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GJBX-103(79)

National Uranium Resource Evaluation

ENGINEERING REPORT ON THE DRILLING IN THE SPOR MOUNTAIN AREA OF UTAH

Bendix Field Engineering Corporation
Grand Junction Operations
Grand Junction, CO 81502

July 1979

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

DISCLAIMER

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Under Contract No. DE-AC-13-76-GJO-1664

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INTRODUCTION

This report presents engineering details, statistics and individual borehole histories of the 30 holes drilled in the project. General information is presented regarding problems of weather and logistics.

No geophysical logs or geological information is included in this report. Geophysical logs are available through the GJO Technical Library. A separate geological report is being prepared and shall also be available through the GJO Technical Library in the near future.

ACKNOWLEDGEMENTS

The project manager was C. Beverly, BFEC. Project geologists were C. Beverly, BFEC; M. Callihan, BFEC; and M. Freeman, BFEC. Drilling supervisors were J. McCaslin, BFEC and M. Callihan, BFEC.

SUMMARY

The Spor Mountain Drilling Project was conducted by Bendix Field Engineering Corporation in support of the United States Department of Energy (DOE) National Uranium Resource Evaluation (NURE) program. This project consisted of 30 drill holes (Table 1), ranging in depth from 372 feet (113.39 m) to 2,525 feet (769.62 m). A total of 33,143 feet (10,101.99 m) were drilled, of which 11,579 feet (3,529.28 m) were cored.

The objective of the project was to test the continuity of uranium bearing host rocks, including the Beryllium Tuff and Yellow Chief sandstones, in several geologically favorable areas of the Thomas Range. This project began June 22, 1978, and continued through May 1979 with final site restoration and cleanup.

LOCATION

This project was conducted entirely in Juab County, Utah (Figure 1), approximately 60 miles (96.5 km) northwest of Delta, Utah. All drill sites were within close proximity to Spor Mountain and the Thomas Range.

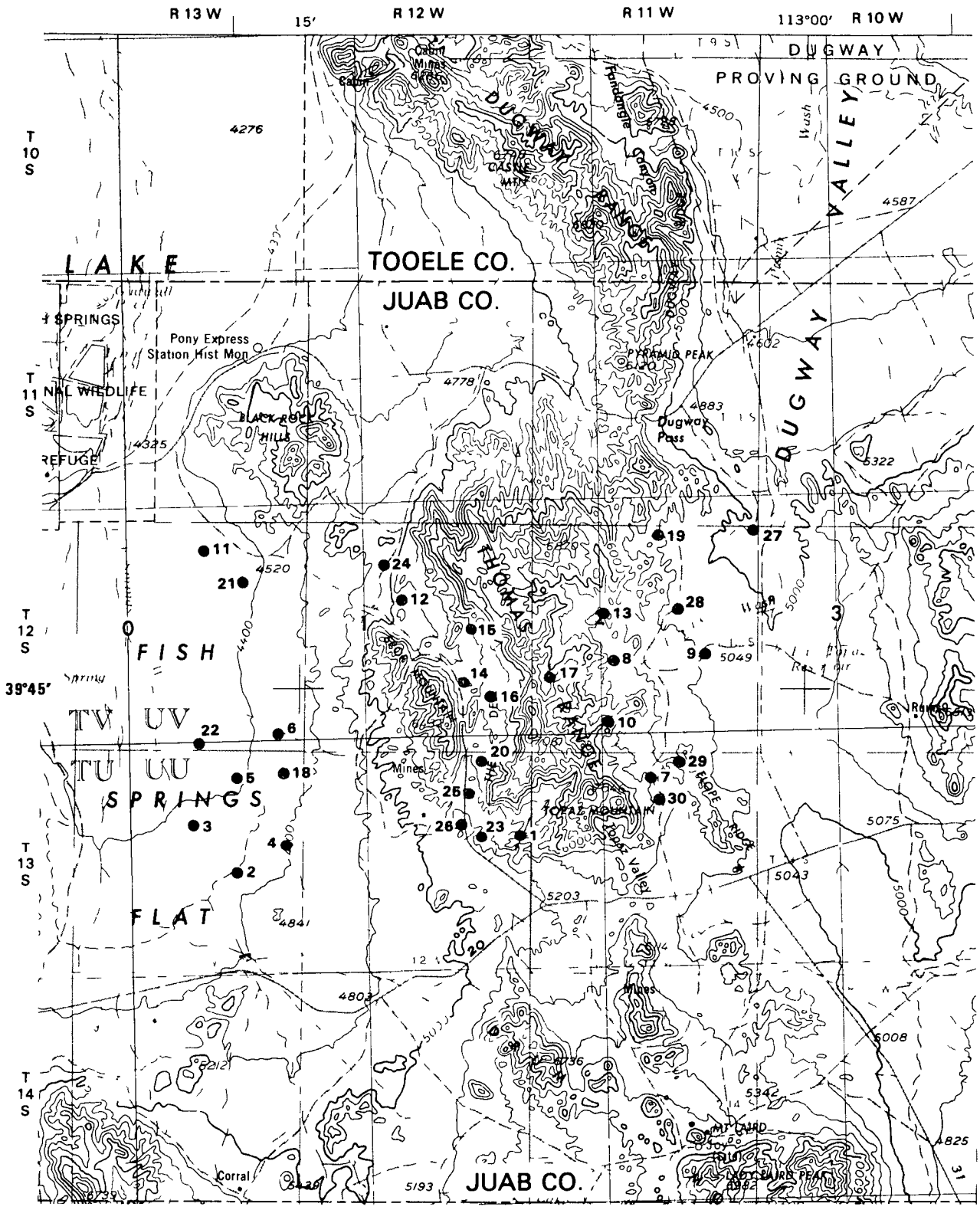
Access to the general project area is by an all-weather, hard surface highway from Delta, Utah. Further access is provided by dirt and gravel roads in fair to good condition throughout the project area.

All drill sites were selected for best possible access with a minimum of road construction, while still remaining in geologically favorable areas.

Surface topography ranges from the fairly level Fish Springs Flat in the west, to the more rugged Dell area of Spor Mountain in the middle, to the rolling hills on the east flank of the Thomas Range.

Table 1. Drillhole Summary

HOLE NO.	ROTARY FOOTAGE	CORE FOOTAGE	TOTAL FOOTAGE	ELEVATION FEET	LOCATION 1/16	1/4	S	T	R	USGS TOPO MAP
SM-1	23	932	955	5350	NW	NE	13	13S	12W	Topaz Mountain 15'
SM-2	987	10	997	4500	NE	NW	23	13S	13W	Sand Pass NE 7.5'
SM-3	1007	7	1014	4425	SW	SW	10	13S	13W	Sand Pass NE 7.5'
SM-4	410	0	410	4569	NW	SE	13	13S	13W	Sand Pass NE 7.5'
SM-5	1449	11	1460	4423	NE	SW	2	13S	13W	Sand Pass NE 7.5'
SM-6	200	747	947	4462	NE	SW	36	12S	13W	Sand Pass NE 7.5'
SM-7	230	1765	1995	5486	SW	NW	3	13S	11W	Topaz Mountain 15'
SM-8	40	1963	2003	5417	SW	NE	21	12S	11W	Dugway Range 15'
SM-9	756	0	756	5168	NW	NE	23	12S	11W	Dugway Range 15'
SM-10	1259	354	1613	5655	SW	NW	33	12S	11W	Topaz Mountain 15'
SM-11	985	0	985	4338	NE	SW	3	12S	13W	Fish Springs SE 7.5'
SM-12	495	5	500	5018	NE	NW	16	12S	12W	Dugway Range 15'
SM-13	2525	0	2525	5588	SE	NE	17	12S	11W	Dugway Range 15'
SM-14	502	0	502	5442	NW	NW	26	12S	12W	Dugway Range 15'
SM-15	718	19	737	5530	SE	SW	14	12S	12W	Dugway Range 15'
SM-16	370	0	370	5557	NW	SE	26	12S	12W	Topaz Mountain 15'
SM-17	875	120	995	6069	NE	NW	30	12S	11W	Dugway Range 15'
SM-18	93	919	1012	4506	NE	SW	1	13S	13W	Sand Pass NE 7.5'
SM-19	1220	60	1280	5215	NE	NW	3	12S	11W	Dugway Range 15'
SM-20	10	710	720	5474	NW	NE	3	12S	11W	Topaz Mountain 15'
SM-21	593	0	593	4399	NE	SW	11	12S	13W	Fish Springs 7.5'
SM-22	1515	0	1515	4370	NE	SE	33	12S	13W	Sand Pass NE 7.5'
SM-23	800	540	1340	5220	NW	SE	14	13S	12W	Topaz Mountain 15'
SM-24	315	0	315	4884	SW	NW	9	12S	12W	Dugway Range 15'
SM-25	1270	230	1500	5300	NE	NW	11	12S	12W	Topaz Mountain 15'
SM-26	186	217	403	5153	SW	SW	11	13S	12W	Topaz Mountain 15'
SM-27	1200	8	1208	4911	NE	NE	1	12S	11W	Dugway Range 15'
SM-28	1500	0	1500	5120	NE	NE	15	12S	11W	Dugway Range 15'
SM-29	10	1490	1500	5357	NE	NE	3	13S	11W	Topaz Mountain 15'
SM-30	20	1472	1492	5511	NE	NW	10	13S	11W	Topaz Mountain 15'



SPOR MOUNTAIN DRILLHOLE LOCATIONS

Figure 1

PRINCIPAL FIRMS AND AGENCIES

OWNER
U.S. Department of Energy
Grand Junction Office
Grand Junction, CO 81502

OPERATOR
Bendix Field Engineering Corp.
Grand Junction Operations
Grand Junction, CO 81502

LAND OWNERS
U.S. Bureau of Land Management

Private land owners and various energy and mining companies

SUBCONTRACTORS AND SERVICE FIRMS

DRILLING CONTRACTOR
Boyles Brothers Drilling Co.
P. O. Box 25068
Salt Lake City, UT

DRILLING MUD
Fluiddrill, Inc.
P. O. Box 25083
Salt Lake City, UT

GEOPHYSICAL LOGGING*
Century Geophysical Corp.
Grand Junction District Office
Grand Junction, CO 81501

WATER SUPPLY
U.S. Bureau of Land Management
Fillmore, UT

Brush-Wellman
Spor Mountain Operations
Delta, UT

U.S. Wildlife Refuge
Fish Springs, UT

*Special geophysical logging was supplied by Bendix Field Engineering Corporation, GJO

WATER HAULING
Northwest Carriers
P.O. Box 2099
Park City, UT

MUD LOGGING
Baroid
NL Baroid/NL Industries
P.O. Box 1675
Houston, TX 77001

DRILLING GUIDELINES

Because of evidence of very unstable surface conditions, it was required that 6-5/8 inch (16.83 cm) O.D. surface casing be used in all rotary drilled holes. This casing was to be fully cemented in the hole annulus to prevent any possible washouts.

Core holes were to be properly cased to the designated core point but left uncemented so that the casing could be pulled and the hole reamed to a greater diameter if so required.

Core holes were to start no smaller than HQ or NC (3-3/4 inch/9.53 cm) or equivalent, carried as far as practical, and then reduced to no smaller than NQ or NX (3 inch/7.62 cm) size, this being the smallest size acceptable for the planned geophysical logging.

Drilling mud was used as the circulation medium. A number of medium depth holes had been attempted with air previous to this project and were generally unacceptable with respect to the information obtained. The use of a good mud program did allow completion of 27 of the 30 holes and the recovery of satisfactory samples and cores.

Plastic sheeting (4 mil Visqueen) was used to prevent water loss in the earthen pits. With proper care used in lining the pits, this method was of great benefit in conserving the available drill water.

Deviation surveys were to be taken every 400 feet (121.92 m) in each hole if possible. A maximum of 10° deviation at total depth was allowed, but all holes remained within acceptable limitations. An Eastman single shot tool was used to determine deviation. Spectral gamma-ray logs (KUT) were run on holes as noted.

DRILLING ASEMBLIES

Boyles Bros. Drilling of Salt Lake City, Utah began their mobilization to the project area on June 19, 1978. Initially three rigs and associated equipment were brought on to the project. These units were:

Rig 892: Longyear Model 44, truck mounted, equipped with a Bean 35 gpm (132.48 lpm) pump, 38 foot (11.58 m) mast, racking board, mixing pump, approximately 1,500 feet (457.2 m) of NCWL drill rod, 10 foot (3.05 m) NCWL core barrel and related equipment. A 4 x 4 water truck with a 1,000 gallon (3,785 l) flat tank was also used for moving drill rod and other equipment.

Rig 860: Failing Model 2500, trailer mounted, equipped with a GD 7-1/2 x 8 mud pump, 58 foot (17.68 m) mast, racking board, etc. Approximately 1,500 feet (457.2 m) of 2-7/8 inch (7.3 cm) x 15 feet (4.57 m) I.F. drill pipe and four 4-1/2 inch (11.43 cm) x 20 feet (6.1 m) drill collars made up the initial drillstring for this rig. A winch truck, a 1,000 gallon (3,785 l) flat tank water truck, and two flat bed trailers served as support for this rig.

Rig 4145: Failing Model CF-15, truck mounted, equipped with a 5 x 6-1/2 mud pump and 38 foot (11.58 m) mast with racking board. Approximately 1,200 feet (365.76 m) of 2-7/8 inch (7.3 cm) x 15 feet (4.57 m) I.F. drill pipe and four 3-3/4 inch (9.53 cm) x 15 feet (4.57 m) drill collars comprised the initial drillstring. A 4 x 4 water truck with a 1,000 gallon (3,785 l) flat tank served for water and pipe haulage. Also a 10 foot (3.05 m) NCWL core barrel was available for use to spot core with this rig and Rig 860. Because of mechanical problems this rig was replaced on July 12 with Rig 4238, which was identical.

On June 27, 1978, another rotary rig was mobilized to the project. This unit was Rig 4146, which was a Failing CF-15 and equipped identically to Rig 4145.

On July 11, 1978, a second core rig was added to the project. This unit, Rig 886, was a Joy Model 22 and equipped similar to Rig 892. Due to frequent mechanical problems this unit was replaced on August 3, 1978, by Rig 838, which was a Longyear Model 44.

In addition to the 1,000 gallon (3,785 l) 4 x 4 water truck, a 4,000 gallon (15,140 l) tanker was put into service 2 weeks after the project commenced. This tanker was taken out of service because of mechanical problems and replaced with supplemental water hauling by Northwest Carriers, using 100 (19,093 l) to 150 barrel (28,650 l) tankers.

LOGISTICS

The project was located some 60 miles (96.6 km) from Delta, Utah, the closest available source of fuel, lodging, parts, etc. The drill crews elected to establish a camp in the project area, thus saving considerable driving time and permitting a good work schedule. Fuel was readily available in Delta, Utah and delivered to a central supply depot in the project area.

Soon after the project began, it was evident that water usage would greatly exceed the available supply in the project area. Supplemental water hauling was initiated, with water being hauled from the vicinity of Delta, Utah.

At least two and sometimes three tankers, having capacities of 100 barrels (19,093 l) to 150 barrels (28,640 l) were required to keep an adequate supply of water at the project site. These tankers also hauled water for road stabilization. Between four and seven hours were required per round trip for each truck between the water source and the project area.

Drilling mud and additives were supplied from Salt Lake City and Milford, Utah.

WEATHER AND ROAD CONDITIONS

The weather from late June to early September was extremely warm with very little precipitation. Daytime temperatures exceeded 100°F much of the time during this period. The weather was quite pleasant through late September and early October, with cooler temperatures prevailing during the latter stages of the project.

Many of the newly built access roads to the drill sites on the west and east edges of the project area deteriorated to deep dust and loose sand during the periods of hot weather, making these roads almost impassable. This necessitated keeping at least one, and sometimes more, tankers hauling water in an attempt to stabilize these roads. This, in part, was successful and allowed completion of work in the areas affected. Water had to be hauled from Delta, Utah during this period because of water shortages in the project area.

WORK SCHEDULES

All rigs were operated on a 24 hour per day basis, when possible, with crews working a 10 day on, 4 day off, schedule. This schedule was modified somewhat to allow all personnel time off for intervening holidays. This working schedule was implemented because of anticipated drilling conditions and to assure completion of the drilling program during favorable weather.

The full complement of rigs worked until August 28, 1978, at which time Rig 860 was released. Rigs 4145 and 838 were released September 27, 1978. Rig 4146 was released October 3, 1978, leaving Rig 892 to complete the project.

INDIVIDUAL HOLE HISTORY

SM-1

Location: NW1/4NE1/4 sec. 13, T. 13 S., R. 12 W.
Total depth: 955 feet (291.28 m).
Spud date: June 22, 1978.
Completion date: July 7, 1978.
Rig: Longyear Model 44, Boyles Brothers No. 892 with Bean 35 gpm (132.48 l pm) pump.
Drill pipe/drill rod size: NCWL 3-1/2 inch (8.89 cm) O.D.
Core barrel type and size: NCWL 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.10 cm) I.D.
Sample interval(s): Continuous core.
Core recovery: 95%.

Borehole History: SM-1 was rotary drilled to a depth of 23 feet (7.02 m) with a 5-1/2 inch (13.97 cm) diameter rock bit. A firm casing seat was established at this depth and 4 inch (10.16 cm) I.D. casing set.

NCWL coring started at 23 feet (7.02 m) and continued to 403 feet (122.92 m), with a complete loss of circulation from 23 feet (7.02 m) to 403 feet (122.92 m). At this point the 23 feet (7.02 m) of 4 inch (10.16 cm) surface casing was pulled and the hole reamed out to 5-1/2 inches (13.97 cm) to a depth of 403 feet (122.92 m). Four-inch (10.16 cm) I.D. casing was set to this depth in an effort to regain circulation and case off the unstable zones. NCWL coring started at 403 feet (122.92 m) and continued to 955 feet (291.28 m). Partial loss of circulation and unstable formation were encountered in this coring interval.

The circulation system used consisted of earthen pits having a capacity of approximately 3,000 gallons (11,355 l). Drilling fluid was primarily of gel base with polymers and other additives, e.g., lost circulation material, lignite, etc. Approximate total water usage was 25,000 gallons (94,625 l).

At the completion of coring, efforts were made to retrieve the 4 inch (10.16 cm) casing. The casing was stuck and had to be cut, which resulted in only 100 feet (30.5 m) being salvaged. Final abandonment consisted of surface cementing and mud plugging.

Bit Record

Make	Type	Size	Footage
Christensen	C-2	5-1/2 in. (13.97 cm)	0-23 ft (0.7.02 m)
Christensen	NC	3-3/4 in. (9.53 cm)	23-403 ft (7.02-122.92 m)
Christensen	NC	3-3/4 in. (9.53 cm)	403-581 ft (122.92-177.21 m)
Christensen	NC	3-3/4 in. (9.53 cm)	581-955 ft (177.21-291.28 m)

Consumables

Quantity	Material
113 sk (50 lb/22.68 kg ea.)	Mud 2
115 sk (2 lb/.91 kg ea.)	Mud 25
1 sk (40 lb/18.14 kg ea.)	Mud Seal
1 ct (10 lb/4.54 kg ea.)	PQ 460
1 pail (5 gal/18.93 l ea.)	HME Energizer
1 sk (50 lb/22.68 kg ea.)	Causticized lignite
2 sk (50 lb/22.68 kg ea.)	Cottonseed hulls
1 sk (50 lb/22.68 kg ea.)	Caustic soda
1 sk (50 lb/22.68 kg ea.)	Rayvan (Disperse)
1 sk (100 lb/45.36 kg ea.)	Soda ash

Deviation Tests

None taken

Geophysical Logs

Gamma	Resistivity
Density	Caliper
Self Potential	

Location: NE1/4NW1/4 sec. 23, T. 13 S., R. 13 W.
Total depth: 997 feet (304.09 m).
Spud date: June 22, 1978.
Completion date: June 27, 1978.
Rig: Failing Model CF-15 with 5 x 6 1/4 duplex pump, Boyles Bros. No. 4145.
Drill pipe size: 2-7/8 inch (7.30 cm) I.F. x 15 feet (4.58 m).
Drill collars: Total of four 3-3/4 inch (9.53 cm) x 15 feet (4.58 m).
Core barrel type and size: NCWL 10 feet (3.05 m) with bit size of 3-3/4 inch (9.53 cm) x 2-2/5 inch (6.10 cm).
Core interval: 987-997 feet (301.04-304.09 m).
Core recovery: 100%;
Sample interval(s): 10 feet (3.05 m), 0-987 feet (0-301.04 m).
Spot core taken from 987-997 feet (301-04-304.09).

Borehole History: An 8-1/4 inch (20.96 cm) hole was rotary drilled to 35 feet (10.68 m), 6-5/8 inch (16.83 cm) O.D. casing run and cemented bottom to top. Cementing of casing was necessary as surface material was mostly valley fill and very unconsolidated. Rotary drilling continued from 35 feet (10.68 m) with a 5-5/8 inch (14.29 cm) diameter hole to 987 feet (301.04 m). No significant drilling problems, other than minor lost circulation, were encountered during this interval.

At 987 feet (301.04 m) a core was cut to a depth of 997 feet (304.09 m) using a 10 foot (3.05 m) NCWL barrel with the 2-7/8 inch (7.30 cm) I.F. drill pipe. No conventional barrel was available, but good results were obtained with the NC wireline barrel.

The hole was drilled with fluid circulation from the surface to the final depth of 955 feet (291.28 m). The mud system consisted of two (2) earthen pits having a total capacity of 3,000 gallons (11,355 l). Initial loss of fluid from the pits was high due to seepage, but reduced as mud viscosity was brought up to drilling levels. Viscosity was held at 38 to 45 seconds, and weight held below 9 pounds per gallon (4.08 kg per 3.79 l). Some fine, lost circulation material was carried in the mud throughout the entire hole. Water loss to actual drilling was minimal. Approximate total usage was 20,000 gallons (75,700 l). The hole was logged to final depth, mud plugged, and a 20 foot (6.1 m) cement surface plug set.

Bit Record

Make	Type	Size	Footage
--	--	8-1/4 in. (20.96 cm)	0-35 ft (0-10.68 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	35-560 ft (10.68-170.8 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	560-680 ft (170.8-207.4 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	680-830 ft (207.4-253.15 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	830-987 ft (253.15-301.04 m)
Christensen	NC	3-3/4 in. (9.53 cm)	987-997 ft (301.04-304.09 m)

Consumables

Quantity	Material
113 sk (50 lb/22.68 kg ea.)	Mud 2
59 sk (2 lb/.91 kg ea.)	Mud 25
1 pail (5 gal/18.93 l ea.)	Air Quik
5 sk (100 lb/45.36 kg ea.)	Cal seal
1 sk (40 lb/18.14 kg ea.)	Mud seal
2 sk (50 lb/22.68 kg ea.)	Causticized lignite
5 sk (50 lb/22.68 kg ea.)	Caustic soda

Geophysical Logs

Gamma	Resisitivity	Density
Caliper	Spectral gamma-ray (KUT)	Self Potential
Neutron		

Location: SW1/4SW1/4 sec. 10, T. 13 S., R. 13 W.
Total depth: 1,014 feet (309.27 m).
Spud date: June 22, 1978.
Completion date: July 9, 1978.
Rig: Failing Model 2500 with 7-1/2 x 8 duplex pump, Boyles Bros. No. 860.
Drill pipe/drill rod size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.58 m).
Drill collars: Four 4-1/2 inch (11.43 cm) x 20 feet (6.1 m).
Core barrel type and size: NCWL 10 feet (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.10 cm) I.D.
Core interval: 800-810 feet (244 m -247.05 m); 1,010-1,014 feet (308.05 m-309.27 m).
Core Recovery: 95%.
Sample interval(s): 10 feet (3.05 m) samples, 0-1,014 feet (0-309.27 m); spot cores taken from 800-810 feet (244-247.05 m) and 1,010-1,014 feet (308.05-309.27 m).

Borehole History: Rig 860 moved to the location on June 22 and spudded the surface hole on June 24. A 7-7/8 inch (20 cm) diameter hole was rotary drilled to 42 feet (12.81 m) and 6-5/8 inch (16.83 cm) O.D. butt-welded casing set and cemented. Cementing of the surface casing was considered absolutely necessary because of the unconsolidated surface materials.

A 5-5/8 inch (14.29 cm) diameter hole was drilled from under the casing to 320 feet (97.6 m). At this depth, all circulation began coming back on the outside of the surface casing, which made further drilling effort useless.

The surface pipe was pulled, revealing that the bottom joint had broken at the weld and caused a massive wash-out near the surface. The lost joint of casing was successfully retrieved and the hole reamed to 7-7/8 inches (20 cm) diameter to 45 feet (13.73 m) and 6-5/8 inch (16.83 cm) O.D. casing set and thoroughly cemented, bottom to top.

A 5-5/8 inch (14.29 cm) hole was continued from 320 feet (97.6 m) to 800 feet (244 m). An NC core was pulled from 800 feet (244 m) to 810 feet (247.05 m) with 90 percent recovery. The hole was reamed out to 5-5/8 inches (14.29 cm) diameter from 800 feet (244 m) to 810 feet (247.05 m) and then rotary drilled to 1,010 feet (308.05 m). Another NC core was pulled from 1,010 feet (308.05 m) to 1,014 feet (309.27 m) with 100 percent recovery. No significant drilling problems occurred after the resetting of the surface casing, other than minor loss of circulation.

Water usage was very high due to seepage from the earthen mud pits. Plastic sheeting (4 mil Visqueen) was used to line the pits but was not as successful as hoped because of pit construction. The pits were much larger than actually needed but were constructed with the anticipation that total depth would be much greater than the final terminal depth of 1,014 feet (309.27 m).

Mud composition was primarily of gel with polymers and other additives used as required to stabilize the hole. Approximate total water usage was 60,000 gallons (227,100 l). Mud properties were checked daily, with weight kept to 9.2 pounds per gallon (4.17 kg per 3.79 l) or less and funnel viscosity at 40 to 45 seconds. Geophysical logging was run to 1,014 feet (309.27 m) and the hole completed. Final completion consisted of mud plugging and a 20 foot (6.1 m) cement surface plug.

Bit Record

Make	Type	Size	Footage
not avail.	med. form.	7-7/8 in. (20 cm)	0-45 ft (0-13.73 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	45-486 ft (13.73-148.23 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	486-616 ft (148.23-187.88 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	616-801 ft (187.88-244.31 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	801-1,010 ft (244.31-308.05 m)
Christensen	NC dia.	3-3/4 in. (9.53 cm)	800-810 ft (244-247.05 m)
			1,010-1,014 ft (308.05-309.27 m)

Mud Record

Quantity	Material
63 sk (50 lb/22.68 kg ea.)	Mud 2
60 sk (2 lb/.91 kg ea.)	Mud 25
1 sk (40 lb/18.14 kg ea.)	Mud Seal
5 sk (50 lb/22.68 kg ea.)	Caustic soda
10 sk (94 lb/42.64 kg ea.)	Portland cement
3 sk (100 lb/45.36 kg ea.)	Soda ash
3 sk (50 lb/22.68 kg ea.)	Causticized lignite

Geophysical Logs

Gamma	Resisitivity	Density
Caliper	Spectral gamma-ray (KUT)	Self Potential
Neutron		

Location: NW1/4SE1/4 sec. 13, T. 13 S., R. 13 W.
Total depth: 410 feet (124.97 m).
Spud date: June 29, 1978.
Completion date: June 30, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4146.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.58 m).
Sample Interval(s): 10 feet (3.05 m).

Borehole History: A 7-7/8 inch (20 cm) diameter hole was rotary drilled to a depth of 35 feet (10.67 m), and 6-5/8 inch (16.83 cm) O.D. casing set and cemented. A 5-5/8 inch (14.29 cm) diameter hole was continued to final depth of 410 feet (124.97 m). Complete circulation loss was encountered at 300 feet (91.44 m) but was regained in 2 hours with the use of cottonseed hulls and fibertex. No other significant drilling problems occurred after the initial circulation loss. Mud weight was kept to 9 pounds per gallon (4.08 kg per 3.79 l) or less and funnel viscosity at 39 to 45 seconds. Approximate total water usage was 8,000 gallons (30,280 l). Earthen pits were used, with an approximate total capacity of 6,000 gallons (22,710 l).

Final abandonment consisted of geophysical logging, mud plugging, and a 20 foot (6.1 m) cement surface plug.

Bit Record

Make	Type	Size	Footage
HTC (Rerun)	OSC	7-7/8 in. (20 cm)	0-35 ft (0-10.67 m)
Christensen	C-3	5-5/8 in.(14.29 cm)	35-335 ft (10.67-102.11 m)
Christensen	C-3	5-5/8 in.(14.29 cm)	335-410 ft (102.11-124.97 m)

Mud Record

Quantity	Material
10 sk (50 lb/22.68 kg ea.)	Mud 2
10 sk (50 lb/22.68 kg ea.)	Experimental Premix Mud
3 sk (100 lb/45.36 kg ea.)	Soda ash
2 sk (50 lb/22.68 kg ea.)	Rayvan (Disperse)
2 sk (50 lbs/22.68 kg ea.)	Causticized lignite
2 sk (50 lbs/22.68 kg ea.)	Cottonseed hulls
2 sk (50 lbs/22.68 kg ea.)	FiberTex (cane fiber)
3 sk (94 lbs/42.64 kg ea.)	Portland cement

Geophysical Logs

Caliper	SP
Spectral gamma-ray (KUT)	Self Potential

Location: NE1/4SE1/4 sec. 2, T. 13 S., R. 13 W.
Total depth: 1,460 feet (445.01 m).
Spud date: June 30, 1978.
Completion date: July 12, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4145.
Drill pipe/drill rod size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.58 m).
Core barrel type and size: NCWL 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Core recovery: 79%.
Sample interval(s): Every 10 feet (3.05 m).
Spot cores at 945-952 feet (288.04 m-290.17 m) and 1,365-1,369 feet (416.05 m-417.27 m).

Borehole History: The drill crews had difficulty in moving the rig onto this location because of loose sand and dust on the newly built access road.

SM-5 was rotary drilled to 18 feet (5.49 m) with a 7-7/8 inch (20 cm) rock bit, and 6-5/8 inch (16.83 cm) O.D. casing set and cemented. A 5-5/8 inch (14.29 cm) hole was continued to 230 feet (70.1 m) where a complete loss of circulation occurred. Circulation was regained in approximately 3 hours and the hole continued to 945 feet (288.04 m) with no drilling problems. A spot core was pulled from 945 feet (288.04 m) to 952 feet (290.17 m), using a NCWL barrel conventionally, with 4 feet (1.22 m) of core recovered.

The core hole was reamed to 5-5/8 inch (14.29 cm) and drilled to 1,365 feet (416.05 m). Another spot core was pulled from 1,365 feet (416.05 m) to 1,369 feet (417.27 m) with 4 foot (1.22 m) of core recovered. Because of bit gauge problems, the hole had to be reamed from 900 feet (274.32 m) to 1,369 feet (417.27 m) before drilling could be resumed. A 5-5/8 inch (14.29 cm) hole was continued to a final depth of 1,460 feet (445.01 m). Mud weight was kept below 9.5 pounds per gallon (4.31 kg per 3.79 l) and funnel viscosity between 39-45 seconds. Approximate total water usage was 20,000 gallons (75,700 l).

Earthen pits, having an approximate total capacity of 8,000 gallons (30,280 l) were used. Several thousand gallons of water were lost due to seepage from these pits. After drilling and logging operations were completed, the hole was mud plugged and a 20 foot (6.1 m) cement surface plug was set.

Bit Record

Make	Type	Size	Footage
not avail.	med. form.	7-7/8 in. (20 cm)	0-18 (0-5.49 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	18-490 ft (5.49-149.35 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	490-705 ft (149.35-214.88 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	705-1,035 ft (214.88-315.47 m)
Christensen	NCWL Face Discharge	3-3/4 in. (9.53 cm)	945-952 ft (288.04-290.17 m)
			1,365-1,369 ft (416.05-417.27 m)
Christensen	C-2	5-5/8 in.(14.29 cm)	1,035-1,185 ft (315.47-361.19 m)
Christensen	C-2	5-5/8 in.(14.29 cm)	1,185-1,365 ft (361.19-416.05 m)
Christensen	C-3	5-5/8 in.(14.29 cm)	1,365-1,460 ft (416.05-445.01 m)

Mud Record

Quantity	Material
71 sk (50 lb/22.68 kg ea.)	Mud 2
43 sk (2 lb/.91 kg ea.)	Mud 25
4 sk (50 lb/22.68 kg ea.)	Rayvan (Uisperse)
7 sk (50 lb/22.68 kg ea.)	Fiber cane
4 sk (50 lb/22.68 kg ea.)	Cottonseed hulls

Deviation Tests

Depth	Degree of Drift
385 ft (117.35 m)	1°
755 ft (230.12 m)	1°
1,075 ft (327.66 m)	1°
1,460 ft (445.01 m)	3°

Geophysical Logs

Gamma	Resisitivity	Density
Caliper	Spectral gamma-ray (KUT)	Self Potential
Neutron		

Location: NE1/4SW1/4 sec. 36, T. 12 S., R. 13 W.
Total depth: 947 feet (288.65 m).
Spud date: July 7, 1978.
Completion date: August 9, 1978.
Rig: Joy Model 22 with Bean 35 gpm (132.48 1 pm) pump, Boyles Bros. No. 886; replaced by a Longyear Model 44, Boyles Bros. 838.
Drill rod size: Boyles Bros. NCWL 3-1/2 inch (8.89 cm) O.D. used 0-600 feet (0-182.9 m). Boyles Bros. NXWL 2-7/8 inch (7.3 cm) O.D. used 600-947 feet (182.88-288.65 m).
Core barrel type and size: Boyles Bros. NCWL, 10 feet (3.05 m) in length, bit size 3-3/4 inch O.D. (9.53 cm) x 2-2/5 inch I.D. (6.1 cm) used 0-600 feet (0-182.88 m); NXWL, 10 feet (3.05 m) in length, bit size 3 inch O.D. (7.62 cm) x 1-7/8 inch I.D. (4.76 cm).
Core recovery: 88%.
Sample interval(s): Every 10 feet (3.05 m) 10-200 feet (3.05-60.96 m); Continuous core from 200-947 feet (60.96-288.65 m).

Borehole History: SM-6 was rotary drilled to 200 feet (60.96 m), using NC wireline drill rod with a 5-5/8 inch (14.29 cm) diameter rock bit. Partial circulation loss was encountered during this interval.

A firm casing seat was established at 200 feet (60.96 m), and 4 inch (10.16 cm) I.D. casing set and NCWL coring commenced. Coring proceeded normally until approximately 500 feet (152.4 m) at which time the drillers began experiencing frequent mislatch problems with the core barrel intertube. This problem persisted to 629 feet (191.72 m). At 629 feet (191.72 m), NX casing (3 inch or 7.78 cm) was set and NXWL 3 inch x 1-7/8 inch or (7.62 x 4.76 cm) coring began. Drilling was hampered by frequent mechanical breakdowns and fractured formations to 787 feet (239.83 m).

Because of the frequent breakdowns and lost time, Rig 886 was replaced by Rig 838 at this time. NXWL coring resumed with the drillers still having mislatch problems and encountering fractured formations to 947 feet (288.65 m). A crown was pulled off a new bit as drillers were washing to the bottom of the hole. Because of this junk in the hole and the deteriorating condition of the hole, no further efforts were made to continue coring. Some difficulty occurred in logging as the hole bridged over after coring was terminated. Several trips were made in an effort to clean and stabilize the hole. The deepest log obtained was 928 feet (282.85 m). A mud of 35-38 second viscosity was maintained with weight under 9 pounds per gallon (4.08 kg per 3.79 1). Earthen pits (two) were used, having an approximate total capacity of 7,500 gallons (28,387 1). Estimated total water usage was 100,000 gallons (378,500 1).

At the conclusion of logging operations all casing was retrieved from the hole. The hole was then mud plugged and a 20 foot (6.1 m) cement surface plug set.

Bit Record

Make	Type	Size	Footage
Christensen	C-3	5-5/8 in. (14.29 cm)	0-200 ft (0-60.96 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	200-360 ft (60.96-109.73 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	360-517 ft (109.73-157.58 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	517-541 ft (157.58-164.9 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	541-601 ft (164.9-183.18 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	601-618 ft (183.18-188.37 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	618-629 ft (188.37-191.72 m)
Christensen	NC	3-3/4 in. (9.53 cm)	No footage
Christensen	NXC3	3 in. (7.62 cm)	629-657 ft (191.72-200.25 m)
Christensen	NXC3	3 in. (7.62 cm)	657-687 ft (200.25-209.4 m)
Christensen	NXC3	3 in. (7.62 cm)	687-714 ft (209.4-217.63 m)
Christensen	NXC3	3 in. (7.62 cm)	714-753 ft (217.63-229.51 m)
Christensen	NX	3 in. (7.62 cm)	753-777 ft (229.51-236.83 m)
Christensen	NX	3 in. (7.62 cm)	777-787 ft (236.83-239.88 m)
Christensen	NXC3	3 in. (7.62 cm)	787-837 ft (239.88-255.12 m)
Christensen	NXC3	3 in. (7.62 cm)	837-947 ft (255.12-288.65 m)
Christensen	NX		No footage. Pulled crown off

Mud Record

Quantity	Material
333 sk (50 lb/22.7 kg ea.)	Mud 2
368 sk (2 lb/.91 kg ea.)	Mud 25
2 sk (50 lb/22.7 kg ea.)	Rayvan (Disperse)
4 sk (50 lb/22.7 kg ea.)	Causticized lignite
3 sk (40 lb/18.1 kg ea.)	Hy-Seal

Deviation Tests

Depth	Degree of Drift
400 ft (121.92 m)	3/4°
800 ft (243.84 m)	1-1/2°

Geophysical Logs

Caliper	Self Potential
Spectral gamma-ray (KUT)	Neutron

Location: SW1/4NW1/4 sec. 3, T.13 S., R. 11 W.
Total depth: 1,995 feet (608.08 m).
Spud date: July 5, 1978.
Completion date: September 13, 1978.
Rig(s): Failing Model CF-15, with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4146. Longyear Model 44 with 35 gpm (132.48 lpm) pump, Boyles Bros. No. 892.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Drill rod size: Boyles Bros. NCWL, 3-1/2 inch (8.80 cm) O.D. used 230-1,445 feet (70.1-440.44 m); Boyles Bros. NXWL, 2-7/8 inch (7.3 cm) O.D. used 1,445-1,995 feet (440.44-608.08 m).
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) in length with bit size of 3-3/4 inch O.D. (9.53 cm) x 2-2/5 inch I.D. (6.1 cm) used 0-1,445 feet (0-440.44 m); NXWL 10 feet (3.05 m) in length with bit size 3 inch O.D. (7.62 m) x 1-7/8 in. I.D. (4.76 cm) used 1,445-1,995 feet (440.44-608.08 m).
Core recovery: 98%.
Sample interval(s): Every 10 feet (3.05 m), 0-230 feet (0-70.1 m); Continuous core from 230-1,995 feet (70.1-608.08 m).

Borehole History: Rig 4146 moved on site and rotary drilled a 7-7/8 inch 20 cm) diameter hole to 20 feet (6.1 m);. 6-5/8 inch (16.83 cm) O.D. casing was then set and cemented. A 6 inch (15.24 cm) hole was drilled from under the casing using a down-hole hammer to 148 feet (45.11 m) where all circulation was lost. All efforts to regain circulation with air failed so drillers switched to mud in an attempt to seal off the fractures.

The hole was continued to 230 feet (70.1 m), drilling blind with no returns. At this time, the crew managed to pull the 20 feet (6.1 m) of surface casing and reamed the hole out to 7-7/8 inch (20 cm) diameter to 230 feet (70.1 m). An attempt was then made to set 6-5/8 inch (16.83 cm) O.D. casing to this depth but crooked hole conditions prevented this. In an effort to continue the hole, 4 inch (10.16 cm) I.D. casing was run to 230 feet (70.1 m) and rig 4146 moved off the hole to await the availability of a core rig. Rig 892 moved on the hole August 8, 1978 to continue coring. NCWL 3-3/4 x 2-2/5 inch (9.53 x 6.1 cm) coring began at 230 feet (70.1 m) and continued to 1,445 feet (440.44 m). All circulation was lost soon after drillers cored out from under the 4 inch (10.16 cm) I.D. casing, with intermittent partial returns during the NC coring interval.

The hole became somewhat unstable at the 1,000 foot (304.8 m) level, but was continued to 1,445 feet (440.44 m) with drillers experiencing tight hole conditions. At 1,445 feet (440.44 m) the hole was cased to NX 3 inch I.D. (7.78 cm) and NXWL 3 inch x 1-7/8 inch (7.62 x 4.76 cm) coring continued. Circulation was again lost soon after drilling out from under the casing. Efforts were made to regain circulation but drillers were only partially successful as returns were intermittent to the final depth. NXWL coring reached a final depth of 1,995 feet (608.08 m) with only minor drilling problems other than circulation loss.

At the conclusion of coring and logging operations, efforts were made to retrieve both the 4 inch (10.16 cm) I.D. casing and the NX 3 inch (7.78 cm) casing. All 230 feet (70.1 m) of 4 inch (10.16 cm) casing was pulled but NX 3 inch 7.78 cm) casing was stuck and had to be cut, leaving 445 feet (135.64 m) in the hole. Final abandonment consisted of mud plugging and setting a 20 foot (6.1 m) cement surface plug. Earthen pits, with plastic liners (Visqueen, 4 mil) were used. Approximate capacity of the pits was 8,000 gallons (30,280 l). Drilling mud viscosity was kept at 32-38 seconds and weight under 8.5 pounds per gallon (3.86 kg per 3.79 l). Total water usage was approximately 140,000 gallons, (529,900 l).

Bit Record

Make	Type	Size	Footage
HTC (Rerun)	--	7-7/8 in. (20 cm)	0-20 ft (0-6.1 m)
		Reaming	20-230 ft (6.1-70.1 m)
Mission	Button Hammer Bit	6 in. (15.24 cm)	20-160 ft (6.1-48.77 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	160-230 ft (48.77-70.1 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	230-481 ft (70.1-146.61 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	481-1,005 ft (146.61-306.32 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	1,005-1,347 ft (306.32-410.57 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	1,347-1,365 ft (410.57-416.05 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	1,365-1,445 ft (416.05-440.44 m)
Christensen	NXC3	3 in. oversize (7.7 cm)	1,445-1,625 ft (440.44-495.30 m)
Christensen	NXC3	3 in. (7.62 cm)	1,625-1,940 ft (495.3-591.31 m)
Christensen	NXC3	3 in. (7.62 cm)	1,940-1,995 ft (591.31-608.08 m)

Mud Record

Quantity	Material
441 sk (50 lb/22.7 kg ea.)	Mud 2
272 sk (2 lb/.9 kg ea.)	Mud 25
4 sk (40 lb/18.1 kg ea.)	Rayvan (Disperse)
4 sk (100 lb/45.36 kg ea.)	Soda ash
17 sk (94 lb/42.64 kg ea.)	Portland cement
16 sk (50 lb/22.7 kg ea.)	Causticized lignite
3 sk (40 lb/18.1 kg ea.)	Mud Seal
6 sk (50 lb/22.7 kg ea.)	FiberTex
21 sk (50 lb/22.7 kg ea.)	Cottonseed hulls
4 pails (5 gal/18.93 l ea.)	HME Energizer
4 ct. (10 lb/4.5 kg ea.)	PQ 460
1 sk (50 lb/22.7 kg ea.)	Caustic soda

Deviation Tests

Depth	Degree of Drift
400 ft (121.92 m)	2°
800 ft (243.84 m)	4°
1,200 ft (365.76 m)	4°
1,600 ft (487.68 m)	4°
1,980 ft (603.5 m)	6°

Geophysical Logs

Gamma	Density
Resistivity	Caliper
Self Potential	

Location: NE1/4SW1/4 sec. 21, T. 12 S., R. 11 W.
Total depth: 2,003 feet (610.51 m).
Spud date: July 9, 1978.
Completion date: August 8, 1978.
Rig: Longyear Model 44 with 35 gpm (132.48 lpm) Bean pump, Boyles Bros. No. 892.
Drill rod size: Boyles Bros. NCWL 3-1/2 inch (8.89 cm) O.D. used 0-1,170 feet (0-356.62 m); Boyles Bros. NXWL, 2-7/8 inch (7.3 cm) O.D. used 1,170-2,003 feet (356.62-610.51 m).
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D. used 0-1,170 feet (0-356.62 m); Boyles Bros. NXWL, 10 foot (3.05 m) with bit size of 3 inch (7.62 cm) O.D. x 1-7/8 inch (4.76 cm) I.D. used 1,170-2,003 feet (356.62-610.51 m).
Core recovery: 99%.
Sample interval(s): Continuous core from 40-2,003 feet (12.19-610.51 m).

Borehole History: SM-8 was rotary drilled to 40 feet (12.19 m) using a 5-5/8 inch (14.29 cm) rock bit on NCWL 3-1/2 inch (8.89 cm) drill rod. A four inch (10.16 cm) I.D. casing was then set and NCWL 3-3/4 x 2-2/5 inch (9.52 x 6.1 cm) coring began.

All circulation was lost at 197 feet (60.05 m) and efforts to regain circulation were unsuccessful. Drillers continued coring ahead with good penetration until drill rod vibration began at 425 feet (129.54 m). Drillers lubricated tools, raised the mud viscosity, lowered bit RPM, and continued coring to 1,170 feet (356.62 m). Because of some tight hole problems and complete loss of circulation, a decision was made to case the hole at 1,170 feet (356.62 m) with NX 3 inch (7.78 cm) I.D. casing and begin coring NXWL 3 x 1-7/8 inch (7.62 x 4.76 cm). NXWL coring proceeded to a final depth of 2,003 feet (610.51 m) with a partial loss of circulation but a minimum of other drilling difficulties. Some time was lost however, due to mechanical breakdowns. At the conclusion of drilling and logging operations, efforts were made to pull the casing. The NX 3 inch (7.78 cm) casing was stuck and had to be cut twice which resulted in leaving 620 feet (188.98 m) of NX 3 inch (7.78 cm) casing in the hole along with the 40 feet (12.19 m) of 4 inch (10.16 cm) I.D. surface casing.

Earthen pits, lined with plastic (Visqueen, 4 mil), were used and had an approximate total capacity of 6,000 gallons (22,710 l). Mud weight was kept below 9 pounds (4.08 kg per 3.79 l) and funnel viscosity at 35 to 42 seconds. Final abandonment consisted of mud plugging and setting a 20 foot (6.1 m) cement surface plug.

Mud Record

Make	Type	Size	Footage
Christensen (rerun)	C-2 RB	5-5/8 in. (14.29 cm)	0-40 ft (0-12.19 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	40-114 ft (12.19-34.75 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	114-441 ft (34.75-134.42 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	441-521 ft (134.42-158.8 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	521-833 ft (158.8-253.9 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	833-994 ft (253.9-302.97 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	994-1,170 ft (302.97-356.62 m)
Christensen	NXC3	3 - in. (7.62 cm)	1,170-1,500 ft (356.62-457.2 m)
Christensen	NXC3	3 - in. (7.62 cm)	1,500-1,611 ft (457.2-491.03 m)
Christensen	NXC3	3 in. O.S. (7.7 cm)	1,611-1,945 ft (491.03-592.84 m)
Christensen	NXC3	3 in. O.S. (7.7 cm)	1,945-2,003 ft (592.84-610.51 m)

Mud Record

Quantity	Material
379 sk (50 lb/22.7 kg ea.)	Mud 2
221 sk (2 lb/.9 kg ea.)	Mud 25
16 sk (50 lb/22.7 kg ea.)	Caustic soda
6 sk (100 lb/45.36 kg ea.)	Soda ash
9 sk (50 lb/22.7 kg ea.)	Causticized lignite
1 sk (40 lb/18.1 kg ea.)	Mud Seal
1 ct (10 lb/4.54 kg ea.)	PQ460
1 pail (5 gal/18.93 l ea.)	HME Energizer
3 cans (5 gal/18.93 l ea.)	Drill rod lubricant

Deviation Tests

Depth	Degree of Drift
400 ft (121.92 m)	3/4°
800 ft (243.84 m)	1°
1,200 ft (365.76 m)	1-3/4°
1,600 ft (487.68 m)	1/2°

Geophysical Logs

Gamma	Resisitivity	Density
Caliper	Spectral gamma-ray (KUT)	Self Potential
Neutron		

Location: NW1/4NE1/4 sec. 23, T. 12 S., R. 1 W.
Total depth: 756 feet (230.43 m).
Spud date: July 13, 1978.
Completion date: July 25, 1978.
Rig: Failing Model 2500 with 7-1/2 x 8 duplex pump, Boyles Bros. No. 860.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Drill collar size: 4-1/2 inch (11.43 cm) x 20 feet (6.1 m), quantity of 4.
Sample interval(s): Every 10 feet (3.05 m).

Borehole History: Rig 860 moved on site July 11, 1978 and began rigging up and spudded the surface hole on July 13, 1978. A 8-3/4 inch (22.23 cm) diamter hole was rotary drilled 300 feet (91.44 m) and then 6-5/8 inch (16.83 cm) O.D. casing was set and cemented. Drillers experienced caving of the hole during this interval. The primary cause of this seemed to be poor quality mud and insufficient mud make up before and during drilling.

A 5-5/8 inch (14.29 cm) diameter hole was drilled out from under the casing. All circulation was lost at 405 feet (123.44 m). Partial circulation was restored and the hole drilled ahead to 522 feet (159.11 m) where a complete loss occurred again.

After considerable time, material, and effort, partial circulation was restored. At 612 feet (186.54 m) a total loss occurred again. Partial circulation was restored and the hole drilled ahead to 756 feet (230.43 m) where all circulation was lost once more. All efforts to regain circulation were unsuccessful. After approximately 36 hours of effort with no progress, the hole was logged and a 20 foot (6.1 m) cement surface plug set.

Mud properties were quite erratic during the drilling. Mud weight was generally kept below 10 pounds per gallon (4.54 kg per 3.79 l) and viscosity varied from 30 to 70 seconds. Earthen pits, lined with plastic sheeting (Visqueen, 4 mil), were used but improper lining limited their holding capacity. Total approximate capacity of the pits was 18,000 gallons (63,130 l).

Bit Record

Make	Type	Size	Footage
HTC	OSC	8-3/4 in. (2.23 cm)	0-300 ft (0-91.44 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	300-582 ft (91.44-177.39 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	582-756 ft (177.39-230.43 m)

Mud Record

Quantity	Material
367 sk (50 lb/22.7 kg ea.)	Mud 2
54 sk (2 lb/.9 kg ea.)	Mud 25
8 sk (50 lb/22.7 kg ea.)	Caustic soda
1 sk (50 lb/22.7 kg ea.)	Causticized lignite
50 sk (94 lb/42.64 kg ea.)	Portland cement
2 sk (80 lb/36.29 kg ea.)	Calcium chloride
57 sk (50 lb/22.7 kg ea.)	Fibertex
30 sk (40 lb/18.1 kg ea.)	Cedar Fiber
3 sk (50 lb/22.7 kg ea.)	Cottonseed hulls
1 sk (100 lb/45.36 kg ea.)	Soda ash

Deviation Tests

Depth	Degree of Drift
400 ft (121.92 m)	3/4°

Geophysical Logs

Gamma	Resistivity	Density
Caliper	Self Potential	Neutron
Spectral gamma-ray (KUT)		

Location: SW1/4NW1/4 sec. 33, T. 12 S., R. 11 W.
Total depth: 1,613 feet (491.64 m).
Spud date: July 12, 1978.
Completion date: August 7, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4146.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Drill rod size: Boyles Bros. NCWL, 3-1/2 inch (8.80 cm) O.D.
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 cm) with bit size of 3-3/4 inch (9.53 cm) x 2-2/5 inch (6.1 cm) I.D.
Core recovery: 95%.
Sample interval(s): Every 10 feet (3.05 m) 0-1,278 feet (0-389.53 m); spot core 485-494 feet (147.83-150.57 m), 920-930 feet (280.42-283.46 m); continuous core 1,278-1,613 feet (389.53-491.64 m).

Borehole History: SM-10 was rotary drilled 7-7/8 inch (20 cm) diameter to 18 feet (5.49 m). A 6-5/8 inch (16.83 cm) O.D. casing was then set and cemented. There was some delay before drilling resumed because of insufficient material on site and an intervening break period.

Drillers drilled out from under the casing with a 6 inch (15.24 cm) tri-cone button bit to 110 feet (33.53 m). A 5-5/8 inch (14.29 cm) diameter hole was continued, with slow progress until adequate bit weight was attained. A spot core was pulled from 485-494 feet (147.83-150.57 m) with good recovery. The core hole was reamed out to 5-5/8 inch (14.29 cm) and drilled ahead to 920 feet (280.42 m) where another spot core was pulled from 920-930 feet (280.42-283.46 m) with good recovery. Some circulation loss occurred from 600 to 800 feet (182.88-243.84 m). The core hole was reamed to 5-5/8 inch (14.29 cm) and drilling continued to 1,263 feet (384.96 m) where drillers hit a void. The drill string was lowered to 1,271 feeet (387.4 m) before encountering formation. All circulation was lost at this time and could not be restored. The hole was drilled blind to 1,278 feet (389.53 m) and a decision was made to case the hole with 4 inch (10.16 cm) I.D. casing and continuous core the remainder of the hole. Rig 4146 was equipped for wireline coring so remained on the hole to continue with coring. After the 4 inch (10.16 cm) I.D. casing was set to 1,278 feet (389.53 m), NCWL 3-3/4 x 2-2/5 inch (9.53 x 6.1 cm) coring began and continued to a final depth of 1,613 feet (491.64 m). Drillers experienced numerous problems in their coring, such as plugged drill rods, stuck innertubes, broken wireline, mislatches, rig breakdown and belled tools. Continued loss of circulation also hampered coring efforts. After completion of coring and logging operations, the 4 inch (10.16 cm) casing was pulled. Casing was stuck and had to be cut, resulting in 1,220 feet (371.86 m) of casing being salvaged. After the casing was pulled, the hole was mud plugged and a 20 foot (6.1 m) cement surface plug set.

Earthen pits, with plastic sheet liners (Visqueen, 4 mil), were used. Total approximate capacity was 8,000 gallons (30,280 l). A 2,000 gallon (7,570 l) steel reserve tank was also on site for storage. Mud properties varied from shift to shift but weight was less than 10.5 pounds per gallon (4.76 kg per 3.79 l) and viscosity varied from 35 to 45 seconds. A Bean 35 gpm (132.48 lpm) triplex pump was used during the coring phase of the hole. Approximate total water usage was 80,000 gallons (302,800 l).

Make	Type	Size	Footage
HTC (Rerun)	OSC	7-7/8 in. (20 cm)	0-18 ft (0-5.49 m)
HTC	J33	6 in. (15.24 cm)	18-110 ft (5.49-33 .53 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	110-140 ft (33.53-42.67 m)
Varel	VH-1	5-5/8 in. (14.29 cm)	140-155 ft (42.67-47.24 m)
Varel	VH-1	5-5/8 in. (14.29 cm)	155-215 ft (47.24-65.53 m)
Christensen	C-1T	5-5/8 in. (14.29 cm)	215-290 ft (65.53-88.39 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	290-410 ft (88.39-124.97 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	410-575 ft (124.97-175.26 m)
Christensen	NC	3 3/4 in. (9.53 cm)	485-494 ft (147.83-150.57 m)
		Face Discharge	920-930 ft (280.42-283.46 m)
			1,278-1,613 ft (389.53-491.64 m)
Christensen	C-1T	5-5/8 in. (14.29 cm)	575-800 ft (175.26-243.84 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	800-920 ft (243.84-280.42 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	920-1,130 ft (280.42-344.42 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	1,130-1,278 ft (344.42-389.53 m)

Mud Record

Quantity	Material
173 sk (50 lb/22.7 kg ea.)	Mud 2
103 sk (2 lb/.9 kg ea.)	Mud 25
4 sk (94 lb/42.64 kg ea.)	Portland cement
1 sk (50 lb/22.7 kg ea.)	Premix Mud
2 sk (50 lb/22.7 kg ea.)	Caustic soda
2 sk (100 lb/45.36 kg ea.)	Soda ash
6 sk (50 lb/22.7 kg ea.)	Causticized lignite
2 sk (40 lb/18.1 kg ea.)	Cedar Fiber
2 sk (50 lb/22.7 kg ea.)	Cottonseed hulls
1 sk (40 lb/18.1 kg ea.)	Hy Seal
1 sk (50 lb/22.7 kg ea.)	Fibertex
1 sk (50 lb/22.7 kg ea.)	Rayvan (Disperse)
3 pails (5 gal/18.93 l)	Drill rod lubricant

Deviation Tests

Depth	Degree of Drift
800 ft (243.84 m)	1°
1,200 ft (365.76 m)	1-3/4°

Geophysical Logs

Gamma	Density	Resistivity
Caliper	Spectral gamma-ray (KUT)	Self Potential
Neutron		

SM-11

Location: NE1/4SW1/4 sec. 3, T. 12 S., R. 13 W.
Total depth: 985 feet (300.23 m).
Spud date: July 19, 1978.
Completion date: July 23, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4238.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Sample interval(s): Every 10 feet (3.05 m).

Borehole History: SM-11 was rotary drilled to 48 feet (14.63 m) with a 7-7/8 inch (20 cm) rock bit, 48 feet (14.63 m) of 6-5/8 inch (16.83 cm) O.D. casing set and cemented.

A 5-5/8 inch (14.29 cm) diameter hole was drilled out from under the casing and continued to 985 feet (300.23 m). Some caving of the hole occurred at approximately 400 feet (121.92 m). Drillers had some loss of circulation at 440 feet (134.11 m) but were able to restore full circulation and continue drilling ahead. Mud viscosity was at 35 to 37 seconds at this time.

The mud pump went down at 985 feet (300.23 m). The hole was logged while the rig was down waiting on parts for the mud pump. A considerable amount of time was lost during this breakdown (36 hours); as a result drillers were unable to proceed because of deterioration of the hole. Not being able to reach the project depth of 1,500 feet (457.2 m), the hole was mud plugged as far as possible and a 20 foot (6.1 m) cement surface plug set.

Earthen pits, with plastic liners (Visqueen, 4 mil), were used. Total capacity was approximately 8,000 gallons (30,280 l). Mud weight was less than 9.5 pounds per gallon (4.31 kg per 3.79 l) and funnel viscosity was 35 to 40 seconds. Total water usage was approximately 30,000 gallons (113,550 l). The access road to this hole was extremely loose and sandy, making travel in and out very difficult.

Bit Record

Make	Type	Size	Footage
Varel	V-2	7-7/8 in. (20 cm)	0-48 ft (0-14.63 m
Christensen	C-3	5-5/8 in. (14.29 cm)	48-260 ft (14.63-79.25 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	260-395 ft (79.25-120.4 m)
Varel	VH-1	5-5/8 in. (14.29 cm)	395-500 ft (120.4-152.4 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	500-665 ft (152.4-202.69 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	665-830 ft (202.69-252.98 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	830-985 ft (252.98-300.23 m)

Deviation Tests

Quantity	Material
74 sk (50 lb/22.7 kg ea.)	Mud 2
47 sk (2 lb/.9 kg ea.)	Mud 25
3 sk (50 lb/22.7 kg ea.)	Caustic soda
2 sk (100 lb/45.36 kg ea.)	Soda
2 sk (50 lb/22.7 kg ea.)	Rayvan (Disperse)
8 sk (100/lb/45.36 kg ea.)	Calseal
1 ct (10 lb/4.54 kg ea.)	PQ 460
2 sk (50 lb/22.7 kg ea.)	Fibertex

Deviation Tests

Depth	Degree of Drift
410 ft (124.97 m)	1-3 4°
815 ft (248.41 m)	2°

Geophysical Logs

Gamma Density Resistivity

SM-12

Location: NE1/4NW1/4 sec. 16, T.12 S., R. 12 W.
Total depth: 500 feet (152.4 m).
Spud date: July 25, 1978
Completion date: August 2, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4238.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Core barrel type and size: NCWL 10 foot (3.05 cm) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Core recovery: 100%.
Sample interval(s): Every 10 feet (3.05 m); spot core 262-267 feet (79.86-81.38 m).

Borehole History: SM-12 was rotary drilled to 18 feet (5.49 m) with a 7-7/8 inch (20 cm) diameter rock bit. A 6-5/8 inch (16.83 cm) O.D. casing was then set and cemented.

A 5-5/8 inch (14.29 cm) diameter hole was drilled out from under the surface casing and continued to 262 feet (79.86 m). A spot core was pulled from 262-267 feet (79.86-81.38 m) with excellent recovery. The core hole was then reamed out and drilled to a final depth of 500 feet (152.4 m) with little difficulty.

Earthen pits, with plastic liners (Visqueen, 4 mil) were used. Total approximate capacity of the pits was 8,000 gallons (30,280 l). Mud weight was kept to less than 9 pounds per gallons (4.08 kg per 3.79 l) and funnel viscosity at 35 to 37 seconds. Approximate total water usage was 7,000 gallons (26,495 l).

After drilling and logging operations were completed, the hole was mud plugged and a 20 foot (6.1 m) cement surface plug set.

Bit Record

Make	Type	Size	Footage
Varel	V-2	7-7/8 in. (20 cm)	0-18 ft (0-5.49 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	18-262 ft(5.49-79.86 m)
Christensen	NCD	3-3/4 in. (14.29 cm)	262-267 ft (79.86-81.38 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	267-335 ft (79.86-102.11 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	335-500 ft (102.11-152.4 m)

Mud Record

Quantity	Material
51 sk (50 lb/22.7 kg ea.)	Mud 2
24 sk (2 lb/.9 kg ea.)	Mud 25
1 sk (50 lb/22.7 kg ea.)	Caustic soda
1 sk (100 lb/45.36 kg ea.)	Soda ash
4 sk (94 lb/42.64 kg ea.)	Portland cement
1 sk (50 lb/22.7 kg ea.)	Rayvan (Disperse)
2 sk (50 lb/22.7 kg ea.)	Cottonseed hulls

Deviation Tests

Depth	Degree of Drift
410 ft (124.97 m)	4°

Geophysical Logs

Gamma Density Resistivity

Location: SE1/4NE1/4 sec. 17, T. 12 S., R. 11 W.
Total depth: 2,525 feet (769.62 m).
Spud date: July 28, 1978.
Completion date: August 26, 1978.
Rig: Failing Model 2500 with 7-1/2 x 8 duplex pump, Boyles Bros. No. 860.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Drill collars: 12 total, 4-1/2 inch (11.43 cm) x 20 feet (6.1 m).
Sample interval(s): Every 10 feet (3.05 m).

Borehole History: SM-13 was rotary drilled to 126 feet (38.4 m) using an 8-1/2 inch (21.59 cm) rock bit. A 6-5/8 inch (16.83 cm) O.D. casing was then set and cemented, bottom to top, in hole annulus. A 5-5/8 inch (14.29 cm) diameter hole was drilled out from under the casing and continued to a final depth of 2,525 ft (769.62 m).

A complete loss of circulation occurred at 144 feet (43.89 m), 214 feet (65.23 m), and 1,260 feet (384.05 m). Drillers were successful in restoring circulation on each occurrence. Circulation loss also occurred on several trips; this was primarily due to bit gauge and tool handling problems.

Drilling proceeded very slowly from the surface to 900 feet (274.32 m). Additional drill collars were added to the drill string to achieve the optimum bit weight and drilling progress did improve to some extent. At the conclusion of drilling, the hole was logged to 2,520 feet (768.1 m), mud plugged and a 20 foot (6.1 m) cement surface plug set.

Earthen pits, with plastic liners (Visqueen, 4 mil), were used. Two pits were used for drilling and a third pit was used for reserve. Approximate total capacity was 20,000 gallons (75, 700 l).

Mud weight was less than 9 pounds per gallon (4.08 kg per 3.79 l) and funnel viscosity varied from 38 to 55 seconds. Approximate total water usage was 300,000 gallons (1,135,500 l).

Bit Record

Make	Type	Size	Footage
HTC	OSC	8-1/2 in. (21.59 cm)	0-126 ft (0-38.4 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	126-315 ft (38.4-96.01 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	315-400 ft (96.01-121.92 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	400-407 ft (121.92-124.05 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	407-506 ft (124.05-154.23 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	506-610 ft (154.23-185.93 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	610-705 ft (185.93-214.88 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	705-753 ft (214.88-229.51 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	753-786 ft (229.51-239.57 m)

Christensen	C-1	5-5/8 in. (14.29 cm)	786-802 ft (239.57-244.45 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	802-1,025 ft (244.45-312.42 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,025-1,109 ft (312.42-338.02 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,109-1,275 ft (338.02-388.62 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,275-1,385 ft (388.62-422.15 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,385-1,490 ft (422.15-454.15 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	1,490-1,530 ft (454.15-466.34 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,530-1,565 ft (466.34-477.01 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,565-1,665 ft (477.01-507.49 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,665-1,830 ft (507.49-557.78 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,830-1,914 ft (557.78-583.39 m)
Christensen	C-1T	5-5/8 in. (14.29 cm)	1,914-2,027 ft (583.39-617.83 m)
Christensen	C-1T	5-5/8 in. (14.29 cm)	2,027-2,150 ft (617.83-655.32 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	2,150-2,285 ft (655.32-696.47 m)
Christensen	C-1T	5-5/8 in. (14.29 cm)	2,285-2,415 ft (696.47-736.09 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	2,415-2,525 ft (736.09-769.62 m)

Mud Record

Quantity	Material
557 sk (50 lb/22.7 kg ea.)	Mud 2
24 sk (50 lb/22.7 kg ea.)	Rayvan (Disperse)
21 sk (50 lb.22.7 kg ea.)	Caustic soda
2 sk (100 lb/45.36 kg ea.)	Soda ash
1 sk (80 lb/36.29 kg ea.)	Calcium chloride
21 sk (94 lb/42.64 kg ea.)	Portland cement
96 sk (50 lb/22.7 kg ea.)	Fibertex
4 sk (50 lb/22.7 kg ea.)	Hay cubes
39 sk (40 lb/18.1 kg ea.)	Cedar fiber
2 sk (50 lb/22.7 kg ea.)	Kwik Seal
14 sk (50 lb/22.7 kg ea.)	Causticized lignite
19 sk (40 lb/18.1 kg ea.)	Hy-Seal
21 sk (50 lb/22.7 kg ea.)	Cottonseed hulls
2 pails (5 gal/18.93 l ea.)	Formaldehyde

Deviation Tests

Depth	Degree of Drift
400 ft (121.92 m)	1°
800 ft (243.84 m)	1°
1,200 ft (365.76 m)	1-3/4°
1,600 ft (487.68 m)	1-3/4°
2,400 ft (731.52 m)	1°

Geophysical Logs

Gamma	Density	Resistivity
Caliper	Spectral gamma-ray (KUT)	Self Potential
Neutron		

Location NW1/4NW1/4 sec. 26, T. 12 S., R. 12 W.
Total depth: 502 feet (153.01 m).
Spud date: August 3, 1978.
Completion date: August 5, 1978.
Rig: Failing Model CF-14 with 5 x 6-1/2 duplex pump, Boyles Bros. No. 4238.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Sample interval(s): Every 10 feet (3.05 m).

Borehole History: SM-14 was rotary drilled to 18 feet (5.49 m) with a 7-7/8 inch (20 cm) rock bit and 6-5/8 inch (16.83 cm) O.D. casing set and cemented. A 5-5/8 inch (14.29 cm) diamter hole was drilled out from under the casing to a final depth of 502 feet (153.01 m).

All circulation was lost at 402 feet (122.53 m) but was regained after 14 hours of effort. No other significant problems occurred during the drilling operations.

No mud properties were recorded during the drilling operations on this hole. Earthen pits, with plastic liners (Visqueen, 4 mil), were used. Approximate total capacity of the pits was 6,000 gallons (22,710 l). Approximate total water usage was 12,000 gallons (45,420 l).

The hole was logged, mud plugged and a 20 foot (6.1 m) cement surface plug set.

Bit Record

Make	Type	Size	Footage
Varel (Rerun)	V-2	7-7/8 in. (20 cm)	0-18 ft (0-5.49 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	18-405 ft (5.49-123.44 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	405-502 ft (123.44-153.01 m)

Mud Record

Quantity	Material
77 sk (50 lb/22.7 kg ea.)	Mud 2
28 sk (2 lb/.9 kg ea.)	Mud 25
2 sk (50 lb/22.7 kg ea.)	Rayvan (Disperse)
3 sk (94 lb/42.64 kg ea.)	Portland cement
1 sk (80 lb/36.29 kg ea.)	Calcium chloride
1 sk (50 lb/22.7 kg ea.)	Caustic soda
5 sk (50 lb/22.7 kg ea.)	Fiber cane
7 sk (50 lb/22.7 kg ea.)	Cottonseed hulls

Deviation Tests

Depth	Degree of Drift
470 ft (143.26 m)	3°

Geophysical Logs

Gamma	Density	Resistivity
Caliper	Self Potential	Neutron
Spectral gamma-ray (KUT)		

Location SE1/4SW1/4 sec. 14, T. 12 S., R. 12 W.
Total depth: 737 feet (224.64 m).
Spud date: August 5, 1978
Completion date: August 8, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4238.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Core recovery: 100%.
Sample interval(s): Every 10 feet (3.05 m); spot cores 68-77 feet (20.73-23.47 m), 440-450 feet (134.11-137.16 m).

Borehole History: SM-15 was rotary drilled to 15 feet (4.57 m) with a 7-7/8 inch (20 cm) diameter rock bit, and 6-5/8 inch (16.83 cm) O.D. casing set and cemented.

A 5-5/8 inch (14.29 cm) diameter hole was drilled to 68 feet (20.73 m). A spot core was then pulled from 68-77 feet (20.73-23.47 m) with excellent recovery. The core hole was reamed to 5-5/8 inch (14.29 mm) and drilled ahead to 440 feet (134.11 m) where another spot core was taken from 440-450 feet (134.11-137.16 m) with excellent recovery. The core hole was reamed out to 5-5/8 inch (14.29 cm) and drilled ahead to 737 feet (224.64 m) where drillers lost a cone off the bit. Due to unsuccessful fishing operations and a mechanical breakdown, the hole was terminated at a final depth of 737 feet (224.64 m) with no significant drilling problems other than the lost cone.

Earthen pits, with plastic liners (Visqueen, 4 mil), were used. Approximate total capacity was 6,000 gallons (22,710 l).

Mud weight was 9.5 pounds per gallon (4.31 kg per 3.79 l) or less and funnel viscosity at 35 to 40 seconds. Approximate total water usage was 13,000 gallons (49,205 l). After logging operations were completed, the hole was mud plugged and a 20 foot (6.1 m) cement surface plug set.

Bit Record

Make	Type	Size	Footage
Varel	V-2	7-7/8 in. (20 cm)	0-15 ft (0-4.57 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	15-440 ft (4.57-134.11 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	440-675 ft (134.11-205.74 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	68-77 ft (20.73-23.47 m)
			440-450 ft (134. 11-137.16 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	675-737 ft (205.74-224.64 m)

Mud Record

Quantity	Material
31 sk (50 lb/22.7 kg ea.)	Mud 2
15 sk (2 lb/0.9 kg ea.)	Mud 25
1 sk (50 lb/22.7 kg ea.)	Rayvan (Disperse)
2 sk (94 lb/42.64 kg ea.)	Portland cement
1 sk (50 lb/22.7 kg ea.)	Caustic soda
1 sk (100 lb/45.36 kg ea.)	Soda ash
1 sk (100 lb/45.36 kg ea.)	Bicarbonate of soda
1 pail (5 gal/18.93 l ea.)	ConDet

Deviation Tests

Depth	Degree of Drift
400 ft (121.92 m)	3/4°

Geophysical Logs

Caliper	Spectral gamma-ray (KUT)	Self Potential
Neutron		

Location: NW1/4SE1/4 sec. 26, T. 12 S., R. 12 W.
Total depth: 370 feet (112.78 m).
Spud date: August 9, 1978.
Completion date: August 15, 1978.
Rig: Failing Model CF-14 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4238.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Sample interval(s): Every 10 feet (3.05 m).

Borehole History: SM-16 was rotary drilled to 8 feet (2.44 m) with a 7-7/8 inch (20 cm) diameter rock bit, and 6-5/8 inch (16.83 cm) O.D. casing set and cemented. A 5-5/8 inch (14.29 cm) diameter hole was drilled from under the casing to the final depth of 370 feet (112.78 m).

Drilling progress was hampered somewhat by bit gauge problems from 160 feet (48.77 m) to the final depth which resulted in an abnormal amount of reaming on each bit change. Drillers also had some difficulty in making connections because of the under gauge problem and crooked hole conditions.

Earthen pits, with plastic liners (Visqueen, 4 mil), were used. Approximate total capacity was 4,000 gallons (15,140 l).

Mud weight was kept at 9 pounds per gallons (4.08 kg per 3.79 l) or less and funnel viscosity at 34 to 38 seconds. Approximate total water usage was 6,000 gallons (22,710 l).

After logging was completed, the hole was mud plugged and a 20 foot (6.1 m) cement surface plug set.

Bit Record

Make	Type	Size	Footage
Varel	V-1	7-7/8 in. (20 cm)	0-8 ft (0-2.44 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	8-125 ft (2.44-38.1 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	125-168 ft (38.1-51.21 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	168-190 ft (51.21-57.91 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	190-210 ft (57.91-64.01 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	210-233 ft (64.01-71.02 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	233-260 ft (71.02-79.25 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	260-305 ft (79.25-92.96 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	305-325 ft (92.96-99.06 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	325-350 ft (99.06-106.68 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	350-370 ft (106.68-112.78 m)

Mud Record

Quantity	Material
21 sk (50 lb/22.7 kg ea.)	Mud 2
9 sk (2 lb/0.9 kg ea.)	Mud 25
1 sk (50 lb/22.7 kg ea.)	Caustic soda
3 sk (50 lb/22.7 kg ea.)	Rayvan (Disperse)
1 sk (50 lb/22.7 kg ea.)	Cottonseed hulls

Geophysical Logs

Caliper	Spectral gamma-ray (KUT)	Self Potential
Neutron		

Location: NE14/NW1/4 sec. 30, T. 12 S., R. 11 W.
Total depth: 995 feet (303.28 m).
Spud date: August 8, 1978.
Completion date: September 11, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4146. Longyear Model 44 with Bean 35 gpm (132.48 lpm) pump, Boyles Bros. No. 838.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Drill rod size: Boyles Bros. NCWL, 3-1/2 inch (8.89 cm) O.D.
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Core recovery: 80%.
Sample interval(s): Every 10 feet (3.05 m), 0-883 feet (0-269.14 m); spot core 200-211 feet (60.96-64.31 m), 400-406 feet (121.92 - 123.75 m), 600-604 feet (182.88 - 184.1 m); continuous core, 883-995 feet (269.14-303.28 m).

Borehole History: SM-17 was rotary drilled to 19 feet (5.79 m) using a 7-7/8 inch (20 cm) diameter rock bit. A 6-5/8 inch (16.83 cm) O.D. casing was then set and cemented. A 5-5/8 inch (14.29 cm) diameter hole was drilled out from under the casing to 200 feet (60.96 m). A spot core was pulled from 200-211 feet (60.96-64.31 m) with very poor recovery. The core hole was reamed out to 5-5/8 inch (14.29 cm) diameter and continued to 400 feet (121.92 m). A spot core was pulled from 400-406 feet (121.92-123.75 m) with 100 percent recovery. The core hole was reamed out to 5-5/8 inch (14.29 cm) and continued to 600 feet (182.88 m). Another spot core was pulled from 600-604 feet (182.88-184.1 m) with 50 percent recovery. The core was reamed out to 5-5/8 inch (14.29 cm) diameter and then continued to 883 feet (269.14 m).

Rotary drillers began losing circulation at 170 feet (51.82m) with complete loss at 200 feet (60.96 m), 440 feet (134.11 m), 470 feet (143.26 m), 600 feet (182.88 m) and 875 feet (266.7 m). Mud weight during rotary drilling was generally 9 pound per gallon (4.08 kg per 3.79 l) or less and funnel viscosity at 32 to 40 seconds.

Because of the frequent loss of circulation and the amount of time required to restore circulation, the hole was cased to 883 feet (269.14 m) with 4 inch (10.16 cm) I.D. casing and a core rig moved on to complete the hole with continuous coring.

A delay in drilling occurred between August 20 and September 7, while waiting for a core rig. Rig 838 moved over the hole on September 7 and NCWL 3-3/4 x 2-2/5 inch (9.53 x 6.1 cm) coring began at 883 feet (269.14 m) and continued to a final depth of 995 feet (303.28 m). Core drilling progress was rather slow due to continued circulation loss and frequent bit changes.

After logging operations were completed, the 4 inch (10.16 mm) I.D. casing was pulled, the hole was mud plugged and a 20 foot (6.1 m) cement surface plug set.

Earthen pits, with plastic liners (Visqueen, 4 mil) were used. Approximate total capacity was 8,000 gallons (30,280 l). Approximate total water usage was 80,000 gallons (302,800 l).

Bit Record

Make	Type	Size	Footage
Varel	V-2	7-7/8 in. (20 cm)	0-19 ft (0-5.79 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	19-200 ft (5.79-60.96 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	200-211 ft (60.96-64.31 m)
			400-406 ft (121.92-123.75 m)
			600-604 ft (182.88-184.1 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	200-400 ft (60.96-121.92 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	400-515 ft (121.92-156.97 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	515-883 ft (156.97-269.14 m)
Christensen	NC	3-3/4 in. (9.53 cm)	883-903 ft (269.14-275.23 m)
Christensen	NC	3-3/4 in. (9.53 cm)	903-920 ft (275.23-280.42 m)
Christensen	NC	3-3/4 in. (9.53 cm)	920-995 ft (280.42-303.28 m)

Mud Record

Quantity	Material
4 sk (94 lb/42.64 kg ea.)	Portland cement
259 sk (50 lb/22.7 kg ea.)	Mud 2
97 sk (2 lb/0.9 kg ea.)	Mud 25
14 sk (40 lb/18.1 kg ea.)	Hy Seal
7 sk (50 lb/22.7 kg ea.)	Causticized lignite
2 sk (50 lb/22.7 kg ea.)	Rayvan (Disperse)
13 sk (40 lb/18.1 kg ea.)	Cedar Fiber
4 sk (50 lb/22.7 kg ea.)	Hay cubes
13 sk (50 lb/22.7 kg ea.)	Fibertex
4 sk (50 lb/22.7 kg ea.)	Cottonseed hulls
3 sk (50 lb/22.7 kg ea.)	Caustic soda
4 sk (100 lb/45.36 kg ea.)	Soda ash
1 ct (10 lb/4.54 kg ea.)	PQ 460

Deviation Tests

Depth	Degree of Drift
400 ft (121.92 m)	3-3/4°
860 ft (262.13 m)	4°

Geophysical Logs

Gamma	Density	Resistivity
Caliper	Spectral gamma-ray (KUT)	Self Potential

Location: NE1/4SW1/4 sec. 1, T. 13 S., R. 13 W.
Total depth: 1,012 feet (308.46 m).
Spud date: August 10, 1978.
Completion date: August 31, 1978.
Rig: Longyear Model 44 with Bean 35 gpm (132.48 lpm) pump, Boyles Bros. No. 838.
Drill rod size: Boyles Bros. NCWL, 3-1/2 inch (8.89 cm) O.D.
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Core Recovery: 82%.
Sample interval(s): Every 10 feet (3.05 m) from 0-93 feet (0-28.35 m); continuous core from 93-1,012 feet (28.35-308.46 m).

Borehole History: SM-18 was drilled to 93 feet (28.35 m) with a 5-5/8 inch (14.29 cm) diameter rock bit and 4 inch (10.16 cm) I.D. casing set. NCWL 3-3/4 x 2-2/5 inch (9.53 x 6.1 cm) coring began at 93 feet (28.35 m) and continued to a final depth of 1,012 feet (308.46 m), with drillers experiencing numerous difficulties. Circulation was lost at 103 feet (31.39 m) with only partial returns restored throughout the remainder of the coring operations. Also, drillers began having problems with core barrel mislatches and broken ground soon after the hole reached 200 feet (60.96 m) in depth and coring progress was slowed considerably. Bit wear was exceptionally high due to broken ground and the redrilling of dropped core. The hole began to deteriorate badly at 1,000 feet (304.8 m) and was terminated at 1,012 feet (308.46 m). A crown was pulled off the bit and no further progress could be attained.

Earthen pits, with plastic liners (Visqueen, 4 mil) were used. Approximate total capacity was 8,000 gallons (30,280 l). Approximate total water usage was 100,000 gallons (378,500 l).

Mud properties were not recorded but weight was less than 9 pounds per gallon (4.08 kg per 3.79 l) and funnel viscosity at approximately 35 seconds. After completion of coring and logging operations, an effort was made to pull the 93 feet (28.35 m) of 4 inch (10.16 cm) I.D. surface casing but without success. The hole was mud plugged and a 20 foot (6.1 m) cement surface plug set.

Bit Record

Make	Type	Size	Footage
Christensen	C-2	5-5/8 in. (14.29 cm)	0-93 ft (0-28.35 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	93-97 ft (28.35-29.57 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	97-195 ft (29.57-59.44 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	195-205 ft (59.44-62.48 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	205-259 ft (62.48-78.94 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	259-516 ft (78.94-157.28 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	516-618 ft (157.28-188.37 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	618-1,000 ft (188.37-304.8 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	1,000-1,012 ft (304.8-308.46 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	No footage

Mud Record

Quantity	Material
629 sk (50 lb/22.7 kg ea.)	Mud 2
28 sk (50 lb/22.7 kg ea.)	Causticized lignite
26 sk (100 lb/45.36 kg ea.)	Soda ash
1 sk (40 lb/18.1 kg ea.)	Hy Seal
6 sk (50 lb/22.7 kg ea.)	Caustic soda
4 sk (94 lb/42.64 kg ea.)	Portland cement

Deviation Tests

Depth	Degree of Drift
400 ft (121.92 m)	3°
800 ft (243.84 m)	2°
1,000 ft (304.8 m)	3°

Geophysical Logs

Gamma	Density
Resistivity	Caliper

Location: NE1/4NW1/4 sec. 3, T. 12 S., R. 11 W.
Total depth: 1,280 feet (390.14 m).
Spud date: August 19, 1978.
Completion date: September 6, 1978.
Rig: Failing Model CF-15, with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4146.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Core recovery: 90%.
Sample interval(s): Every 10 feet (3.05 m); spot cores from 200-210 feet (60.96-64.01 m), 392-402 feet (119.48-122.53 m), 590-600 feet (179.83-182.88 m), 780-790 feet (237.74-240.79 m), 1,000-1,010 feet (304.8-307.85 m), 1,200-1,210 feet (365.76-368.81 m).

Borehole History: SM-19 was rotary drilled to 20 feet (6.1 m) with a 7-7/8 inch (20 cm) diameter rock bit, and 6-5/8 inch (16.83 cm) O.D. casing set and cemented. A 5-5/8 inch (14.29 cm) diameter hole was drilled out from under the casing and continued to 1,280 feet (390.14 m). Spot cores were pulled from 200-210 feet (60.96-64.01 m), 392-402 feet (119.48-122.53 m), 590-600 feet (179.83-182.88 m), 780-790 feet (237.74-240.79 m), 1,000-1,010 feet (304.8-307.85 m), and 1,200-1,210 feet (365.76-368.81 m). Circulation loss occurred at 150 feet (45.72 m), 590 feet (179.83 m) and 900 feet (274.32 m) but was restored at each occurrence.

Drillers began to have difficulty in tripping the rock bit at approximately 1,000 feet (304.8 m) and had to wash the tools. The same problem developed at 1,210 feet (368.81 m) and required wash-in of the bottom 90 feet (27.43 m) of the hole. The drillers tripped out for a bit at 1,280 feet (390.14 m) and stuck the bit at 1,110 feet (338.33 m) on the trip into the hole. The drillers worked approximately 28 hours trying to free the tools by washing and pipe tension. Drillers finally backed off the drill pipe down to the 30 feet (9.14 m) of drill collars and the bit. They then attempted to wash-over the drill collars with 5 inch (12.7 cm) I.D. wash-over pipe in the 5-5/8 inch (14.29 cm) hole but only reached a depth of 200 feet (60.96 m) because of insufficient clearance in the hole. No further efforts were made by the drilling contractor to retrieve the stuck tools and the hole had to be abandoned.

Final completion consisted of mud plugging and a 20 foot (6.1 m) cement plug at the surface. Mud weight remained at 9 pounds per gallon (4.08 kg per 3.79 l) or less and funnel viscosity at 36 to 40 seconds during the rotary drilling. Earthen pits, with plastic liners (Visqueen, 4 mil), were used. Approximate total capacity was 8,000 gallons (30,280 l). Approximate total water usage was 61,000 gallons (230,885 l).

Bit Record

Make	Type	Size	Footage
Varel	V-2	7-7/8 in. (20 cm)	0-20 ft (0-6.1 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	20-200 ft (6.1-60.96 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	200-210 ft (60.96-64.01 m)
			392-402 ft (119.48-122.53 m)
			590-600 ft (179.83-182.88 m)
			780-790 ft (237.74-240.79 m)
			1,000-1,010 ft (304.8-307.85 m)
			1,200-1,210 ft (365.76-368.81 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	200-392 ft (60.96119.48 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	392-485 ft (119.48-147.83 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	485-590 ft (147.83-179.83 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	590-790 ft (179.83-240.79 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	790-890 ft (240.79-271.27 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	890-950 ft (271.27-289.56 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	950-1,000 ft (289.56-304.8 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,000-1,130 ft (304.8-344.42 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,130-1,210 ft (344.42-368.81 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,210-1,280 ft (368.81-390.14 m)

Mud Record

Quantity	Material
166 sk (50 lb/22.7 kg ea.)	Mud 2
48 sk (2 lb/0.9 kg ea.)	Mud 25
7 sk (50 lb /22.7 kg ea.)	Fibertex
5 sk (50 lb/22.7 kg ea.)	Causticized lignite
11 sk (40 lb/18.1 kg ea.)	Cedar Fiber
3 sk (50 lb/22.7 kg ea.)	Rayvan (Disperse)
4 sk (100 lb/45.36 kg ea.)	Soda ash
3 sk (40 lb/18.1 kg ea.)	Hy Seal
1 sk (50 lb/22.7 kg ea.)	Cottonseed hulls
3 sk (94 lb/42.64 kg ea)	Portland cement

Deviation Tests

Depth	Degree of Drift
400 ft (121.92 m)	2°
800 ft (243.84 m)	3°
1,200 ft (365.76 m)	4-1/2°

Geophysical Logs

Gamma
Resistivity
Self Potential
Density
Caliper

Location: NW1/4NE1/4 sec. 3, T. 12 S., R. 11 W.
Total depth: 720 feet (219.46 m).
Spud date: August 17, 1978.
Completion date: August 25, 1978.
Rig: Failing Model CF-15, with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4248.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Core Recovery: 60%.
Sample interval(s): Every 10 feet (3.05 m); spot core from 410-412 feet (124.97-125.58 m).

Borehole History: SM-20 was rotary drilled to 13 feet (3.96 m) using a 7-7/8 inch (20 cm) diameter rock bit. A 6-5/8 inch (16.83 cm) O.D. casing was then set and cemented. A 5-5/8 inch (14.29 cm) diameter hole was drilled out from under the casing to 410 feet (124.97 m). A spot core was pulled from 410-412 feet (124.97-125.58 m) with 60% recovery. The hole was then reamed to 5-5/8 inch (14.29 cm) diameter and drilled ahead. Some circulation was lost at 620 feet (188.98 m) and circulation continued to decrease to total loss at 675 feet (205.74 m). A total of 59 hours of rig time was used in drilling from 675-720 feet (205.74-219.46 m), and trying to restore circulation. The hole bridged over at 593 feet (180.75 m) during a trip for a bit change. In attempting to get past the bridge, drillers drilled out of the original hole at 583 feet (177.7 m) and continued to 718 feet (218.85 m), cutting a new hole. Circulation was lost temporarily but regained and drilling continued to 719 feet (219.15 m) where the drill pipe twisted off 480 feet (146.3 m) from the surface. The drillers spent 9 hours fishing without success and then abandoned the hole. Final abandonment consisted of mud plugging and setting a 20 foot (6.1 m) cement surface plug.

Earthen pits, with plastic liners (Visqueen, 4 mil) were used. Approximate total capacity was 6,000 gallons (22,710 l). Approximate total water usage was 45,000 gallons (170,325 l). Mud weight was not recorded. Funnel viscosity at 412 feet (125.58 m) was recorded as 34 seconds.

Bit Record

Make	Type	Size	Footage
Varel	V-2	7-7/8 in. (20 cm)	0-13 ft (0-3.96 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	13-410 ft (3.96-124.97 m)
Christensen	NCD	3-3/4 in. (14.29 cm)	410-412 ft (124.97-125.58 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	410-720 ft (124.97-219.46 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	583-719 ft (177.7-219.15 m) (redrill)

Mud Record

Quantity	Material
207 sk (50 lb/22.7 kg ea.)	Mud 2
90 sk (2 lb/0.9 kg ea.)	Mud 25
1 sk (80 lb/36.29 kg ea.)	Calcium chloride
2 sk (94 lb/42.64 kg ea.)	Portland cement
43 sk (50 lb/22.7 kg ea.)	Cottonseed hulls
1 sk (40 lb/18.1 kg ea.)	Hy Seal
1 sk (50 lb/22.7 kg ea.)	Caustic soda
1 sk (100 lb/45.36 kg ea.)	Soda ash
1 sk (50 lb/22.7 kg ea.)	Causticized lignite
16 sk (50 lb/22.7 kg ea.)	Fibertex
26 sk (40 lb/18.1 kg ea.)	Cedar Fiber

Deviation Tests

Depth	Degree of Drift
400 ft (121.92 m)	2-1/2°

Geophysical Logs

Gamma	Resistivity
Density	Self Potential
Caliper	

Hole logged to 682 feet (207.87 m).

Location: NE1/4SW1/4 sec. 11, T. 12 S., R. 13 W.
Total depth: 593 feet (180.75 m).
Spud date: August 27, 1978.
Completion date: August 31, 1978.
Rig: Failing Model CF-15, with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4238.
Drill pipe or drill rod size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Sample interval(s): Every 10 feet (3.05 m).

Borehole History: SM-21 was rotary drilled to 47 feet (14.33 m) using a 7-7/8 inch (20 cm) diameter rock bit. A 6-5/8 inch (16.83 cm) O.D. casing was then set and cemented. A 5-5/8 inch (14.29 cm) hole was rotary drilled from under the casing to a final depth of 593 feet (180.75 m). A complete loss of circulation occurred at 568 feet (173.13 m). Drillers continued ahead in an attempt to regain circulation but without success. The drilling contractor worked 39 hours, drilling from 568-593 feet (173.13-180.75 m) and trying to restore circulation. The hole was abandoned at 593 feet (180.75 m) as it was apparent no further useful information could be obtained.

After logging operations were completed, a 20 foot (6.1 m) cement surface plug was set. Earthen pits, with plastic liners (Visqueen, 4 mil), were used. Approximate total capacity of pits was 8,000 gallons (30,280 l). Approximate total water usage was 26,000 gallons (98,410 l). Mud weight recorded at 300 feet (91.44 m) was 8.6 pounds per gallons (3.90 kg per 3.79 l) and funnel viscosity at 34 seconds.

Bit Record

Make	Type	Size	Footage
Varel	V-2	7-7/8 in. (20 cm)	0-47 ft (0-14.33 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	47-585 ft (14.33-178.31 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	585-593 ft (178.31-180.75 m)

Mud Record

Quantity	Material
3 sk (94 lb/42.64 kg ea.)	Portland cement
87 sk (50 lb/22.68 kg ea.)	Mud 2
49 sk (2 lb/0.9 kg ea.)	Mud 25
3 sk (50 lb/22.68 kg ea.)	Rayvan (Disperse)
19 sk (50 lb/22.68 kg ea.)	Fibertex
7 sk (50 lb/22.68 kg ea.)	Cottonseed hulls
3 sk (40 lb/18.14 kg ea.)	Cedar Fiber
1 sk (40 lb/18.14 kg ea.)	Hy Seal

Geophysical Logs

Gamma Density Resistivity

Location: NE1/4SE1/4 sec. 33, T. 12 S., R. 13 W.
Total depth: 1,515 feet (461.77 m).
Spud Date: September 6, 1978.
Completion date: September 12, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4238.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Sample interval(s): Every 10 feet (3.05 m); spot core from 1,020-1,022 feet (310.9-311.51 m).

Borehole History: SM-22 was rotary drilled to 21 feet (6.4 m) using a 7-7/8 inch (20 cm) diameter rock bit. A 6-5/8 inch (16.83 cm) O.D. casing was then set and cemented. A 5-5/8 inch (14.29 cm) diameter hole was rotary drilled out from under the casing to 1,020 feet (310.9 m) with little difficulty. A spot core was attempted from 1,020-1,022 feet (310.9-311.51 m), but no core was recovered. Drillers reamed 267 feet (81.38 m) before drilling could be resumed at this depth. The hole continued to final depth without any significant drilling problems. After completion of drilling and logging operations, the hole was mud plugged and a 20 foot (6.1 m) cement surface plug set.

Earthen pits, with an approximate capacity of 6,000 gallons (22,710 1) were used. The pits were lined with plastic (Visqueen, 4 mil) to prevent excessive seepage loss. Mud weight was kept below 9 pounds per gallons (4.08 kg per 3.79 1) and funnel viscosity at 37 to 40 seconds. Approximate total water usage was 43,000 gallons (162,755 1).

Bit Record

Make	Type	Size	Footage
Varel	V-2	7 7/8 in. (20 cm)	0-21 ft (0-6.4 m)
Christensen	C-2	5 5/8 in. (14.29 cm)	21-330 ft (6.4-100.58 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	330-585 ft (100.58-178.31 m)
Christensen	C-2	5 5/8 in. (14.29 cm)	585-885 ft (178.31-269.75 m)
Christensen	C-2	5 5/8 in. (14.29 cm)	885-1,085 ft (269.75-330.71 m)
Christensen	NC	3 3/4 in. (9.53 cm)	1,020-1,022 ft (310.9-311.51 m)
Christensen	C-2	5 5/8 in. (14.29 cm)	1,085-1,310 ft (330.71-399.29 m)
Christensen	C-2	5 5/8 in. (14.29 cm)	1,310-1,425 ft (399.29-434.34 m)
Christensen	C-1	5 5/8 in. (14.29 cm)	1,425-1,515 ft (434.34-461.77 m)

Mud Record

Quantity	Material
57 sk (50 lb/22.68 kg ea.)	Mud 2
24 sk (2 lb/0.9 kg ea.)	Mud 25
1 sk (80 lb/36.29 kg ea.)	Calcium chloride
2 sk (50 lb/22.68 kg ea.)	Caustic soda
3 sk (94 lb/42.64 kg ea.)	Portland cement
2 sk (100 lb/45.36 kg ea.)	Soda ash
4 sk (50 lb/22.68 kg ea.)	Rayvan (Disperse)

Deviation Tests

Depth	Degree of Drift
400 ft (121.92 m)	1°
795 ft (242.32 m)	3/4°

Geophysical Logs

Gamma Density Resistivity

Location: NW1/4SE1/4 sec. 14, T. 13 S., R. 12 W.
Total depth: 1,340 feet (408.43 m).
Spud date: September 8, 1978.
Completion date: September 27, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4146. Longyear Model 44 with Bean 35 gpm (132.48 l) pump; Boyles Bros. No. 838.
Drill pipe: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Drill rod: Boyles Bros. NCWL, 3-1/2 inch (8.89 cm) O.D.
Core barrel: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Core recovery: 85%.
Sample interval(s): Every 10 feet (3.05 m), 0-800 feet (0-243.84 m); continuous core from 880-1,340 feet (268.22 m-408.43 m).

Borehole History: SM-23 was rotary drilled to 19 feet (5.79 m), using a 7-7/8 inch (20 cm) diameter rock bit. A 6-5/8 inch (16.82 cm) O.D. casing was then set and cemented. A 5-5/8 inch (14.29 cm) diameter hole was drilled out from under the casing and continued to 800 feet (243.84 m). The hole was logged at 800 feet (243.84 m) and 4 in. (10.16 cm) I.D. casing set. After completion of casing operations, the rotary rig was moved off the hole and Rig 838 moved on hole to continue with continuous core. NCWL 3-3/4 x 2-2/5 inch (9.53 x 6.1 cm) coring began at 800 feet (243.84 m) and continued to a final depth of 1,340 feet (408.43 m). Drillers began having difficulties soon after coring out from under the casing. Sand was pumped into the hole from the pits and sanded in the core barrel intertube. The pits were cleaned in an effort to prevent any reoccurrence, but this problem, along with inter-barrel mislatches, continued throughout the remainder of the drilling on this hole.

After drilling and logging operations were completed an effort was made to retrieve the 4 inch (10.16 cm) I.D. casing. The casing broke 60 feet (18.29 m) from the surface, leaving 740 feet (225.55 m) of casing in the hole. No further effort was made by the drilling contractor to retrieve the remaining casing. After all drilling and logging operations were completed, the hole was mud plugged and a 20 foot (6.1 m) cement surface plug set.

Earthen pits, with an approximate total capacity of 6,000 gallons (22,710 l), were used. The pits were lined with plastic (Visqueen, 4 mil) in an effort to minimize fluid loss due to seepage. Mud weight was kept below 9 pounds per gallons (4.08 kg per 3.79 l) and funnel viscosity at 34 to 37 seconds during the rotary portion of the hole. No mud property values are available for the coring interval. Approximate total water usage was 30,000 gallons (113,550 l).

Bit Record

Make	Type	Size	Footage
Varel	V-2	7-7/8 in. (20 cm)	0-19 ft (0-5.79 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	19-500 ft (5.79-152.4 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	500-800 ft (152.4-243.84 m)
Christensen	NCD-3	3-3/4 in. (9.53 cm)	800-895 ft (243.84-272.8 m)
Christensen	NCD-3	3-3/4 in. (9.53 cm)	895-1,115 ft (272.8-339.85 m)
Christensen	NCD-3	3-3/4 in. (9.53 cm)	1,115-1,225 ft (339.85-373.38 m)
Christensen	NCD-3	3-3/4 in. (9.53 cm)	1,225-1,330 ft (373.38-405.38 m)
Christensen	NCD-3	3-3/4 in. (9.53 cm)	1,330-1,340 ft (405.38-408.43 m)

Mud Record

Quantity	Material
120 sk (50 lb/22.68 kg ea.)	Mud 2
50 sk (2 lb/0.9 kg ea.)	Mud 25
4 sk (94 lb/42.64 kg ea.)	Portland cement
8 sk (50 lb/22.68 kg ea.)	Rayvan (Disperse)
2 sk (100 lb/45.36 kg ea.)	Soda ash
12 sk (50 lb/22.68 kg ea.)	Causticized lignite
6 sk (50 lb/22.68 kg ea.)	Caustic soda

Geophysical Logs

Gamma
Caliper
Self Potential
Density
Resistivity

Location: SW1/4NW1/4 sec. 9, T. 12 S., R. 12 W.
Total depth: 315 feet (96.01 m).
Spud date: September 13, 1978.
Completion date: September 14, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4238.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Sample interval(s): Every 10 feet (3.05 m); spot core from 200-203 feet (60.96-61.87 m).

Borehole History: SM-24 was rotary drilled to 14 feet (4.27 m) using a 7-7/8 inch (20 cm) diameter rock bit. A 6-5/8 inch (16.83 cm) O.D. casing was then set and cemented. A 5-5/8 inch (14.29 cm) diameter hole was rotary drilled from under the casing to 200 feet (60.96 m). A spot core was pulled from 200-203 feet (60.96-61.87 m) with good recovery. The core hole was reamed out to 5-5/8 inch (14.29 cm) diameter and drilled to a final depth of 315 feet (96.01 m). No significant problems developed during the drilling of this hole other than slow penetration rates.

Earthen pits, with plastic liners (Visqueen, 4 mil) were used. Approximate total capacity of the pits was 6,000 gallons (22,710 l). Mud weight was kept below 9 pounds per gallons (4.08 kg per 3.79 l) and funnel viscosity at 33 to 35 seconds. Approximate total water usage was 16,500 gallons (62,452 l). After drilling and logging operations were completed, the hole was mud plugged and a 20 foot (6.1 m) cement surface plug set.

Bit Record

Make	Type	Size	Footage
Varel	V-2	7-7/8 in. (20 cm)	0-14 ft (0-4.27 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	14-165 ft (4.27-50.29 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	165-260 ft (50.29-79.25 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	200-203 ft (60.96-61.87 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	260-290 ft (79.25-88.39 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	290-315 ft (88.39-96.01 m)

Mud Record

Quantity	Material
19 sk (50 lb/22.68 kg ea.)	Mud 2
2 sk (100 lb/45.36 kg ea.)	Soda ash
3 sk (94 lb/42.64 kg ea.)	Portland cement
1 sk (2 lb/0.9 kg ea.)	Mud 25

Geophysical Logs

Gamma
Resistivity
Self Potential
Density
Caliper

Location: NE1/4NW1/4 sec. 11, T. 12 S., R. 12 W.
Total depth: 1,500 feet (457.2 m).
Spud date: September 12, 1978.
Completion date: September 24, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4146.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Core Recovery: 74%.
Sample interval(s): Every 10 feet (3.05 m); spot cores from 86-96 feet (26.21-29.26 m), 170-180 feet (51.82-54.86 m), 290-300 feet (88.39-91.44 m), 430-440 feet (131.06-134.11 m), 560-570 feet (170.69-173.74 m), 770-780 feet (234.7-237.74 m), 970-980 feet (295.66-298.7 m), 1,200-1,215 feet (365.76-370.33 m).

Borehole History: SM-25 was rotary drilled to 20 feet (6.1 m) with a 7-7/8 inch (20 cm) diameter rock bit, and 6-5/8 inch (16.83 cm) O.D. casing set and cemented. A 5-5/8 inch (14.29 cm) diameter hole was drilled out from under the casing and continued to a final depth of 1,500 feet (457.2 m).

Spot cores were pulled from 86-96 ft (26.21-29.26 m) with 75 percent recovery, from 170-180 feet (51.82-54.86 m) with 75 percent recovery, from 290-300 feet (88.39-91.44 m) with 100 percent recovery, from 430-440 feet (131.06-134.11 m) with 100 percent recovery, from 560-570 feet (170.69-173.74 m) with 100 percent recovery, from 770-780 feet (234.7-237.74 m) with 100 percent recovery, from 970-980 feet (295.66-298.7 m) with 100 percent recovery, and from 1,200-1,215 feet (365.76-370.33 m) with 33 percent recovery. After each spot core was pulled, the hole was reamed out to 5-5/8 inch (14.29 cm) diameter and drilled to the next interval to be cored. Very few drilling problems were encountered in the drilling of this hole. One trip was necessary to clean out the hole to permit logging operations. After logging and drilling operations were completed the hole was mud plugged and a 20 foot (6.1 m) cement surface plug set.

Earthen pits, having an approximate capacity of 8,000 gallons (30,280 l) were used. These pits were lined with plastic (Visqueen, 4 mil) in an effort to prevent excessive seepage. Mud weight was kept below 9 pounds per gallon (4.08 kg per 3.79 l) and funnel viscosity at 34 to 37 seconds. Approximate total water usage was 75,000 gallons (283.875 l).

Bit Record

Make	Type	Size	Footage
Varel	V-2	7-7/8 in. (20 cm)	0-20 ft (0-6.1 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	20-290 ft (6.1-88.39 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	86-96 ft (26.21-29.26 m)
			170-180 ft (51.81-54.86 m)
			290-300 ft (88.39-91.44 m)
			430-440 ft (131.06-134.11 m)
			560-570 ft (170.69-173.74 m)
			770-780 ft (234.7-237.74 m)
			970-980 ft (295.66-298.7 m)
			1,200-1,215 ft (365.76-370.33 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	290-600 ft (88.39-182.88 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	600-800 ft (182.88-243.84 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	800-890 ft (243.84-271.27 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	890-970 ft (271.27-295.66 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	970-1,085 ft (295.66-330.71 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,085-1,100 ft (330.71-335.28 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,100-1,215 ft (335.28-370.33 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	1,215-1,370 ft (370.33-417.58 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,370-1,445 ft (417.58-440.44 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,445-1,500 ft (440.44-457.2 m)

Mud Record

Quantity	Material
75 sk (50 lb/22.68 kg ea.)	Mud 2
43 sk (2 lb/0.9 kg ea.)	Mud 25
4 sk (94 lb/42.64 kg ea.)	Portland cement
3 sk (50 lb/22.68 kg ea.)	Causticized lignite
6 sk (50 lb/22.68 kg ea.)	Rayvan (Disperse)

Deviation Tests

Depth	Degree of Drift
400 ft (121.92 m)	2-1/4°
800 ft (243.84 m)	3°
1,200 ft (457.2 m)	1-3/4°
1,500 ft (365.76 m)	1°

Geophysical Logs

Gamma
Resistivity
Caliper
Density
Self Potential

Location: SW1/4SW1/4 sec. 11, T. 13 S., R. 12 W.
Total depth: 403 feet (122.83 m).
Spud date: September 14, 1978.
Completion date: September 23, 1978.
Rig: Longyear Model 44 with Bean 35 gpm (132.48 lpm) pump, Boyles Bros. No. 892.
Drill rod size: Boyles Bros. NCWL, 3-1/2 inch (8.89 cm) O.D. used 0-320 feet (0-97.54 m); NXWL, 2-7/8 inch (7.3 cm) O.D. used 320-403 feet (97.54-122.83 m). Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D. used 50-320 feet (15.24-97.54 m); NXWL, 10 foot (3.05 m) with bit size of 3 inch (7.62 cm) O.D. x 1-7/8 inch (4.76 cm) I.D. used from 320-403 feet (97.54-122.83 m).
Core recovery: 95%.
Sample interval(s): Every 10 feet (3.05 m) from surface to 50 feet (15.24 m). Continuous core 50-403 feet (15.24-122.83 m).

Borehole History: SM-26 was rotary drilled (with the core rig) to 50 feet (15.24 m) using a 5-5/8 inch (14.29 cm) diameter rock bit attached to the NCWL tools. A 4 inch (10.16 cm) I.D. casing was set to 50 feet (15.24 m) and NCWL coring 3-3/4 x 2-2/5 inch (9.53 x 6.1 cm) continued to 320 feet (97.54 m).

Because of unconsolidated material in the upper portion of the hole, the hole was cased with NX 3 inch (7.77 cm) I.D. casing to 320 feet (97.54 m) and NXWL coring 3 x 1-7/8 inch (7.62 x 4.76 cm) continued to the final depth of 403 feet (122.83 m). Drilling progress was hampered by very hard and broken formation from 320-403 feet (97.54-122.83 m). Almost the entire hole was drilled without circulation.

After drilling and logging operations were completed, the NX casing was pulled. An effort was made to pull the 4 inch (10.16 m) casing but resulted in only 20 feet (6.1 m) being salvaged, leaving 30 feet (9.14 m) of the casing in the hole. Earthen pits with plastic liners (Visqueen, 4 mil) were used. Approximate total capacity of the pits was 6,000 gallons (22,710 l). The approximate total water usage was 26,500 gallons (100,303 l).

No mud properties were recorded for this hole.

Final abandonment consisted of mud plugging and setting a 20 foot (6.1 m) cement surface plug.

Bit Record

Make	Type	Size	Footage
Christensen	C-2	5-5/8 in. (14.29 cm)	0-50 ft (0-15.24 m)
Christensen	NCD-3	3-3/4 in. (9.53 cm)	50-314 ft (15.24-95.71 m)
Christensen	NCD-3	3-3/4 in. (9.53 cm)	314-320 ft (95.71-97.54 m)
Christensen	NXC-3	3 in. (7.62 cm)	320-342 ft (97.54-104.24 m)
Christensen	NXC-3	3 in. (7.62 cm)	342-377 ft (104.24-114.91 m)
Christensen	NXC-3	3 in. (7.62 cm)	377-403 ft (114.91-122.83 m)

Mud Record

Quantity	Material
70 sk (50 lb/22.68 kg ea.)	Mud 2
39 sk (2 lb/0.9 kg ea.)	Mud 25
2 sk (50 lb/22.68 kg ea.)	Rayvan (Disperse)
3 sk (94 lb/42.64 kg ea.)	Portland cement
5 sk (50 lb/22.68 kg ea.)	Causticized lignite
1 pail (5 gal/18.9 l ea.)	HME Energizer

Geophysical Logs

Caliper

Self Potential

Location: NE1/4NE1/4 sec. 1, T. 12 S., R 11 W.
Total depth: 1,208 feet (368.2 m).
Spud date: September 20, 1978.
Completion date: September 28, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4238.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) x 2-2/5 inch (6.1 cm) I.D.
Sample interval(s): Every 10 feet (3.50 m); spot cores taken from 665 feet (202.69 m) to 672 feet (204.83 m) and from 1,010 feet (307.85 m) to 1,015 feet (309.37 m).
Core recovery: 45%.

Borehole History: SM-27 was rotary drilled to 20 feet (6.1 m) with a 7-7/8 inch (20 cm) diameter rock bit. A 6-5/8 inch (16.83 cm) O.D. casing was then set and cemented. A 5-5/8 inch (14.29 cm) diameter hole was drilled from under the casing and continued to the final depth of 1,208 feet (368.2 m). Spot cores were pulled from 665 feet (202.69 m) to 672 feet (204.83 m) with 50 percent recovery and from 1,010 feet (307.85 m) to 1,015 feet (309.37 m) with 40 percent recovery. The core hole was reamed out to 5-5/8 inch (14.29 cm) diameter after each coring interval and drilled ahead. Penetration rates were slow due to the hardness of the formations being drilled. No appreciable amount of lost circulation was encountered during the drilling or coring of this hole. Drillers did, however, encounter difficulties with bits losing gauge and the necessity of reaming in after a bit change.

Earthen pits, with plastic liners (Visqueen 4 mil) were used. Approximate total capacity was 6,000 gallons (22,710 l). Mud weight remained at or below 9.4 pounds per gallon (4.26 kg per 3.79 l) with funnel viscosity ranging from 33 to 37 seconds. Approximate total water usage was 20,000 gallons (75,700). After drilling and logging operations were completed, the hole was mud plugged and a 20 foot (6.1 m) cement surface plug.

Bit Record

Make	Type	Size	Footage
Varel	V-2	7-7/8 in. (20 cm)	0-20 ft (0-6.1 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	20-103 ft (6.1-31.39 m)
Christensen	C-2	5-5/8 in. (14.29 cm)	103-295 ft (31.39-89.92 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	295-475 ft (89.92-144.78 m)
Christensen	-3	5-5/8 in. (14.29 cm)	475-560 ft (144.78-170.69 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	560-600 ft (170.69-182.88 m)
Christensen	C-1H	5-5/8 in. (14.29 cm)	600-630 ft (182.88.192.02 m)
Christensen	C-2H	5-5/8 in. (14.29 cm)	665-672 ft (202.69-204.83 m)
			1,010-1,015 ft (307.85-309.27 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	720-770 ft (219.46-234.7 m)
Christensen	C-3	5-5/8 in. (14.29 cm)	770-875 ft (234.7-266.7 m)

Christensen	C-3	5-5/8 in. (14.29 cm)	875-1,100 ft (266.7-335.28 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,100-1,180 ft (335.28-359.66 m)
Christensen	C-1H	5-5/8 in. (14.29 cm)	1,180-1,190 ft (359.66-362.71 m)
Christensen	C-1H	5-5/8 in. (14.29 cm)	1,190-1,202 ft (362.71-366.37 m)
Christensen	C-1	5-5/8 in. (14.29 cm)	1,202-1,208 ft (366.37-368.2 m)

Mud Record

Quantity	Material
66 sk (50 lb/22.68 kg ea.)	Mud 2
25 sk (2 lb/0.9 kg ea.)	Mud 25
3 sk (50 lb/22.68 kg ea.)	Rayvan (Disperse)
1 sk (80 lb/36.29 kg ea.)	Calcium chloride
4 sk (94 lb/42.64 kg ea.)	Portland cement
1 sk (100 lb/45.36 kg ea.)	Soda ash

Geophysical Logs

Gamma	Density
Resistivity	Caliper
Self Potential	

Location: NE1/4NE1/4 sec. 15, T. 12 S., R. 11 W.
Total depth: 1,500 feet (457.2 m).
Spud date: September 25, 1978.
Completion date: October 3, 1978.
Rig: Failing Model CF-15 with 5 x 6-1/4 duplex pump, Boyles Bros. No. 4146.
Drill pipe size: 2-7/8 inch (7.3 cm) I.F. x 15 feet (4.57 m).
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Core recovery: 50%.
Sample interval(s): Every 10 feet (3.05 m); spot core from 230 feet (70.1 m) to 240 feet (73.15 m).

Borehole History: SM-28 was rotary drilled to 20 feet (6.1 m) using an 8-1/4 inch (20.96 cm) diameter rock bit. A 6-5/8 inch (16.83 cm) O.D. casing was then set and cemented. A 6 inch (15.24 cm) diameter hole was drilled out from under the casing and continued to 1,500 feet (457.2 m). A spot core was pulled from 230 feet (70.1 m) to 240 feet (73.15 m) with the core hole being reamed to 6 inch (15.24 cm) and continued to final depth.

Circulation loss, either complete or partial, hampered drillers between 230 feet (70.1 m) and 660 feet (201.17 m). Minor loss was experienced between 1,070 feet (326.14 m) and 1,280 feet (390.14 m). Drillers were able to restore circulation on each occurrence and continue drilling ahead without any other significant problems. Mud weight was kept at or below 9.1 pounds per gallon (4.13 kg per 3.79 l) and funnel viscosity at 36 to 40 seconds. Approximate total water usage was 60,000 gallons (227,100 l). Earthen pits, with plastic liners (Visqueen 4 mil), were used. Approximate total capacity of the pits was 8,000 gallons (30,280 l). After drilling and logging operations were completed, the hole was mud plugged and a 20 foot (6.1 m) cement surface plug set.

Bit Record

Make	Type	Size	Footage
HTC	OSC	8-1/4 in. (20.96 cm)	0-20 ft (0-6.1m)
HTC	J-33	6 in. (15.24 cm)	20-1,500 ft (6.1-457.2 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	230-240 ft (70.1-73.15 m)

Mud Record

Quantity	Material
156 sk (50 lb/22.68 kg ea.)	Mud 2
81 sk (2 lb/0.9 kg ea.)	Mud 25
13 sk (50 lb/22.68 kg ea.)	Causticized lignite
7 sk (50 lb/22.68 kg ea.)	Rayvan (Disperse)
7 sk (40 lb/18.14 kg ea.)	Hy Seal
10 sk (50 lb/22.68 kg ea.)	Fibertex
7 sk (50 lb/22.68 kg ea.)	Cottonseed hulls
1 sk (100 lb/45.36 kg ea.)	Soda ash
13 sk (40 lb/18.14 kg ea.)	Cedarfiber
6 sk (94 lb/42.64 kg ea.)	Portland cement

Geophysical Logs

Gamma	Density
Resistivity	Caliper
Self Potential	

Location: NE1/4NE1/4 sec. 3, T. 13 S., R. 11 W.
Total depth: 1,500 feet (457.2 m).
Spud date: October 11, 1978.
Completion date: November 9, 1978.
Rig: Longyear Model 44 with Bean 35 gpm (132.48 lpm) pump, Boyles Bros. No. 892.
Drill rod size: Boyles Bros. NCWL 3-1/2 inch (8.89 cm) O.D. used from surface to 600 feet (182.88 m). Boyles Bros. NXWL, 2-7/8 inch (7.3 cm) O.D. used from 600 feet (182.88 m) to 1,500 feet (457.2 m).
Core barrel type and size: Boyles Bros. NCWL, 10 feet (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D. used from 10 feet (3.05 cm) to 600 feet (182.88 m). Boyles Bros. NXWL, 10 feet (3.05 m) with bit size of 3 inch (7.62 cm) O.D. x 1-7/8 inch (4.76 cm) I.D. used from 600 feet (182.88 m) to 1,500 feet (457.2 m).
Sample interval(s): Continuous core.
Core recovery: 95%.

Borehole History: SM-29 was rotary drilled to 10 feet (3.05 m) using the NCWL tools and a 5-5/8 inch (14.29 cm) diameter rock bit. A 4 inch (10.16 cm) I.D. casing was then set and NCWL coring 3-3/4 x 2-2/5 inch (9.53 x 6.1 cm) began. Total circulation loss occurred at 203 feet (61.87 m) and could not be restored. NCWL coring continued to 600 feet (182.88 m) with drillers hampered by a tight hole and tool vibration.

The hole was cased to NX 3 inch (7.77 cm) I.D. at 600 feet (182.88 m) in an attempt to regain circulation and seal off the unstable zones. NXWL coring 3 x 1-7/8 inch (7.62 x 4.76 cm) began at 600 feet (182.88 m) and was maintained to a final depth of 1,500 feet (457.2 m). Total circulation was lost again soon after the drillers cored out from under the NX 3 inch (7.77 cm) I.D. casing, with loss continuing to final depth. Hole conditions remained much the same as in the upper portions, in that the hole was quite sticky and had a tendency to squeeze as coring progressed. After drilling and logging operations were completed efforts were made to pull the NX 3 inch (7.77 cm) I.D. casing. The casing was cut at 500 feet (152.4 m) and 300 feet (91.44 m) but pulled apart at 200 feet (60.96 m) resulting in a 380 foot (115.82 m) loss of casing in the hole.

Earthen pits, with plastic linings (Visqueen, 4 mil), were used. Approximate total capacity was 8,000 gallons (30,280 l). No mud properties were recorded but drillers used a mud containing a high percentage of polymers and lignite. Approximate total water usage was 41,000 gallons (155,185 l).

Final abandonment consisted of mud plugging and setting a 20 foot (6.1 m) cement surface plug.

Bit Record

Make	Type	Size	Footage
Christensen	C-2	5-5/8 in. (14.29 cm)	0-10 ft (0-3.05 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	10-95 ft (3.05-28.96 m)
Christensen	NCD-3	3-3/4 in. (9.53 cm)	95-195 ft (28.96-59.44 m)
Christensen	NC	3-3/4 in. (9.53 cm)	195-600 ft (59.44-182.88 m)
Christensen	NXC-3	3 in. (7.62 cm)	600-745 ft (182.88-227.08 m)
Christensen	NXC-3	3 in. (7.62 cm)	745-905 ft (227.08-275.84 m)
Christensen	NXC-3	3 in. (7.62 cm)	905-1,022 ft (275.84-311.51 m)
Christensen	NXC-3	3 in. (7.62 cm)	1,022-1,152 ft (311.51-351.13 m)
Christensen	NXC-3	3 in. (7.62 cm)	1,152-1,500 ft (351.13-457.2 m)

Mud Record

Quantity	Material
192 sk (50 lb/22.68 kg ea.)	Mud 2
149 sk (2 lb/0.9 kg ea.)	Mud 25
2 cts (10 lb/4.54 kg ea.)	PQ 460
1 pail (5 gal/18.9 l ea.)	HME Energizer
13 sk (50 lb/22.68 kg ea.)	Causticized lignite

Geophysical Logs

Gamma	Density	Resistivity
Caliper	Spectral gamma-ray (KUT)	Self Potential
Neutron		

Location: NE1/4NW1/4 sec. 10, T. 13 S., R. 11 W.
Total depth: 1,492 feet (454.76 m).
Spud date: September 24, 1978.
Completion date: October 10, 1978.
Rig: Longyear Model 44 with Bean 35 gpm (132.48 lpm) pump, Boyles Bros. No. 892.
Drill rod size: Boyles Bros. NCWL, 3-1/2 inch (8.89 cm) O.D.
Core barrel type and size: Boyles Bros. NCWL, 10 foot (3.05 m) with bit size of 3-3/4 inch (9.53 cm) O.D. x 2-2/5 inch (6.1 cm) I.D.
Sample interval(s): Continuous core from 20 feet (6.1 m) to 1,492 feet (454.76 m).
Core Recovery: 98%.

Borehole History: SM-30 was rotary drilled to 20 feet (6.1 m) using NCWL tools and a 5-5/8 inch (14.29 cm) diameter rock bit. A 4 inch (10.16 cm) I.D. casing was then set and NCWL coring 3-3/4 x 2-2/5 inch (9.53 x 6.1 cm) began. Coring progressed with good penetration to 1,300 feet (396.24 m) where minor mechanical problems slowed the coring somewhat. These difficulties were overcome and coring proceeded to a final depth of 1,492 feet (454.76 m) without any other appreciable drilling problems.

Circulation loss was common, as with other holes drilled in the area but did not present any problems in the coring. The hole remained open from 20 feet (6.1 m) to 1,492 feet (454.76 m) without additional casing, allowing good logs to be obtained. After drilling and logging operations were completed, the hole was mud plugged and a 20 foot (6.1 m) surface plug set.

Earthen pits, with plastic liners (Visqueen, 4 mil), were used. Approximate total capacity was 8,000 gallons (30,280 l). No mud properties were recorded for this hole. Total approximate water usage was 73,000 gallons (276,305 l).

Bit Record

Make	Type	Size	Footage
Christensen	C-2	5-5/8 in. (14.29 cm)	0-20 ft (0-6.1 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	20-755 ft (6.1-230.12 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	755-1,065 ft (230.12-324.61 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	1,065-1,393 ft (324.61-424.59 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	1,393-1,433 ft (424.59-436.78 m)
Christensen	NCD	3-3/4 in. (9.53 cm)	1,433-1,492 ft (436.78-454.76 m)

Mud Record

Quantity	Material
134 sk (50 lb/22.68 kg ea.)	Mud 2
86 sk (2 lb/0.9 kg ea.)	Mud 25
7 sk (50 lb/22.68 kg ea.)	Causticized lignite
2 pails (5 gal/18.9 ea.)	HME Energizer
2 ct (10 lb/4.54 kg ea.)	PQ 460
2 sk (94 lb/42.64 kg ea.)	Portland cement

Deviation Tests

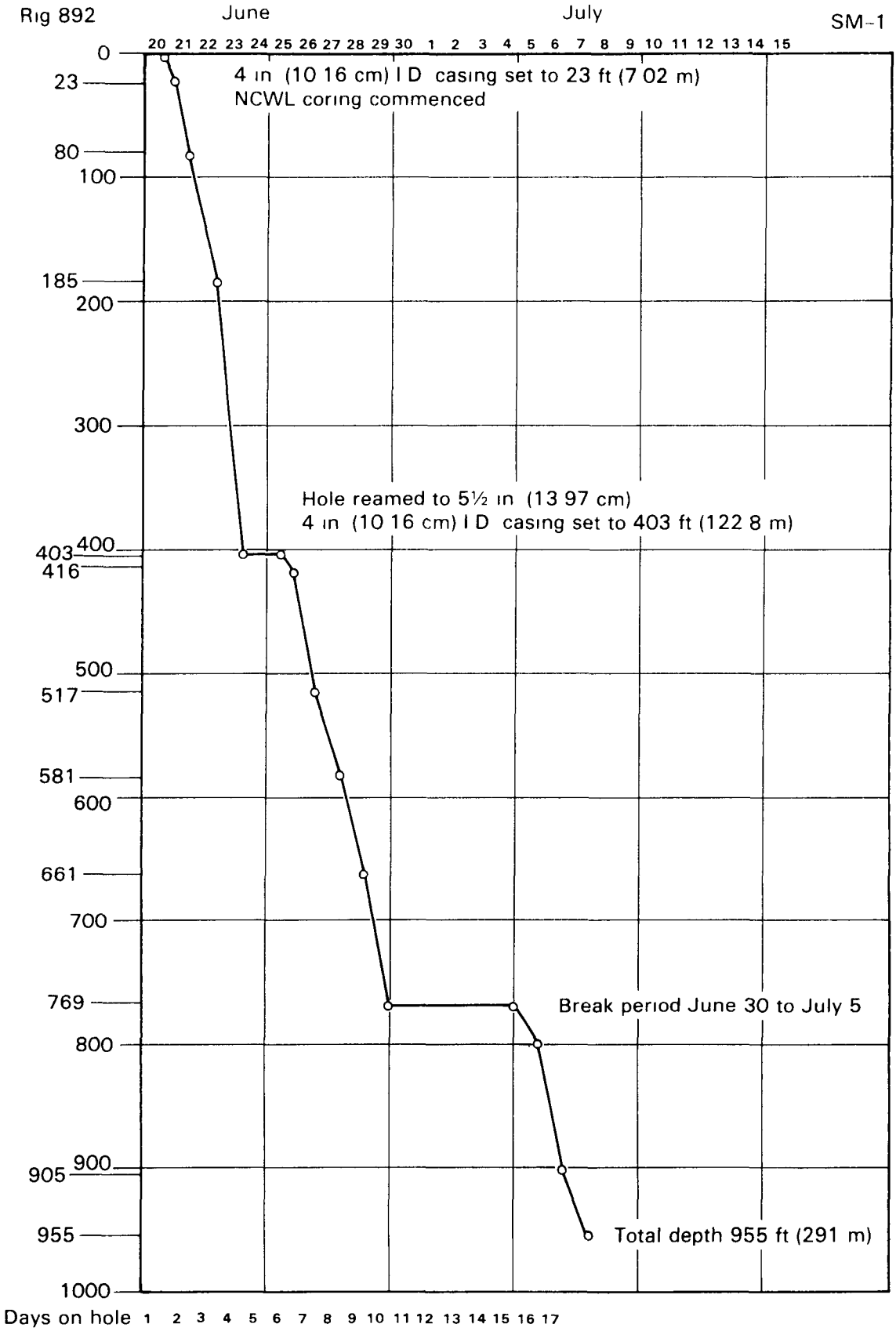
Depth	Degree of Drift
400 ft (121.92 m)	1°
755 ft (230.12 m)	1-3/4°
1,200 ft (365.76 m)	1-3/4°

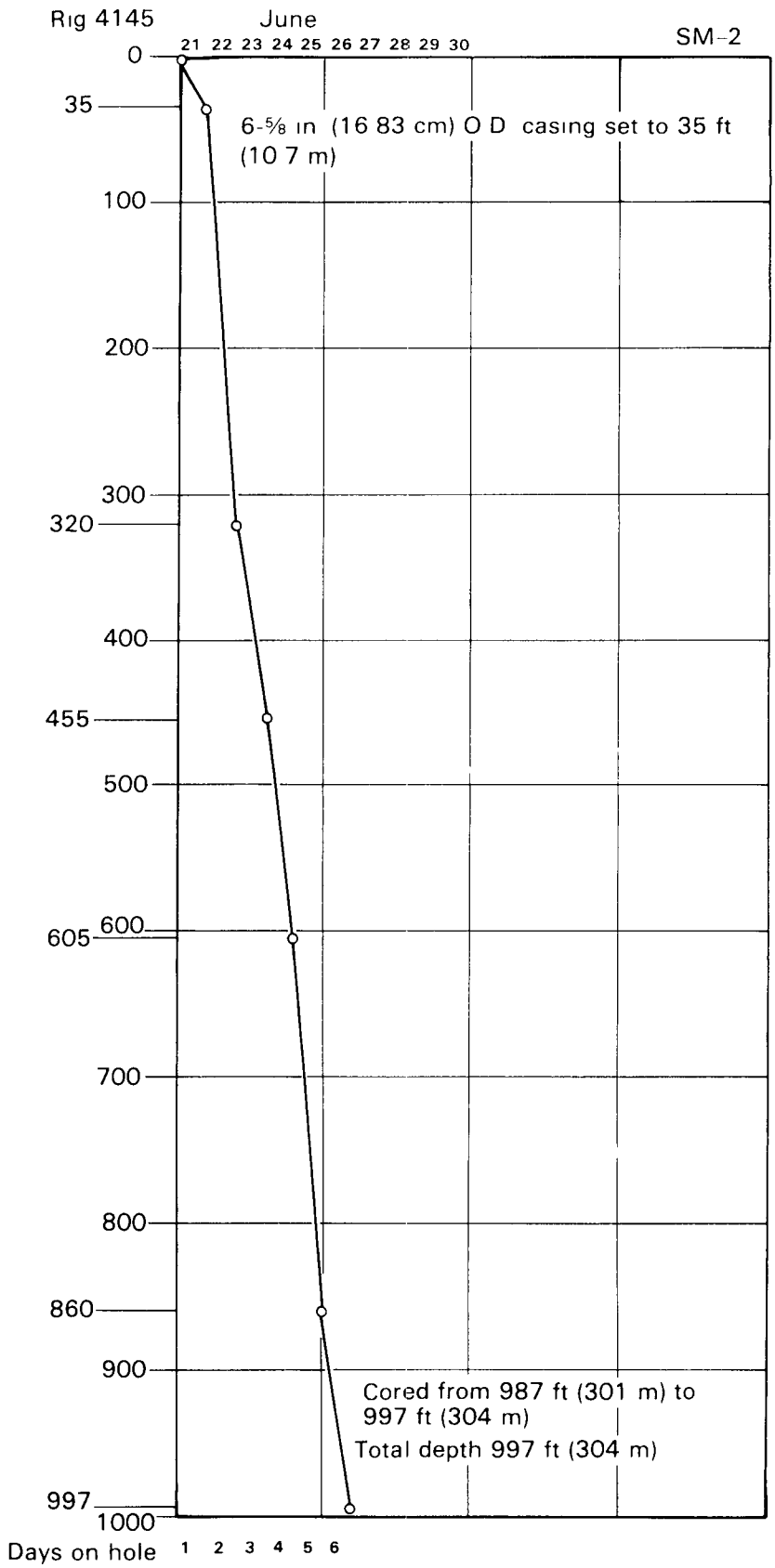
Geophysical Logs

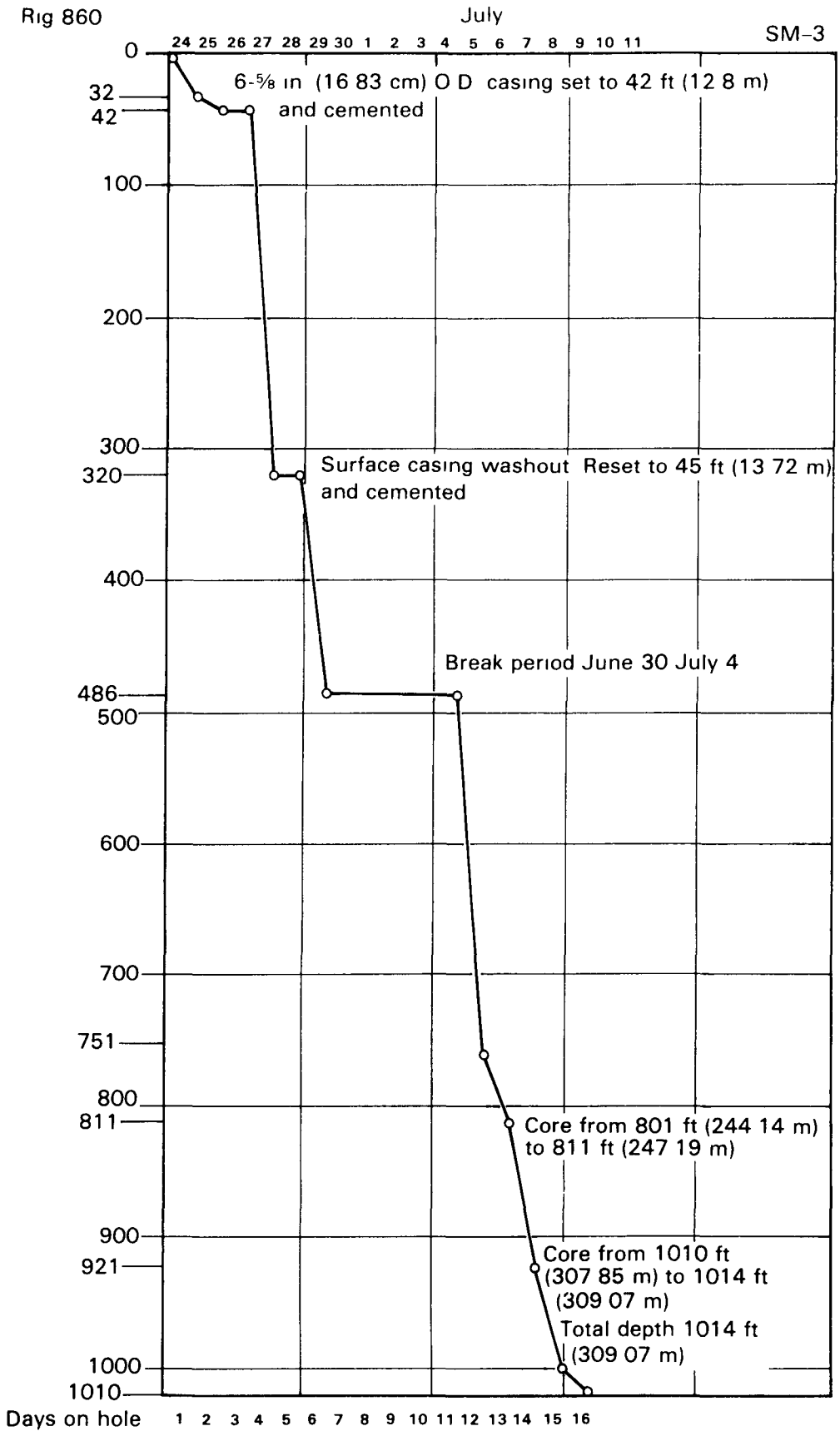
Gamma	Density
Resistivity	Caliper
Self Potential	

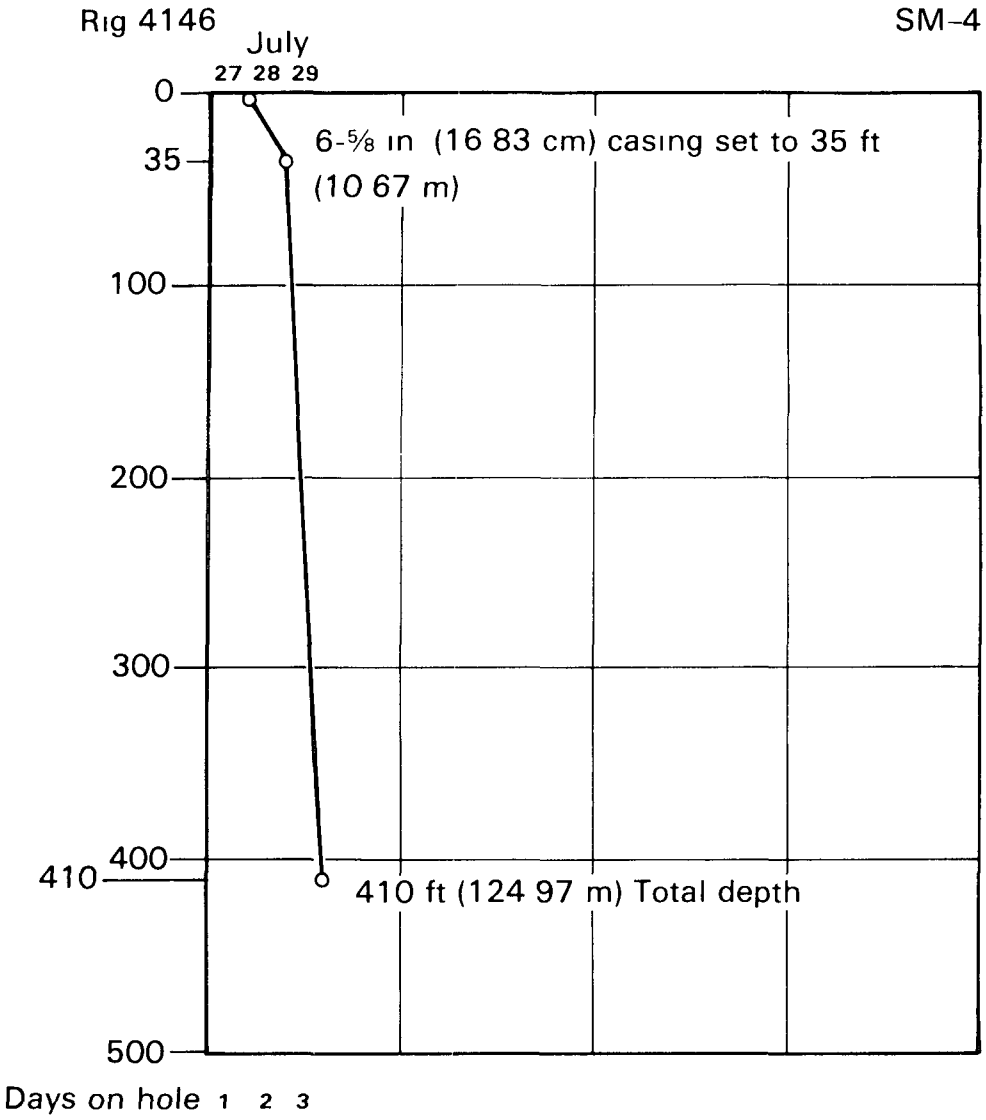
APPENDIX A

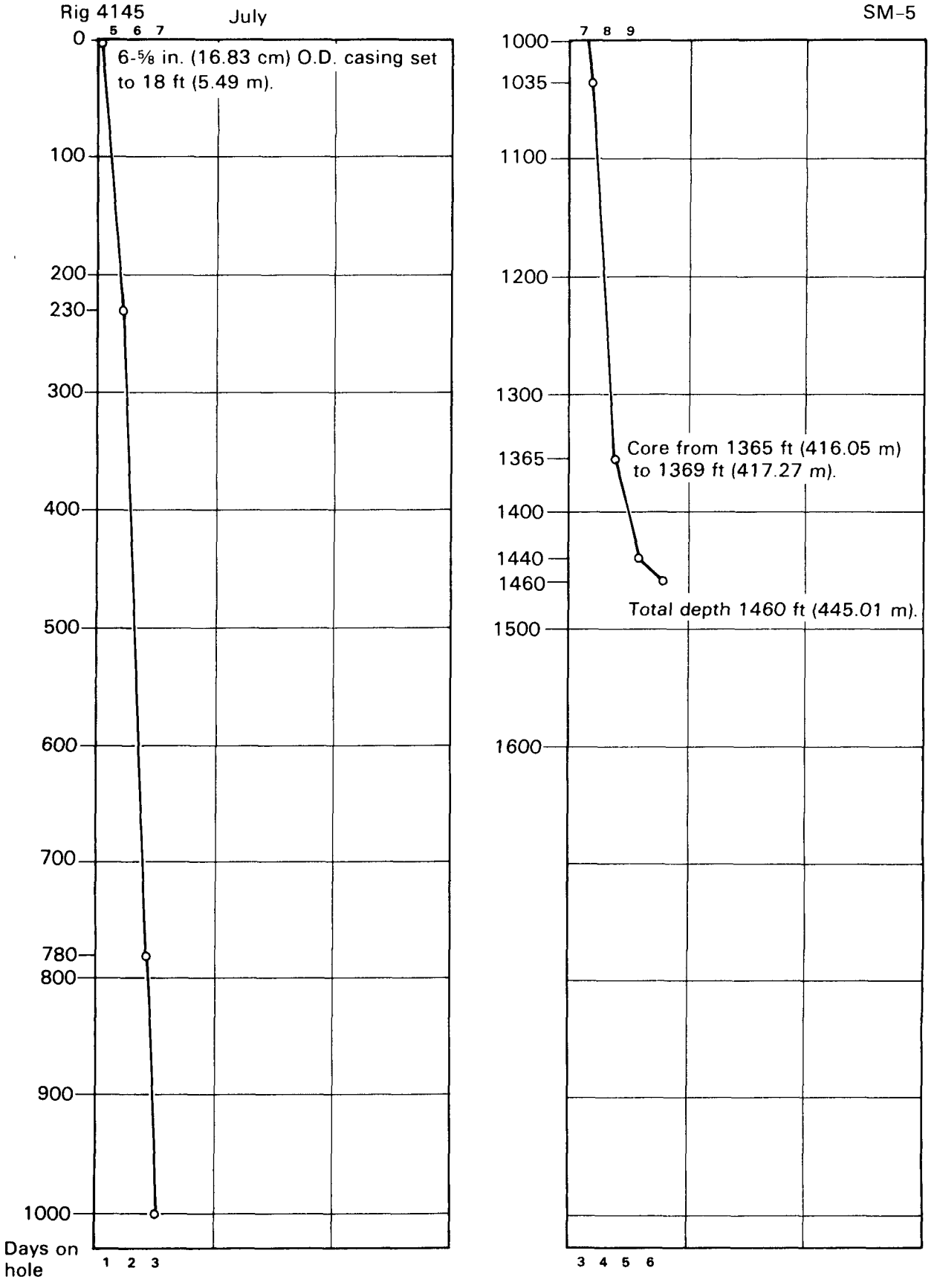
Daily Progress Summary Charts

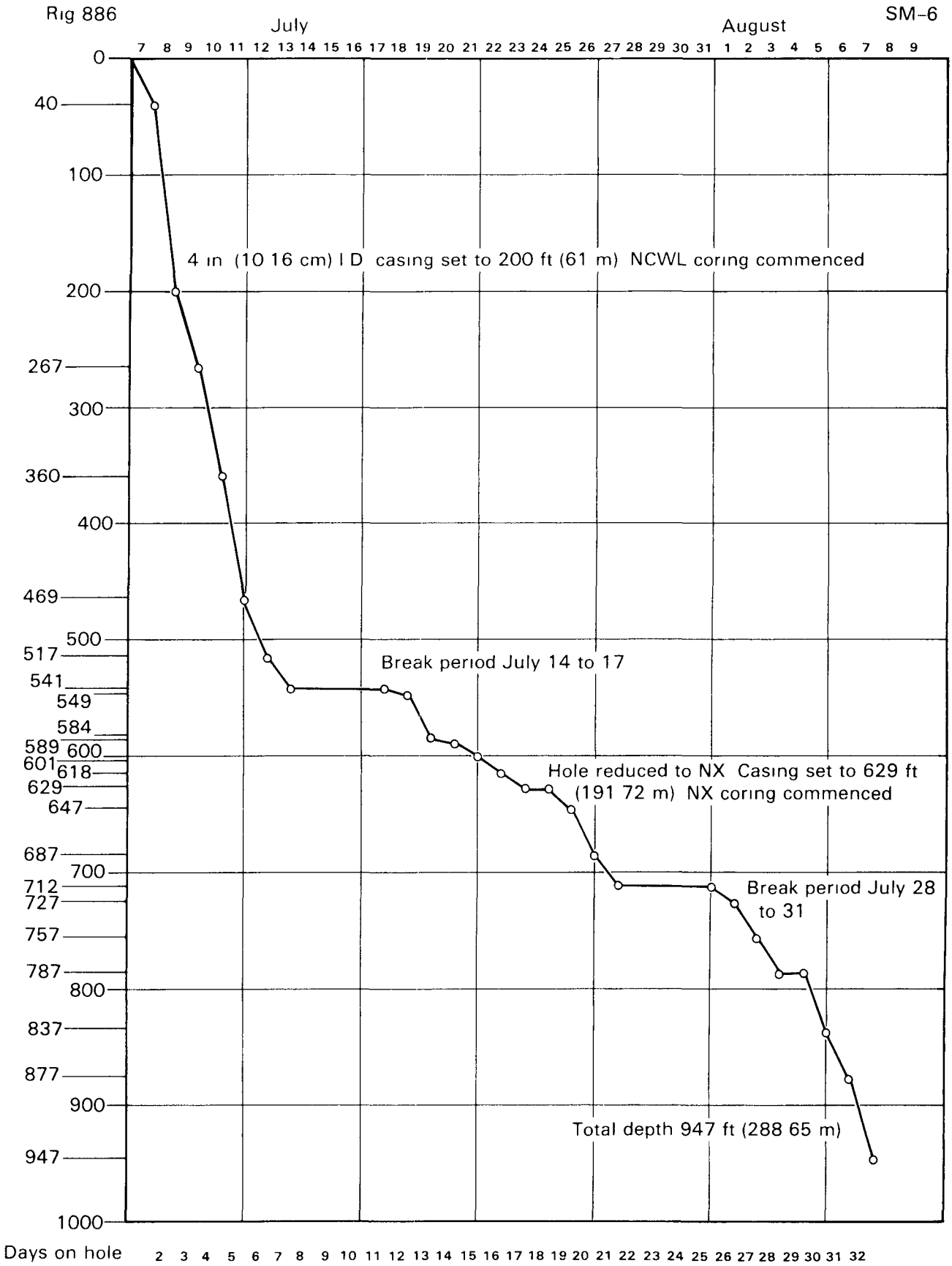

Rig 892
June
July
SM-1
20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0
23
80
100
185
200
300
400
403
416
500
517
581
600
661
700
769
800
900
905
955
1000
4 in (10 16 cm) I D casing set to 23 ft (7 02 m)
NCWL coring commenced
Hole reamed to 5½ in (13 97 cm)
4 in (10 16 cm) I D casing set to 403 ft (122 8 m)
Break period June 30 to July 5
Total depth 955 ft (291 m)
Days on hole 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

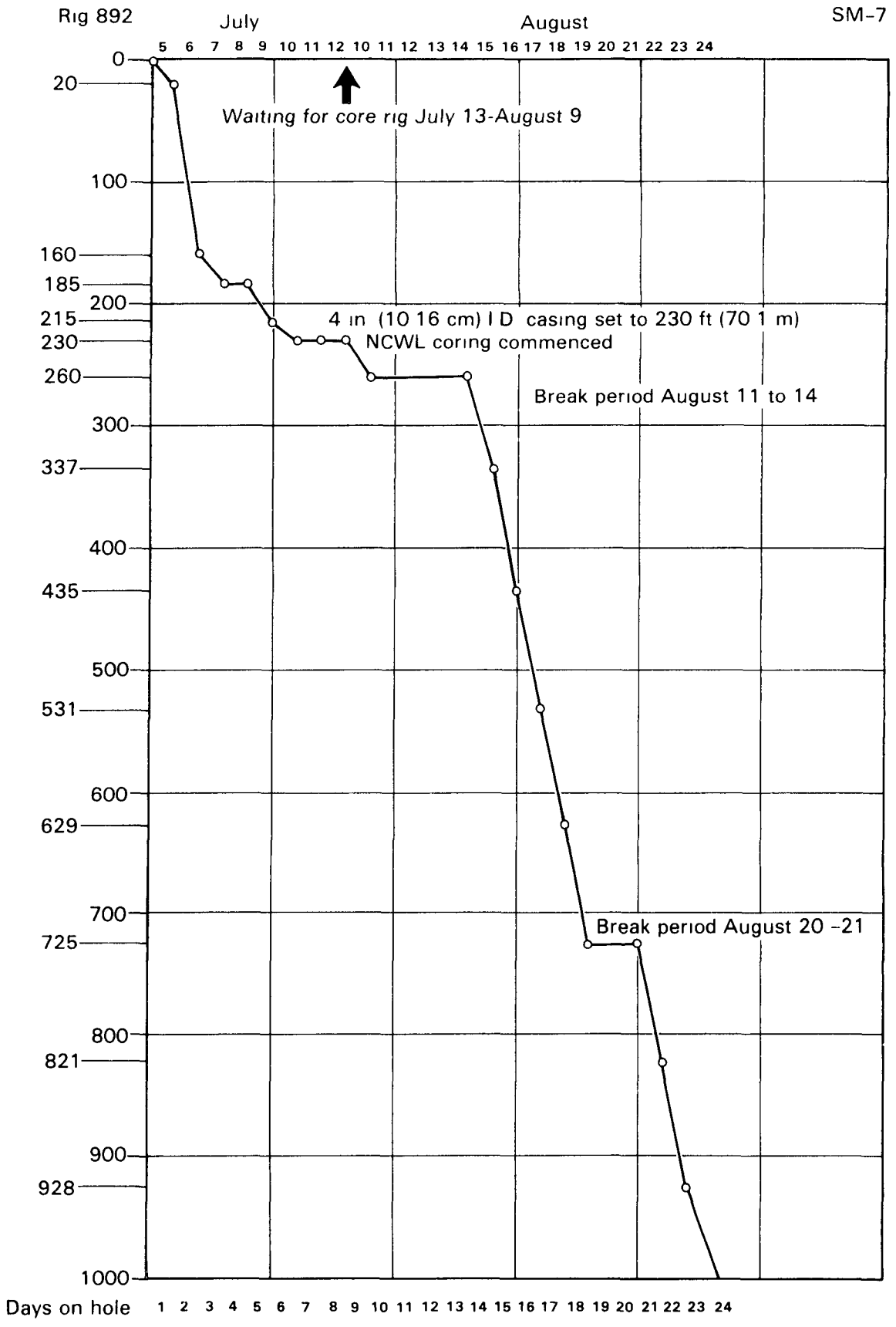

Rig 4145
June
21 22 23 24 25 26 27 28 29 30
SM-2
0
35
100
200
300
320
400
455
500
600
605
700
800
860
900
997
1000
6-⅝ in (16 83 cm) O D casing set to 35 ft
(10 7 m)
Cored from 987 ft (301 m) to
997 ft (304 m)
Total depth 997 ft (304 m)
Days on hole 1 2 3 4 5 6

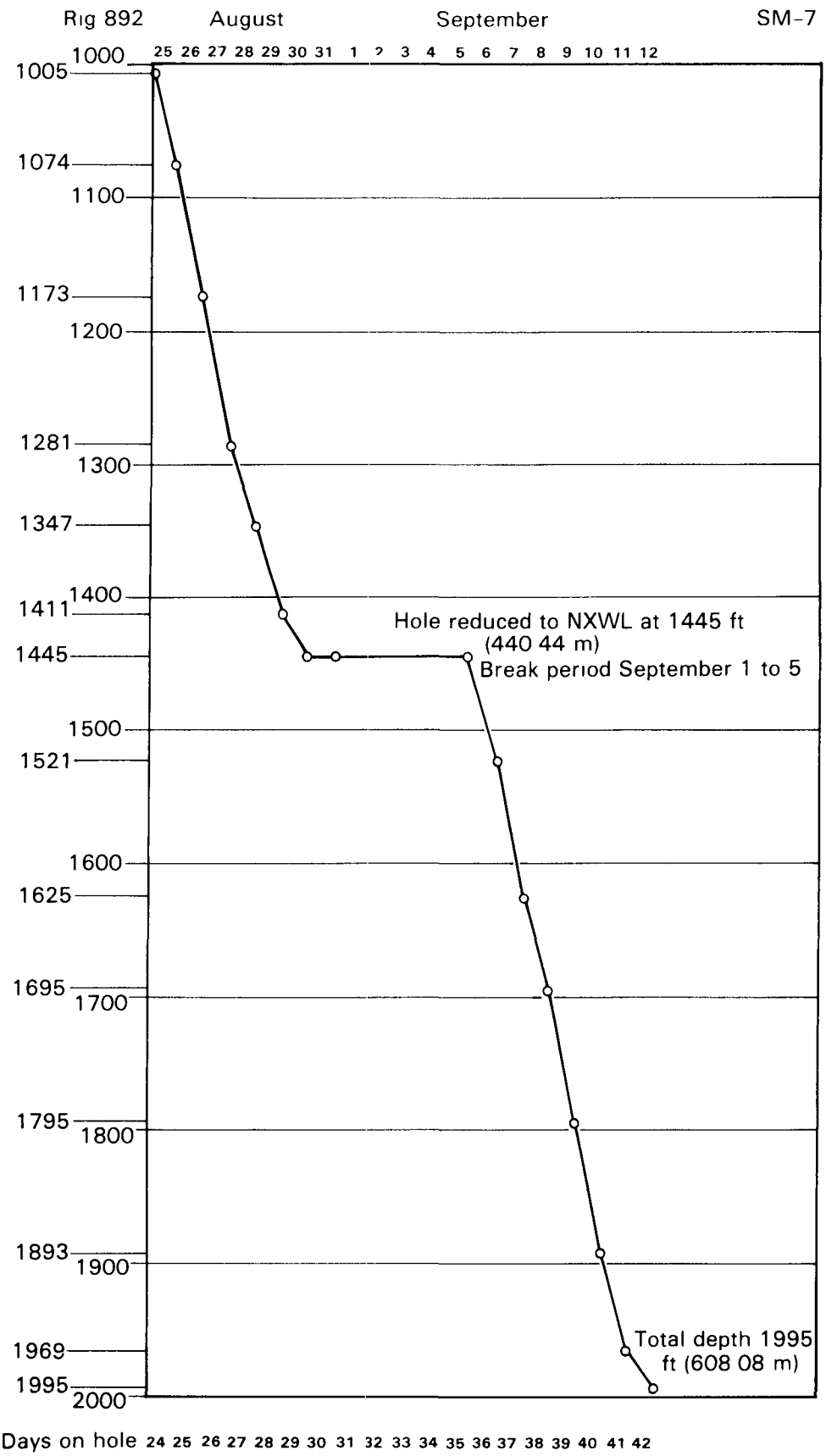

Rig 860
July
SM-3
24 25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11
0
32
42
100
200
300
320
400
486
500
600
700
751
800
811
900
921
1000
1010
6-⅝ in (16 83 cm) O D casing set to 42 ft (12 8 m) and cemented
Surface casing washout Reset to 45 ft (13 72 m) and cemented
Break period June 30 July 4
Core from 801 ft (244 14 m) to 811 ft (247 19 m)
Core from 1010 ft (307 85 m) to 1014 ft (309 07 m)
Total depth 1014 ft (309 07 m)
Days on hole
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

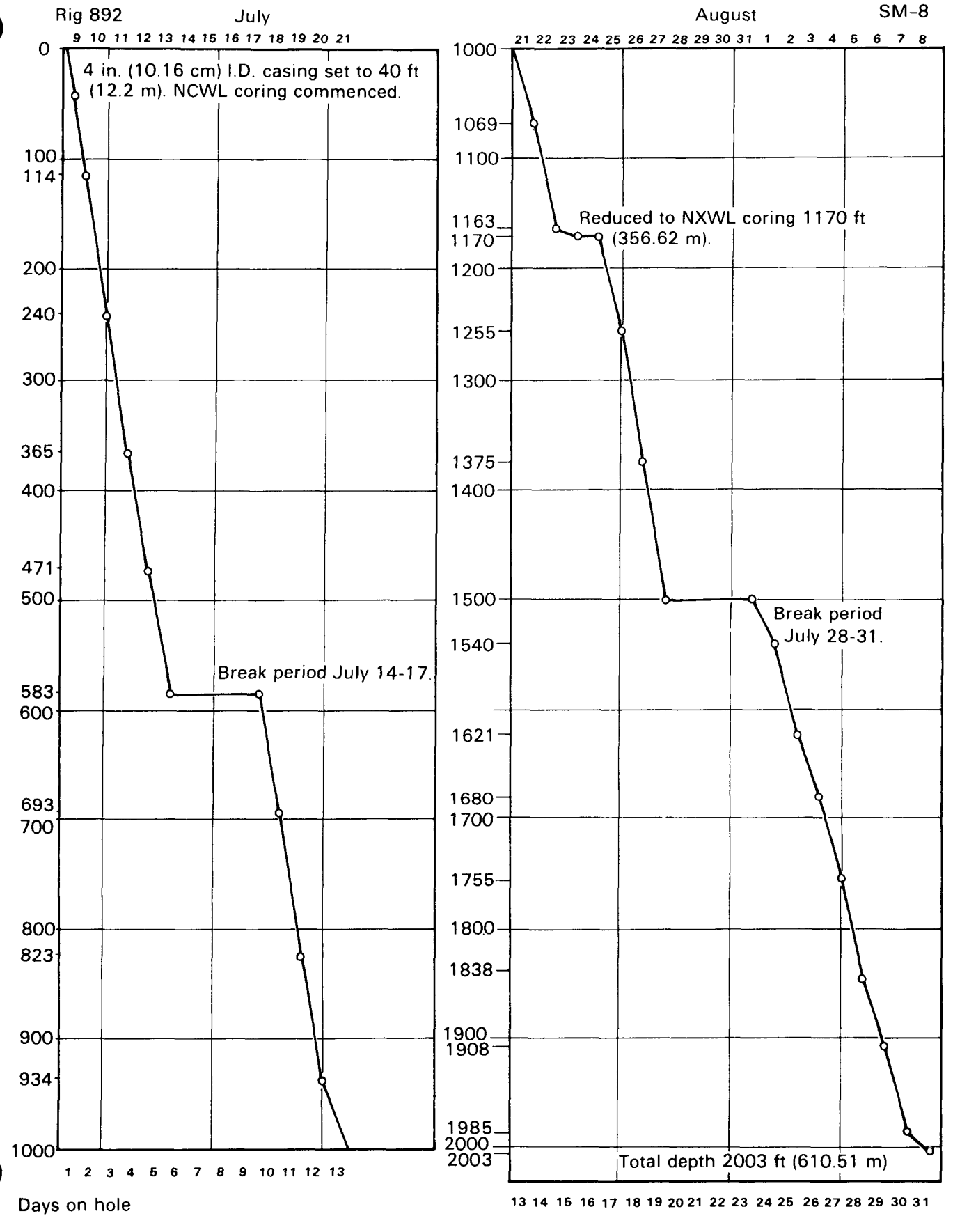

Rig 4146
SM-4
July
27 28 29
0
35
100
200
300
400
410
500
6-⅝ in (16 83 cm) casing set to 35 ft
(10 67 m)
410 ft (124 97 m) Total depth
Days on hole 1 2 3

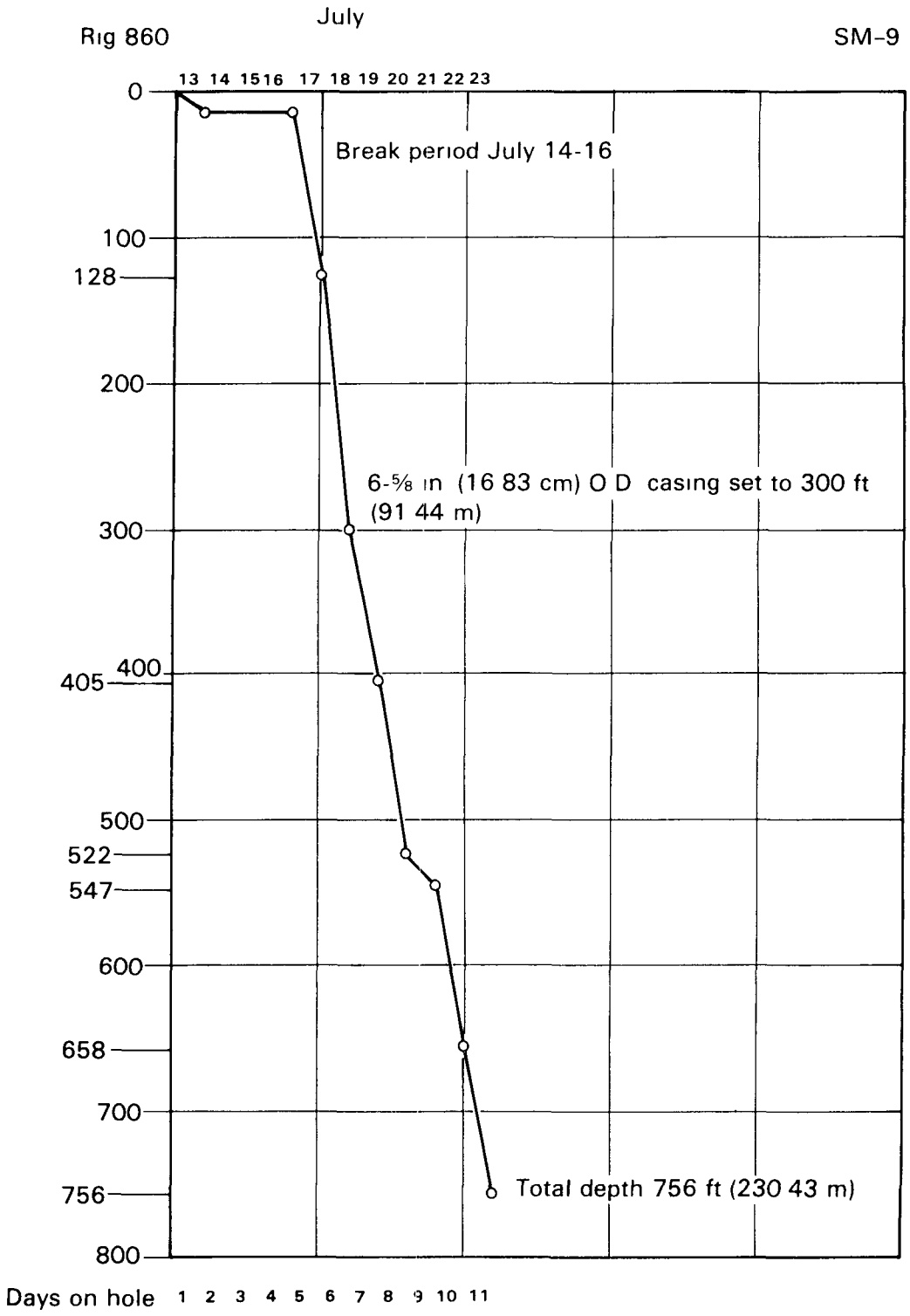

Rig 4145
July
SM-5
0
5 6 7
6-⅝ in. (16.83 cm) O.D. casing set to 18 ft (5.49 m).
100
200
230
300
400
500
600
700
780
800
900
1000
Days on hole
1 2 3
1000
7 8 9
1035
1100
1200
1300
1365
Core from 1365 ft (416.05 m) to 1369 ft (417.27 m).
1400
1440
1460
Total depth 1460 ft (445.01 m).
1500
1600
3 4 5 6


Rig 886
SM-6
July
August
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9
0
40
100
200
267
300
360
400
469
500
517
541
549
584
589
600
601
618
629
647
687
700
712
727
757
787
800
837
877
900
947
1000
4 in (10 16 cm) I D casing set to 200 ft (61 m) NCWL coring commenced
Break period July 14 to 17
Hole reduced to NX Casing set to 629 ft
(191 72 m) NX coring commenced
Break period July 28
to 31
Total depth 947 ft (288 65 m)
Days on hole
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

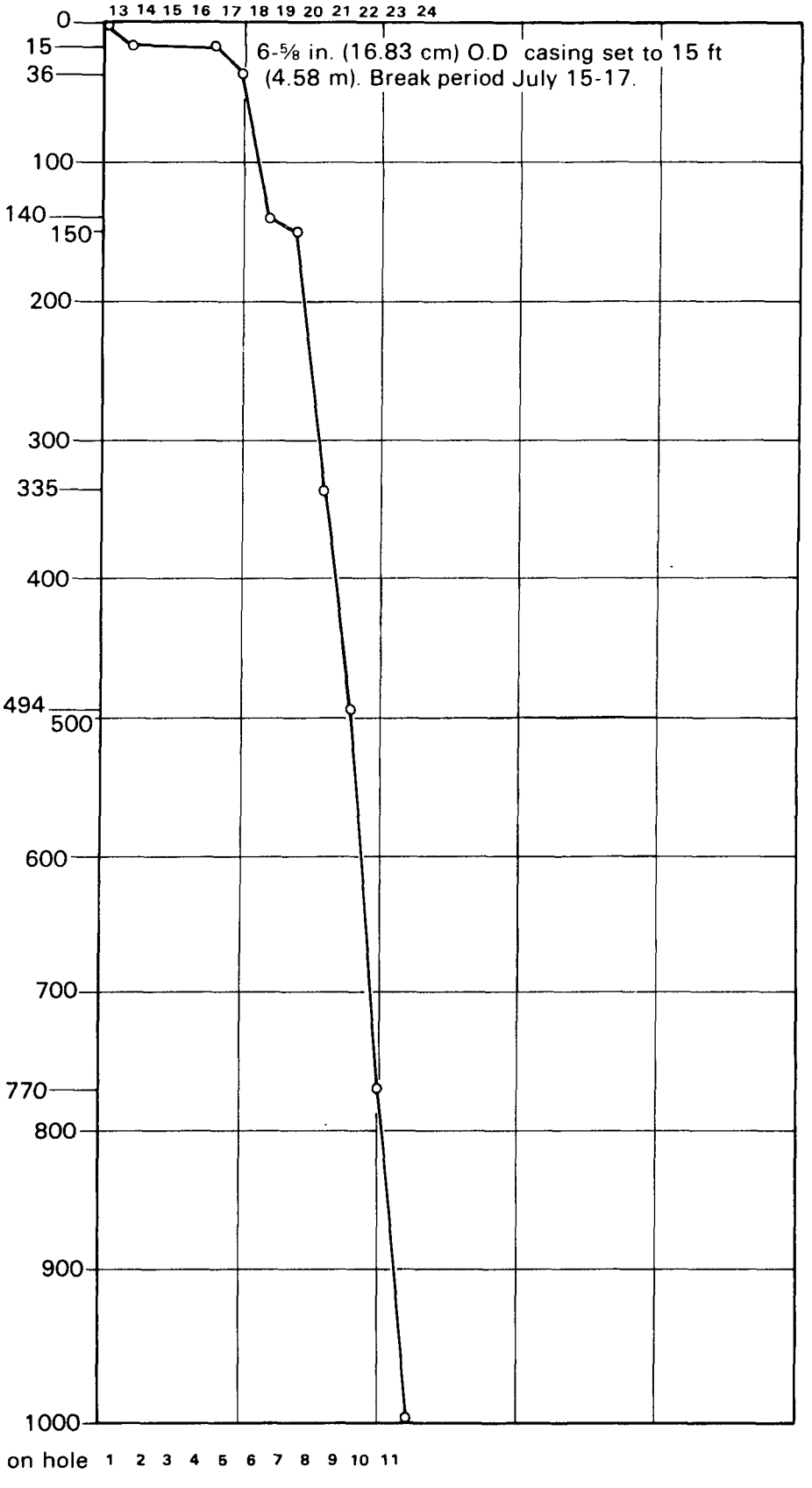

Rig 892
July
August
SM-7
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
0
20
100
160
185
200
215
230
260
300
337
400
435
500
531
600
629
700
725
800
821
900
928
1000
Waiting for core rig July 13-August 9
4 in (10 16 cm) I D casing set to 230 ft (70 1 m)
NCWL coring commenced
Break period August 11 to 14
Break period August 20 -21
Days on hole 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

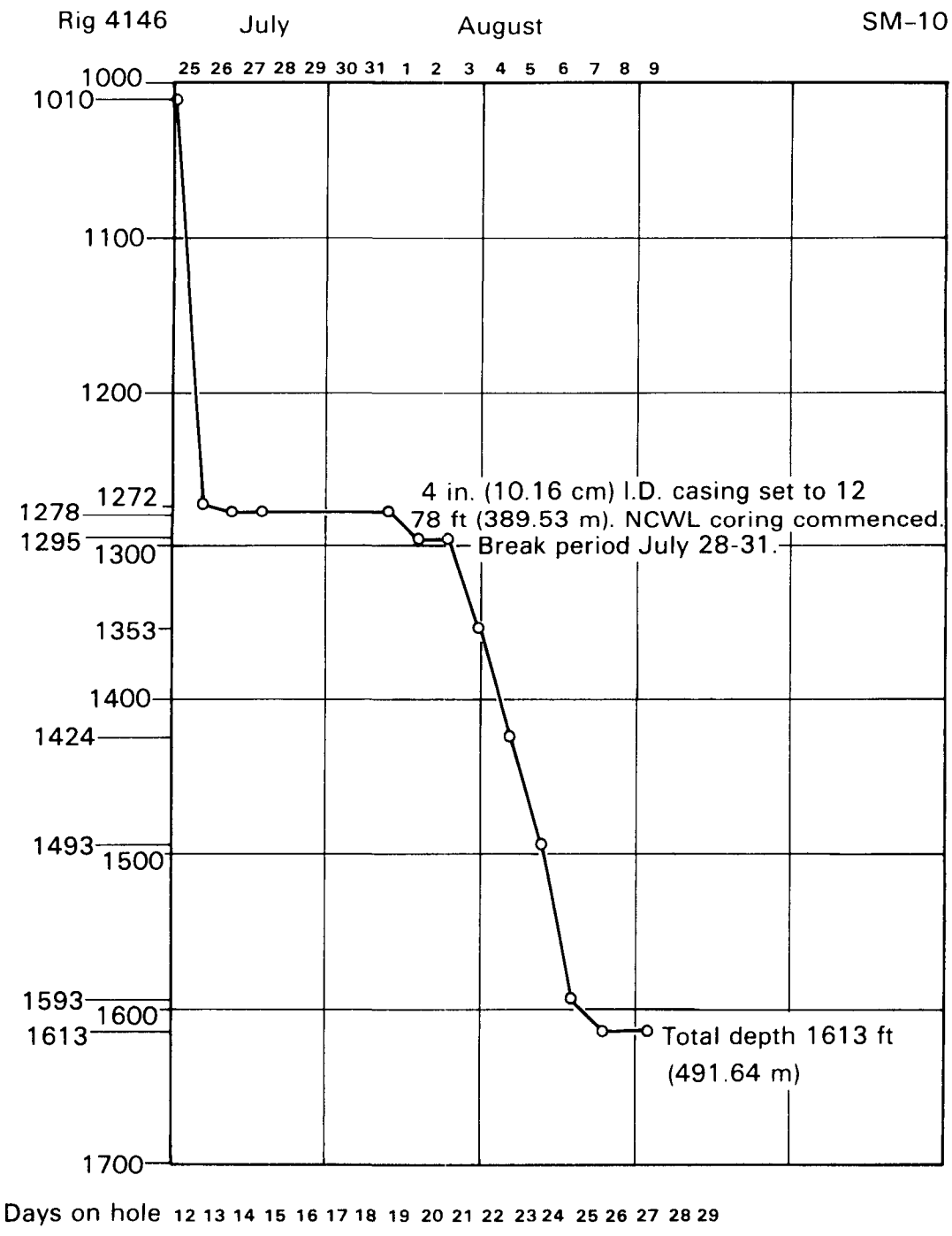

Rig 892
August
September
SM-7
25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12
1000
1005
1074
1100
1173
1200
1281
1300
1347
1400
1411
1445
1500
1521
1600
1625
1695
1700
1795
1800
1893
1900
1969
1995
2000
Hole reduced to NXWL at 1445 ft
(440 44 m)
Break period September 1 to 5
Total depth 1995
ft (608 08 m)
Days on hole 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42


Rig 892
July
August
SM-8
9 10 11 12 13 14 15 16 17 18 19 20 21
21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8
0
100
114
200
240
300
365
400
471
500
583
600
693
700
800
823
900
934
1000
1000
1069
1100
1163
1170
1200
1255
1300
1375
1400
1500
1540
1621
1680
1700
1755
1800
1838
1900
1908
1985
2000
2003
4 in. (10.16 cm) I.D. casing set to 40 ft (12.2 m). NCWL coring commenced.
Reduced to NXWL coring 1170 ft (356.62 m).
Break period July 14-17.
Break period July 28-31.
Total depth 2003 ft (610.51 m)
1 2 3 4 5 6 7 8 9 10 11 12 13
13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Days on hole

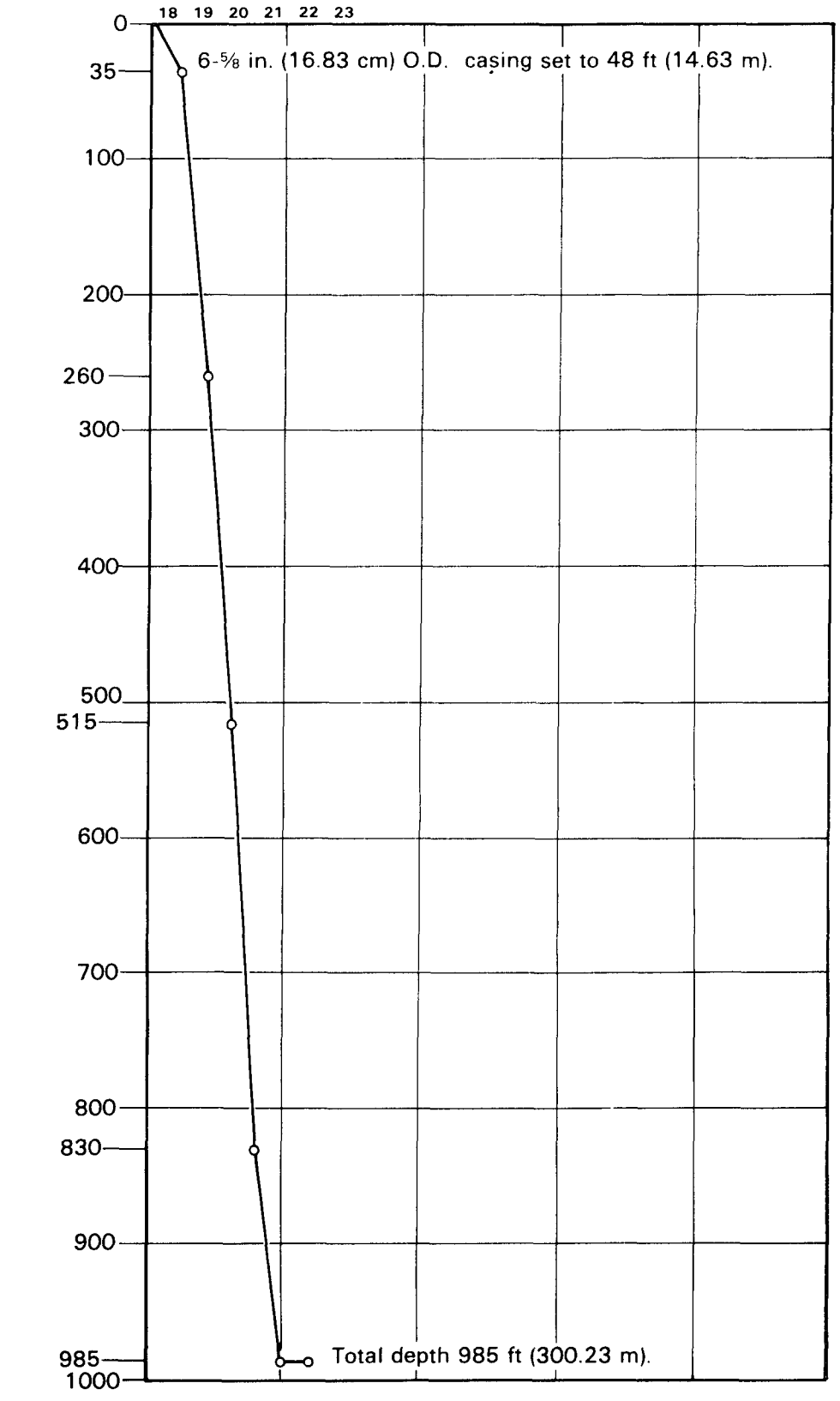

July
Rig 860
SM-9
13 14 15 16 17 18 19 20 21 22 23
0
Break period July 14-16
100
128
200
6-⅝ in (16 83 cm) O D casing set to 300 ft
(91 44 m)
300
400
405
500
522
547
600
658
700
756
Total depth 756 ft (230 43 m)
800
Days on hole 1 2 3 4 5 6 7 8 9 10 11

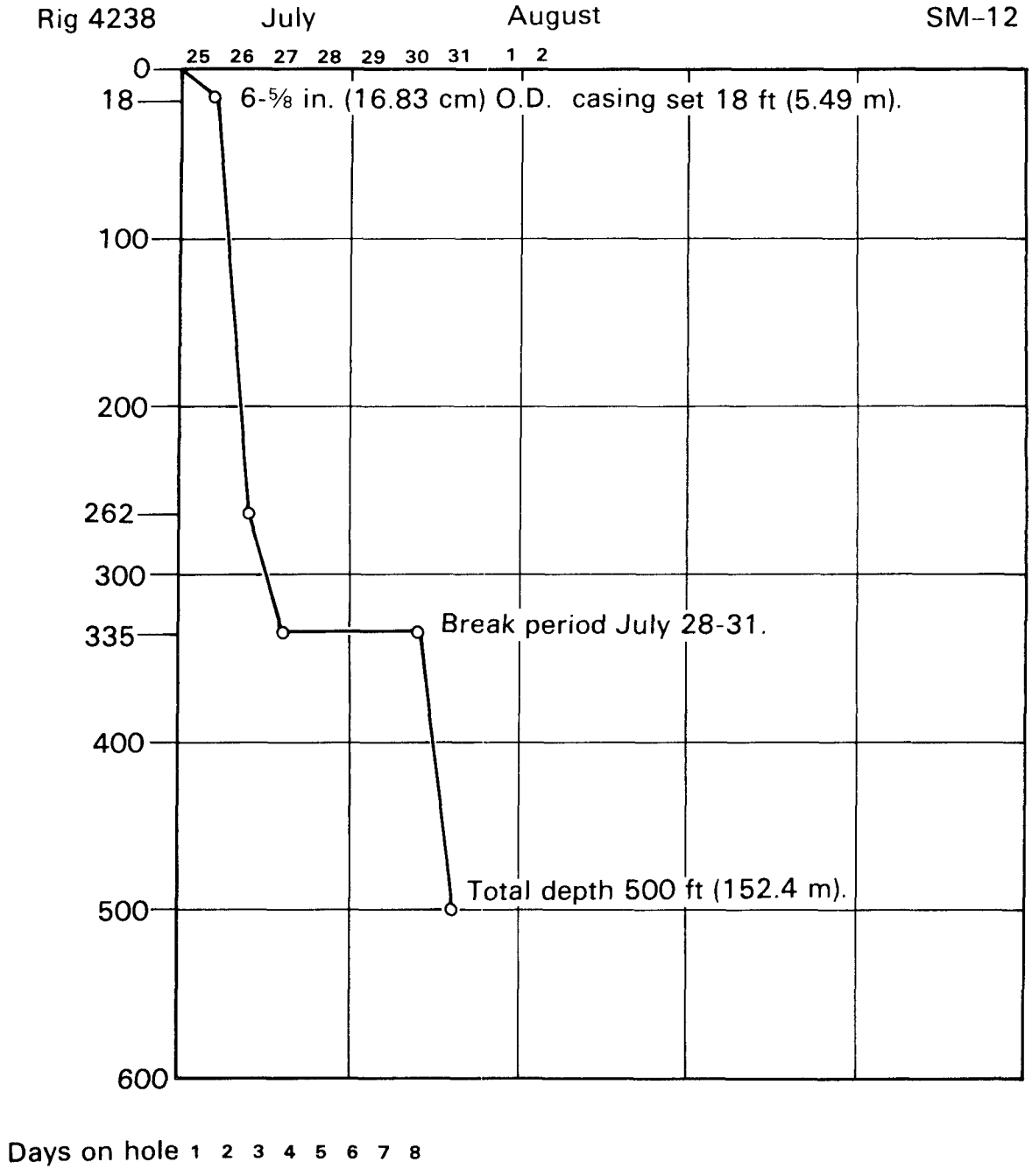
Rig 4146 July SM-10

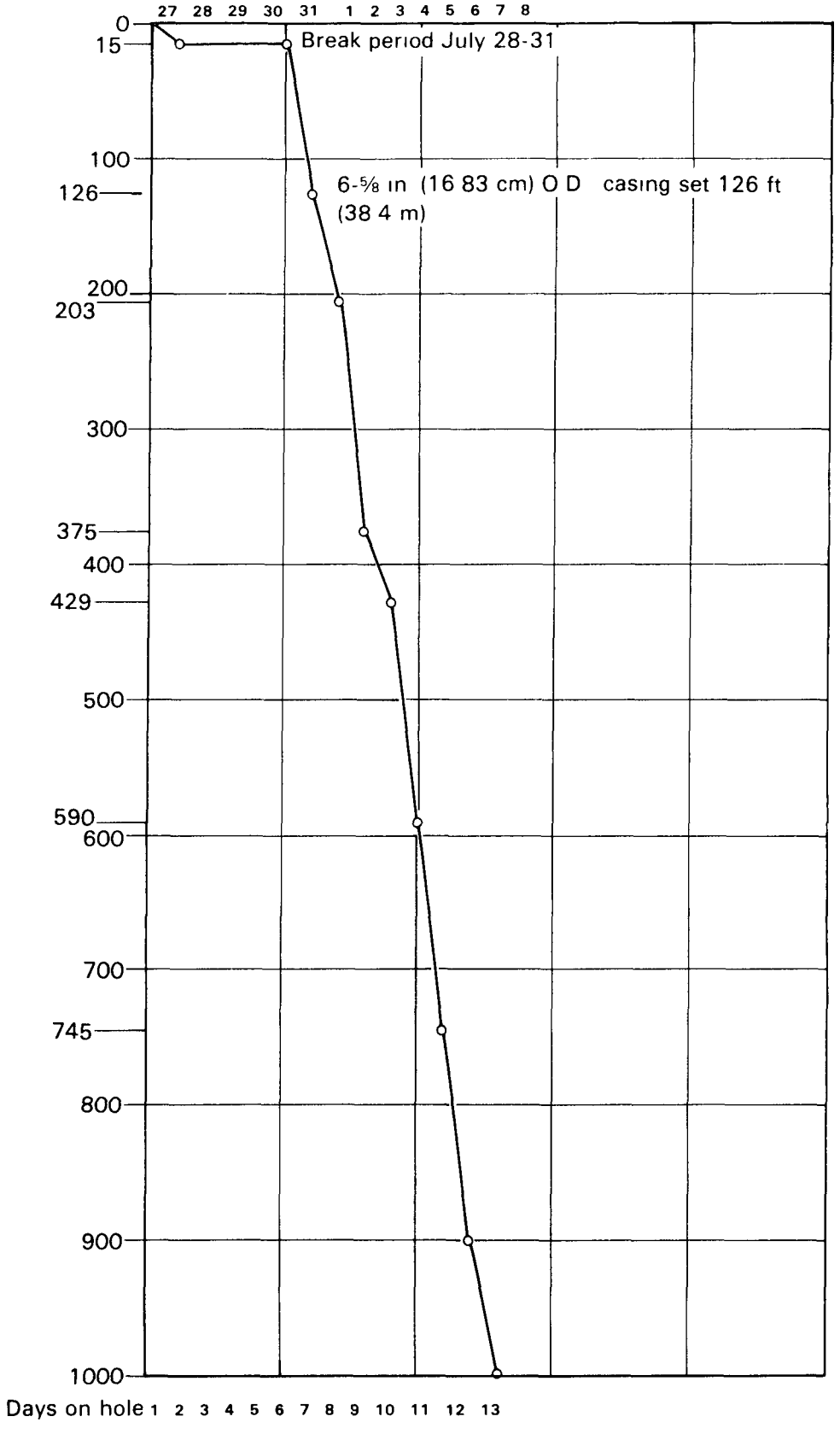


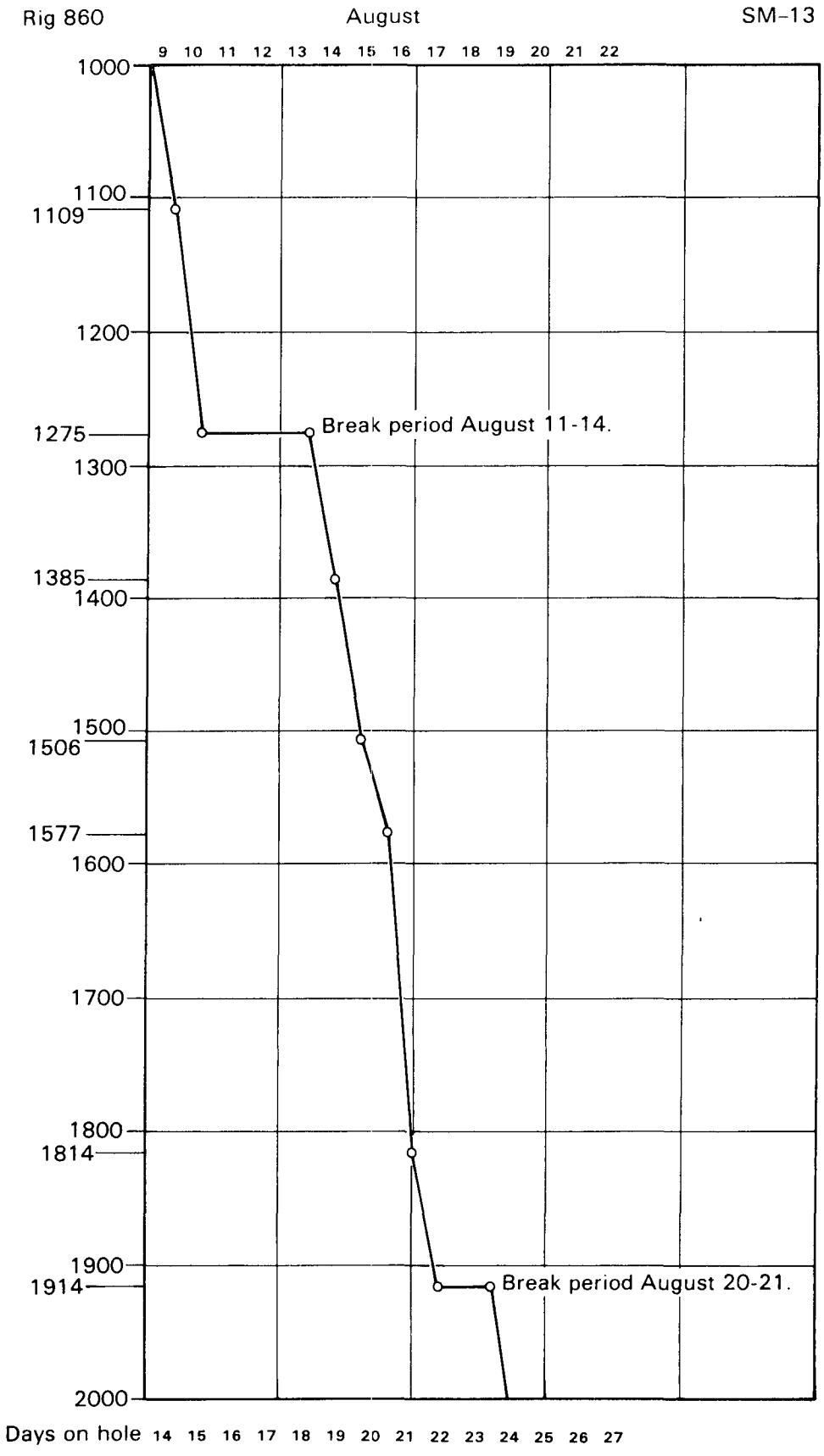

Rig 4146
July
August
SM-10
25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9
1000
1010
1100
1200
1272
1278
1295
1300
1353
1400
1424
1493
1500
1593
1600
1613
1700
4 in. (10.16 cm) I.D. casing set to 12
78 ft (389.53 m). NCWL coring commenced.
Break period July 28-31.
Total depth 1613 ft
(491.64 m)
Days on hole 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

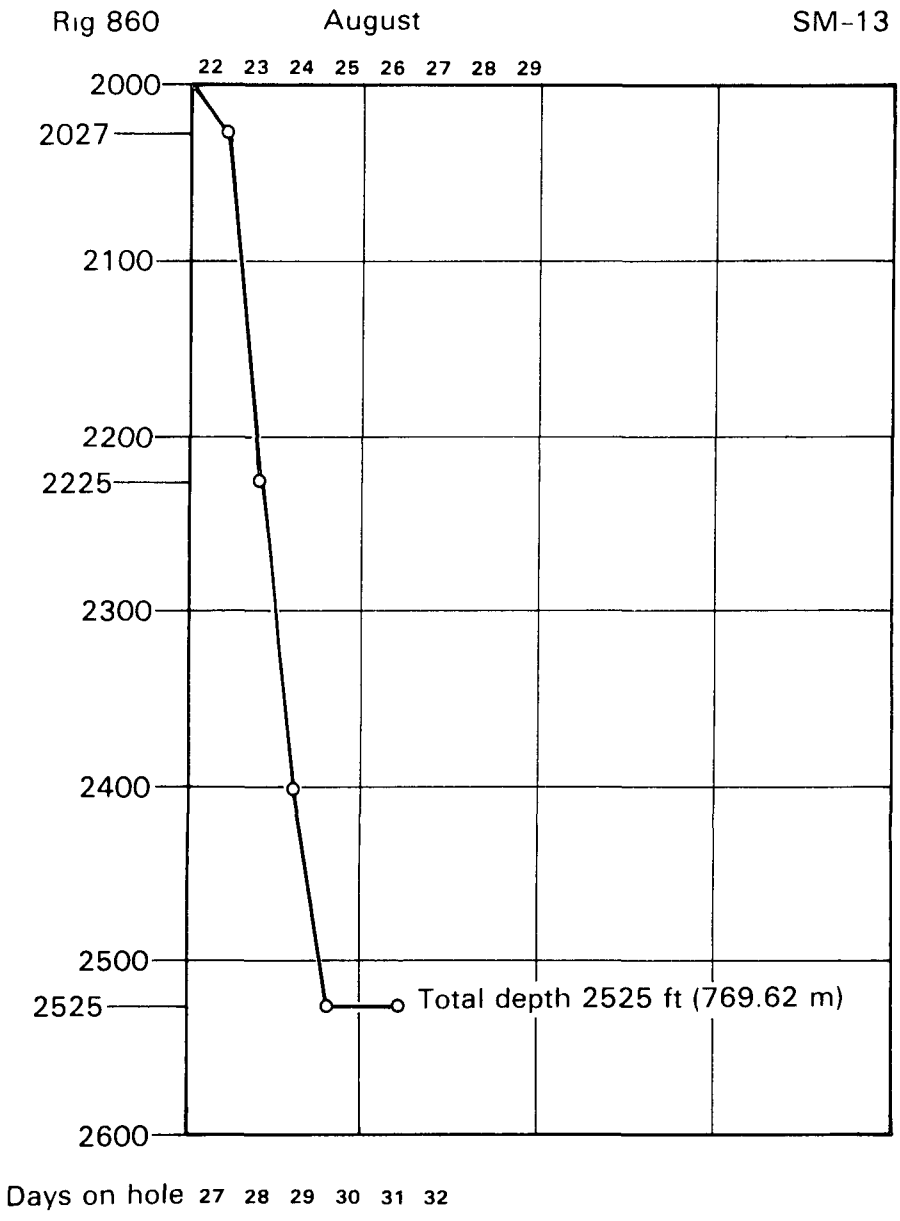
Rig 4238 October SM-11



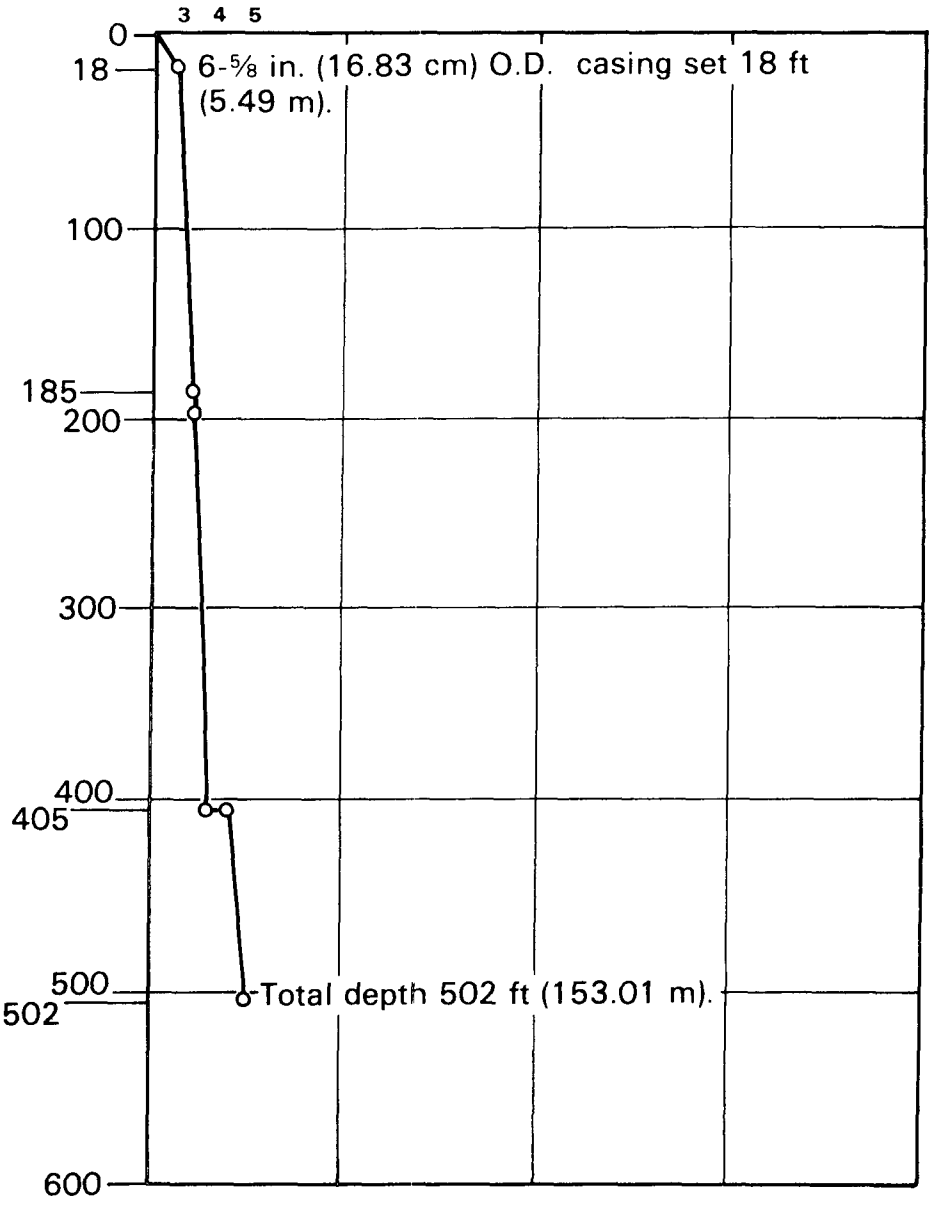

Rig 4238
July
August
SM-12
25 26 27 28 29 30 31 1 2
0
18
100
200
262
300
335
400
500
600
6-⅝ in. (16.83 cm) O.D. casing set 18 ft (5.49 m).
Break period July 28-31.
Total depth 500 ft (152.4 m).
Days on hole 1 2 3 4 5 6 7 8


Rig 860
July
August
SM-13
27 28 29 30 31 1 2 3 4 5 6 7 8
0
15
100
126
200
203
300
375
400
429
500
590
600
700
745
800
900
1000
Break period July 28-31
6-⅝ in (16 83 cm) O D casing set 126 ft
(38 4 m)
Days on hole 1 2 3 4 5 6 7 8 9 10 11 12 13


Rig 860
August
SM-13
9 10 11 12 13 14 15 16 17 18 19 20 21 22
1000
1100
1109
1200
1275
1300
1385
1400
1500
1506
1577
1600
1700
1800
1814
1900
1914
2000
Break period August 11-14.
Break period August 20-21.
Days on hole 14 15 16 17 18 19 20 21 22 23 24 25 26 27

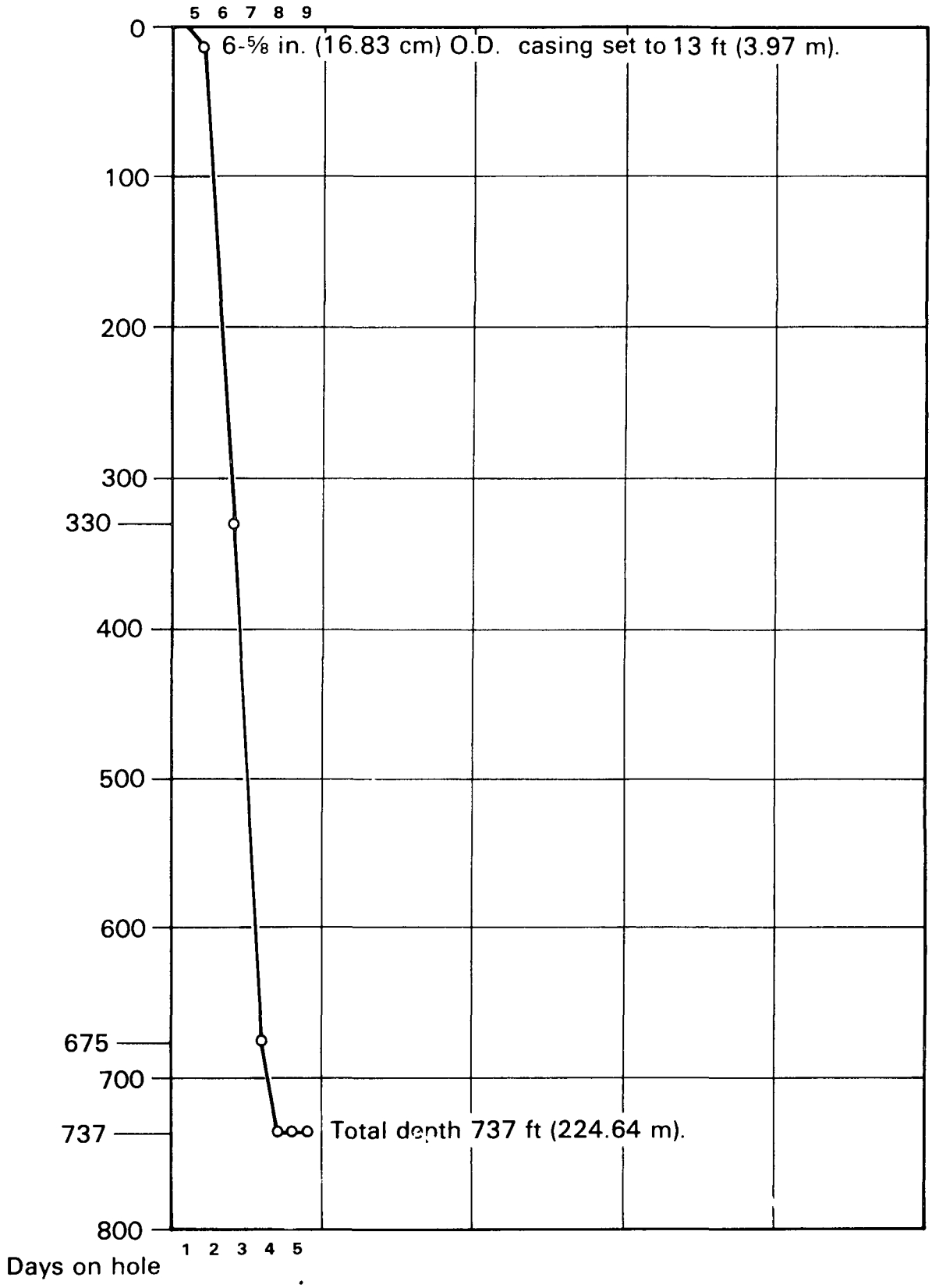

Rig 860
August
SM-13
22 23 24 25 26 27 28 29
2000
2027
2100
2200
2225
2300
2400
2500
2525
2600
Total depth 2525 ft (769.62 m)
Days on hole 27 28 29 30 31 32

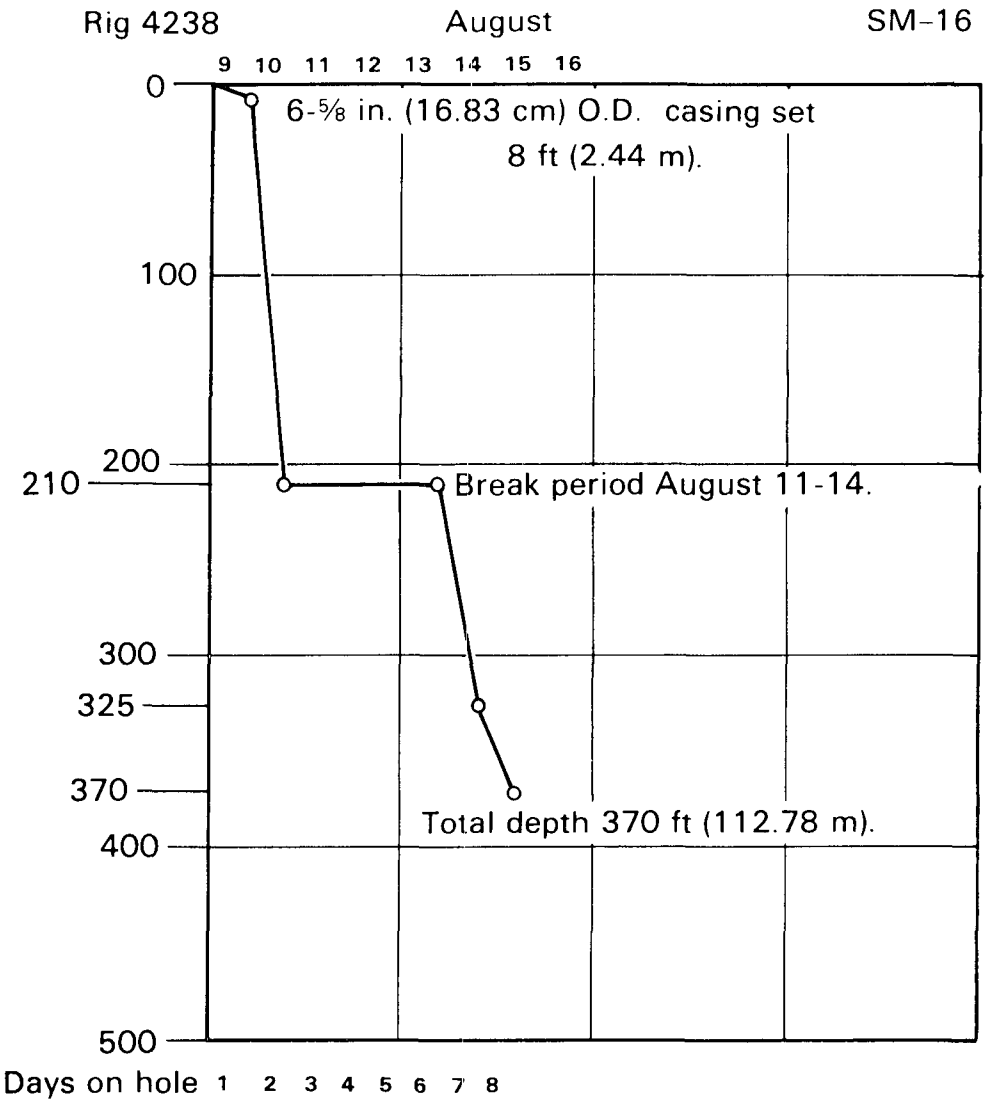
Rig 4238 August SM-14



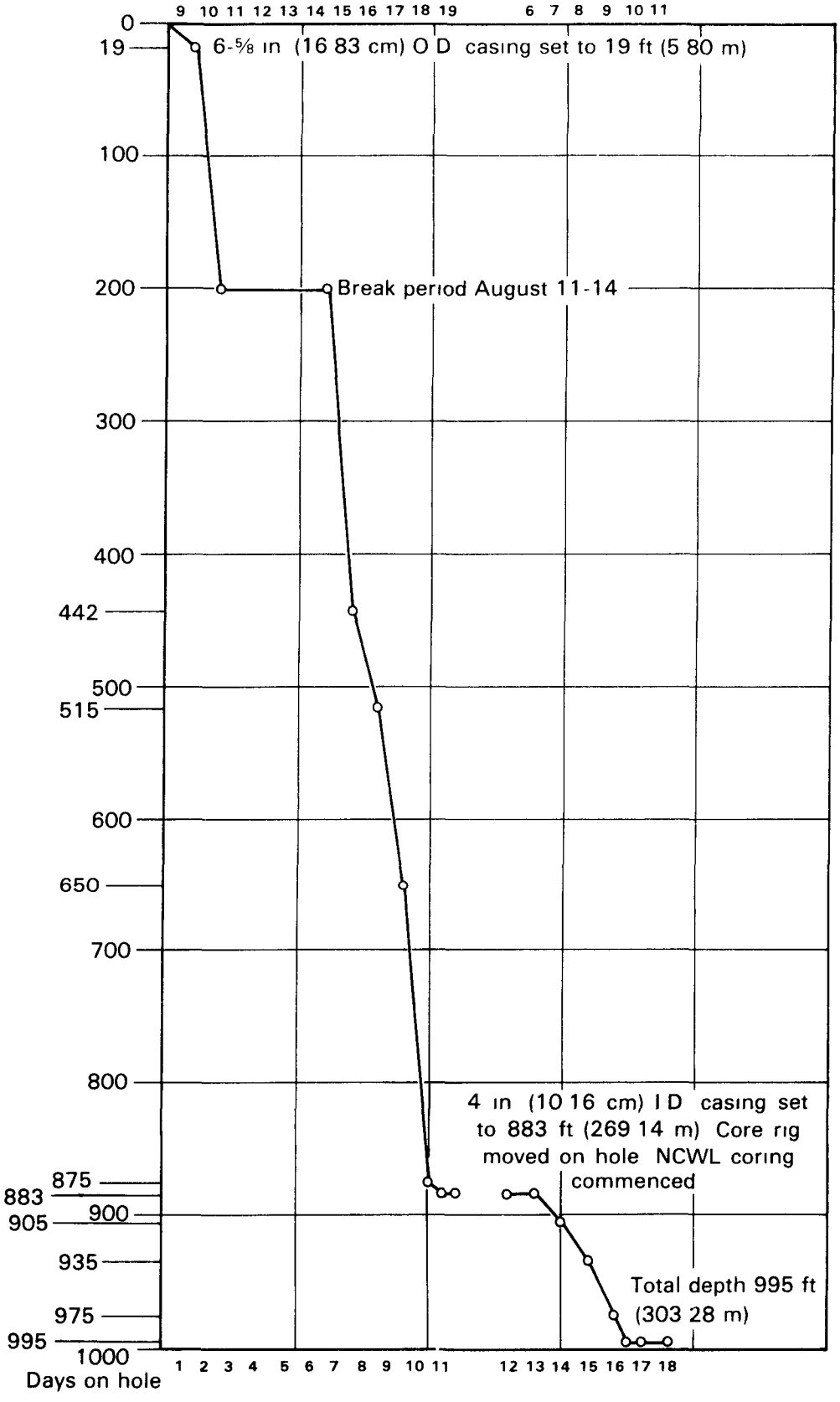
Days on hole 1 2 3

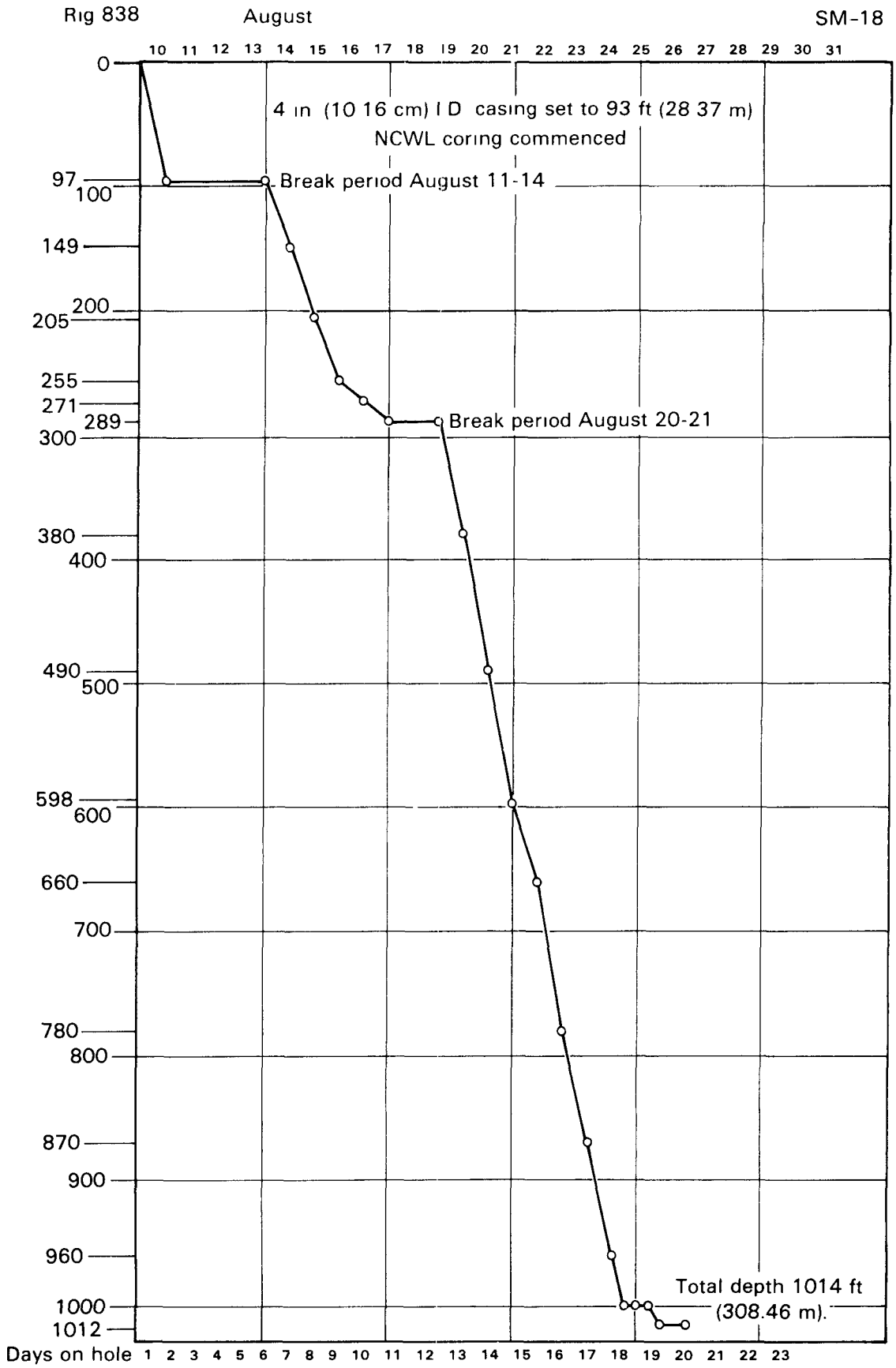
Rig 4238 August SM-15

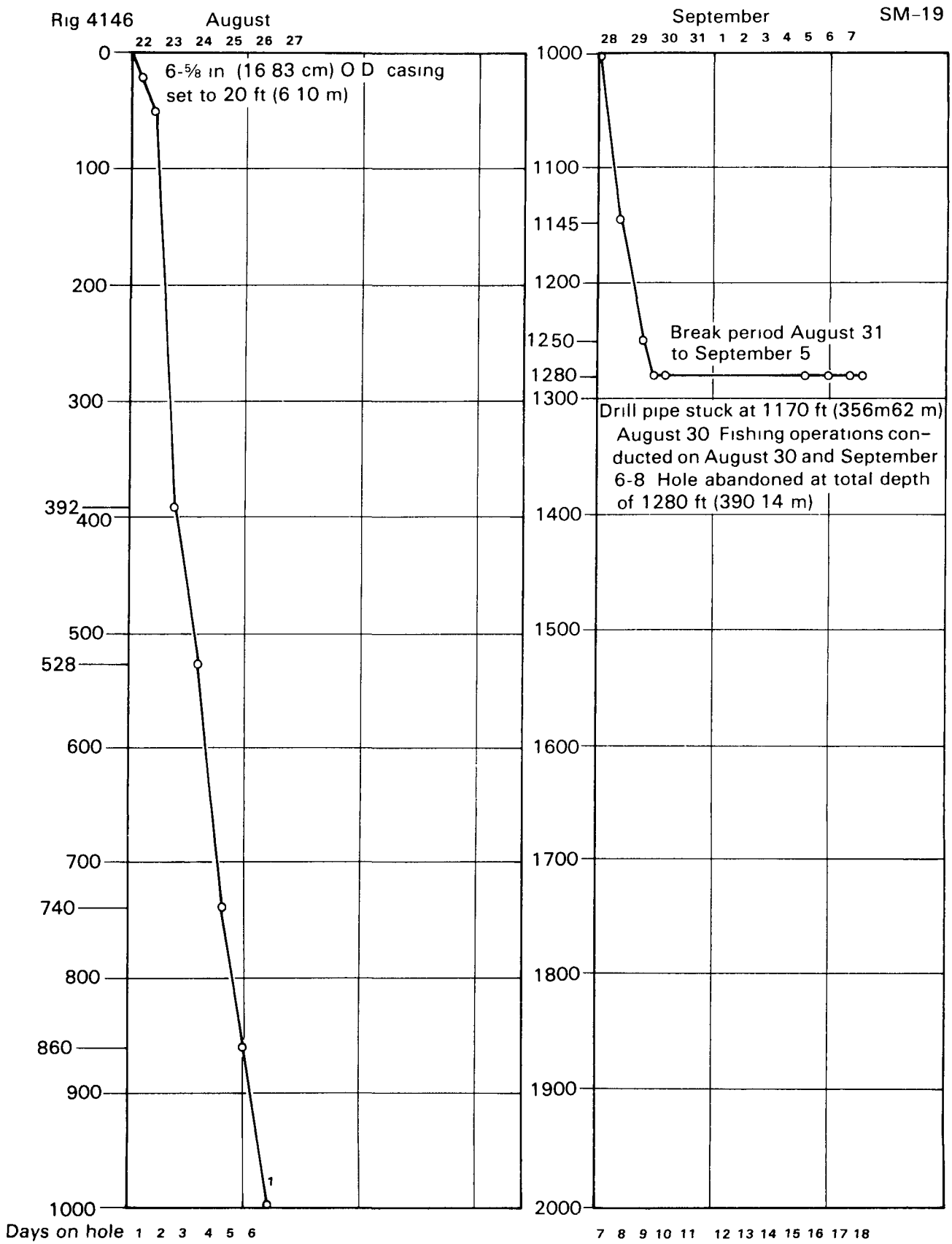


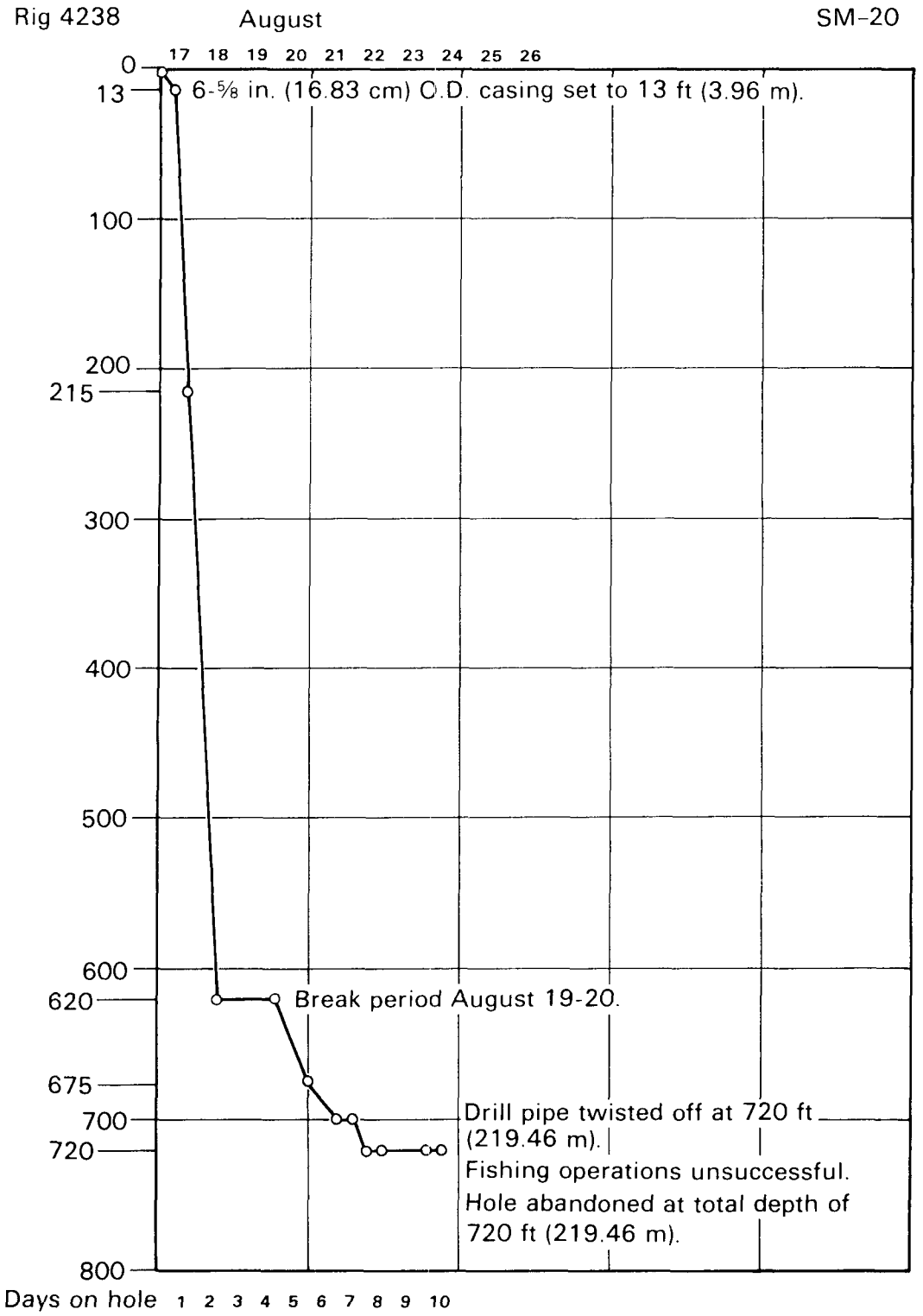

Rig 4238
August
SM-16
9 10 11 12 13 14 15 16
0
100
200
210
300
325
370
400
500
6-⅝ in. (16.83 cm) O.D. casing set
8 ft (2.44 m).
Break period August 11-14.
Total depth 370 ft (112.78 m).
Days on hole 1 2 3 4 5 6 7 8

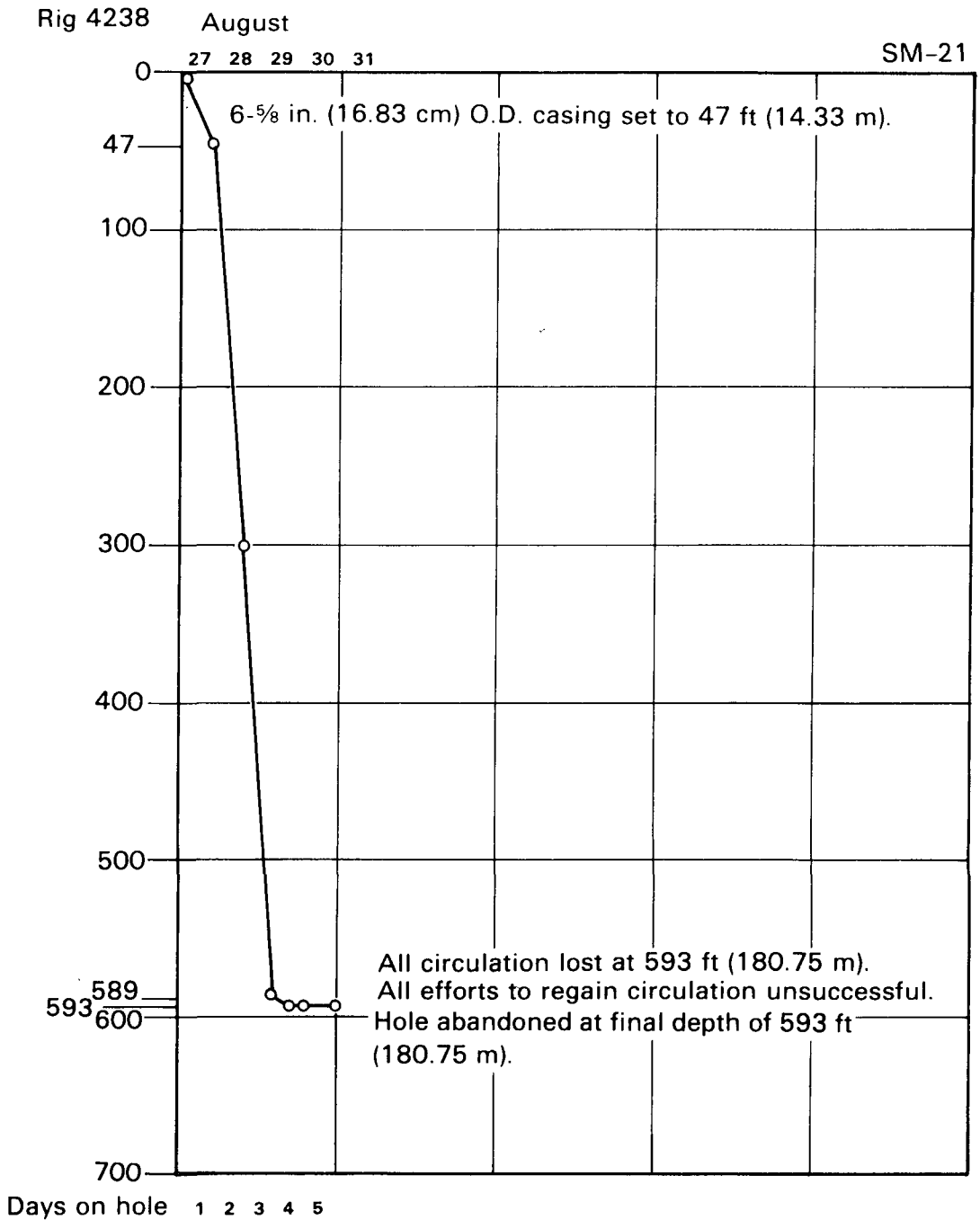
Rig 4146, 838 August September SM-17

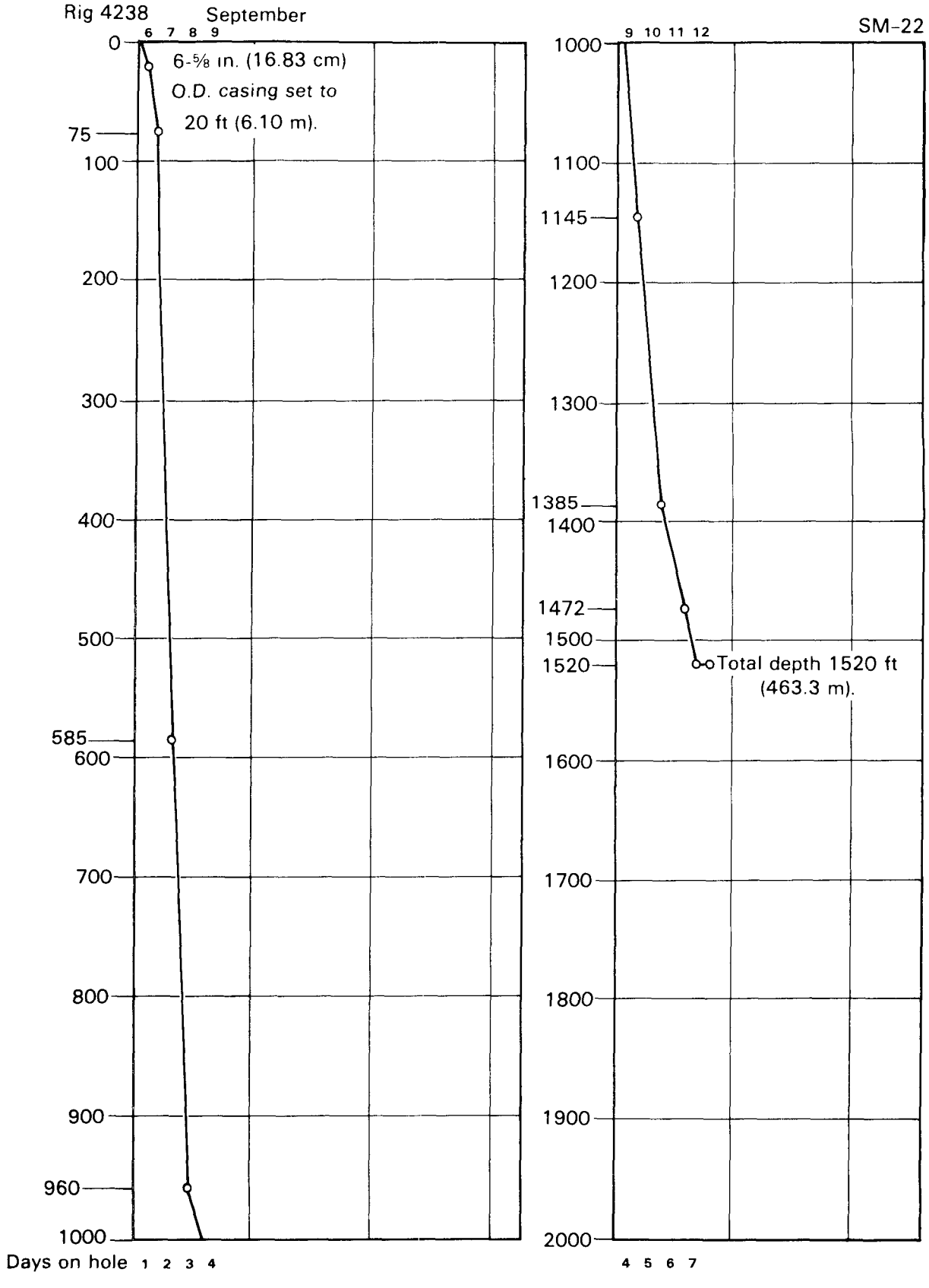


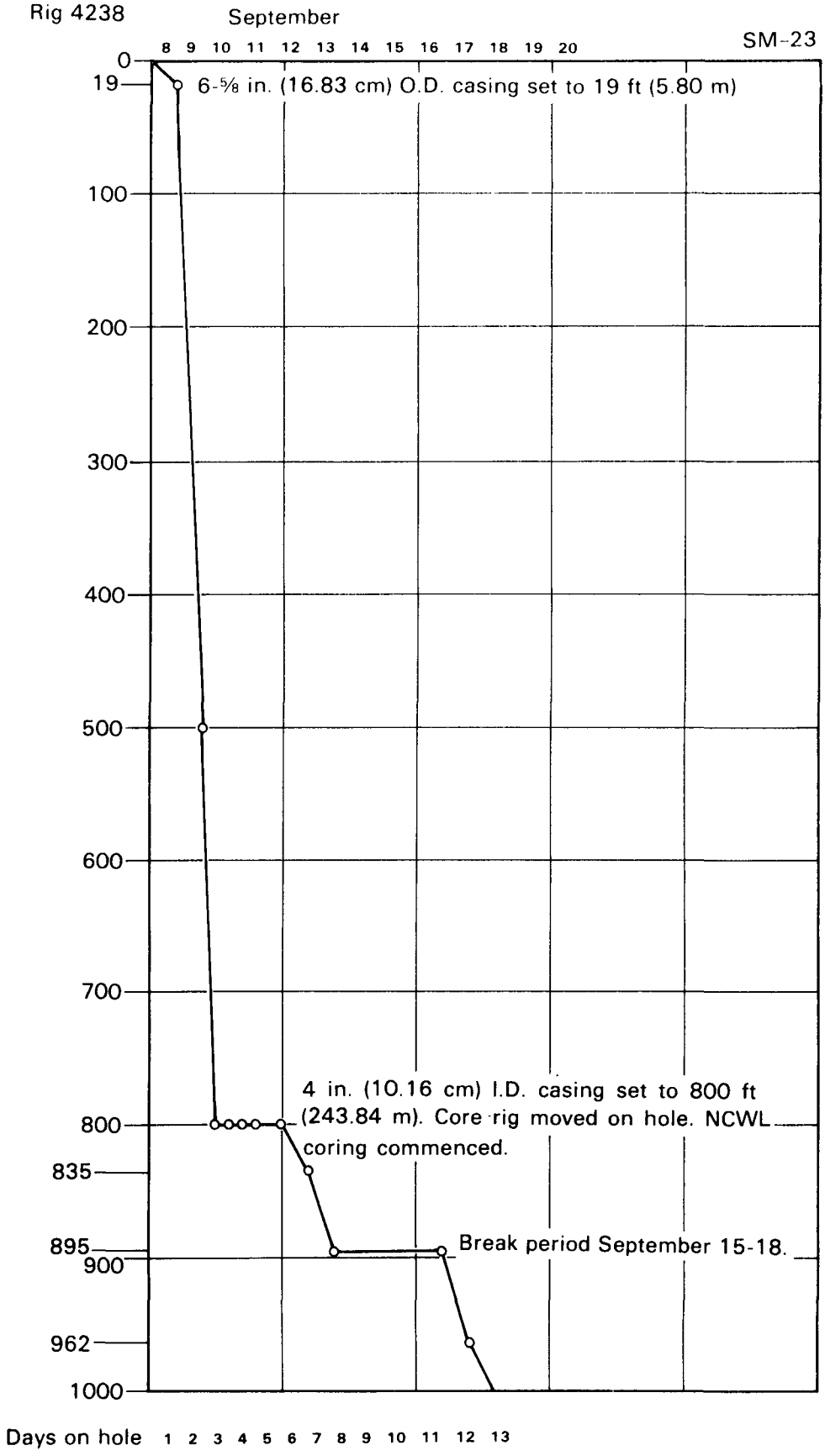

Rig 838
August
SM-18
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
0
4 in (10 16 cm) I D casing set to 93 ft (28 37 m)
NCWL coring commenced
97
100
Break period August 11-14
149
200
205
255
271
289
300
Break period August 20-21
380
400
490
500
598
600
660
700
780
800
870
900
960
1000
1012
Total depth 1014 ft
(308.46 m).
Days on hole 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

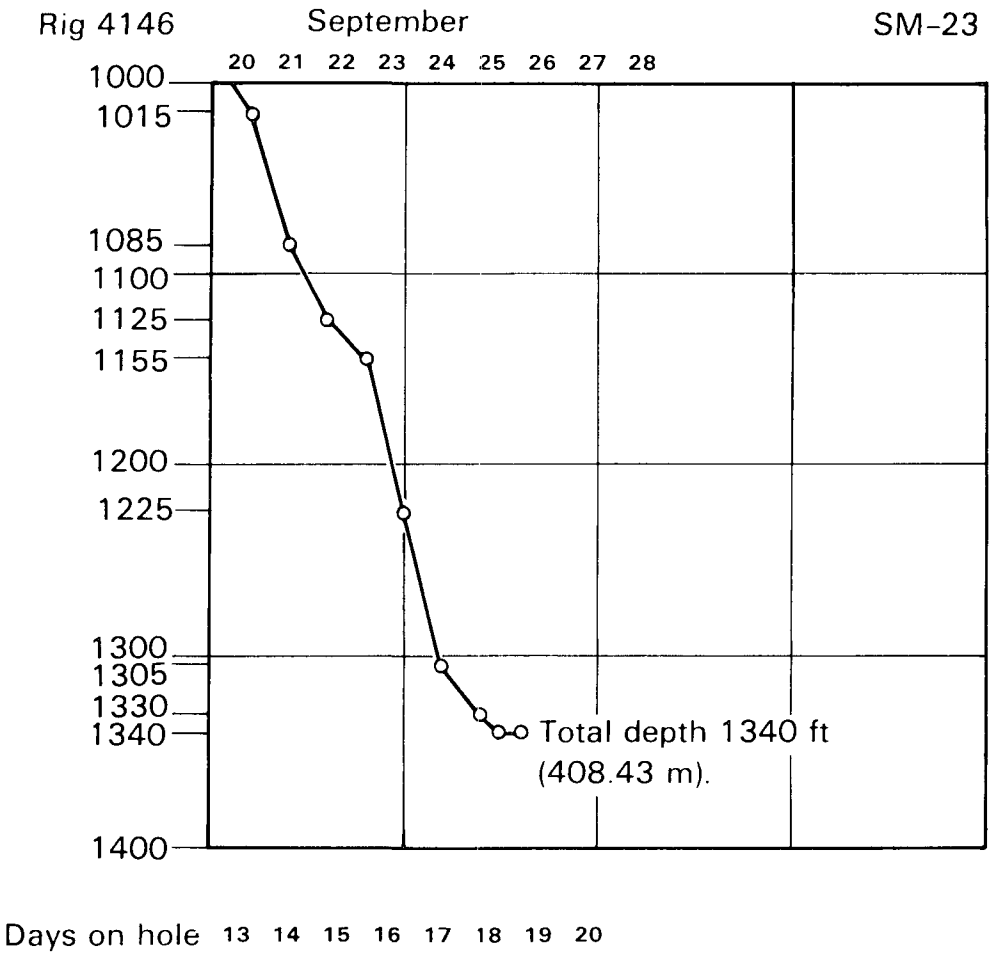

Rig 4146
August
September
SM-19
22 23 24 25 26 27
28 29 30 31 1 2 3 4 5 6 7
6-5/8 in (16 83 cm) O D casing set to 20 ft (6 10 m)
Break period August 31 to September 5
Drill pipe stuck at 1170 ft (356m62 m) August 30 Fishing operations conducted on August 30 and September 6-8 Hole abandoned at total depth of 1280 ft (390 14 m)
0
100
200
300
392
400
500
528
600
700
740
800
860
900
1000
1000
1100
1145
1200
1250
1280
1300
1400
1500
1600
1700
1800
1900
2000
Days on hole 1 2 3 4 5 6
7 8 9 10 11 12 13 14 15 16 17 18


Rig 4238
August
SM-20
17 18 19 20 21 22 23 24 25 26
0
13
100
200
215
300
400
500
600
620
675
700
720
800
6-5/8 in. (16.83 cm) O.D. casing set to 13 ft (3.96 m).
Break period August 19-20.
Drill pipe twisted off at 720 ft (219.46 m).
Fishing operations unsuccessful.
Hole abandoned at total depth of 720 ft (219.46 m).
Days on hole 1 2 3 4 5 6 7 8 9 10

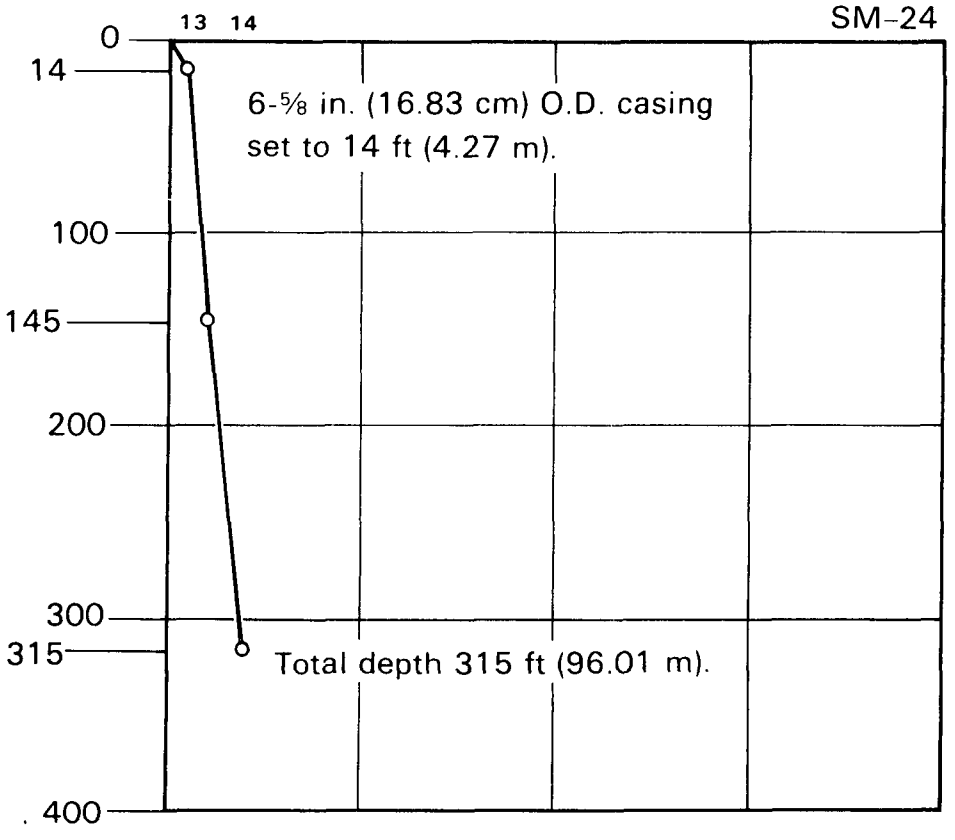

Rig 4238
August
27 28 29 30 31
SM-21
0
47
100
200
300
400
500
589
593
600
700
6-⅝ in. (16.83 cm) O.D. casing set to 47 ft (14.33 m).
All circulation lost at 593 ft (180.75 m).
All efforts to regain circulation unsuccessful.
Hole abandoned at final depth of 593 ft (180.75 m).
Days on hole 1 2 3 4 5


Rig 4238
September
6 7 8 9
SM-22
9 10 11 12
0
6-5/8 in. (16.83 cm)
O.D. casing set to
20 ft (6.10 m).
75
100
200
300
400
500
585
600
700
800
900
960
1000
1000
1100
1145
1200
1300
1385
1400
1472
1500
1520
Total depth 1520 ft
(463.3 m).
1600
1700
1800
1900
2000
Days on hole 1 2 3 4
4 5 6 7

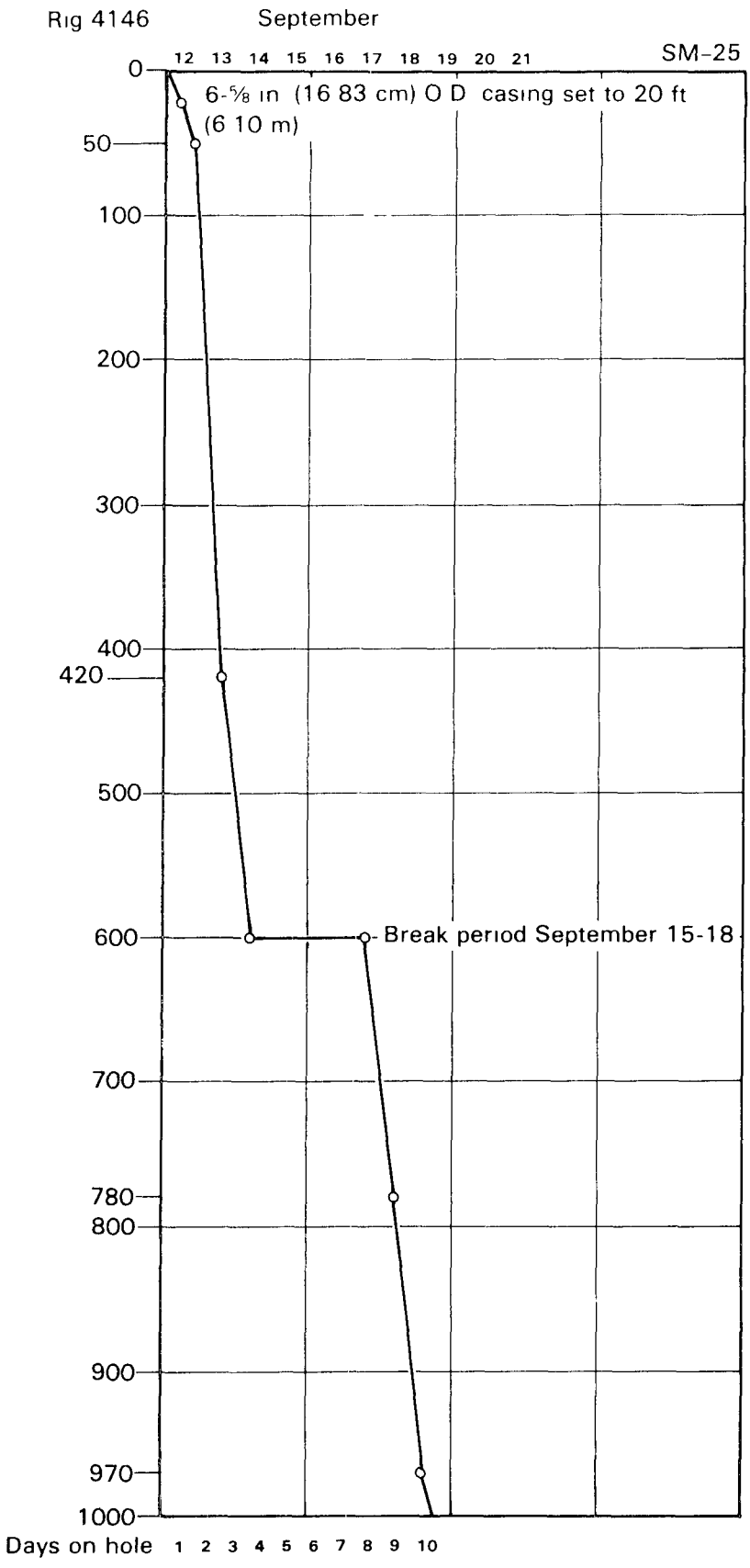

Rig 4238
September
8 9 10 11 12 13 14 15 16 17 18 19 20
SM-23
0
19
100
200
300
400
500
600
700
800
835
895
900
962
1000
6-⅝ in. (16.83 cm) O.D. casing set to 19 ft (5.80 m)
4 in. (10.16 cm) I.D. casing set to 800 ft
(243.84 m). Core rig moved on hole. NCWL
coring commenced.
Break period September 15-18.
Days on hole 1 2 3 4 5 6 7 8 9 10 11 12 13

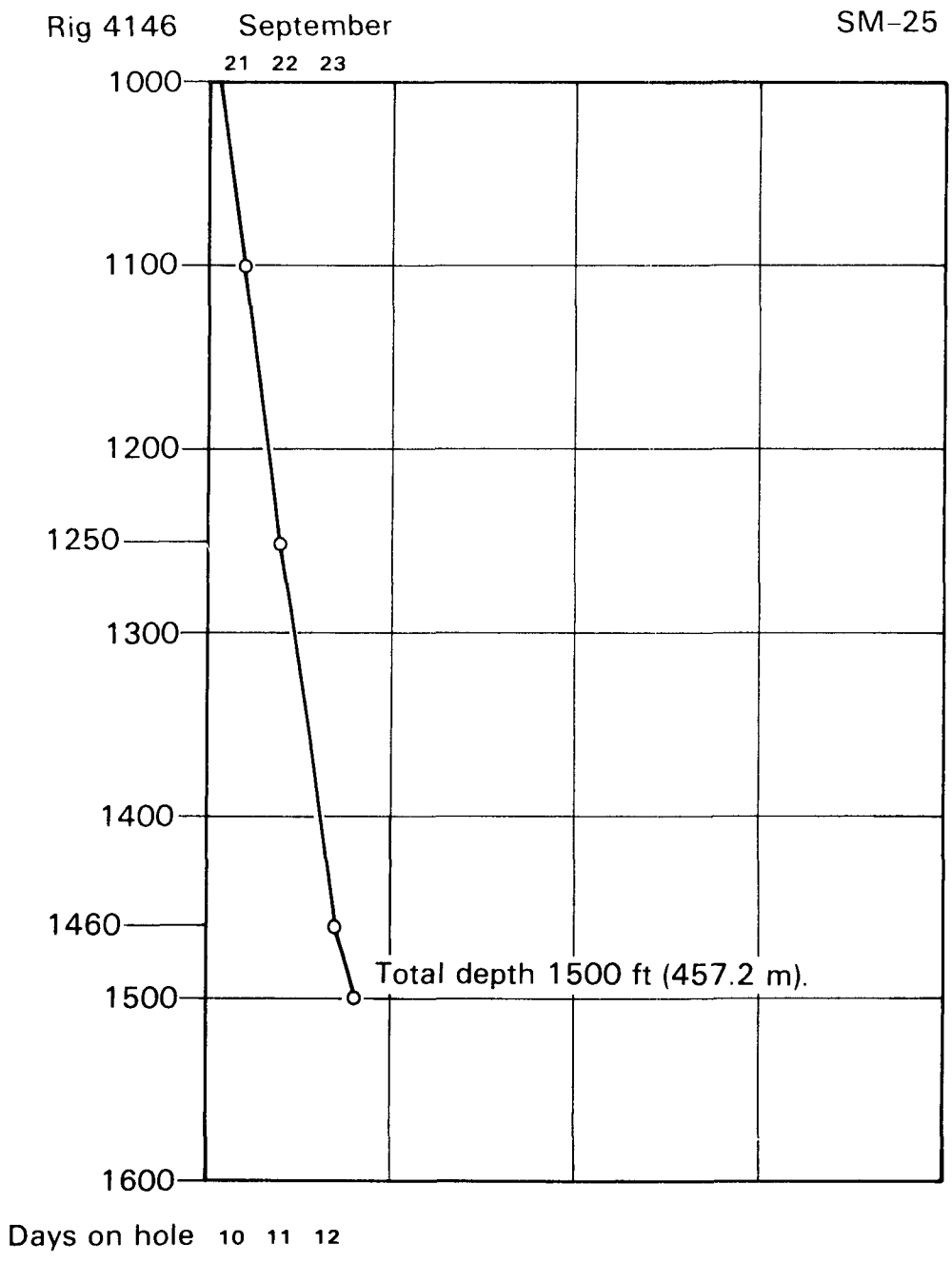

Rig 4146
September
SM-23
20 21 22 23 24 25 26 27 28
1000
1015
1085
1100
1125
1155
1200
1225
1300
1305
1330
1340
1400
Total depth 1340 ft
(408.43 m).
Days on hole 13 14 15 16 17 18 19 20

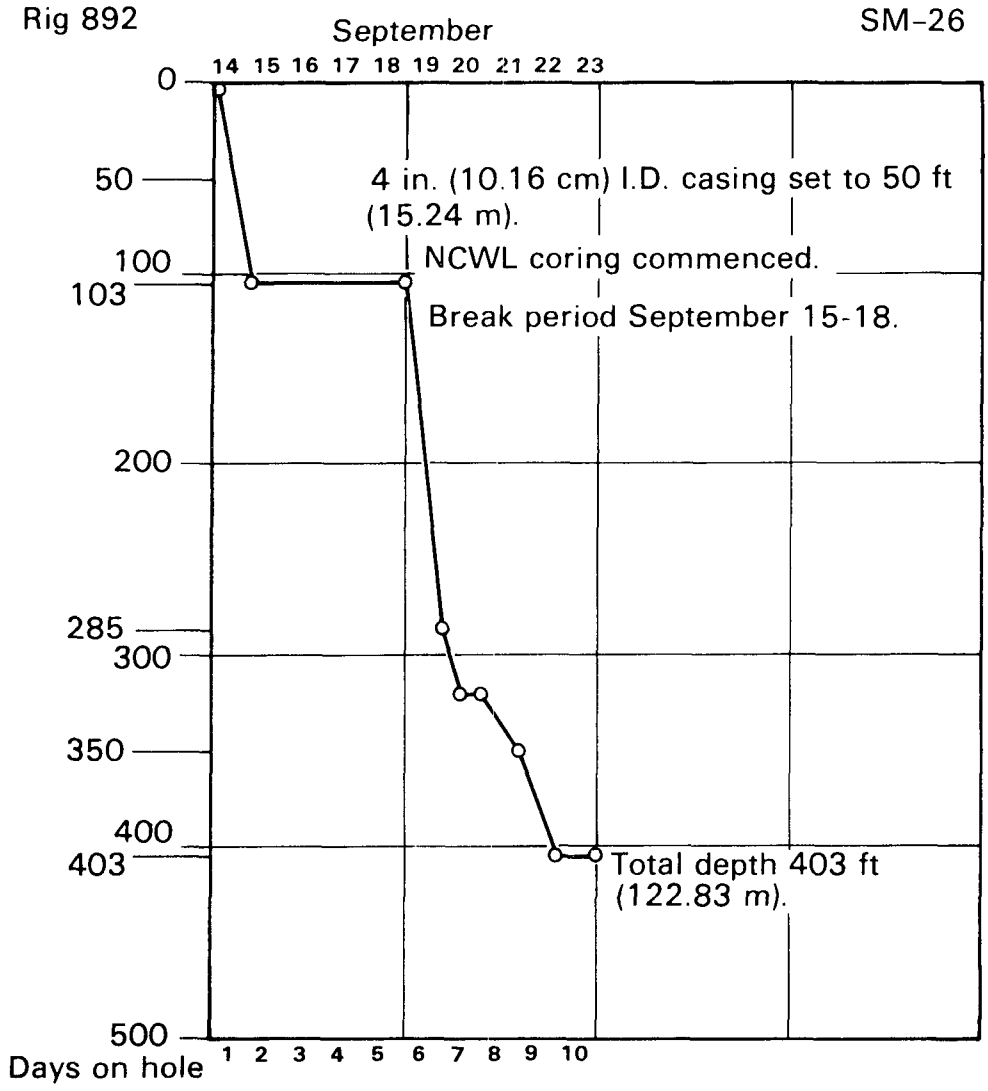
Rig 4238 September



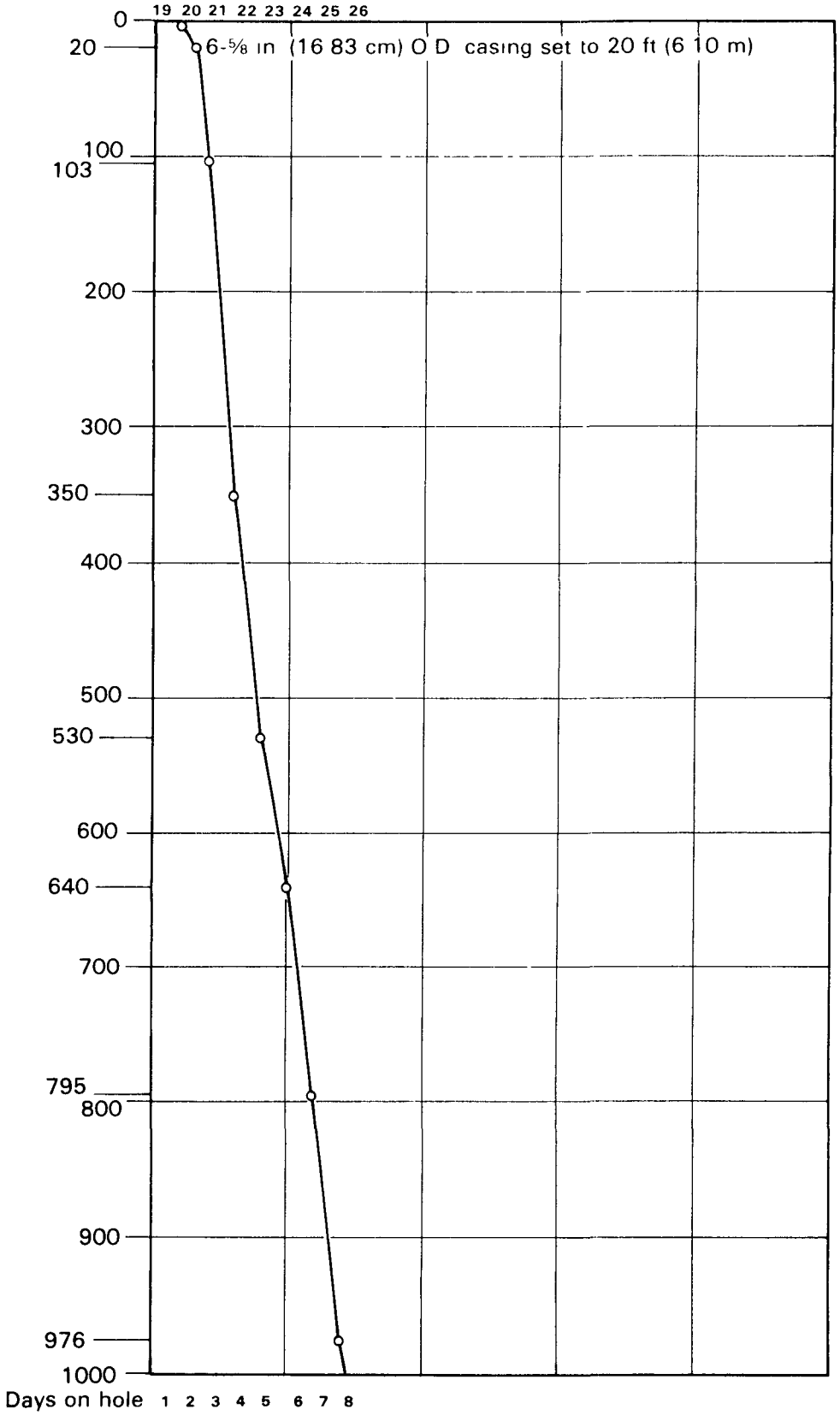
Days on hole 1 2


Rig 4146
September
SM-25
12 13 14 15 16 17 18 19 20 21
0
50
100
200
300
400
420
500
600
700
780
800
900
970
1000
6-⅝ in (16 83 cm) O D casing set to 20 ft
(6 10 m)
Break period September 15-18
Days on hole 1 2 3 4 5 6 7 8 9 10

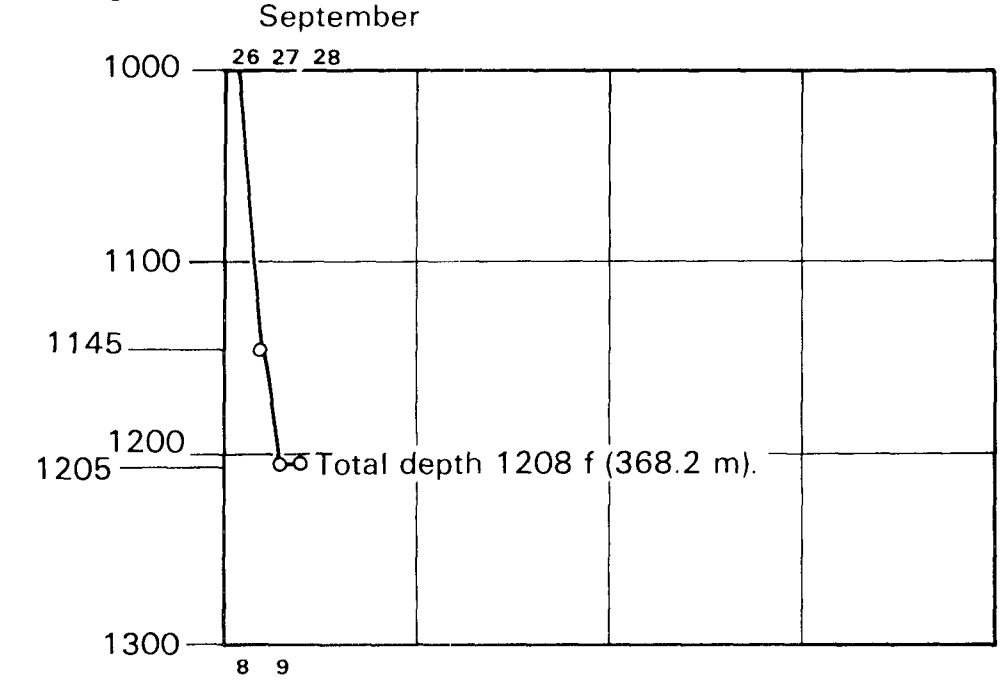

Rig 4146
September
SM-25
21 22 23
1000
1100
1200
1250
1300
1400
1460
1500
1600
Total depth 1500 ft (457.2 m).
Days on hole 10 11 12


Rig 892
September
SM-26
14 15 16 17 18 19 20 21 22 23
0
50
100
103
200
285
300
350
400
403
500
4 in. (10.16 cm) I.D. casing set to 50 ft (15.24 m).
NCWL coring commenced.
Break period September 15-18.
Total depth 403 ft (122.83 m).
1 2 3 4 5 6 7 8 9 10
Days on hole

Rig 4238 September SM -27

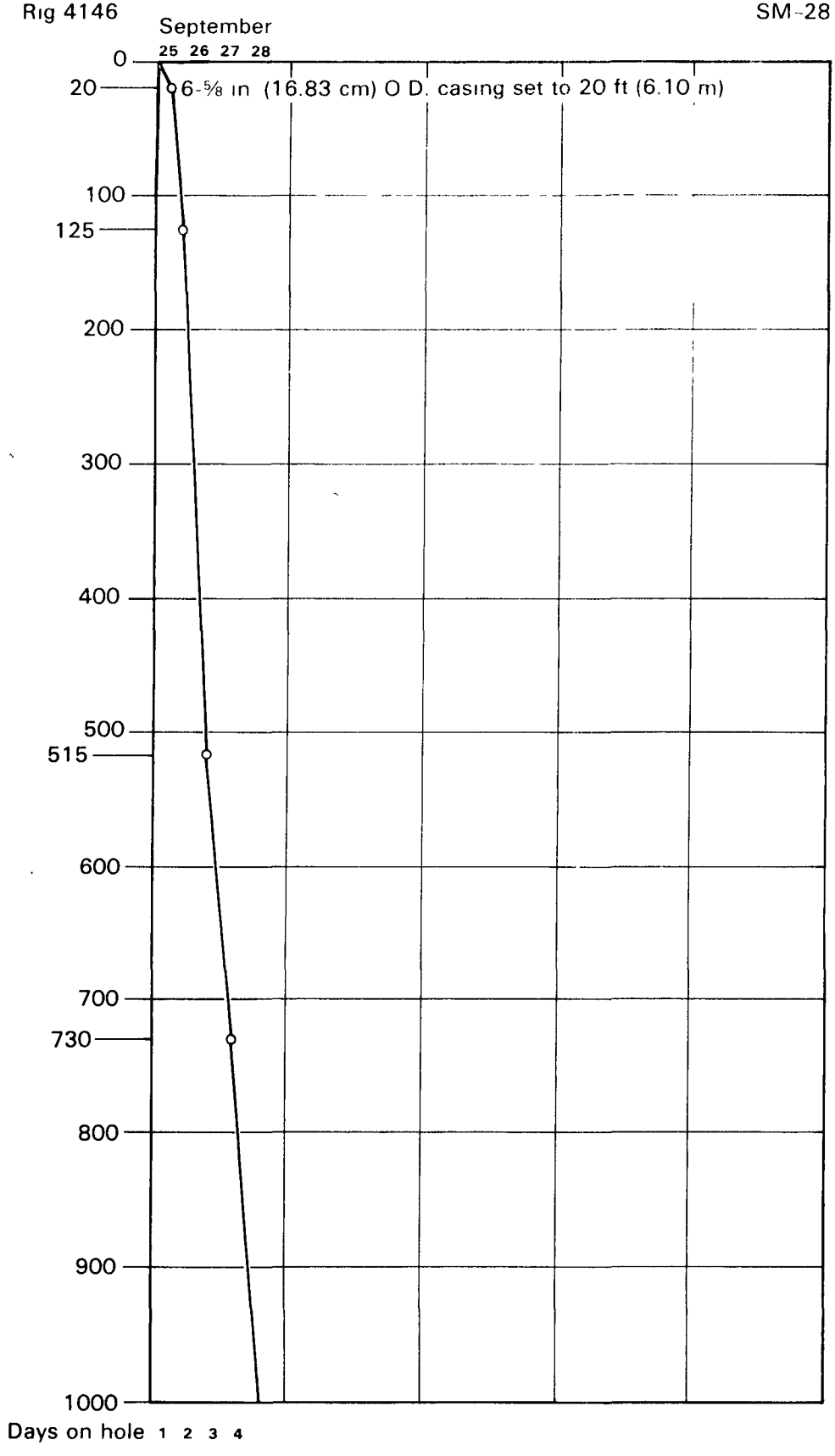


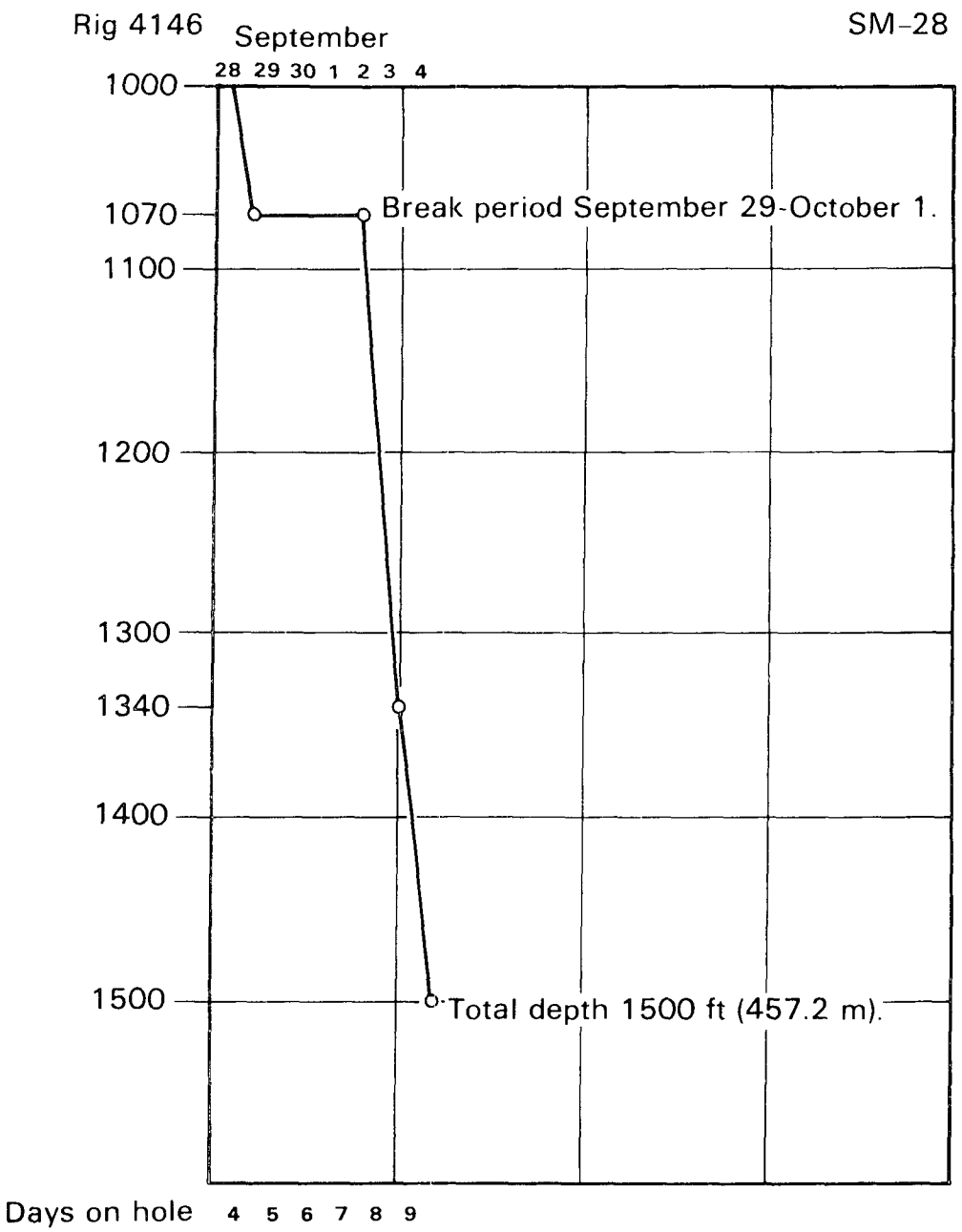
Rig 4238 SM-27

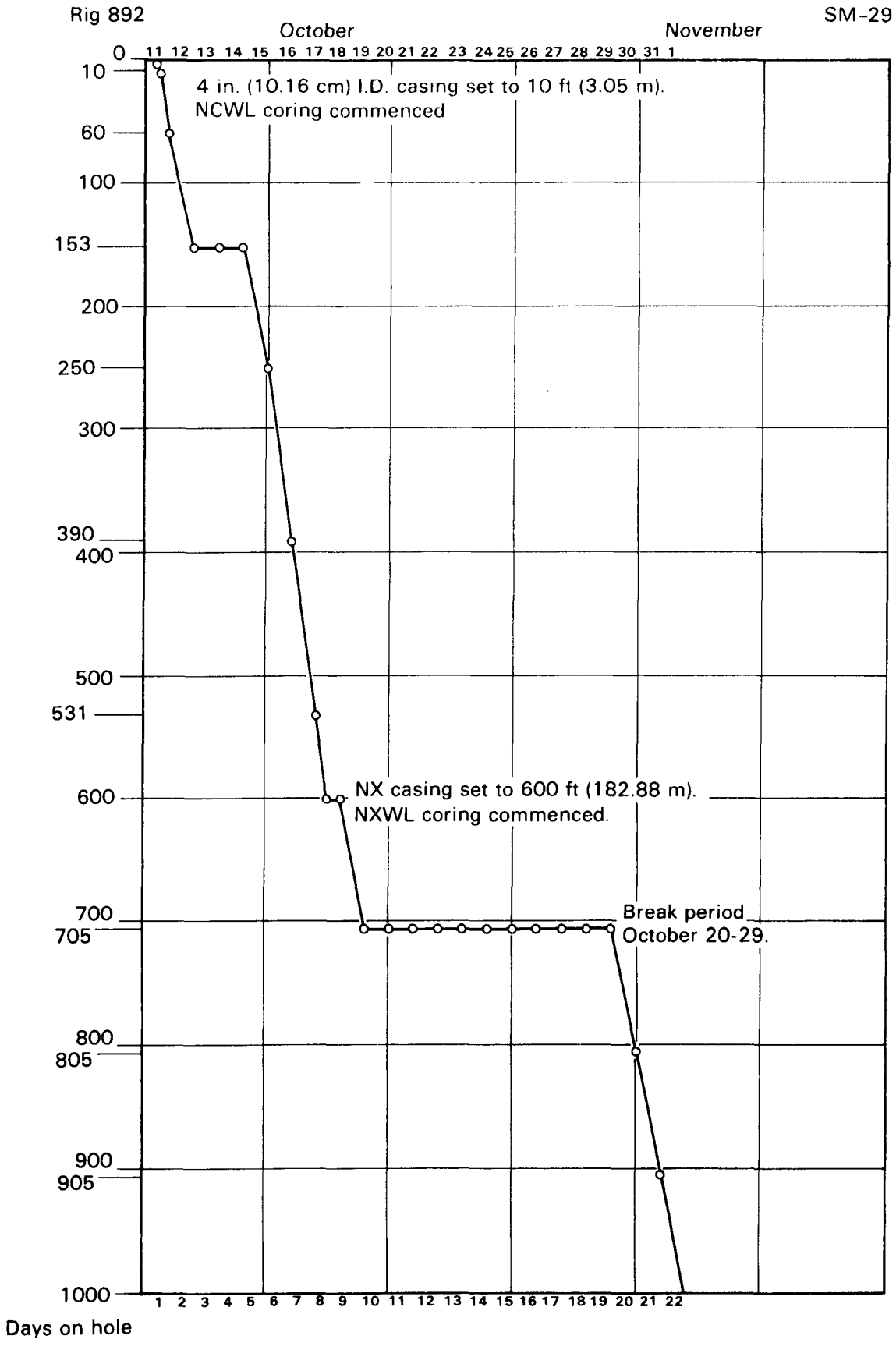


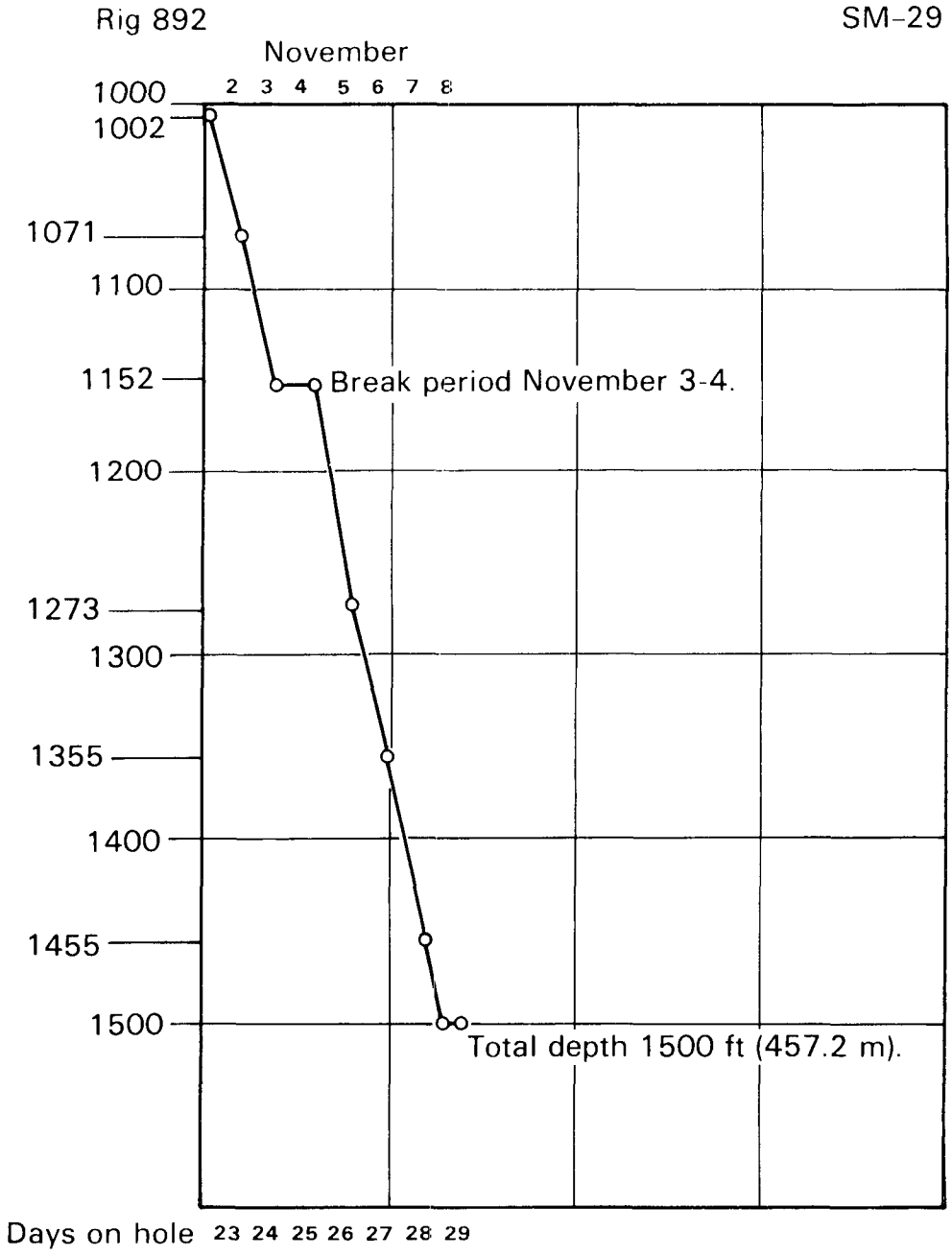
Rig 4146

SM-28



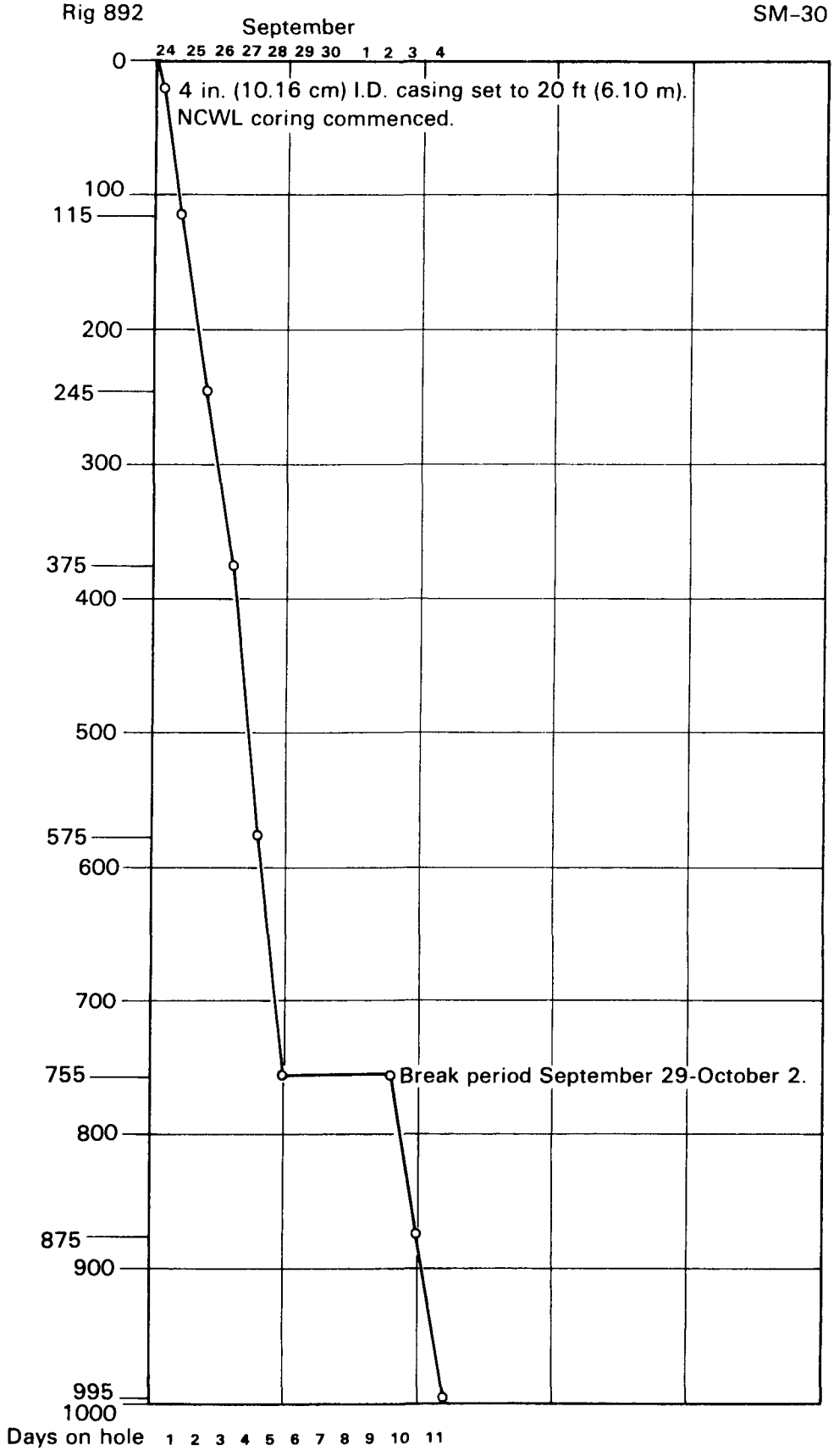

Rig 4146
September
SM-28
28 29 30 1 2 3 4
1000
1070
1100
1200
1300
1340
1400
1500
Break period September 29-October 1.
Total depth 1500 ft (457.2 m).
Days on hole 4 5 6 7 8 9

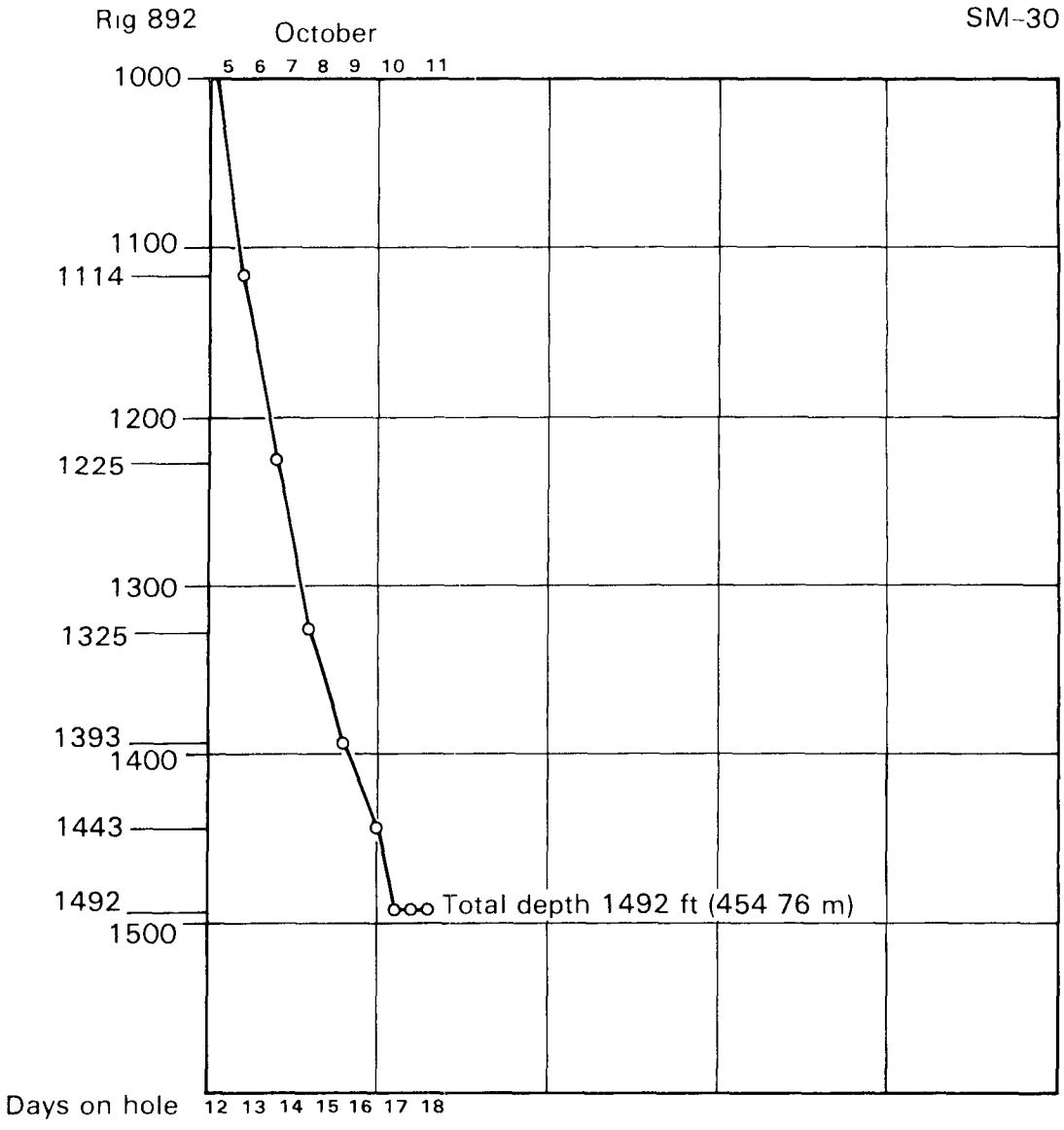

Rig 892
SM-29
October
November
0
11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1
10
4 in. (10.16 cm) I.D. casing set to 10 ft (3.05 m).
NCWL coring commenced
60
100
153
200
250
300
390
400
500
531
600
NX casing set to 600 ft (182.88 m).
NXWL coring commenced.
700
705
Break period
October 20-29.
800
805
900
905
1000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Days on hole


Rig 892
SM-29
November
2 3 4 5 6 7 8
1000
1002
1071
1100
1152
1200
1273
1300
1355
1400
1455
1500
Break period November 3-4.
Total depth 1500 ft (457.2 m).
Days on hole 23 24 25 26 27 28 29

Rig 892

SM-30


September
24 25 26 27 28 29 30 1 2 3 4
0
4 in. (10.16 cm) I.D. casing set to 20 ft (6.10 m).
NCWL coring commenced.
100
115
200
245
300
375
400
500
575
600
700
755
Break period September 29-October 2.
800
875
900
995
1000
Days on hole 1 2 3 4 5 6 7 8 9 10 11


Rig 892
October
SM-30
5 6 7 8 9 10 11
1000
1100
1114
1200
1225
1300
1325
1393
1400
1443
1492
1500
Total depth 1492 ft (454 76 m)
Days on hole
12 13 14 15 16 17 18