NMex-17-C Part 2

Pilot hole of the University of New MExico water well No. 7

By

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DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Albuquerque, New Mexico

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Prepared for the University of New Mexico by the U.S. Geological Survey

Open-file report

November 1966

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Introduction

The steady growth of the University of New Mexico is placing heavy demands upon its water-supply and distribution system. A new medical school complex, under construction, will require additional water that cannot be supplied by the four wells now in operation on the main campus.

The university plans to construct, during 1967, a new well near the east edge of the university grounds at the corner of Girard Blvd. NE and Campus Blvd. NE (fig. 1). This location was chosen because of

Figure 1 (caption on next page) belongs near here.

land accessibility, nearness of water-distribution lines, distance from existing wells, and proximity to the new medical complex.

The proposed well will be known as water well No. 7. At present the university owns five wells on the main campus, one of which has been abandoned, and one well on the University Golf Course at the south edge of the city.

Figure 1.--Location of the pilot hole of the University of New Mexico water well No. 7.

Water well No. 7 will be constructed by gravel-packing the annulus between the walls of the drill hole and the pipe and screen sections. Stainless steel wire-wrapped screen will be selectively placed opposite permeable sections of the water-bearing formation and blank pipe will be placed opposite the less permeable or impermeable zones.

This type of well construction requires detailed knowledge of the location, thickness, grain size, and grading of the water-bearing formation so that the optimum placing and slot size of the expensive stainless steel screen will be obtained. Because of this, university officials and representatives of the State Engineer of New Mexico and the Geological Survey thought it prudent to drill a pilot hole at the site of the proposed well to determine accurately the subsurface conditions prior to construction of the water well.

Pilot Hole

Specifications were prepared for the drilling of the pilot hole and were issued by the university for public bid in May 1966. Allison and Haney, Inc., was low bidder and was awarded the drilling contract. Howard Sheets, Albuquerque water well contractor, was in charge of drilling operations.

Drilling of the pilot hole began on June 16,1966, and geophysical logs were made in the completed 1,024-foot hole on August 6, 1966. Drilling was slowed somewhat because of the contract provisions limiting work to the hours between 7:00 a.m. and 9:00 p.m. so as to prevent undue noise in the early and late hours from disturbing occupants of nearby residences. After the geophysical logging of the pilot hole heavy drilling mud was placed in the hole and a capped 10-foot section of 16-inch [illegible] pipe was set in the top of the hole. It is planned that the pilot hole will be enlarged for construction of water well No. 7.

The static water level at the site of the pilot hole could not be determined because the drilling fluid sealed off the water-bearing formations and permitted no water to enter the hole. According to water-level contours of the area, shown by Bjorklund and Maxwell (1961, pl. 3c 1a), the water level should stand at about 200 feet below the land surface.

Formation Samples

Particular attention was given to the collection of formation samples at minimum intervals of 10 feet as the pilot hole was drilled. Circulation samples were taken frequently and every effort was made to collect representative samples of the formation drilled. These precautions were necessary because the size and grading of the gravel, and the length and slot sizes of the screen, to be placed in the well will be designed according to the composition, grain sizes, and permeability of the formation samples.

Analyses of the formation samples will be made by the manufacturer of the well screen. From the results of the analyses the manufacturer will recommend slot sizes, gravel sizes and grading, and placement of screen sections.

To aid university officials in the construction design of the screen and pipe sections that will be placed in the well, the formation samples were examined with a binocular microscope and a descriptive log of these samples was prepared by the Geological Survey. This log is given in table 1.

Table 1.--Descriptive log of formation samples from the pilot hole of the University of New Mexico water well No. 7.

Location: SE¼NE¼NW¼ sec. 22, T. 10 N., R. 3 E., Bernalillo County, New Mexico. In city of Albuquerque at northwest corner of Grand Blvd. NE and Campus Blvd. NE.

Altitude of land surface: 5,155 feet above mean sea level.

Total depth: 1,024 feet.

Diameter: 16 inches to 10 feet; 7 7/8 inches to 1,024 feet.

Date drilled: June 16 to August 6, 1966.

Tools: Hydraulic rotary

Driller: Allison and Haney, Inc. (Contractor); Howard Sheets (Driller)

Logs available: Formation sample; microlog (with caliper); induction-electrical; driller's.

Table 1.--Descriptive log of formation samples from water well No. 7 - Continued

Material	Thickness (feet)	Depth (feet)
Santa Fe Group:		
No sample	10	10
Sand and gravel; mostly very coarse subround quartz sand and fine gravel; some calcareous silt; unconsolidated; contains a few round granules of igneous rock	10	20
Gravel and sand; mostly subround quartz gravel 1/8 to 3/16 inch in diameter; some coarse sand and calcareous silt; unconsolidated; contains a few round granules of quartz and igneous rock	30	50
Gravel, sand, and silt; subround to subangular quartz gravel to 1/8 inch in diameter; some coarse sand; much tan calcareous silt; many chips and fragments to $\frac{1}{4}$ inch of quartz and igneous rock	5	55
Sand; coarse to very coarse, subround well-sorted quartz sand; trace tan silt; a few angular pieces as large as $\frac{1}{4}$ inch in diameter of dark igneous rock and quartz	5	60

Table 1.--Descriptive log of formation samples from water well No. 7 - Continued

Material	Thickness (feet)	Depth (feet)
Santa Fe Group - Continued		
Sand; coarse to very coarse, subround to subangular quartz sand; a few chips of quartz and igneous rocks	10	70
Gravel; poorly sorted angular to round quartz and igneous rock 1/8 to $\frac{1}{4}$ inch in diameter; some coarse to very coarse sand; much calcareous tan silt	10	80
Sand; similar to sample from 60-70 feet	40	120
Gravel; angular to subround quartz and igneous rock gravel to 3/16 inch in diameter; erratics to 3/4 inch; fragments of round gravel; some coarse to very coarse sand; trace light-tan silt	40	160
Silt; very fine to fine; light-grayish-pink; calcareous	10	170
Sand and gravel; coarse to very coarse sub-round quartz sand; much quartz and igneous gravel to $\frac{1}{4}$ inch in diameter; some white to tan silt	20	190
Gravel; angular to subround quartz and black chert gravel to $\frac{1}{4}$ inch in diameter; poorly sorted; some coarse to very coarse quartz sand	10	200

Table 1.--Descriptive log of formation samples from water well No. 7 - Continued

Material	Thickness (feet)	Depth (feet)
Santa Fe Group - Continued		
Sand; medium to very coarse poorly sorted subangular quartz sand; a few fragments of angular to subround quartz gravel and subround to round black chert gravel to $\frac{1}{4}$ inch in diameter; much light-tan silt	40	240
Gravel; angular to subround poorly sorted quartz gravel to $\frac{1}{2}$ inch in diameter; some coarse sand; much white to light-tan silt	10	250
Sand and silt; medium to coarse quartz sand; much white to light-tan silt; occasional quartz and chert gravel to $\frac{1}{4}$ inch in diameter	30	280
Sand and gravel; medium to very coarse, angular to subround, quartz and dark igneous sand; angular to subround and chips and fragments of quartz and igneous rock to 1/8 inch in diameter; some light-tan silt	110	390
Gravel and sand; similar to sample from 280-390 feet, except gravel sizes are predominant	20	410

Table 1.--Descriptive log of formation samples from water well No. 7 - Continued

Material	Thickness (feet)	Depth (feet)
Santa Fe Group - Continued		
Sand and gravel; similar to sample from 280-390 feet	40	450
Silt; fine, light-gray, calcareous; contains subround poorly sorted sand and gravel of quartz and igneous rock	10	460
Sand; coarse to very coarse; a few fragments of angular to subround quartz and igneous rock; minor quantity of tan silt	30	490
Silt and sand; very fine to fine light-tan silt; medium to coarse quartz sand; minor quartz gravel	20	510
Sand; coarse, well-sorted, subround quartz sand; minor quantity of quartz gravel	20	530
Sand and gravel; fine to very coarse quartz sand; angular to subround; poorly sorted; much subangular to subround quartz and igneous gravel up to 1/8 inch in diameter	10	540
Sand; coarse; quartz and igneous rock; well-sorted; subround; silty	30	570
Sand and silt; sand similar to sample from 540-570; much calcareous tan silt	10	580

Table 1.--Descriptive log and formation samples from water well No. 7 - Continued

Material	Thickness (feet)	Depth (feet)
Santa Fe Group - Continued		
Silt; fine; grayish-orange-pink; calcareous; contains minor coarse quartz sand -------	60	640
Sand; coarse; quartz and dark igneous rock; well-sorted; subround; occasional fine quartz gravel; trace silt ----------	40	680
Silt and sand; fine grayish-pink calcareous silt; subangular coarse sand; occasional fine gravel ----------	10	690
Silt; very fine to fine; grayish-orange-pink; partly cemented with white calcareous material; some sand and gravel ----------	10	700
Sand; coarse to very coarse; fairly well sorted; quartz and dark igneous rock; subround to subangular; minor fine gravel; trace silt ----------	20	720
Sand; fine to medium; well-sorted; silty; subround; quartz and dark igneous rock ---	20	740
Silt; fine; grayish-pink; calcareous; a few grains of fine quartz sand ----------	130	870
Sand and silt; very fine to fine, well-sorted quartz sand and fine grayish-pink and tan silt ----------	20	890

Table 1.--Descriptive log and formation samples from water well No. 7 - Continued

Material	Thickness (feet)	Depth (feet)
Santa Fe Group - Continued		
Sand and silt; similiar to samples from 870 to 890 feet except sand percentage is greater	20	910
Sand and silt; medium to coarse; subround; fairly well sorted; quartz and igneous rock; much fine tan silt and some white clay	110	1,020
No sample	4	1,024
Total depth		1,024

All of the formations penetrated during the drilling of the pilot hole belong to the Santa Fe group of middle(?) Miocene to Pleistocene(?) age. Sand and gravel, with minor amounts of silt, predominate and constitute 75 percent of the section penetrated. The remaining 25 percent of the section is composed of very fine to fine silt and clay deposited in a series of six separate beds that range in thickness from 10 to 130 feet. The sand and gravel is composed mostly of quartz, with a minor fraction of igneous rock. Grain size, degree of sorting, and shape of individual grains vary throughout the section, which results in some zones being more permeable than others. The identification and definition of these permeable zones, opposite which screen will be placed, was the primary purpose of examining the formation samples.

Geophysical Logs

Microlog (with caliper) and induction-electrical logs were made in the pilot hole on August 6, 1966, by the Schlumberger Well Surveying Corporation. (See figs. 2 and 3.)

Figures 2 and 3 (captions on next page) belong near here.

Figure 2.--Microlog (with caliper) of the pilot hole of the University of New Mexico water well No. 7.

3.--Induction-electrical log of the pilot hole of the University of New Mexico water well No. 7.

Driller's Log

A descriptive log of the formations penetrated during the drilling of the pilot hole was maintained daily by the driller. (See table 2.)

Table 2.--Driller's log of the pilot hole of University of New Mexico water well No. 7

Material	From (feet)	To (feet)
Coarse granitic wash (decomposed granite), grey to brown	0	53
Silty clay, brownish-red	53	58
Sand, med.; coarse, grey to brown	58	67
Gravel, sand, heavy and coarse	67	83
Sandy clay, brown	83	87
Gravel, sand, grey and coarse. Cobbles? (running rough)	87	109
Sandy clay, brown	109	118
Gravel, sand and cobbles, grey	118	136
Sandy clay, brown	136	142
Gravel, sand, coarse, grey	142	163
Clay, white to grey	163	178
Sand, coarse, pea gravel, grey	178	193
Gravel, coarse sand, grey	193	210
Sand and gravel, cemented? stiff	210	216
Sand, gravel, coarse, grey	216	223
Sand, coarse, grey	223	241
Sandy clay, gravel and cobbles	241	255
Sandy clay, brown	255	276
Clay, grey, some sand	276	286

Table 2.--Driller's log of the pilot hole of UNM - Continued

Material	From (feet)	To (feet)
Sand, coarse, gravel, grey----------	286	298
Sandy clay, brown----------	298	308
Sand, coarse, grey, pea gravel----------	308	351
Clay, light brown----------	351	358
Sand, coarse, grey, pea gravel----------	358	365
Sand, grey----------	365	376
Sand, coarse, grey, pea gravel----------	376	418
Clay, white to grey----------	418	420
Sand, coarse, grey, pea gravel, streaks of grey clay----------	420	456
Clay, brown----------	456	467
Sand, coarse, grey, pea gravel----------	467	492
Clay, brown----------	492	511
Sand, coarse, grey----------	511	543
?Sandy clay, brown (think this is unpure bentonite; no sample; drilled fast, mixed with drilling mud)----------	543	555
Sand, coarse, grey, pea gravel showing-------	555	576
Clay, brown, with streaks of gravel or interbedded (struck a gas at 596 ft; it broke up the solidity of the drilling fluid, mud lift pump could not pick it up to run the mud over the shale shaker, had to make a flat baffled trough to help dissipate gas to the atmosphere before resuming drilling operations; think gas is carbon dioxide— reported it to the office.)----------	576	645

Table 2.--Driller's log of the pilot hole of UNM - Concluded

Material	From (feet)	To (feet)
Sand, coarse, grey, gravel; gravel starts at 650 ft	645	682
Clay, buff brown, with rock and cobbles interbedded	682	708
Sand, coarse, grey, gravel, some heavy gravel, cobbles?	708	726
Clay, light brown, silty	726	843
Sandstone, brown	843	848
Sandy clay, brown, cobbles and/or boulders interbedded in this strata [sic]	848	862
Cemented sand and gravel, hard, grey	862	866
Sand, coarse and loose, grey, pea gravel (drill string was stuck at 872 ft; finally the drill pipe was string shot at 810-830 ft; did not loosen; inadvertently the drill pipe was shot and loosened at 402 ft, forcing a wash-over operation from 402-872 ft. The wash-over operation and fishing job were successful, drilling operations were resumed. A drill collar and one joint of drill pipe were destroyed by the deep string shot. 31 days were used up on this operation)	866	905
Sandy clay, reddish brown, streaks of grey sand	905	917
Sand, coarse, grey, pea gravel, loose	917	951
Clay, brown, brittle, thin streaks of brown sandstone	951	959
Sand, very coarse, grey, pea gravel; loose gravel shows at 987 ft; the 990-ft sample shows it	959	1,016
Sandy clay, brown, rock and cobbles interbedded. Bottomed at 1,024.2 ft 8-6-66 at 1:00 AM	1,016	1,024

Formation Permeability

Examination of the geophysical logs and the formation sample log indicates close agreement as to location and thickness of the most permeable zones of sand and gravel penetrated during drilling of the pilot hole. All logs show that the uppermost permeable zone starts at a depth of 170 feet and that the lowermost zone ends at a depth of about 716 feet. From 716 feet to the bottom of the pilot hole at 1,024 feet the formation samples contain much silt and only minor percentages of sand and gravel. The geophysical logs indicate that the formations from 716 feet to 1,024 feet are generally of low permeability and contain only a few, scattered thin zones of permeability comparable to those in the formations above 716 feet.

The location, depth, and thickness of the most permeable zones in the formations penetrated by the pilot hole, as interpreted from the geophysical logs and the formation sample log, are given in table 3. A graphic comparison of these permeable zones is given in figure 4.

Figure 4 (caption on next page) belongs near here.

Figure 4.--Graphic logs showing location of permeable zones in the pilot hole of the University of New Mexico water well No. 7.

Table 3.--Permeable zones in the pilot hole of the University of New Mexico water well No. 7.

Types of well logs

Microlog			Resistivity			Formation samples		
From (feet)	To (feet)	Thickness (feet)	From (feet)	To (feet)	Thickness (feet)	From (feet)	To (feet)	Thickness (feet)
170	210	40	170	192	22	170	200	30
240	248	8	200	210	10	240	250	10
262	276	14	236	244	8	280	450	170
288	296	8	286	296	10	460	490	30
302	350	48	304	348	44	510	570	60
410	450	40	408	450	42	640	680	40
462	490	28	462	490	28	700	720	20
510	534	24	512	532	20			360
550	576	26	550	572	22			
640	678	38	640	678	38			
698	716	18	700	716	16			
		292			260			

Conclusions

The drilling of the pilot hole for the University of New Mexico water well No. 7 has provided accurate and significant data on subsurface conditions and water-supply potential at the proposed well site. Advance knowledge of subsurface conditions to be encountered during drilling of a large diameter hole for the water well, and information on the location and thickness of the most permeable zones, will materially aid university officials in the planning for the construction of the well, and will result in an economic saving both in the preparation of drilling specifications and in the actual construction of the well.

The most permeable zones penetrated during the drilling of the pilot hole extend downward, at intervals, from a depth of 170 feet to 716 feet. The interval from 716 feet to 1,024 feet, the bottom of the hole, mostly has a low permeability due to the large percentage of silt in the formations.

Locations and depth intervals of the most permeable zones penetrated in the pilot hole are summarized graphically in figure 4. No recommendations are made as to which, or how much of each, permeable zone should be selected for screening. These decisions will depend upon future quantitative recommendations of the well-screen manufacturer and upon the amount of water planned to be pumped from the well.

Reference Cited

Bjorklund, L. J., and Maxwell, B. W., 1961, Availability of ground water in the Albuquerque area, Bernalillo and Sandoval Counties, New Mexico: N.Mex. State Engineer Tech. Rept. 21, 117 p.

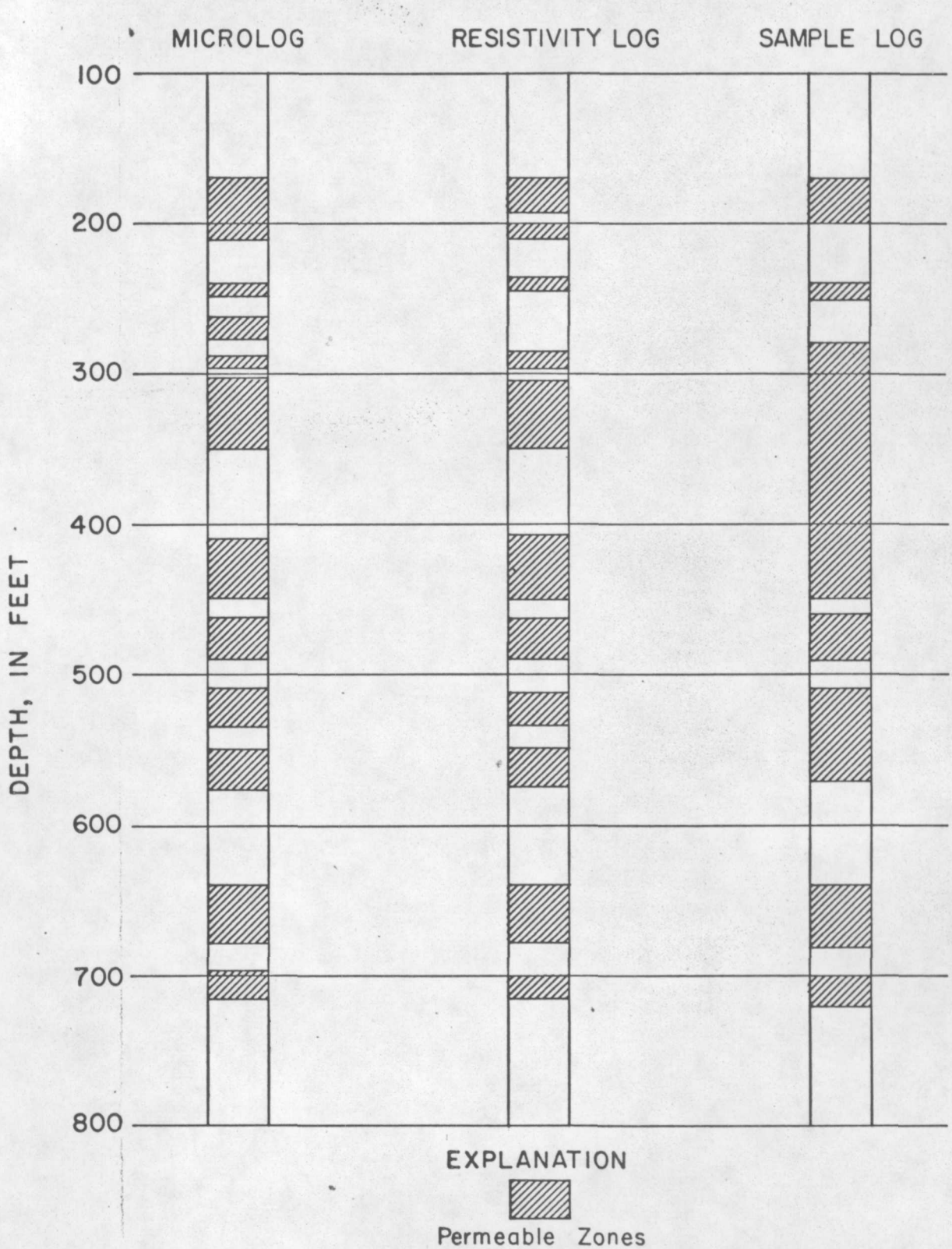

Figure 4.-- Graphic logs showing location of permeable zones in the pilot hole of the University of New Mexico Water Well No. 7.

0 1/2 1 Mile

SCALE 1:24,000

FIGURE 1. —— Location of the pilot hole of the University of New Mexico Water Well No. 7.