GL02975-6

COMPLETION REPORT:

RAFT RIVER

GEOTHERMAL INJECTION WELL SIX

(RRGI-6)

February 1979

L. G. Miller
EG&G Idaho, Inc

and

S. M. Prestwich
DOE-ID

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APPROVED:

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ABSTRACT

Raft River Geothermal Injection Well Six (RRGI-6) is an intermediate-depth injection well designed to accept injected water in the 600 to 1000 m (2000 to 3500 ft) depth range.[a] It has one barefoot leg, and it was drilled so that additional legs can be added later; if there are problems with intermediate-depth injection, one or more additional legs could be directionally drilled from the current well bore.

Included in this report are the reports of daily drilling records of drill bits, casings, and loggings, and descriptions of cementing, coring, and containment.

[a] All depths are referenced from the Kelly Bushing, 420 cm (14 ft) above ground level, unless otherwise noted.

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COMPLETION REPORT:
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I. INTRODUCTION

This report describes the drilling and completion of Raft River Geothermal Injection Well Six (RRGI-6). Previous Raft River wells established the feasibility of using the valley's resource for a 5-MW power plant, as well as for numerous nonelectrical applications. RRGI-6, planned as an injection well, will accept the spent geothermal fluid. This will prevent the pollution that surface disposal could cause. RRGI-6 is located about 1/2 mile east of the RRGE-3 well in the area selected by DOE-ID as the site for all injection wells (see Figures 1 and 2).

RRGI-6 was designed for injection into the intermediate-depth zone. This 600- to 1000-m (2000- to 3500-ft) zone was selected in order to minimize contamination of near-surface groundwater, prevent the cooling of production aquifers, and to reduce well cost. The well is designed so that it can either be deepened and cased with 25-cm (9-5/8-in.) casing or drilled with additional legs.

II. DRILLING SUMMARY

Procurement of the drill rig was completed near the end of March. The bid was awarded to Colorado Well Service of Rangely, Colorado. The rig moved in was a truck-mounted Cabot 750, with a 4.3-m (14-ft) substructure, a 140,000-kg (300,000-lb) hoist capacity, and a total capacity of 55 L/sec (900 gpm) in rig pumps.

Drilling began on April 12, 1978. Using a 44-cm (17-1/2-in.) bit, a hole was drilled to 619 m (2030 ft) and logs were run (see Figure 3). On April 17, while trying to run in casing, the casing stuck at 214.9 m (1522 ft). At that point, circulating did not alleviate the problem. Oil and pipe lax were used to lubricate the pipe. On April 20 the casing moved downhole, allowing the casing to be run to a total depth of 517 m (1698 ft). Cementing began at 1:00 A.M. and was completed at 3:30 A.M. on April 21, 1978. During the 24-hour cement waiting period, the blowout preventer (BOP) was nippled up.

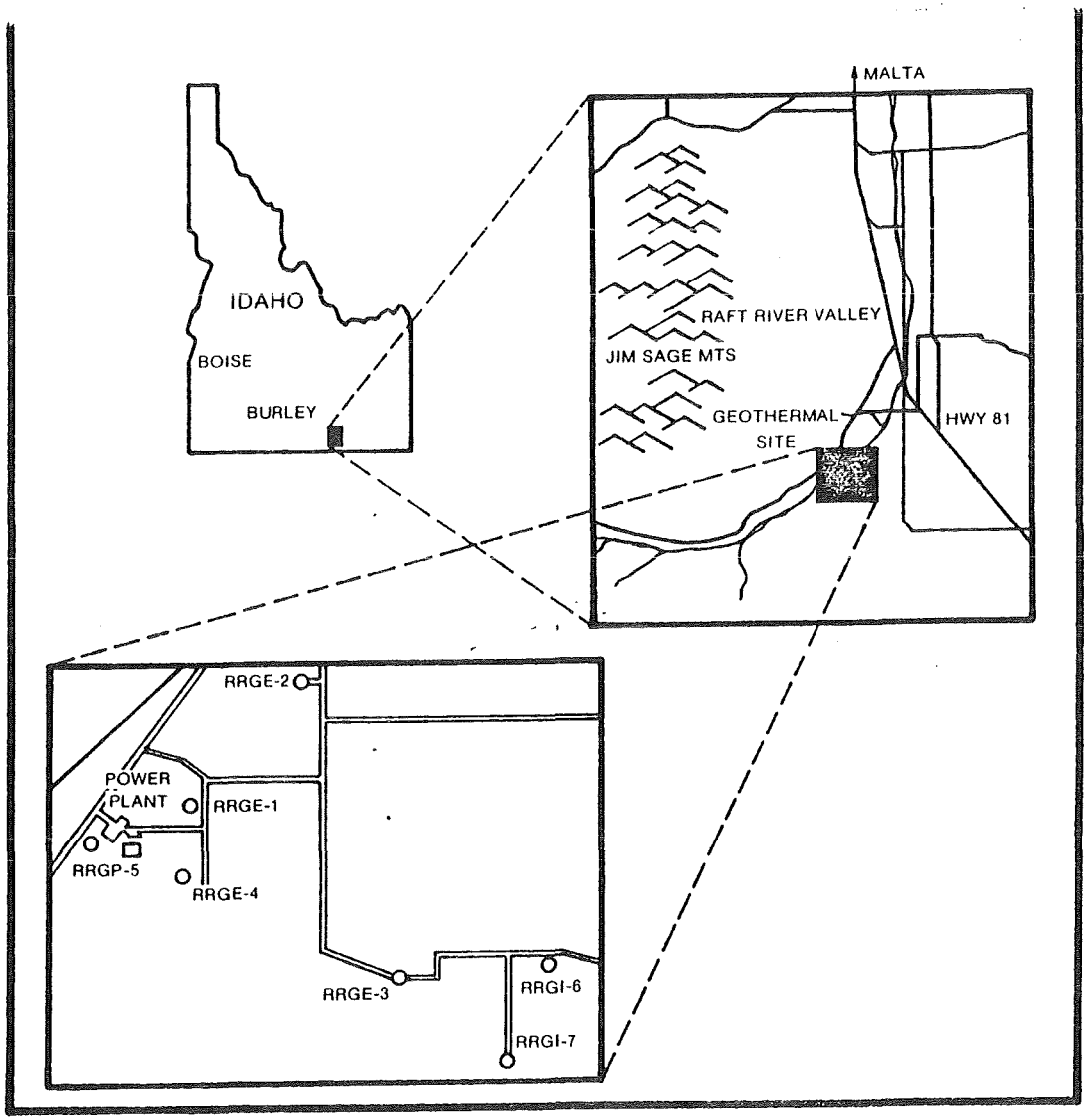


Fig. 1 Raft River Geothermal site and location of wells.

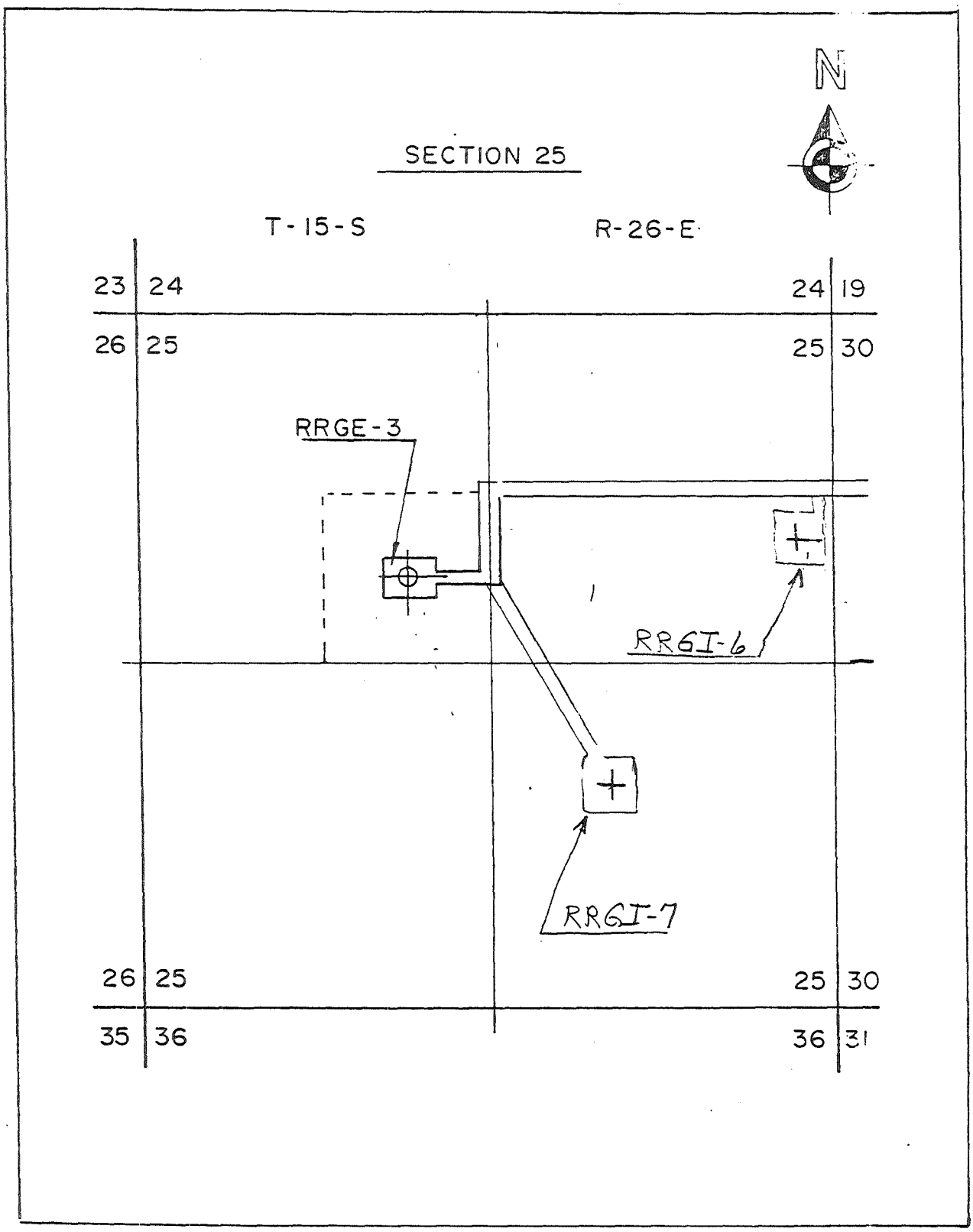
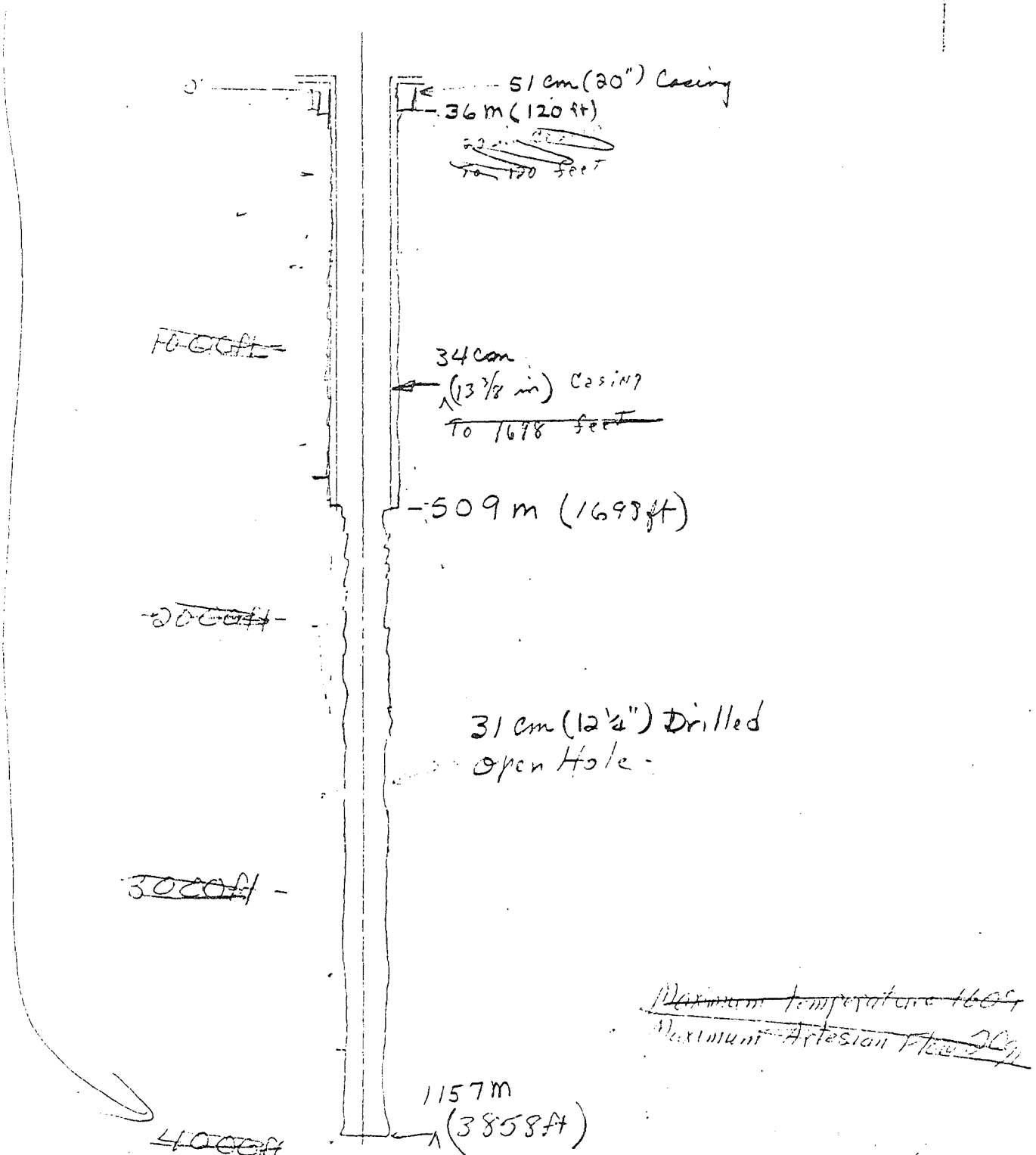


Figure 2. Location survey.

Subsurface Well Status

Figure 4 - ~~Salt River Geothermal Injection Well No. 6~~



~~Drilling began on April 11, 1978 and was completed on May 3, 1978.~~ Fig. 3 Subsurface well status

Drilling proceeded to 911 m (2290 ft) with no problems, using a 31-cm (12-1/4-in.) bit. At that point, it was necessary to trip out for a new bit. The hole was cored to 925 m (3035 ft) and 6 m (21 ft) of core were recovered. On April 27 drilling began again with a new bit. Circulation was intermittently lost, but this posed no problems in drilling. On April 30, at a depth of 1176 m (3858 ft),the drill string was pulled out and a core barrel was run in the hole. Drillers encountered 18 m (60 ft) of fill on the bottom and 3 m (9 ft) of core were recovered. The bottom-hole temperature was 70°C (158°F), with a maximum temperature of 71°C (160°F) at 1036 m (3400 ft).

An eight-hour injection test was run on May 1, 1978. Injection rates were 12, 24, 36, and 48 L/sec(200,400, 600, and 800 gpm). A pressure increase up to 2100 kPa (305 psi) was noted during the five-hour, 48-L/sec (800-gpm) test.

Following the injection test, the well was air lifted to clean and stimulate the hole, and to remove injected water so that formation-water quality samples could be taken and analyzed. The well was allowed to recover for six hours following the air lift. The water level reached 5 m (18 ft) below ground level, with no artesian-pressured flows. One week later, artesian flows of 0.6 L/sec (10 gpm) began. Long-term tests are planned prior to full-scale injection. A drilling and operations summary is shown in Figure 4.

III. SURFACE AND CONTAINMENT EQUIPMENT AND SERVICES

1. CONTAINMENT EQUIPMENT - SURFACE HOLE

A 51-cm (20-in.) single-gate Shaffer blowout preventer (BOP) was set between the 51-cm (20-in.) casing head and the drilling nipple for drilling the 44-cm (17-1/2-in.) hole to 619 m (2030 ft).

2. CONTAINMENT EQUIPMENT - PRODUCTION HOLE

After setting the 34-cm (13-3/8-in.) casing at 518 m (1698 ft), the following containment stack (listed from expansion spool up) was used (see Figure 5).

(1) WKM 51- x 30-cm (20- x 12-in.) expansion spool

(2) WKM 30-cm (12-in.) master valve

(3) Adaptor spool

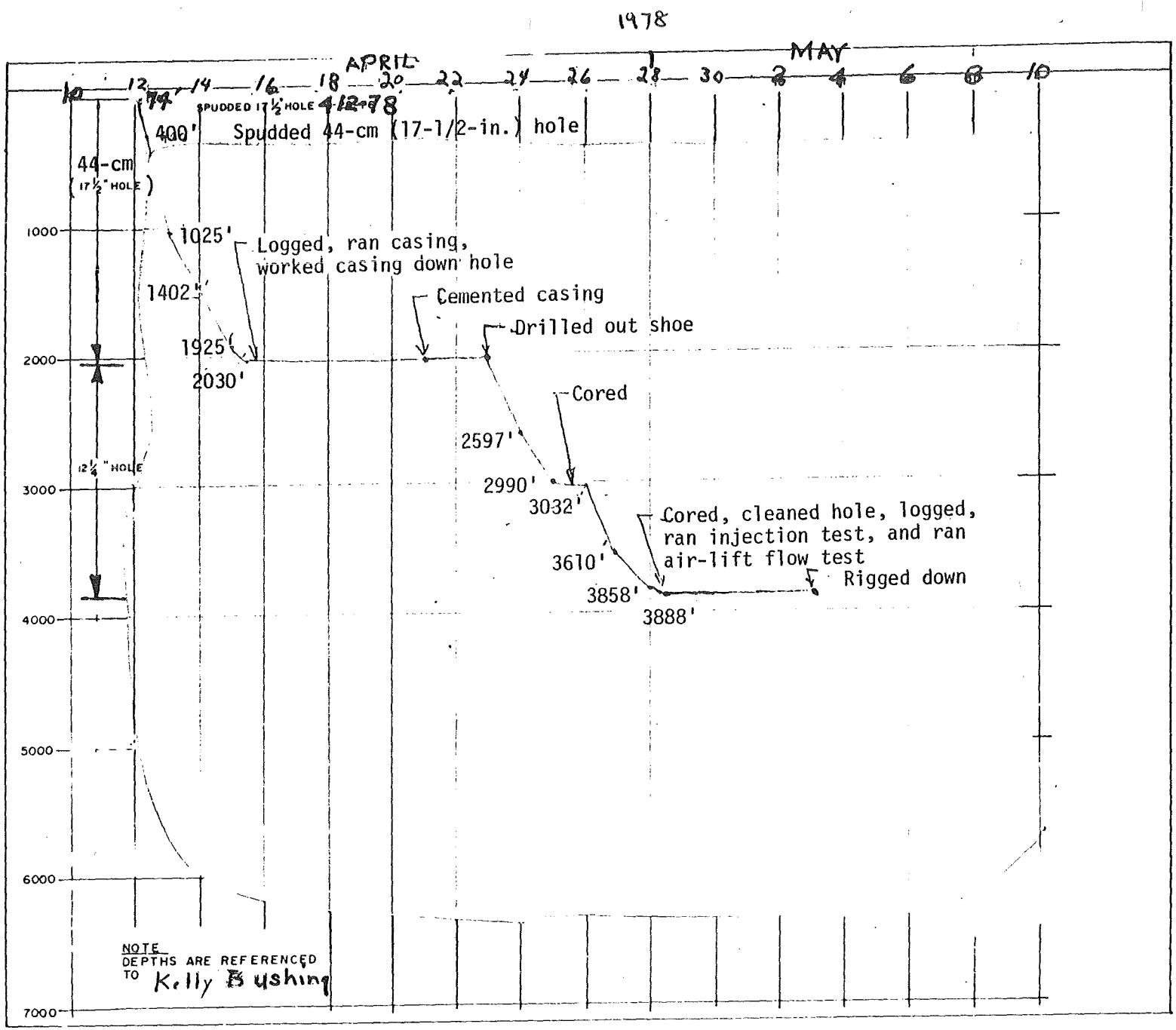


Figure 4. RRGI-6 drilling and operations summary

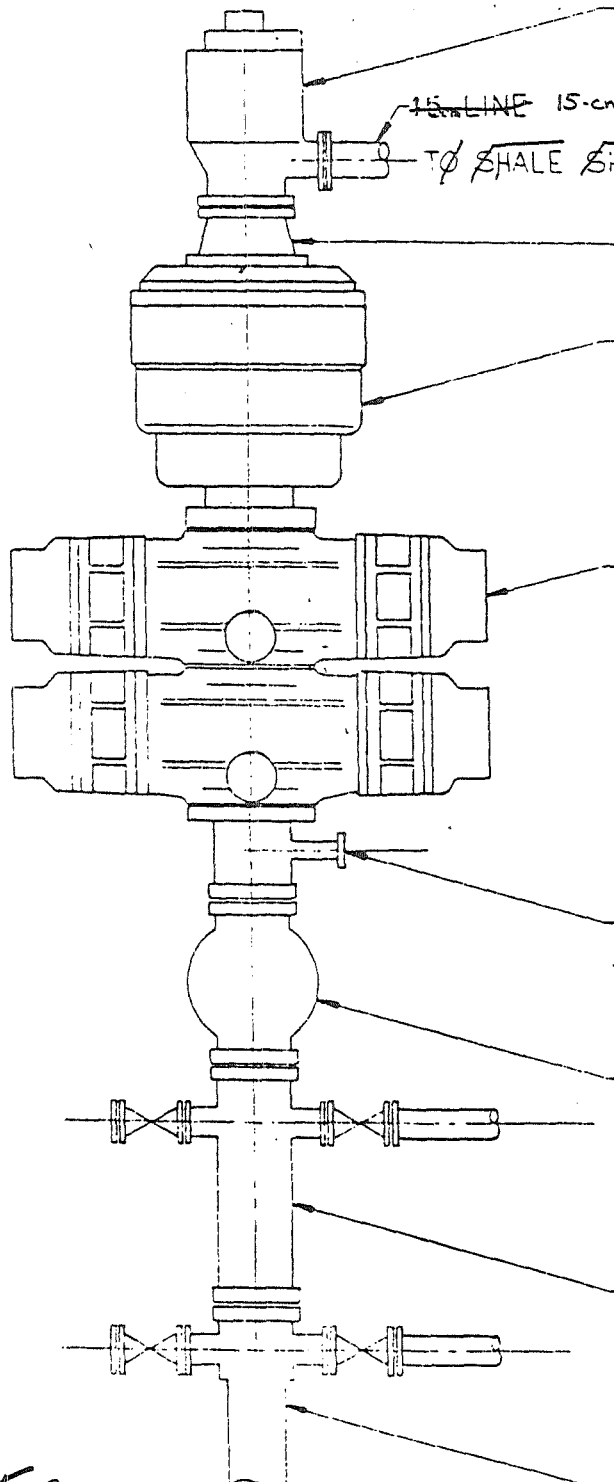


Fig. 5 Blowout preventer ~~FIGURE 5~~ ~~BOP~~ for drilling below the ~~13-3/8 inch~~ intermediate casing shoe.

(4) Shaffer double-gate 30-cm (12-in.) BOP

(5) Hydril Type-GK 30-cm (12-in.) BOP

(6) Grant 30-cm (12-in.) rotating head.

3. CELLAR

A 2.4- x 3- x 2.4-m (8- x 10- x 8-ft) reinforced-concrete cellar was built to accommodate the BOP stack.

4. WELLHEAD

The permanent wellhead on this well consists of a standard WKM wellhead system. Thecasing head, with its 51-cm (20-in.) 14,000-kPa (2000-psi) API flange, is welded directly to the 51-cm (20-in.) well casing. The expansion spool mates to the 51-cm (20-in.) 14,000-kPa (2000-psi) API casing headflange on the bottom, and the 30-cm (12-in.), 2760-kPa (400-psi) ANSI flanged master gate valve on the top. Both sides of the expansion spool contain 7.5-cm (3-in.) valved outlets with 7.5-cm (3-in.), 14,000-kPa (2000-psi) API flanges.

A hanger spool mates with the master valve on the bottom, and with a 20-cm (8-in.), 1860-kPa (600-psi) ANSI flanged power-seal gate valve on top. Above the power-seal gate valve is a 20-cm (8-in.), 1860-kPa (600-psi) ANSI tee (or cross).

For logging access into the well, a double-studded, 20-cm (8-in.), 1860-kPa (600-psi) ANSI to 10-cm (4-in.) 130-kPa (300-psi) ANSI flange is mounted above the 20-cm (8-in.) valve. A 10-cm (4-in.) gate valve is mounted on top of the double-studded flange. Figure 6 depicts a schematic view of the completed wellhead system, showing the expansion capabilities for the production casing and the packoff system. The packoff system is designed to be repacked under pressure.

5. DRILLING RECORDER

A six-pen recorder charted the weight on the derrick, the drilling rate, the rotary torque, the standpipe pressure, and the pump strokes on the number-one and number-two pumps during drilling.

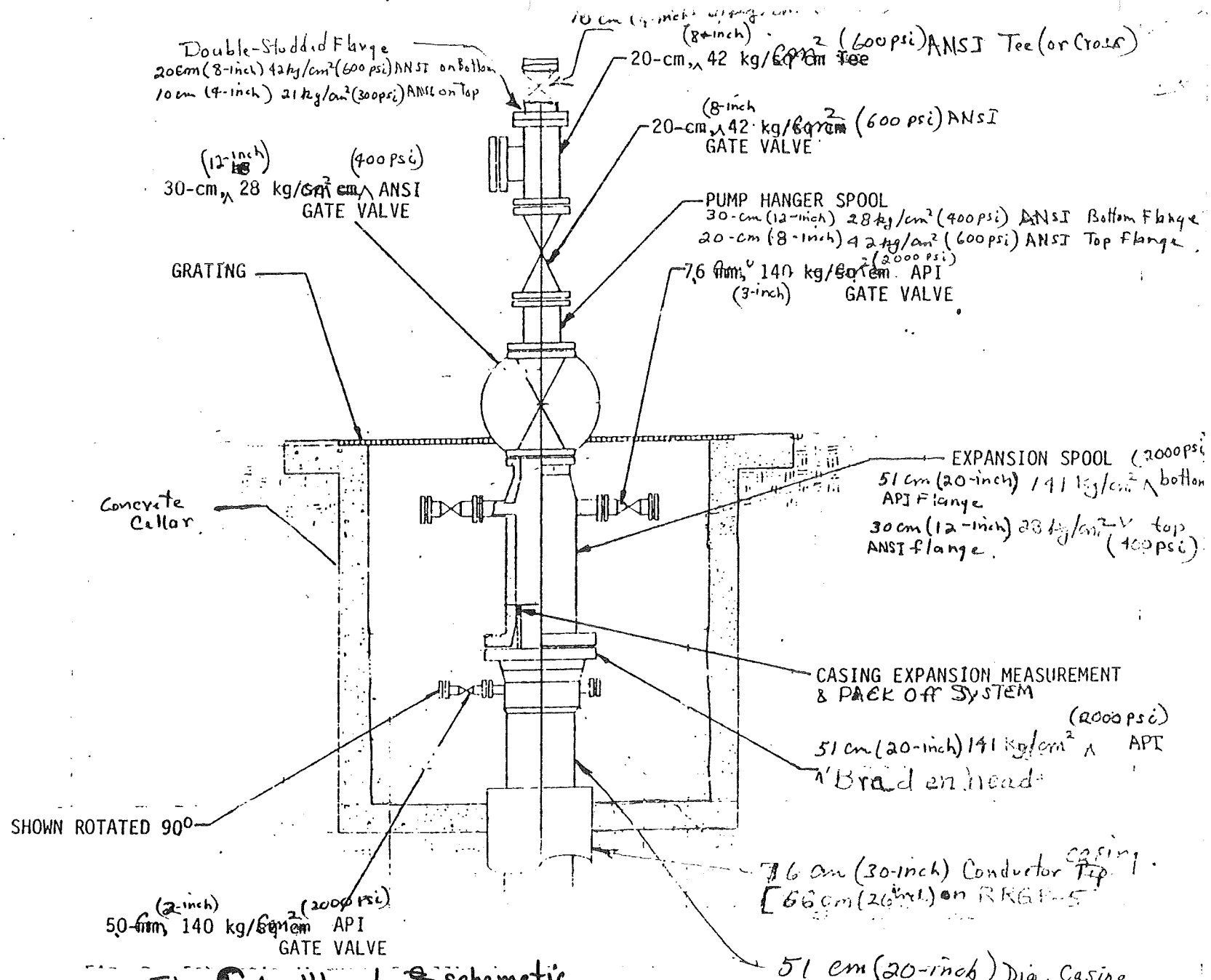


Fig. 6 Wellhead ~~Schematic~~

~~Figure 7 Schematic Diagram of Completed Wellhead~~

IV. DOWNHOLE EQUIPMENT AND SERVICES

1. SURFACE CASING

Three joints of 51-cm (20-in.) H-40 casing were welded at each joint, set, and cemented to a 34-m (110-ft) depth by Bill Martin of Rathole Drilling, Inc.

2. INTERMEDIATE CASING

A subcontractor ran forty joints of 34-cm (13-3/8-in.), 81.1-kg/m 54.5-lb/ft) K-55 casing, guide shoe, and float collar.

3. DRILL BIT SUMMARY

A 44-cm (17-1/2-in.) hole was drilled to 337 m (1106 ft) with a Hughes OSCIG Jet bit, then to 619 m (2030 ft) with a Hughes OWV Jet bit.

Two Smith 31-cm (12-1/4-in.) SVH-J bits were used to drill the hole to 1176 m (3858 ft), and the well was completed open hole.

4. CORING

Two 9-cm (3-1/2-in.) OD cores were taken using a 20- x 9-cm (7-7/8- x 3-1/2-in.) diamond coring bit and a 9-m (30-ft) corebarrel. Drilling fluid for both cores was water. The first core was cut to 925 m (3035 ft), and 6 m (21 ft) of core were recovered. The second core was cut to 1185 m (3888 ft), and 3 m (9 ft) of core were recovered.

5. DRILLING FLUID

A flocculated gel mud was used to drill the 44-cm (17-1/2-in.) hole. Mud weight ranged from 1.12 to 1.17 kg/L (9.4 to 9.8 lb/gal), with a viscosity of 38 to 47 sec/L. Drilling continued below the 34-cm (13-3/8-in.) casing to total depth, with water pumped from the RRGE-3 reserve pit. Some loss of circulation occurred between 630 and 660 m (2100 to 2200 ft), and again at 930 m (3100 ft).

6. SAMPLES AND MUD LOGGING SERVICE

A mud logging service was employed to monitor drilling fluid and cutting returns. This service monitored fluid temperatures (in and out), and hydrogen sulfide and hydrocarbon concentrations. Lithologic characteristics were also determined from the analysis of drill cuttings. Samples of cuttings were taken at 6-m (20-ft) intervals.

7. CEMENTING

Surface Casing - The 51-cm (20-in.) casing was cemented from 34 m (110 ft) to ground level, using 260 sacks plant-mix concrete with 39 kg (20 lb) fine sand per sack of cement.

Intermediate Casing - The intermediate, 34-cm (13-3/8 in.) casing was cemented to 518 m (1698 ft) in a 44-cm (17-1/2-in.) hole, using RFC Thrixotropic cement. A 4770-L (30-bbl) water preflush, followed by a 3815-L (24-bbl) chemical wash, pretreated the hole. A flow of 795 L (5 bbl) of water led 625 sacks of Class-G cement with 8% gel, at a slurry weight of 1.62 kg/L (13.5 lb/gal). This was followed by 780 sacks Class-G cement, with 11.5 kg (25 lb) Kolite per sack of cement, 20% silica flour and 8% D-53, amounting to a slurry weight of 1.67 kg/L (14 lb/gal). Cement was displaced with 71,300 L (260 bbl) water. During cementing, 8740 L (55 bbl) of returns were lost.

8. DRILLING PROBLEMS

While running in the 34-cm (13-3/8-in.) casing, the casing crew encountered tight spots at 166 m (546 ft) - 13th joint, and at 180 m (589 ft) - 14th joint. They ran two more joints by circulating at 215 m (705 ft) - 16th joint. They worked the pipe to 464 m (1522 ft) - 37th joint, where it stuck. An attempt to free it by circulating failed. A try at lubricating the pipe by soaking and circulating 18,150 L (5000 gal) diesel oil and 9800 L (2700 gal) pipe lax for 20 hours freed it. The casing was run to 518 m (1698 ft).

9. GEOPHYSICAL LOGGING PROGRAM

Various logs were run in the RRGI-6 well in order to determine the condition of the hole at different stages of the drilling operations. A listing of the logs, the intervals, and the lengths is shown in the following table.

TABLE I

LOGS RUN ON RRGI-6

Log	Type	Date	Shallowest Reading [m(ft)]	Deepest Reading [m(ft)]	Total Length Logged [m(ft)]
1	Compensated Neutron	4-16-78	30 (100)	615 (2017)	584 (1917)
2	Dual Induction Focused Log	4-16-78	27 (90)	616 (2020)	588 (1930)
3	Borehole Compensated Acoustilog	4-17-78	30 (100)	613 (2011)	582 (1911)
4	Differential Temperature Log	4-17-78	30 (100)	615 (2016)	584 (1916)
5	Four-Arm Caliper Log	4-17-78	27 (90)	615 (2019)	588 (1929)
6	Epilog - Computer Log Analysis	4-27-78	37 (120)	616 (2020)	579 (1900)
7	Dual Induction Focused Log	4-30-78	518 (1700)	1153 (3782)	635 (2082)
8	Borehole Compensated Acoustilog	4-30-78	518 (1700)	1150 (3773)	632 (2073)
9	Differential Temperature Log	4-30-78	506 (1660)	1153 (3782)	647 (2122)
10	Compensated Densilog - Compensated Neutron	4-30-78	518 (1700)	1154 (3787)	636 (2087)
11	Compensated Densilog	4-30-78	518 (1700)	1154 (3787)	636 (2087)

RRGI-6, Completion Report
IDO-

APPENDIX A

DAILY DRILLING REPORTS

The following table contains excerpts from the notes recorded in the driller's IADC "Daily Drilling Report."

TABLE A-I

DAILY DRILLING REPORTS

February 20, 1978	Rat and mouse holes drilled and conductor pipe set.
March 3, 1978	Cellar completed.
April 5, 1978	Rig on location.
April 5 to 11, 1978	Rigging up Colorado Well Service Rig #75, a truck-mounted Cabot 750 with 34-m (112-ft) derrick. Substructure was 4 m (14 ft) above ground level.
April 12, 1978	Spudded. Drilled 44-cm (17-1/2 in.) hole from 23 to 112 m (74 to 400 ft) (Kelly Bushing) in 15 hours. Drilled with 34-m (17-1/2-in.) Hughes OSCIG-Jet bit. Mud: gel; vis.: 55 sec/1000 cm^3 (had to be brought down from 120). Stabilization: nonrotating stabilizers and eleven 20-cm (8-in.) drill collars.
April 13, 1978	Drilled 12 hours with Bit 1 to 312 m (1025 ft). Survey showed 1/2-degree deviation at 160 m (525 ft). Repaired shale shaker, tong pulley, and weight indicator. Hole become tight. Used Bit 1, two nonrotating stabilizers, and eleven 20-cm (8-in.) drill collars. Mud: gel; vis.: 51 sec/1000 cc; wt.: 1.12 kg/L (9.4 ppg).
April 14, 1978	Drilled to 337 m (1106 ft) in 3 hours. Bit 1 made 315 m (1032 ft) in 31 hours. Bit 2, in at 337 m (1106 ft), was a Hughes 44-cm (17-1/2-in.) OWV-J. Tight hole dragged up to 22,720 kg (50,000 lb) over string weight. Drilled to 427 m (1402 ft). Used eleven 20-cm (8-in.) drill collars and two nonrotating stabilizers. Mud: gel; vis.: 44 sec/1000 cm^3; wt.: 1.14 kg/L (9.5 ppg).
April 15, 1978	Drilled from 425 to 570 m (1402 to 1925 ft) in 18 hours using Bit 2. Used two nonrotating stabilizers and eleven 20-cm (8-in.) drill collars. Mud: gel; vis.: 44 sec/1000 cm^3 wt.: 1.14 kg/L (0.5 ppg).

TABLE A-I (cont.)

April 16, 1978	Drilled to 619 m (2030 ft) in 5 hours. Used Bit 2, two nonrotating stabilizers, and eleven 20-cm (8-in.) drill collars. Conditioned hole for logs. Ran temperature, caliper, and dual-induction logs.
April 17, 1978	Finished logging 10:00 A.M. Circulated, rigged up casing crew, and started running casing.
April 18, 1978	Ran casing. Casing went to 45 m (148 ft) in tight hole and stuck. Worked casing to 180 m (589 ft). Circulated and worked casing to 466 m (1528 ft). Conditioned hole. Casing stuck.
April 19, 1978	Circulated around stuck casing. At 3:00 P.M., started displacing mud with diesel oil and pipe lax. Spotted oil at surface 5:00 P.M. Weight indicator showed 9070 kg (20,000 lb) at 5:00 P.M. and 14,060 kg (31,000 lb) at 7:30 P.M. Pipe moved 9 m (30 ft) down hole at 8:30 P.M.
April 20, 1978	Worked casing until it reached 518 m (1698 ft), where it stuck again. Circulated hole. Hooked up dowell to start cementing operations.
April 21, 1978	Cemented forty joints of 81.1-kg/m (54-lb/ft) 34-cm (13-3/8-in.) casing. Shoed at 518 m (1698 ft). Cemented with 625 sacks of Class-G cement with 11.5 kg (25 lb) Kolite per sack of cement, 20% silica flour, and 8% D-53. Total of 1405 sacks Class-G cement at 1.67 kg/L (14 ppg). Plug down at 3:30 A.M. WOC Cut off casing. Cleaned mud pits, cellar, and lines.
April 22, 1978	Nippled up BOP and cleaned mud tank. At 10:00 P.M., rigged up and started into hole.
April 23, 1978	Drilled cement with Bit 3, a 31-cm (12-1/4-in.) Smith SVH. Reamed soft stringers with eleven joints out. Kelly down at 8:00 A.M. Circulated to clean hole. Tripped out and changed bottom hole assembly to shock sub, 6-point reamer, and blade stabilizer. Used eleven 20-cm (8-in.) drill collars. Started back into hole. Drilled with water.
April 24, 1978	Drilled 13 hours to 792 m (2597 ft) with Bit 3 and eleven 20-cm (8-in.) drill collars, shock sub, 3-point reamer, 6-point reamer, and blade stabilizer. Changed Grant rotating head rubber. Serviced rig. Ran deviation survey showing 1 degree at 782 m (2566 ft). Drilled with water.

TABLE A-I (cont.)

April 25, 1978	Drilled 19 hours to 911 m (2990 ft) with Bit 3, eleven 20-cm (8-in.) drill collars, shock sub, 3-point reamer, 6-point reamer, and blade stabilizer. Deviation survey showed 1 degree at 911 m (2990 ft). Drilled with water.
April 26, 1978	Pulled out of hole and picked up core barrel, jars, collars, Bit 4, and Hycalog 20-x 8.9-cm (7-7/8-x 3-1/2-in.) CMHP diamond-core bit. Tested BOP. Tripped in hole with corebarrel. Cored two hours. Pulled out and found one joint of drill pipe with a hole. Replaced it and went back in hole. Encountered 18 m (60 ft) of fill. Cored 1-1/2 hours. Recovered 6 m (21 ft) of core. Tripped for Bit 5, a Smith 31-cm (12-1/4-in.) SVH. Drilled with water and got 50% returns. From 9:30 to 11:00 P.M., lost 127,000 L (800 bbls) of water.
April 27, 1978	Reamed core hole with Bit 4. Drilled 19-3/4 hours to 970 m (3183 ft) with Bit 4 using shock sub, 3-point reamer, 6-point reamer, blade stabilizer, and eleven 20-cm (8-in.) drill collars. Cleaned out fill. Drilled with water, losing 12,700 L/hr (80 bbls/hr).
April 28, 1978	Drilled to 1084 m (3555 ft) in nine hours with Bit 5, eleven 20-cm (8-in.) drill collars, 3-point reamer, 6-point reamer, shock sub, and blade stabilizer. Pulled out of hole and laid down bottom hole assembly. Tripped in to clean out 18 m (59 ft) of fill. Circulated to clean hole. Tripped out.
April 29, 1978	Picked up corebarrel jars, sub, and diamond Bit 4. Tripped in hole. Circulated to wash out 18 m (60 ft) of fill. Started coring from 1176 to 1185 m (3858 to 3889 ft). Tripped out with core and laid down bottom hole assembly. Recovered 3 m (9 ft) of core. Hole left open for nine hours. Fluid level measured at 10 m (34 ft) below ground level.
April 30, 1978	Water level held at 10 m (34 ft). Waited on logging truck. Truck arrived 9:00 A.M. Rigged up and started running logs.
May 1, 1978	Logging operations completed at 1:00 A.M. Rigged up for injection test. Results of test as follows:

Time	Injection Rate [L/sec (gpm)]	Wellhead Pressure [kPa (psi)]
9:10 to 10:10 A.M.	12 (200)	207 (30)
10:10 to 11:10 A.M.	24 (400)	1175 (170)
11:10 to 1:10 P.M.	Closed in	
1:10 to 2:10 P.M.	37 (615)	1900 (275)
2:10 to 4:00 P.M.	Closed in	
4:00 to 9:30 P.M.	48 (800)	2100 (305)
9:30 Completion of Test		

TABLE A-I (cont.)

May 2, 1978

Prepared for air lift test at 73 m (240 ft). Air lifted for 9-1/2 hours. Water level rose as follows:

Time	Rise [m (ft, in.)]
6:25 P.M.	14.9 (49, 0)
6:30 P.M.	14.3 (46, 10)
6:35 P.M.	13.6 (44, 9)
6:40 P.M.	13.2 (43, 3)
6:45 P.M.	13.2 (43, 3)
6:50 P.M.	12.6 (41, 2)
6:55 P.M.	11.9 (39, 1)
7:00 P.M.	11.7 (38, 3)
7:05 P.M.	11.4 (37, 5)
7:10 P.M.	10.8 (35, 6)
7:15 P.M.	10.7 (35, 0)
7:20 P.M.	10.6 (34, 8)
7:30 P.M.	10.3 (33, 9)
11:00 P.M.	5.5 (18, 0)

May 3, 1978

Layed down collars and Kelly. Nippled down BOP. At 4:30 P.M. started rig-down operations.

APPENDIX B

BIT RECORD

The following table provides a performance record for each of the bits used to drill RRGI-6. This information was also obtained from the IADC "Daily Drilling Report."

TABLE B-I

BIT RECORD

Bit	Make	Size [cm (in.)]	Type	Jets	Serial Number		Depth Out [m (ft)KB]		Length Drilled [m (ft)]	
1	Hughes	44.5 (17-1/2)	OSCIG-J	32nd open	BX517	337	(1106)	313	(1026)
2	Hughes	44.5 (17-1/2)	OWV-J	15	CA413	619	(2030)	282	(924)
3	Smith	31.1 (12-1/4)	SVH-J	Open	469KN	911	(2990)	293	(960)
4	NL Hycalog	20 x 9 (7-7/8 x 3-1/2)	CMHIP-Diamond	Diamond	16960	922	(3025)	11	(35)
5	Smith	31.1 (12-1/4)	SVH-J	Open	443JR	1158	(3800)	247	(810)
6	NL Hycalog	20 x 9 (7-7/8 x 3-1/2)	CMHIP-Diamond	Diamond	16960	1185	(3888)	9	(30)

TABLE B-I (Continued)

Bit	Hours	Weight [kg x 100 lb x 1000]	RPM	Pump Pressure [kg (psi)]	SPM	Dull Cond. T/B/G	Formation/Remarks
1	38-1/4	45-90 (10-20)	65	2070 (300)	63	5/7/0	Drilled with gel mud to 619 m (2030 ft). Drilled with water from 619 m (2030 ft) to TD.
2	35-1/2	90 (20)	65	7930 (1150)	65	4/2/0	
3	36-1/4	45-90 (10-20)	60	4140 (600)	70	6/0/-1/8 in.	
4	2-1/4	81 (18)	80	4140 (600)	65	Good	Recovered 6.4 m (21 ft) of core.
5	27-1/2	68-90 (15-20)	60-70	4140 (600)	70	7/0/-1/8 in.	
6	3	81 (18)	80	4140 (600)	70	Good	Recovered 2.7 m (9 ft) of core (rerun of Bit 4).

APPENDIX C

CASING RECORD

The following table contains excerpts from notes recorded in the drilling superintendent's casing record notebook.

TABLE C-1

CASING RECORD [a]

Joint	Measured Length [m (ft)]	Cumulative Length [m (ft.)]	Remarks
1	13.3 (43.64)	13.3 (43.64)	Centralizer
2	12.4 (40.65)	25.7 (84.29)	
3	12.9 (42.30)	38.6 (126.59)	Centralizer
4	13.3 (43.50)	51.8 (170.09)	
5	12.8 (41.95)	64.6 (212.04)	Centralizer
6	12.7 (41.73)	77.4 (253.77)	
7	12.6 (41.46)	90.0 (295.23)	Centralizer
8	12.6 (41.40)	102.6 (336.63)	
9	12.0 (39.49)	114.6 (376.12)	Centralizer
10	13.0 (42.62)	127.6 (418.74)	
11	12.9 (42.26)	140.5 (461.00)	Centralizer
12	13.1 (43.10)	153.6 (504.10)	
13	13.0 (42.77)	166.7 (546.87)	Centralizer
14	12.9 (42.30)	179.6 (589.17)	
15	13.0 (40.65)	192.0 (629.82)	Centralizer
16	13.2 (43.22)	205.1 (673.04)	
17	12.5 (40.95)	217.6 (713.99)	Centralizer
18	12.9 (42.48)	230.6 (756.47)	
19	12.8 (41.96)	243.4 (798.43)	
20	12.9 (42.16)	256.2 (840.59)	
21	13.4 (43.91)	269.6 (884.50)	
22	13.0 (42.80)	282.6 (927.30)	
23	13.1 (42.89)	295.7 (970.19)	
24	13.3 (43.59)	309.0 (1013.78)	
25	13.2 (43.35)	322.2 (1057.13)	
26	13.1 (42.88)	335.3 (1100.01)	
27	13.1 (42.88)	348.4 (1142.89)	
28	13.0 (42.78)	361.4 (1185.67)	
29	13.1 (42.92)	374.5 (1228.59)	
30	13.3 (43.78)	387.8 (1272.37)	
31	12.8 (42.05)	400.6 (1314.42)	
32	13.1 (43.05)	413.8 (1357.47)	
33	12.9 (42.30)	426.7 (1399.77)	
34	13.0 (42.74)	439.7 (1442.51)	
35	13.0 (42.75)	452.7 (1485.26)	
36	13.2 (43.25)	465.9 (1528.51)	
37	13.1 (43.14)	479.1 (1571.65)	
38	13.3 (43.50)	492.3 (1615.15)	
39	13.0 (42.60)	505.3 (1657.75)	
40	12.2 (39.89)	517.4 (1697.64)	

[a] All intermediate casing was 34 cm (13-3/8 in.) OD, 81.3 kg/m (54.5 lb/ft) ST&C, K-55, Range 3.

ROCKY MOUNTAIN GEO-ENGINEERING COMPANY

Grand Junction, Colorado

COMPANY	RMG IDAHO INC.	LOCATION	SE NE SECTION 25 T15S R26E
WELL	RRGE #5	COUNTY	CASSIA
FIELD	RAFT RIVER GEOTHERMAL	STATE	IDAHO
ELEVATION	4015 GL 4031 KB	DRILLING FLUID	MUD & WATER

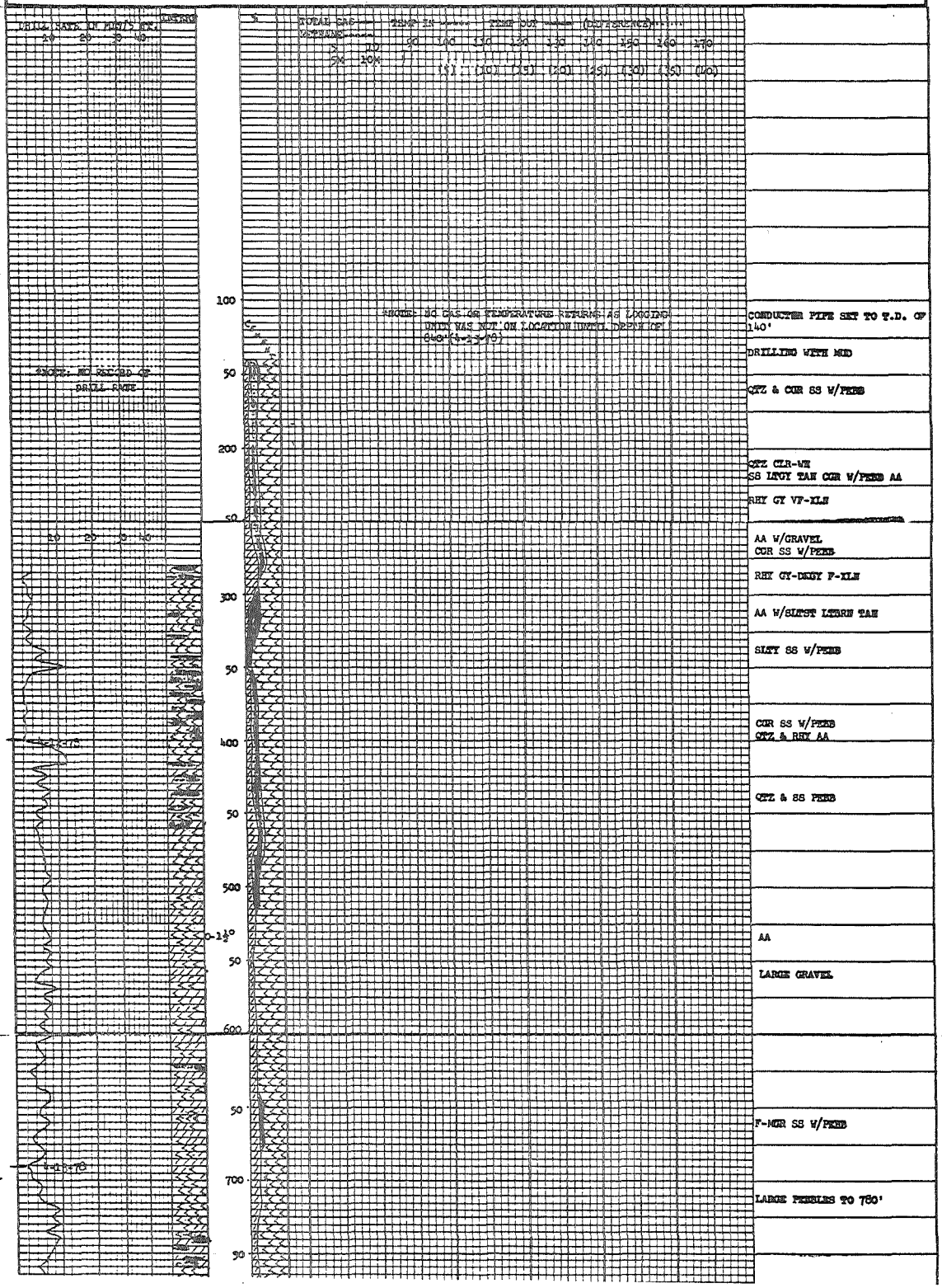
	FROM	TO
DEPTH LOGGED	810	3888
DATE LOGGED	4-13-78	4-29-78

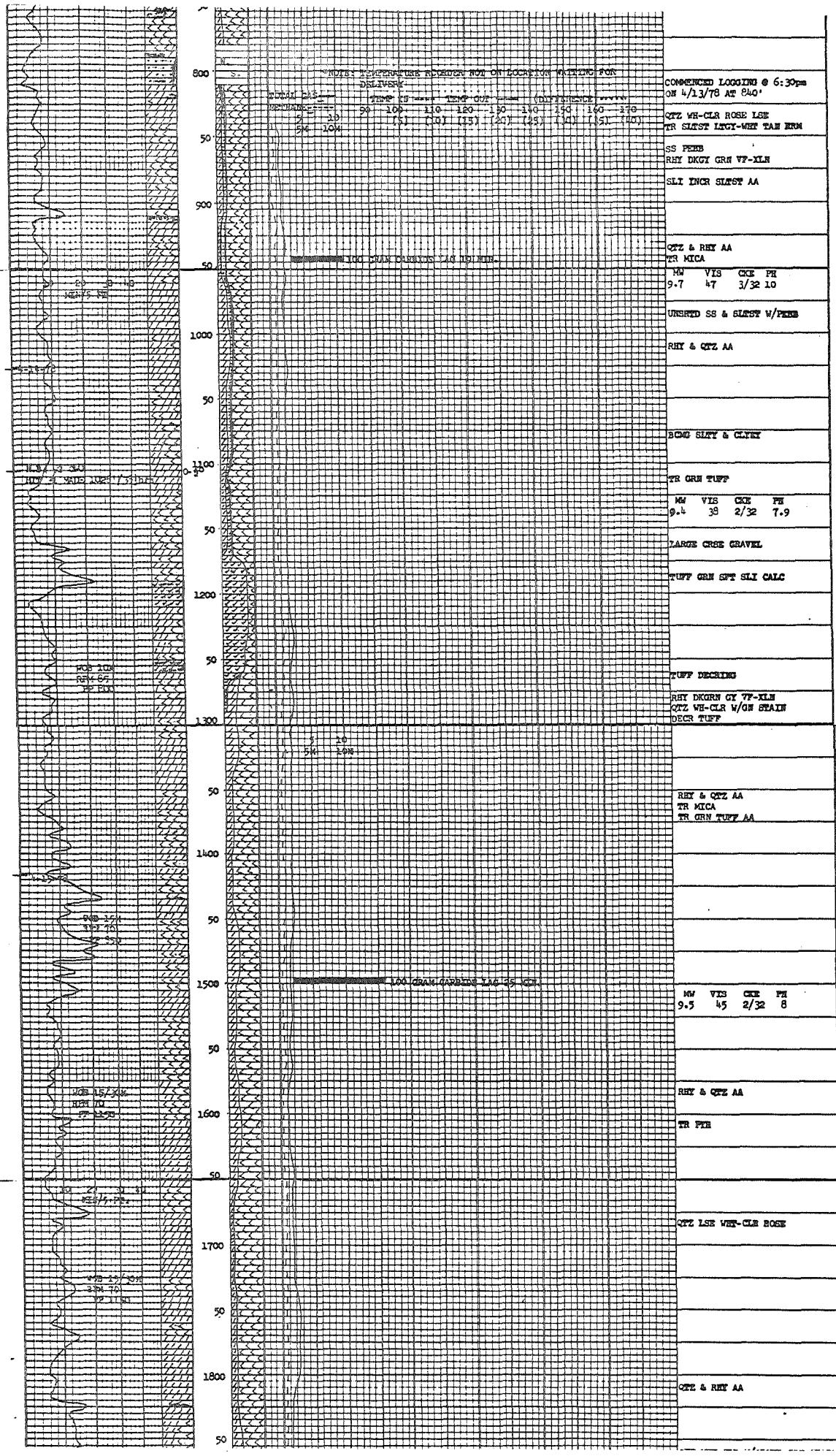
ENGINEERS BLAIR COPELAND

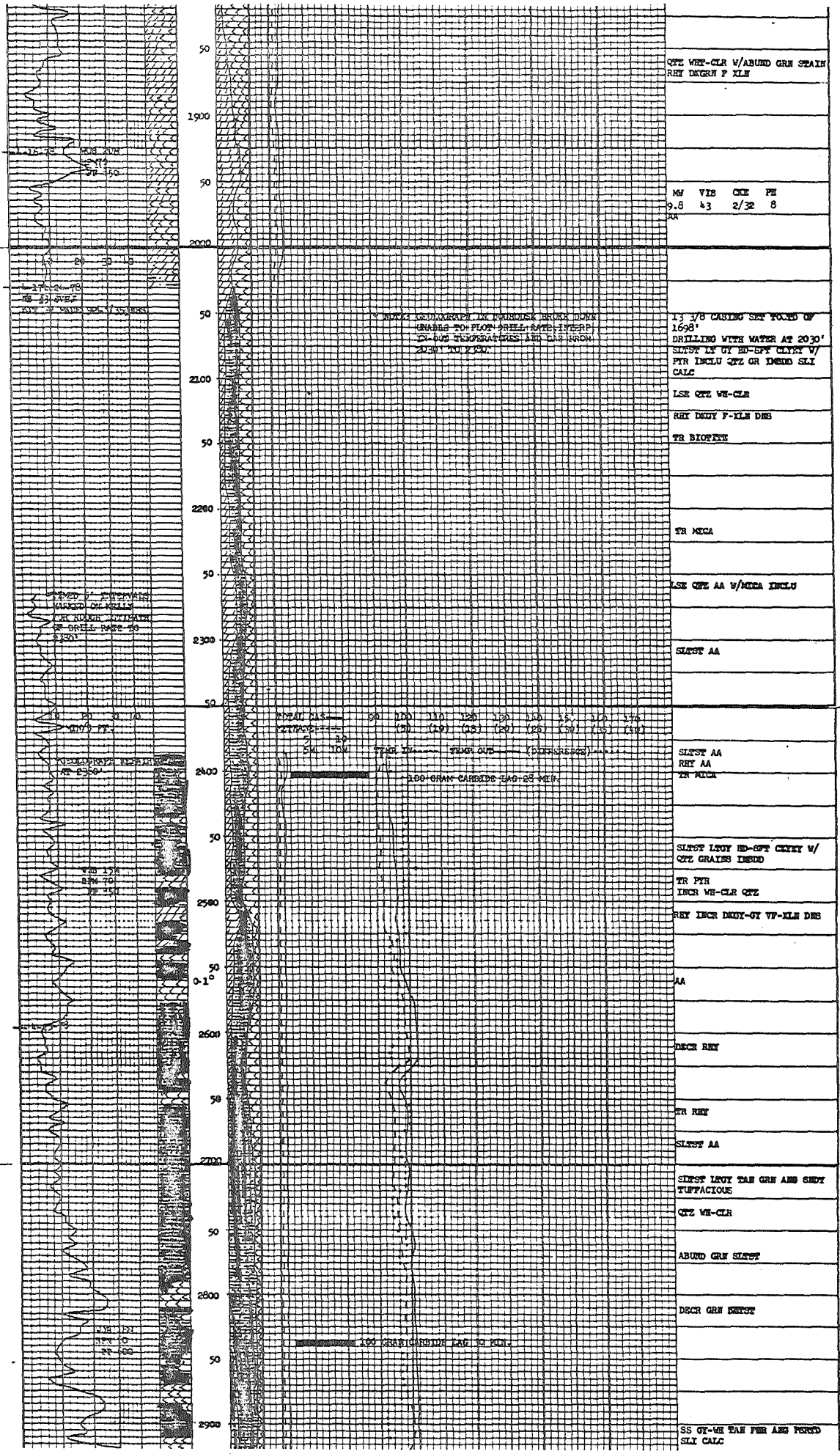
SHALE · SILTSTONE · QUARTZITE · M MICA · CORE NO. · NB - NEW BIT · NR - NO RETURNS · CO - CIRCULATE OUT · NS - NO SAMPLE · TG - TRIP GAS

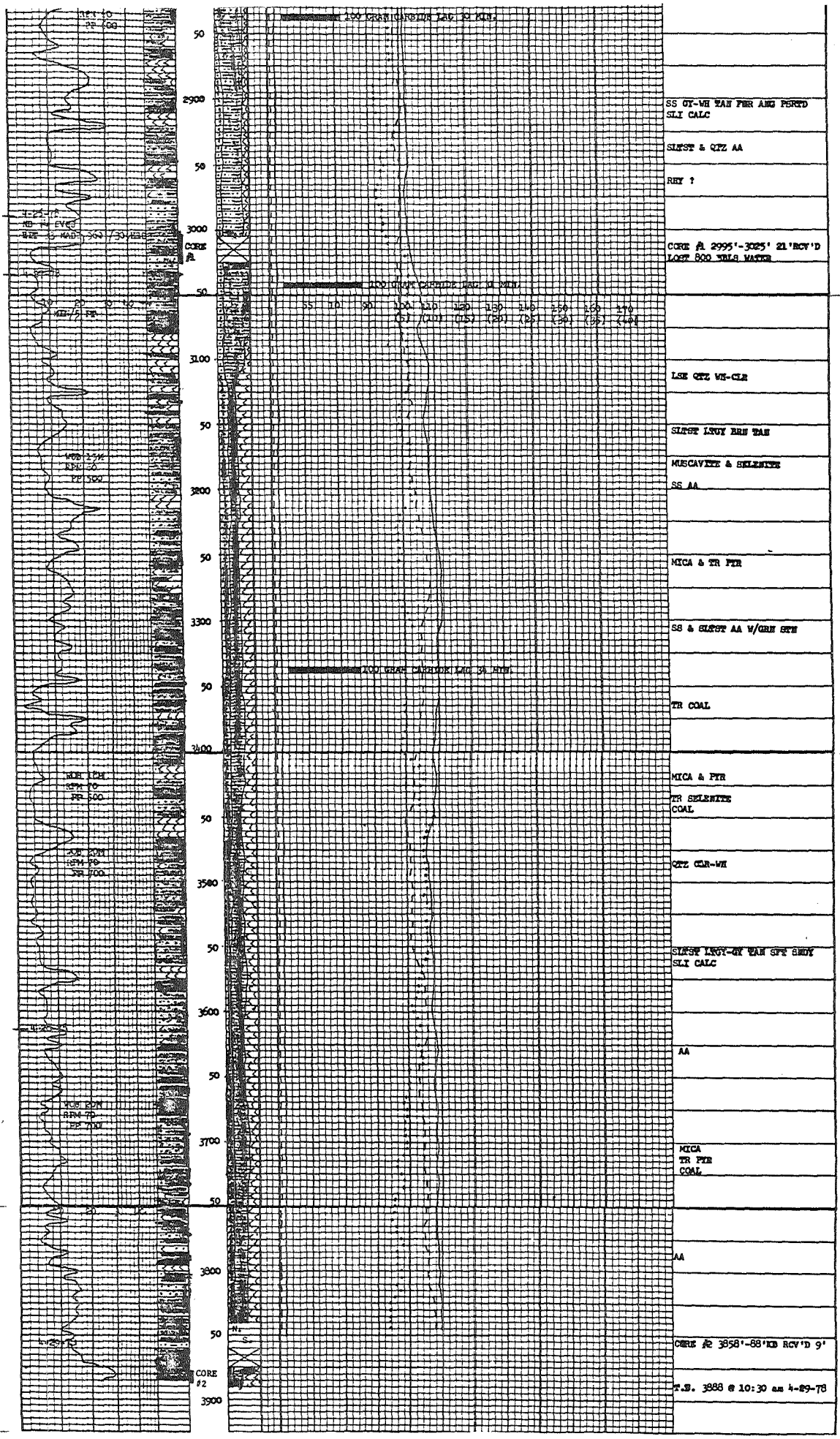
SANDSTONE · TUFF · QUARTZ MONZONITE · P PYRITE · DST NO.

CONGLOMERATE · SCHIST · RHYOLITE · DEVIATION




*NOTE: TEMPERATURE RECORDED NOT ON LOCATION WAITING FOR DELIVERY
TOTAL DISTANCE
DEPARTURE
TEMP IN
TEMP OUT
DIFFERENCE
90 100 110 120 130 140 150 160 170
(5) (10) (15) (20) (25) (30) (35) (40)
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
50
100 GRAM CARBIDE LAG 60 MIN.
100 GRAM CARBIDE LAG 60 MIN.
COMMENCED LOGGING @ 6:30pm ON 4/13/78 AT 840'
QTZ WH-CLR ROSE LSE TR SLTST LTGY-WHT TAN BRN
SS PEBB RHY DKGY GRN VF-XLN
SLI INCR SLTST AA
QTZ & RHY AA TR MICA
MW 9.7 VIS 47 CKE 3/32 PH 10
UNSRTD SS & SLTST W/PEBB
RHY & QTZ AA
BCMG SLTY & CLYEY
TR GRN TUFF
MW 9.4 VIS 38 CKE 2/32 PH 7.9
LARGE CRSE GRAVEL
TUFF GRN SFT SLI CALC
TUFF DECRING
RHY DKGRN GY VF-XLN QTZ WH-CLR W/GN STAIN DECR TUFF
RHY & QTZ AA TR MICA TR GRN TUFF AA
MW 9.5 VIS 45 CKE 2/32 PH 8
RHY & QTZ AA
TR PYR
QTZ LSE WHT-CLR ROSE
QTZ & RHY AA


50
1900
50
2000
50
2100
50
2200
50
2300
50
2400
50
2500
50
0-1°
2600
50
2700
50
2800
50
2900
QTZ WHT-CLR W/ABUND GRN STAIN RHY DKGRN F XLN
MW 9.8 VIS 43 CKE 2/32 PH 8
AA
13 3/8 CASING SET TO 1698'
DRILLING WITH WATER AT 2030'
SLTST LT GY TO MED GY CLYEY W/ FTR INCLU QTZ GR INCRD SLI CALC
LSE QTZ WH-CLR
RHY DKGY F-XLN DNS
TR BIOTITE
TR MICA
LSE QTZ AA W/MICA INCLU
SLTST AA
SLTST AA
RHY AA
TR MICA
SLTST LTGY TO MED GY CLYEY W/ QTZ GRAINS INCRD
TR PYR
INCR WH-CLR QTZ
RHY INCR DKGY-GY VF-XLN DNS
AA
DECR RHY
TR RHY
SLTST AA
SLTST LTGY TAN GRN ABD SHGY TUFFACIOUS
QTZ WH-CLR
ABUND GRN SLTST
DECR GRN SLTST
SS GY-WH TAN FER ARG PORO SLI CALC


100 GRAM CARBIDE LAG 30 MIN.
200 GRAM CARBIDE LAG 30 MIN.
300 GRAM CARBIDE LAG 30 MIN.
50
2900
50
3000
CORE #1
50
3100
50
3200
50
3300
50
3400
50
3500
50
3600
50
3700
50
3800
50
CORE #2
3900
SS GY-WH TAN FER ARG PERTD SLI CALC
SLTST & QTZ AA
RHY ?
CORE #1 2995'-3025' 21'RCV'D LOST 800 BBLS WATER
LSE QTZ WH-CLR
SLTST LTGY BRN TAN
MUSCAVITE & SELENITE
SS AA
MICA & TR FER
SS & SLTST AA W/GRN STN
TR COAL
MICA & FER
TR SELENITE
COAL
QTZ CLR-WH
SLTST LTGY-GY TAN SFT SHGY SLI CALC
AA
MICA
TR FER
COAL
AA
CORE #2 3858'-88'KB RCV'D 9'
T.D. 3888 @ 10:30 am 4-29-78