UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

HYDROLOGIC DATA FROM MONITORING OF SALINE-WATER INTRUSION IN THE CAPE CORAL AREA, LEE COUNTY, FLORIDA

By Daniel J. Fitzpatrick

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CONVERSION FACTORS AND ABBREVIATIONS

Factors for converting inch-pound units to International System (SI) of metric units

Multiply	By	To obtain
	Length	
inch (in)	25.40	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "mean sea level." NGVD of 1929 is referred to as sea level in this report.

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ABSTRACT

As a result of declining water levels and saline-water intrusion in the Cape Coral area, the U.S. Geological Survey in cooperation with the City of Cape Coral established a monitoring well network in Cape Coral and adjacent areas in 1978-79. The network was designed to provide indication of lateral movement of saline water in the upper part of the Hawthorn Formation; to provide trends in water levels; and to provide background data from: (1) the aquifer in the upper part of the Hawthorn Formation; (2) the aquifer in the lower part of the Hawthorn Formation and upper part of the Tampa Limestone; and (3) the surficial aquifer. The monitoring well network consists of 77 wells.

Data collected in this network since 1978, as well as data collected from selected wells in the network prior to 1978, are compiled in this report. These data include water-quality data from 69 wells, water-level data from 29 wells, and lithologic logs from 18 wells. Other data compiled in this report include municipal pumpage and rainfall data supplied by the City of Cape Coral.

INTRODUCTION

The artesian aquifer in the upper part of the Hawthorn Formation is a major source of water supply for municipal, domestic, and irrigation uses in Cape Coral. Wells that hydraulically connect the aquifer in the upper part of the Hawthorn Formation to overlying and underlying saline water-bearing units provide a direct conduit for saline-water movement into the aquifer. This condition has resulted in a deterioration of the water quality in parts of the aquifer (Boggess and others, 1977). Declines in water levels in some areas have increased the potential for inland movement of highly saline water from the coast, as well as movement of saline water from overlying and underlying water-bearing units into the aquifer.

The U.S. Geological Survey in cooperation with the City of Cape Coral designed and established a monitoring well network in 1978-79 to evaluate the movement of saline water and water-level changes in the aquifer in the upper part of the Hawthorn Formation in Cape Coral and adjacent areas and to collect salinity and water-level data from the underlying aquifer in the lower part of the Hawthorn Formation and upper part of the Tampa Formation and from the overlying surficial aquifer.

The aquifer in the upper part of the Hawthorn Formation is locally designated as the upper Hawthorn aquifer. The aquifer in the lower part of the Hawthorn Formation and upper part of the Tampa Limestone is locally designated the lower Hawthorn aquifer. Although these aquifer names are not formally recognized by the U.S. Geological Survey, they are the local (Lee County, Florida) designations for the aquifers.

The purpose of this report is to present previously existing data as well as data collected from the monitoring well network during the initial phases of the investigation. The final phase of the investigation will evaluate the data.

HYDROLOGIC DATA COLLECTION NETWORK

Hydrologic data from the existing monitoring well network have been collected since 1978 for three aquifers that underlie Cape Coral and the adjacent area. The network of hydrologic monitoring sites now consists of 34 wells that tap the artesian upper Hawthorn aquifer, 6 wells that tap the artesian lower Hawthorn aquifer (fig. 1), and 37 wells that tap the unconfined surficial aquifer (fig. 2). Figure 3 shows the stratigraphic position and lithology of the aquifers (Sproul and others, 1972).

Water levels in five wells that tap the upper Hawthorn aquifer (fig. 1) were monitored by continuous recording devices. Water levels in selected wells that tap the three aquifers were measured monthly, bimonthly, or semiannually.

Water-quality samples were collected and analyzed semiannually from 1978-80 for wells that tap the upper Hawthorn aquifer. Background water-quality data for selected wells that tap the surficial aquifer and the lower Hawthorn aquifer were also collected.

Rainfall data (table 1) are collected at the City of Cape Coral's reverse osmosis plant in west Cape Coral and the lime water-treatment plant in south Cape Coral (fig. 1). Municipal ground-water pumpage data from the upper and lower Hawthorn aquifers at these plants (figs. 4 and 5) are also collected. Rainfall and pumpage data are supplied by the City of Cape Coral Utilities Department.

WELL-CONSTRUCTION DATA

Construction data for 77 monitoring wells (figs. 1 and 2) are given in table 2. Also included are well numbers, aquifers tapped, lithologic logs obtained, and information on whether continuous water-level data are being recorded. The altitude of land surface, relative to sea level, is also given where known.

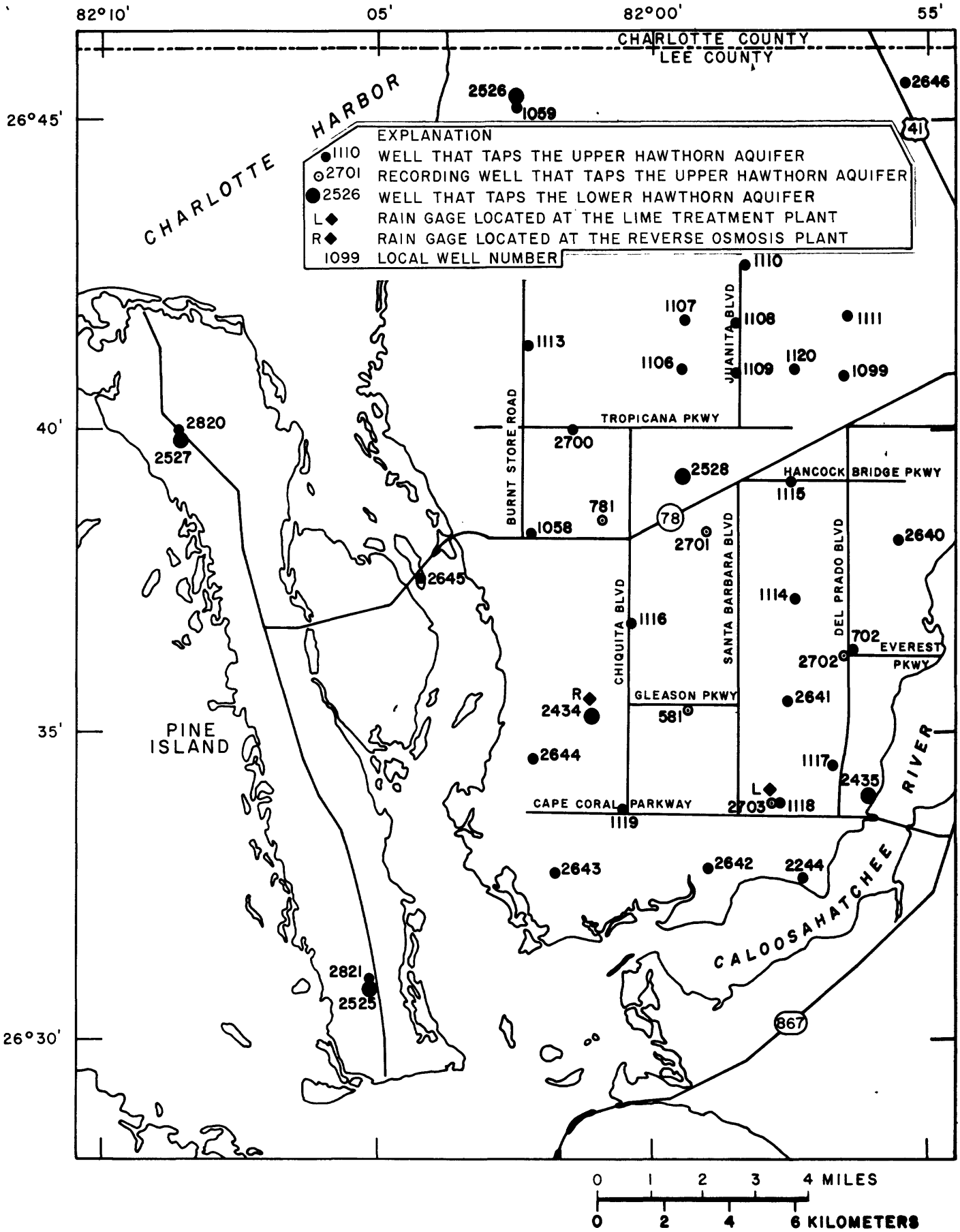

Figure 1.--Location of rain gages and monitoring wells that tap the upper and lower Hawthorn aquifers in Cape Coral and adjacent areas.

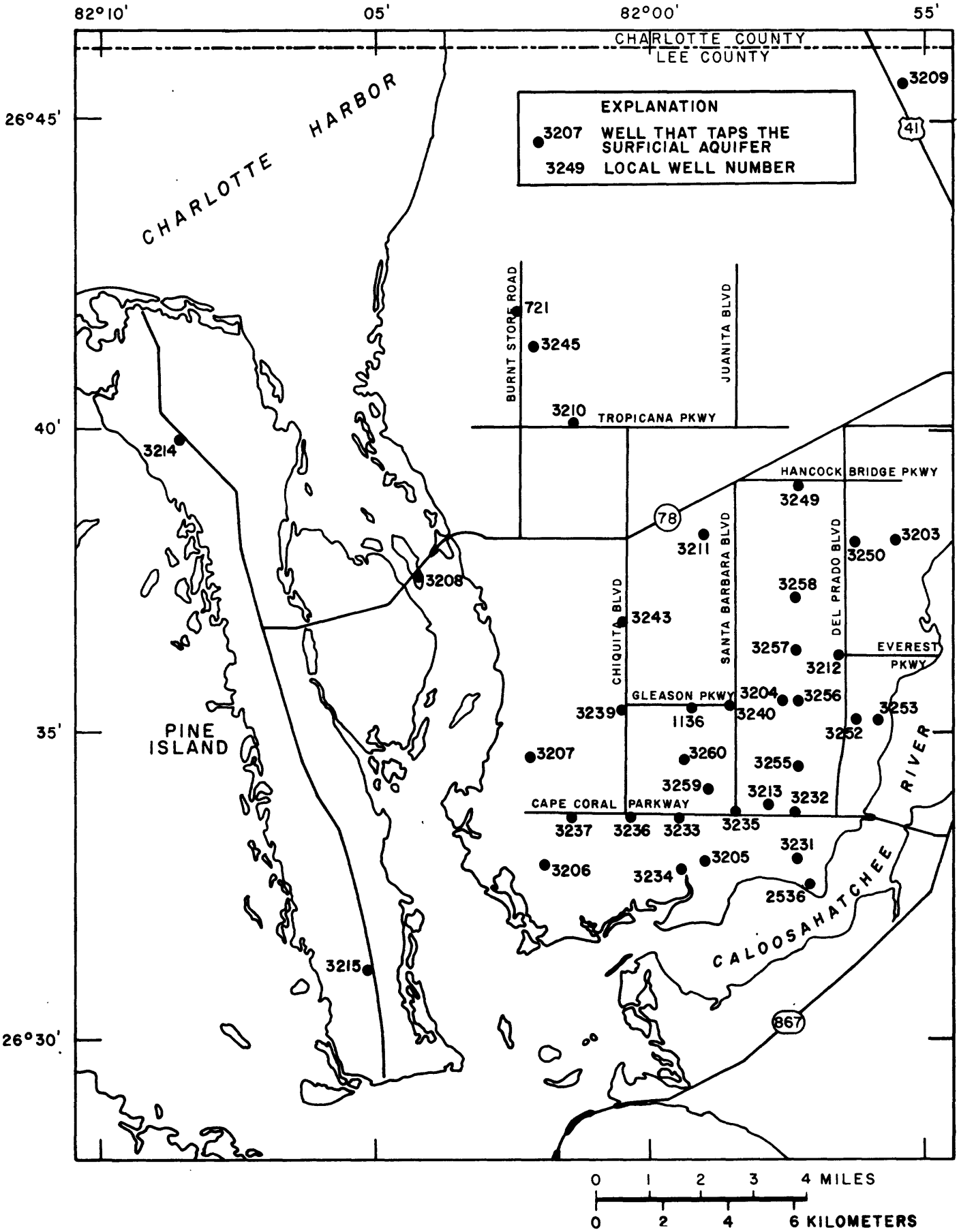

Figure 2.--Location of monitoring wells that tap the surficial aquifer in Cape Coral and adjacent areas.

Each well is identified by two numbering systems: a local number and a unique number. The local well number consists of a sequence number. This system is used in Lee County for ease of identification; however, the numbers are not necessarily unique as the well number could be duplicated in areas other than Lee County. The unique identification numbers are used for computer storage of data and are based on the grid system of latitude and longitude. These numbers consist of 15 digits and provide the geographic locations of the wells. The first six digits represent degrees, minutes, and seconds of the latitude; the next seven represent the degrees, minutes, and seconds of the longitude. The last two digits are a sequential number within a 1 second grid. For example, if the latitude-longitude for two or more sites are identical, sequential numbers 01, 02, or 03 are assigned to give each site a unique number.

WATER-QUALITY DATA

Water samples were collected from wells that tap the upper Hawthorn aquifer to detect changes in water quality. Since 1978, chloride concentrations were determined semiannually (table 3), and analyses for major ion concentrations were made annually for wells in the upper Hawthorn aquifer (table 4). Analyses for major ion concentrations made prior to 1978 are also included in table 4.

Water samples from wells that tap the surficial aquifer were analyzed for chloride concentrations and specific conductance (table 5).

Water samples from wells that tap the lower Hawthorn aquifer were analyzed for major ion concentrations (table 6).

WATER-LEVEL FLUCTUATIONS

Selected water-level data from wells in the monitoring well network are illustrated in figures 4-19. Data used in the hydrographs are based on either monthly, bimonthly, or semiannual tape measurements for those wells without continuous water-level recorders. Wells with recorders (table 2) are represented by hydrographs of the daily high on the last day of each month. Monthly water-level fluctuations in well 2434 that taps the lower Hawthorn aquifer and well 581 that taps the upper Hawthorn aquifer are illustrated with monthly municipal pumpage in figures 4 and 5. In addition to well 581, long-term fluctuations in the upper Hawthorn aquifer (1966-80) are represented by wells 702 and 2702 in figure 6. In 1978, well 702 was replaced by well 2702.

Water levels in the surficial aquifer, relative to those in the upper Hawthorn aquifer, are illustrated in figures 6-17 where data from the two aquifers are available at or near the same location. Hydrographs of other wells that tap the lower Hawthorn aquifer are shown in figures 18 and 19.

LITHOLOGIC DATA

Selected lithologic logs for wells from the monitoring well network are given in table 7. All logs were prepared by the U.S. Geological Survey.

REFERENCES CITED

Boggess, D. H., Missimer, T. M., and O'Donnell, T. H., 1977, Saline-water intrusion related to well construction in Lee County, Florida: U.S. Geological Survey Water-Resources Investigations 77-33, 29 p.

Sproul, C. R., Boggess, D. H., Woodard, H. J., 1972, Saline-water intrusion from deep artesian sources in the McGregor Isles area of Lee County, Florida: Florida Division of Geology Information Circular no. 75, 30 p.

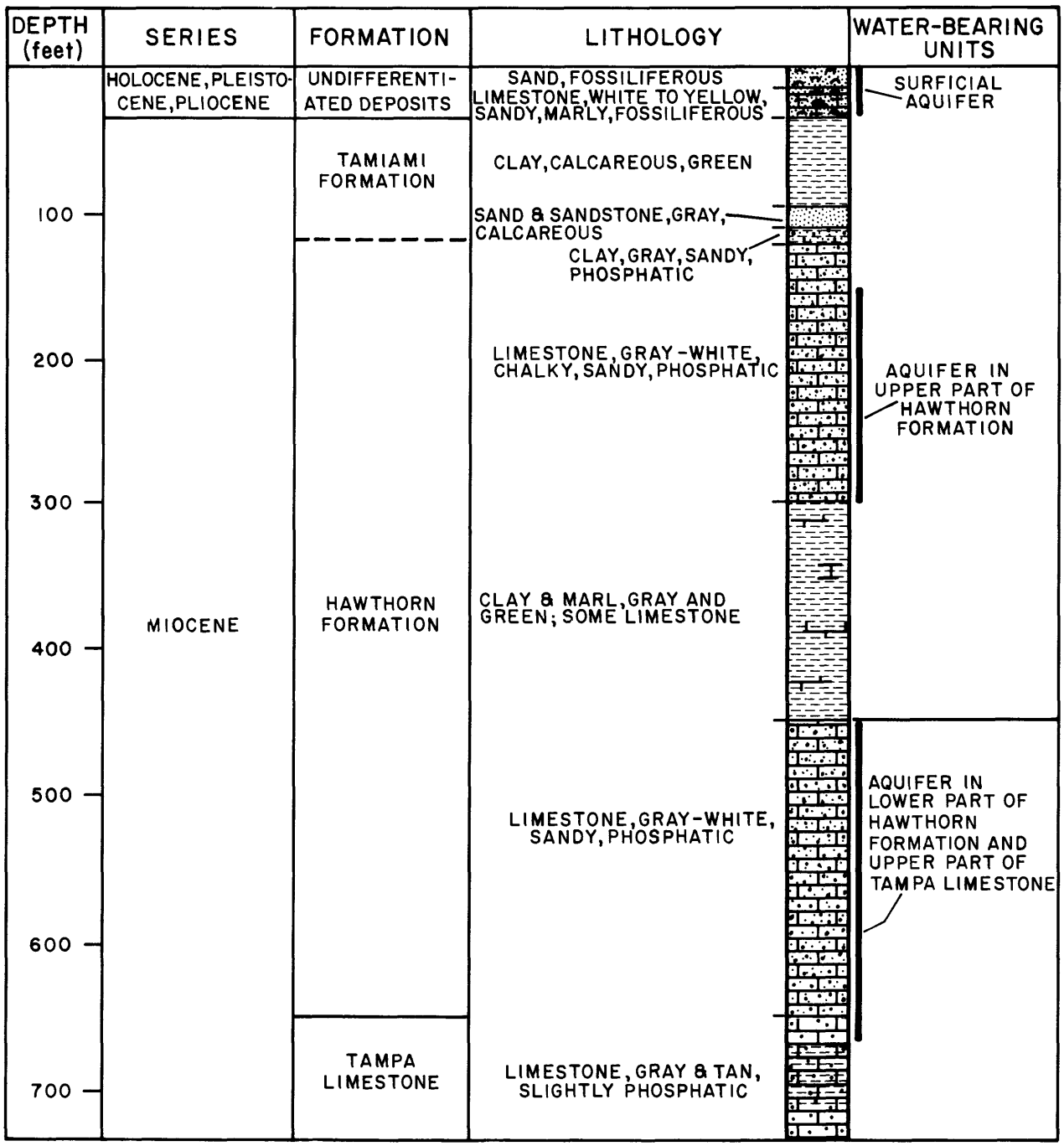

Figure 3.--Geologic formations, lithology, and water-bearing units underlying Cape Coral (modified from Boggess and others, 1977).

Table 1.--Monthly rainfall data at the reverse osmosis and lime-treatment water plants in Cape Coral[1]/

[Rainfall shown in inches; LT - lime-treatment plant, RO - reverse osmosis plant]

Month	1975		1976		1977		1978		1979		1980		Mean	
	LT	RO	LT	RO	LT	RO	LT	RO	LT	RO	LT	RO	LT	RO
January	0.6	-	0.0	-	5.6	-	3.5	3.9	7.8	8.65	2.25	2.0	3.3	4.85
February	0.9	-	2.6	-	0.1	-	5.0	3.8	2.8	1.45	1.75	2.2	2.2	2.5
March	2.0	-	0.3	-	0.0	-	4.9	4.8	0.45	1.0	3.7	2.7	1.9	2.8
April	3.0	-	1.1	-	1.4	-	2.0	1.6	3.15	5.3	5.3	2.3	2.65	3.1
May	2.4	-	4.5	-	2.7	-	7.6	2.4	9.4	8.7	3.6	3.35	5.03	4.8
June	4.5	-	5.4	-	7.4	-	9.65	5.7	3.65	1.85	2.5	2.05	5.5	3.2
July	17.4	-	5.8	-	7.8	-	13.95	14.6	2.45	3.95	7.05	9.15	9.1	9.2
August	4.1	-	12.65	-	15.2	16.0	11.7	8.45	16.45	17.25	10.25	8.3	11.7	12.5
September	8.35	-	12.3	-	13.2	9.5	7.2	3.95	9.85	15.95	5.9	2.1	9.46	7.9
October	3.6	-	2.9	-	1.4	0.2	2.5	2.65	0.55	0.55	2.85	3.05	2.3	1.6
November	1.4	-	3.3	-	1.4	2.0	0.75	0.5	1.15	1.85	3.5	3.9	1.91	2.1
December	0.3	-	2.25	-	4.55	3.25	5.7	4.45	4.4	5.55	0.55	0.45	2.95	3.4
TOTAL	48.55	-	53.1	-	60.75	-	74.45	56.8	62.1	72.05	49.2	41.55	58.0	57.95

1/ Rainfall data supplied by the City of Cape Coral.

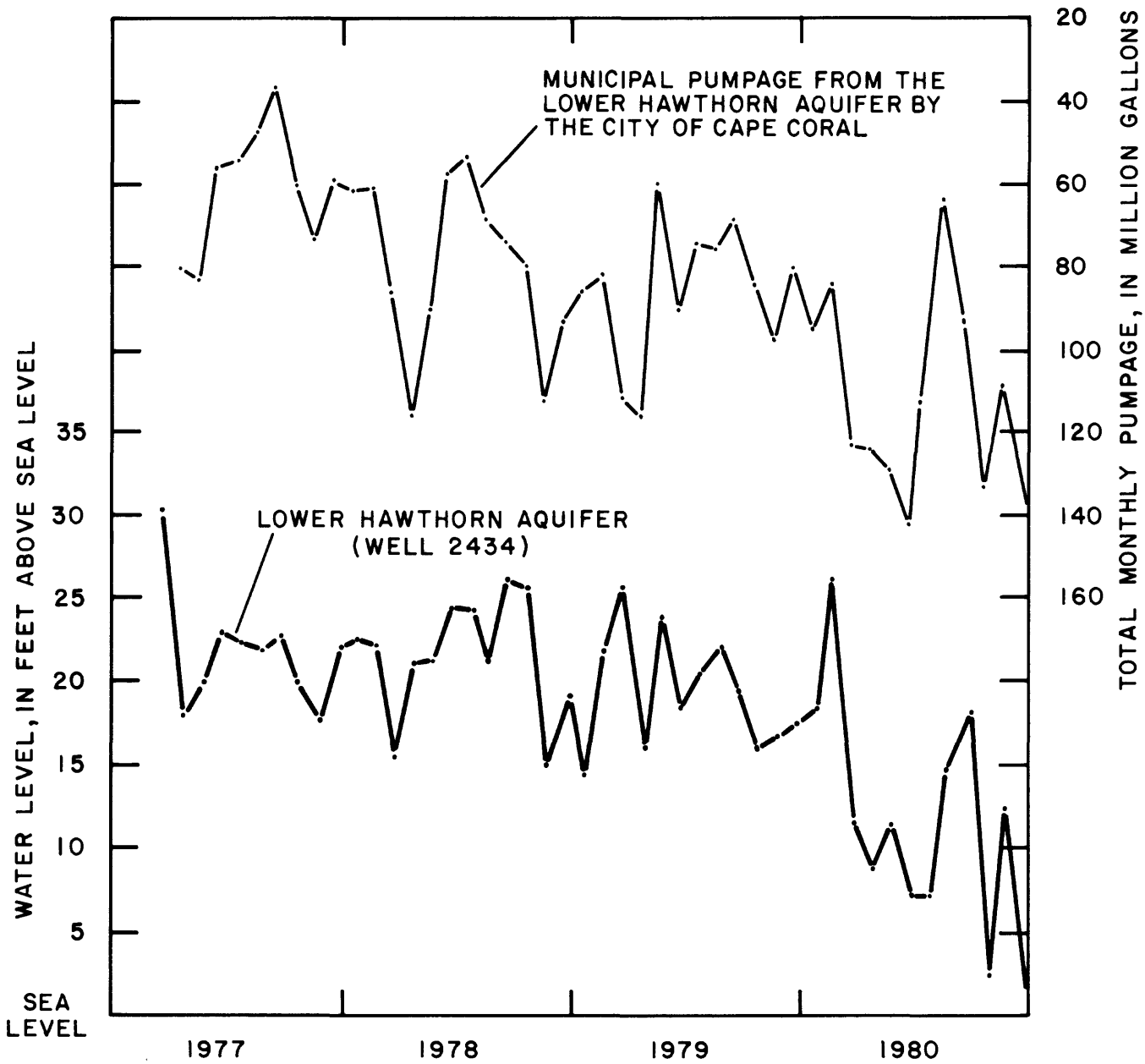

Figure 4.--Water levels in well 2434 that taps the lower Hawthorn aquifer and municipal pumpage from the lower Hawthorn aquifer by the City of Cape Coral.

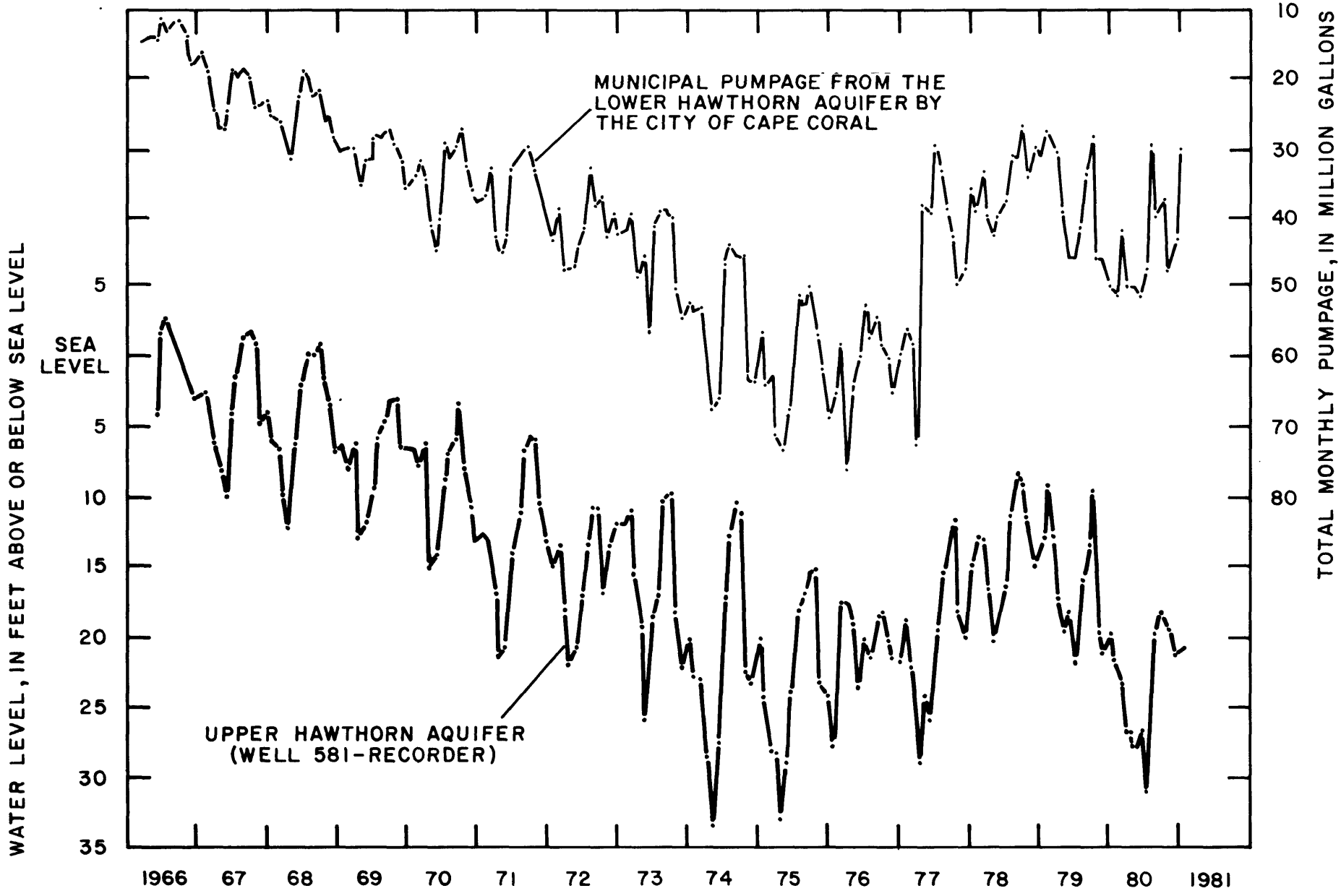

Figure 5.—Water levels in well 581 that taps the upper Hawthorn aquifer and municipal pumpage from the upper Hawthorn aquifer by the City of Cape Coral.

Table 2.--Construction data for observation wells in Cape Coral and adjacent areas

[Aquifer designation: WT, surficial; UH, Upper Hawthorn; LH, Lower Hawthorn]

Local well No.	Identification number	Aquifer	Date drilled (year)	Well depth (feet)	Depth cased (feet)	Well diameter (inches)	Datum of land surface above sea level (feet)	Water level recorder	Lithologic log
581	2635320815922.01	UH	1965	177	-	8	9.58	X	
702	2636270815627.01	UH	1966	108	-	2	7.45		
721	2641530820223.01	WT	1968	18	9	4	6.23		
781	2638340820053.01	UH	1966	279	82	6	10.01	X	
1058	2638140820207.01	UH	1964	146	95	4	6.00		
1059	2645170820221.01	UH	1970	163	156	2	10.55		X
1099	2640530815632.01	UH	-	219	129	2	14.98		
1106	2640540815926.01	UH	1970	228	143	2	11.96		
1107	2641460815923.01	UH	1970	191	136	2	14.37		
1108	2641440815826.01	UH	1970	216	137	2	15.20		
1109	2640550815381.01	UH	1970	87	84	2	13.06		
1110	2642410815824.01	UH	1970	238	147	2	15.79		
1111	2641470815627.01	UH	1970	166	-	2	16.76		
1113	2641200820221.01	UH	1970	130	126	2	5.95		
1114	2637200815731.01	UH	1970	172	126	2	9.55		
1115	2639050815728.01	UH	1970	169	147	2	12.99		
1116	2636330820027.01	UH	1970	201	106	2	9.02		
1117	2634380815632.01	UH	1970	248	-	2	6.75		
1118	2634040815758.01	UH	1970	213	126	2	5.45		
1119	2633470820026.01	UH	1970	224	42	2	4.35		
1120	2640550815727.01	UH	1970	106	-	2	13.99		
1136	2635320815922.02	WT	1970	20	15	4	9.71		
2244	2632420815721.01	UH	1975	207	150	4	5.38		
2434	2635260820102.01	LH	1977	700	353	4	6.34		X
2435	2633070815559.01	LH	1977	704	352	4	5.19		X
2525	2631170820510.01	LH	1977	645	405	4	3.89		X
2526	2645170820221.02	LH	1977	605	300	4	10.71		X
2527	2639550820831.01	LH	1977	605	360	4	7.94		X
2528	2639070815927.01	LH	1977	625	420	4	11.96		X
2536	2632360815708.01	WT	1977	45	19	4	5.36		X

Table 2.--Construction data for observation wells in Cape Coral and adjacent areas--Continued

[Aquifer designation: WT, surficial; UH, Upper Hawthorn; LH, Lower Hawthorn]

Local well No.	Identification number	Aquifer	Date drilled (year)	Well depth (feet)	Depth cased (feet)	Well diameter (inches)	Datum of land surface above sea level (feet)	Water level recorder	Lithologic log
2640	2638130815528.01	UH	1978	180	128	4	7.54		X
2641	2635330815734.01	UH	1978	170	118	4	8.29		X
2642	2632570815857.01	UH	1978	160	108	4	5.12		X
2643	2632530820142.01	UH	1978	200	141	4	6.53		X
2644	2634400820220.01	UH	1978	178	128	4	6.60		X
2645	2637430820412.01	UH	1978	210	160	4	5.54		X
2646	2645370815522.02	UH	1978	220	170	4	20.81		X
2700	2640020820128.01	UH	1978	205	165	4	6.46		X
2701	2638190815858.01	UH	1978	206	175	4	13.04	X	X
2702	2636210815637.01	UH	1978	155	120	4	7.83	X	X
2703	2633570815756.02	UH	1978	159	120	4	5.20	X	X
2820	2639550820831.02	UH	1978	241	192	4	7.56		X
2821	2631170820510.02	UH	1978	340	290	4	3.95		X
3203	2638130815528.02	WT	1978	20	8	1.25	7.54		X
3204	2635330815734.02	WT	1978	20	8	1.25	8.29		X
3205	2632570815857.02	WT	1978	18	8	1.25	5.12		X
3206	2632530820142.02	WT	1978	18	8	1.25	6.53		X
3207	2634400820220.02	WT	1978	18	8	1.25	6.60		X
3208	2637430820412.02	WT	1978	18	8	1.25	5.54		X
3209	2645370815522.03	WT	1978	18	8	1.25	20.81		X
3210	2640020820128.02	WT	1978	18	8	1.25	6.46		X
3211	2638190815858.02	WT	1978	18	8	1.25	13.04		X
3212	2636210815637.02	WT	1978	18	8	1.25	7.83		X
3213	2633570815756.03	WT	1978	18	8	1.25	5.20		X
3214	2639550820831.04	WT	1978	18	8	1.25	7.56		X
3215	2631170820510.03	WT	1978	18	8	1.25	3.95		X
3231	2633110815728.01	WT	1979	45	35	2	-		
3232	2633470815729.01	WT	1979	27	22	2	-		
3233	2633450815729.01	WT	1979	20	10	2	-		

Table 2.--Construction data for observation wells in Cape Coral and adjacent areas--Continued

[Aquifer designation: WT, surficial; UH, Upper Hawthorn; LH, Lower Hawthorn]

Local well No.	Identification number	Aquifer	Date drilled (year)	Well depth (feet)	Depth cased (feet)	Well diameter (inches)	Datum of land surface above sea level (feet)	Water level recorder	Lithologic log
3234	2632580815927.01	WT	1979	23	13	2	-		
3235	2633470815827.01	WT	1979	17	7	2	-		
3236	2633460820025.01	WT	1979	20	10	2	-		
3237	2633470820125.01	WT	1979	40	30	2	-		
3239	2635300820027.01	WT	1979	17	12	2	-		
3240	2635310815829.01	WT	1979	22	17	2	-		
3243	2637220820028.01	WT	1979	27	17	2	-		
3245	2641230820221.01	WT	1979	27	17	2	-		
3249	2639050815726.01	WT	1979	15	10	2	-		
3250	2638100815623.01	WT	1979	22	12	2	-		
3252	2635180815627.01	WT	1979	40	35	2	-		
3253	2635180815555.01	WT	1979	35	30	2	-		
3255	2634290815724.01	WT	1979	25	20	2	-		
3256	2635330815723.01	WT	1979	28	23	2	-		
3257	2636240815724.01	WT	1979	25	22	2	-		
3258	2637190815724.01	WT	1979	29	25	2	-		
3259	2634140815857.01	WT	1979	22	17	2	-		
3260	2634390815926.01	WT	1979	25	20	2	-		

Table 3.--Chloride concentrations in ground water from the upper Hawthorn aquifer in Cape Coral and adjacent areas

[Concentrations in milligrams per liter]

Well No.	1978 Apr-May	1978 Nov	1979 May	1979 Oct	1980 May	1980 Oct
581	250	240	250	235	310	215
702	87	90	92	100	-	-
781	440	420	440	410	410	400
1058	500	450	580	500	570	560
1059	450	430	440	445	440	400
1099	-	75	-	-	77	85
1106	180	185	200	175	190	175
1107	200	190	190	190	190	175
1108	260	260	260	250	260	220
1109	79	75	88	90	110	165
1110	400	400	380	380	440	420
1111	230	245	240	230	170	-
1113	980	1,125	1,100	1,080	1,100	1,100
1114	460	465	340	-	-	480
1115	280	280	260	245	220	220
1117	89	50	89	-	-	95
1118	340	340	360	350	-	320
1119	340	370	270	375	260	280
1120	110	120	87	75	80	75
2244	390	300	430	360	380	355
2640	200	200	200	190	180	185
2641	150	140	140	140	140	140
2642	260	280	280	275	290	280
2643	1,100	975	1,100	1,025	980	1,000
2644	980	1,000	980	975	990	900
2645	460	450	450	450	430	400
2646	-	50	85	90	-	75
2700	-	1,050	980	1,000	980	1,050
2701	-	40	50	50	52	60
2702	-	205	230	250	210	200
2703	-	450	420	385	400	-
2820	-	620	650	725	660	650
2821	-	550	420	430	510	500

Table 4.--Major ion concentrations in ground water from the upper Hawthorn aquifer in Cape Coral and adjacent areas

[Concentrations in milligrams per liter, except as noted]

Well No.	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Strontium (Sr)	Sodium (Na)	Potassium (K)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Bicarbonate (HCO_3)	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$		Dissolved solids		Specific conductance (umhos/cm at 25°C)	pH (units)	Temperature (°C)
														Calcium/magnesium	Noncarbonate	Residue at 180°C	Calculated			
581	04/25/78	43	0.06	56	44	3.3	95	12	15	250	0.8	240	200	320	130	580	-	1,140	8.3	26
	05/10/79	60	0.03	57	45	3.2	82	13	14	250	0.9	240	200	330	130	717	643	1,170	8.1	26
	05/14/80	59	0.08	57	49	4.0	120	16	10	310	1.2	-	180	350	170	877	735	1,400	7.6	27
702	04/24/78	49	0.05	46	34	2.2	41	8.5	21	87	0.7	280	230	260	28	431	427	735	7.8	25
	05/09/79	44	0.01	45	39	2.1	47	8.3	15	92	0.8	280	230	280	46	449	431	730	8.0	26
781	04/27/78	36	0.00	63	61	5.0	190	16	81	440	1.6	210	170	410	240	1,050	997	1,790	8.1	26
	05/08/79	37	0.02	64	60	4.8	180	19	65	440	1.5	210	170	410	240	1,040	975	1,900	8.1	28
	05/13/80	36	0.01	56	59	5.0	180	18	70	410	1.7	-	170	390	220	1,020	938	1,850	8.0	28
1058	04/27/78	29	0.03	78	70	6.4	250	15	150	500	0.9	200	160	490	330	1,230	1,200	2,190	7.8	25
	05/08/79	30	0.01	74	72	5.0	260	19	120	580	0.8	200	160	490	320	1,350	1,260	2,350	7.5	26
	05/13/80	32	0.03	82	75	6.3	260	18	120	570	1.0	-	160	520	360	1,310	1,260	2,375	7.8	27
1059	08/27/75	31	0.01	98	48	3.9	170	6.9	13	440	0.7	209	172	440	270	1,028	912	1,600	-	27
	04/27/78	38	0.01	95	45	5.0	170	7.2	17	450	0.8	210	170	430	260	1,050	932	1,780	7.9	26
	05/07/79	30	0.01	94	46	4.7	170	7.5	15	440	0.9	210	170	430	260	1,110	912	1,810	7.3	26
	05/16/80	33	0.01	84	47	4.8	160	6.5	12	440	1.0	-	170	410	240	1,020	891	1,900	-	28
1099	06/27/75	31	0.03	40	37	2.4	44	5.8	12	72	1.4	284	233	260	22	393	386	650	7.6	26
	05/09/79	-	0.00	54	41	1.7	55	5.6	-	-	-	290	240	310	68	-	-	840	7.9	26
	05/12/80	42	0.08	45	35	1.5	60	6.2	18	77	1.0	-	240	260	18	426	430	850	7.8	30

Table 4.--Major ion concentrations in ground water from the upper Hawthorn aquifer in Cape Coral and adjacent areas--Continued

[Concentrations in milligrams per liter, except as noted]

Well No.	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Strontium (Sr)	Sodium (Na)	Potassium (K)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Bicarbonate (HCO_3)	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$		Dissolved solids		Specific conductance (umhos/cm at 25°C)	pH (units)	Temperature (°C)
														Calcium/magnesium	Noncarbonate	Residue at 180°C	Calculated			
1106	07/17/75	48	0.02	56	44	3.1	94	16	36	180	1.4	289	237	320	87	684	621	1,060	7.3	26
	04/27/78	48	0.00	52	41	2.9	95	14	43	180	1.2	290	240	300	64	641	620	1,080	8.0	26
	05/07/79	47	0.07	53	46	2.8	87	17	40	200	1.2	280	230	330	95	683	632	1,130	7.3	26
	05/13/80	48	0.01	46	44	2.7	77	16	33	190	1.3	-	230	300	69	645	596	1,140	7.9	26
1107	07/23/75	37	0.02	58	41	3.0	75	12	18	190	1.4	249	204	320	110	675	558	1,100	7.3	27
	04/26/78	32	0.01	55	38	2.8	75	12	21	200	1.2	240	200	300	100	591	555	995	8.2	25
	05/08/79	36	0.00	55	40	2.8	68	12	17	190	1.3	250	210	310	100	581	545	1,080	8.0	26
	05/13/80	39	0.01	51	42	2.6	76	12	15	190	1.3	-	210	300	93	586	555	1,060	8.0	26
1108	07/16/75	29	0.01	63	53	6.0	94	10	15	250	1.4	262	215	380	170	688	650	1,210	7.4	26
	04/26/78	30	0.00	57	54	6.3	100	11	18	260	1.3	260	210	370	160	691	666	1,215	7.9	26
	05/08/79	30	0.00	60	54	5.4	82	12	14	260	1.3	260	210	380	170	720	647	1,300	7.7	26
	05/13/80	31	0.01	53	54	5.7	77	12	9.3	260	1.4	-	210	360	150	698	630	1,270	8.0	26
1109	07/16/75	37	0.02	40	34	1.0	54	12	22	85	1.5	275	226	320	98	410	420	-	-	-
	04/27/78	48	0.01	40	31	2.2	60	12	26	79	1.4	280	230	230	0	417	-	725	7.9	26
	05/07/79	40	0.09	41	35	1.9	57	12	24	88	1.3	290	240	250	11	448	443	770	7.2	26
	05/13/80	46	0.01	39	34	1.9	76	12	24	110	1.2	-	230	240	10	482	-	850	8.1	26
1110	07/16/75	37	0.00	69	64	7.1	140	16	28	410	1.3	229	188	440	260	1,130	885	1,650	7.3	-
	04/27/78	38	0.00	74	65	7.7	140	14	32	400	1.3	230	190	460	270	949	885	1,630	7.8	26
	05/09/79	35	0.00	71	61	6.9	120	17	30	380	1.2	230	190	440	250	1,030	835	1,680	7.8	26
	05/12/80	38	0.02	63	63	6.4	180	16	24	440	1.3	-	190	420	230	1,020	946	1,950	7.9	26

Table 4.--Major ion concentrations in ground water from the upper Hawthorn aquifer in Cape Coral and adjacent areas--Continued

[Concentrations in milligrams per liter, except as noted]

Well No.	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Strontium (Sr)	Sodium (Na)	Potassium (K)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Bicarbonate (HCO_3)	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$: Calcium/magnesium	Hardness as $CaCO_3$: Noncarbonate	Dissolved solids: Residue at 180°C	Dissolved solids: Calculated	Specific conductance (umhos/cm at 25°C)	pH (units)	Temperature (°C)
1111	07/23/75	37	0.14	73	50	2.7	94	11	19	230	1.1	307	252	390	140	630	669	1,200	7.3	27
	04/27/78	38	0.00	69	50	2.8	95	10	26	230	0.9	300	250	380	140	683	670	1,210	8.1	26
	05/09/79	37	0.02	69	51	2.5	82	11	21	240	0.8	310	250	390	130	729	667	1,240	7.9	27
	05/12/80	29	0.01	48	39	1.8	76	8	18	170	1.0	-	200	280	83	558	511	1,000	8.0	26
1113	08/27/75	21	0.02	150	110	8.1	500	18	240	1,000	0.9	169	139	840	700	2,360	2,130	3,900	7.4	27
	04/26/78	21	0.04	140	110	7.7	460	16	250	980	0.7	160	130	810	680	2,310	2,060	4,000	7.6	26
	05/07/79	21	0.03	150	120	5.6	490	19	230	1,100	0.7	160	130	880	740	2,460	2,220	4,100	7.5	26
	05/16/80	23	0.01	160	120	7.4	480	18	230	1,100	0.8	-	130	900	770	2,340	2,220	4,150	7.9	28
1114	04/25/78	37	0.01	75	66	3.8	200	11	110	460	1.0	220	180	460	280	1,140	1,070	1,900	8.0	26
	05/11/79	34	0.00	70	59	3.2	180	12	69	340	0.8	220	180	420	240	936	876	1,900	7.9	27
1115	04/25/78	27	0.15	83	45	2.2	95	4.4	15	280	0.6	280	230	400	170	644	-	1,300	7.3	28
	05/09/79	27	0.03	82	50	1.8	72	3.9	14	260	0.6	270	220	410	190	772	644	1,350	8.0	28
	05/13/80	26	0.00	77	44	1.1	76	2.6	13	220	0.5	-	180	370	190	586	568	1,150	8.0	26
1116	04/25/78	61	0.03	45	32	2.0	36	12	19	95	1.0	250	210	250	41	432	426	710	8.0	25
1117	04/24/78	20	0.05	44	27	1.5	36	4.4	33	89	0.7	200	160	220	59	381	354	650	8.1	25
	05/09/79	20	0.00	44	30	1.4	39	4.4	31	89	0.8	200	160	240	71	385	358	630	7.9	26
1118	04/24/78	55	0.05	56	44	2.0	170	10	68	340	0.9	210	170	320	150	772	-	1,500	8.0	25
	05/09/79	37	0.01	57	49	2.4	170	12	64	360	1.0	220	180	350	170	922	861	1,550	7.9	26

Table 4.--Major ion concentrations in ground water from the upper Hawthorn aquifer in Cape Coral and adjacent areas--Continued

[Concentrations in milligrams per liter, except as noted]

Well No.	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Strontium (Sr)	Sodium (Na)	Potassium (K)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Bicarbonate (HCO_3)	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$		Dissolved solids		Specific conductance (umhos/cm at 25°C)	pH (units)	Temperature (°C)
														Calcium/magnesium	Noncarbonate	Residue at 180°C	Calculated			
1119	04/25/78	36	0.04	80	50	1.8	140	10	47	340	0.4	250	210	410	200	794	828	1,520	7.6	25
	05/10/79	65	0.02	89	48	1.3	79	7.3	17	270	0.4	260	210	420	210	865	705	1,300	7.9	26
	05/14/80	63	0.01	83	46	1.3	85	8.2	12	260	0.4	-	220	400	180	750	691	1,320	7.9	27
1120	07/17/75	45	0.02	45	43	1.3	69	14	43	130	1.4	281	230	290	61	530	530	920	7.4	26
	04/27/78	33	0.01	43	36	2.6	65	14	44	110	1.1	290	240	260	21	488	492	845	8.0	26
	05/09/79	46	0.03	40	38	2.3	52	14	31	87	1.1	290	240	260	21	457	454	770	7.8	26
	05/12/80	56	0.04	38	31	1.3	52	11	-	80	1.0	-	190	220	34	437	393	680	8.2	26
2244	04/26/78	23	0.03	45	40	1.9	190	10	49	390	1.4	220	180	280	99	833	859	1,520	8.2	24
	05/11/79	23	0.04	51	51	2.0	210	9.9	40	430	1.3	210	170	340	170	999	922	1,750	7.9	26
	05/14/80	22	0.01	44	42	1.8	210	9.6	42	380	1.3	-	170	280	110	958	855	1,700	7.9	27
2640	05/19/78	23	0.01	63	42	1.5	90	4.4	46	200	0.6	230	190	330	140	665	584	1,100	7.8	-
	05/10/79	25	0.02	62	42	1.9	68	4.5	40	200	0.6	240	200	330	130	587	562	1,040	7.0	26
	05/13/80	25	0.01	62	40	1.8	81	4.2	38	180	0.8	-	170	320	150	590	535	1,100	7.8	27
2641	05/18/78	51	0.01	49	37	2.0	55	9.5	14	150	0.9	240	200	280	80	513	487	870	-	27
	05/11/79	51	0.06	47	39	2.2	56	9.7	12	140	1.0	240	200	280	84	508	476	890	7.8	26
	05/14/80	50	0.01	47	35	2.2	61	10	8.9	140	1.1	-	200	260	64	509	475	930	8.2	28
2642	05/18/78	42	0.01	55	42	1.4	120	12	32	260	0.7	230	190	310	120	779	679	1,300	-	28
	05/10/79	44	0.00	57	45	1.8	120	12	33	280	0.9	230	190	330	140	740	707	1,390	7.8	25
	05/14/80	43	0.01	54	45	1.8	130	12	30	290	0.9	-	190	320	130	817	721	1,300	7.9	27

Table 4.--Major ion concentrations in ground water from the upper Hawthorn aquifer in Cape Coral and adjacent areas--Continued

[Concentrations in milligrams per liter, except as noted]

Well No.	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Strontium (Sr)	Sodium (Na)	Potassium (K)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Bicarbonate (HCO_3)	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$		Dissolved solids		Specific conductance (umhos/cm at 25°C)	pH (units)	Temperature (°C)
														Calcium/magnesium	Noncarbonate	Residue at 180°C	Calculated			
2643	05/16/78	27	0.01	88	97	9.5	550	24	190	1,100	0.7	220	180	630	450	2,400	2,190	3,860	-	-
	05/10/79	29	0.05	-	-	-	-	-	200	1,100	0.8	220	180	-	-	2,290	-	4,300	7.7	26
	05/14/80	30	0.03	97	100	7.2	540	24	190	980	0.9	-	180	660	480	2,460	2,080	3,900	7.8	27
2644	05/17/78	27	0.01	82	95	11	550	24	190	980	0.7	240	200	610	410	2,340	2,080	3,690	-	-
	05/10/79	28	0.11	79	100	9.9	520	26	210	980	0.9	240	200	620	420	2,240	2,070	3,800	7.8	26
	05/14/80	30	0.02	90	110	10	520	24	180	990	1.0	-	200	690	490	2,320	2,080	3,800	7.7	28
2645	05/23/78	31	0.01	70	58	6.3	210	15	71	460	0.9	240	200	420	220	1,160	1,040	1,930	-	26
	05/08/79	30	0.00	69	54	6.4	210	15	66	450	1.1	250	210	400	200	1,110	1,020	1,970	7.2	26
	05/16/80	32	0.01	62	55	6.5	210	14	59	430	1.1	-	200	390	190	1,080	990	1,900	-	26
2646	05/22/78	43	0.01	50	36	3.0	70	11	23	-	1.4	220	180	280	96	538	506	842	7.9	30
	05/07/79	39	0.08	38	35	2.9	37	10	17	85	1.6	230	190	240	54	409	379	670	7.3	24
2700	09/08/78	17	0.01	130	100	24	480	20	270	1,100	0.5	170	140	760	620	2,330	2,230	3,810	-	26
	05/08/79	17	0.01	120	100	26	450	21	260	980	0.5	170	140	740	600	2,270	2,060	4,000	7.4	28
	05/16/80	18	0.04	130	110	25	470	19	250	980	0.6	-	140	810	670	2,240	2,090	4,000	7.1	28
2701	09/06/78	21	0.00	41	25	1.3	37	4.1	13	52	1.1	240	200	210	10	303	314	-	8.0	26
	05/09/79	22	0.02	37	27	1.3	34	4	12	50	1.2	230	190	210	16	309	302	580	7.9	26
	05/13/80	23	0.01	34	26	1.2	45	4.2	11	52	1.3	-	200	190	0	302	-	580	8.2	28
2702	09/01/78	33	0.03	66	45	3.4	120	10	68	230	1.0	240	200	350	160	702	695	1,170	-	-
	05/09/79	34	0.00	57	44	3.4	96	8.5	63	230	1.0	250	210	330	120	693	660	1,160	8.0	26
	05/13/80	33	0.01	55	41	3.4	120	8.9	60	210	1.1	-	200	310	110	-	653	1,300	8.2	26

Table 4.--Major ion concentrations in ground water from the upper Hawthorn aquifer in Cape Coral and adjacent areas--Continued

[Concentrations in milligrams per liter, except as noted]

Well No.	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Strontium (Sr)	Sodium (Na)	Potassium (K)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Bicarbonate (HCO_3)	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$		Dissolved solids		Specific conductance (umhos/cm at 25°C)	pH (units)	Temperature (°C)
														Calcium/magnesium	Noncarbonate	Residue at 180°C	Calculated			
2703	08/31/78	39	0.00	62	46	2.6	190	11	69	380	0.8	220	180	350	170	991	909	1,710	7.9	25
	05/10/79	34	0.00	67	46	1.8	200	12	74	420	0.7	230	190	360	170	1,020	973	1,750	7.6	25
	05/14/80	37	0.01	62	44	1.8	200	11	71	400	0.8	-	180	340	160	1,120	936	1,800	8.1	26
2820	09/19/78	19	0.00	83	64	7.8	210	21	19	560	1.3	180	150	480	330	1,250	1,070	2,260	-	26
	05/08/79	18	0.00	84	66	7.9	250	23	28	650	1.4	180	150	490	340	1,480	1,220	2,500	7.3	26
	05/16/80	20	0.03	95	74	9.0	270	22	25	660	1.4	-	140	550	410	1,380	1,260	2,575	-	28
2821	10/26/78	25	0.00	66	74	6.8	250	20	210	480	1.8	200	160	480	310	1,250	1,230	2,050	-	-
	05/08/79	24	0.00	63	68	7.1	240	20	220	420	1.8	190	160	450	290	1,250	-	2,170	7.6	28
	05/16/80	24	0.02	72	76	8.6	260	18	200	510	1.8	-	150	500	350	1,310	1,260	2,300	-	28

Table 5.--Chloride concentrations and specific conductance in ground water from the surficial aquifer in Cape Coral and adjacent areas for May 1980

Local well No.	Specific conductance (umhos/cm at 25°C)	Chloride (mg/L)
1136	575	30
2536	57,000	20,500
3203	485	40
3205	3,200	740
3206	14,300	4,040
3207	4,900	1,260
3208	9,100	1,140
3214	600	60
3215	1,170	250
3231	22,500	8,100
3232	1,020	145
3233	2,250	400
3234	25,000	9,600
3235	920	75
3236	1,650	260
3237	8,500	2,500
3239	1,850	280
3240	570	45
3243	2,750	725
3245	710	10
3249	660	10
3250	575	15
3252	16,600	5,100
3253	44,000	21,200
3255	900	80
3256	735	45
3257	585	40
3258	700	15
3259	970	125
3260	815	75

Table 6.--Major ion concentrations in ground water from the lower Hawthorn aquifer in Cape Coral and adjacent areas

[Concentrations in milligrams per liter, except as noted]

Well No.	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Strontium (Sr)	Sodium (Na)	Potassium (K)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Bicarbonate (HCO_3)	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$		Dissolved solids		Specific conductance (umhos/cm at 25°C)	pH (units)	Temperature (°C)
														Calcium/magnesium	Noncarbonate	Residue at 180°C	Calculated			
2434	06/16/78	21	0.00	56	69	8.4	220	18	130	400	2.2	240	200	430	240	1,200	1,040	1,900	7.5	26
2525	06/22/78	26	0.00	70	67	9.3	230	19	180	420	1.7	190	160	460	310	1,190	1,120	2,060	7.6	27
2526	06/22/78	15	0.00	74	81	13	300	15	150	580	1.7	170	140	530	390	1,420	1,310	2,530	7.8	28
2527	06/22/78	17	0.00	170	160	27	920	30	310	1,900	1.2	150	120	1,100	990	4,230	3,610	6,510	7.5	27
2528	06/09/78	16	0.01	99	100	20	500	22	240	920	1.2	170	140	680	540	2,220	2,000	3,650	7.4	28

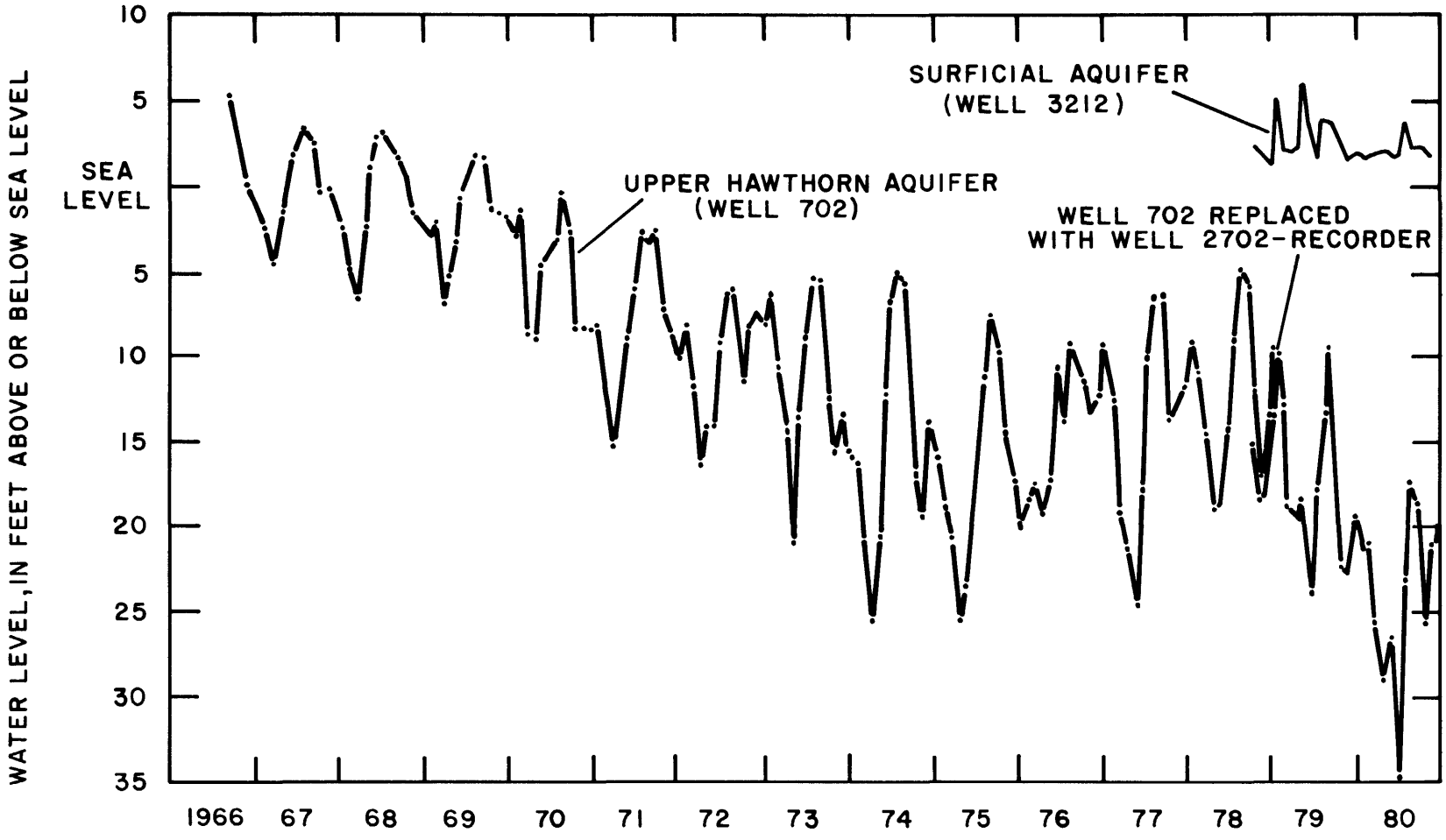

Figure 6.--Water levels in wells 702 and 2702 that tap the upper Hawthorn aquifer and well 3212 that taps the surficial aquifer.

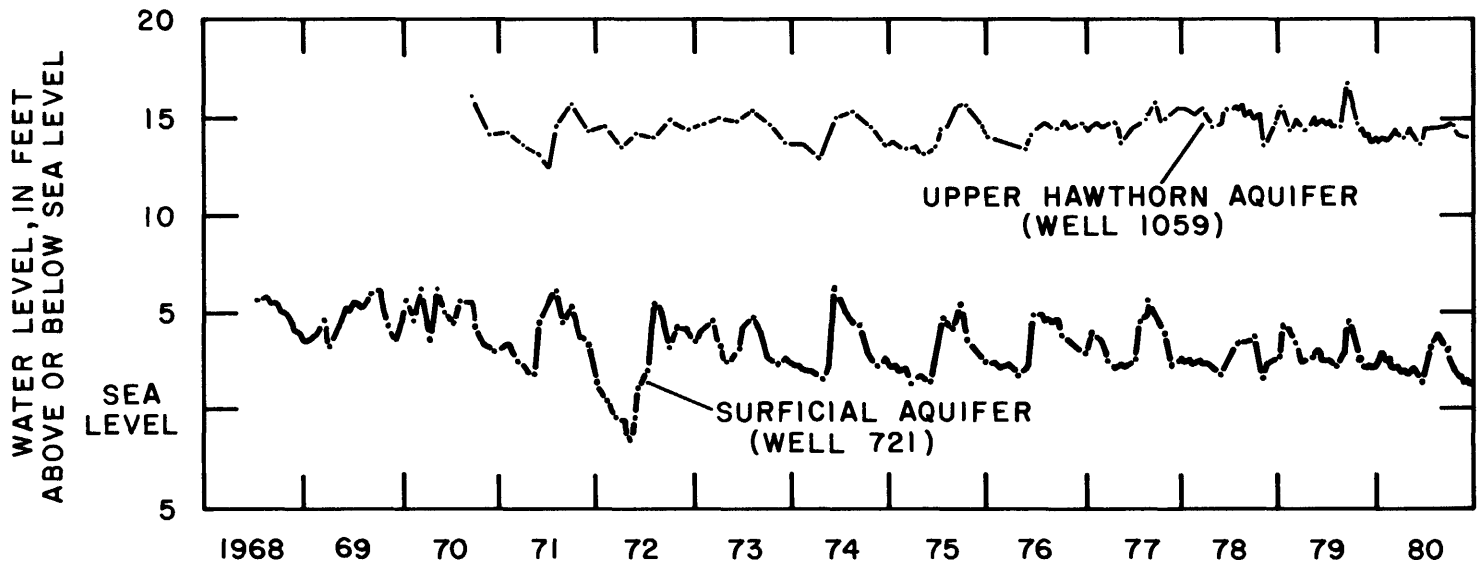

Figure 7.--Water levels in well 1059 that taps the upper Hawthorn aquifer and well 721 that taps the surficial aquifer.

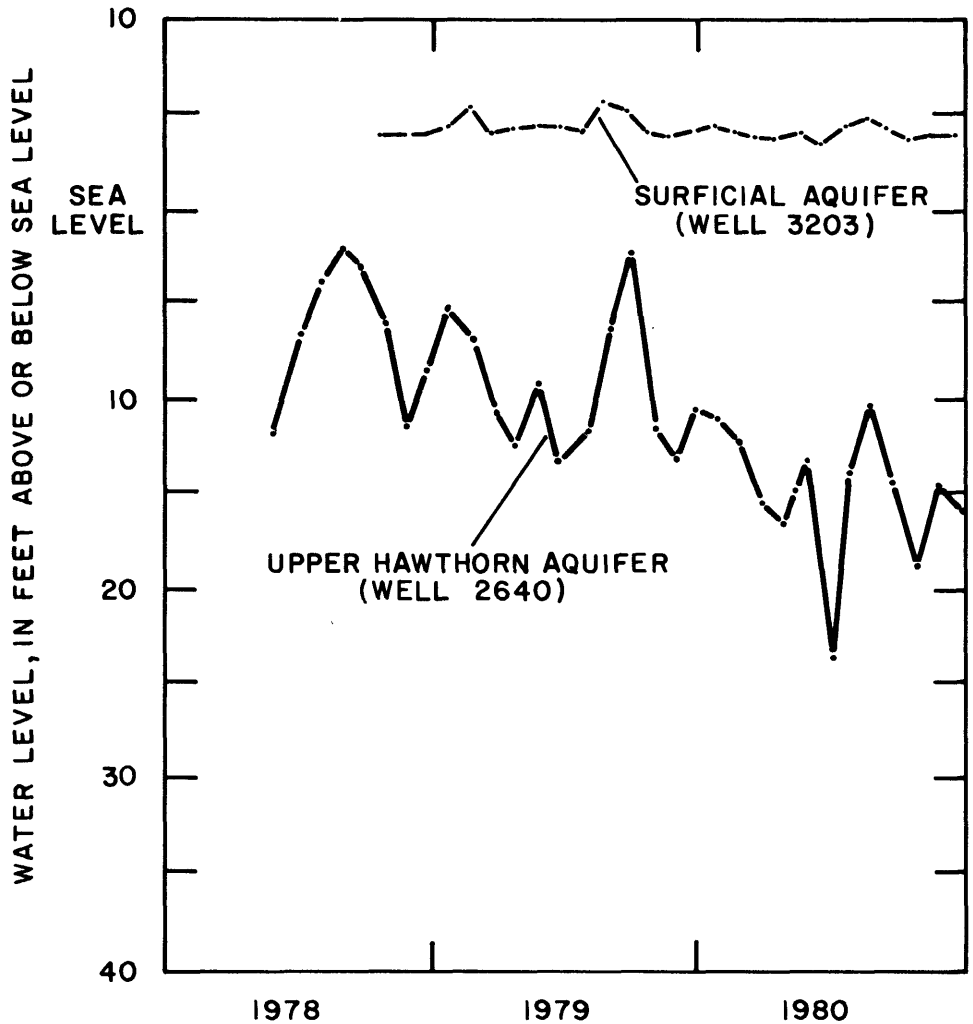

Figure 8.--Water levels in well 2640 that taps the upper Hawthorn aquifer and well 3203 that taps the surficial aquifer.

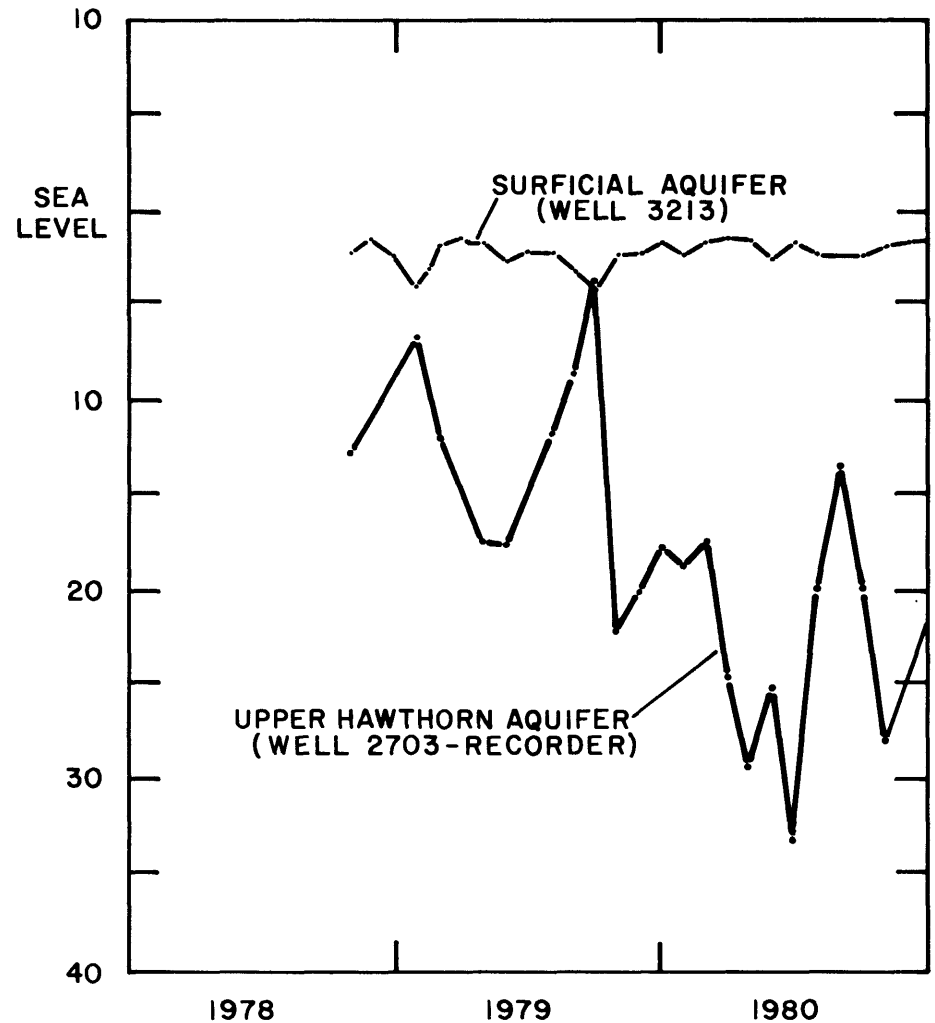

Figure 9.--Water levels in well 2703 that taps the upper Hawthorn aquifer and well 3213 that taps the surficial aquifer.

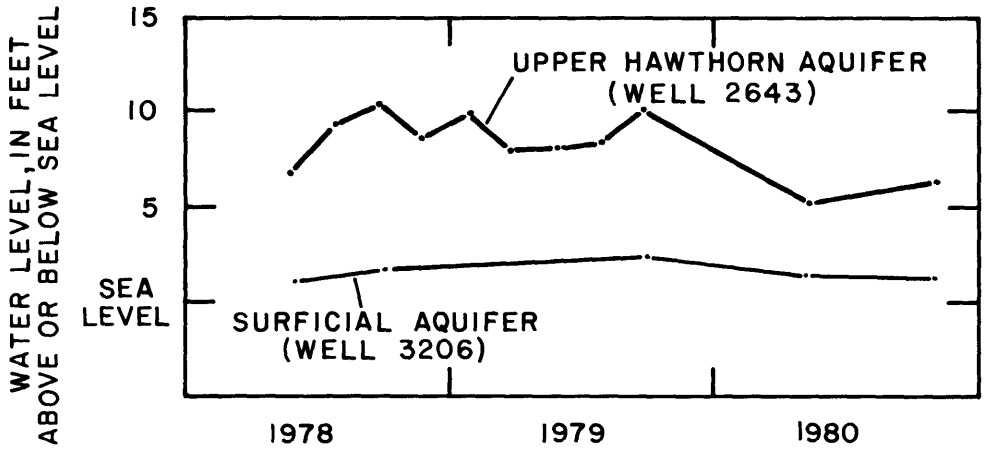

Figure 10.--Water levels in well 2643 that taps the upper Hawthorn aquifer and well 3206 that taps the surficial aquifer.

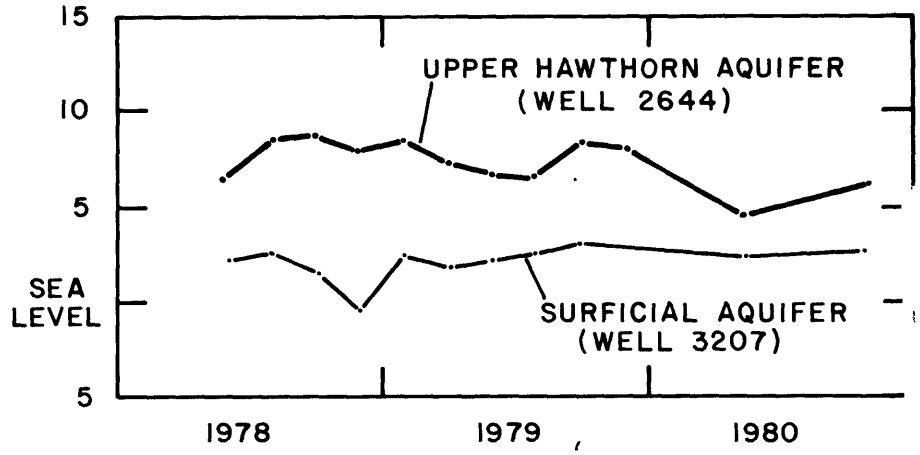

Figure 11.--Water levels in well 2644 that taps the upper Hawthorn aquifer and well 3207 that taps the surficial aquifer.

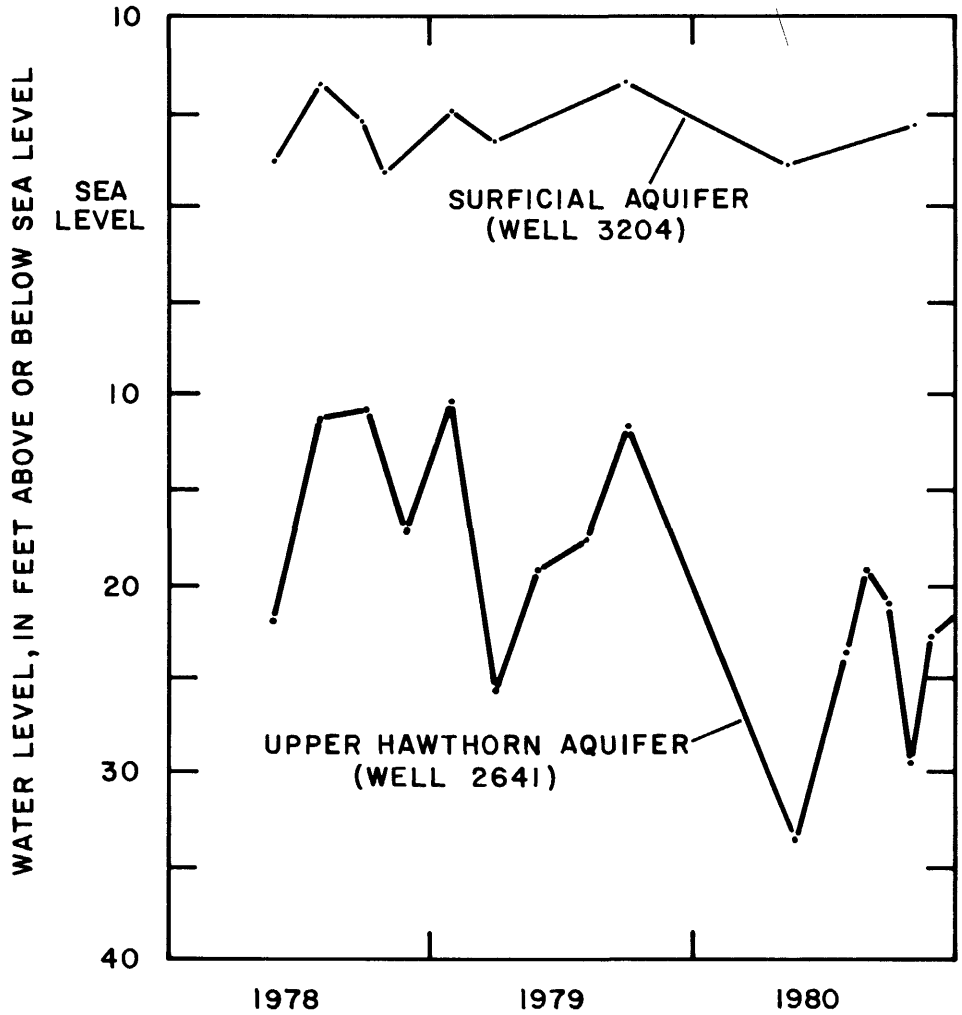

Figure 12.--Water levels in well 2641 that taps the upper Hawthorn aquifer and well 3204 that taps the surficial aquifer.

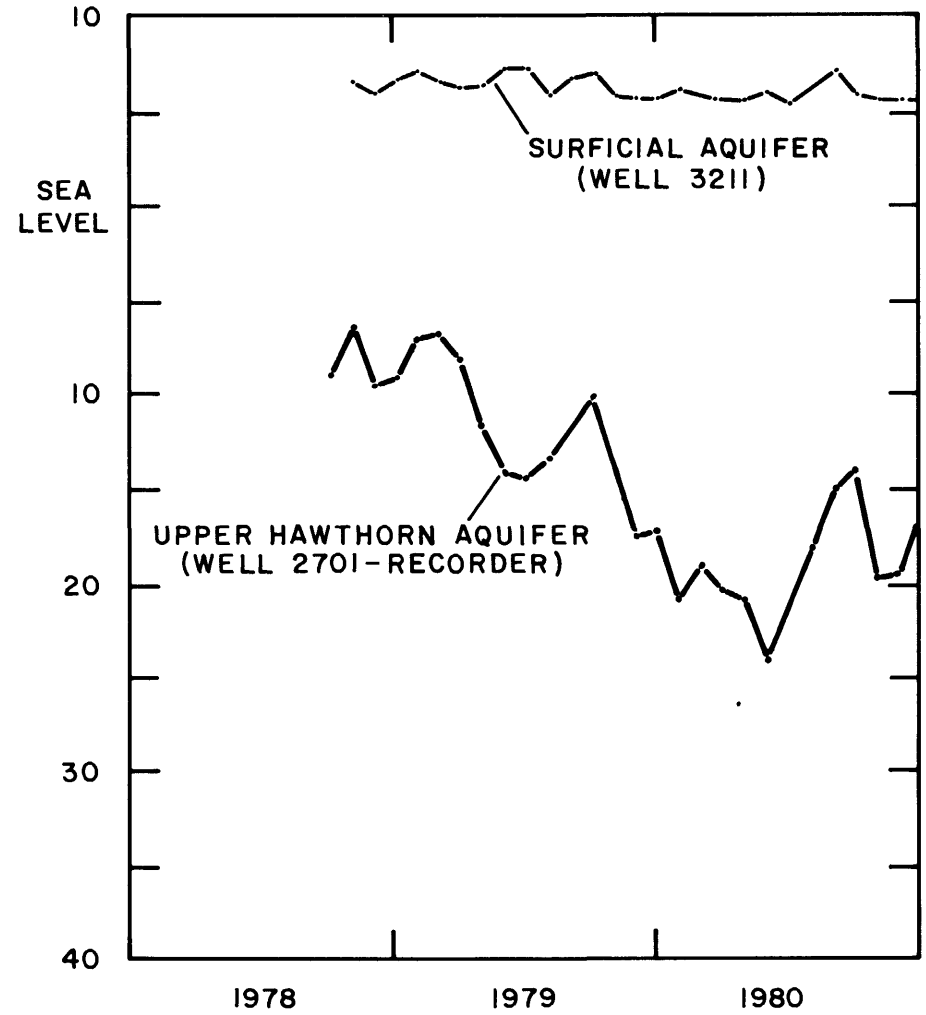

Figure 13.--Water levels in well 2701 that taps the upper Hawthorn aquifer and well 3211 that taps the surficial aquifer.

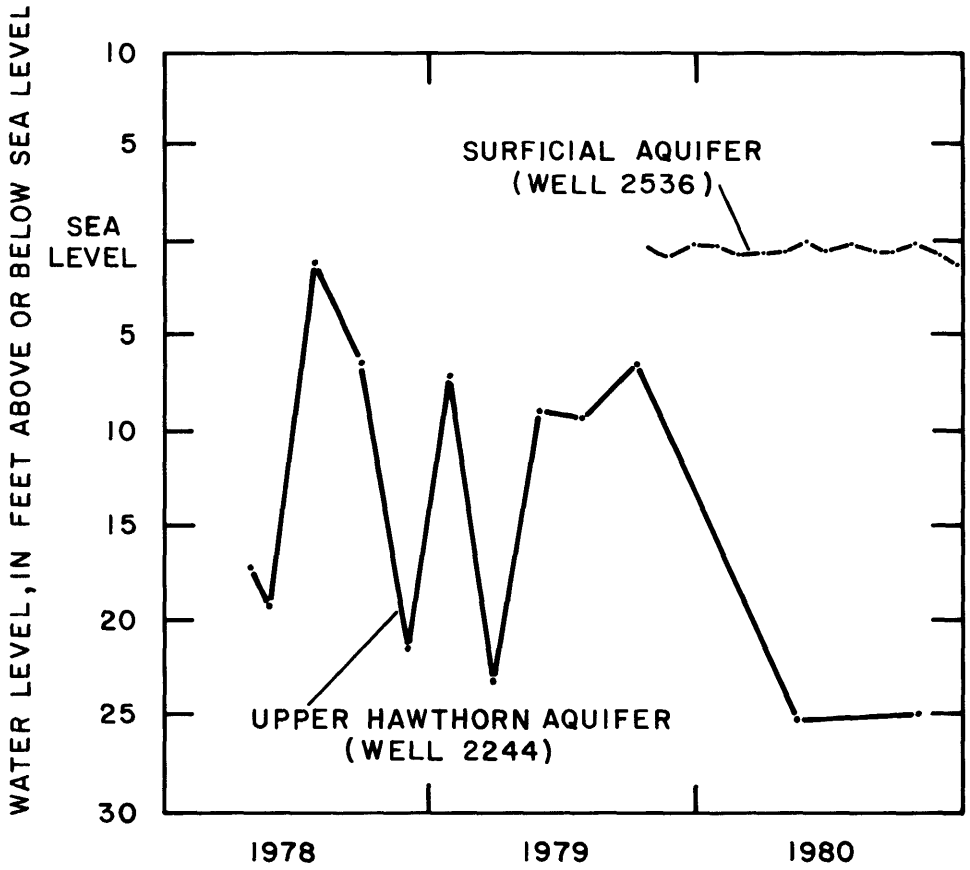

Figure 14.--Water levels in well 2244 that taps the upper Hawthorn aquifer and well 2536 that taps the surficial aquifer.

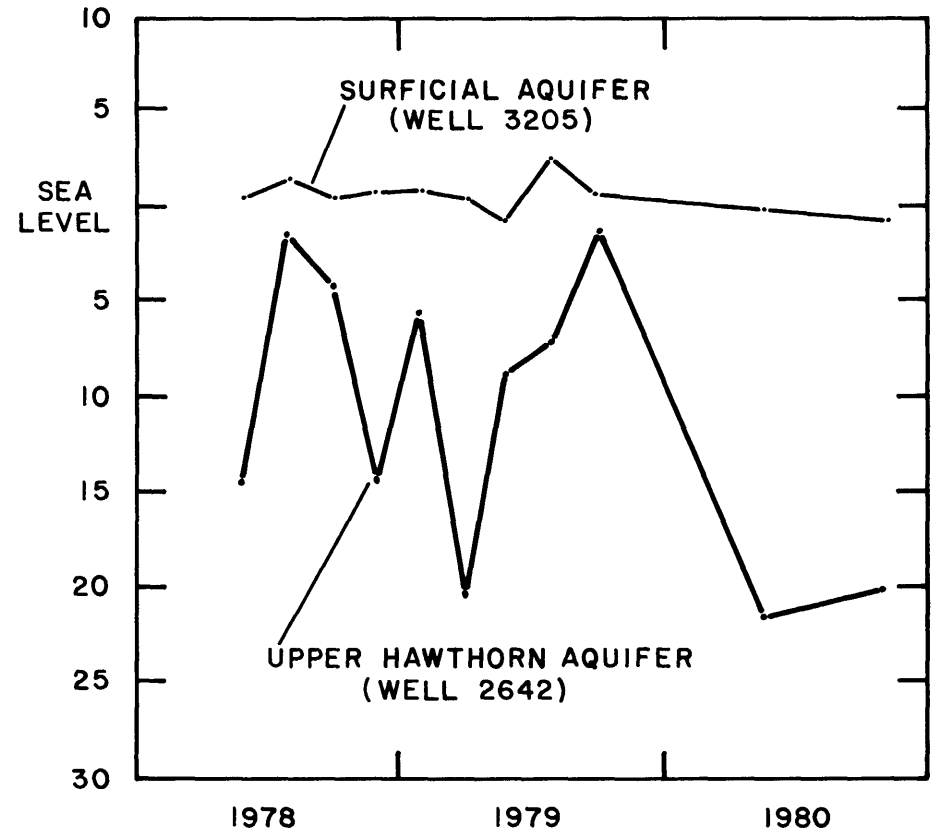

Figure 15.--Water levels in well 2642 that taps the upper Hawthorn aquifer and well 3205 that taps the surficial aquifer.

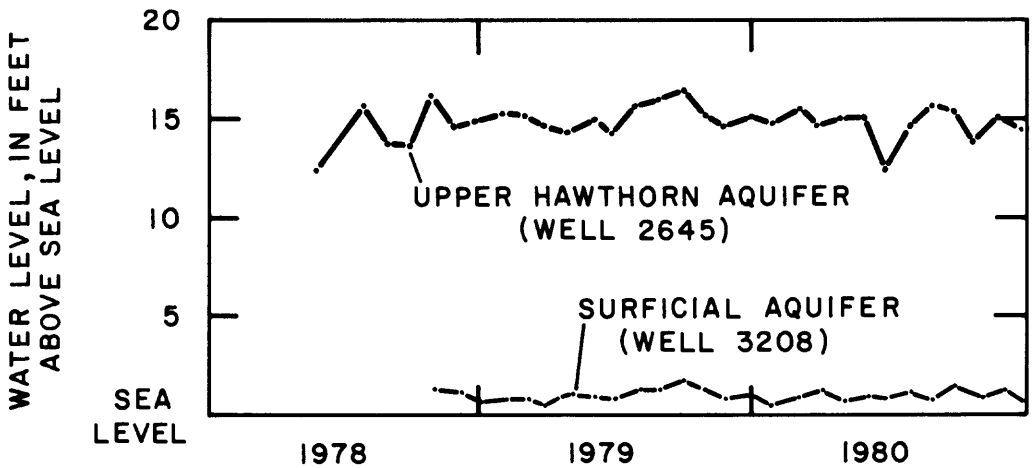

Figure 16.--Water levels in well 2645 that taps the upper Hawthorn aquifer and well 3208 that taps the surficial aquifer.

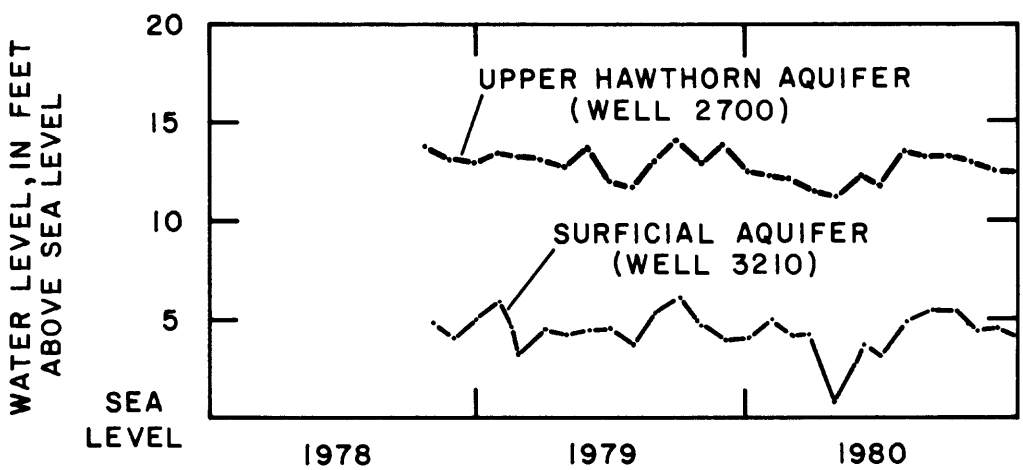

Figure 17.--Water levels in well 2700 that taps the upper Hawthorn aquifer and well 3210 that taps the surficial aquifer.

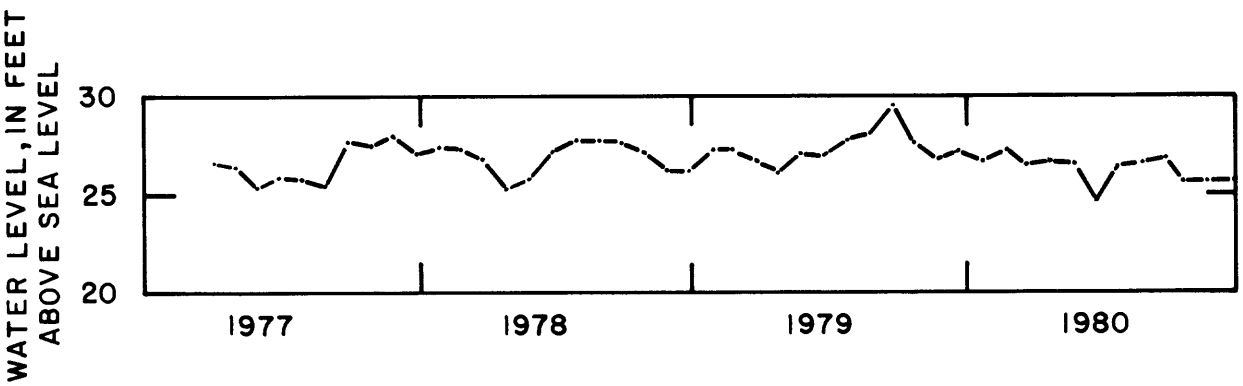

Figure 18.--Water levels in well 2435 that taps the lower Hawthorn aquifer.

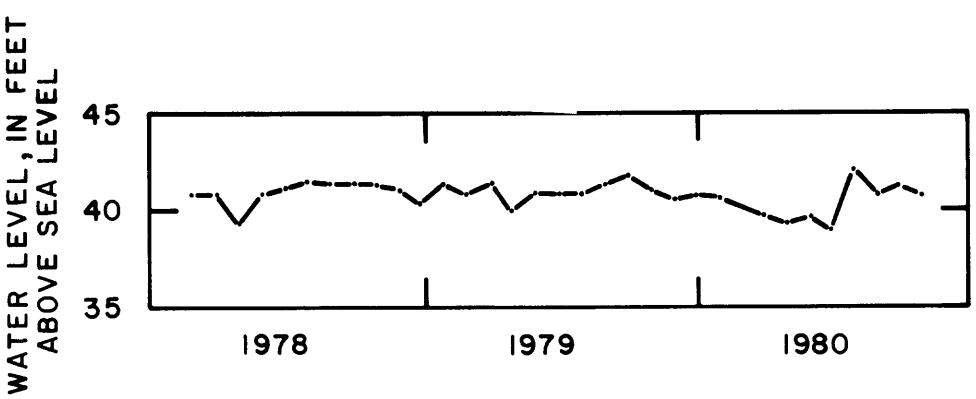

Figure 19.--Water levels in well 2526 that taps the lower Hawthorn aquifer.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas

Well 2434	
Depth (feet)	Description
0-15	Sand, fine to medium, tan, slightly phosphatic; some limestone.
15-25	Same, shell fragments.
25-30	Clay, gray, sandy; some limestone and shell fragments.
30-40	Clay, gray; some limestone.
40-45	Sandstone, dark gray, clayey; some limestone.
45-80	Clay, green.
80-90	Clay, green; some shell.
90-105	Clay, gray-green, sandy; some phosphate gravel and limestone.
105-135	Limestone, gray-white, marly, phosphatic.
135-150	Limestone, gray-white, sandy, marly, phosphatic.
150-165	Limestone, gray-white, phosphatic.
165-190	Limestone, gray-white, marly, phosphatic.
190-205	Same, more marl.
205-225	Limestone, gray-white, marly, and phosphatic.
225-230	Limestone, gray-white, marly; some phosphate.
230-255	Limestone, gray-white, phosphatic, and marl.
255-270	Same, less phosphate.
270-275	Marl, gray-white, phosphatic; some limestone.
275-280	Limestone, gray-white, marly, phosphatic.
280-300	Marl, gray-white, phosphatic; some limestone.
300-315	Clay, gray-green, phosphatic; some limestone.
315-330	Limestone, gray-white, marly, phosphatic.
330-335	Marl, gray-white phosphatic; some limestone.
335-340	Limestone, gray-white, marly, phosphatic.
340-355	Marl, gray-white, phosphatic; some limestone.
355-370	Limestone, gray-white, marly, phosphatic.
370-400	Same, less marl.
400-415	Limestone, gray-white, marly.
415-420	Same, slightly crystalline; some phosphate.
420-515	Limestone, gray-white, marly, slightly crystalline.
515-570	Limestone, gray-white, crystalline, marly.
570-605	Limestone, gray-white, marly.
605-675	Limestone, gray-white, crystalline, marly.
675-700	Limestone, gray-white, marly, crystalline.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2525	
Depth (feet)	Description
0-5	Sand, fine, brown.
5-10	Sand, fine, tan; shell.
10-27	Shell fragments, some sand.
27-30	Shell, limestone fragments.
30-40	Limestone, gray and tan, sandy; shell fragments.
40-55	Clay, gray, sandy.
55-135	Clay, green.
135-140	Clay, gray and white, phosphatic.
140-145	Clay, white.
145-155	Clay, gray and white, sandy, phosphatic.
155-165	Clay, gray, phosphate gravel.
165-185	Clay, gray, phosphatic.
185-210	Clay, gray, sandy, phosphatic.
210-240	Sand, fine, gray, phosphatic, clayey.
240-265	Marl, gray, sandy, phosphatic.
265-290	Limestone, gray, phosphatic, marly.
290-340	Limestone, gray-white, sandy, phosphatic.
340-360	Limestone, gray-white, sandy, phosphatic, marly.
360-417	Limestone, gray-white, slightly phosphatic.
417-420	Limestone, dark gray and tan, hard, phosphatic.
420-430	Marl, green.
430-440	Marl, gray-white, phosphatic.
440-445	Marl, green, phosphatic.
445-485	Limestone, gray and tan, hard.
485-505	Limestone, gray, phosphatic.
505-525	Marl, gray-white, phosphatic.
525-545	Limestone, tan, phosphatic.
545-555	Marl, gray, phosphatic.
555-625	Limestone, tan, sugary.
625-645	Limestone, light gray, slightly phosphatic.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2526	
Depth (feet)	Description
5-10	Limestone, creamy tan, sandy, marly; some shell fragments.
10-15	Sand, fine, tan, marly; some limestone and shell fragments.
15-20	Sand, fine, dark tan, marly; some fill and shell fragments.
20-30	Limestone, creamy tan, sandy.
30-35	Sandstone, creamy tan, marly; some limestone.
35-50	Clay, gray, sandy; some limestone.
50-55	Clay, green, sandy; some limestone and shell fragments.
55-65	Clay, gray, sandy; some shell fragments.
65-80	Clay, gray, sandy; some limestone.
80-125	Clay, green, sandy.
125-130	Sandstone, gray, marly, phosphatic; some limestone.
130-145	Sand, fine, dark gray, marly, phosphatic; some limestone.
145-160	Limestone, gray-white, sandy, marly, phosphatic.
160-170	Sandstone, gray-white, phosphatic; some limestone.
170-185	Sandstone, gray-white, phosphatic, dolomitic; some limestone.
185-200	Limestone, gray-white, sandy, phosphatic.
200-205	Sandstone, gray-white, phosphatic; some limestone.
205-225	Limestone, white, sandy, phosphatic.
225-250	Limestone, gray-white, sandy, marly, phosphatic.
250-265	Limestone, gray-white, sandy, very marly, phosphatic.
265-275	Marl, tan; some limestone.
275-295	Limestone, gray, marly, sandy, phosphatic.
295-305	Limestone, white to gray, very marly, phosphatic.
305-310	Sand, fine to medium tan, very marly; some limestone.
310-330	Clay, white to gray, phosphatic.
330-340	Limestone, gray-white, marly, phosphatic; some shell fragments.
340-375	Limestone, gray-white, very marly, phosphatic.
375-405	Limestone, gray-white, sandy, phosphatic.
405-415	Limestone, gray-white, marly, phosphatic.
415-435	Marl, white to gray, phosphatic; some limestone.
435-445	Limestone, gray-white, marly, phosphatic.
445-485	Marl, gray-white, phosphatic; some limestone.
485-495	Limestone, gray-white, marly, very phosphatic.
495-505	Limestone, gray-white, marly, phosphatic.
505-535	Limestone, white to gray, marly.
535-545	Marl, white to gray, slightly phosphatic, some limestone.
545-555	Limestone, tan, marly.
555-595	Marl, white to gray; some limestone.
595-605	Limestone, tan-white, marly, slightly phosphatic.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2527	
Depth (feet)	Description
0-20	Sand, fine to medium, tan; shell fragments.
20-55	Limestone, creamy tan, sandy; some crystalline, gray, limestone; shell fragments.
55-65	Sandstone, creamy tan and limestone, gray, crystalline.
65-70	Same as above; some shell fragments.
70-85	Marl, gray, sandy, slightly phosphatic; some limestone.
85-100	Sand, fine to medium, dark green, very marly, phosphatic; some shell fragments.
100-120	Clay, gray-green, sandy, phosphatic; some limestone.
120-160	Clay, green, sandy.
160-170	Sand, medium, green, very marly, phosphatic.
170-180	Limestone, green, marly, phosphatic.
180-195	Clay, green, slightly phosphatic.
195-205	Clay, green, sandy, very phosphatic; some limestone.
205-215	Limestone, gray-white, slightly marly.
215-235	Limestone, gray-white, marly, phosphatic.
235-245	Marl, gray-white, phosphatic; some limestone.
245-275	Limestone, gray-white, marly, phosphatic.
275-285	Marl, gray-white, phosphatic; some limestone.
285-325	Limestone, gray-white, marly, phosphatic.
325-375	Marl, gray-white, phosphatic; some limestone.
375-385	Marl, gray-white, phosphatic; some limestone, and dolomite.
385-405	Limestone, gray-white, crystalline.
405-425	Marl, gray-white, phosphatic; some limestone.
425-435	Limestone, gray-white, slightly marly.
435-455	Limestone, white to gray, slightly crystalline.
455-505	Limestone, gray-white, slightly phosphatic, crystalline.
505-525	No sample.
525-555	Limestone, gray-white, slightly phosphatic and crystalline.
555-565	Limestone, white to tan, slightly crystalline.
565-605	Limestone, gray-white and tan, crystalline.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2528	
Depth (feet)	Description
0-10	Shell, creamy tan, sandy.
10-20	Sandstone, creamy tan; shell fragments.
20-40	Marl, creamy tan, sandy; shell fragments.
40-50	Clay, gray; some shell fragments.
50-65	Sand, medium, dark brown, very clayey; some shell fragments.
65-85	Clay, green, sandy; some shell.
85-105	Same, phosphatic.
105-125	Sand, medium to coarse, gray-green, marly; some shell.
125-145	Same, without shell.
145-165	Clay, green, sandy.
165-225	Clay, dark gray, sandy; some shell fragments.
225-245	Sand, medium to coarse, dark gray, very marly.
245-260	Clay, gray, sandy; some shell fragments.
260-275	Sand, medium to coarse, gray, marly, phosphatic; some shell fragments.
275-295	Same as above; some limestone.
295-305	Clay, green, sandy; some shell fragments and limestone.
305-345	Sand, medium to coarse, dark gray, marly, phosphatic; some limestone and shell fragments.
345-405	Limestone, gray-white, marly, phosphatic.
405-415	Same, some crystalline limestone.
415-435	Limestone, gray-white, very marly, phosphatic.
435-465	Limestone, gray-white, phosphatic, slightly crystalline.
465-625	No samples available.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2536	
Depth (feet)	Description
0-10	Sand, fine to medium dark brown.
10-19	Sand, medium to coarse, light brown.
19-20	Sand and shell, phosphatic, clayey.
20-30	Clay, gray.
30-45	Clay, green, sandy.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2640	
Depth (feet)	Description
0-10	Sand, tan, medium grained; some shell fragments and white clay.
10-30	Limestone, creamy tan, sandy, marly and shell fragments.
30-40	Clay, green; some shell fragments.
40-70	Clay, green.
70-80	Clay, green; some shell fragments.
80-90	Clay, green, sandy; some shell fragments.
90-100	Sand, fine, gray, clayey; some shell.
100-110	Sand, fine, gray, very clayey; phosphate gravel.
110-120	Sand, fine, dark gray, clayey, phosphatic.
120-130	Limestone, gray-white, sandy, phosphatic.
130-140	Limestone, gray-white, phosphatic.
140-180	Limestone, gray-white, marly, phosphatic.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2641	
Depth (feet)	Description
0-10	Sand, tan; some marl; shell fragments.
10-20	Limestone creamy tan, sandy; some shell fragments.
20-30	Sand, tan, marly; some limestone; phosphate.
30-40	Clay, green; some shell fragments.
40-80	Clay, green.
80-90	Clay, green, sandy; some shell fragments.
90-100	Sand, fine, dark gray, clayey, phosphatic.
100-120	Limestone, gray-white, sandy, phosphatic.
120-140	Limestone, gray-white, marly; sand, phosphatic.
140-170	Limestone, gray-white, very marly, sandy, phosphatic.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2642	
Depth (feet)	Description
0-10	Sand, fine to medium, tan; some limestone.
10-30	Sand, fine to medium, tan, clayey; some limestone.
30-40	Clay, gray, sandy; some limestone, shell fragments.
40-60	Clay, gray, very sandy, phosphatic.
60-70	Clay, green, sandy; some limestone; shell fragments.
70-80	Clay, green, sandy.
80-90	Clay, gray, sandy.
90-100	Clay, dark gray, sandy, very phosphatic.
100-120	Limestone, gray-white, sandy, phosphatic.
120-140	Limestone, gray-white, marly, sandy, phosphatic.
140-160	Limestone, gray-white, very marly, sandy, phosphatic.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2643	
Depth (feet)	Description
0-10	Sand, fine to medium, tan.
10-30	Sand, fine to medium, tan; some limestone; shell fragments.
30-40	Sand, fine to medium, tan, clayey, phosphatic; some limestone.
40-50	Clay, gray, sandy; some shell fragments.
50-60	Clay, green, sandy; some shell.
60-80	Clay, green.
80-90	Clay, green, sandy.
90-110	Clay, green.
110-120	Clay, gray, sandy, phosphatic.
120-130	Clay, dark gray, sandy, phosphatic.
130-140	Limestone, gray-white, marly, sandy, phosphatic.
140-160	Limestone, gray-white, sandy, phosphatic.
160-190	Limestone, gray-white, sandy, marly, phosphatic.
190-200	Limestone, gray-white, sandy, very marly, phosphatic.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2644	
Depth (feet)	Description
0-10	Sand, fine to medium, tan.
10-30	Sand, fine to medium, tan; some limestone; shell fragments.
30-40	Sand, fine to medium, tan, marly; some limestone; shell fragments.
40-50	Sand, fine to medium, tan, very marly; some limestone and shell fragments.
50-60	Clay, gray, sandy; some shell fragments.
60-70	Clay, gray, some shell fragments.
70-100	Clay, green; some shell.
100-120	Clay, green.
120-140	Sand, dark gray, clayey; some limestone, phosphate.
140-160	Limestone, gray-white, sandy, phosphatic.
160-178	Limestone, gray-white, marly, sandy, phosphatic.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2645	
Depth (feet)	Description
0-10	Sand, fine to medium, tan, clayey, phosphatic.
10-20	Sand, fine to medium, tan, clayey, some shell fragments; fill.
20-50	Limestone, creamy tan, sandy, marly; some shell fragments.
50-70	Clay, gray, sandy; some limestone.
70-90	Clay, green; some shell fragments.
90-130	Clay, green.
130-150	Sand, dark gray, clayey, phosphatic; some limestone.
150-170	Limestone, gray-white, sandy, phosphatic.
170-190	Limestone, gray-white, marly, sandy, phosphatic.
190-210	Limestone, gray-white, very marly, sandy, phosphatic.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2646	
Depth (feet)	Description
0-10	Limestone, creamy tan; some shell.
10-20	Limestone, creamy tan, marly, sandy.
20-40	Clay, gray; some limestone and shell fragments.
40-50	Clay, green, sandy; some shell.
50-90	Clay, green.
90-100	Clay, green, sandy; some shell fragments.
100-140	Sand, dark gray, clayey, phosphatic; some limestone.
140-160	Limestone, gray-white, sandy, phosphatic.
160-180	Limestone, gray-white, sandy, marly, phosphatic.
180-200	Limestone, gray-white, marly; sand, very fine, phosphatic.
200-220	Limestone, gray-white, marly, sandy, phosphatic.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2700	
Depth (feet)	Description
0-10	Sand, fine, tan and shell fragments.
10-20	Limestone, tan, sandy and shell fragments.
20-30	Limestone, tan, marly, phosphatic and shell fragments.
30-70	Clay, green.
70-90	Clay, green and shell fragments.
90-100	Clay, green, sandy.
100-110	Sand, fine, gray.
110-120	Sand, fine, gray, clayey, phosphatic; shell fragments.
120-130	Sandstone, gray, phosphatic.
130-140	Sand, dark gray, fine, phosphatic.
140-150	Sand, gray, fine, clayey, phosphatic.
150-160	Limestone, gray-white, sandy, phosphatic.
160-170	Limestone, gray, sandy, marly, phosphatic.
170-180	Limestone, gray-white, sandy, phosphatic.
180-205	Limestone, gray-white, sandy, phosphatic; some shell fragments.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2701	
Depth (feet)	Description
0-10	Limestone, iron stained, sandy and shell fragments.
10-20	Sand, fine, tan and shell fragments.
20-30	Sand, medium, tan and shell fragments.
30-40	Limestone, gray; sand, medium, tan; shell fragments.
40-50	Limestone, gray and shell fragments.
50-60	Sand, fine, gray, clayey; shell fragments; some limestone.
60-70	Clay; sandstone, gray; shell fragments.
70-80	Clay, green, slightly sandy.
80-100	Clay, green.
100-110	Sandstone, gray; shell fragments.
110-120	Sandstone, gray, clayey, phosphatic; shell fragments.
120-130	Sand, fine, dark gray, clayey, phosphatic.
130-140	Marl, gray-white, sandy, phosphatic.
140-150	Limestone, gray-white, sandy, phosphatic.
150-170	Limestone, gray-white, phosphatic.
170-190	Limestone, gray-white, marly, phosphatic.
190-206	Limestone, gray-white, phosphatic.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2702	
Depth (feet)	Description
0-10	Sand, fine to medium, tan.
10-20	Sand, fine to medium, tan and shell fragments.
20-30	Clay, gray; shell fragments.
30-50	Limestone, gray, marly; shell fragments.
50-60	Limestone, gray; green clay; shell fragments.
60-70	Clay, green.
70-80	Clay, green; sandstone, gray; shell fragments.
80-95	Sand, dark gray, very phosphatic, clayey.
95-155	Limestone, gray-white, phosphatic.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2703	
Depth (feet)	Description
0-10	Sand, fine to medium, tan.
10-30	Limestone, tan, sandy.
30-50	Limestone, gray, sandy, marly.
50-70	Sand, very fine and green clay.
70-90	Clay, green, sandy.
90-100	Clay, gray, sandy; slightly phosphatic.
100-110	Sand, dark gray, clayey, very phosphatic.
110-140	Limestone, gray-white, phosphatic.
140-150	Limestone, gray-white, clayey, phosphatic.
150-159	Limestone, gray-white, phosphatic; shell fragments.

Table 7.--Lithologic logs of wells in Cape Coral and adjacent areas--Continued

Well 2820	
Depth (feet)	Description
0-10	Sand, fine, tan.
10-50	Sand, fine, tan and shell fragments.
50-60	Sandstone, tan and shell fragments.
60-70	Sandstone, tan; limestone, gray; shell fragments.
70-90	Limestone, gray, marly, sandy and green clay.
90-160	Clay, green, sandy.
160-170	Clay, green, sandy, slightly phosphatic
170-190	Sand, very fine, green, slightly phosphatic.
190-200	Sand, very fine, green, phosphatic; some gray clay.
200-210	Sand, gray, slightly phosphatic, some limestone.
210-220	Limestone, gray-white, marly, slightly phosphatic; shell fragments.
220-230	Limestone, gray, marly, phosphatic.
230-241	Limestone, gray-white, marly, phosphatic.