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WATER WELLS IN FRENCHMAN AND
YUCCA VALLEYS, NEVADA TEST SITE,
NYE COUNTY, NEVADA

By J. W. Hood

Trace Elements Investigations Report 788

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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This report is preliminary
and has not been edited
for conformity with Geological
Survey format.

*Prepared on behalf of the
U. S. Atomic Energy Commission.

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ABSTRACT

Three wells in Frenchman Valley and one well in Yucca Valley are used to supply water at the Nevada Test Site. The pumps were removed from these wells in 1959 to permit the replacement of air lines and the inspection, cleaning, and repair of pumps and casing. Afterward, tests by pumping were made in each well.

The yields of the wells range from about 40 gpm to about 160 gpm, and their specific capacities from about 0.7 to 3.7 gpm per ft of draw-down. The coefficients of transmissibility range from about 1,000 gpd per ft at a well in tuff of the Oak Spring formation to about 3,000 gpd per ft, or more, at a well in valley fill.

Water levels in the Frenchman Valley wells have declined no more than about 6 feet, as a result of pumping, but the water level in the well in Yucca Valley has declined about 31 feet.

Measurements of depth showed that wells in Frenchman Valley had filled from 10 to 16 feet since their construction, but that the well in Yucca Valley had not filled at all. The well water corrodes both well casing and pumps; hence, the use of protective cathodic devices and corrosion resistant well screen is suggested.

The yield of one of the wells might be increased by lowering the pump. The total supply of water probably could be increased by employing more wells, which, however, would not seriously dewater the aquifers.

To afford maximum yields, new wells should be as deep and as large in diameter as practical. Frenchman Valley is especially promising because the aquifer in the vicinity of the present well field is at least 500 feet thick.

INTRODUCTION

The Nevada Test Site is used by the Atomic Energy Commission for many activities. Camp Mercury, in the southern part of the Test Site, is the major installation. The water supplied to this and to most other installations is obtained from four deep wells, which are in Frenchman and Yucca Valleys, 10 to 24 miles north of Camp Mercury.

The U. S. Geological Survey is making geologic, hydrologic and geophysical studies of the Test Site in support of the activities of the Atomic Energy Commission. An essential part of these studies is the determination of the rate and direction of movement of the ground water, yet in 1959 the data necessary for this determination were scarce. The records of depth to water in the few existing wells were of uncertain value. New measurements of water level also would have been of dubious value because the condition of air lines in the wells was not known, and in some wells the measurements could not be made because access to the water level was obstructed. The Survey therefore proposed that the pumps be removed from the wells, that defective air lines be replaced, and that pumping tests be made.

Purpose and scope

This report summarizes the work that was done at the wells and brings together the available data on depth to bottom, depth to water level, discharge rate, and drawdown for each well, together with coefficients of transmissibility determined in aquifer tests. It gives information also on the condition of pumps and casing when, after several years of service, the pumps were removed. The extent of dewatering

of the aquifers, as reflected by declining water levels, is considered. Suggestions are offered for increasing the yield of both the individual wells and the well fields.

Location, extent, and topography

The Test Site is in southeastern Nye County and the extreme northwest border of Clark County, Nev., and is about 70 miles northwest of Las Vegas, Nev. Frenchman and Yucca Valleys are, respectively, the first and second intermontane valleys north of Camp Mercury; they are the dominant topographic features of the eastern half of the Test Site.

Frenchman Valley is about 13 miles wide and 18 miles long; Yucca Valley is about 7 miles wide and 20 miles long. Both are enclosed basins without exterior drainage and each has an ephemeral lake. The lake in Yucca Valley is about 3,900 feet above sea level, and that in Frenchman Valley is about 3,100 feet above sea level. The mountains enclosing the valleys rise at places to altitudes above 6,000 feet.

Previous investigations

Johnson and Hibbard (1957) have mapped and described the geology of the Nevada Test Site. Clebsch and Winograd (1959, p. 36-49) have given a preliminary description of the hydrology of Yucca Valley, including a discussion of the possibility of an hydraulic connection between Yucca and Frenchman Valleys. Included also are several logs of wells and test holes that had been drilled in Yucca Valley, and radiochemical analyses of water from wells in both Yucca and Frenchman Valleys.

Figure 1.--Locations of wells in Frenchman and Yucca Valleys, Nevada Test Site, Nye County, Nevada.

Chemical and radiochemical analyses of water samples from the wells considered here are reported also by Moore (1961, p. 11-15).

Methods of this investigation

Reynolds Electrical and Engineering Co. (hereafter REECO), acting as prime contractor for the AEC, issued on August 10, 1959, an invitation to bid on the proposed work. The Allen Water Well Service, Las Vegas, Nev., was awarded the contract, and work began on August 24. The job was completed about October 9.

The subcontractor removed the pumps, column pipe, and motors, replacing defective parts; cleaned the wells by bailing as needed; reinstalled the pumping equipment; put in new air lines; and then pumped the wells for about 48 hours.

The Geological Survey measured the depths of the wells and the depths to water while the pumps were out of them; made the measurements of discharge rate, water temperature, and water level for the pumping tests; and made gamma-ray logs in them. REECO provided support services including personnel for disconnecting utilities and for cleaning, painting, and repairing the pumping equipment, and inspected the work.

Depths to water in the wells were determined by means of a steel tape, by electrical cable, or by air line.

Measurements made with the steel tape are best, and generally are accurate to 0.1 foot. The lower end of the tape is immersed in the water and the upper end is held to a reference mark at the top of the well (the measuring point). The depth to water is the total length of tape in the well minus the wetted part of the tape. This

method of measurement was used in Frenchman Valley where the depth to water was less than 900 feet, the length of the longest available tape.

Electrical water-level indicators were used for depths greater than 900 feet and where wet casing or water falling to the water level would obscure the water mark on a tape. The instrument consists of cable, battery, milliammeter, and electrode. When the electrode at the end of the cable contacts the water in the well an electrical circuit is completed and the flow of current is indicated on the meter. The depth to water is the length of cable lowered into the well.

Measurements by means of electric cables are less accurate than those made with a steel tape, owing to stretch of the cable or to slippage of the cable over the sheave used to measure the length of cable in the hole. The electric cable used for the measurements reported here is considered to be accurate within 2 feet per thousand. By substituting a sounding weight for the electrode, the same device was used for measuring the depths of the wells.

An air line consists of a pipe or tube extending from the top of the well to some point below the water level. Air is pumped into the line until all the water in the tube is driven out at the bottom. When this happens, the air pressure required to keep water out becomes constant. The air pressure is measured in feet of water by a gage at the top of the air line, and represents the length of the line that contained water. This length is subtracted from the total length of the line to yield the depth to water from the surface. The accuracy of this method depends on several factors, of which the accuracy of

the gage is the principal one if the line itself is straight and tight. Air lines were used for measuring the water levels in all the pumping tests.

In this report the measurements made with a steel tape are taken as the standard for comparison of measurements made by the air-line method. (See table 6.) The measurements by the air-line method indicate depths to water about 1 foot deeper than measurements by steel tape in well 5A; 4.0 to 4.7 feet deeper than by steel tape in well 5B; and 3 to 6 feet greater than by steel tape in well 5C.

For well 3 the air-line method must be compared with the electric-cable method because the water level is beyond the reach of the available steel tape. Only two measurements are available, and these are two days apart. The air-line measurement was greater by about 7 feet.

Acknowledgments

Observations of operations at the wells and measurements during the tests were made by F. E. Busch, J. B. Cooper, W. D. Purtymun, J. E. Weir, Jr., I. J. Winograd, and the author. Mr. Busch prepared the aquifer-test data for analysis. W. A. Bradley, of the Branch of Geophysics, made the gamma-ray logs, which will be included in another report. R. P. Schreck, field engineer, was the REECO inspector in charge of the work performed by Allen Water Well Service. The assistance of Willard Martin during all phases of the work is gratefully acknowledged.

GENERAL GEOLOGY

The rocks exposed in the Nevada Test Site consist of varied sedimentary rocks of Paleozoic age, volcanic and sedimentary rocks of

Tertiary age, and alluvial and playa deposits of Quaternary age (Johnson and Hibbard, 1957; Hansen and Lemke, 1958). The Paleozoic rocks have a total thickness of about 22,000 feet and are dominantly limestone and dolomite, together with quartzite, marble, argillite, shale, and conglomerate. The Paleozoic rocks have been intruded at a few places by a granodiorite stock and by sills, of Cretaceous or Tertiary age. The Tertiary rocks consist principally of vitric and zeolitic tuff, basalt, rhyolite, and dacite of the Oak Spring formation. The Quaternary and Tertiary alluvium consists principally of detritus deposited in the intermontane basins, much of it in the form of fans. All the wells considered in this report penetrate hundreds of feet of the alluvium. They tap water in either the alluvium or the Oak Spring formation.

DESCRIPTION OF WELLS

Wells 5A, 5B, and 5C are in Frenchman Valley near the west end of Frenchman Lake. Well 3 is in Yucca Valley about 0.4 mile west of the main north-south highway and 2 miles northwest of the north end of Yucca Lake. All the wells are cased with steel casing, which ranges from 6 to 12 inches in diameter, and all except well 5B have an uncased lower section. All have below the water level well screens made by perforating a part of the casing by oxyacetylene torch. All are equipped with turbine pumps powered by submersible electric motors installed below the pumps. This type of installation leaves little clearance between motor and casing or walls of the hole, and in some wells it tends to impede the entrance of the water into the pump. Other data on the wells and their equipment are given in tables 1 and 2.

Table 1.--Records of production wells in Frenchman and Yucca Valleys, Nevada Test Site, Nye County, Nevada

Data in columns 1-8 reported by Reynolds Electrical and Engineering Co. Data in columns 3 and 5 verified from driller's report to Nevada State Engineer. Data in columns 9-20 prior to 1954 reported by REECO; after 1954, from records of U. S. Geological Survey.

LSD - Land-surface datum, MP - Measuring point, m - Measured by U. S. Geological Survey, E - Estimated.

Well no.	Coordinates (Nevada State System central zone)	Date completed	Altitude of LSD (feet)	Depth below LSD (feet)	Casing			Water-bearing formation	Measuring point		Depth to water			Yield (gpm)	Drawdown		Specific capacity (gpm per foot)	Temperature (°F)	Method of measurement and remarks
					Diameter (inches)	Depth (feet)	Perforated zone (feet) and slot size (inches)		Description	Height, above(+) or below(-) LSD (feet)	Below MP (feet)	Below LSD (feet)	Date of measurement		Feet	Pumping time (hours)			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
5A	N 738,361.00	3-23-51	3,092.7	910	12	608		Oak Spring (?)	Top of csg. (?)	1.4	700.3	699	3- -51	110	119	30	0.92	76	
	N 707,514.00				10	877	642-877 3/16 x 10		-----	---	750	---	2- -52	90	52	.5	----	--	Water level probably measured while pumping.
									Center of air-line gage	3	695	692	12- -58	---	---	----	----	--	Air line; assumed length 805 ft (47.5 psi).
									----do----	3	701	698	1-26-59	107	82	3.5	1.3	--	Air line (45.1 psi).
				m894.0	--	---	-----	-----	Top of casing	1.4	698.56	697.2	9-14-59	---	---	----	---	--	Steel tape. Pump off 2 days.
									-----do-----	1.4	698.6	697	9-15-59	---	---	----	----	--	Electric cable.
									-----do-----	1.4	697.14	695.7	9-23-59	---	---	----	----	--	Steel tape. Pump off 12 days.
									Center of air-line gage	3.2	700.1	697	9-24-59	100	86	25.2	1.2	74	Air line (46.0 psi.).
									----do----	3.0	699.7	697	10- 7-59	---	---	----	---	--	Air line (46.25 psi.).
									Top of air-line gage	2.8	698.73	695.9	10- 7-59	100	82	24.8	1.2	--	Steel tape. Pump off 6 days.

Well no.	Coordinates (Nevada State System central zone)	Date completed	Altitude of LSD (feet)	Depth below LSD (feet)	Casing			Water-bearing formation	Measuring point		Depth to water			Yield (gpm)	Drawdown		Specific capacity (gpm per foot)	Temperature (°F)	Method of measurement and remarks
					Diameter (inches)	Depth (feet)	Perforated zone (feet) and slot size (inches)		Description	Height, above(+) or below(-) LSD (feet)	Below MP (feet)	Below LSD (feet)	Date of measurement		Feet	Pumping time (hours)			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
5B	N 747,358.84	5- 7-51	3,092.1	900	12	460	700-900	Valley fill	Top of csg. (?)	1.12	683	682	1951	160	---	48	----	76	
	E 704,262.59			---	10	440-900	3/16 x 12												
				---	--	----	-----	-----	-----	----	770	---	2- -52	180	53	.5	3.4	--	Do.
				---	--	----	-----	-----	-----	----	---	---	-----	150	48	----	3.1	--	Do.
				m890.0	--	----	-----	-----	Top of csg.	1.12	684.2	683	8-25-59	---	---	----	----	--	Elec. cable. Pump off 6 days. Top of csg. is top of concrete block.
									----do----	1.12	684.1	683	8-25-59	---	---	----	----	--	Elec. cable.
									----do----	1.12	684.7	684	8-26-59	---	---	----	----	--	Do.
									----do----	1.12	683.71	682.6	8-26-59	---	---	----	----	--	Steel tape. Pump off 6 days.
									Top of air-line	2.26	685.10	682.8	8-27-59	---	---	----	----	--	Steel tape.
									Center of air-line gage	2.46	689.8	687	8-27-59	162	44	11.5	3.7	76	Air line (52 psi.).
									Top of air line	2.26	686.74	684.5	8-29-59	164	44.5	47.4	3.7	76	Steel tape.
									-----do----	1.96	685.35	683.4	8-31-59	---	----	----	----	--	Steel tape. Pump off 2 days.
									-----do----	2.08	685.36	683.3	12-23-60	---	----	----	----	--	Steel tape. Pump off 4 days.

Table 1.--Records of production wells in Frenchman and Yucca Valleys, Nevada Test Site, Nye County, Nevada.--Continued.

Well no.	Coordinates (Nevada State System central zone)	Date completed	Altitude of LSD (feet)	Depth below LSD (feet)	Casing			Water-bearing formation	Measuring point		Depth to water			Yield (gpm)	Drawdown		Specific capacity (gpm per foot)	Temperature (°F)	Method of measurement and remarks
					Diameter (inches)	Depth (feet)	Perforated zone (feet) and slot size (inches)		Description	Height, above(+) or below(-) LSD (feet)	Below MP (feet)	Below LSD (feet)	Date of measurement		Feet	Pumping time (hours)			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
5C	N 742,859.85 N 705,888.17	3-24-54	3,081.00	1,200	12	20	887-	Valley fill	-----	----	-----	693.0	4-26-54	155	112	102	1.4	76	Air line
				ml,189.2	10	1,187	1,187		-----	-----	-----	687.2	9- 3-59	---	---	---	---	--	Elec. line.
					--	-----	-----		-----	-4.70	689.7	694.4	9- 3-59	---	---	---	---	--	Steel tape. Pump off 3 days.
									-----	-4.70	690.5	695	9- 4-59	---	---	---	---	--	Elec. cable.
									-----	-4.70	687.7	692.4	9- 9-59	---	---	---	---	--	Steel tape. Pump off 9 days.
									Top of air line	+3.05	695.1	692.0	9-14-59	132	95	44.8	1.4	75	Steel tape. Pump off 4 days.
									-----do-----	-2.95	696.9	699.9	12-13-60	---	---	----	---	--	Steel tape. Pump off 7 days.
									-----do-----	-2.95	695.1	698.0	12-30-60	---	---	----	---	--	Steel tape. Pump off 3 days.
									-----do-----	-2.95	692.7	695.6	1-13-61	---	---	----	---	--	Steel tape. Pump off 17 days.
									-----do-----	-2.95	691.7	694.6	1-20-61	---	---	----	---	--	Steel tape. Pump off 24 days.
									-----do-----	-2.95	690.6	693.6	1-27-61	---	---	----	---	--	Steel tape. Pump off 31 days.
									-----do-----	-2.95	690.5	693.4	2- 3-61	---	---	----	---	--	Steel tape. Pump off 38 days.

Table 1.--Records of production wells in Frenchman and Yucca Valleys, Nevada Test Site, Nye County, Nevada--Continued.

Well no.	Coordinates (Nevada State System central zone)	Date completed	Altitude of LSD (feet)	Depth below LSD (feet)	Casing			Water-bearing formation	Measuring point		Depth to water			Yield (gpm)	Drawdown		Specific capacity (gpm per foot)	Temperature (°F)	Method of measurement and remarks
					Diameter (inches)	Depth (feet)	Perforated zone (feet) and slot size (inches)		Description	Height, above(+) or below(-) LSD (feet)	Below MP (feet)	Below LSD (feet)	Date of measurement		Feet	Pumping time (hours)			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
5C--Continued.									Top of air line	-2.95	688.9	691.8	2-16-61	---	---	----	---	--	Steel tape. Pump off 51 days.
									----do----	-2.95	688.1	691.0	3- 3-61	---	---	----	---	--	Steel tape. Pump off 66 days.
3	N 817,794.96 E 677,761.73	2-10-51	3,969.3	1,575	12 10 8 6	25 256 1,209 1,765	1,535 - 1,765 1/8 x ?	Oak Spring	-----	-----	-----	1,530	2- -51	---	---	----	---	--	Reported.
									-----	-----	-----	1,545	3- -52	50	195	24	---	--	-----
									-----	-----	-----	-----	-----	38	85	.5	0.45	76	Reported.
									Center of air-line gage.	E2	1,574	1,572	12- 1-58	---	---	----	----	--	Air line.
									-----	E2	1,575	1,573	12- 2-58	30	46	16.9	.65	--	Do.
									Top of csg.	1.0	1,574.6	1,574	9-19-59	---	---	----	----	--	Elec. cable. Pump off 2 days.
									-----	1.0	1,573.8	1,573	9-30-59	---	---	----	----	--	Elec. cable. Pump off 14 days.
									Center of air-line gage.	2.2	1,582	1,580	10- 2-59	---	---	----	----	--	Air line.
									----do----	2.2	1,581	1,579	10- 5-59	40	55	48	.73	--	Do.
									Top of csg.	1.0	1,572.3	1,571	2- 4-60	---	---	----	----	--	Elec. cable. Pump off 35 days.
									----do----	1.0	1,576.8	1,576	11-22-60	---	---	----	----	--	Do.

Table 2.--Records of equipment in wells 3, 5A, 5B, and 5C, after installing new air lines, October 1959

[Data from R. P. Schreck, field engineer, Reynolds Electrical and Engineering Co.]

LSD - Land-surface datum

Well No.	Length of air line (feet)		No. of joints	Inside diameter (inches)	Pump column pipe				Pump setting (feet below LSD)		Pump and motor		
	Total	Below LSD			Check valves		Length (feet)		Intake	Bottom of motor	No. of stages	Horse- power	Maximum diameter of assembly (inches)
					No.	Depths to top of assembly (feet)	Total	Below LSD					
5A	806.4	803.4	38	3	2	250.1 693.4	803.4	801.6	819.4	825.7	31	30	7.81
5B	809.9	807.8	37	3	2	404.0 681.0	788.6	787.6	809.5	816.1	32	50	9.75
5C	867.6	870.6	25	3	2	320.2 687.2	862.8	867.5	890.5	898.1	35	50	9.75
3	1,709.0	1,708.0	54	2.5	1	1,706.4	1,709.8	1,708.8	1,716.8	1,724.2	33	30	5.38
b3	1,708.2	1,707.2	54	2.5	3	569.8 1,139.2 1,708.6	1,711.4	1,710.4	1,718.4	1,725.8			

a/ 17 joints approximately 40 feet long and 8 joints approximately 20 feet long.

b/ Changes made in equipment in March 1960.

The new air lines installed in wells 5A, 5B, and 5C consist of 3/8-inch ID screw-coupled steel pipe in 20±-foot lengths, which for installation was strapped, together with the power cable, to the pump-column pipe. The air line installed in well 3 (Yucca Valley) consists of 1/2-inch OD copper tubing installed in the same manner.

Condition of wells and equipment

When the pumps were removed from the wells, some parts of the equipment were found to have been damaged by contact with the water. The following paragraphs summarize observations on the condition of the equipment in each well.

Well 5A

When the pump had been removed from well 5A, the well casing was scrubbed with a wire brush and the scale thus loosened was bailed from the well. The column pipe that had been at the water level and the upper flange of the pump assembly were found to be badly pitted. They were replaced.

During the first pumping test after the reinstallation had been completed, the air line became plugged so that measurements of water level could not be made. The pump and air line were pulled out of the well, and it was found that a small piece of a patch from the steel measuring tape had lodged in the air line. Rust and other debris from inside the air line had accumulated on this obstruction to a depth of about 2 feet. The water discharged during the pumping was at first charged with rust and fine sand but cleared within an hour.

The pump and air line were installed a second time, and a pumping test then was satisfactorily concluded. The water cleared of suspended matter after about 15 minutes of pumping.

There seems to be enough sediment or rust in the water or in the air line to clog the air line readily. It was found to be plugged again by late 1960.

Well 5B

The pump and the pump-column pipe that had been below the water level in well 5B were found to be badly rusted, and the lowermost five joints of pipe had to be replaced. The pump, however, was in good condition except for need of external cleaning. The check valve assemblies of the column pipe each contain a "weep" hole about $\frac{1}{4}$ inch in diameter.

The old air line had not been functioning. This failure was due to plugging by corrosion products, not to pinching of the line as had been supposed. After the pump had been reinstalled, the water pumped from the well was charged with rust. It cleared in about 5 hours.

Well 5C

The column pipe in well 5C was found to consist of joints about 40 feet long, and the lower 169.4 feet was seriously corroded. The lower part, therefore, was replaced with eight joints each about 20 feet long. The outside of the pump was cleaned by sand blasting and was repainted. The lower 300 feet of the well casing was scrubbed with a wire brush to clean off rust and scale, which then fell to the

bottom of the well and was bailed out. The air line was kinked and crumpled at the first joint, and the power cable was "wadded" and had a half hitch around the column pipe. These conditions may have been created when the column pipe was being pulled out through small openings rather than when it was being installed. Both the air line and the power cable were replaced. In pumping after completion of the repair job, the water at first contained rust but cleared in about three hours.

Well 3

The pump in well 3 was found to be stuck so tight that threads on the column pipe were stripped when a pull was exerted. To loosen it, the annular space between the pump and casing was washed with clear water, and a strain was maintained on the column overnight. Further pulling then dislodged the pump so that the assembly could be removed.

The lower part of the 3-inch column pipe was so badly rusted, especially on the inside, that cleaning it appeared to be impractical. Because suitable 3-inch pipe could not be obtained immediately, $2\frac{1}{2}$ -inch ID pipe was substituted. The pump was found to need repair and was replaced with a spare pump. The well had filled in very little, and bailing 10 to 12 times sufficed to remove all the loose material from the bottom of the well. With this material was a 7-foot length of copper air line.

Pump repair and meter replacement have been required frequently at well 3. To reduce wear on meter bearings due to the sediment carried by the water a sand trap was installed ahead of the meter. On

microscopic examination, the "sand" from this trap proved to consist almost exclusively of rust. At least part of the rust comes from outside the pump, as shown by the fact that when removed from the well the outer lower half of the pump intake screen was clogged with fragments too large to enter. When pumping was resumed after replacement of the pump, the water was charged with much rust scale but slowly cleared and in about 2 hours was nearly free of suspended matter.

A further improvement was made on February 6, 1960, by installing three positive-type check valves in the pump column (table 2).

AQUIFER TESTS

When reconditioning in a well had been completed, the well was tested by pumping at a nearly constant rate for about 48 hours to show whether the pump installation had been properly made and to provide information on the hydraulic properties of the aquifer. All the tests were supervised by personnel of the Geological Survey. Measurements of discharge, depth to water, and water temperature were made during the pumping, and water-level measurements were continued afterward until the level had recovered approximately to the position it had before pumping was begun.

The resulting data were analyzed in several ways to determine the specific capacity of each well and the coefficients of transmissibility of the aquifers. Comparison is made with the results of similar tests previously made at well 5C (Brown, written communication, 1955), at well 3 (Clebsch and Winograd, 1959, p. 41-44), and at well 5A. The test at well 5A was made by Winograd and Philip Cohen, and is described for the first time in the present report.

Specific capacity

The specific capacity of a well is its rate of discharge in gallons per minute per foot of drawdown. Although the specific capacity is not a constant for any well, it approaches a constant value closely enough to be useful for estimating the maximum yield of a well and for comparing the productiveness of different wells. If the specific capacities of different wells are to be comparable, they should be based on approximately equal discharge rates and pumping periods.

Specific capacities were determined repeatedly in each of the tests reported here and are illustrated by the curves in figure 2. These show that the specific capacities of wells 5A, 5B, and 3 reached nearly constant values after 1,440 minutes (1 day) of pumping, but still were decreasing at a very slow rate. The curve for well 5C, however, shows that the specific capacity still was diminishing at a fairly constant rate at the end of 2,880 minutes (2 days), and would have continued to diminish for an extended period had pumping continued longer. The indications are that wells 5A, 5B, and 3 could be pumped for relatively long periods of time at the rates which prevailed during the tests (table 3) with only small increases in drawdown.

Coefficient of transmissibility

The coefficient of transmissibility (T) represents the ability of a water-bearing formation to transmit water under certain assumptions (Theis, 1935; Wenzel, 1942; Brown, 1953) and for field conditions is defined as the quantity of water that would flow through a section of the water-bearing formation 1 mile wide under a hydraulic gradient

Figure 2.--Graph showing change of specific capacity with time, for production wells in Frenchman and Yucca Valleys, Nevada Test Site.

of 1 foot per mile. Thus, the coefficient is expressed in gallons per day per foot (gpd/ft). It can be determined from a controlled pumping test, even though the thickness of the aquifer is not known.

Several limiting assumptions are required by the mathematical model on which the method for determining transmissibility is based (Theis, 1935), and these are not always met in practical tests. The departures from the ideal result largely from variations in the lithologic properties of the aquifers and the accompanying variations in their hydraulic characteristics. The magnitude of the variations in Frenchman and Yucca Valleys is likely to be considerable; therefore the coefficients of transmissibility determined in the pumping tests are only approximations.

Tests at well 5A

Two aquifer tests were made at well 5A. The first was made in late January and early February 1959, and the second in October 1959.

In the first test, the well was pumped for 9 days, 23 hours, and 40 minutes at rates varying from 46 to 100 gpm. The rate of discharge was changed intentionally from time to time in order to produce changes in drawdown by steps. The changes, unfortunately, make it impossible to use the drawdown data directly, and they complicate the analysis of the recovery curve.

The recovery data from this test were analyzed by using a variation of Theis's recovery formula, which relates the rate of recovery of the water level to the rate of discharge and the lengths of time since pumping started and stopped, in the following manner:

$$T = \frac{264Q}{s} \log_{10} \frac{t}{t'}$$

Wherein: T = coefficient of transmissibility

Q = rate of discharge in gpm

s = residual drawdown in feet

t = time since pumping began to time of measurement
of s, in any unit

t' = time since pumping stopped

During a step-drawdown test however, there are several values for Q and therefore, several values for t, all of which must be taken into account as follows:

$$T = \frac{264}{s} \left[q_1 \log_{10} \frac{t_1 + t'}{t_2 + t'} + q_2 \log_{10} \frac{t_2 + t'}{t'} \right]$$

where: s = residual drawdown at the pumped well

T = coefficient of transmissibility, in gallons per day per
foot

q₁ = discharge of well, in gallons per minute, during the first
step

q₂ = discharge of well, in gallons per minute, during the sec-
ond step

t = time since pumping started in the step indicated by the
subscript to the time that pumping stopped

t' = time since pumping stopped

The values of s are plotted on arithmetic graph paper against the values of the term in brackets for each of various intervals after pumping stopped, and should theoretically fall along a straight line.

By selecting two points on the line and dividing the difference in the two values of the term in brackets at those points by the difference in the two values of s at those two points and multiplying the quotient by 264, a value for T is obtained. The same procedure applies to a computation of T from the recovery following any number of pumping steps, an additional term in brackets being added for each additional pumping step. Thus:

$$T = \frac{264}{s} \left[q_1 \log_{10} \frac{t_1 + t'}{t_2 + t'} + q_2 \log_{10} \frac{t_2 + t'}{t_3 + t'} + \dots + q_n \log_{10} \frac{t_n + t'}{t'} \right]$$

Figure 3 shows the results of the computation of T for the recovery of water level in well 5A based on the test of Feb. 5, 1959, using the formula cited above. The plotted points do not fall along a straight line, but can be fitted approximately to two straight lines for overlapping segments of the curve. The straight lines show the general slope of the plotted points for residual drawdown and the value in brackets, and indicate values for the coefficient of transmissibility of about 1,550 and 2,350 gpd/ft.

The second test in well 5A is illustrated by figures 4 and 5. Figure 4 shows the water levels measured during and after pumping, together with the measured rate of discharge. Figure 5 gives the analysis of these data by means of the Theis non-equilibrium formula (Wenzel, 1942). The observed data on the logarithmic graph fit the theoretical curve at two or more places, thus yielding several values for the coefficient of transmissibility. These range from 425 to 2,340 gpd/ft.

Figure 3.--Analysis of recovery data from step-pumping test of aquifer at well 5A, January 26 - February 5, 1959.

Figure 4.--Measured depths to water and rates of discharge during aquifer test at Well 5A, October 7 - 9, 1959.

Figure 5.--Analysis of drawdown and recovery data from aquifer test at well 5A, October 7 - 9, 1959.

Test at well 5B

A test was made at well 5B in August 1959. The drawdown and recovery of water level and the rate of discharge are shown in figure 6, and the analyses of the drawdown and recovery are given in figure 7. The coefficients of transmissibility computed from these data range from 1,530 to 7,440 gpd/ft.

Tests at well 5C

Aquifer tests at well 5C were made in 1954 by Brown (written communication, 1955), and again in September 1959. Brown analyzed his drawdown data by means of the non-equilibrium formula, and reported a coefficient of transmissibility of 710 gpd/ft based on the early part of the test. His plot of the drawdown by the straight-line method of Cooper and Jacob (1946) indicates a T of 836 gpd/ft early in the test; 2,250 gpd/ft somewhat later; and 3,410 gpd/ft near the end. His straight-line analysis of the recovery of water level indicates a T of 822 gpd/ft early in the recovery period, 2,150 gpd/ft somewhat later, and 6,200 gpd/ft near the end.

Results of the test of September 1959 are shown in figures 8 and 9. Analyzed by the non-equilibrium formula, the drawdown data yield a T amounting to 2,510 gpd/ft; and the recovery data yield values for T amounting to 355 and 2,840 gpd/ft.

Tests at well 3

Two aquifer tests were made at well 3. The first, made in December 1958, is illustrated in figure 10. Analysis of the data by means of the non-equilibrium formula yielded a T of 724 gpd/ft.

Figure 6.--Measured depths to water and rates of discharge during aquifer test at well 5B, August 27 - 29, 1959.

Figure 7.--Analysis of drawdown and recovery data from aquifer test at well 5B, August 27 - 29, 1959.

Figure 8.--Measured depths to water and rates of discharge during aquifer test at well 5C, September 9 - 14, 1959.

Figure 9.--Analysis of drawdown and recovery data from aquifer test at well 5C, September 9 - 14, 1959.

Figure 10.--Analysis of drawdown and recovery data from aquifer test at well 3, December 2, 1958.

The second test (October 2-5, 1959) yielded four figures for T. The drawdown and recovery curves and the discharge rates are illustrated in figure 11. Logarithmic plots of the drawdown and recovery (fig. 12) show the curves to consist of at least two segments having distinctly different slopes. Analysis of the slopes on the drawdown curve yielded the figures 520 and 1,260 gpd/ft; and analysis of those on the recovery yielded the figures 191 and 1,000 gpd/ft.

Summary of aquifer tests

Table 3 summarizes the results of the several pumping tests, including the specific capacity at the end of each test and all values obtained for the coefficient of transmissibility.

Most of the graphs used for analyzing the aquifer tests have three distinct segments whereas the theoretically ideal graph would not. They have an early segment that has a relatively steep slope, an intermediate segment that has a moderate to low slope, and a late segment that is nearly flat. The first change in slope took place between 10 and 40 minutes after the beginning of drawdown or recovery; and the second change took place between 2 hours and 1 day or more after the beginning of drawdown or recovery.

The reasons for these departures from the theoretical curve are not known, but they doubtless are due to conditions in the aquifer that deviate from the assumptions of the Theis formula, such as changes in the rate of release of water from the aquifer, or the proximity of hydraulic boundaries. The similarity of the graphs for wells finished in two different aquifers suggests a common cause for the departures.

Figure 11.--Measured depths to water and rates of discharge during aquifer test at well 3, October 2 - 5, 1959.

Figure 12.--Analysis of drawdown and recovery data from aquifer test at well 3, October 2 - 5, 1959.

Table 3. Results of aquifer tests in wells at the Nevada Test Site, Nye County, Nev.

Well no.	Date	Average rate of discharge (gpm)	Maximum drawdown (feet)	Length of pumping (days)	Specific capacity at end of test (gpm/ft)	Coefficient of transmissibility (gpd/ft)	
						Part of test	
						Drawdown	Recovery
5A	Jan. 26-	<u>a/</u>	76.4	10.0	1.12	-----	1,550
	Feb. 5, 1959						2,350
	Oct. 7- 9, 1959	100.1	84.3	1.03	1.18	574 2,340	425 1,540
5B	Aug. 27-29, 1959	161.1	44.5	2.0	3.69	2,460 7,440	1,530
5C	Apr. 26-	155	111	4.25	1.4	710	822
	May 1, 1954					836 2,250 3,410	2,150 6,200
	Sept. 9-14, 1959	131.4	97.0	1.88	1.38	2,510	355 2,840
3	Dec. 1- 2, 1958	30	45.8	.93	.67	-----	724
	Oct. 2- 5, 1959	40.2	54.9	2.0	.73	520 1,260	191 1,000

a/Discharge rate ranged from 46.1 to 100 gpm, by steps.

Each phase of each test yielded two or three values for the coefficient of transmissibility (table 3). The lower figures, which were obtained early in the tests, are believed to be erroneous. Those obtained later in the tests may be nearer the correct order of magnitude, because the non-equilibrium formula and its variations (used to compute T) are based on a two-dimensional flow model and should not be used where there is a third dimension, namely vertical flow. During an aquifer test the rate of drawdown diminishes as pumping time increases and the effect of vertical flow in the aquifer diminishes. Hence, conditions late in the tests more closely approach the assumptions used in the derivation of the non-equilibrium formula than do those early in the tests.

The values for T may be tested for validity, in a general way, by comparing them with the values for specific capacity. There is a relation between the two figures, because both the transmissibility and the specific capacity involve discharge rate, drawdown, and time. If the coefficient of transmissibility is greater or smaller at one well than at another, the specific capacity also should be greater or smaller. This general relation is demonstrated in table 3 and in the abstracted values in table 4.

RELATION OF LITHOLOGY TO TRANSMISSIBILITY

The coefficients of transmissibility are clearly related to the lithologic character of the different aquifers (table 5). The alluvial fill has higher transmissibilities at wells 5B and 5C than the

Table 4. Specific capacity compared with
coefficient of transmissibility

Well no.	Specific capacity after 1 day or more (gpm/ft of drawdown)	Transmissibility (gpd/ft)
3	0.7	1,000 to 1,300
5A	1.2	1,500 to 2,300
5C	1.4	2,200 to 6,200
5B	3.7	2,500 to 7,400

tuff of the Oak Spring formation has at well 3, and higher than the tuffaceous conglomerate (probably part of the Oak Spring formation) at well 5A.

Although the logs of the wells offer no explanatory clue, the lithologic character of the alluvial fill doubtless differs from place to place. At well 5B the coefficients of transmissibility are slightly higher than those at well 5C, even though the screened interval is 130 feet shorter in well 5B than in well 5C.

Table 5. Logs of wells in Frenchman and Yucca Valleys,
Nevada Test Site

Log of well 3, Yucca Valley
[From Wilmarth and other (1959). Apparently based on driller's
log and sample descriptions by a geologist.]

	Thickness (feet)	Depth (feet)
Brown silty sand with medium and fine gravel. .	340	340
Coarse sand and fine gravel	6	346
Brown silty sand with fine gravel	14	360
Brown fine gravel and sand with streaks of silty sand.	330	690
Brown fine gravel and sand.	70	760
Brown sand and fine gravel with streaks of silty sand.	240	1,000
Volcanic and sedimentary rock fragments in the size range of cobbles, gravel, and sand, all of which occur in a matrix of reddish-brown silt and/or clay.	445	1,445
Coarse volcanic gravel and sand in volcanically derived silt and clay, finer textured at 1,450 to 1,520 feet	75	1,520
Transition from valley fill to soft, faintly reddish-brown, volcanic tuff.	10	1,530
Tuff, hard, faintly reddish-brown	45	1,575
Tuff, soft, with streaks of sand.	110	1,685

Table 5. Logs of wells in Frenchman and Yucca Valleys,
Nevada Test Site--Continued

Log of well 3, Yucca Valley--Continued

	Thickness (feet)	Depth (feet)
Sandstone	80	1,765
Conglomerate	35	1,800

Sample log of well 5A, Frenchman Valley

Valley fill, coarse gravel, sand, silt, and clay. Rock fragments are predominantly lime- stone with some quartzite. Enough silt and clay present to make a good drilling mix . . .	180	180
Valley fill, limestone and quartzite gravel and sand, with enough silt and clay for good drilling mix. Materials are coarser than above.	70	250
Valley fill, subangular quartzite and limestone fragments in gravel and sand layers inter- bedded with increasing thicknesses of strata of these rocks embedded in a silt and clay matrix. Some gravel layers are well cemented.	300	550
Transition zone. Valley alluvium to conglomer- ate composed of rounded pebbles in a tuffa- ceous matrix. Pebbles are largely of quartz and quartzite origin	35	585

Table 5. Logs of wells in Frenchman and Yucca Valleys,
Nevada Test Site--Continued

Sample log of well 5A, Frenchman Valley--Continued

	Thickness (feet)	Depth (feet)
Conglomerate. Interbedded layers of cobbles, pebbles, and granules, largely of quartz and quartzite origin, well rounded and embedded in tuffaceous matrix	285	870
Hard, silicious conglomerate. Cobbles and pebbles, largely of quartz and quartzite origin, embedded in a silicious matrix	20	890
Unknown	20	910

Driller's log of well 5B, Frenchman Valley

Gravel and clay	57	57
Clay, sand, and gravel	375	432
Cemented gravel	206	638
Sand and gravel, lightly cemented	262	900

Sample log of well 5C, Frenchman Valley
[Brown, written communication, 1955]

Undifferentiated Pleistocene and Recent

Sand, fine to coarse; gravel, fine to coarse;

Table 5. Logs of wells in Frenchman and Yucca Valleys,
Nevada Test Site--Continued

Sample log of well 5C, Frenchman Valley--Continued

	Thickness (feet)	Depth (feet)
pink, gray. Consists of limestone, dolomite, tuff, rhyolite, quartz, and quartzite	55	55
Gravel, fine to coarse, and intermixed fine to coarse sand; pink, gray, green. Consists of limestone, dolomite, tuff, rhyolite, quartz, and quartzite	102	157
Sand, coarse, with fine to coarse sand and fine to coarse gravel; pink, gray, green, tan. Consists of limestone, dolomite, tuff, rhyo- lite, quartz, quartzite, and argillite	31	188
Clay, light tan, soft, plastic, contains inter- mixed tan, fine to coarse sand	20	208
Sand, fine to coarse, and fine gravel; with intermixed light tan, soft, plastic clay. Coarse clastic sediments are predominantly quartz, quartzite, and limestone	52	260
Sand, fine to coarse, with fine to coarse gravel; pink, gray, tan. Consists of lime- stone, dolomite, quartz, quartzite, and argillite	31	291
Sand, fine to coarse, with fine to coarse gravel; pink, tan, cemented with CaCO_3 .		

Table 5. Logs of wells in Frenchman and Yucca Valleys,
Nevada Test Site--Continued

Sample log of well 5C, Frenchman Valley--Continued

	Thickness (feet)	Depth (feet)
Consists predominantly of limestone, quartz- ite, and rhyolite. Contains a few intermixed pebbles, cobbles, and boulders, mostly of limestone	92	383
Gravel, fine to coarse, pebbles, cobbles, and boulders; with intermixed fine to coarse sand; brown, pink, gray, green; cemented with CaCO ₃ . Consists predominantly of limestone, quartzite, and rhyolite	97	480
Clay, tan, hard, plastic, contains interbedded tan, pink, gray, red, green, fine to coarse sand and fine gravel; estimated 3- to 6-inch alternating beds. Coarse clastic sediments are predominantly limestone, dolomite, quartzite, and rhyolite	32	512
Gravel, fine to coarse, pebbles, cobbles, and boulders; with intermixed fine to coarse sand; red, pink, green, gray, black; cemented with CaCO ₃ . Consists predominantly of lime- stone, dolomite, quartzite, and rhyolite . . .	92	604
Clay, tan, hard, plastic, interbedded with tan, pink, gray, red, green, fine to coarse sand		

Table 5. Logs of wells in Frenchman and Yucca Valleys,
Nevada Test Site--Continued

Sample log of well 5C, Frenchman Valley--Continued

	Thickness (feet)	Depth (feet)
and fine to coarse gravel, pebbles, and cobbles. Some silica cement. Estimated 6-inch alternating beds. Coarse clastic sediments are predominantly limestone, dolomite, quartzite, and rhyolite	128	732
Gravel, fine to coarse, pebbles, cobbles, and boulders; with intermixed fine to coarse sand, red, pink, green, gray, black. Some silica cement. Consists predominantly of limestone, dolomite, quartzite, and rhyolite .	35	767
Gravel, fine to coarse, pebbles, cobbles, and boulders; with intermixed fine to coarse sand; red, pink, green, gray, tan, some silica cement; interbedded with estimated 6-inch layers of sand, tan, hard, plastic, clay. Coarse clastic sediments are predominantly limestone, dolomite, quartzite, and rhyolite .	82	849
Gravel, fine to coarse, pebbles, cobbles, and boulders; with intermixed fine to coarse sand; pink, gray, green, red, tan, brown. Some silica cement. Consists predominantly		

Table 5. Logs of wells in Frenchman and Yucca Valleys,
Nevada Test Site--Continued

Sample log of well 5C, Frenchman Valley--Continued.

	Thickness (feet)	Depth (feet)
of quartzite, with major quantities of rhyo-		
lite, limestone and dolomite.	351	1,200

EXTENT OF DEWATERING

Pumping from the wells in Frenchman Valley has been in progress since 1951. Exceptionally large quantities of water were pumped from them in 1960. Pumping from well 3 in Yucca Valley has been in progress since 1952, with periodic interruptions of 4 to 6 weeks for pump repair or replacement.

The effect of protracted pumping on the water levels seems not to have been great but it cannot be appraised exactly because of uncertainty with respect to the initial water levels. The methods and the reference points for the early measurements were not recorded except for well 5C, where Brown (written communication, 1955) used the airline method. In the absence of information to the contrary, this method is assumed to have been used for making all the initial water-level measurements. The early water levels as recorded (Table 1) therefore have been adjusted in accord with the comparative data presented in table 6 so that they correspond as nearly as possible to the tape measurements made later.

Table 6. Air-line measurements compared with tape or electric-line measurements of water levels in wells 5A, 5B, 5C, and 3, August to October 1959

Well no. and date	Water level in feet below land-surface datum		Difference	Remarks
	Air-line measurements	Tape or electric-cable measurements		
<u>5A</u>				
Sept. 24	696.9	695.7	+1.2 ft	Static level.
Oct. 7	696.6	695.9	+ .7 ft	Static level.
<u>5B</u>				
Aug. 27	687.5	682.8	+4.7 ft	Static level.
27	730.2	725.9	+4.3 ft	Pumping.
28	730.2	726.2	+4.0 ft	Pumping.
29	688.6	684.5	+4.1 ft	Water level recovering.
31	688.1	683.4	+4.7 ft	Static level.
<u>5C</u>				
Sept. 9	695.9	692.43	+3.5 ft	Static level.
11	791.2	788.48	+2.7 ft	Pumping.
14	698.2	692.02	+6.2 ft	Not pumped for 67 hours; error due to recovery less than 1 foot.

Table 6. Air-line measurements compared with tape or electric-line measurements of water levels in wells 5A, 5B, 5C, and 3, August to October 1959--Continued

Well no. and date	Water level in feet below land-surface datum		Difference	Remarks
	Air-line measurements	Tape or electric-cable measurements		
<u>3</u>				
Sept. 30	-----	^a 1,573	-----	Error due to recovery after pumping probably less than 1 foot.
Oct. 2	1,580	-----	+7.0± ft	

^aElectric-cable measurement.

The early water level for well 3 is uncertain because the well was deepened after a year or two, and the deepening appears to have been accompanied by a 15-foot decline in head. The first water level measured after the deepening may afford the fairest basis for comparison with the recent measurements.

The early water levels are compared below with the highest water levels observed in 1959-1961.

Well no.	Earliest reported static level ^{1/}		Highest static level, 1959-1961 (feet)	Decline through 1960-61	Remarks
	Depth (feet)	Date			
5A	694-700	1951	695.7	0- 2	
5B	677-682	1951	682.6	1- 6	
5C	687-693	1954	691.0	0- 4	
3	1,530	1951	-----	-----	Well 1,575 ft deep.
^{2/} 3	1,538-1,545	1952	1,576	31-38	Well 1,800 ft deep.

^{1/} Deeper static level is that reported by drillers or by Brown (1955); shallower static level is reported level minus maximum air-line error (table 6).

^{2/} Drop in head from 1,530 to 1,545 ft believed to be due to deepening of well. Similar drop in head has been documented in another well in Yucca Flat.

The apparent downward trend of the water levels in Frenchman Valley probably will continue unless the rate of withdrawal is reduced, or unless additional wells are employed, permitting the withdrawal to be distributed over a larger area. Water-level declines of the magnitude

observed thus far are not, however, a cause for alarm. Pumping from the existing wells can continue at present rates for a long time to come.

The three wells in Frenchman Valley are about 1 mile apart, and apparently do not interfere with each other. Evidence is lacking to show that pumping from any one of them affects the water level in the others.

The greatest effect of pumping has appeared in the water level in well 3, in Yucca Valley, where as tabulated above the decline in about 8 years was about 31 feet. Even in the last 10 months of record there was a decline of 5 feet. The last two measurements of water level were made when the pump had been shut down for 35 days, in both cases after 3 months of nearly equal pumping.

The rather large decline recorded at well 3 may be expected to continue and ultimately to result in a reduction in the yield of the well. On the other hand, it may not indicate extensive dewatering of the aquifer tapped by the well. Significant lowering of the water table may be confined to a radius of about a mile, or at most a few miles, from the well, because the transmissibility of the aquifer is low (as demonstrated by pumping tests).

METHODS OF INCREASING PRODUCTION

Water is a critical item of supply at the Nevada Test Site, and all of it must come from underground sources because accessible and adequate surface sources are lacking. An increase in demand for water

might be met by making changes designed to increase the yields of individual wells or by adding more wells.

Increased yields from existing wells

The principal change that might increase the yields of the existing wells would be to lower the pumps, thus allowing water to move to the pump intakes more freely and decreasing the drawdown. In all wells the motor is below the pump, and the diameter of the motor is only a fraction of an inch less than the diameter of the casing. This condition, of itself, will cause considerable drawdown or loss of head at present pumping rates because most of the pumped water must pass through this constricted annular opening. In well 5C, especially, it appears that flow to the intake is impeded because the pump is only 5 feet below the top of the 300-foot length of perforated casing. Lowering the pump would expose more of the screen, through which the water would have relatively easy access to the pump.

The yield of well 5C probably could be increased also by perforating the casing immediately below the pumping level. The top of the perforations in 1959 was about 90 feet below the pumping level, and the strata opposite this 90-foot blank interval probably would yield water, as judged from the sample log and the electric logs (fig. 13). Additional perforations would let water enter the well more freely.

In wells 5A and 5B the casing is fully slotted below the pumping level. Hence, no improvement is possible by extending the slotted section of casing in these wells. The records show that the pump assembly in well 5B fills the casing just as the pump assembly fills

LANE *Electrolog* WELLS

COMPANY

FILE NO.

COMPANY: ATOMIC ENERGY COMMISSION	Location of Well NO REC.
WELL: NO. 5-C	
FIELD: FRENCHMAN'S FLAT	
COUNTY: KERN NEV. STATE: CALIF.	
LOCATION: NO REC.	
LOG MEAS. FROM: GROUND LEVEL	ELEV. NO REC
DRLG. MEAS. FROM: GROUND LEVEL	ELEV. NO REC
PERM. DATUM: GROUND LEVEL	ELEV. NO REC

RUN NO.	1
DATE	3-22-54
FOOTAGE	1094
TOTAL DEPTH—EL. LOG	1094
TOTAL DEPTH—DRILLER	1100
CSG. SHOE—EL. LOG	-
CSG. SHOE—DRILLER	-
BIT SIZE	13 3/8" 1100

MUD—KIND	AQUA GEL
TREATMENT	NONE
WEIGHT	66
VISCOSITY	-
PH	NO. @ REC °F @ °F @ °F @ °F @ °F
LOSS ML/30 MIN	NO. @ REC °F @ °F @ °F @ °F @ °F
LOSS ML/ MIN	NO. @ REC °F @ °F @ °F @ °F @ °F
RESISTIVITY	17 @ 60 °F @ °F @ °F @ °F @ °F

MAX RECORDED TEMP	-100 °F °F °F °F °F
-------------------	---------------------

ELECTRODE SPACING	10"
SYMMETRICAL	

NON-SYMMETRICAL	
100"-20"	
230"-20"	

RECORDED BY	KNOX
WITNESSED BY	HALEY

FILE NO.

REMARKS OR OTHER DATA

ATOMIC ENERGY COMMISSION
WELL NO. 5-C
FRENCHMAN'S FLAT

Figure 13.--Electric log of well 5C, Nevada Test Site.

the casing in well 5C. In well 5A, however, the pump assembly is slightly smaller and therefore probably does not restrict the movement of water to the intake.

Additional wells

If the demand for water should exceed the capacity of the present well field, more water doubtless can be obtained from the aquifers in Frenchman Valley by drilling more wells and connecting them to the system. The known saturated section at the well field is about 500 feet thick and if present also in substantial thickness throughout the valley it could contain a great quantity of water in storage. Even at the 1960 rate, which was relatively high, pumping could continue for many years without causing serious depletion.

If new wells are drilled they should be far enough apart to minimize interference between them caused by pumping. If maximum yields are to be obtained, the wells should be as large in diameter as may be practical, especially if large-capacity submersible pumps are to be used in them. They should be cased and screened so as to take advantage of the full potential of the aquifers. Pumps should be set low enough to permit considerable drawdown.

Wells finished in tuff of the Oak Spring formation yield less water than those in valley fill but the water supply in the tuff in Yucca Valley can be developed further. The relatively large decline in water level at well 3 suggests that wells in the tuff should be farther apart than those in alluvial fill in order to avoid excessive mutual interference.

CONCLUSIONS

The water in the wells at the Nevada Test Site tends to attack the metal of pumps, motors, and casing. Scale may partly close the perforations in well screens. Use of corrosion-resistant manufactured well screens and of cathodic devices might increase the life of wells and equipment. Manufactured screens might also admit water more efficiently than slotted casing does.

Filling of wells has not been excessive even though three of the four have uncased lower sections. Conditions related to the sloughing of the wall of an uncased hole differ so greatly from place to place, however, that it would be unwise to construct wells without casing them.

Drawdown and recovery curves obtained in aquifer tests deviated markedly from the theoretical curves and therefore indicate that the hydraulic conditions in the aquifer are not those required by the non-equilibrium formula. The figures for the coefficient of transmissibility range within wide limits--from about 1,000 to more than 6,000 gpd/ft, depending on the aquifer being tested and on the portion of drawdown or recovery being analyzed.

Yields from some of the existing wells might be increased by making appropriate changes in them.

Greater demands for water could be met by increasing the number of producing wells.

The ground-water supply probably comes almost entirely from storage, but the quantity in storage will last for a long time at present or anticipated rates of withdrawal.

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