GJBX-48(80)

ENGINEERING REPORT ON THE BRUSHY BASIN DRILLING PROJECT CEDAR MOUNTAIN, EMERY COUNTY, UTAH

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PREPARED FOR U.S. DEPARTMENT OF ENERGY
Assistant Secretary for Resource Applications
Grand Junction Office, Colorado

Contract No. DE-AC13-76GJ01664

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INTRODUCTION

This report presents engineering details, statistics, and 12 individual borehole histories of the Brushy Basin drilling project. General information is presented regarding problems of weather and logistics.

Neither geophysical logs nor geologic information is included in this report. The logs and a separate geologic report are available through the Bendix Field Engineering Corporation-Grand Junction (BFEC-GJ) technical library [GJBX-31(80)].

ACKNOWLEDGMENTS

The project manager was Henry Vizcaino. Project geologists were K. Kiloh and M. McNeil. Drilling supervisors were L. Jones and T. Price.

SUMMARY

The Brushy Basin drilling project was conducted by Bendix Field Engineering Corporation (BFEC) in support of the United States Department of Energy (DOE) National Uranium Resource Evaluation (NURE) program.

This project consisted of 12 drill holes (table 1), ranging in depth from 101 feet (30.78 m) to 920 feet (280.39 m). A total of 6,867.5 feet (2,093.17 m) was drilled by rotary methods. The purpose was to obtain subsurface data for estimating the intermediate-grade (0.01 percent to 0.05 percent U_3O_8) uranium resources of the Brushy Basin Member of the Morrison Formation (Jurassic) in the Cedar Mountain area of the San Rafael swell, Emery County, Utah. Drilling began on June 16, 1979, and was completed on July 29, 1979, with final site restoration.

LOCATION

This project was in the northwest part of the Cedar Mountain-Castle Valley area on the northwestern flank of the San Rafael swell in Emery County, Utah (fig. 1). Access is by improved dirt roads and jeep trails.

All drill sites were selected for best possible access, with a minimum of road construction while remaining in geologically favorable areas. The surface topography is predominantly rolling hills with some flat areas.

Table 1. Drill-hole summary.

Hole no.	Total depth feet	meters	Elevation feet	meters	Location Qtr.	Sec.	T.S.	R.E.	Topographic map name
1a	540.0	164.59	5,978	1,822.09	NESW	02	18	10	Cleveland, UT.
2	703.0	214.21	5,758	1,755.03	NENW	29	17	11	Cow Flats, UT.
5	101.0	30.78	5,838	1,779.42	SENE	16	18	10	Cleveland, UT.
5a	635.5	193.72	5,838	1,779.42	SENE	16	18	10	Cleveland, UT.
7	520.0	158.49	5,996	1,827.58	SWNE	02	18	10	Cleveland, UT.
8	618.0	188.38	6,408	1,953.15	SESE	12	18	10	Cow Flats, UT.
9	530.0	161.54	6,739	2,054.04	SWSW	17	18	11	Cow Flats, UT.
10	920.0	280.39	5,536	1,687.37	NESW	34	19	08	Castle Dale, UT.
11	430.0	131.04	7,108	2,166.51	SWSW	27	18	11	Bob Hill Knoll, UT.
12	410.0	124.94	7,210	2,197.60	SWNE	34	18	11	Bob Hill Knoll, UT.
13	860.0	262.09	5,462	1,664.81	SWNE	08	16	12	Mounds, UT.
14	600.0	182.90	5,543	1,689.50	NWSW	26	18	09	Hadden Holes, UT.

PRINCIPAL FIRMS AND AGENCIES

Owner

U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado 81502.

Operator

Bendix Field Engineering Corporation
Grand Junction Operations
Grand Junction, Colorado 81502.

Landowners

U.S. Bureau of Land Management
Price, Utah.

Various energy and mining companies.

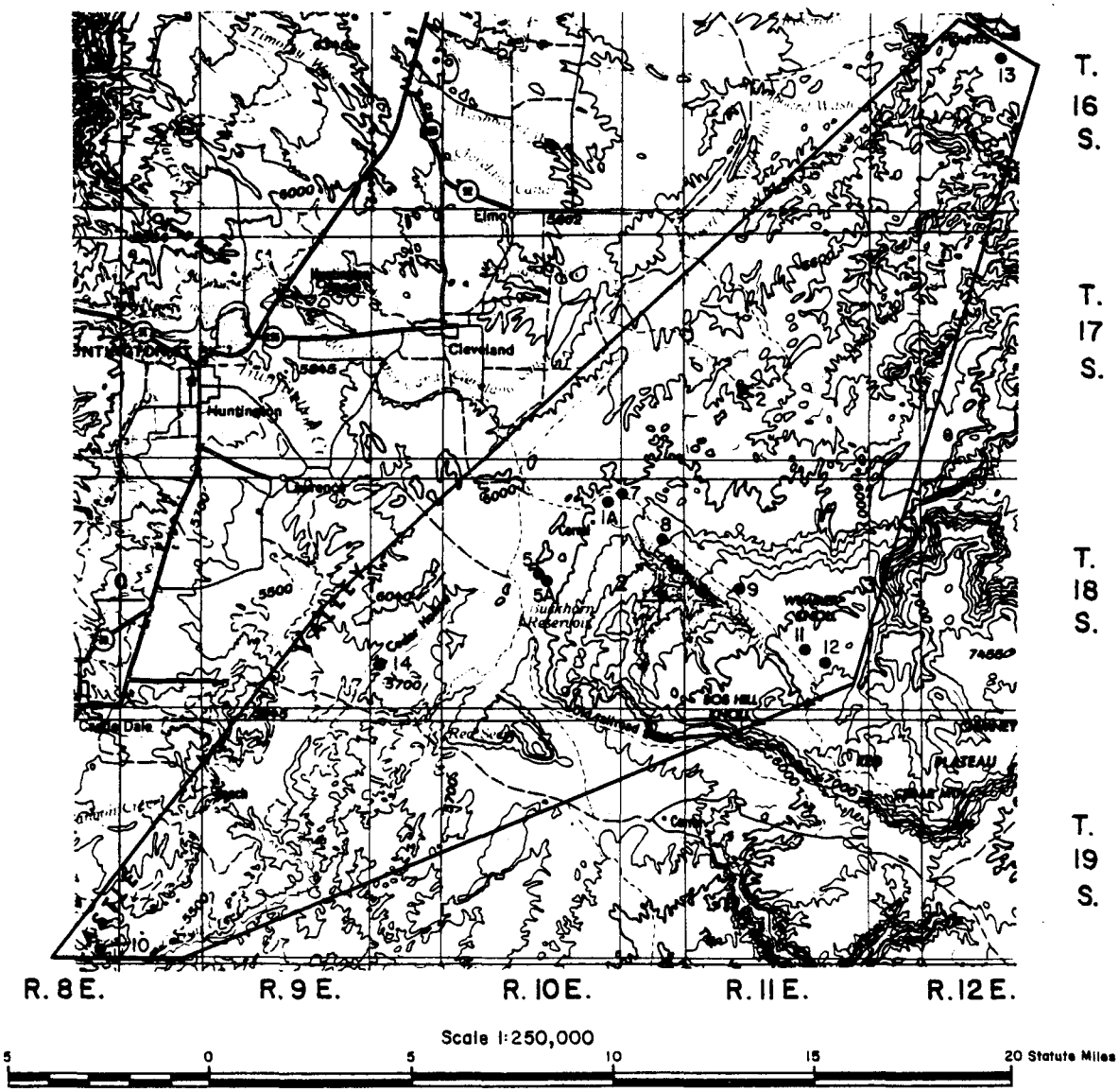

Figure 1. Index map of Brushy Basin drilling project and drill-hole locations, Emery County, Utah.

SUBCONTRACTORS AND SERVICE FIRMS

Drilling contractor

Himes Drilling Co., Incorporated
2390 Highways 6 & 50
Grand Junction, Colorado 81501.

Geophysical logging

Bendix Field Engineering Corporation
Grand Junction Operations
Grand Junction, Colorado 81502.

Water supply

U.S. Bureau of Land Managment
Price, Utah.

DRILLING

Guidelines

The drilling contract specified that surface casing of at least 7-inches (17.78 cm) outer diameter (OD) be used in all holes when necessary to prevent possible washouts. This casing was pulled after the hole was completed and logged. Each hole was then plugged and cemented to satisfy State of Utah requirements.

A Sta-Foam 202 and water mixture was used as the circulation medium. Soda ash, gel, cement, starch, and caustic soda were used only when prolonged or completely lost circulation occurred.

Earthen pits were dug to confine the drill water and cuttings. The pits were not lined with plastic sheeting to prevent water loss because the water supply was nearby. Livestock tanks and steel drums were used to mix the circulation additives. Total gamma-ray, spectral gamma-ray (KUT), self-potential, resistivity, and neutron logs were run in the holes as noted.

Assemblies

Himes Drilling Company, Incorporated, of Grand Junction, Colorado, began moving to the project area on June 5, 1979. One rig (CR-5) and associated equipment was assigned to the project. This rig was replaced on June 18, 1979, with Rig R-5. The units used were:

Rig CR-5: 1978 Longyear HC-44 core drill powered by a 453-cc GMC diesel engine, a John Bean 435 water pump, and a 35-foot mast equipped with a wire-line hoist, all mounted on a 1968 Ford tandem-axle truck.

Rig R-5: 1975 Gardner-Denver 15-W rotary drill powered by a 350-cc Cummins diesel engine, a Gardner-Denver 5 by 8-inch mud- and water-injection pump and a WEJ 6-cylinder air compressor, all mounted on a 1975 Mack tandem-axle truck, model DM800.

Rig R-6: 1974 Failing CF-15 rotary drill powered by a 350-cc Cummins diesel engine, a Gardner-Denver 5 by 8-inch mud- and water-injection pump, a model 256-S2 Le-Roi air compressor, and a 38-foot mast, all mounted on a 1974 tandem-axle Mack truck.

Additional equipment used on the project included: A 1972 Gardner-Denver WEJ 250-lb air compressor mounted on a 1962 Kenworth truck, both powered by a NH 262-cc Cummins diesel engine; a 1967 Ford F-700 truck with a 1,500 gallon (5,678 l) water tank, and a 1975 Ford F-600 4-wheel-drive truck with a 1,300 gallon (4,921 l) water tank.

Work Schedules

All rigs were operated on a 11-hour per day basis, when possible, with the crews working a 10-day on; 4-day off schedule. This working schedule was implemented because the subsurface data was needed quickly.

LOGISTICS

The project area was located approximately 7 miles (12 km) east of Huntington, Utah, the closest available source of fuel, lodging, parts, etc.

Huntington and Ferron Creeks, U.S. Bureau of Land Management catchment ponds, and irrigation ditches were the sources of drilling water.

Drilling additives were supplied from Grand Junction, Colorado, and Huntington and Price, Utah.

WEATHER AND ROAD CONDITIONS

The weather from mid-June to late July was extremely warm; no precipitation was recorded. Daytime temperatures were generally 90° F (32° C) or above, with several days exceeding 100° F (43° C) during the drilling project.

Access to the drill sites was by county-maintained gravel roads and unimproved dirt roads. All sites were located from 100 to 200 feet (30.48 to 60.96 m) off the dirt roads so additional road construction was not required.

INDIVIDUAL HOLE HISTORIES

Hole no. BB-1a

Location:	NESW, sec. 2, T. 18 S., R. 10 E.
Total depth:	540 feet (164.59 m)
Spud date:	June 24, 1979
Completion date:	June 25, 1979
Rig:	Failing CF-15 (Rig no. 6)
Drill-pipe size:	3.5 inches (8.89 cm) x 20 feet (6.09 m)
Drill collars:	Four 4.5 inches (11.43 cm) x 20 feet (6.09 m)
Sample interval(s) and type:	5 feet (1.52 m); drill cuttings

Hole BB-1a was rotary drilled to a depth of 20 feet (6.09 m) using an 8.75-inch (22.22 cm) diameter rock bit. A firm casing-seat was established and a 7-inch (17.78 cm) interior diameter (ID) casing set. A 6.25-inch (15.87 cm) hole was rotary drilled below the casing to 140 feet (42.67 m). Drilling continued from 140 to 460 feet (42.67 to 140.19 m) using a 5.625-inch (14.40 cm) rock bit. Between 420 feet (127.99 m) and 460 feet (140.19 m) the hole required excessive amounts of water and unloading problems occurred. An aquifer in the Salt Wash Member of the Morrison Formation was apparently responsible. Within 2 hours normal circulation and unloading of the hole had resumed. Rotary drilling continued using a 5.125-inch (13.00 cm) diameter rock bit from 460 feet (140.19 m) to a final depth of 540 feet (164.59 m) without any additional problems.

The hole was drilled with fluid from 20 feet (6.09 m) to final depth. The circulation system consisted of one earthen pit with an approximate capacity of 2,500 gallons (9,463 l) and one 55-gallon (208.23 l) steel drum. The earthen pit was used for drilling water and cuttings disposal, and the steel drum was used to mix additives. After drilling and logging operations were completed the hole was plugged with a 6-foot (1.82 m) cement surface plug.

Bit record

Make	Type	Hole diameter inches	Hole diameter centimeters	Depth feet	Depth meters
Walker Mac	3	8.75	22.22	0- 20	0- 6.09
Smith	F3	6.25	15.87	20-140	6.09- 42.67
Smith	F2	5.625	14.40	140-420	42.67-127.99
Smith	F2	5.125	13.00	420-460	127.99-140.19
Smith	F3	5.125	13.00	460-540	140.19-164.59

Consumables

Quantity	Material
5 gallons (18.93 l)	Sta-Foam 202

Geophysical logs

Gamma	Resistivity
Self-potential	Neutron

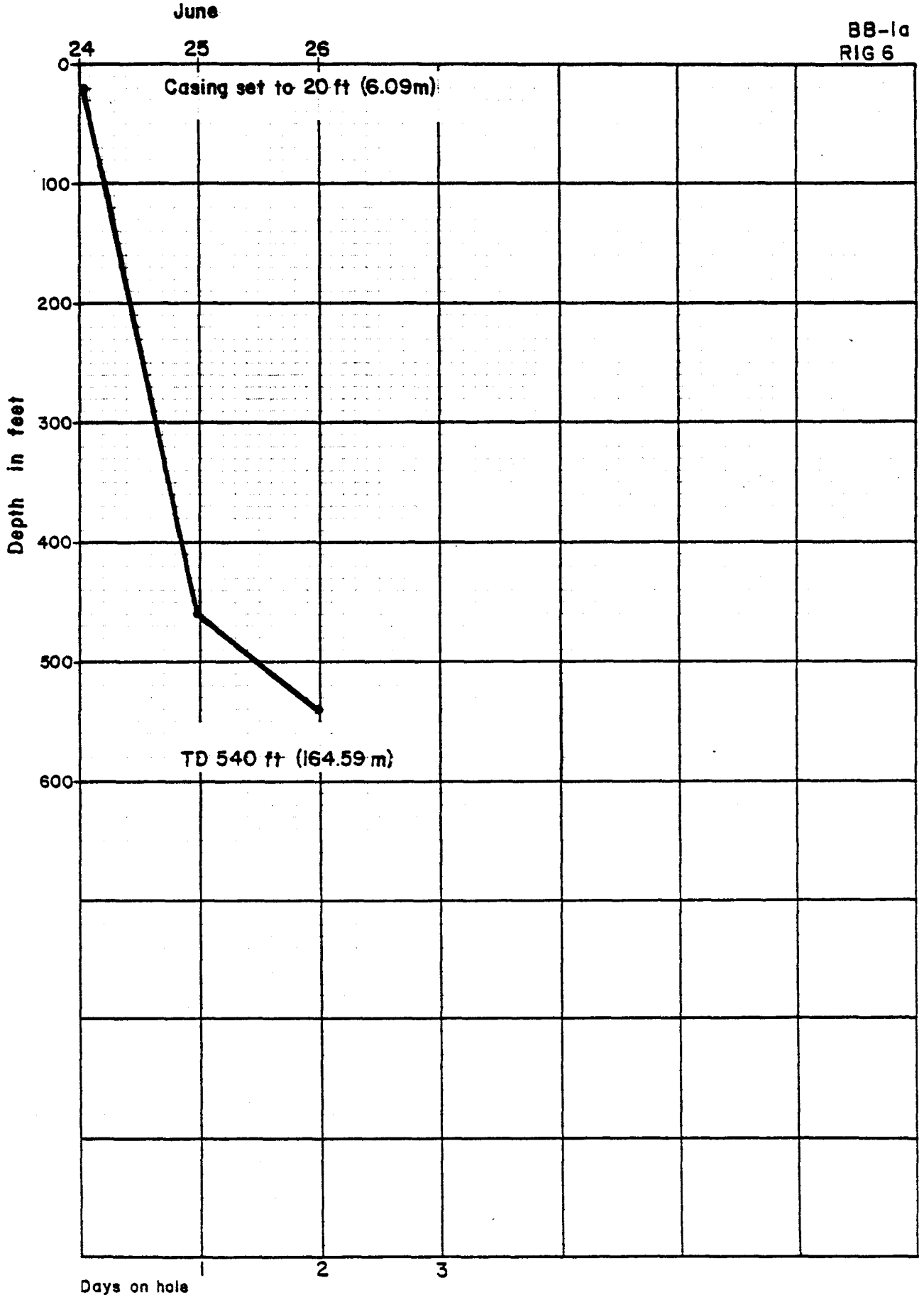

Figure 2. Daily progress chart, hole no. BB-1a.

Hole no. BB-2

Location:	NENW, sec. 29, T. 17 S., R. 11 E.
Total depth:	703 feet (214.21 m)
Spud date:	July 10, 1979
Completion date:	July 11, 1979
Rig:	Failing CF-15 (Rig no. 6)
Drill-pipe size:	3.5 inches (8.89 cm) x 20 feet (6.09 m)
Drill collars:	4.5 inches (11.43 cm) x 20 feet (6.09 m)
Sample interval(s) and type:	5 feet (1.52 m); drill cuttings

Hole BB-2 was rotary drilled to a depth of 140 feet (42.67 m) using a 6.25-inch (15.87 cm) diameter button bit. No surface casing was used because there was no unconsolidated alluvial cover. Rotary drilling continued from 140 feet (42.67 m) to a final depth of 703 feet (214.21 m) using a 5.625-inch (14.40 cm) diameter rock bit. No circulation problems occurred although the hole became extremely tight at 520 feet (158.49 m).

The entire hole was drilled with fluid to the final depth of 703 feet (214.21 m). The circulation system consisted of one earthen pit with a capacity of 2,500 gallons (9,463 l) and one 55-gallon (208.23 l) steel drum. The pit was used for drilling water and cuttings disposal, and the drum was used for mixing circulation additives. After drilling and logging operations were completed the hole was plugged with a 5-foot (1.52 m) cement surface plug.

Bit record

Make	Type	Hole diameter		Depth	
		inches	centimeters	feet	meters
Smith	F3	6.25	15.87	0-140	0- 42.67
Walker Mac	2	5.625	14.40	140-703	42.67-214.21

Consumables

Quantity	Material
6 gallons (22.71 l)	Sta-Foam 202

Geophysical logs

Gamma	Self-potential
Neutron	Resistivity
Spectral gamma-ray (KUT)	

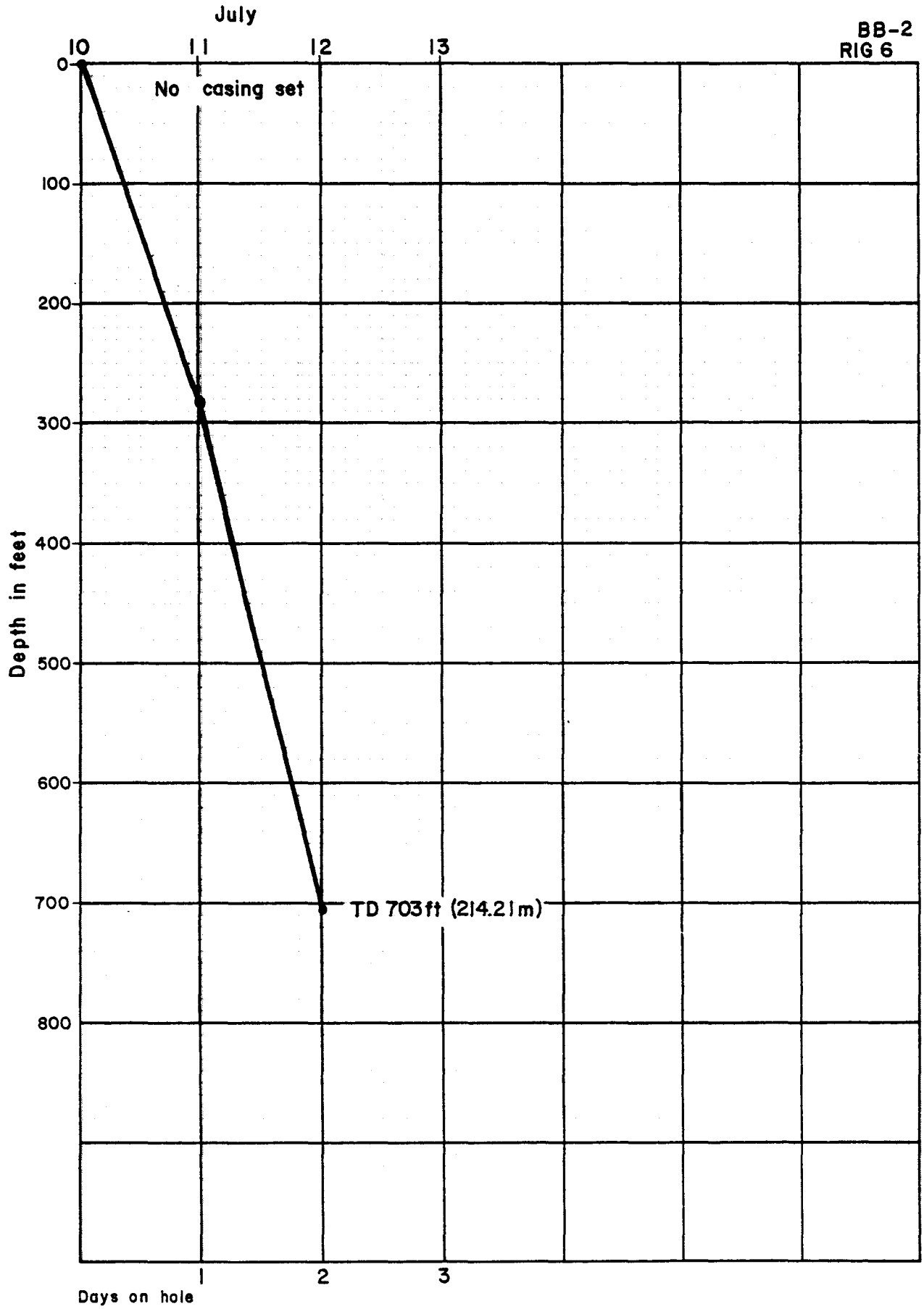

Figure 3. Daily progress chart, hole no. BB-2.

Hole no. BB-5

Location:	SENE, sec. 16, T. 18 S., R. 10 E.
Total depth:	101 feet (30.78 m)
Spud date:	June 16, 1979
Completion date:	June 19, 1979
Rig:	Longyear HC-44 (CR-5) and Gardner-Denver 15-W (R-5)
Drill-pipe size:	3.5 inches (8.89 cm) x 20 feet (6.09 m)
Drill collars:	Four 4.5 inches (11.43 cm) x 20 feet (6.09 m)
Sample interval(s) and type:	5 feet (1.52 m); drill cuttings

Hole BB-5 was air-hammer drilled to a depth of 14.5 feet (4.41 m) with an 8.75-inch (22.22 cm) diameter rock bit. A casing-seat was established and a 7-inch (17.78 cm) ID casing set. Air-hammer drilling using a 3.25-inch (8.25 cm) button bit continued from 14.5 feet (4.41 m) to 58 feet (17.67 m). Water saturated mudstones clogged the button bit, therefore air-hammer drilling became impractical. On June 18, 1979, Rig CR-5 was moved off the hole and Rig R-5 moved on. The initial casing was pulled, and the hole reamed to 15.5 feet (4.71 m) with an 8.75-inch (22.22 cm) diameter rock bit. Another casing-seat was established and the 7-inch (17.78 cm) ID casing was set. Rotary drilling continued from 15.5 to 58 feet (4.71 to 17.67 m), reaming the hole from 3.25 to 5.625 inches (8.25 to 14.40 cm) in diameter. Drilling continued to 101 feet (30.78 m) until the button bit wore out. The hole was reamed again to a depth of 72 feet (21.93 m) using a 5.625-inch (14.40 cm) mill-tooth bit. At this depth all circulation began coming back on the outside of the casing which made further drilling useless. The surface casing was pulled and the hole logged.

One earthen pit, having an approximate total capacity of 2,500 gallons (9,463 l) was used for drilling water and cuttings disposal, while one metal livestock tank having a total capacity of approximately 350 gallons (1,325 l) was used for mixing the circulation medium. After drilling and logging operations were completed a 5-foot (1.52 m) cement surface plug was set.

Bit record

		Hole diameter		Depth	
Make	Type	inches	centimeters	feet	meters
Walker Mac	RB	8.75	22.22	0- 14.5	0- 4.41
Smith	F3	3.25	8.25	14.5- 58.0	4.41-17.67
Smith	F3	5.625	14.40	58.0-101.0	17.67-30.78
Veral	RB	5.625	14.40	0- 72.0	0-21.93

Consumables

Quantity	Material
1 gallon (3.78 l)	Sta-Foam 202

Geophysical logs

Gamma
Neutron
Self-potential

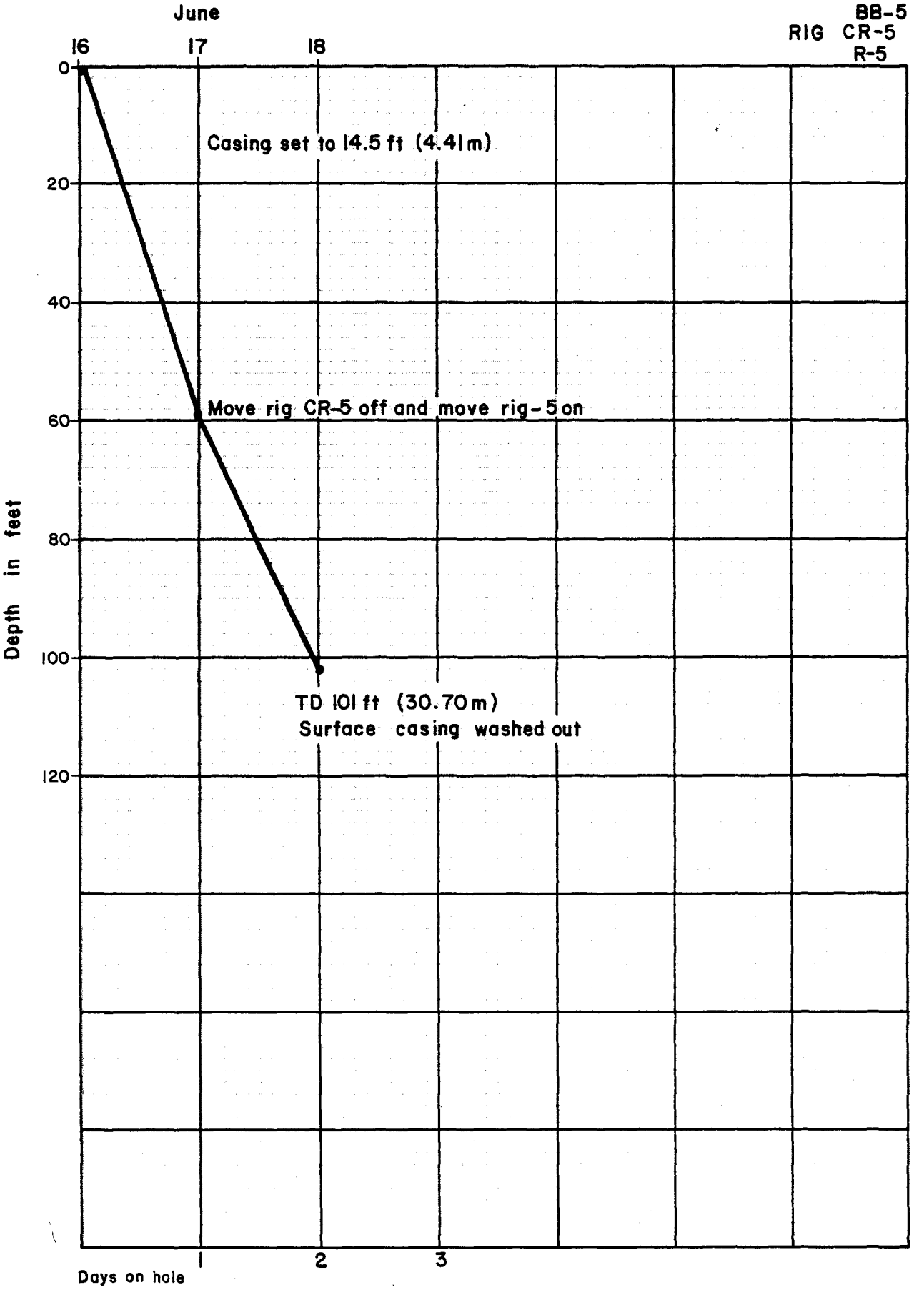

Figure 4. Daily progress chart, hole no. BB-5.

Hole no. BB-5a

Location:	SENE, sec. 16, T. 18 S., R. 10 E. (15 feet; 4.57 m SSE of hole BB-5)
Total depth:	635.5 feet (193.72 m)
Spud date:	June 19, 1979
Completion date:	June 22, 1979
Rig:	Gardner-Denver Model 15-W (Rig no. 5)
Drill-pipe size:	3.5 inches (8.89 cm) x 20 feet (6.09 m)
Drill collars:	Four 4.5 inches (11.43 cm) x 20 feet (6.09 m)
Sample interval(s) and type:	5 feet (1.52 m); drill cuttings

Hole BB-5a was rotary drilled to a depth of 14 feet (4.26 m) using an 8.75-inch (22.22 cm) diameter rock bit. A casing-seat was established and a 7-inch (17.78 cm) ID casing set. Rotary drilling continued from 14 to 510 feet (4.26 to 155.44 m) with a 5.625-inch (14.40 cm) diameter rock bit. No significant drilling problems occurred in this interval. The hole was deepened with a 5.125-inch (13.00 cm) diameter rock bit from 510 to 580 feet (155.44 to 176.78 m) and logged. Rotary drilling continued using a 5-inch (12.70 cm) diameter rock bit for the interval from 580 to 635.5 feet (176.78 to 193.72 m).

The hole was drilled with fluid from 14 feet (4.26 m) to final depth. The circulation medium system consisted of a 350-gallon (1,325 l) aluminum livestock tank and the earthen pit from hole BB-5, whose capacity was approximately 2,500 gallons (9,463 l). Upon completion of drilling and logging operations the hole was plugged with a 5-foot (1.52 m) cement surface plug.

Bit record

		Hole diameter		Depth	
Make	Type	inches	centimeters	feet	meters
Walker Mac	3	8.75	22.22	0.0- 14.0	0- 4.26
Varel	3	5.625	14.40	14.0-510.0	4.26-155.44
Varel	3	5.125	13.00	510.0-580.0	155.44-176.78
Varel	2	5.0	12.70	580.0-635.5	176.78-193.72

Consumables

Quantity	Material
8 gallons (30.28 l)	Sta-Foam 202

Geophysical logs

Gamma	Neutron
Self-potential	Resistivity
Spectral gamma-ray (KUT)	

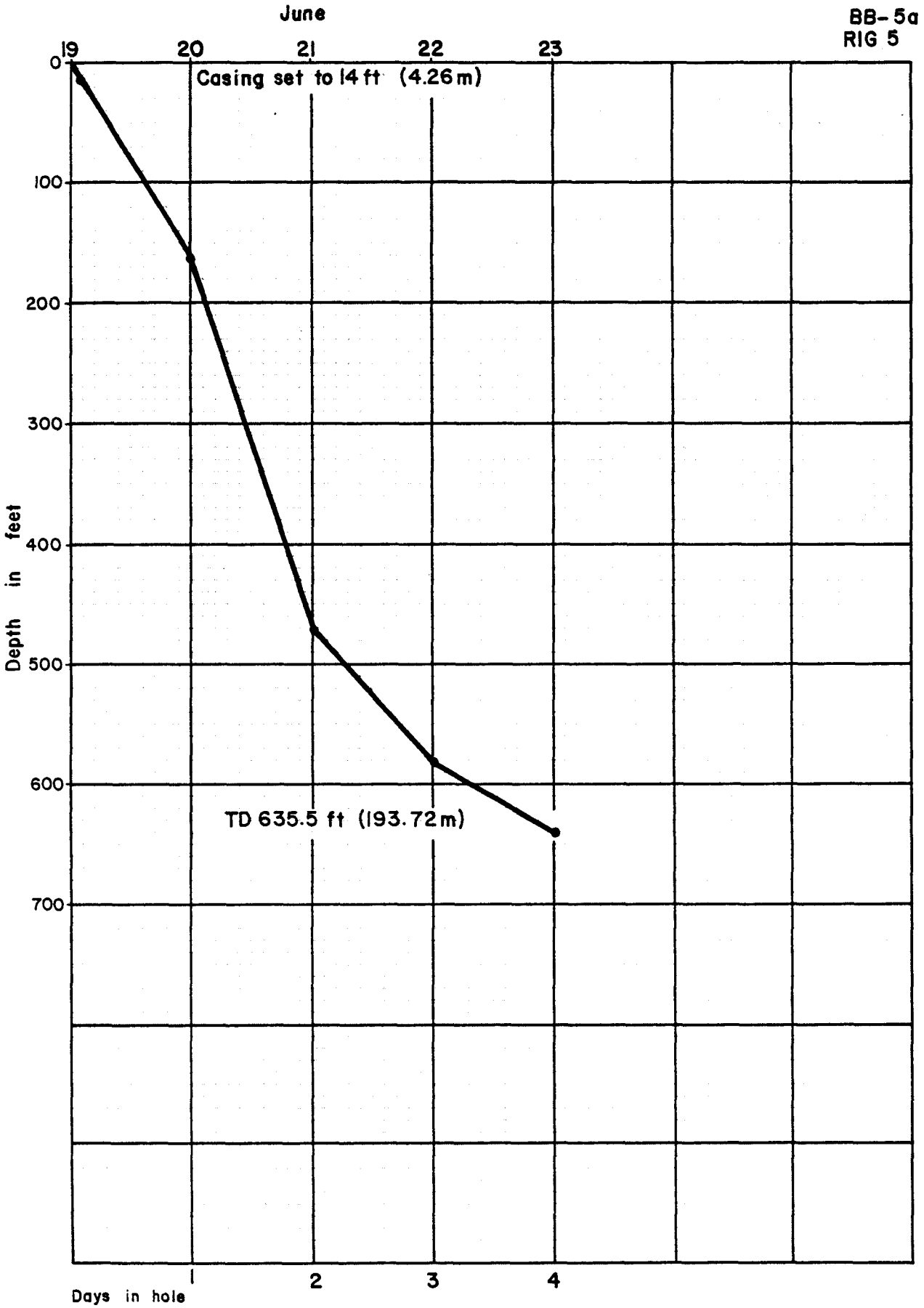

Figure 5. Daily progress chart, hole no. BB-5a.

Hole no. BB-7

Location:	SWNE, sec. 2, T. 18 S., R. 10 E.
Total depth:	520 feet (158.49 m)
Spud date:	June 20, 1979
Completion date:	June 21, 1979
Rig:	Failing CF-15 (Rig no. 6)
Drill-pipe size:	3.5 inches (8.89 cm) x 20 feet (6.09 m)
Drill collars:	Four 4.5 inches (11.43 cm) x 20 feet (6.09 m)
Sample interval(s) and type:	5 feet (1.52 m); drill cuttings

Hole BB-7 was rotary drilled to a depth of 21.5 feet (6.55 m) using an 8.75-inch (22.22 cm) diameter rock bit. A casing-seat was established and a 7-inch (17.78 cm) ID casing set. Rotary drilling continued from 21.5 to 120 feet (6.55 to 36.58 m) using a 5.625-inch (14.27 cm) diameter button bit. A 5.125-inch diameter (13.00 cm) hole was drilled from 120 to 200 feet (36.57 to 60.96 m) where a complete loss of circulation occurred. Circulation was regained in approximately 1 hour and drilling continued to 440 feet (134.09 m) with no additional problems. A 5-inch (12.70 cm) diameter button bit was used to rotary drill from 440 to 520 feet (134.09 to 158.49 m) without significant problems.

The hole was drilled with fluid from 21.5 feet (6.55 m) to final depth. The circulation medium system consisted of two earthen pits with an approximate total capacity of 5,000 gallons (18,939 l). These pits were used for drilling water and cuttings disposal. A 55-gallon (208.23 l) steel drum was used for mixing the circulation additives. After drilling and logging operations were completed the hole was plugged with a 5-foot (1.52 m) cement surface plug.

Bit record

Make	Type	Hole diameter inches	Hole diameter centimeters	Depth feet	Depth meters
Walker Mac	3	8.75	22.22	0- 21.5	0- 6.55
Smith	F3	5.625	14.40	21.5-120.0	6.55- 36.57
Walker Mac	2	5.125	13.00	120.0-440.0	36.57-134.09
Walker Mac	2	5.0	12.70	440.0-520.0	134.09-158.49

Consumables

Quantity	Material
7 gallons (26.50 l)	Sta-Foam 202

Geophysical logs

Gamma	Resistivity
Neutron	Self-potential
Spectral gamma-ray (KUT)	

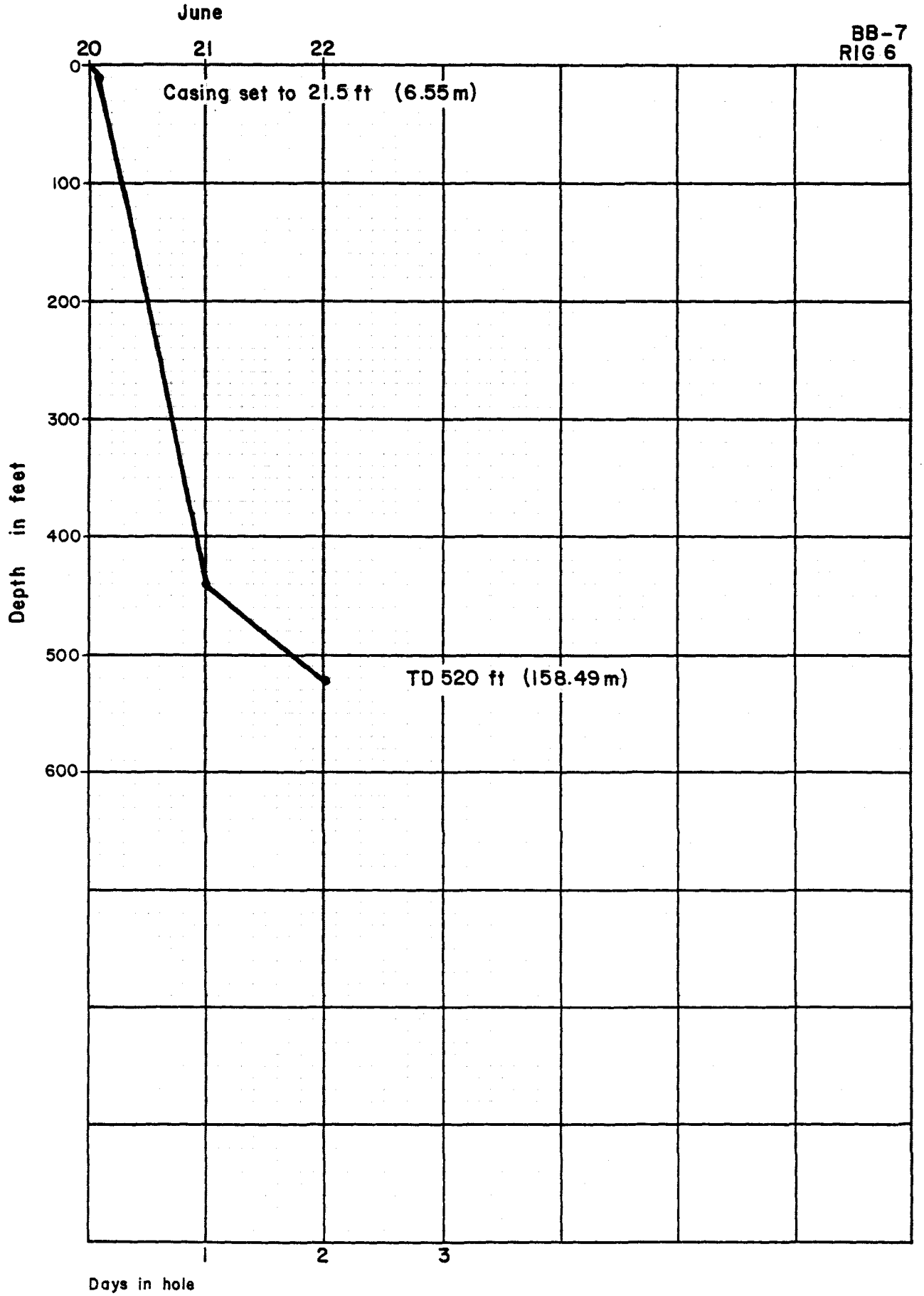

Figure 6. Daily progress chart, hole no. BB-7.

Hole no. BB-8

Location:	SESE, sec. 12, T. 18 S., R. 10 E.
Total depth:	618 feet (188.38 m)
Spud date:	June 21, 1979
Completion date:	June 23, 1979
Rig:	Failing CF-15 (Rig no. 6)
Drill-pipe size:	3.5 inches (8.89 cm) x 20 feet (6.09 m)
Drill collars:	Four 4.5 inches (11.43 cm) x 20 feet (6.09 m)
Sample interval(s): and type:	5 feet (1.52 m); drill cuttings

Hole BB-8 was rotary drilled to a depth of 45 feet (13.71 m) using a 5.625-inch (14.40 cm) diameter button bit. No surface casing was set because only about 1 foot of unconsolidated alluvial cover was present. Rotary drilling continued from 45 to 500 feet (13.71 to 152.40 m) using a 5.125-inch (13.00 cm) diameter rock bit. A 5-inch (12.70 cm) hole was drilled from 500 to 520 feet (152.40 to 158.50 m) when the air compressor clutch caught fire. The rig was shut down for 3 hours while a truck-mounted air compressor was brought to the drill site. Rotary drilling resumed and continued from 520 feet to a final depth of 618 feet (158.50 to 188.38 m).

The hole was drilled with fluid from 45 to 618 feet (13.71 to 188.38 m). The circulation system consisted of one earthen pit with an approximate capacity of 2,500 gallons (9,463 1) for drilling water and cuttings disposal, and one 55-gallon (208.23 1) steel drum for mixing circulation additives. After drilling and logging operations were completed the hole was plugged with a 6-foot (1.82 m) cement surface plug.

Bit record

Make	Type	Hole diameter		Depth	
		inches	centimeters	feet	meters
Smith	F3	5.625	14.40	0- 45	0- 13.71
Walker Mac	2	5.125	13.00	45-240	13.71- 73.15
Walker Mac	3	5.125	13.00	240-500	73.15-152.40
Walker Mac	2	5.0	12.70	500-580	152.40-176.78
Walker Mac	1	5.0	12.70	580-618	176.78-188.38

Consumables

Quantity	Material
5 gallons (18.93 1)	Sta-Foam 202

Geophysical logs

Gamma	Resistivity
Neutron	Self-potential

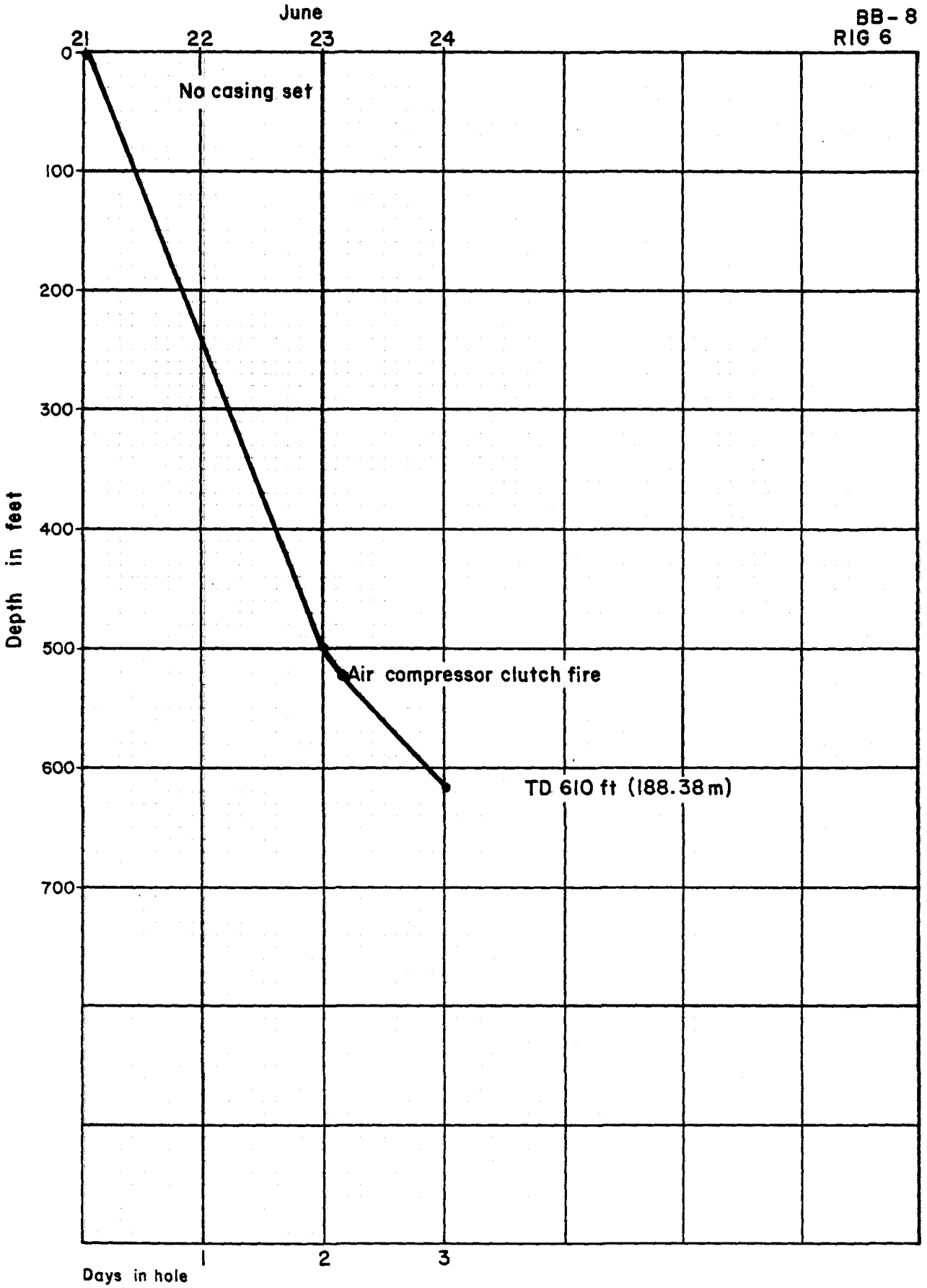

Figure 7. Daily progress chart, hole no. BB-8.

Hole no. BB-9

Location:	SWSW, sec. 17, T. 18 S., R. 11 E.
Total depth:	530 feet (161.54 m)
Spud date:	June 25, 1979
Completion date:	June 26, 1979
Rig:	Failing CF-15 (Rig no. 6)
Drill-pipe size:	3.5 inches (8.89 cm) x 20 feet (6.09 m)
Drill collars:	Four 4.5 inches (11.43 cm) x 20 feet (6.09 m)
Sample interval(s) and type:	5 feet (1.52 m); drill cuttings

Hole BB-9 was rotary drilled to a depth of 60 feet (18.29 m) using a 6.25-inch (15.87 cm) diameter button bit. No surface casing was set because the unconsolidated alluvial cover was less than 1 foot thick. A 5.625-inch (14.40 cm) hole was drilled from 60 to 415 feet (18.29 to 126.47 m). No significant drilling problems, only minor lost circulation, were encountered in this interval. Rotary drilling continued using a 5.125-inch (13.00 cm) rock bit from 415 feet (126.47 m) to a final depth of 530 feet (161.54 m).

The entire hole was drilled with fluid. The circulation system consisted of one earthen pit with a total capacity of 2,500 gallons (9,463 l) and one 55-gallon (208.23 l) steel drum. The pit was used for drilling water and cuttings disposal while the drum was used for mixing circulation additives. After drilling and logging operations were completed the hole was plugged with a 5-foot (1.52 m) cement surface plug.

Bit record

Make	Type	Hole diameter inches	Hole diameter centimeters	Depth feet	Depth meters
Smith	F3	6.25	15.87	0- 60	0- 18.29
Walker Mac	2	5.625	14.40	60-415	18.29-126.47
Walker Mac	3	5.125	13.00	415-530	126.47-161.54

Consumables

Quantity	Material
6 gallons (22.71 l)	Sta-Foam 202

Geophysical logs

Gamma	Resistivity
Self-potential	Spectral gamma-ray (KUT)
Neutron	

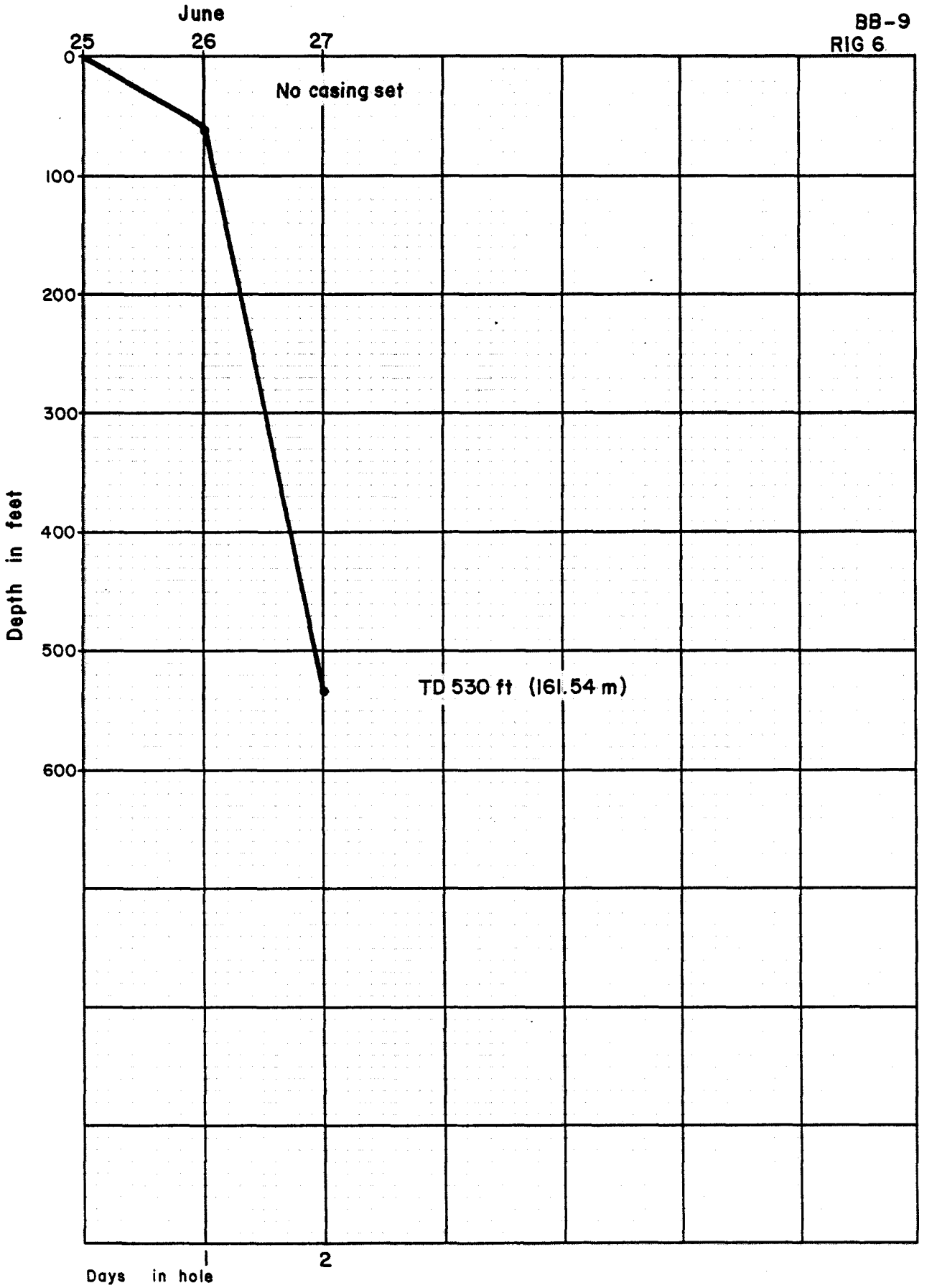

Figure 8. Daily progress chart, hole no. BB-9.

Hole no. BB-10

Location:	NESW, sec. 34, T. 19 S., R. 8 E.
Total depth:	920 feet (280.39 m)
Spud date:	July 12, 1979
Completion date:	July 18, 1979
Rig:	Failing CF-15 (Rig no. 6)
Drill-pipe size:	3.5 inches (8.89 cm) x 20 feet (6.09 m)
Drill collars:	4.5 inches (11.43 cm) x 20 feet (6.09 m)
Sample interval(s) and type:	5 feet (1.52 m); drill cuttings

Hole BB-10 was rotary drilled to a depth of 20 feet (6.09 m) using an 8.75-inch (22.22 cm) diameter rock bit. A casing-seat was established and a 7-inch (17.78 cm) ID casing set. Rotary drilling continued from 20 to 140 feet (6.09 to 42.67 m) using a 6.25-inch (15.87 cm) diameter rock bit. Twelve and one-half hours of drilling time were lost when a pull-down chain broke. After the chain had been repaired a 6.25-inch (15.87 cm) diameter hole was drilled from 140 to 800 feet (42.67 to 243.80 m). A washout occurred at 120 feet (36.57 m) and 16 hours were required to regain circulation. The following drilling additives were used: soda ash, Red Devil gel, Drispal, starch, caustic soda, and diesel fuel. The surface casing was cemented to prevent future washouts. Rotary drilling continued from 800 to 825 feet (243.80 to 250.42 m) using a 5.625-inch (13.40 cm) button bit. A rock bit was used from 825 feet (250.42 m) to a final depth of 920 feet (280.39 m).

The entire hole was drilled with fluid. The circulation system consisted of one earthen pit with an approximate total capacity of 2,500 gallons (9,463 l) and one 55-gallon (208.23 l) steel drum. The pit was used for drilling water and cuttings disposal, while the drum was used for mixing circulation additives. The hole was plugged with a 5-foot (1.52 m) cement surface plug after drilling and logging operations were completed.

Bit record

Make	Type	Hole diameter inches	Hole diameter centimeters	Depth feet	Depth meters
Walker Mac	3	8.75	22.40	0- 20	0- 6.09
Walker Mac	2	6.25	15.87	20-140	6.09- 42.67
Smith	F3	6.25	15.87	140-800	42.67-243.80
Smith	F2	5.625	13.40	800-825	243.80-250.42
Walker Mac	2	5.625	13.40	825-920	250.42-280.39

Consumables

Quantity	Material
10 gallons (37.85 l)	Sta-Foam 202
100 pounds (45.36 kg)	Soda ash
31 bags	Red Devil gel
150 pounds (68.04 kg)	Drispal
10 gallons (37.85 l)	Diesel fuel
100 pounds (45.36 kg)	Drilling starch
Two 94-pound bags (85.27 kg)	Cement

Geophysical logs

Gamma	Resistivity
Self-potential	Neutron

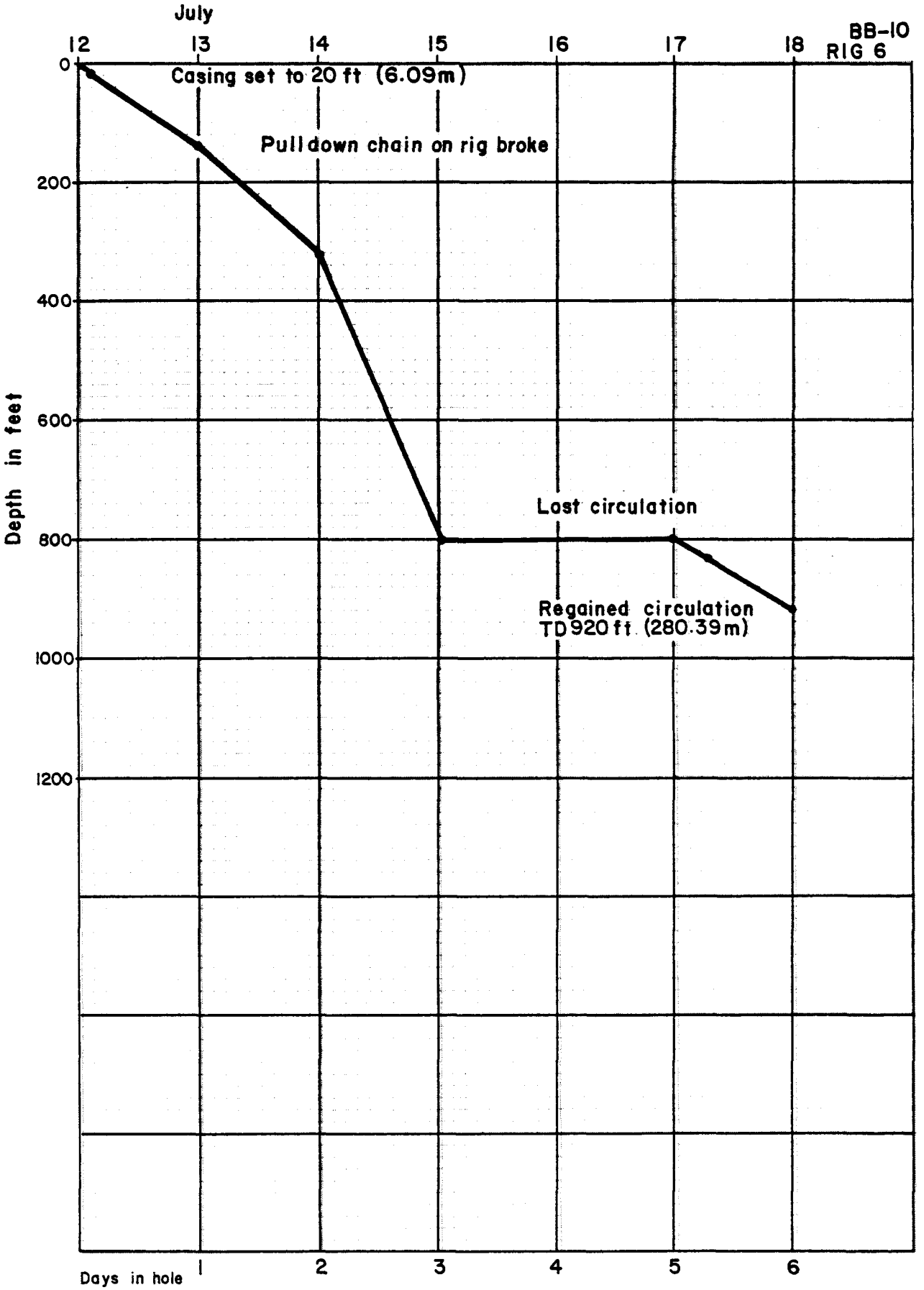

Figure 9. Daily progress chart, hole no. BB-10.

Hole no. BB-11

Location:	SWSW, sec. 27, T. 18 S., R. 11 E.
Total depth:	430 feet (131.04 m)
Spud date:	June 27, 1979
Completion date:	June 29, 1979
Rig:	Failing CF-15 (Rig no. 6)
Drill-pipe size:	3.5 inches (8.89 cm) x 20 feet (6.09 m)
Drill collars:	Four 4.5 inches (11.43 cm) x 20 feet (6.09 m)
Sample interval(s) and type:	5 feet (1.52 m); drill cuttings

Hole BB-11 was rotary drilled to a depth of 70 feet (21.33 m) using a 6.25-inch (15.87 cm) diameter button bit. Rotary drilling continued from 70 to 340 feet (21.33 to 103.63 m) using a 5.625-inch (13.40 cm) diameter rock bit with only minor and periodic problems of lost circulation. A 5.125-inch (13.00 cm) hole was rotary drilled from 340 to 395 feet (103.63 to 120.39 m) until a cone on the rock bit broke. Two and one-half hours were lost in an unsuccessful attempt to fish for the cone. An additional 6.5 hours were lost waiting for a coring tool to be delivered to the rig. Coring from 395 to 396.5 feet (120.39 to 120.84 m) proved ineffective in retrieving the broken cone. Rotary drilling continued using a 5.125-inch (13.00 cm) diameter rock bit from 396.5 feet (120.84 m) to a final depth of 430 feet (131.04 m).

The circulation system consisted of one earthen pit with an approximate total capacity of 2,500 gallons (9,463 l) and one 55-gallon (298.23 l) steel drum. The pit was used for drilling water and cuttings disposal, and the drum served as a mixing container for the circulation additives. After drilling and logging operations were completed, the hole was plugged with a 5-foot (1.52 m) cement surface plug.

Bit record

Make	Type	Hole diameter inches	Hole diameter centimeters	Depth feet	Depth meters
Smith	F3	6.25	15.87	0- 70.0	0- 21.33
Walker Mac	1	5.625	14.40	70.0-340.0	21.33-103.63
Walker Mac	1	5.125	13.00	340.0-395.0	103.63-120.39
Himes-TRASHBASKET	---[1]	4.5	11.43	395.0-396.5	120.39-120.84
Walker Mac	2	5.125	13.00	396.5-430.0	120.84-131.04

[1]Not applicable, ---.

Consumables

Quantity	Material
5 gallons (18.93 l)	Sta-Foam 202

Geophysical logs

Gamma
Self-potential
Resistivity
Neutron
Spectral gamma-ray (KUT)

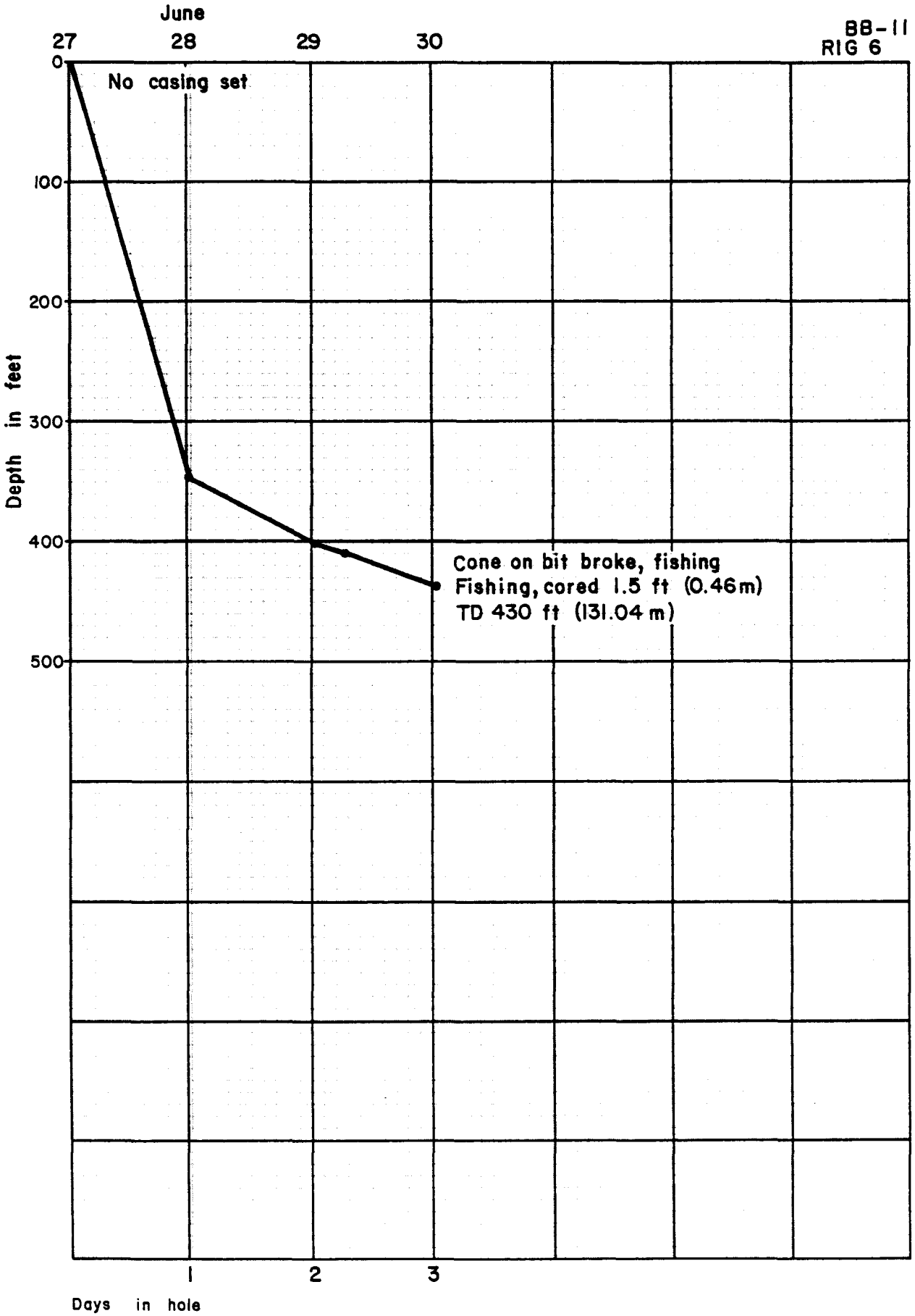

Figure 10. Daily progress chart, hole no. BB-11.

Hole no. BB-12

Location:	SWNE, sec. 34, T. 18 S., R. 11 E.
Total depth:	410 feet (124.94 m)
Spud date:	June 29, 1979
Completion date:	June 30, 1979
Rig:	Failing CF-15 (Rig no. 6)
Drill-pipe size:	3.5 inches (8.89 cm) x 20 feet (6.09 m)
Drill collars:	Four 4.5 inches (11.43 cm) x 20 feet (6.09 m)
Sample interval(s) and type:	5 feet (1.52 m); drill cuttings

Hole BB-12 was rotary drilled to a depth of 100 feet (30.48 m) using a 5.625-inch (14.40 cm) diameter button bit. No casing was set. Rotary drilling continued from 100 feet (30.48 m) to a total depth of 410 feet (124.94 m) using the same bit. The hole caved in extensively, so the first logging run was incomplete. The hole was redrilled from the surface to a total depth with a 5-inch (12.70 cm) button bit and relogged.

The entire hole was drilled with fluid. The circulation system consisted of one earthen pit with a total capacity of 2,500 gallons (9,463 l) and one 55-gallon (208.23 l) steel drum. The pit was used for drilling water and cuttings disposal, and the drum was used for mixing circulation additives. Upon completion of drilling and logging operations the hole was plugged with a 5-foot (1.52 m) cement surface plug.

Bit record

Make	Type	Hole diameter		Depth	
		inches	centimeters	feet	meters
Walker Mac	1	5.625	14.40	0-410	0-124.94
Walker Mac	5	5.0	12.70	0-410	0-124.94

Consumables

Quantity	Material
5 gallons (18.93 l)	Sta-Foam 202

Geophysical logs

Gamma
Self-potential
Resistivity
Neutron
Spectral gamma-ray (KUT)

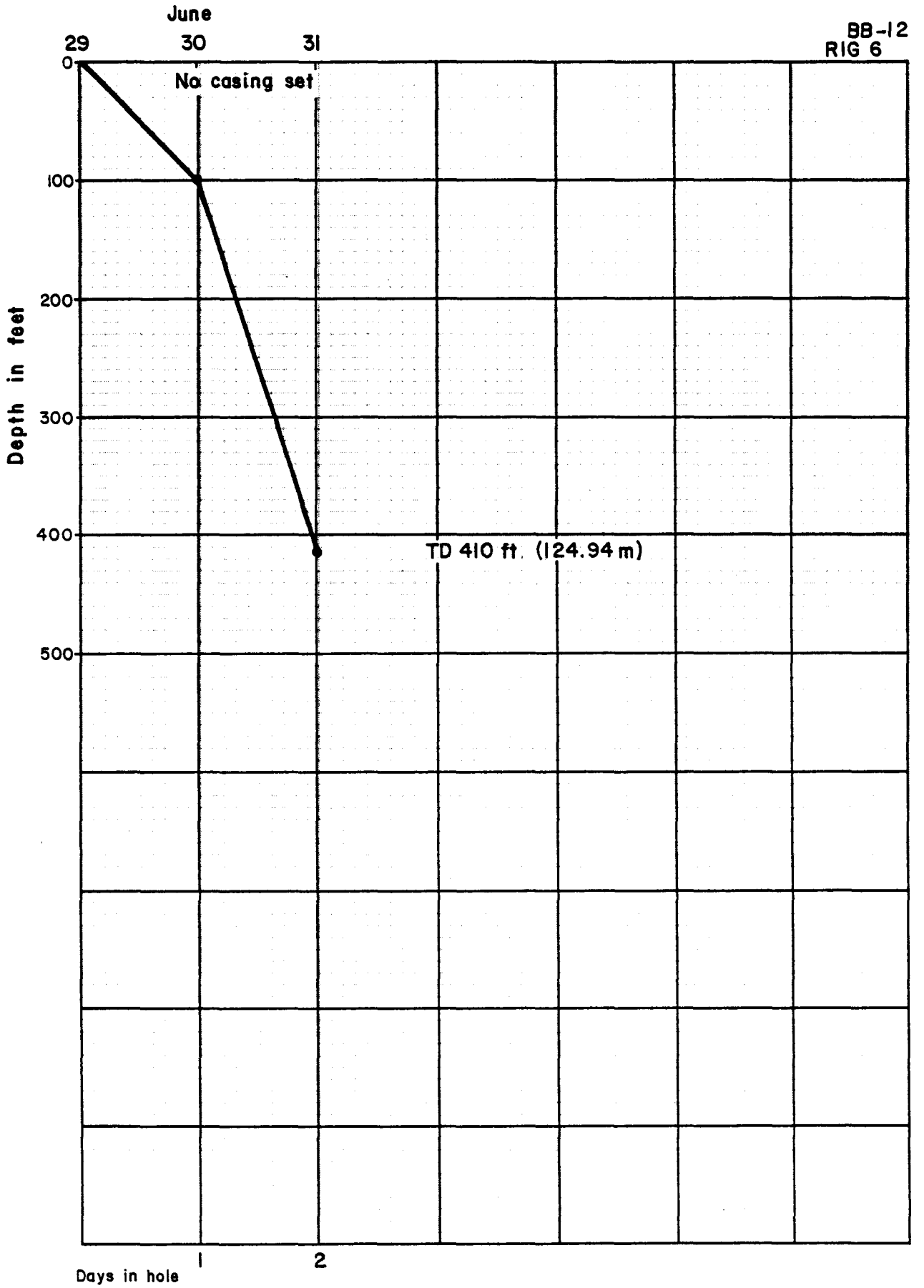

Figure 11. Daily progress chart, hole no. 12.

Hole no. BB-13

Location:	SWNE, sec. 8, T. 16 S., R. 12 E.
Total depth:	860 feet (262.09 m)
Spud date:	July 25, 1979
Completion date:	July 28, 1979
Rig:	Failing CF-15 (Rig no. 6)
Drill-pipe size:	3.5 inches (8.89 cm) x 20 feet (6.09 m)
Drill collars:	Four 4.5 inches (11.43 cm) x 20 feet (6.09 m)
Sample interval(s) and type:	5 feet (1.52 m); drill cuttings

Hole BB-13 was rotary drilled to a depth of 40 feet (12.19 m) using a 6.25-inch (15.87 cm) diameter button bit. No casing was set. A 5.625-inch (14.40 cm) hole was drilled from 40 to 360 feet (12.19 to 109.73 m) with only minor lost circulation incidents. Rotary drilling continued from 360 to 860 feet (109.73 to 262.09 m) using 5.125-inch (13.00 cm) rock and button bits. At 700 feet (213.30 m) a washout occurred. The problem was quickly solved by redrilling the hole from 550 to 860 feet (167.64 to 262.09 m) using a 5-inch (12.70 cm) diameter rock bit. Self-potential and resistivity logs were not obtained because natural gas in the hole forced the fluids out.

The hole was drilled with fluid from the surface to total depth. The circulation system consisted of one earthen pit with an approximate total capacity of 2,500 gallons (9,463 l) and one 55-gallon (208.23 l) steel drum. The pit served for drilling water and cuttings disposal; the drum was used for mixing circulation additives. After drilling and logging operations were completed, the hole was plugged with a 5-foot (1.52 m) cement surface plug.

Bit record

Make	Type	Hole diameter inches	Hole diameter centimeters	Depth feet	Depth meters
Smith	F3	6.25	15.87	0- 40	0- 12.19
Walker Mac	2	5.625	14.40	40-180	12.19- 54.86
Smith	F3	5.625	14.40	180-360	54.86-109.73
Walker Mac	2	5.125	13.00	360-445	109.73-135.61
Smith	F2	5.125	13.00	445-860	135.61-262.09
Walker Mac	2	5.0	12.70	550-860	167.64-262.09

Consumables

Quantity	Material
5 gallons (18.93 l)	Sta-Foam 202

Geophysical logs

Gamma
Neutron
Spectral gamma-ray (KUT)

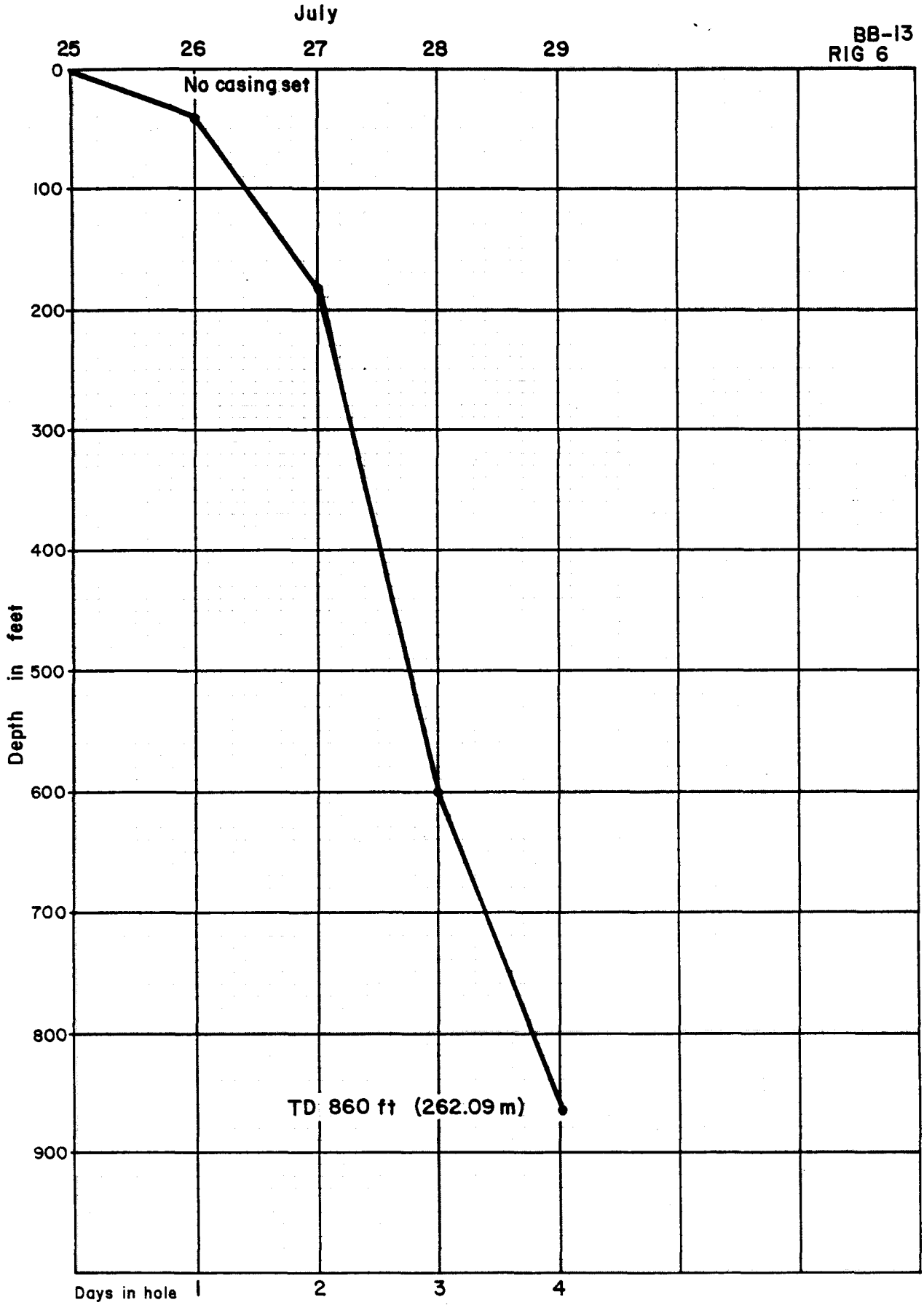

Figure 12. Daily progress chart, hole no. 13.

Hole no. BB-14

Location:	NWSW, sec. 26, T. 18 S., R. 9 E.
Total depth:	600 feet (182.90 m)
Spud date:	July 18, 1979
Completion date:	July 25, 1979
Rig:	Failing CF-15 (Rig no. 6)
Drill-pipe size:	3.5 inches (8.89 cm) x 20 feet (6.09 m)
Drill collars:	Four 4.5 inches (11.43 cm) x 20 feet (6.09 m)
Sample interval(s) and type:	5 feet (1.52 m); drill cuttings

Hole BB-14 was rotary drilled to a depth of 20 feet (6.09 m) using a 8.75-inch (22.22 cm) diameter rock bit. A casing-seat was established and a 7-inch (17.78 cm) ID casing set. Rotary drilling continued from 20 feet (6.09 m) to a final depth of 600 feet (182.90 m) using a 6.25-inch (15.87 cm) diameter button bit. No significant drilling problems occurred.

The hole was drilled with fluid from the casing seat to total depth. The circulation system consisted of one earthen pit with an approximate capacity of 2,500 gallons (9,463 l) and one 55-gallon (208.23 l) steel drum. The earthen pit was used for drilling water and cuttings disposal; the steel drum served as a mixing container for circulation additives. Upon completion of drilling and logging operations the hole was plugged with a 5-foot (1.52 m) cement surface plug.

Bit record

Make	Type	Hole diameter inches	Hole diameter centimeters	Depth feet	Depth meters
Walker Mac	3	8.75	22.22	0- 20	0- 6.09
Smith	F2	6.25	15.87	20-600	6.09-182.90

Consumables

Quantity	Material
5 gallons (18.93 l)	Sta-foam 202

Geophysical logs

Spectral gamma-ray (KUT)

The conventional suite was not run due to probe malfunction.

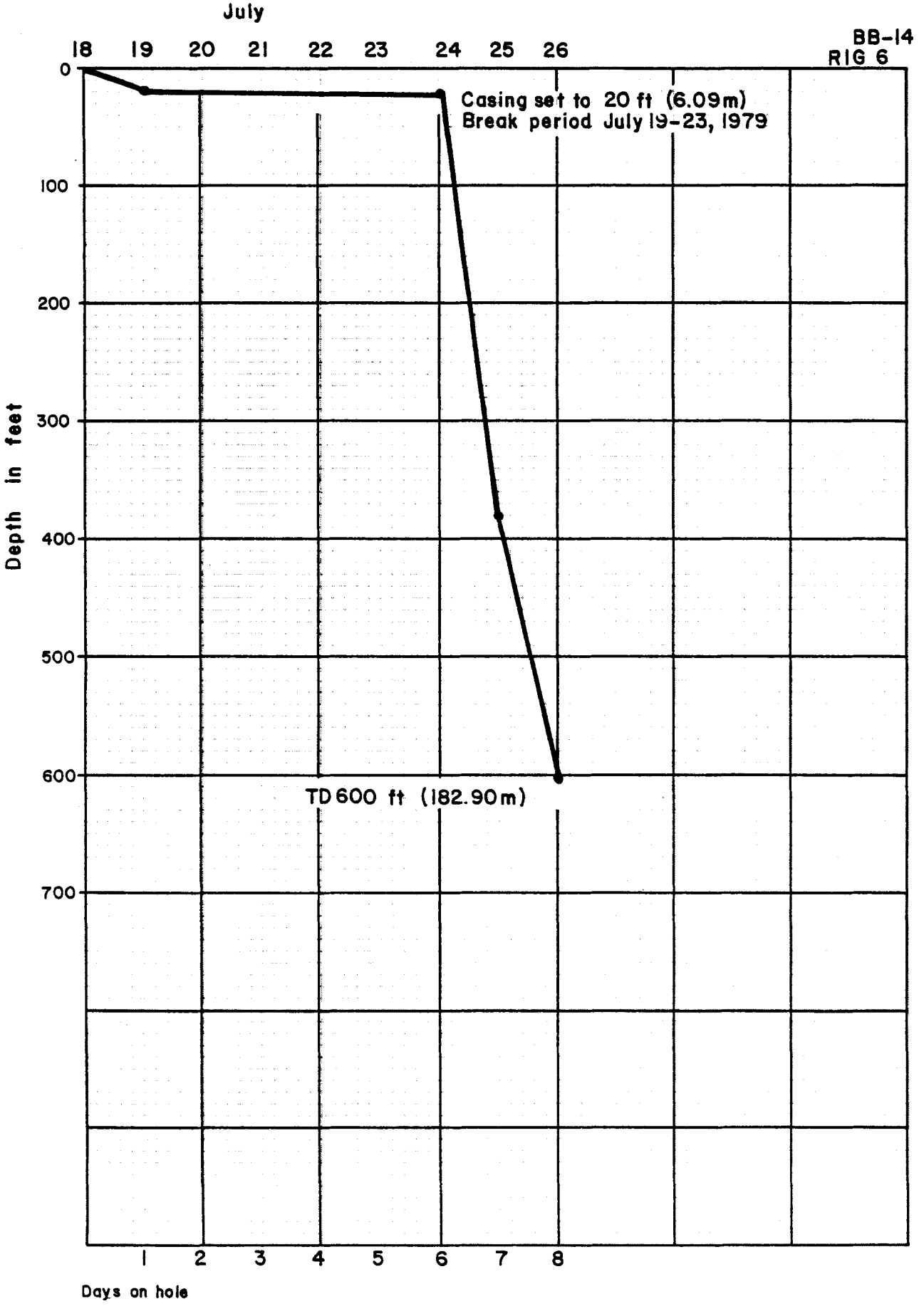

Figure 13. Daily progress chart, hole no. 14.