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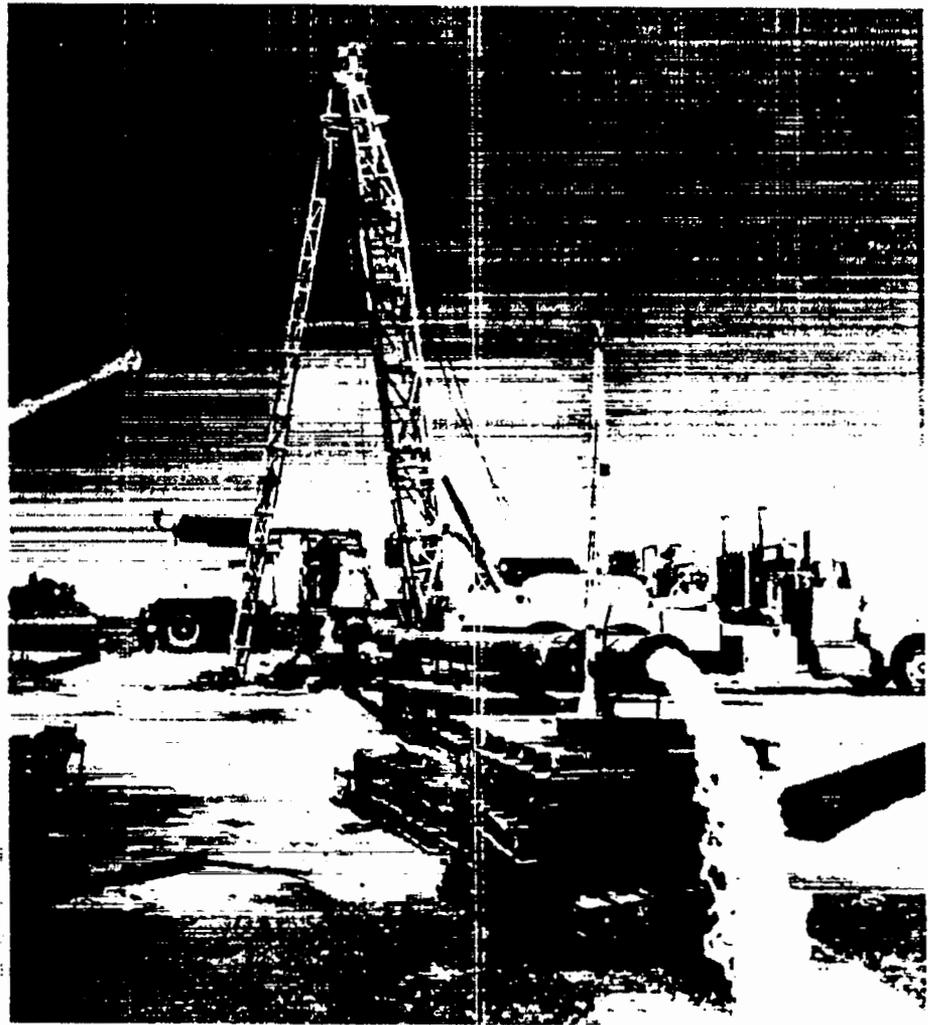
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Water Supply at Los Alamos During 1986



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Cover photo: Aquifer test at supply well PM-5, Pajarito Well Field, Los Alamos, New Mexico, August 1982.

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Water Supply at Los Alamos During 1986

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WATER SUPPLY AT LOS ALAMOS DURING 1986

by

W. D. Purtymun, A. K. Stoker, and M. N. Maes

ABSTRACT

Water supply operations during 1986 were satisfactory with municipal and industrial usage supplied by 1497×10^6 gal. from wells in three well fields and 28×10^6 gal. from the spring gallery in Water Canyon. About 2.4×10^6 gal. of water from Guaje Reservoir and 1.5×10^6 gal. from Los Alamos Reservoir were used for irrigation; thus the total water usage in 1986 was about 1529×10^6 gal. The total water usage was down in 1986 about 99×10^6 gal. from the total usage of 1628×10^6 gal. in 1985. Primary and secondary chemical quality of water in the distribution system was in compliance with federal regulations.

I. INTRODUCTION

This report summarizes pumpage and aquifer conditions for wells in the Los Alamos, Guaje, and Pajarito well fields (Fig. 1). These wells supply most of the water used for municipal and industrial purposes in Los Alamos County and at the Los Alamos National Laboratory. The spring gallery in Water Canyon supplies the balance of water to the system. A summary of surface water data from Guaje and Los Alamos Reservoirs used for irrigation of lawns is included in this report. The chemical quality of water from wells, gallery (spring), and the distribution system is also discussed.

This report is a joint effort between the Environmental Surveillance Group (HSE-8), Los Alamos National Laboratory, and the Utilities Department of Pan American World Services (Pan Am). The purpose of the report is to ensure a continuing historical record and to provide guidance for management of water resources and long-range planning for the water supply system. We have issued 1 summary report (1947-1971) and 15 annual reports as a result of these studies.¹⁻¹⁶ An additional report summarizes the hydrology of the main aquifer with reference to future development of ground water supplies.¹⁷

Pan Am World Services is the support services contractor to the Los Alamos National Laboratory and the Department of Energy at Los Alamos. Pan Am maintains and operates the water supply system. Water is pumped from the wells into distribution lines and is lifted by booster pumps through chlorination stations into

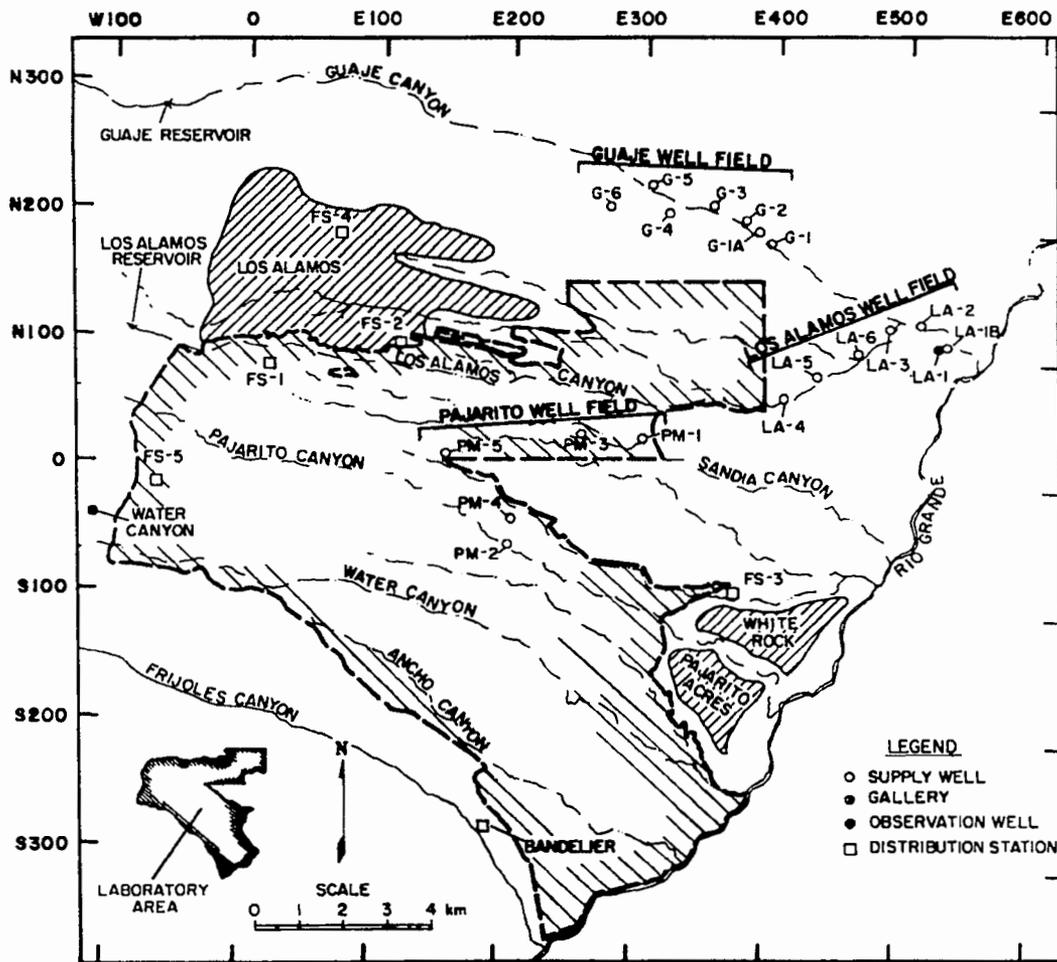


Fig. 1. Location of reservoirs, well fields, supply wells, and gallery water supply.

reservoirs for storage and distribution to the community and Laboratory areas (Fig. 1). Water from the gallery flows by gravity through microfilter and chlorination stations and is pumped into one of the system reservoirs for distribution. Pan Am maintains monthly records of hours of operation for each well along with records of daily and monthly production. The monthly average nonpumping and pumping water levels are computed from air-line pressure or transducer data recorded continuously at each well. These data provide input for calculating pumping rates, drawdown (difference between nonpumping and pumping water levels), and other well-field statistics that are included in this report.

Appendix A contains annual pumping and production information for each supply well and the gallery for the period of record.

Water for the Laboratory and community is supplied from 17 deep wells in 3 well fields and 1 gallery. The well fields are located on the Pajarito Plateau and

in Los Alamos and Guaje Canyon east of the plateau (Fig. 1). The wells are completed in the main aquifer, the only aquifer capable of municipal and industrial water supply in the area. The depth to water ranges from about 25 to 30 ft (semi-artesian) in the well field in lower Los Alamos Canyon to about 760 ft along the eastern edge of the Pajarito Plateau, and increases to about 1200 ft near the center of the plateau. Water in the aquifer moves from the recharge area in the Valles Caldera eastward beneath the Pajarito Plateau to the Rio Grande where a part is discharged into the river through seeps and springs.

The gallery is located west of the Laboratory on the flanks of the Sierra de los Valles. The gallery discharges from a small aquifer perched in the volcanic rocks.

II. WELL FIELD CHARACTERISTICS

Production from the three well fields decreased 90×10^6 gal. from 1587×10^6 gal. in 1985 to 1497×10^6 gal. (Table I). The months of heaviest pumpage in 1986 were May, July, and August. The production during these months was 503×10^6 gal., a decrease from 524×10^6 gal. for a similar period of heavy production in 1985. The months of lightest pumpage were February, March, and November. The production for these months was 262×10^6 gal., an increase from 248×10^6 gal. for the same period in 1985.

The difference in demand between periods of heavy and light production (summer and winter) is mainly because of water usage for lawn and yard irrigation. The water levels in the wells respond accordingly, with the highest water levels observed during months of least pumpage and the lowest during months of greatest production.

The production and use of water at the Laboratory and the community increased from about 230×10^6 gal. in 1947 to 1700×10^6 gal. in 1976. Water use in 1977 declined to about 1500×10^6 gal. and has varied since 1977 from about 1450×10^6 gal. in 1979 to 1625×10^6 in 1985 (Fig. 2). The decline in 1977 was attributed largely to a rate increase for water used in the community. Much of the landscaping at that time was changed from lawns and shrubs, which required watering, to southwestern landscaping (native plants and gravels were used to replace lawns), which requires little if any water other than normal rainfall.

Projections of future water demand were made in 1985 based on production data from 1977 through 1985. This projection indicated an annual increase of about 17×10^6 gal. The 1986 production fell below the projected production by about 105×10^6 gal. (Fig. 2). Actual water use tends to vary inversely with the amount of precipitation. A cool summer with abundant precipitation will reduce the water demand, while a hot, dry summer will require additional water production.

The peak demand period for 1986 was a 14-day period, July 28 through August 10, when pumpage was 91×10^6 gal. or about 6.5×10^6 gal./day (Table II). The peak demand period was down 47×10^6 gal. from the peak demand period of 18 days in 1985.

Table I
Production in Millions of Gallons
from Wells and Gallery
1947-1986

<u>Year</u>	<u>Los Alamos Field</u>	<u>Guaje Field</u>	<u>Pajarito Field</u>	<u>Water Canyon Gallery</u>	<u>Production Total</u>
1947	147	0	0	84	231
1948	264	0	0	97	361
1949	302	0	0	92	394
1950	547	3	0	54	604
1951	702	68	0	39	809
1952	448	350	0	48	846
1953	444	372	0	39	855
1954	380	374	0	40	794
1955	407	375	0	33	815
1956	437	506	0	23	966
1957	350	378	0	40	768
1958	372	395	0	60	827
1959	391	478	0	54	923
1960	530	533	0	48	1 111
1961	546	624	0	54	1 224
1962	577	597	0	67	1 241
1963	539	654	0	51	1 244
1964	627	665	0	45	1 337
1965	447	571	99	72	1 189
1966	450	613	127	82	1 272
1967	373	464	481	56	1 374
1968	345	474	584	65	1 468
1969	331	435	569	80	1 415
1970	360	423	595	65	1 443
1971	412	484	657	37	1 590
1972	380	467	662	40	1 549
1973	406	475	685	49	1 615
1974	369	453	802	35	1 659
1975	356	431	749	42	1 578
1976	343	531	817	41	1 732
1977	345	515	614	57	1 531
1978	302	444	690	45	1 481
1979	289	456	662	44	1 451
1980	339	485	743	32	1 599
1981	336	469	701	45	1 551
1982	317	422	773	46	1 558
1983	221	338	904	38	1 501
1984	326	460	780	34	1 600
1985	290	456	841	37	1 624
1986	179	460	858	28	1 525
<u>Total</u>	<u>15 526</u>	<u>16 698</u>	<u>14 393</u>	<u>2 038</u>	<u>48 655</u>

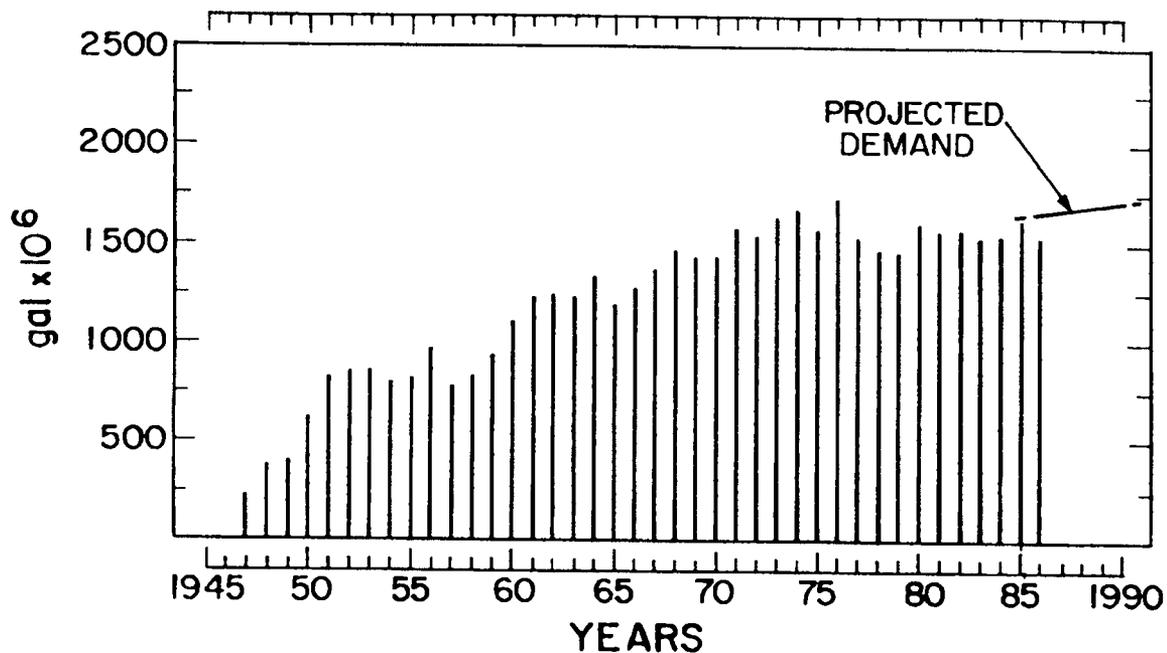


Fig. 2. Water production and usage from 1947 to 1986 and projected demand from 1986 to 1990.

Table II
Peak Demand Periods
1982-1986

	Demand Period				
	June 23- July 11 1982	June 30- July 11 1983	June 8- June 18 1984	June 29- July 16 1985	July 28- Aug 10 1986
No. of Days	19	12	11	18	14
Total Production (gal.)	145 x 10 ⁶	91 x 10 ⁶	81 x 10 ⁶	138 x 10 ⁶	91 x 10 ⁶
Av Daily Production (gal.)	8.1 x 10 ⁶	7.6 x 10 ⁶	7.4 x 10 ⁶	7.7 x 10 ⁶	6.5 x 10 ⁶
No. of Days Exceeding (gal.)					
10 x 10 ⁶	---	---	---	---	---
9 x 10 ⁶	1	---	---	3	---
8 x 10 ⁶	9	6	2	4	2
7 x 10 ⁶	9	2	6	9	2
<7 x 10 ⁶	0	4	3	2	10

Table III

Production Characteristics for 1985 and 1986

	Pumpage		Production		Total Pumpage	
	(10 ⁶ gal)		(per cent)		(per cent)	
	1985	1986	1985	1986	1985	1986
Los Alamos Well Field						
Well LA-1	---	---	---	---	---	---
Well LA-1B	68.5	54.9	24	31	4	4
Well LA-2	37.1	24.1	13	13	2	2
Well LA-3	41.9	26.9	14	15	3	2
Well LA-4	86.4	38.8	30	22	5	2
Well LA-5	55.8	34.6	19	19	4	2
Well LA-6	---	---	---	---	---	---
Subtotal	289.7	179.3	100	100	18	12
Guaje Well Field						
Well G-1	48.3	30.3	11	7	3	2
Well G-1A	128.4	130.4	28	28	8	9
Well G-2	96.6	109.3	21	24	6	7
Well G-3	22.1	26.7	5	6	1	2
Well G-4	21.7	33.9	5	7	1	2
Well G-5	67.9	52.4	15	11	4	3
Well G-6	71.4	76.7	15	17	5	5
Subtotal	456.4	459.7	100	100	28	30
Pajarito Well Field						
Well PM-1	95.4	73.9	11	9	6	5
Well PM-2	143.3	84.4	17	10	9	6
Well PM-3	221.2	224.8	26	28	14	16
Well PM-4	379.2	307.4	45	36	23	20
Well PM-5	2.0	147.3	<1	17	<1	9
Subtotal	841.1	857.8	100	100	52	56
Water Canyon (Gallery)						
Subtotal	36.6	28.2	100	100	2	2
Total	1623.8	1525.0	---	---	100	100

Table IV
Average Pumping Rate and Specific Capacity
1985 and 1986

	<u>Pumping Rate</u> <u>(gpm)</u>		<u>Specific Capacity</u> <u>(gpm/ft/drawdown)</u>	
	<u>1985</u>	<u>1986</u>	<u>1985</u>	<u>1986</u>
Los Alamos Well Field				
Well LA-1	---	---	---	---
Well LA-1B	595	573	4.8	4.8
Well LA-2	305	312	1.7	1.8
Well LA-3	336	338	1.9	2.0
Well LA-4	540	552	6.3	5.9
Well LA-5	432	419	3.2	2.9
Subtotal	<u>2208</u>	<u>2194</u>	Average <u>3.6</u>	<u>3.5</u>
Guaje Well Field				
Well G-1	268	249	1.6	1.5
Well G-1A	483	468	11.5	11.4
Well G-2	371	382	12.8	14.7
Well G-3	232	196	2.0	1.7
Well G-4	207	211	1.2	1.2
Well G-5	516	394	9.2	9.6
Well G-6	299	293	3.8	3.8
Subtotal	<u>2376</u>	<u>2193</u>	Average <u>6.0</u>	<u>6.3</u>
Pajarito Well Field				
Well PM-1	576	578	27.4	26.3
Well PM-2	1365	1359	21.0	21.2
Well PM-3	1395	1397	63.4	58.2
Well PM-4	1328	1305	37.9	37.3
Well PM-5	---	1199	---	---
Subtotal	<u>4664</u>	<u>5838</u>	Average <u>37.4</u>	<u>37.8</u>
Water Canyon (Gallery)				
Subtotal	<u>70</u>	<u>54</u>	---	---
Total	9318	10 279	---	---

Table V
Average Nonpumping and Pumping Water Levels
and Drawdown, 1985 and 1986

	<u>Water Levels</u>				<u>Drawdown</u> (ft)	
	<u>Nonpumping</u> (ft)		<u>Pumping</u> (ft)			
	<u>1985</u>	<u>1986</u>	<u>1985</u>	<u>1986</u>	<u>1985</u>	<u>1986</u>
Los Alamos Well Field						
Well LA-1	63	34	---	---	---	---
Well LA-1B	55	25	179	144	124	119
Well LA-2	112	74	291	252	179	178
Well LA-3	104	88	280	255	176	167
Well LA-4	292	284	378	377	86	93
Well LA-5	174	168	308	310	134	142
Well LA-6	---	---	---	---	---	---
Average	<u>133</u>	<u>112</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
Guaje Well Field						
Well G-1	278	279	450	450	172	171
Well G-1A	306	310	348	351	42	41
Well G-2	352	369	381	395	29	26
Well G-3	351	375	470	492	119	117
Well G-4	402	396	572	574	170	178
Well G-5	453	453	509	494	56	41
Well G-6	586	576	664	654	78	78
Average	<u>390</u>	<u>394</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
Pajarito Well Field						
Well PM-1	749	748	770	770	21	22
Well PM-2	851	851	916	915	65	64
Well PM-3	762	763	784	787	22	24
Well PM-4	1066	1084	1101	1109	35	35
Well PM-5	---	---	---	---	---	---
Average	<u>857</u>	<u>862</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>

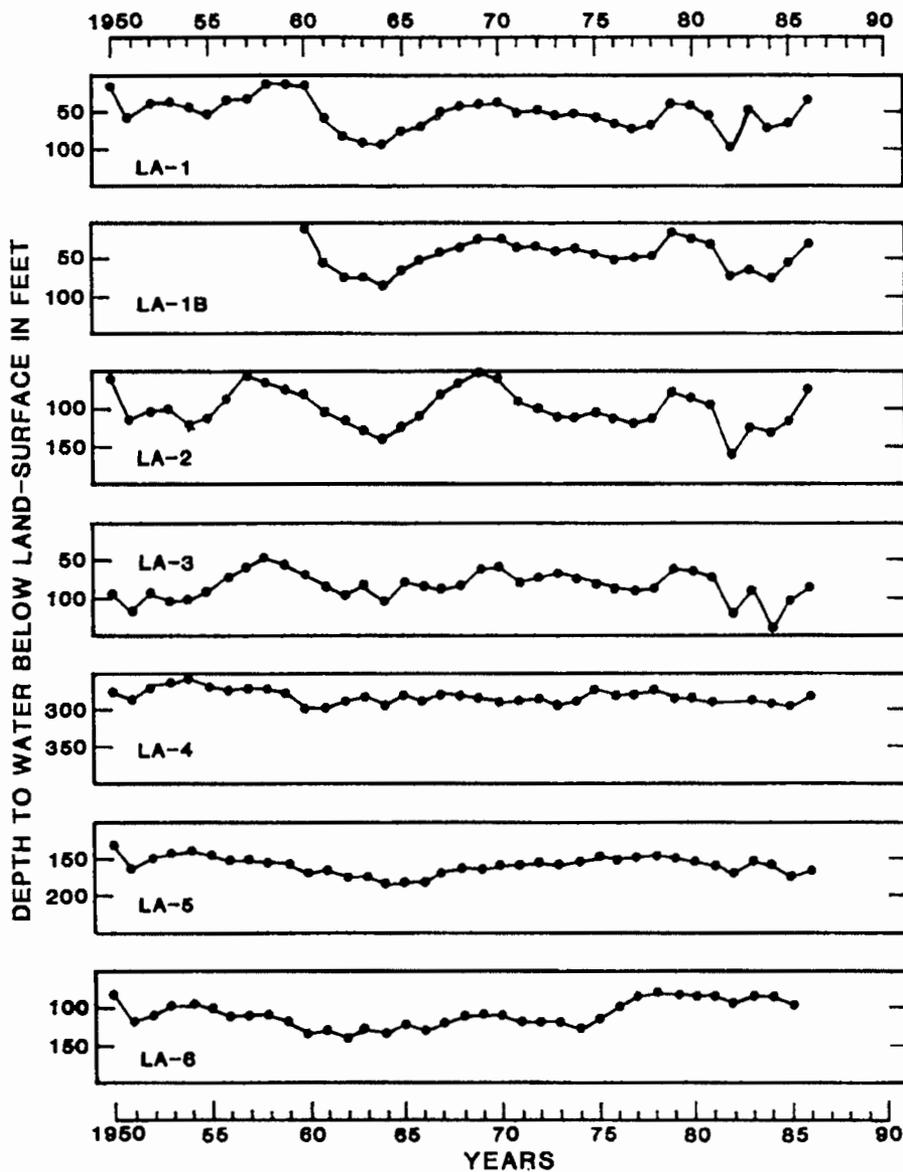


Fig. 3. Nonpumping water levels in the Los Alamos well field.

Pumpage from the well field increased about 4×10^6 gal. from 456×10^6 gal. in 1985 to 460×10^6 gal. in 1986 (Table III). The well field produced about 30% of the total production in 1986 compared with 28% in 1985.

The pumping rates of the individual wells ranged from 196 to 468 gpm in 1986 (Table IV). The total pumping rates declined about 183 gpm from 2376 gpm in 1985 to 2193 gpm in 1986. The largest decline occurred in well G-5 because the pump in the well was replaced with a pump with a lower capacity. The submersible pump was replaced because of repeated electrical failures.

The specific capacities of the wells ranged from 1.2 to 14.7 gpm per ft of drawdown. There were no significant changes in the individual wells in 1986. The average specific capacities increased slightly from 6.0 gpm per ft of drawdown in 1985 to 6.3 gpm per ft of drawdown in 1986 (Table IV).

The water levels in the individual wells fluctuated with the amount of pumpage. The average annual water level changed only slightly, with a decline from 390 ft in 1985 to 394 ft in 1986 (Fig. 4).

C. Pajarito Well Field

The Pajarito well field includes five wells. The wells were completed over a 17-year period, 1965 through 1982. They range in depth from 2300 to 3100 ft. Because they are located on the Pajarito Plateau, the depths to water range from about 750 ft at PM-1 to more than 1200 ft at PM-5.

The production from the well field in 1986 was about 858×10^6 gal., an increase of 17×10^6 compared with about 841×10^6 gal. in 1985. This was about 56% of the total water production during 1986 compared with 52% in 1985. Most of the pumpage came from wells PM-3 and -4 (Table III).

The pumping rates of the wells ranged from 578 to 1397 gpm. Four of the wells have high yields (PM-2, -3, -4, and -5) with pumping rates greater than 1000 gpm (Table IV). The total pumping rate of the field increased with the addition of well PM-5 to the system, from 4664 gpm in 1985 to 5838 gpm in 1986. There was no significant change in pumping rates for the individual wells between 1985 and 1986.

The specific capacities of the wells ranged from 21 to 58 gpm per ft of drawdown. Compared with the 1985 specific capacities, there was no significant change (Table IV)

The water levels in the individual wells fluctuated during the year in response to the amount of pumpage from the wells. The average water level in the well field declined slightly, from about 857 ft in 1985 to 862 ft in 1986 (Fig. 5). There was little or no change in the nonpumping water levels in wells PM-1, -2, and -3 from 1985 to 1986; however, because of heavy pumpage from well PM-4, there was an 18 ft water level decline from 1985 to 1986 (Table V).

D. Pump Failures and Transducer Problems

The pump in well LA-4 failed in late August 1986. The pump is scheduled to be pulled from the well and repaired early in 1987. As a result of the loss of that well, production was down for the well and the Los Alamos well field for 1986.

The pumping rate of well G-3 declined from about 230 gpm in May to less than 150 gpm in June and early July. There has been a steady decline in the specific capacity of the well since 1979, which indicates well deterioration. The well was taken out of service in early July because of the low production rate. The pump should be pulled and the well rehabilitated through bailing and swabbing,

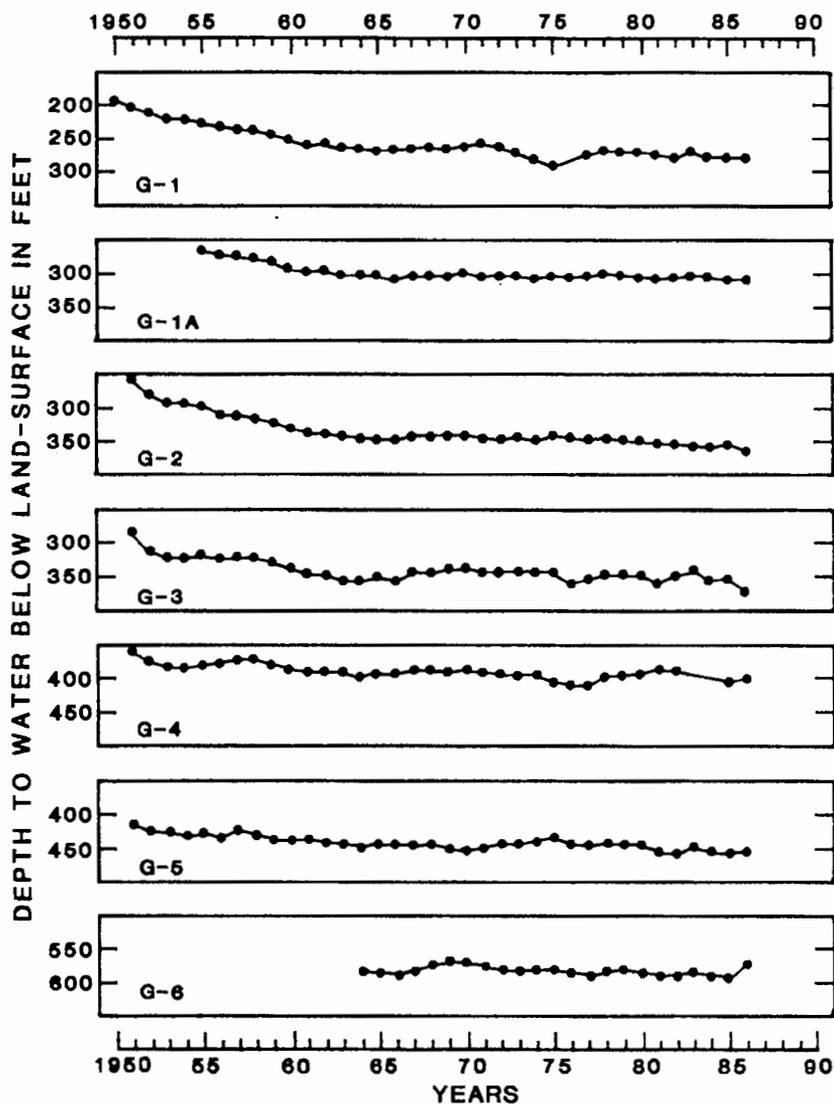


Fig. 4. Nonpumping water levels in the Guaje well field.

possible acid treatment, or use of explosives to clean slots and scale from the casing.

The pump in well G-5 failed in December 1985. It was replaced and put back in service in July 1986. The replacement pump has a lower pumping rate, about 450 gpm, compared with the previous pump's rate of about 500 gpm.

Failure of well PM-4 occurred when the back spin preventer failed in January 1986. The equipment was repaired and the well was back in service in May. This is a high yield well with a pumping rate of over 1300 gpm. Though it was out of service for about 4 months, the well still contributed about 20% of the total water production at Los Alamos during 1986.

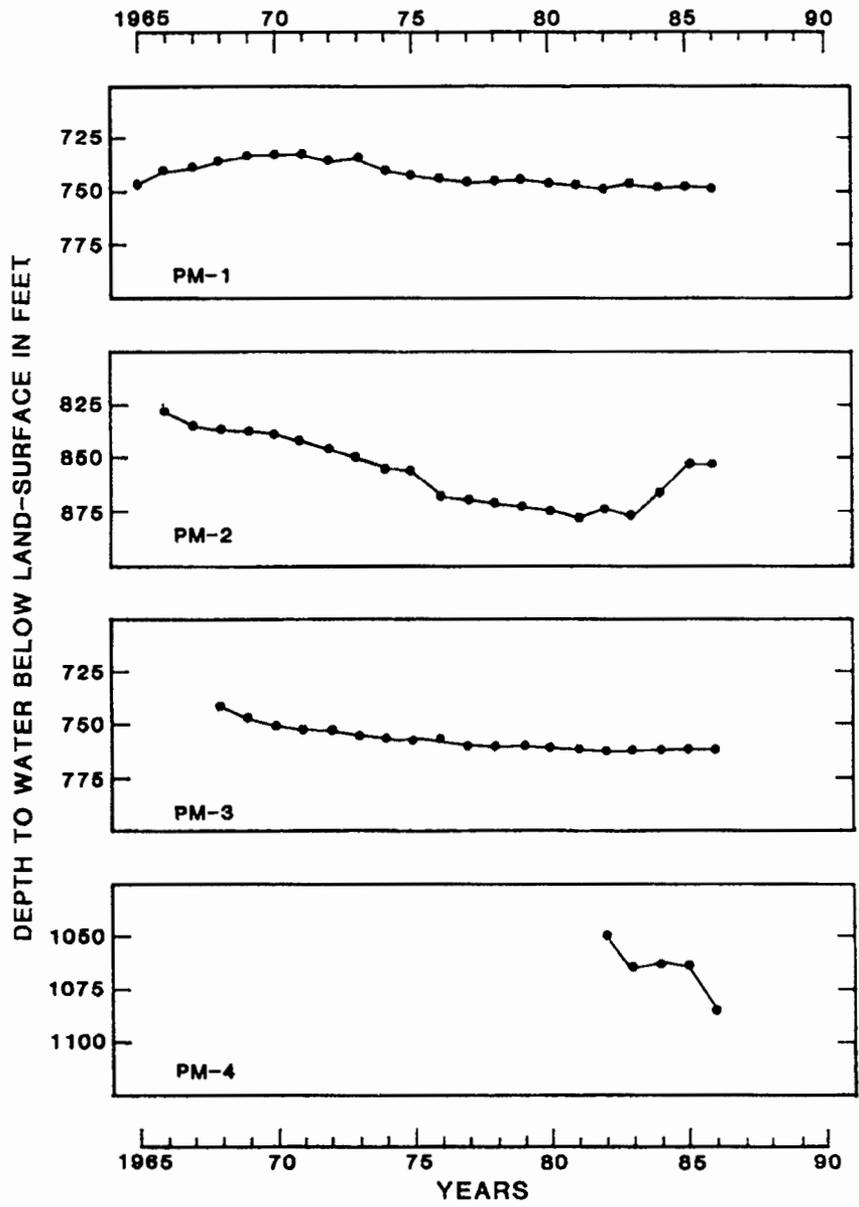


Fig. 5. Nonpumping water levels in the Pajarito well field.

The transducer (water level measuring equipment) in well LA-1B failed in 1986. The transducer in PM-5 has not been operational since the well was placed in service in 1985. The transducers should be repaired or replaced to record water level data. Water level records are necessary for each well to determine well characteristics and maintain efficient operation of the wells and well fields.

III. WATER CANYON GALLERY

The spring gallery in Water Canyon is dug back about 30 ft into the Bandelier Tuff. The gallery or tunnel is framed with timbers and sheet metal to keep the walls and ceiling from collapsing. The floor of the gallery is constructed to form a catchment basin. About 1 mile of water line connects the gallery to the microfilter station, located near S-Site along the southwestern edge of the Laboratory. The water is chlorinated and pumped to a tank for storage and distribution.

The water occurs in the fractures of a welded tuff. The welded tuff is underlain by a nonwelded tuff (few fractures) that perches the water in the fractures of the overlying welded tuff. Recharge to the perched aquifer is rapid. In the spring when snowmelt occurs, the discharge of the gallery increases. The increase in discharge results in suspended sediment. When the sediment concentration in the water reaches the limits for municipal water supply, a turbidity control switches the flow to waste to keep the sediments out of the distribution system.

The gallery is a valuable source of water supply. During 1986, about 2% of the total municipal and industrial water supply was obtained from the gallery. The production decreased about 8×10^6 gal., from 36×10^6 gal. in 1985 to about 28×10^6 gal. in 1986 (Table III). The average annual discharge rate decreased from 70 gpm in 1985 to 54 gpm in 1986. Since 1947, the total production from the gallery has been 2038×10^6 gal. (Table I).

IV. GUAJE AND LOS ALAMOS RESERVOIRS

Water from Guaje and Los Alamos reservoirs was used for municipal and industrial supply at Los Alamos during the early days of the Manhattan Project. Use of the water from the reservoirs for municipal supply was discontinued in about 1959 because of intermittent periods of turbidity caused by storm run-off and difficulties in maintaining bacteriological levels below limits for municipal water supply. Both of the reservoirs and adjacent areas are now open for recreational use. Water from the reservoirs has been and is available for irrigation of lawns and shrubs in the community and Laboratory through a separate distribution system. As parts of the lines are above ground, they are subject to freezing; thus water use from the reservoirs is limited to the period from late spring to early fall.

Guaje Reservoir in upper Guaje Canyon has a capacity of 0.25×10^6 gal., with a drainage area of 5.6 mi^2 . The reservoir is for diversion rather than storage, as perennial flow is maintained by springs in the canyon above the reservoir. Water flows by gravity through 6.8 mi of distribution line for irrigation of lawns and shrubs at Los Alamos Middle School and Guaje Pines Cemetery. The line from the reservoir is not a part of or connected to the municipal water supply distribution system.

The annual production from Guaje Reservoir when used for municipal supply from 1947 through 1958, ranged from an estimated 24×10^6 gal. to 213×10^6 gal. (Table VI). There is no record of water used for irrigation from 1959 through

1971. Since 1972 the amount of water used for irrigation has ranged from 2.4×10^6 to 9.7×10^6 gal. The amount used in 1986 was 2.4×10^6 gal., a decrease from 2.8×10^6 gal. used in 1985.

Los Alamos Reservoir in upper Los Alamos Canyon has a capacity of 13.4×10^6 gal., with a drainage area of 6.4 mi^2 . The reservoir is used for storage and recreation. The water flows by gravity through about 2.6 mi of distribution lines for irrigation of lawns and shrubs at the Laboratory's Health Research Building, the Los Alamos High School, and Mesa School. The line from the reservoir is not a part of or connected to the municipal water supply distribution system.

The annual production from Los Alamos Reservoir when used for municipal supply from 1947 through 1958 ranged from 4.8×10^6 gal. to 54.8×10^6 gal. (Table VI). There is no record of water usage from the reservoir from 1959 through 1978. Since 1978 the amount of water used for irrigation has ranged from 0.9×10^6 gal. to 2.8×10^6 gal. The amount of water from the reservoir used for irrigation in 1986 was 1.5×10^6 gal., an increase from the 0.9×10^6 gal. used in 1985.

V. QUALITY OF WATER

The quality of water is monitored to determine whether water from the wells, gallery, and in the distribution system meets the federal requirements (standards) for municipal supply. Water samples are collected and analyzed from the wells, gallery, and at six stations in the distribution system (five fire stations and at Bandelier National Monument).

Primary drinking water standards are related directly to safety of drinking water supply.¹⁹ Table VII shows the standards and maximum concentrations observed in samples from the individual sources and the distribution system. The maximum concentrations of all the chemicals were below the standards except fluoride found in water from well LA-1B, which was 3 mg/L. Mixing of the water from well LA-1B in the distribution system lowered the concentration to an acceptable level.

Secondary drinking water standards are related more to aesthetics and supply system maintenance. Iron in water from the gallery exceeds the secondary standard.²⁰ The iron in the water from the gallery is from the pipe between the gallery and the microfilter station. The concentration is reduced to acceptable levels by mixing in the distribution. The water from the wells, gallery, and in the distribution system is in compliance with the radiochemical standards (Table VII).

Individual primary, secondary, radiochemical, and miscellaneous chemical analyses for each well, the gallery, and stations in the distribution system are presented in "Environmental Surveillance at Los Alamos During 1986."²¹ In summary, the water in the distribution system is in compliance with federal primary, secondary, and radiochemical standards.²²

Table VI

Production from Guaje and Los Alamos Reservoirs
(1947-1958 and 1972-1986)

Year	Guaje Reservoir ^a (10 ⁶ gal)	Los Alamos Reservoir (10 ⁶ gal)
1947	87.8	21.7
1948	119.8	31.9
1949	116.1	14.7
1950	79.9	20.6
1951	41	10.5
1952	131	33.6
1953	58	14.8
1954	66	16.9
1955	71	18.1
1956	24	4.8
1957	213	54.8
1958	193	49.4
1972	5.8	---
1973	9.7	---
1974	4.9	---
1975	5.3	---
1976	4.4	---
1977	4.1	---
1978	2.8	---
1979	3.7	1.3
1980	4.7	2.3
1981	2.7	2.1
1982	3.4	2.8
1983	3.4	1.4
1984	3.0	1.3
1985	2.8	0.9
1986	2.4	1.5

^aProduction Guaje Reservoir 1951-1958 estimated.

Note: Municipal supply production, 1947-1958; irrigation production, 1972-1986.

VI. SUMMARY AND CONCLUSIONS

Well and well field operations in 1986 were satisfactory. Pumpage was not excessive, even in the summer when demand can be high. Projected water demand can be handled through increased operation of the wells in the three well fields. Water-level fluctuations (recovery and declines) are as anticipated with current

Table VII

Comparison of Maximum Chemical and Radiochemical Quality
of Water Supply with Standards for Drinking Water

	<u>Standards</u>	<u>Maximum Concentration</u>	
		<u>Supply Well and Gallery</u>	<u>Distribution System</u>
Primary Standards^a (mg/L)			
Ag	0.05	<0.001	<0.001
As	0.05	0.039	0.017
Ba	1.0	0.104	0.057
Cd	0.01	0.0004	<0.0005
Cr	0.05	0.024	0.011
F	2.0	3.3	0.8
Hg	0.002	<0.0002	<0.0002
NO ₃ (N)	10	1.7	0.3
Pb	0.05	0.009	<0.002
Se	0.01	<0.003	<0.003
Secondary Standards^b (mg/L)			
Cl	250	17	8
Cu	1.0	0.019	0.023
Fe	0.3	0.049	0.020
Mn	0.05	<0.001	<0.001
SO ₄	250	40	114
Zn	5.0	0.03	0.14
TDS ^c	500	456	234
pH ^d	6.5-8.5	8.5	8.3
Radiochemical Standards^a (10 ⁻⁹ μCi/mL)			
¹³⁷ Cs	200	165	40
²³⁸ Pu	15	0.021	0.025
^{239,240} Pu	15	0.012	0.023
Gross alpha	15	11	3.0
Gross beta	15	1.9	5.6
Total U ^e	1800	5.1	7.0
³ H ^f	20	0.1	1.4

^aReference 19.

^bReference 20.

^cTotal dissolved solids.

^dNo units.

^eμg/L; Reference 22.

^f10⁻⁶ μCi/mL.

pumpage. The pump in well G-3 should be removed and some attempt should be made to rehabilitate the well. It may be possible to rehabilitate the well at a small fraction of the cost of replacing the well.

Future operations should be carried out as in the past year. Hydrologic data should continue to be collected in 1987 with an annual evaluation prepared at the beginning of 1988.

ACKNOWLEDGMENTS

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APPENDIX A

ANNUAL AQUIFER CHARACTERISTICS

Well LA-1

<u>Year</u>	<u>Pump Time (h)</u>	<u>Pumpage (million gal)</u>	<u>Pump Rate (gpm)</u>	<u>Nonpumping Water Level (ft)</u>
1947	3468	54.0	259.5	--
1948	2988	34.7	193.6	--
1949	1361	26.7	327.0	--
1950	563	10.5	310.8	19.0
1951	1215	14.6	200.3	59.0
1952	286	3.4	198.1	40.0
1953	0	0.0	0.0	36.0
1954	0	0.0	0.0	44.0
1955	690	9.7	234.3	51.0
1956	39	0.0	0.0	33.0
1957	0	0.0	0.0	33.0
1958	0	0.0	0.0	10.0
1959	0	0.0	0.0	13.0
1960	0	0.0	0.0	13.0
1961	0	0.0	0.0	59.0
1962	0	0.0	0.0	84.0
1963	0	0.0	0.0	90.0
1964	0	0.0	0.0	95.0
1965	0	0.0	0.0	76.0
1966	0	0.0	0.0	70.0
1967	0	0.0	0.0	52.0
1968	0	0.0	0.0	42.0
1969	0	0.0	0.0	38.0
1970	0	0.0	0.0	37.0
1971	0	0.0	0.0	51.0
1972	0	0.0	0.0	49.0
1973	0	0.0	0.0	55.0
1974	0	0.0	0.0	53.0
1975	0	0.0	0.0	58.0
1976	0	0.0	0.0	69.0
1977	0	0.0	0.0	74.0
1978	0	0.0	0.0	68.0
1979	0	0.0	0.0	38.0
1980	0	0.0	0.0	40.0
1981	0	0.0	0.0	51.0
1982	0	0.0	0.0	98.0
1983	0	0.0	0.0	46.0
1984	0	0.0	0.0	71.0
1985	0	0.0	0.0	63.0
1986	0	0.0	0.0	34.0

APPENDIX A (cont)

Well LA-1B

<u>Year</u>	<u>Pump Time (h)</u>	<u>Pumpage (million gal)</u>	<u>Pump Rate (gpm)</u>	<u>Water Level</u>		<u>Draw-down (ft)</u>	<u>Specific Capacity (gpm/ft)</u>
				<u>Nonpump (ft)</u>	<u>Pump (ft)</u>		
1960	415	36.3	1457.8	7.0	111.0	104.0	14.0
1961	3727	124.7	557.6	54.0	154.0	100.0	5.6
1962	3936	129.1	546.7	72.0	169.0	97.0	5.6
1963	3649	117.4	536.2	74.0	170.0	96.0	5.6
1964	4174	130.3	520.3	81.0	183.0	102.0	5.1
1965	3007	97.9	542.6	63.0	170.0	107.0	5.1
1966	2589	83.9	540.1	50.0	169.0	119.0	4.5
1967	2519	84.9	561.7	39.0	153.0	114.0	4.9
1968	2183	74.0	565.0	32.0	147.0	115.0	4.9
1969	2244	75.7	562.2	22.0	142.0	120.0	4.7
1970	2369	79.7	560.7	22.0	143.0	121.0	4.6
1971	2633	89.1	564.0	31.0	162.0	131.0	4.3
1972	2215	75.3	566.6	31.0	163.0	132.0	4.3
1973	2628	87.2	553.0	37.0	170.0	133.0	4.2
1974	2282	73.9	539.7	35.0	161.0	126.0	4.3
1975	2308	74.4	537.3	42.0	168.0	126.0	4.3
1976	2521	79.6	526.2	50.0	176.0	126.0	4.2
1977	2782	84.2	504.4	47.0	167.0	120.0	4.2
1978	2306	75.6	546.3	42.0	162.0	120.0	4.6
1979	1354	45.9	564.6	13.0	134.0	121.0	4.7
1980	1955	62.9	536.3	21.0	146.0	125.0	4.3
1981	2299	73.9	537.7	26.0	144.0	118.0	4.5
1982	3707	108.1	486.0	71.0	180.0	109.0	4.5
1983	407	12.1	495.0	61.0	160.0	99.0	5.0
1984	2673	96.9	604.0	75.0	201.0	126.0	4.8
1985	1919	68.5	595.0	55.0	179.0	124.0	4.8
1986	1598	54.9	573.0	25.0	144.0	119.0	4.8

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well LA-2		Draw-down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1947	963	27.6	477.7	--	--	--	--
1948	3659	59.3	270.1	--	--	--	--
1949	1654	41.8	421.2	--	--	--	--
1950	614	15.6	423.5	59.0	285.0	226.0	1.9
1951	2415	57.7	398.2	111.0	305.0	194.0	2.1
1952	1980	46.3	389.7	101.0	300.0	199.0	2.0
1953	2201	47.2	357.4	100.0	301.0	201.0	1.8
1954	2601	56.8	364.0	116.0	--	--	--
1955	2223	49.4	370.4	110.0	--	--	--
1956	1805	44.2	408.1	84.0	--	--	--
1957	1066	29.6	462.8	53.0	277.0	224.0	2.1
1958	1166	31.1	444.5	60.0	270.0	210.0	2.1
1959	1599	40.7	424.2	71.0	303.0	232.0	1.8
1960	2169	51.6	396.5	76.0	305.0	229.0	1.7
1961	2149	44.4	344.3	101.0	313.0	212.0	1.6
1962	1823	35.7	326.4	111.0	314.0	203.0	1.6
1963	1999	40.7	339.3	127.0	332.0	205.0	1.7
1964	1924	34.2	296.3	137.0	347.0	210.0	1.4
1965	1911	39.8	347.1	121.0	330.0	209.0	1.7
1966	1070	21.4	333.3	108.0	340.0	232.0	1.4
1967	238	4.9	343.1	78.0	304.0	226.0	1.5
1968	502	11.3	375.2	64.0	305.0	241.0	1.6
1969	155	3.8	408.6	50.0	297.0	247.0	1.7
1970	341	7.2	351.9	59.0	310.0	251.0	1.4
1971	1787	31.8	296.6	88.0	318.0	230.0	1.3
1972	2189	39.3	299.2	96.0	322.0	226.0	1.3
1973	2625	46.7	296.5	106.0	334.0	228.0	1.3
1974	2033	36.8	301.7	109.0	325.0	216.0	1.4
1975	2310	40.2	290.0	103.0	320.0	217.0	1.3
1976	2488	39.9	267.3	113.0	322.0	209.0	1.3
1977	2775	42.5	255.3	118.0	314.0	196.0	1.3
1978	2299	39.5	286.4	112.0	338.0	226.0	1.3
1979	1353	26.2	323.0	75.0	316.0	241.0	1.3
1980	1960	33.8	287.4	84.0	318.0	234.0	1.2
1981	1991	34.4	300.0	94.0	336.0	242.0	1.2
1982	3174	51.2	269.0	161.0	348.0	187.0	1.4
1983	2752	54.5	330.0	121.0	321.0	200.0	1.6
1984	2753	53.7	325.0	130.0	323.0	193.0	1.7
1985	2027	37.1	305.0	112.0	291.0	179.0	1.7
1986	1289	34.1	312.0	74.0	252.0	178.0	1.8

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well LA-3		Draw-down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1947	1476	64.9	732.8	--	--	--	--
1948	3647	82.5	377.0	--	--	--	--
1949	1505	41.7	461.8	--	--	--	--
1950	2793	57.8	344.9	97.0	231.0	134.0	2.6
1951	3554	66.9	313.7	116.0	233.0	117.0	2.7
1952	2514	58.6	388.5	94.0	218.0	124.0	3.1
1953	3104	69.7	374.2	103.0	229.0	126.0	3.0
1954	2595	57.3	368.0	101.0	225.0	124.0	3.0
1955	2195	48.7	369.8	91.0	226.0	135.0	2.7
1956	1849	42.1	379.5	74.0	222.0	148.0	2.6
1957	1080	26.1	402.8	56.0	219.0	163.0	2.5
1958	1612	33.6	347.4	49.0	225.0	176.0	2.0
1959	1821	35.0	320.3	54.0	231.0	177.0	1.8
1960	2174	38.4	294.4	68.0	230.0	162.0	1.8
1961	1939	34.7	298.3	85.0	189.0	104.0	2.9
1962	2361	45.4	320.5	93.0	192.0	99.0	3.2
1963	2128	42.5	332.9	81.0	197.0	116.0	2.9
1964	2574	50.4	326.3	104.0	217.0	113.0	2.9
1965	1961	43.3	368.9	79.0	220.0	141.0	2.6
1966	2236	46.1	343.6	81.0	219.0	138.0	2.5
1967	2274	47.4	347.4	86.0	218.0	132.0	2.6
1968	2127	42.7	334.6	82.0	251.0	169.0	2.0
1969	2072	40.1	322.6	58.0	246.0	188.0	1.7
1970	2303	44.0	318.4	55.0	241.0	186.0	1.7
1971	2556	45.4	296.0	77.0	250.0	173.0	1.7
1972	2205	39.7	300.1	73.0	251.0	178.0	1.7
1973	977	20.3	346.3	65.0	248.0	183.0	1.9
1974	2291	43.5	316.5	73.0	244.0	171.0	1.9
1975	2306	43.3	313.0	80.0	253.0	173.0	1.8
1976	2474	42.3	285.0	88.0	260.0	172.0	1.7
1977	2779	47.3	283.7	89.0	248.0	159.0	1.8
1978	2308	42.4	306.4	87.0	250.0	163.0	1.9
1979	1343	28.1	348.1	58.0	243.0	185.0	1.9
1980	1952	35.1	299.9	61.0	237.0	176.0	1.7
1981	2297	41.5	301.1	70.0	240.0	170.0	1.8
1982	3691	54.9	247.0	118.0	246.0	128.0	1.9
1983	949	14.7	258.0	89.0	203.0	129.0	2.0
1984	838	16.6	329.0	142.0	301.0	159.0	2.0
1985	2078	41.9	336.0	104.0	280.0	176.0	1.9
1986	1328	26.9	338.0	88.0	255.0	167.0	2.0

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well LA-4		Draw-down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1948	1570	42.7	453.3	--	--	--	--
1949	940	37.5	664.9	--	--	--	--
1950	4350	164.9	631.8	278.0	353.0	75.0	8.4
1951	4909	173.6	589.4	285.0	357.0	72.0	8.2
1952	3429	119.6	581.3	267.0	339.0	72.0	8.1
1953	3034	109.1	599.3	264.0	335.0	71.0	8.4
1954	2133	78.2	611.0	255.0	329.0	74.0	8.3
1955	2647	94.5	595.0	268.0	341.0	73.0	8.2
1956	3402	120.0	588.9	273.0	346.0	73.0	8.1
1957	2844	105.4	617.7	270.0	345.0	75.0	8.2
1958	2973	110.3	618.3	270.0	342.0	72.0	8.6
1959	3084	113.5	613.4	275.0	346.0	71.0	8.6
1960	4084	145.6	594.2	296.0	365.0	69.0	8.6
1961	3687	129.7	586.3	296.0	365.0	69.0	8.5
1962	3688	129.3	584.3	286.0	359.0	73.0	8.0
1963	3718	130.5	585.0	280.0	351.0	71.0	8.2
1964	4500	155.0	574.1	291.0	361.0	70.0	8.2
1965	3110	111.4	597.0	279.0	349.0	70.0	8.5
1966	3279	115.6	587.6	285.0	356.0	71.0	8.3
1967	2127	77.1	604.1	278.0	350.0	72.0	8.4
1968	2276	81.7	598.3	280.0	351.0	71.0	8.4
1969	1694	61.8	608.0	282.0	358.0	76.0	8.0
1970	2333	83.5	596.5	286.0	363.0	77.0	7.7
1971	2519	89.0	588.9	287.0	373.0	86.0	6.8
1972	2322	82.6	592.9	282.0	367.0	85.0	7.0
1973	2616	92.4	588.7	294.0	377.0	83.0	7.1
1974	2306	82.2	594.1	286.0	367.0	81.0	7.3
1975	2319	82.3	591.5	272.0	355.0	83.0	7.1
1976	2802	98.2	584.1	277.0	373.0	96.0	6.1
1977	2741	96.4	586.2	278.0	374.0	96.0	6.1
1978	2248	80.1	594.2	271.0	368.0	97.0	6.1
1979	2964	104.6	587.9	280.0	376.0	96.0	6.1
1980	3322	115.3	578.5	284.0	385.0	101.0	5.7
1981	2573	89.4	579.1	289.0	393.0	104.0	5.6
1982	0	0	0	--	--	--	--
1983	1840	61.5	577.0	287.0	392.0	105.0	5.3
1984	2695	87.1	539.0	290.0	383.0	93.0	5.8
1985	2667	86.4	540.0	292.0	378.0	86.0	6.3
1986	1172	38.8	552.0	284.0	377.0	93.0	5.9

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well LA-5		Draw-down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1948	1171	40.4	575.0	--	--	--	--
1949	1763	58.5	553.0	--	--	--	--
1950	4052	130.1	535.1	131.0	254.0	123.0	4.4
1951	6004	187.4	520.2	162.0	272.0	110.0	4.7
1952	3425	109.6	533.3	147.0	259.0	112.0	4.8
1953	3278	103.9	528.3	141.0	257.0	116.0	4.6
1954	2546	80.1	524.4	137.0	259.0	122.0	4.3
1955	3158	97.3	513.5	145.0	267.0	122.0	4.2
1956	3476	104.5	501.1	150.0	276.0	126.0	4.0
1957	2868	86.0	499.8	150.0	277.0	127.0	3.9
1958	3009	89.9	498.0	151.0	277.0	126.0	4.0
1959	3088	93.5	504.6	155.0	280.0	125.0	4.0
1960	4088	119.1	485.6	168.0	288.0	120.0	4.0
1961	3534	100.3	473.0	165.0	288.0	123.0	3.8
1962	3735	107.7	480.6	172.0	--	--	--
1963	3726	105.0	469.7	171.0	--	--	--
1964	4236	118.8	467.4	184.0	--	--	--
1965	1740	50.5	483.7	180.0	--	--	--
1966	2817	79.3	469.2	180.0	--	--	--
1967	2533	73.7	484.9	168.0	--	--	--
1968	2233	63.3	472.5	161.0	300.0	139.0	3.4
1969	2402	68.5	475.3	161.0	298.0	137.0	3.5
1970	2353	66.1	468.2	157.0	300.0	143.0	3.3
1971	2659	74.4	466.3	155.0	302.0	147.0	3.2
1972	2301	64.4	466.5	153.0	304.0	151.0	3.1
1973	2476	68.3	459.7	156.0	308.0	152.0	3.0
1974	1903	52.5	459.8	154.0	306.0	152.0	3.0
1975	2318	63.9	459.4	149.0	309.0	160.0	2.9
1976	2799	77.6	462.1	150.0	310.0	160.0	2.9
1977	2665	74.8	467.8	147.0	303.0	156.0	3.0
1978	2274	64.9	475.8	145.0	299.0	154.0	3.1
1979	2964	84.0	472.4	149.0	301.0	152.0	3.1
1980	3316	92.2	463.6	153.0	300.0	147.0	3.2
1981	3523	96.5	456.5	158.0	304.0	146.0	3.1
1982	3654	102.3	467.0	168.0	299.0	136.0	3.4
1983	2842	78.1	458.0	154.0	295.0	141.0	3.2
1984	2889	72.1	416.0	156.0	281.0	125.0	3.1
1985	2153	55.8	432.0	174.0	308.0	134.0	3.2
1986	1376	34.6	419.0	168.0	310.0	142.0	2.9

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well LA-6		Draw-down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1948	116	4.9	704.0	--	--	--	--
1949	2451	95.8	651.4	--	--	--	--
1950	4490	167.9	623.2	83.0	136.0	53.0	11.8
1951	5882	201.6	571.2	115.0	160.0	45.0	12.7
1952	3168	110.3	580.3	108.0	151.0	43.0	13.5
1953	3177	113.8	597.0	95.0	139.0	44.0	13.6
1954	2894	107.1	616.8	92.0	135.0	43.0	14.3
1955	2911	108.0	618.3	97.0	140.0	43.0	14.4
1956	3438	125.8	609.9	106.0	149.0	43.0	14.2
1957	2833	102.4	602.4	107.0	152.0	45.0	13.4
1958	2957	106.9	602.5	108.0	131.0	43.0	14.0
1959	3096	108.3	583.0	115.0	158.0	43.0	13.6
1960	4084	138.6	565.6	130.0	172.0	42.0	13.5
1961	3284	112.5	571.0	129.0	171.0	42.0	13.6
1962	3886	129.4	555.0	135.0	175.0	40.0	13.9
1963	2953	102.9	580.8	125.0	171.0	46.0	12.6
1964	4244	138.3	543.1	132.0	172.0	40.0	13.6
1965	3145	103.8	550.1	120.0	160.0	40.0	13.8
1966	3173	104.0	546.3	129.0	169.0	40.0	13.7
1967	2511	85.4	566.8	118.0	158.0	40.0	14.2
1968	2111	71.6	565.3	109.0	150.0	41.0	13.8
1969	2402	81.6	566.2	109.0	151.0	42.0	13.5
1970	2337	79.1	564.1	106.0	149.0	43.0	13.1
1971	2472	82.5	556.2	119.0	160.0	41.0	13.6
1972	2317	79.2	569.7	117.0	155.0	38.0	15.0
1973	2638	90.6	572.4	118.4	155.0	37.0	15.5
1974	2337	79.8	569.1	120.0	156.0	36.0	15.8
1975	1571	51.9	550.6	113.0	151.0	38.0	14.5
1976	175	5.1	485.7	96.0	--	--	--
1977	--	--	--	82.0	--	--	--
1978	33	1.1	572.7	77.0	142.0	65.0	8.8
1979	6	0.2	555.6	80.0	146.0	66.0	8.4
1980	4	0.1	520.8	82.0	142.0	60.0	8.7
1981	2.3	0.08	579.8	84.0	141.0	57.0	10.2
1982	--	--	--	90.0	--	--	--
1983	--	--	--	81.0	--	--	--
1984	--	--	--	83.0	--	--	--
1985	--	--	--	92.0	--	--	--
1986	--	--	--	--	--	--	--

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well G-1		Draw-down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1950	0	2.8	0.0	195.0	--	--	--
1951	1168	37.7	538.0	202.0	309.0	107.0	5.0
1952	2476	75.5	508.2	213.0	295.0	82.0	6.2
1953	3275	97.3	495.2	221.0	292.0	71.0	7.0
1954	2616	77.8	495.7	221.0	290.0	69.0	7.2
1955	2406	70.5	448.4	226.0	295.0	69.0	7.1
1956	2958	83.2	468.8	235.0	303.0	68.0	6.9
1957	2098	55.9	444.1	236.0	307.0	71.0	6.3
1958	2460	68.1	461.4	238.0	308.0	70.0	6.6
1959	2952	82.4	465.2	245.0	314.0	69.0	6.7
1960	3564	96.0	448.9	254.0	325.0	71.0	6.3
1961	4236	112.4	442.2	260.0	333.0	73.0	6.1
1962	3431	93.6	454.7	258.0	342.0	84.0	5.4
1963	4519	114.9	423.8	265.0	348.0	83.0	5.1
1964	4374	113.8	433.6	269.0	352.0	83.0	5.2
1965	3530	90.7	428.2	268.0	352.0	84.0	5.1
1966	4074	102.6	419.7	269.0	363.0	94.0	4.5
1967	2615	69.9	445.5	266.0	362.0	96.0	4.6
1968	2996	78.9	438.9	264.0	366.0	102.0	4.3
1969	2657	68.3	428.4	266.0	376.0	110.0	3.9
1970	2712	64.7	397.6	264.0	377.0	113.0	3.5
1971	2908	67.9	389.2	258.0	378.0	120.0	3.2
1972	2865	66.1	384.5	264.0	389.0	125.0	3.1
1973	2997	67.5	375.4	271.0	403.0	132.0	2.8
1974	2767	62.3	375.3	283.0	412.0	129.0	2.9
1975	2467	55.7	376.3	293.0	411.0	118.0	3.2
1976	2962	65.1	366.3	--	--	--	--
1977	2734	57.9	353.0	275.0	426.0	151.0	2.3
1978	2656	56.0	351.4	270.0	419.0	149.0	2.4
1979	2998	61.7	342.9	271.0	422.0	151.0	2.3
1980	3459	68.3	329.0	273.0	428.0	155.0	2.1
1981	4427	81.6	307.2	275.0	444.0	169.0	1.8
1982	3678	69.0	313.0	278.0	443.0	165.0	1.9
1983	2871	52.2	303.0	272.0	443.0	171.0	1.8
1984	3804	62.8	275.0	276.0	448.0	172.0	1.5
1985	3004	48.3	268.0	278.0	450.0	172.0	1.6
1986	2027	30.3	249.0	279.0	450.0	171.0	1.5

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well G-1A		Draw-down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1954	108	4.6	709.0	--	--	--	--
1955	1531	53.0	577.0	265.0	316.0	51.0	11.3
1956	3130	107.7	573.5	273.0	323.0	50.0	11.5
1957	2470	87.0	587.0	274.0	327.0	53.0	11.1
1958	2670	92.5	577.4	279.0	331.0	52.0	11.1
1959	2965	102.7	577.3	284.0	333.0	49.0	11.8
1960	3641	122.8	562.1	291.0	342.0	51.0	11.0
1961	4297	147.3	571.3	298.0	350.0	52.0	11.0
1962	3972	136.1	571.1	295.0	344.0	49.0	11.7
1963	4525	149.7	551.4	301.0	350.0	49.0	11.3
1964	3852	129.3	559.4	302.0	353.0	51.0	11.0
1965	3505	116.5	554.0	302.0	353.0	51.0	10.9
1966	3964	133.4	560.9	306.0	355.0	49.0	11.4
1967	2720	91.3	559.4	302.0	351.0	49.0	11.4
1968	3089	103.2	556.8	302.0	352.0	50.0	11.1
1969	2695	90.7	560.9	303.0	356.0	53.0	10.6
1970	2772	92.5	556.2	300.0	357.0	57.0	9.8
1971	3313	111.8	562.4	303.0	361.0	58.0	9.7
1972	2879	94.0	544.2	302.0	361.0	59.0	9.2
1973	2760	87.9	530.8	302.0	362.0	60.0	8.8
1974	2974	92.7	519.5	307.0	355.0	48.0	10.8
1975	2740	85.3	518.9	304.0	351.0	47.0	11.0
1976	2983	91.6	511.8	302.0	350.0	48.0	10.7
1977	2942	88.7	502.5	302.0	350.0	48.0	10.5
1978	2631	77.9	493.5	300.0	345.0	45.0	11.0
1979	2974	88.0	493.9	301.0	345.0	44.0	11.0
1980	3480	103.2	494.4	305.0	345.0	40.0	12.4
1981	4212	131.2	519.1	307.0	347.0	40.0	13.0
1982	3618	109.7	505.0	305.0	347.0	42.0	12.0
1983	2901	86.7	498.0	301.0	336.0	35.0	14.2
1984	3789	113.9	501.0	302.0	345.0	43.0	11.7
1985	4430	128.4	483.0	306.0	348.0	42.0	11.5
1986	4644	130.4	468.0	310.0	351.0	41.0	11.4

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well G-2 Water Level		Draw-down (ft)	Specific Capacity (gpm/ft)
				Nonpump (ft)	Pump (ft)		
1951	123	3.9	528.5	259.0	--	--	--
1952	2372	78.3	550.2	279.0	327.0	48.0	11.5
1953	3254	105.6	540.9	290.0	334.0	44.0	12.3
1954	2682	86.3	536.3	291.0	335.0	44.0	12.2
1955	2487	78.8	528.1	299.0	345.0	46.0	11.5
1956	3109	95.8	513.6	310.0	357.0	47.0	10.9
1957	2458	76.1	516.0	311.0	360.0	49.0	10.5
1958	2707	80.1	493.2	315.0	361.0	46.0	10.7
1959	2938	84.6	479.9	320.0	363.0	43.0	11.2
1960	3535	96.6	455.4	328.0	370.0	42.0	10.8
1961	3982	105.3	440.7	336.0	375.0	39.0	11.3
1962	4076	99.8	408.1	338.0	374.0	36.0	11.3
1963	4563	105.7	386.1	344.0	379.0	35.0	11.0
1964	4541	105.3	386.5	346.0	380.0	34.0	11.4
1965	3535	82.6	389.4	346.0	381.0	35.0	11.1
1966	3994	94.7	395.2	349.0	383.0	34.0	11.6
1967	2743	67.6	410.7	344.0	379.0	35.0	11.7
1968	2732	66.5	405.7	344.0	379.0	35.0	11.6
1969	2679	68.6	426.8	344.0	381.0	37.0	11.5
1970	2431	62.8	430.5	343.0	381.0	38.0	11.3
1971	3420	87.4	425.9	345.0	384.0	39.0	10.9
1972	2887	73.4	423.7	348.0	388.0	40.0	10.6
1973	2816	72.4	428.5	344.0	385.0	41.0	10.5
1974	3056	82.0	447.2	347.0	390.0	43.0	10.4
1975	2724	74.5	455.8	341.0	384.0	43.0	10.6
1976	2990	81.1	452.1	344.0	388.0	44.0	10.3
1977	2981	80.4	449.5	346.0	388.0	42.0	10.7
1978	2562	71.6	451.9	345.0	386.0	41.0	11.0
1979	2975	80.0	448.0	347.0	388.0	41.0	11.0
1980	3478	92.4	443.0	350.0	389.0	39.0	11.4
1981	1432	38.3	445.8	352.0	390.0	38.0	11.7
1982	2833	25.7	476.0	352.0	399.0	47.0	10.1
1983	624	16.5	441.0	356.0	399.0	43.0	10.3
1984	2018	43.7	361.0	358.0	385.0	27.0	13.4
1985	4339	96.6	371.0	352.0	381.0	29.0	12.8
1986	4769	109.3	382.0	369.0	395.0	26.0	14.7

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well G-3		Draw-down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1951	192	7.3	633.7	281.0	--	--	--
1952	2379	65.4	458.2	310.0	358.0	48.0	9.5
1953	3192	76.4	398.9	322.0	360.0	38.0	10.5
1954	2675	66.1	411.8	322.0	370.0	48.0	8.6
1955	2369	69.4	488.3	316.0	368.0	52.0	9.4
1956	3149	87.9	465.2	324.0	380.0	56.0	8.3
1957	2517	70.2	464.8	324.0	385.0	61.0	7.6
1958	2562	69.5	452.1	323.0	386.0	63.0	7.2
1959	2931	74.6	424.2	326.0	395.0	69.0	6.1
1960	3591	82.5	382.9	335.0	407.0	72.0	5.3
1961	3612	79.9	368.7	343.0	414.0	71.0	5.2
1962	4057	83.7	343.9	348.0	418.0	70.0	4.9
1963	4555	86.7	317.2	352.0	422.0	70.0	4.5
1964	4487	78.6	292.0	355.0	424.0	69.0	4.2
1965	3498	65.6	312.6	350.0	419.0	69.0	4.5
1966	3991	73.7	307.8	353.0	420.0	67.0	4.6
1967	2752	52.9	320.4	344.0	418.0	74.0	4.3
1968	3086	56.5	305.1	341.0	418.0	77.0	4.0
1969	2672	50.8	316.9	338.0	417.0	79.0	4.0
1970	2736	55.4	337.5	336.0	419.0	83.0	4.1
1971	3337	64.2	320.6	342.0	423.0	81.0	4.0
1972	2838	50.9	298.9	341.0	421.0	80.0	3.7
1973	2843	47.3	277.3	341.0	418.0	77.0	3.6
1974	3006	49.3	273.3	342.0	424.0	82.0	3.3
1975	2632	43.1	272.9	341.0	428.0	87.0	3.1
1976	2971	82.6	463.4	359.0	447.0	88.0	5.3
1977	2961	78.9	444.1	353.0	448.0	95.0	4.7
1978	2590	66.4	427.5	345.0	443.0	98.0	4.4
1979	3014	69.0	381.0	345.0	450.0	105.0	3.6
1980	3448	61.8	298.6	348.0	453.0	105.0	2.8
1981	4315	66.6	257.2	357.0	467.0	110.0	2.3
1982	3550	51.0	239.0	349.0	459.0	110.0	2.2
1983	2183	31.3	239.0	340.0	463.0	123.0	1.9
1984	1211	19.0	267.0	355.0	475.0	120.0	2.2
1985	1587	22.1	232.0	351.0	470.0	119.0	2.0
1986	2266	26.7	196.0	375.0	492.0	117.0	1.7

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well G-4		Draw-down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1951	--	12.5	--	357.0	477.0	120.0	--
1952	2401	56.9	395.0	374.0	474.0	100.0	3.9
1953	2677	55.2	343.7	380.0	472.0	92.0	3.7
1954	2256	58.8	434.4	383.0	526.0	143.0	3.0
1955	1172	22.7	322.8	378.0	481.0	103.0	3.1
1956	1800	33.9	313.9	377.0	491.0	114.0	2.8
1957	1324	24.2	304.6	373.0	498.0	125.0	2.4
1958	1970	35.9	303.7	370.0	490.0	120.0	2.5
1959	1819	31.6	289.5	378.0	494.0	116.0	2.5
1960	2457	37.0	251.0	385.0	509.0	124.0	2.0
1961	2787	45.0	269.1	389.0	512.0	123.0	2.2
1962	2738	41.7	253.8	386.0	505.0	119.0	2.1
1963	3519	46.4	219.8	388.0	504.0	116.0	1.9
1964	3561	42.9	200.8	396.0	499.0	103.0	1.9
1965	2100	23.8	188.9	394.0	492.0	98.0	1.9
1966	2219	33.6	252.4	391.0	498.0	107.0	2.4
1967	2690	44.8	277.6	388.0	509.0	121.0	2.3
1968	2083	31.4	251.2	386.0	509.0	123.0	2.0
1969	1309	17.4	221.5	387.0	505.0	118.0	1.9
1970	606	7.7	211.8	384.0	504.0	120.0	1.8
1971	1640	21.0	213.4	389.0	503.0	114.0	1.9
1972	2840	33.3	195.4	391.0	507.0	116.0	1.7
1973	3006	37.2	206.3	392.0	521.0	129.0	1.6
1974	2672	34.3	213.9	392.0	519.0	127.0	1.7
1975	1977	41.0	345.6	403.0	559.0	156.0	2.2
1976	2859	57.8	336.9	406.0	571.0	165.0	2.0
1977	2954	62.4	352.1	406.0	589.0	183.0	1.9
1978	2607	49.5	316.5	398.0	589.0	191.0	1.7
1979	2974	52.9	296.4	395.0	586.0	191.0	1.6
1980	2235	35.6	265.7	394.0	580.0	186.0	1.4
1981	432	8.2	316.4	385.0	573.0	188.0	1.7
1982	3657	65.2	297.0	386.0	578.0	192.0	1.5
1983	2604	42.2	270.0	--	--	--	--
1984	3766	49.7	220.0	--	--	--	--
1985	1747	21.7	207.0	402.0	572.0	170.0	1.2
1986	2678	33.9	211.0	396.0	574.0	178.0	1.2

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well G-5		Draw-down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1951	--	6.7	--	414.0	--	--	--
1952	2579	73.8	476.9	422.0	480.0	58.0	8.2
1953	1433	37.8	439.6	425.0	467.0	42.0	10.5
1954	2617	80.9	515.2	429.0	473.0	44.0	11.7
1955	2529	80.4	529.9	427.0	472.0	45.0	11.8
1956	3052	97.0	529.7	431.0	478.0	47.0	11.3
1957	2385	64.1	447.9	424.0	466.0	42.0	10.7
1958	1523	49.1	537.3	428.0	477.0	49.0	11.0
1959	2917	101.7	581.1	435.0	495.0	60.0	9.7
1960	2828	98.0	577.6	437.0	501.0	64.0	9.0
1961	3908	134.0	571.5	438.0	507.0	69.0	8.3
1962	4186	142.0	565.4	440.0	511.0	71.0	8.0
1963	4528	151.0	555.8	441.0	513.0	72.0	7.7
1964	4532	150.4	553.1	446.0	516.0	70.0	7.9
1965	3520	117.1	554.5	443.0	516.0	73.0	7.6
1966	2555	83.2	542.7	445.0	520.0	75.0	7.2
1967	2405	80.0	554.4	444.0	519.0	75.0	7.4
1968	2513	81.2	538.5	443.0	517.0	74.0	7.3
1969	2649	83.3	524.1	450.0	520.0	70.0	7.5
1970	2771	88.9	534.7	453.0	521.0	68.0	7.9
1971	2657	88.3	553.9	450.0	521.0	71.0	7.8
1972	2902	92.4	530.7	441.0	514.0	73.0	7.3
1973	3003	97.5	541.1	444.0	515.0	71.0	7.6
1974	2054	69.0	559.9	440.0	513.0	73.0	7.7
1975	2266	74.7	549.4	433.0	500.0	67.0	8.2
1976	2955	95.0	535.8	442.0	504.0	62.0	8.6
1977	2836	92.1	541.3	444.0	504.0	60.0	9.0
1978	2608	84.2	538.4	442.0	502.0	60.0	9.0
1979	2766	86.5	521.5	442.0	502.0	60.0	8.7
1980	2896	89.0	512.4	442.0	502.0	60.0	8.5
1981	2124	66.7	523.4	451.0	528.0	77.0	6.8
1982	1219	38.2	522.0	455.0	510.0	55.0	9.5
1983	2904	73.2	420.0	445.0	492.0	47.0	8.9
1984	3838	115.4	501.0	452.0	507.0	55.0	9.4
1985	2193	67.9	516.0	453.0	509.0	56.0	9.2
1986	2219	52.5	394.0	453.0	494.0	41.0	9.6

APPENDIX A (cont)

Well G-6

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Water Level		Draw-down (ft)	Specific Capacity (gpm/ft)
				Nonpump (ft)	Pump (ft)		
1964	1912	45.0	392.3	581.0	659.0	78.0	5.0
1965	3200	74.9	390.1	582.0	660.0	78.0	5.0
1966	3931	92.2	390.9	585.0	658.0	73.0	5.4
1967	2454	57.8	392.6	580.0	653.0	73.0	5.4
1968	2597	56.2	360.7	574.0	647.0	73.0	4.9
1969	2698	55.6	343.5	568.0	636.0	68.0	5.1
1970	2765	51.0	307.4	569.0	634.0	65.0	4.7
1971	2932	42.8	243.3	573.0	629.0	56.0	4.3
1972	2516	57.0	377.6	578.0	670.0	92.0	4.1
1973	2991	65.3	363.9	579.0	667.0	88.0	4.1
1974	2950	63.8	360.5	579.0	665.0	86.0	4.2
1975	2717	56.7	347.8	577.0	659.0	82.0	4.2
1976	2966	57.8	324.8	584.0	662.0	78.0	4.2
1977	2954	54.4	306.9	586.0	659.0	73.0	4.2
1978	2218	38.4	288.9	581.0	645.0	64.0	4.5
1979	1030	18.2	295.1	579.0	645.0	66.0	4.8
1980	1789	34.5	321.5	583.0	670.0	87.0	3.7
1981	4302	76.5	296.4	586.0	673.0	87.0	3.4
1982	3763	63.6	281.0	588.0	669.0	81.0	3.5
1983	1960	35.4	301.0	582.0	668.0	86.0	3.5
1984	3010	55.3	306.0	589.0	666.0	77.0	3.9
1985	3980	71.4	299.0	586.0	664.0	78.0	3.8
1986	4420	76.7	293.0	576.0	654.0	78.0	3.8

APPENDIX A (cont)

<u>Year</u>	<u>Pump Time (h)</u>	<u>Pumpage (million gal)</u>	<u>Pump Rate (gpm)</u>	<u>Well PM-1</u>		<u>Draw-down (ft)</u>	<u>Specific Capacity (gpm/ft)</u>
				<u>Water Level</u>			
				<u>Nonpump (ft)</u>	<u>Pump (ft)</u>		
1965	2754	99.2	600.3	746.0	786.0	40.0	15.0
1966	3086	108.0	583.3	740.0	779.0	39.0	15.0
1967	2870	111.0	644.6	737.0	781.0	44.0	14.6
1968	1846	68.1	614.8	735.0	769.0	34.0	18.1
1969	951	34.4	602.9	733.0	766.0	33.0	18.3
1970	1781	66.2	619.5	733.0	769.0	36.0	17.2
1971	2728	101.0	617.1	733.0	766.0	33.0	18.7
1972	2415	84.9	585.9	735.0	762.0	27.0	21.7
1973	1688	46.5	459.1	736.0	755.0	19.0	24.2
1974	2649	96.3	605.9	740.0	768.0	28.0	21.6
1975	2567	94.8	615.5	741.0	766.0	25.0	24.6
1976	2933	106.8	606.9	744.0	767.0	23.0	26.4
1977	2969	105.4	591.7	745.0	767.0	22.0	26.9
1978	2544	90.6	593.3	745.0	767.0	22.0	27.0
1979	2350	83.4	591.5	744.0	766.0	22.0	26.9
1980	2786	98.5	588.6	746.0	769.0	23.0	25.7
1981	2789	98.5	588.6	747.0	769.0	22.0	26.8
1982	2820	99.6	589.0	748.0	770.0	22.0	26.8
1983	2464	86.5	585.0	747.0	769.0	22.0	26.6
1984	2667	92.8	580.0	749.0	772.0	23.0	25.6
1985	2760	95.4	576.0	749.0	770.0	21.0	27.4
1986	2130	73.9	578.0	748.0	770.0	22.0	26.3

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well PM-2		Draw- down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1966	221	18.9	1425.3	826.0	889.0	63.0	22.6
1967	4336	370.0	1422.2	834.0	888.0	54.0	26.3
1968	3865	328.2	1415.3	838.0	889.0	51.0	27.8
1969	3304	279.9	1411.9	838.0	890.0	52.0	27.2
1970	3529	300.6	1419.7	839.0	893.0	54.0	26.3
1971	4035	339.5	1402.3	841.0	898.0	57.0	24.6
1972	4611	385.3	1392.7	845.0	902.0	57.0	24.4
1973	4571	380.6	1387.7	849.0	907.0	58.0	23.9
1974	5443	450.9	1380.7	853.0	912.0	59.0	23.4
1975	4644	385.3	1382.8	854.0	913.0	59.0	23.4
1976	5382	442.0	1368.8	866.0	924.0	58.0	23.6
1977	3306	272.8	1375.3	868.0	924.0	56.0	24.6
1978	4743	388.4	1364.9	871.0	928.0	57.0	23.9
1979	4671	381.8	1262.2	872.0	924.0	52.0	26.2
1980	5023	409.6	1359.2	873.0	931.0	58.0	23.4
1981	4551	370.1	1355.4	876.0	934.0	58.0	23.4
1982	4319	359.3	1386.0	874.0	934.0	60.0	23.1
1983	1922	157.9	1369.0	876.0	935.0	59.0	23.2
1984	996	81.6	1365.0	866.0	930.0	64.0	21.7
1985	1749	143.3	1365.0	851.0	916.0	65.0	21.0
1986	1036	84.4	1359.0	851.0	915.0	64.0	21.2

APPENDIX A (cont)

<u>Year</u>	<u>Pump Time (h)</u>	<u>Pumpage (million gal)</u>	<u>Pump Rate (gpm)</u>	<u>Well PM-3</u>		<u>Draw-down (ft)</u>	<u>Specific Capacity (gpm/ft)</u>
				<u>Water Level</u>			
				<u>Nonpump (ft)</u>	<u>Pump (ft)</u>		
1968	2327	187.4	1342.2	743.0	771.0	28.0	47.9
1969	3241	254.7	1309.8	746.0	772.0	26.0	50.4
1970	2905	227.8	1306.9	750.0	774.0	24.0	54.5
1971	2774	216.3	1299.6	751.0	774.0	23.0	56.5
1972	2445	192.1	1309.5	752.0	775.0	23.0	56.9
1973	3256	257.8	1319.6	755.0	778.0	23.0	57.4
1974	3241	255.3	1312.9	756.0	779.0	23.0	57.1
1975	3421	269.3	1312.0	757.0	780.0	23.0	57.0
1976	3171	268.3	1410.2	758.0	784.0	26.0	54.2
1977	2792	235.5	1405.8	758.0	784.0	26.0	54.1
1978	2516	211.0	1397.6	759.0	784.0	25.0	55.9
1979	2359	197.2	1393.0	760.0	784.0	24.0	58.0
1980	2796	234.4	1397.2	760.0	785.0	25.0	55.9
1981	2784	232.4	1391.3	761.0	786.0	25.0	55.6
1982	2831	238.1	1402.0	762.0	785.0	23.0	60.9
1983	2496	207.6	1386.0	762.0	785.0	23.0	60.3
1984	3317	275.6	1385.0	762.0	787.0	25.0	55.4
1985	2643	221.2	1395.0	762.0	784.0	22.0	63.4
1986	2920	244.8	1397.0	763.0	787.0	24.0	58.2

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well PM-4		Draw-down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1982	869	76.2	1460	1050	1091	41	35.6
1983	5267	452.5	1432	1066	1101	35	40.9
1984	4059	325.8	1338	1065	1104	39	34.3
1985	4759	379.2	1328	1066	1101	35	37.9
1986	3925	307.4	1305	1084	1119	35	37.3

APPENDIX A (cont)

Year	Pump Time (h)	Pumpage (million gal)	Pump Rate (gpm)	Well PM-5		Draw-down (ft)	Specific Capacity (gpm/ft)
				Water Level			
				Nonpump (ft)	Pump (ft)		
1985	--	2.0	--	--	--	--	--
1986	2047	147.3	1199	--	--	--	--

APPENDIX A (cont)

Water Canyon Gallery

<u>Year</u>	<u>Time (h)</u>	<u>Production (million gal)</u>	<u>Discharge Rate (gpm)</u>
1947	8760	84.0	159.8
1948	8784	97.0	184.0
1949	8760	92.0	175.0
1950	8760	54.0	102.7
1951	8760	39.0	74.2
1952	8784	48.0	91.1
1953	8760	39.0	74.2
1954	8760	40.0	76.1
1955	8760	33.0	62.8
1956	8784	23.0	43.6
1957	8760	40.0	76.1
1958	8760	60.0	114.2
1959	8760	54.0	102.7
1960	8784	48.0	91.1
1961	8760	54.0	102.7
1962	8760	67.0	127.5
1963	8760	51.0	97.0
1964	8784	45.0	85.4
1965	8760	72.0	137.0
1966	8760	82.0	156.0
1967	8760	56.0	106.5
1968	8784	65.0	123.3
1969	8760	80.0	152.2
1970	8760	65.0	123.7
1971	8760	37.0	70.4
1972	8784	40.0	75.9
1973	8760	49.0	93.2
1974	8760	35.0	66.6
1975	8760	42.0	79.9
1976	8784	41.0	77.8
1977	8760	57.0	108.4
1978	8760	45.0	86.2
1979	8760	44.0	83.7
1980	8784	32.0	60.7
1981	8760	45.5	86.6
1982	8760	45.9	94.9
1983	8760	38.2	72.7
1984	8784	34.0	65.4
1985	8760	36.6	69.6
1986	8760	28.2	53.6

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