

1 December 2017

To: Mr. John Kieling
Chief, Hazardous Waste Bureau
New Mexico Environment Department, 2905 Rodeo Park Drive East,
Building 1, Santa Fe, New Mexico 87505-6303

From: JohnDavid Nance, Sundance Consulting, Inc. (Sundance)

Subject: Well Construction and Installation Report for Well 69, Fort Wingate Depot
Activity, McKinley County, New Mexico

Dear Mr. Kieling:

Please find attached one hard copy of the Drilling and Testing of Well 69, Fort Wingate Depot Activity, McKinley County, New Mexico. This submits to NMED the attachment as outlined in the response to comment #4 in the Army's response letter dated 28 November 2017.

If you have any questions regarding this deliverable, please contact me at (505) 585-7744 or by e-mail at jnance@sundance-inc.net.

Very best regards,



JohnDavid Nance
Program Manager, Sundance Consulting, Inc.

Cc:
Saqib Khan
Chuck Broom

FW 71-2

Administrative Record

FORT WINGATE DEPOT ACTIVITY, GALLUP, NEW MEXICO

Document No. 71-2

*Drilling and Testing of Well 69,
Fort Wingate Army Depot,
McKinley County, New Mexico
Open File Report*

J. W. Mercer and E. G. Lappala
U.S. Geological Survey
in cooperation with Fort Wingate Army Depot

November 1971



INQUIRIES REGARDING THIS DOCUMENT AND/OR THE ADMINISTRATIVE RECORD FOR
FORT WINGATE DEPOT ACTIVITY SHOULD BE MADE TO:
COMMANDER, TOOELE ARMY DEPOT, TOOELE, UTAH 84074

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Albuquerque, New Mexico



Drilling and testing of well 69, Fort Wingate Army Depot,
McKinley County, New Mexico

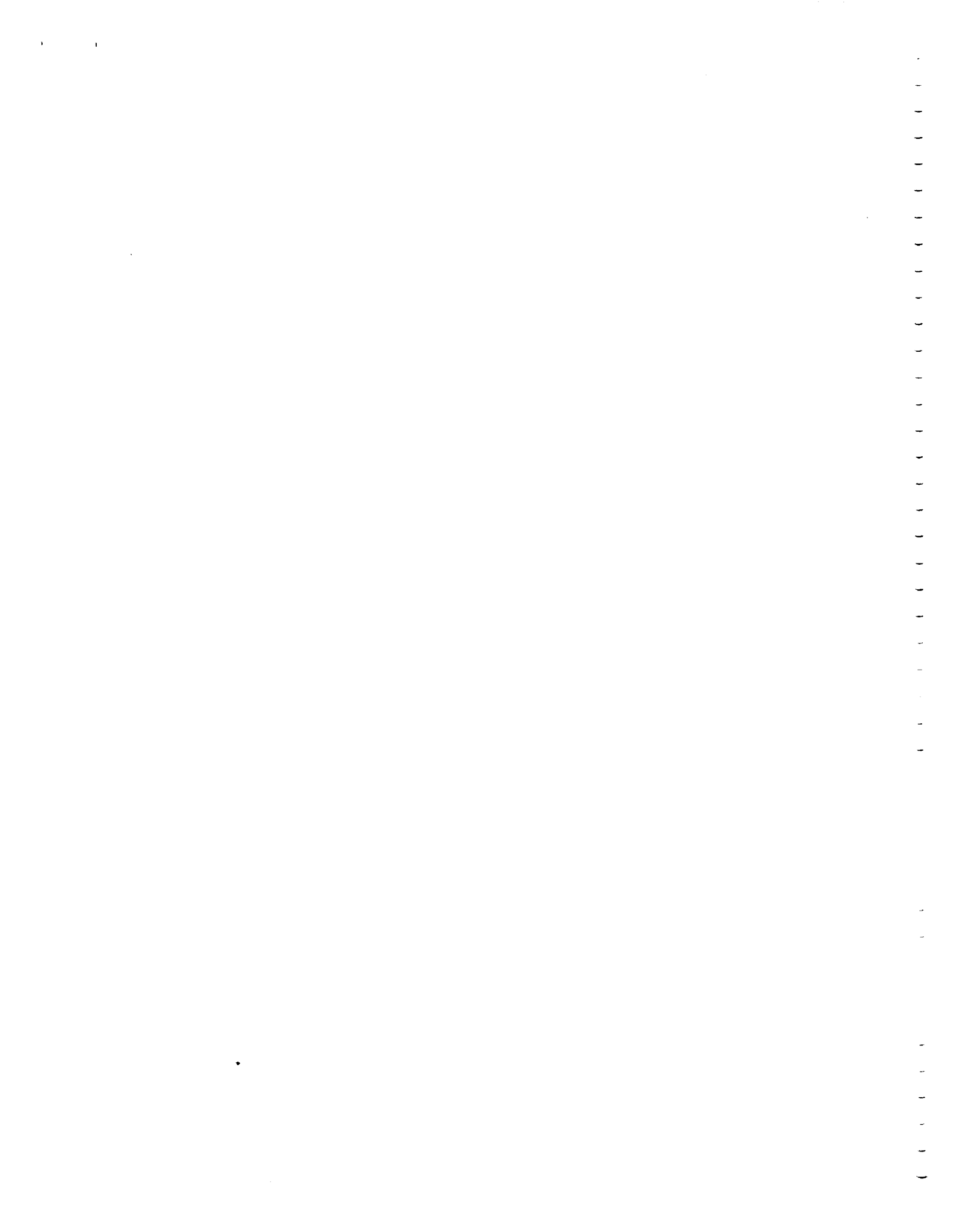
By

Jerry W. Mercer and Eric G. Lappala

Open-file report

Prepared by the U.S. Geological Survey in cooperation with
the Fort Wingate Army Depot

November 1971



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Drilling and testing of well 69, Fort Wingate Army Depot,
McKinley County, New Mexico

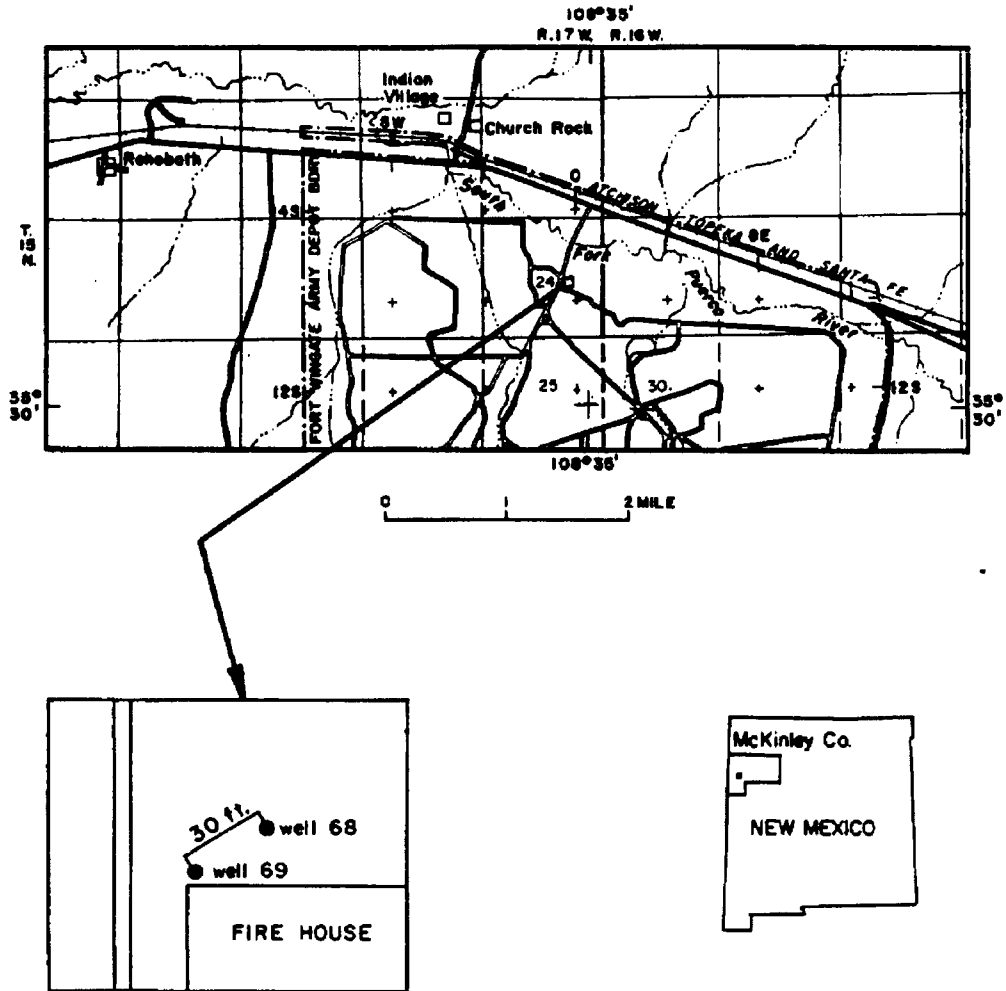
By

Jerry W. Mercer and Eric G. Lappala

Introduction

Fort Wingate Army Depot requested that the U.S. Geological Survey give technical assistance in drilling and testing a new production well. This technical assistance was given in close cooperation with Mr. Don M. Coulter, Engineering Department, Fort Wingate Army Depot, who supervised the engineering aspects of well drilling and construction.

The only aquifer beneath the depot known to yield sufficient water to be considered as a supply source is the Glorieta Sandstone of Permian age. This aquifer has been tapped by several wells on the depot grounds; however, only one well (well 68, fig. 1) yielded an adequate supply of water. The well flowed at the surface.



- Figure 1.--Location of well 69 on Fort Wingate Army Depot,
McKinley County,

Well 68 was drilled in 1942. Examination of the well by the Geological Survey in 1968 (U.S. Geol. Survey, written communication) indicated that the casing had deteriorated and that water under artesian pressure was probably leaking into formations above the aquifer. Army officials decided to drill a new well (well 69) to replace well 68. Well 69 was drilled as close to well 68 as feasible.

Location of the well

Well 69 (fig. 1) was drilled at Fort Wingate Army Depot in the NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24, T. 15 N., R. 17 W. (projected section) at an altitude of 6,680 feet. It is located 30 feet southwest of well 68.

Well construction

Drilling of well 69 was begun in July 1970 by Coffey Drilling Co. of Ramah, N. Mex. A 12½-inch pilot hole was drilled to a depth of 110 feet using a bentonite-base drilling mud. The pilot hole was then reamed to 20 inches and cased to 100 feet with 16-inch casing and cemented to prevent caving. A 15½-inch hole was then drilled to a depth of 1,050 feet. After gamma-ray and neutron logs were made by the U.S. Geological Survey (figs. 2A and 2B), the hole was cased to 1,037 feet with 12 3/4-inch casing and cemented. An 11½-inch hole was then drilled to 1,350 feet. Acoustic velocity and induction-electric logs (figs. 3A and 3B) were made by Welex Well Service Co. for the interval from 1,028 to 1,350. After logging, the hole was cased with 8 3/4-inch casing; slotted 8 3/4-inch casing was placed opposite the producing interval (1,100 to 1,350 feet). Construction details of the well are shown in figure 4 and a summary record of the well is given in table 1. Samples of drill cuttings were collected at 10-foot intervals and a sample-description log (Appendix A) was made.

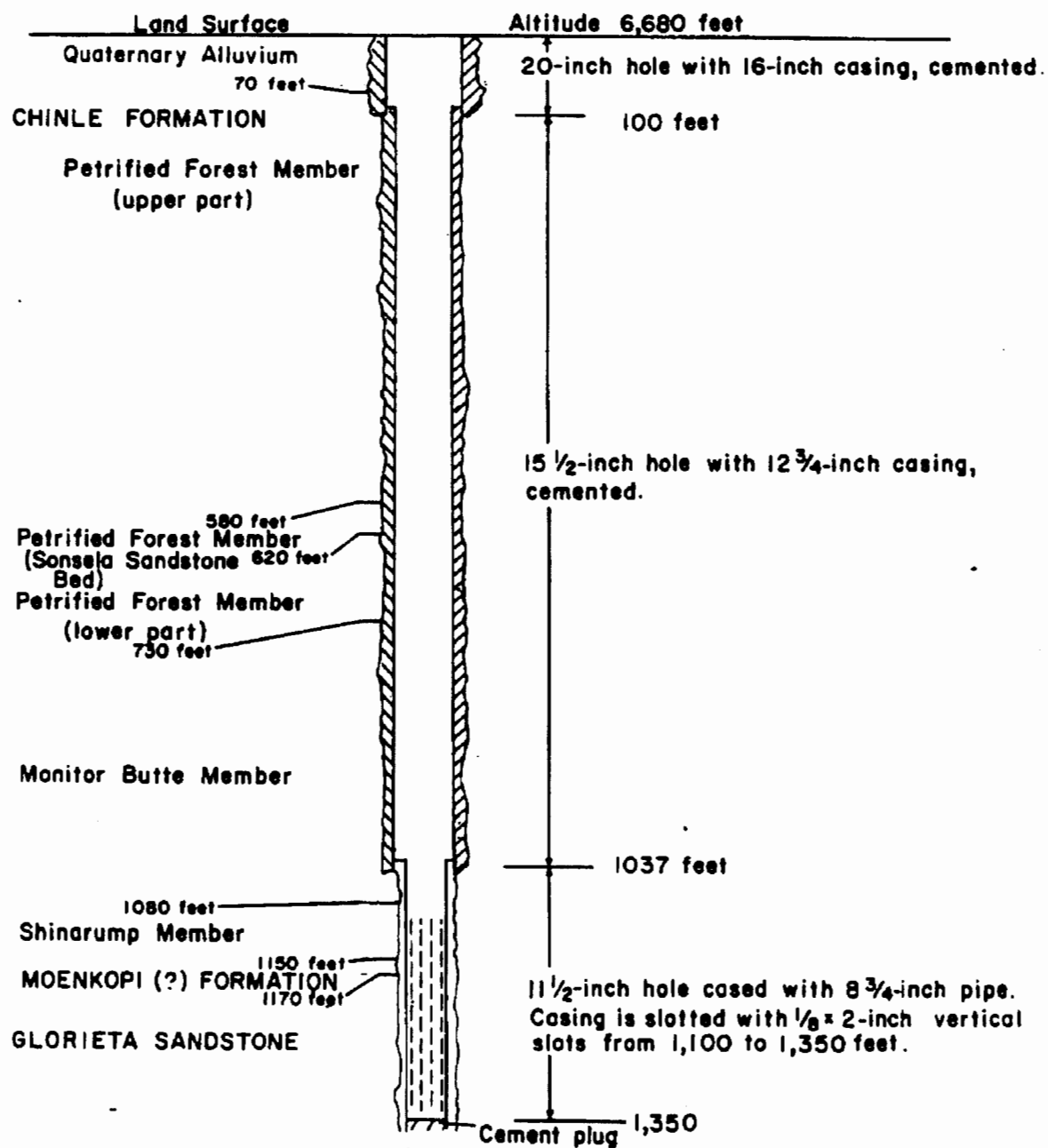


Figure 4.--Construction details of well 69, Fort Wingate Army Depot.

Table 1.--Summary record of well 69, Fort Wingate Army Depot

Location: NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24, T. 15 N., R. 17 W. (McKinley
County, N. Mex.)

Altitude: 6,680 feet (ground level)

Depth drilled: 1,350 feet (driller)

Depth logged: 1,356 feet (Welex)

Date completed: September 10, 1970

Drilling contractor: Coffey Drilling Co., Ramah, N. Mex.

Drilling method: Hydraulic rotary

Casing and well record: From 0-100 feet, 16-inch casing; from
100-1,037 feet, 12 3/4-inch casing;
from 1,030 to 1,350 feet, 8 3/4-inch
casing.
Slotted casing from 1,100 to 1,350 feet.

Formation logs: Gamma neutron (0-1,050 feet); acoustic velocity and
induction-electric log (1,028-1,356 feet)

Water quality: Analyses in table 3

Aquifer testing

After development of well 69 by surging and bailing, a turbine pump was installed in the well and a 72-hour aquifer-performance test was started on October 2, 1970.

Prior to pumping, the well was flowing at a rate of 33 gpm (gallons per minute). Pumping began at an average rate of 310 gpm. Water levels were measured both in the pumped well and in an observation well (well 68) with an electric measuring line and steel tape. The pump discharge was measured with a flow meter installed in the discharge line. At the end of the test the average pumping rate was 300 gpm and the depth to water in the pumped well was 303.40 feet. At no time during the test was sand observed in water pumped from the well.

The well-head pressure in the observation well was 4 psi (pounds per square inch) prior to pumping. This is equivalent to a head of 9.24 feet above land surface. After 72 hours of pumping the water level declined to 59.40 feet below land surface.

During the recovery period the water level was again measured periodically. The pumped well (well 69) began to flow 22½ minutes after the pump was shut off. After 930 minutes of recovery the well was flowing at a rate of 23 gpm.

The observation well (well 68) began to flow 19½ minutes after pumping ceased. After 930 minutes of recovery the well-head pressure was again at 4 psi.

Analysis of aquifer-test data

The Glorieta Sandstone beneath Fort Wingate Army Depot is a confined, extensive aquifer. Formations above and below the Glorieta are not believed to contribute significant amounts of water to the aquifer through leakage. Consequently, the non-equilibrium method and the modified non-equilibrium method (Walton, 1970) were applied to the aquifer-test data.

A logarithmic plot of drawdown in the observation well against the distance, in feet, between the pumped well and the observation well (squared) divided by time since pumping began, in days, is shown in figure 5. Application of the non-equilibrium method to these data yields a transmissivity of $160 \text{ ft}^2/\text{day}$ and a storage coefficient of 0.0012.

Recovery of water levels in both wells is plotted against the logarithm of time since pumping started divided by time since pumping stopped in figures 6 and 7. Transmissivity determined from recovery in the pumped well is $540 \text{ ft}^2/\text{day}$, and from recovery in the observation well is $460 \text{ ft}^2/\text{day}$. Table 2 shows a summary of hydraulic properties determined from application of the non-equilibrium or modified non-equilibrium methods to drawdown and recovery data. All solutions yield results of the same order of magnitude but the range in values is appreciable.

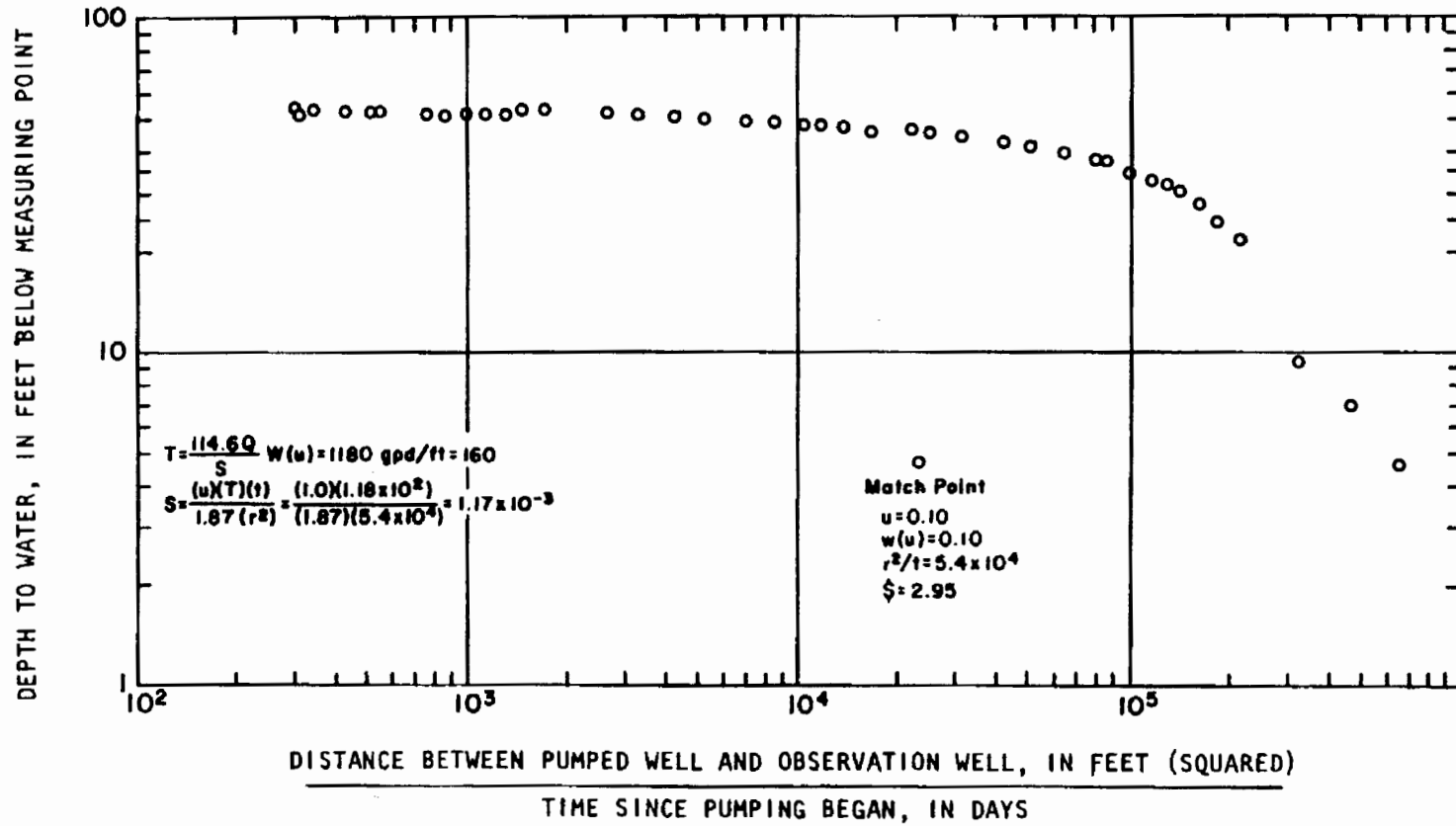


Figure 5.--Drawdown in the observation well (well 68) during pumping of well 69, October 2-5, 1970.

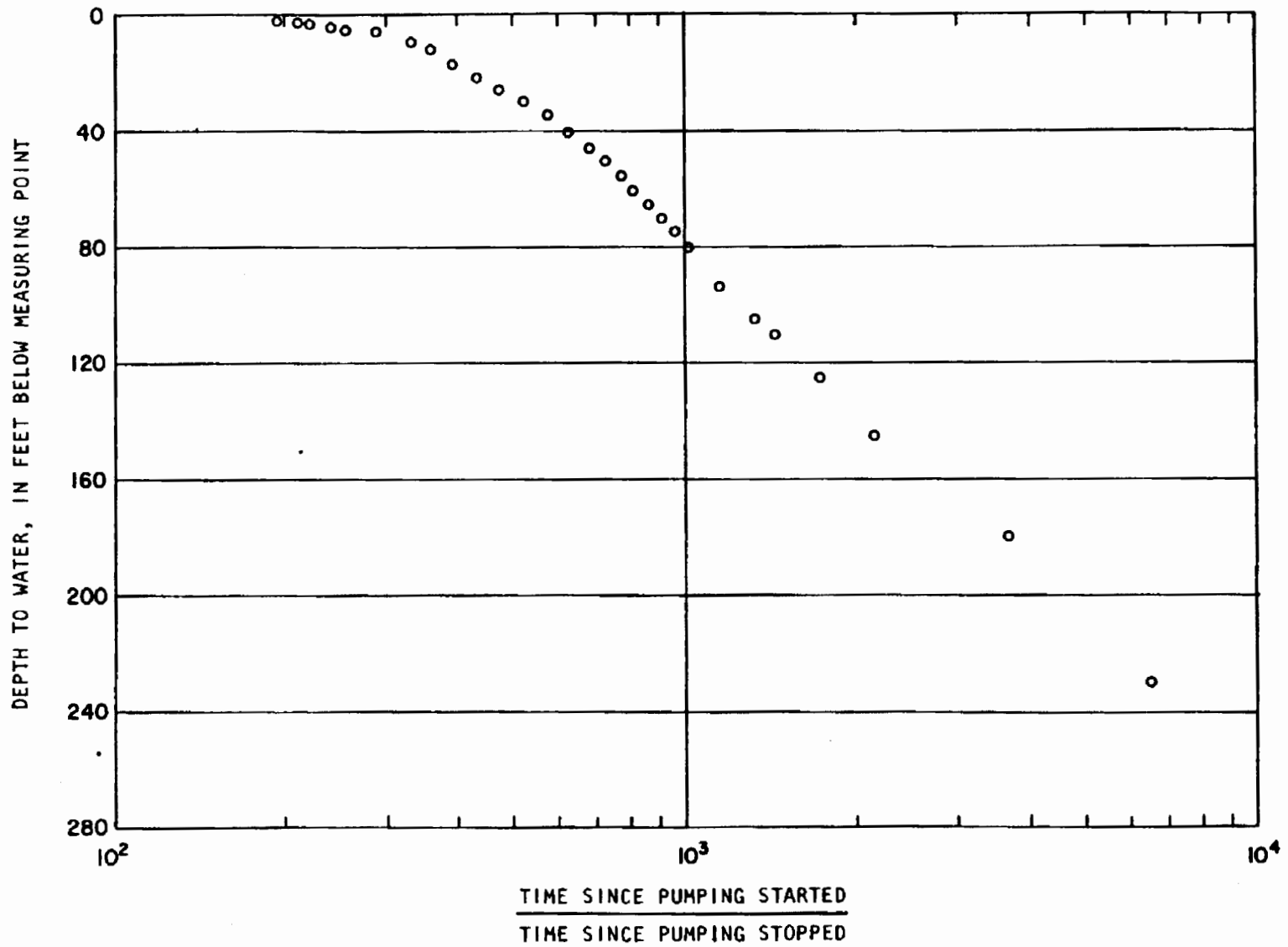


Figure 6.--Depth to water in the pumped well (well 69) during recovery period.

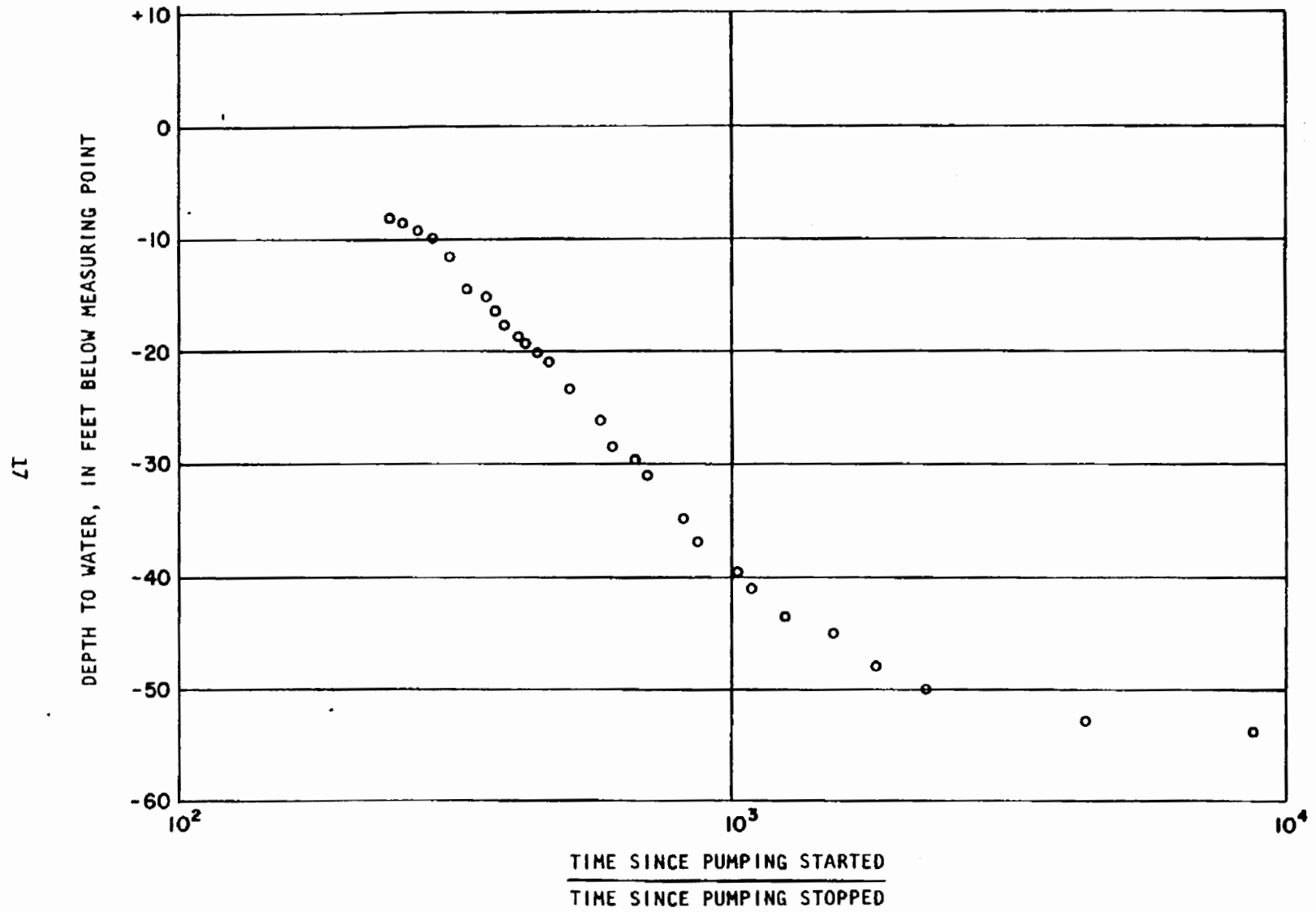


Figure 7.--Depth to water in the observation well (well 68) during recovery period.

Table 2.--Hydraulic properties of the Glorieta Sandstone determined
from pumping test, October 2-5, 1970

<u>Method of Analysis</u>	<u>Transmissivity (ft²/day)</u>	<u>Storage coefficient (dimensionless)</u>
Nonequilibrium, drawdown in observation well	160	0.0012
Modified nonequilibrium, recovery in pumped well	540	--
Modified nonequilibrium, recovery in observation well	460	--

The inferred transmissivity of the Glorieta Sandstone determined from this test is about 400 ft²/day. The storage coefficient is about 0.001. These values can be used for projecting drawdowns at varying distances from the pumped well, and for different discharge rates and durations of pumping.

Chemical quality of water

Analysis of water from the Glorieta Sandstone (table 3) indicates the water is high in bicarbonate and sulfate ions. The total dissolved solids of 918 mg/l (milligrams per liter) exceeds the maximum of 500 mg/l as recommended by the U.S. Public Health Service. However, in many parts of New Mexico ground-water supplies do not meet these standards and waters of higher salinity are used with no noticeable ill effects.

Table 3.--Chemical analysis of water from well 69

(Analyses by U.S. Geological Survey;
chemical constituents in milligrams per liter)

Date of collection - October 5, 1970

Silica as SiO ₂	11
Iron as Fe, (Total)39
Calcium as Ca	92
Magnesium as Mg	102
Sodium Na+Potassium K (calculated) .	53
Bicarbonate as HCO ₃	214
Carbonate as CO ₃	0
Sulfate as SO ₄	564
Chloride as Cl	1.6
Fluoride as F2
Nitrate as NO ₃	0
Dissolved solids:	
Calculated	929
Residue at 180°C	918
Total hardness as CaCO ₃	650
Noncarbonate hardness as CaCO ₃	474
Alkalinity as CaCO ₃	175
Specific conductance	1,280
pH, standard units	7.7
Color, Hazen units	3
SAR9

Summary and conclusions

Well 69, Fort Wingate Army Depot, was completed in 1970 at a depth of 1,350 feet. It is located in the NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24, T. 15 N., R. 17 W. (projected section) at an altitude of 6,680 feet. The well produces water from the Glorieta Sandstone of Permian age and was test pumped at a rate of 300 gpm. Prior to the test, the well flowed at a rate of 33 gpm; after 72 hours of pumping the water level had declined to a depth of 303.4 feet.

During pumping of well 69 the water level in well 68, 30 feet northeast, was observed. At the end of the test the water level in well 68 had declined from a static level of 9.24 feet above land surface (4 psi well-head pressure) to a depth of 59.40 feet below land surface.

The well was completed approximately 50 feet above the base of the Glorieta Sandstone because of restricted funding. Penetration of the entire thickness of the sandstone might have resulted in a moderately increased yield of the well.

The water pumped from well 69 contained 918 mg/l total dissolved solids. The water is hard and high in sulfate and bicarbonate ions.

References cited

Walton, W. C., 1970, Groundwater resource evaluation: New York,
McGraw-Hill, 664 p., 29 figs.

Appendix A.--Sample-description log of well 69, Fort Wingate

Army Depot, McKinley County, New Mexico

Note: Drill cuttings samples were collected at 10-foot intervals.

An effort was made to adjust sample-description log to geophysical logs and to identify cavings and exclude them from the description.

Color symbols in parentheses following the color of the rock are from the "Rock-Color Chart", 1963, distributed by the Geological Society of America, New York, N. Y.

Sample description by J. W. Mercer

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
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. Quaternary System:

Alluvium:

Sand, pale-red (5 R 6/2); fine to medium-grained; silty; composed of subangular to subrounded, stained, quartz; minor dark accessory minerals, unconsolidated -----	50	50
Silt, pale-red (10 R 6/2); sandy; contains subrounded, stained, quartz grains; minor fragments of claystone and sandstone, unconsolidated -----	20	70

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Triassic System:		
Chinle Formation:		
Petrified Forest Member (upper part):		
Claystone, pale reddish-brown (10 R 5/4); silty; calcareous; dark-gray limestone fragments common; minor stained quartz grains -----	60	130
Claystone, grayish-red (5 R 4/2); silty; calcareous; contains light- gray spots; white crystalline calcite and dark gray limestone fragments common -----	30	160
Claystone, pale-red (5 R 6/2) to grayish-red (5 R 4/2); silty; slightly calcareous -----	10	170
Claystone, pale-red (5 R 6/2); silty; slightly calcareous; grayish-pink (5 R 8/2) to pale-red (5 R 6/2) fine-grained calcareous sandstone common to abundant -----	20	190

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
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Triassic System - Continued:

Chinle Formation - Continued:

Petrified Forest Member (upper part) - Continued:

Sandstone, pale-red (5 R 6/2); silty; very fine- to fine-grained; poorly sorted; composed of clear to gray, angular, quartz grains; moderately cemented; slightly calcareous; red claystone and gray limestone fragments common -----	20	210
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Siltstone, pale-red (5 R 6/2) to grayish-red (5 R 4/2); very sandy; slightly calcareous; contains minor mica flakes; red sandstone and claystone fragments common -----	50	260
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Sandstone, pale-red (10 R 6/2) to grayish-orange-pink (5 YR 7/2); silty; very fine- to fine-grained; poorly sorted; composed of clear to amber, subangular, quartz grains; moderately cemented; slightly calcareous; contains minor mica and dark accessory minerals; red siltstone and gray limestone frag- ments common -----	10	270
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Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

Stratigraphic unit and material	Thickness (feet)	Depth (feet)
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Triassic System - Continued:

Chinle Formation - Continued:

Petrified Forest Member (upper part) - Continued:

Siltstone, grayish-red (10 R 4/2) to
pale-red (5 R 6/2); sandy; slightly
calcareous; mica flakes and clear quartz
grains common; claystone minor sandstone
fragments common ----- 10 280

Sandstone, pale-pink (5 RP 8/2) to pale
red-purple (5 RP 6/2); silty; very
fine- to fine-grained; poorly sorted;
composed of subangular to rounded,
clear to amber, quartz grains with
dark accessory minerals common;
moderately cemented; slightly cal-
careous; minor white crystalline
calcite; red claystone fragments
common ----- 10 290

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
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Triassic System - Continued:

Chinle Formation - Continued:

Petrified Forest Member (upper part) - Continued:

Siltstone, grayish red-purple (5 RP 4/2);

sandy; slightly calcareous; contains

mica flakes; abundant pale red-purple

(5 RP 6/2) sandstone fragments;

red claystone fragments common ----- 10 300 .

Sandstone, pale-red (5 R 6/2) to grayish

orange-pink (10 R 8/2); silty; very

fine- to fine-grained; moderately sorted;

composed of angular to subrounded, clear

to frosted, quartz grains; minor dark

accessory minerals; moderately cemented,

calcareous; abundant grayish-red

(5 R 4/2) and light olive-gray (5 Y 5/2)

claystone ----- 10 310

Claystone, grayish-red (10 R 4/2); silty;

calcareous; gray limestone and red silt-

stone fragments common ----- 20 330

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
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Triassic System - Continued:

Chinle Formation - Continued:

Petrified Forest Member (upper part) - Continued:

Claystone, grayish-red (10 R 4/2) to pale-olive (10 Y 6/2); silty; minor gray limestone and red siltstone fragments -----	10	340
Claystone, pale-red (5 R 6/2) to grayish- red (10 R 4/2); silty; slightly cal- careous; gray limestone and red siltstone minor to common; minor pink sandstone fragments; some of the claystone con- tains light colored "reduced" zones --	40	380
Claystone, pale-red (5 R 6/2) to grayish- red (10 R 4/2); silty; calcareous; minor red siltstone; minor pale-olive (10 Y 6/2) claystone fragments -----	20	400
Claystone, pale-red (5 R 6/2) to grayish- red (5 R 4/2); silty; very calcareous; common to abundant white to dark-gray, subangular to rounded, limestone frag- ments; red siltstone fragments common; minor pale-olive claystone fragments -	40	440

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Triassic System - Continued:		
Chinle Formation - Continued:		
Petrified Forest Member (upper part) - Continued:		
Siltstone, grayish red-purple (5 RP 4/2) to grayish-red (10 R 4/2); clayey; contains rounded gray limestone fragments; very calcareous; red and grayish red-purple (5 RP 4/2) claystone common to abundant -----	10	450
Claystone, grayish red-purple (5 RP 4/2) to greenish-gray (5 GY 6/1); silty; very calcareous; gray to white limestone fragments common; minor sandstone fragments -----	10	460
Sandstone, light brownish-gray (5 YR 6/1); silty; very fine- to fine-grained: poorly sorted; composed of subangular to rounded clear to amber, quartz grains; dark accessory minerals common; minor mica flakes; moderately cemented, slightly calcareous; gray limestone and red claystone fragments common -----	30	490

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Triassic System - Continued:		
Chinle Formation - Continued:		
Petrified Forest Member (upper part] - Continued:		
Claystone, grayish-red (10 R 4/2) to pale reddish-brown (10 R 5/4); silty; slightly calcareous; abundant light brownish-gray (5 YR 6/1) sandstone; gray limestone fragments common -----	20	510
Sandstone, light brownish-gray (5 YR 6/1); silty; very fine- to fine-grained; poorly sorted; composed of angular to subrounded, clear, quartz grains; dark accessory minerals common; minor mica flakes; moderately cemented; noncalcareous; red claystone common -----	10	520
Claystone, grayish-red (10 R 4/2) to grayish red-purple (5 RP 4/2); silty; calcareous; white to gray, angular to sub- rounded limestone common to abundant; brown sandstone common -----	20	540

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
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Triassic System - Continued:

Chinle Formation - Continued:

Petrified Forest Member (upper part) - Concluded:

Claystone, grayish-red (5 R 4/2) to yellowish-gray (5 Y 8/1); silty; slightly calcareous; contains sub- rounded grains of yellowish-gray limestone; minor white crystalline calcite; light-brown sandstone common; pale-red siltstone common -----	30	570
Claystone, grayish red-purple (5 RP 4/2) to grayish-red (10 R 4/2); silty; slightly calcareous; contains white limestone fragments; light-brown sandstone and siltstone fragments common -----	10	580

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
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Triassic System - Continued:

Chinle Formation - Continued:

Petrified Forest Member (Sonsela Sandstone Bed):

Sandstone, pinkish-gray (5 YR 8/1) to very light-gray (N 8); clayey; very fine- to fine-grained; poorly sorted; composed of angular to subrounded, frosted to clear, quartz grains; moderately cemented; slightly calcareous; rare dark accessory minerals; red siltstone and claystone (cavings?) common - 40 620

Petrified Forest Member (lower part):

Claystone, grayish red-purple (5 RP 4/2) to grayish-purple (5 P 4/2); silty; contains spots of pale greenish-yellow (10 Y 8/2) clay; calcareous; grayish-red siltstone and dark-gray limestone minor to common ----- 30 650

Claystone, yellowish-gray (5 Y 7/2) with minor grayish-red (10 R 4/2) fragments; silty; contains very fine-grained quartz grains; very slightly calcareous ----- 10 660

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

Stratigraphic unit and material	Thickness (feet)	Depth (feet)
Triassic System - Continued:		
Chinle Formation - Continued:		
Petrified Forest Member (lower part) - Continued:		
Claystone, grayish red-purple (5 RP 4/2) with spots of pale yellowish-gray (10 Y 8/2) clay; silty; calcareous; minor dark-gray clay; minor grayish- red siltstone; clear quartz grains rare -----	30	690
Sandstone, yellowish-gray (5 Y 8/1) to grayish orange-pink (10 R 8.2); silty; very fine- to medium-grained sand; poorly sorted; composed of angular to subrounded, clear to frosted, quartz grains; well cemented; noncalcareous; common dark accessory minerals; minor grayish-purple claystone fragments --	20	710
Claystone, grayish red-purple (5 RP 4/2) with pale greenish-yellow (10 Y 8/2) reduced zones; silty; slightly cal- careous; minor quartz grains; minor red siltstone -----	10	720

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Triassic System - Continued:		
Chinle Formation - Continued:		
Petrified Forest Member (lower part) - Concluded:		
Claystone, pale red-purple (5 RP 6/2) with pale greenish-yellow (10 Y 8/2) re- duced zones; silty; slightly calcareous; contains minor, amber, quartz grains --	10	730
Monitor Butte Member:		
Claystone, grayish-red (10 R 4/2) to moderate reddish-brown (10 R 4/6); silty; calcareous; some fragments contain very fine-grained, amber, quartz grains; red siltstone common -----	60	790
Claystone, grayish-red-purple (5 RP 4/2) to grayish-red (10R 4/2); silty; cal- careous; contains some fragments of pale-greenish-yellow (10 Y 8/2) grayish- red siltstone common; minor mica flakes; minor brown sandstone -----	90	880

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Triassic System - Continued:		
Chinle Formation - Continued		
Monitor Butte Member - Continued:		
Siltstone, dark reddish-brown (10 R 3/4) to grayish-red (10 R 4/2); slightly calcareous; abundant grayish-red claystone fragments -----	20	900
Claystone, moderate reddish-brown (10 R 4/6) to grayish-red (10 R 4/2); silty; very calcareous; reddish-brown siltstone common -----	20	920
Claystone, grayish-red (5 R 4/2); silty; light-gray (N 7) clay fragments common; very calcareous; minor reddish- brown siltstone -----	20	940
Claystone, variegated grayish red- purple (5 RP 4/2), grayish-purple (5 P 4/2), grayish-red (10 R 4/2), and light-gray (N 6); silty; cal- careous; reddish-brown siltstone fragments common; minor gray lime- stone fragments -----	80	1,020

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
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Triassic System - Continued:

Chinle Formation - Continued

Monitor Butte Member - Concluded

Claystone, medium light-gray (N 6) to grayish red-purple (5 RP 4/2); silty; calcareous; minor grayish-red silt- stone -----	30	1,050
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Claystone, medium light-gray (N 6) to medium gray (N 5); slightly cal- careous; minor grayish red-purple siltstone -----	10	1,060
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Claystone, grayish red-purple (5 RP 4/2) to grayish-purple (5 P 4/2); silty; slightly calcareous -----	20	1,080
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Shinarump Member:

Claystone, grayish-purple (5 P 4/2); silty; slightly calcareous; grayish- pink (4 R 8/2) sandstone common to abundant; silty; very fine-grained, moderately sorted; composed of sub- angular to subrounded, clear, quartz grains; moderately cemented; non- calcareous -----	20	1,100
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Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
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Triassic System - Continued:

Chinle Formation - Concluded:

Shinarump Member - Concluded:

Sandstone, grayish-pink (5 R 8/2)

to white (N 9); medium to very

coarse sand; moderately sorted;

composed of subangular to rounded,

clear to amber, quartz grains;

moderately cemented, dark accessory

minerals common; grayish-purple

claystone minor to common ----- 40 1,140

Conglomerate, pale-red (10 R 6/2) to

grayish-pink (5 R 8/2); coarse sand

to fine gravel; composed of sub-

angular to rounded, clear to amber

quartz grains; minor feldspar and

dark accessory minerals; greenish-

gray (5 GY 6/1) claystone common;

sample not consolidated, mostly

individual grains ----- 10 1,150

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
Triassic System - Concluded		
Moenkopi(?) Formation (may be part of Chinle Formation)		
Siltstone, pale-reddish-brown (10 R 5/4);		
clayey; slightly calcareous; clear to amber		
quartz grains common; light-gray (N 7)		
claystone common to abundant; silty;		
slightly calcareous -----	20	1,170
Permian System:		
San Andres Limestone: (not present in this hole)(?)		
Glorieta Sandstone:		
Sandstone, light-brown (5 YR 6/4) to		
moderate orange-pink (5 YR 8/4); very		
fine- to fine-grained; moderately		
sorted; composed of subangular to		
rounded, clear to amber, quartz		
grains; moderately cemented, slightly		
calcareous; rare dark accessory		
minerals; light-gray claystone frag-		
ments common to abundant -----	50	1,220

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Continued

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
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Permian System - Continued:

San Andres Limestone - Continued:

Glorieta Sandstone - Continued:

Sandstone, moderate orange-pink (5 YR 8/4); very fine- to fine-grained; moderately sorted; composed of subangular to rounded, clear, quartz grains; moderately cemented, very slightly calcareous; rare dark accessory minerals; grayish-purple (5 P 4/2) claystone (cavings?) common to abundant -----	70	1,290
Sandstone, moderate orange-pink (5 YR 8/4); same as 1,220-1,290 but samples contain no claystone -----	10	1,300
Sandstone, pale-red (5 R 6/2) to grayish- red (10 R 4/2); silty; very fine- to fine-grained; poorly sorted; composed of angular to subrounded, amber, quartz grains; well cemented; very slightly calcareous; grayish-purple claystone fragments minor to common -----	10	1,310

Appendix A.--Sample-description log of well 69, Fort Wingate Army

Depot, McKinley County, New Mexico - Concluded

<u>Stratigraphic unit and material</u>	<u>Thickness (feet)</u>	<u>Depth (feet)</u>
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Permian System - Concluded:

San Andres Limestone - Concluded:

Glorieta Sandstone - Concluded:

Sandstone, moderate orange-pink (5 YR 8/4);

fairly well sorted; composed of sub-

angular to subrounded, clear to amber,

quartz grains; well cemented; contains

white clay in matrix; minor white clay-

stone fragments ----- 40 1,350

Form with header and multiple columns of data.

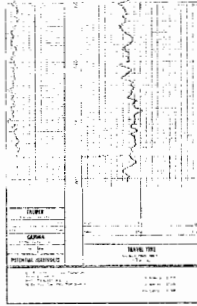
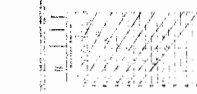
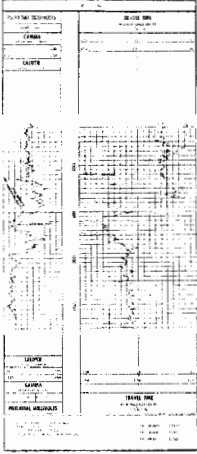
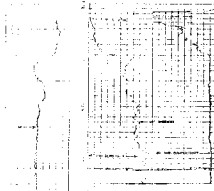


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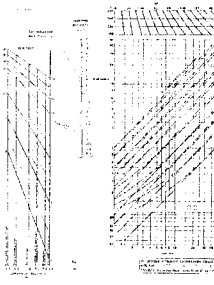
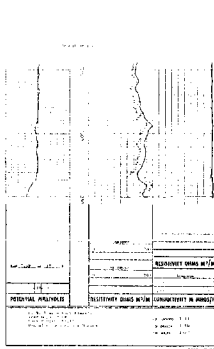
Velocity

DATE	TIME	WIND	SEA	TEMP	DEPTH	WAVE	SWELL	STATE	NO.

POTENTIAL RESISTIVITY	RESISTIVITY SOUND #1/2	CONDUCTIVITY IN Mhos/cm



POTENTIAL RESISTIVITY	RESISTIVITY SOUND #1/2	CONDUCTIVITY IN Mhos/cm



U.S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
FORM NO. 5-A (REV. 1-65)

STATION NO. 10-10-10
DATE 10/10/10
TIME 10:10 AM
SUN 10/10/10

WATER TEMPERATURE 10.0
WIND DIRECTION 100
WIND VELOCITY 10
RELATIVE HUMIDITY 10
PRESSURE 10.0
STATE 10

NO. OF SAMPLES 10
ANALYST 10

PROJECT NO. 10
SHEET NO. 10

