.S. GOVERNMENT PRINTING OFFICE: 1996-776-760/45067