National Uranium Resource Evaluation

**ENGINEERING REPORT ON
DRILLING IN THE
SAND WASH BASIN, COLORADO**

MASTER

**Field Engineering
Corporation**

Grand Junction Operations
Grand Junction, CO 81502

June 1980

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

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Master

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ENGINEERING REPORT
ON DRILLING IN THE
SAND WASH BASIN, COLORADO

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CONTENTS

	Page
Abstract	1
Introduction	3
Location	3
Principal Firms and Agencies	5
Owner.	5
Operator	5
Land Owners.	5
Subcontractor and Service Firms.	5
Drilling Contractors	5
Lithologic Logging	5
Sampling	5
Drilling Mud	5
Geophysical Logging.	5
Water Hauling.	5
Drilling Guidelines.	6
Drilling Assemblies.	6
Weather and Road Conditions.	7
Work Schedules	7
Individual Borehole History.	8
SWB-1.	8
SWB-2.	10
SWB-2A	12
SWB-3.	14
SWB-4.	16
SWB-5.	18
SWB-6.	20
SWB-9.	22
SWB-11	24
SWB-11A.	25
SWB-12	27
SWB-13	29
SWB-14	31
SWB-15	33
SWB-16	34
SWB-18	36
SWB-19	38
SWB-20	40
SWB-24	42
SWB-25	44
SWB-26	46
SWB-26A.	47
SWB-27	49
SWB-28	51
SWB-28A.	53
SWB-29	55
SWB-30	57
Appendix A. Daily Progress Summary Charts	59
Appendix B. Geophysical Logs (microfiche)	Pocket

FIGURES

	Page
Figure 1. Sand Wash Basin drill-hole locations	4

TABLES

Table 1. Drill-hole summary	2
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ABSTRACT

The Sand Wash Basin Drilling project was conducted by Bendix Field Engineering Corporation in support of the U.S. Department of Energy (DOE) National Uranium Resource Evaluation (NURE) program. This project consisted of 27 drill holes (Table 1) ranging in depth from 110 feet (33.5 m) to 1,995 feet (608.1 m). A total of 24,514 feet (7,471.9 m) was rotary drilled, and 1,593.5 feet (485.7 m) were cored resulting in a total of 26,107.5 feet (7,957.6 m) drilled for the project.

The objective of the project was to provide comprehensive subsurface geologic data relevant to uranium mineralization. This was accomplished by drilling in major outcrop areas of the Browns Park Formation in Moffat and Routt Counties, Colorado. The project began May 18, 1979; drilling was completed November 4, 1979. Most site restoration and cleanup was completed during the fall of 1979 with the remainder to be completed during the spring of 1980.

Table 1. Drill-hole summary

Hole Number	Rotary		Core		Total		Elevation		Qtr.	Location			USGS Topographic Map
	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters		sec.	T(N)	R(W)	
SWB-1	20	6.1	1,115.0	352.00	1,175.0	358.1	6,041	1,841.3	CW1/2	31	7	102	Maybell
SWB-2	510	155.5	10.0	3.05	520.0	158.5	6,945	2,116.8	SWNW	27	11	101	Sugar Loaf Butte
SWB-2A	881	268.5	-0-	-0-	881.0	268.5	6,942	2,115.9	SWNW	27	11	101	Sugar Loaf Butte
SWB-3	1,020	310.9	-0-	-0-	1,020.0	310.9	5,730	1,746.5	SESE	12	10	103	Lodore School
SWB-4	637	194.2	10.0	3.05	647.0	197.2	5,787	1,763.9	S1/2SE	4	9	102	Big Joe Basin
SWB-5	1,160	353.6	10.0	3.05	1,170.0	356.6	5,705	1,738.9	W1/2	30	9	101	Jack Springs
SWB-6	1,192	363.3	17.0	5.20	1,209.0	369.5	6,374	1,942.8	SW	12	8	101	Vermillion Mesa
SWB-9	1,230	374.9	10.0	3.05	1,240.0	378.0	5,907	1,800.5	NENE	35	8	98	Lone Mountain
SWB-11	500	152.4	-0-	-0-	500.0	152.4	6,043	1,841.9	S1/2SW	11	6	97	Elk Springs
SWB-11A	1,243	378.9	-0-	-0-	1,243.0	387.9	6,044	1,842.2	S1/2SW	11	6	97	Elk Springs
SWB-12	1,200	365.8	20.0	6.10	1,220.0	371.9	6,390	1,947.7	SE	6	5	96	Citadel Plateau
SWB-13	1,820	554.7	-0-	-0-	1,820.0	554.7	5,985	1,824.2	NWSW	13	7	96	Maybell
SWB-14	1,499	456.9	10.0	3.05	1,509.0	459.9	6,068	1,849.5	SWNE	20	7	95	Maybell
SWB-15	162	49.4	9.0	2.70	171.0	52.1	6,267	1,910.2	NESE	10	6	95	Citadel Plateau
SWB-16	1,140	347.5	70.0	21.30	1,210.0	368.8	6,129	1,868.0	NWSW	31	6	95	Citadel Plateau
SWB-18	1,000	304.5	50.0	15.20	1,050.0	320.0	6,345	1,934.0	SE	16	7	93	Lay SE
SWB-19	460	140.2	30.0	9.10	490.0	149.4	6,299	1,919.9	CNW	22	7	93	Lay SE
SWB-20	495	150.9	8.0	2.40	503.0	153.3	6,209	1,892.5	NWSE	36	7	94	Lay
SWB-24	952	290.2	30.0	9.10	982.0	299.3	6,898	2,102.5	SESE	8	7	91	Craig
SWB-25	264	80.5	26.0	7.90	290.0	88.4	8,202	2,500.0	SENW	10	10	87	Bears Ears Peak
SWB-26	100	30.5	10.0	3.05	110.0	33.4	8,820	2,688.3	SW	25	10	87	Meaden Peak
SWB-26A	1,624	495.0	24.0	7.30	1,648.0	502.3	9,000	2,743.2	NWNE	36	10	87	Meaden Peak
SWB-27	231	70.4	19.0	5.80	250.0	76.2	9,260	2,822.5	N1/2	8	10	85	Hahns Peak
SWB-28	1,660	506.0	-0-	-0-	1,660.0	506.0	9,370	2,856.0	NE	32	10	86	Meaden Peak
SWB-28A	1,937	590.4	58.0	17.70	1,995.0	608.1	9,370	2,856.0	NE	32	10	86	Meaden Peak
SWB-29	1,317	401.4	10.0	3.05	1,327.0	404.5	7,038	2,145.2	NENE	12	4	85	Blacktail Mountain
SWB-30	260	79.3	7.5	2.30	267.5	81.5	9,415	2,869.7	N1/2	6	2	84	Green Ridge

INTRODUCTION

This report consists of engineering details, statistics, individual borehole histories, and logistics for the 27 boreholes drilled in the project. Geophysical logs are included.

A separate geology report will be prepared and made available through the Bendix Field Engineering Corporation-Grand Junction-Technical Library in the near future.

LOCATION

This project was located entirely within Moffat and Routt Counties, Colorado (Figure 1).

All drill sites were selected in geologically favorable areas which allowed reasonable access, thereby reducing the amount of road construction. General access to the area is by all-weather hard surface highways.

Surface topography ranges from low relief in the Maybell, Colorado, area to mountainous alpine in the Hahns Peak area near Steamboat Springs, Colorado.

ACKNOWLEDGMENTS

The project manager was T. Wayland, BFEC. Project geologists were T. Wayland, T. Carter, and A. Benfer, BFEC. Drilling supervisors were M. Callihan, P. Weiser, N. Abramiuk, BFEC.

Figure 1. Sand Wash Basin drill-hole locations

PRINCIPAL FIRMS AND AGENCIES

OWNER

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

OPERATOR

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

LAND OWNERS

U.S. Bureau of Land Management
U.S. Forest Service
Private Land Owners

SUBCONTRACTORS AND SERVICE FIRMS

DRILLING CONTRACTORS

American Drilling Company
P.O. Box 122
Casper, Wyoming 82602

Camp Drilling Company
P.O. Box 953
Lamar, Colorado 81052

LITHOLOGIC LOGGING

Exploration Services, Inc.
P.O. Drawer 90
Midland, Texas 79702

SAMPLING

Cuttings Sample Master
1106 Payne
Casper, Wyoming 82601

DRILLING MUD

Northwestern Mud Company
P.O. Box 357
Craig, Colorado 81625

GEOPHYSICAL LOGGING

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

WATER HAULING

(Via Drilling Contractors)

DRILLING GUIDELINES

Unstable surface conditions required the use of 10 to 80 feet (3.05 to 24.4 m) of steel surface casing on all boreholes except SWB-1. The casing was firmly cemented in the surface hole to prevent washouts.

Rotary drill hole size below the surface casing was generally maintained between 4.750 and 5.625 inches (12.07 and 14.28 cm).

A minimum core size requirement of 1.750 inches (4.45 cm) was met by employing NC 3.750-inch (9.53 cm) and 3.875- x 2.125-inch (9.84 x 5.40 cm) diamond core bits for all coring operations.

Drilling mud was used as the circulation medium; this allowed mechanical sampling (by Sample Masters) at 5-foot (1.5 m) intervals. The drilling fluid was generally composed of a gel-based mud with occasional use of polymers and lost circulation material, as additives, to aid in the prevention of water loss and to improve mud properties.

The mud pits were lined with six (6) mil plastic to conserve drill water.

Deviation surveys were originally planned for 400-foot (121.9 m) intervals or at the convenience of the drillers. This requirement was relaxed somewhat during the last phase of the project because hole deviation problems were not encountered and vertical deviation surveys were available via Bendix geophysical logging at the completion of each hole.

DRILLING ASSEMBLIES

During the course of the project, four drilling rigs were mobilized to the project area. American Drilling provided three rigs and Camp Drilling, acting as a subcontractor to American Drilling, provided one rig. These units were:

American Drilling Rig No. 408: Gardner-Denver model 1500, truck mounted, equipped with a 5 x 10 mud pump and a 38 foot (11.6 m) mast. Approximately 2,500 feet (762.0 m) of 2.875-inch (7.30 cm) I.F. (Internal Flush) x 20-foot (6.1 m) drill pipe and three 3.500-inch (8.89 cm) x 20-foot (6.1 m) drill collars comprised the initial drill string. The rig was also equipped with an Eastman Star Recorder geolograph. Water hauling was provided by an American Drilling Company water truck.

American Drilling Rig No. 409: Ingersoll Rand model R0 300, truck mounted, equipped with a Gardner-Denver 5 x 8 mud pump and a 38-foot (11.6 m) mast. Approximately 2,000 feet (609.6 m) of 2.875-inch (7.30 cm) I.F. x 20-foot (6.1 m) drill pipe and three 3.500-inch (8.89 cm) x 20-foot (6.1 m) drill collars comprised the initial drill string. The rig was also equipped with an Eastman Star Recorder geolograph. Water hauling was provided by an American Drilling Company water truck.

American Drilling Rig No. 413: Gardner-Denver model 1400, truck mounted equipped with a Gardner-Denver 5 x 6 mud pump and a 35-foot (10.7 m) mast. Approximately 2,000 feet (609.6 m) of 2.875-inch (7.30 cm) I.F. x 20-foot drill pipe and three 3.500-inch (8.89 cm) x 20-foot (6.1 m) drill collars comprised the initial drill string. The rig was also equipped with an Eastman Star Recorder geograph. Water hauling was provided by an American Drilling Company water truck.

Camp Drilling Rig No. 1: Portadrill model 524, truck mounted, equipped with a Gardner-Denver 5 x 6 mud pump and a 36-foot (10.8 m) mast. Approximately 2,000 feet (609.6 m) of 2.875-inch (7.30 cm) I.F. x 20-foot (6.1 m) drill pipe and two 3.500-inch (8.89 cm) x 20-foot (6.1 m) drill collars comprised the initial drill string. The rig was also equipped with an Eastman Star Recorder geograph. Water hauling was provided by a Camp Drilling Company water truck.

WEATHER AND ROAD CONDITIONS

Weather conditions were quite pleasant throughout the project area except for a mid-October snow storm that hampered operations for three days and halted the cleanup of drill sites at the higher elevations. These drill sites are scheduled for final cleanup and re-seeding during the spring of 1980.

Road conditions were generally very good for the entire project except during the above-mentioned storm. Most locations were within easy access of all-weather state highways and county roads. Some four wheel drive roads were utilized in the vicinity of SWB-28, SWB-26, SWB-25, and SWB-27. SWB-30 required considerable road improvement and resulted in the most difficult access of the project.

WORK SCHEDULES

All rigs were operated on a 24-hour basis with crews working 12-hour shifts. Drilling was performed on a 10-day on and 4-day off cycle with some adjustments for holidays and bad weather. This drilling schedule was necessary to assure completion of the project during favorable weather.

SWB-1

Location: CW1/2, sec. 31, T. 7 N., R. 102 W.
 Total depth: 1,175 feet (358.1 m)
 Spud date: May 18, 1979
 Completion date: June 19, 1979
 Rig: Ingersoll Rand 1500, American Drilling Rig No. 409
 Drill pipe: 2.875-inch (7.32 cm) I.F. x 20-feet (6.1 m) NC wireline
 Core interval(s): 20 feet (6.1 m) to 1,175 feet (358.1 m) continuous core
 Percent core recovery: 92%

Borehole history: SWB-1 was rotary drilled to a depth of 20 feet (6.1 m) with a 7.875-inch (20.0 cm) bit. Surface casing was not used.

The borehole went to a depth of 1,175 feet (358.1 m) with NC diamond core bits. Wireline coring was utilized to 992 feet (302.4 m) and conventional coring used to total depth. Borehole reaming was commonly required because of unstable hole conditions.

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had a capacity of approximately 8,000 gallons (30,280 dm³). The drilling fluid consisted of a gel-based mud having a funnel viscosity of 35-70 seconds and a weight that averaged 8.5-9.0 pounds (3.86-4.09 kg)/gallon.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-20	0-6.1
Christensen	NCD	3.750	9.53	20-525	6.1-160.0
Rockmaster	3/W Step	5.125	13.02	Ream	
Christensen	NCD	3.750	9.53	525-992	160.0-302.4
Rockmaster	3/W Step	5.125	13.02	Ream	
Christensen	NCD	3.750	9.53	992-1,175	302.4-358.1

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
30 sk (50 lb/22.68 kg ea.)	Quick Gel
3 sk (50 lb/22.68 kg ea.)	Lo-Loss
21 sk (2 lb/0.91 kg ea.)	Quik Trol
20 sk (40 lb/22.68 kg ea.)	Shur Gel
3 sk (50 lb/22.68 kg ea.)	Cellex
8 gal (30.28 dm ³)	Diesel
3 sk (50 lb/22.68 kg ea.)	CMC
3 sk (50 lb/22.68 kg ea.)	Bran
6 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

658.5 feet (200.7 m)	4°
900 feet (274.3 m)	5°

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Spectral Gamma (KUT)
Resistivity	Vertical Deviation

SWB-2

Location: SWNW, Sec. 27, T. 11 N., R. 101 W.
Total depth: 520 feet (158.5 m)
Spud date: June 20, 1979
Completion date: June 29, 1979 (Hole abandoned)
Rig: Ingersoll Rand 1500, American Drilling Rig No. 409
Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
Core interval(s): 380-390 feet (115.8-118.9 m) Recovered 3.7 feet (1.13 m)
Percent core recovery: 37%

Borehole history: SWB-2 was rotary drilled to a depth of 80 feet (24.4 m) with a 12.750-inch (32.39 cm) bit. Eighty feet (24.4 m) of 6.625-inch (16.83 cm) steel casing was set and cemented. A blowout preventer was mounted to the casing head.

A 5.00-inch (12.70 cm) borehole was drilled to the total depth of 520 feet (158.5 m) where the drill pipe became stuck in the hole and twisted off. The hole was cored from 380 to 390 feet (115.8 to 118.9 m). Fishing attempts were unsuccessful; consequently, the hole was abandoned and relocated 47 feet (14.3 m) to the south. The borehole was redesignated SWB-2A.

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had a capacity of approximately 8,000 gallons (30,280 dm³). The drilling fluid was composed of a gel-based mud with lost circulation material added to control fluid loss.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		12.750	32.39	0-80	0-24.4
Rockmaster	3/W Step	5.250	13.34	80-260	24.4-79.2
Rockmaster	3/W Step	5.125	13.02	260-270	79.2-82.3
Retip		5.000	12.70	270-285	82.3-86.9
Retip		5.000	12.70	285-305	86.9-93.0
Retip		5.000	12.70	305-315	93.0-96.0
Retip		5.000	12.70	315-325	96.0-99.1
Retip		5.000	12.70	325-327	99.1-99.7
Retip		5.000	12.70	327-332	99.7-101.2
Rockmaster	3/W Step	5.000	12.70	332-340	101.2-103.6
Rockmaster	3/W Step	5.000	12.70	340-343	103.6-104.5
Rockmaster	3/W Step	4.750	12.07	343-353	104.5-107.6
Rockmaster	3/W Step	4.750	12.07	353-358	107.6-109.1
Rockmaster	3/W Step	5.000	12.70	358-361	109.1-110.0
Rockmaster	3/W Step	5.000	12.70	361-380	110.0-115.8
Christensen	NCD	3.750	9.53	380-390	115.8-118.9
Walker	WM 1	5.000	12.70	390-400	118.9-121.9
MacDonald					
Varel	QM 7	5.000	12.70	400-423	121.9-128.9
Varel	QM 7	5.000	12.70	423-460	128.9-140.2
Varel	V 1	5.000	12.70	460-485	140.2-147.8
Varel	V 1	5.000	12.70	485-520	147.8-158.5
Varel	V 1	5.000	12.70	Lost in hole	

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
35 sk (50 lb/22.68 kg ea.)	Quik Gel
14 sk (2 lb/0.91 kg ea.)	Dril Trol
4 sk (50 lb/22.68 kg ea.)	CMC
10 sk (50 lb/22.68 kg ea.)	Cedar Fiber
5 gal (18.93 dm ³)	Quik Foam
4 gal (15.14 dm ³)	Diesel
20 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

400 feet (121.9 m) 3.5°

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Spectral Gamma (KUT)
Resistivity	Vertical Deviation

SWB-2A

Location: SWNW, sec. 27, T. 11 N., R. 101 W.
 Total depth: 881 feet (268.5 m)
 Spud date: July 1, 1979
 Completion date: July 18, 1979
 Rig: Ingersoll Rand 1500, American Drilling Rig No. 409
 Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
 Core interval(s): No cored intervals

Borehole history: SWB-2(A) was drilled to a depth of 80 feet (24.4 m) with a 12.750-inch (32.39 cm) bit. Eighty feet (24.4 m) of 6.625-inch (16.83 cm) steel casing was set and cemented. A blowout preventer was mounted to the casing head.

A 5.625-inch (14.29 cm) borehole was drilled from below the casing to 448 feet (136.6 m); drilling continued to a total depth of 881 feet (268.5 m) with a 5.125-inch (13.02 cm) bit. Penetration rates were low and bit usage high due to the hardness of the conglomeratic sandstone that was drilled.

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with lost circulation material added to control fluid loss.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		12.750	32.39	0-80	0-24.4
Varel	VH 1	5.625	14.29	80-240	24.4-73.2
Varel	VH 1	5.625	14.29	240-270	73.2-82.3
Varel	VH 1	5.625	14.29	270-300	82.3-91.4
Varel	VH 1	5.625	14.29	300-340	91.4-103.6
Varel	VH 1	5.625	14.29	340-355	103.6-108.2
Varel	VH 1	5.625	14.29	355-365	108.2-111.3
Varel	VH 1	5.625	14.29	365-390	111.3-118.9
Varel	VH 1	5.625	14.29	390-395	118.9-120.4
Varel	VH 1	5.625	14.29	395-405	120.4-123.4
Mission	Button	5.250	13.34	405-423	123.4-128.9
Varel	VH 1	5.625	14.29	423-440	128.9-134.1
Mission	Button	5.125	13.02	440-540	134.1-164.6
Mission	Button	5.125	13.02	540-820	164.6-249.9
Varel	V 1	5.000	12.70	820-881	249.9-268.5

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
40 sk (50 lb/22.68 kg ea.)	Quik Gel
10 sk (2 lb/0.91 kg ea.)	Dril Trol
7 sk (50 lb/22.68 kg ea.)	Cedar Fiber
2 sk (50 lb/22.68 kg ea.)	Bran
2 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

800 feet (243.8 m) 9.5°

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Spectral Gamma (KUT)
Resistivity	Vertical Deviation

SWB-3

Location: SESE, sec. 12, T. 10 N., R. 103 W.

Total depth: 1,020 feet (310.9 m)

Spud date: July 18, 1979

Completion date: July 27, 1979

Rig: Ingersoll Rand 1500, American Drilling Rig No. 409

Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)

Core interval(s): No cored intervals

Borehole history: SWB-3 was rotary drilled to a depth of 20 feet (6.1 m) with a 7.875-inch (20.00 cm) bit. Twenty feet (6.1 m) of 6.625-inch (16.83 cm) steel casing was set and cemented.

A 5.250-inch (13.34 cm) borehole was drilled to 420 feet (128.0 m) where the borehole was continued to 897 feet (273.4 m) with a 5.125-inch (13.02 cm) rock bit. The borehole was drilled to a total depth of 1,020 feet (310.9 m) with a 5.000-inch (12.70 cm) rock bit. Drilling problems included occasional lost circulation, at various depths, and bridging at 908 feet (276.8 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³) The drilling fluid was composed of a gel-based mud with lost circulation material added to control fluid loss.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-20	0-6.1
Rockmaster	3/W Step	5.250	13.34	20-150	6.1-45.7
Rockmaster	3/W Step	5.250	13.34	150-420	45.7-128.0
Walker Mac	WM 2	5.125	13.02	420-520	128.0-158.5
Walker Mac	WM 2	5.125	13.02	520-620	158.5-189.0
Walker Mac	WM 2	5.125	13.02	620-790	189.0-240.8
Walker Mac	WM 2	5.125	13.02	790-897	240.8-273.4
Varel	V 1	5.000	12.70	897-947	273.4-288.6
Varel	V 1	5.000	12.70	947-1,005	288.6-306.3
Varel	V 1	5.000	12.70	1,005-1,020	306.3-310.9

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
76 sk (50 lb/22.68 kg ea.)	Quik Gel
30 sk (50 lb/22.68 kg ea.)	Cedar Fiber
3 sk (50 lb/22.68 kg ea.)	Mud Seal
1 sk (50 lb/22.68 kg ea.)	Cello Flake
1 sk (50 lb/22.68 kg ea.)	Cotton Seed Hulls
4 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

400 feet (121.9 m)	2°
790 feet (240.8 m)	1.5°

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Spectral Gamma (KUT)
Resistivity	Vertical Deviation

SWB-4

Location: S1/2SE, sec. 4, T. 9 N., R. 102 W.
 Total depth: 647 feet (197.2 m)
 Spud date: August 8, 1979
 Completion date: August 11, 1979
 Rig: Ingersoll Rand 1500, American Rig No. 409
 Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
 Core interval(s): 620-630 feet (189.0-192.0 m), Recovered 10 feet (3.05 m)
 Percent core recovery: 100%

Borehole history: SWB-4 was rotary drilled to a depth of 16 feet (4.9 m) with a 7.875-inch (20.00 cm) bit, and 16 feet (4.9 m) of 6.625 inch (16.82 cm) steel casing was set and cemented.

A 5.250-inch (13.34 cm) borehole, using a 3/W Step bit, was drilled to 340 feet (103.6 m). Drilling continued to 556 feet (169.5 m) with a 5.125-inch (13.02 cm) rock bit. A 5.000-inch (12.70 cm) button bit was used to drill to 620 feet (189.0 m).

The borehole was cored with a 3.750-inch (9.53 cm) diamond core bit to a total depth of 647 feet (197.2 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had a capacity of approximately 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with cedar fiber added to aid in the control of water loss.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-16	0-4.9
Rockmaster	3/W Step	5.250	13.34	16-340	4.9-103.6
Christensen	C 2	5.125	13.02	340-548	103.6-167.0
Christensen	C 2	5.128	13.02	548-556	167.0-169.5
Varel	QM 7	5.000	12.70	556-620	169.5-189.0
Christensen	NCD	3.750	9.53	620-630	189.0-192.0

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
15 sk (50 lb/22.68 kg ea.)	Quik Gel
4 sk (50 lb/22.68 kg ea.)	Cedar Fiber
5 sk (94 lb/42.64 kg ea.)	Cement

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Spectral Gamma (KUT)
Resistivity	Vertical Deviation

SWB-5

Location: W1/2, sec. 30, T. 9 N., R. 101 W.
Total depth: 1,170 feet (356.6 m)
Spud date: July 28, 1979
Completion date: August 8, 1979
Rig: Ingersoll Rand 1500, American Rig No. 409
Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
Core interval(s): 1,160-1,170 feet (353.6-356.6 m) Recovered 10 feet
(3.05 m)
Percent core recovery: 100%

Borehole history: SWB-5 was rotary drilled to a depth of 17 feet (5.2 m) with a 7.875-inch (20.00 cm) bit, and 17 feet (5.2 m) of 6.625-inch (16.83 cm) steel casing was set and cemented.

A 5.125-inch (13.02 cm) borehole was drilled to 1,030 feet (313.9 m). Hole size was reduced to 5.00 inches (12.70 cm) and drilled to 1,160 feet (353.6m). The borehole was cored with a 3.750-inch (9.53 cm) diamond core bit to a total depth of 1,170 feet (356.6 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with cedar fiber added to aid in controlling fluid loss. Funnel viscosity averaged 39 seconds and mud weights averaged 10.5 pounds (4.76 kg)/gallon.

Bit Record

<u>Make</u>	<u>Type</u>	Size		Footage	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-16	0-4.9
Rockmaster	3/W Step	5.125	13.02	16-520	4.9-158.5
Walker	WM 2	5.125	13.02	520-740	158.5-225.6
MacDonald					
Walker	WM 2	5.125	13.02	740-850	225.6-259.1
MacDonald					
Walker	WM 1	5.125	13.02	850-878	259.1-267.6
MacDonald					
Walker	WM 1	5.125	13.02	878-955	267.6-291.1
MacDonald					
Walker	WM 2	5.125	13.02	955-1,002	291.1-305.4
MacDonald					
Walker	WM 2	5.125	13.02	1,002-1,030	305.4-313.9
MacDonald					
Varel	V 1	5.000	12.70	1,030-1,052	313.9-320.7
Walker	WM 1	5.000	12.70	1,052-1,090	320.7-332.2
MacDonald					
Walker	WM 1	5.000	12.70	1,090-1,149	332.2-350.2
MacDonald					
Varel	V 1	5.000	12.70	1,149-1,160	350.2-353.6
Christensen	NCD	3.750	9.53	1,160-1,170	353.6-356.6

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
27 sk (50 lb/22.68 kg ea.)	Quik Gel
8 sk (50 lb/22.68 kg ea.)	Cedar Fiber
1 sk (50 lb/22.68 kg ea.)	CMC
5 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

400 feet (121.9 m)	1.5°
740 feet (225.6 m)	1°

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Spectral Gamma (KUT)
Resistivity	Vertical Deviation

SWB-6

Location: SW, sec. 12, T. 8 N., R. 101 W.

Total depth: 1,209 feet (368.5 m)

Spud date: August 11, 1979

Completion date: August 16, 1979

Rig: Ingersoll Rand 1500, American Rig No. 409

Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)

Core interval(s): 1,015-1,025 feet (309.4-312.4 m) Recovered 10 feet (3.05 m)

1,202-1,209 feet (366.4-368.5 m) Recovered 5 feet (1.52 m)

Percent core recovery: 88%

Borehole history: SWB-6 was rotary drilled to a depth of 16 feet (4.9 m) with a 7.875-inch (20.00 cm) bit, and 16 feet (4.9 m) of 6.625-inch (16.83 cm) steel casing was set and cemented.

A 5.250-inch (13.34 cm) borehole was drilled from below casing to 442 feet (134.7 m). The borehole was continued to 899 feet (274.0 m) with 5.125-inch (13.02 cm) C 2 bits. The borehole was reduced to 5.000 inches in diameter (12.70 cm) and was drilled to 1,015 feet (309.4 m), where 10 feet (3.05 m) of NC core was taken to 1,025 feet (312.4 m). The 5.000-inch (12.70 cm) borehole was continued to 1,202 feet (366.4 m), where another 7-foot (2.1 m) section of NC core was taken to bring the total depth to 1,209 feet (368.5 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had a capacity of approximately 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with cedar fiber added to control fluid loss. Funnel viscosity averaged 43 seconds and mud weights averaged 9.9 pounds (4.49 kg)/gallon.

Bit Record

Make	Type	Size		Footage	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-16	0-4.9
Rockmaster	3/W Step	5.250	13.34	16-442	4.9-134.7
Christensen	C 2	5.125	13.02	442-680	134.7-207.3
Christensen	C 2	5.125	13.02	680-760	207.3-231.6
Christensen	C 2	5.125	13.02	760-899	231.6-274.0
Varel	QM 7	5.000	12.70	899-979	274.0-298.4
Varel	V 1	5.000	12.70	979-1,015	298.4-309.4
Christensen	NCD	3.750	9.53	1,015-1,025	309.4-312.4
Varel	V 1	5.000	12.70	1,025-1,202	312.4-366.4
Christensen	NCD	3.750	9.53	1,202-1,209	366.4-368.5

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
19 sk (50 lb/22.68 kg ea.)	Quik Gel
6 sk (50 lb/22.68 kg ea.)	Cedar Fiber
1 sk (40 lb/18.14 kg ea.)	Petro Seal
10 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

400 feet (121.9 m)	1°
760 feet (231.6 m)	2.5°
800 feet (243.8 m)	2.5°
1,209 feet (368.5 m)	4°

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Vertical Deviation
Resistivity	

SWB-9

Location: NENE, sec. 35, T. 8 N., R. 98 W.

Total depth: 1,240 feet (378.0 m)

Spud date: October 17, 1979

Completion date: October 24, 1979

Rig: Gardner-Denver 1400, American Drilling Rig No. 413

Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)

Core interval(s): 1,195-1,205 feet (364.2-367.3 m) Recovered 5 feet (1.52 m)

Percent core recovery: 50%

Borehole history: SWB-9 was rotary drilled to a depth of 20 feet (6.1 m) with a 7.875-inch (20.00 cm) bit, and 20 feet (6.1 m) of 6.625-inch (16.83 cm) steel casing was set and cemented.

A 5.125-inch (13.02 cm) borehole was drilled from below the steel casing to 1,195 feet (364.2 m) using drag and rock bits. The hole was cored from 1,195 to 1,205 feet (364.2 to 367.3 m). Rotary drilling with a 5.125-inch (13.02 cm) bit completed the hole to the total depth of 1,240 feet (378.0 m). No drilling problems were encountered.

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had a capacity of approximately 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with polymers. Lost circulation material was not required.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.20	0-20	0-6.1
Rockmaster	3/W Step	5.125	13.02	20-400	6.1-121.9
Rockmaster	3/W Step	5.125	13.02	400-520	121.9-158.5
Rockmaster	3/W Step	5.125	13.02	520-780	158.5-237.7
Walker	WM 3	5.125	13.02	780-1,020	237.7-310.9
MacDonald					
Rockmaster	3/W Step	5.125	13.02	1,020-1,113	310.9-339.2
Rockmaster	3/W Step	5.125	13.02	1,113-1,160	339.2-353.6
Walker	WM 2	5.125	13.02	1,160-1,170	353.6-356.6
MacDonald					
Varel	VH 2	5.125	13.02	1,170-1,195	356.6-364.2
Christensen	Diamond	3.875	9.84	1,195-1,205	364.2-367.3
	Core	x 2.125	x 5.40		
Varel	VH 2	5.125	13.02	1,205-1,240	367.3-378.0

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
40 sk (50 lb/22.68 kg ea.)	Quik Gel
4 sk (10 lb/4.54 kg ea.)	Dril Trol
2 sk (50 lb/22.68 kg ea.)	CMC
5 sk (94 lb/42.64 kg ea.)	Cement

Geophysical Logs

Gamma
Neutron
Resistivity

Spontaneous Potential
Vertical Deviation

SWB-11

Location: S1/2SW, sec. 11, T. 6 N., R. 97 W.
 Total depth: 500 feet (152.4 m)
 Spud date: July 16, 1979
 Completion date: July 17, 1979
 Rig: Portadrill 524, Camp Rig No. 1
 Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
 Core interval(s): No cored intervals

Borehole history: SWB-11 was rotary drilled to 100 feet (30.5 m) with air using a 7.875-inch (20.00 cm) bit. An adequate casing seat could not be located. The borehole was continued to 500 feet (152.4 m) with a 5.125-inch (13.02 cm) drag bit.

Considerable caving was encountered because of unconsolidated lithologies, and eventually the hole was lost at a total depth of 500 feet (152.4 m). The drill rig was relocated on the drill site and a new hole spudded on July 19, 1979. The new hole was designated SWB-11A.

From 100 feet (30.5 m) to 500 feet (152.4 m) the borehole was drilled with a gel-based mud mixed with lost circulation material. The earthen mud pits were lined with 6 mil plastic and had a capacity of approximately 7,000 gallons (26,495 dm³).

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-100	0-30.5
Rockmaster	3/W Step	5.125	13.02	100-500	30.5-152.4

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
8 sk (50 lb/22.68 kg ea.)	Quik Gel
2 sk (50 lb/22.68 kg ea.)	Cotton Seed Hulls

SWB-11A

Location: S1/2SW, sec. 11, T. 6 N., R. 97 W.
 Total depth: 1,243 feet (378.9 m)
 Spud date: July 18, 1979
 Completion date: July 27, 1979
 Rig: Portadrill 524, Camp Rig No. 1
 Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
 Core interval(s): No cored intervals

Borehole history: SWB-11A was rotary drilled to 20 feet (6.1 m) with a 7.875-inch (20.00 cm) rock bit, and 20 feet (6.1 m) of 6.625-inch (16.83 cm) steel casing was set and cemented.

A 5.000-inch (12.70 cm) borehole was drilled from below the casing to 1,105 feet (336.8 m). The borehole was reduced to 4.750 inches (12.07 cm) and continued to the total depth of 1,243 feet (378.9 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with lost circulation material added to control fluid loss.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-20	0-6.1
Varel	V 1	5.000	12.70	20-380	6.1-115.8
Varel	V 1	5.000	12.70	380-960	115.8-292.6
Varel	V 1	5.000	12.70	960-1,105	292.6-336.8
Varel	QM 7	4.750	12.07	1,105-1,220	336.8-371.9
Hughs	M	4.750	12.07	1,220-1,243	371.9-378.9

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
32 sk (50 lb/22.68 kg ea.)	Quik Gel
14 sk (2 lb/0.91 kg ea.)	Dril Trol
1 sk (50 lb/22.68 kg ea.)	Soda Ash
2 sk (50 lb/22.68 kg ea.)	Cotton Seed Hulls
6 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

400 feet (121.9 m)	3°
800 feet (243.8 m)	0°

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Vertical Deviation
Resistivity	

SWB-12

Location: SE, sec. 6, T. 5 N., R. 96 W.

Total depth: 1,220 feet (371.9 m)

Spud date: October 10, 1979

Completion date: October 21, 1979

Rig: Portadrill 524, Camp Rig No. 1

Drill pipe: 2.875-inch (7.32 cm) I.F. x 20 feet (6.1 m)

Core interval(s): 440-450 feet (134.1-137.2 m) Recovered 10 feet (3.05 m)

840-850 feet (256.0-259.1 m) Recovered 0 feet

Percent core recovery: 50%

Borehole history: SWB-12 was rotary drilled to a depth of 20 feet (6.1 m) with a 7.875-inch (20.00 cm) bit, and 20 feet (6.1 m) of 6.625-inch (16.83 cm) O.D. steel casing was set and cemented.

A 5.000-inch (12.70 cm) borehole was drilled from below the casing to 440 feet (134.1 m). The hole was NC cored from 440 to 450 feet (134.1-137.2 m) with 100% recovery. Rotary drilling continued with a 5.000-inch (12.70 cm) bit to 840 feet (256.0 m). The next 10-foot (3.05 m) NC core interval was attempted, but no core was recovered. The borehole was rotary drilled with a 5.00-inch (12.70 cm) bit to a total depth of 1,220 feet (371.9 m), where stuck pipe and suspected caving resulted in drilling termination.

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,500 gallons (28,388 dm³). The drilling fluid was composed of a gel-based mud with funnel viscosity averaging 40 seconds and weights averaging 9.9 pounds (4.49 kg)/gallon. Detergent and Sta Foam were used to unstick the drill pipe prior to hole termination.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		8.625	21.91	0-20	0-6.1
Security	S 3	5.000	12.70	20-440	6.1-134.1
Christensen	NCD	3.750	9.53	440-450	134.1-137.2
Security	S 3	5.000	12.70	450-840	137.2-256.0
Christensen	NCD	3.750	9.53	840-850	256.0-259.1
Security	S 3	5.000	12.70	850-1,220	259.1-371.9

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
54 sk (50 lb/22.68 kg ea.)	Quik Gel
1/2 sk (50 lb/22.68 kg ea.)	CMC
10 cans (5 gal/18.93 dm ³ ea.)	Detergent
3 cans (10 gal/37.85 dm ³ ea.)	Sta Foam
5 sk (94 lb/42.64 kg ea.)	Cement

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Vertical Deviation
Resistivity	

SWB-13

Location: NSW, sec. 13, T. 7 N., R. 96 W.

Total depth: 1,820 feet (554.7 m)

Spud date: August 11, 1979

Completion date: August 13, 1979

Rig: Portadrill 524, Camp Rig No. 1

Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)

Core interval(s): No cored intervals

Borehole history: SWB-13 was rotary drilled to a depth of 22 feet (6.7 m) with a 7.875-inch (20.00 cm) bit, and 22 feet (6.7 m) of 6.625-inch (16.83 cm) steel casing was set and cemented.

A 5.000-inch (12.70 cm) borehole was drilled from below the casing to a total depth of 1,820 feet (554.7 m). No difficulties were encountered.

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had a capacity of approximately 8,000 gallons (30,280 dm³). The drilling fluid was composed of a gel-based mud with small amounts of lost circulation material added to prevent fluid loss. The mud weight was maintained at approximately 9.5 pounds (4.31 kg)/gallon and funnel viscosity at 37 seconds.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-18	0-5.5
Varel	V 1	5.000	12.70	18-260	5.5-79.2
Varel	V 1	5.000	12.70	260-1,080	79.2-329.2
Varel	V 1	5.000	12.70	1,080-1,400	329.2-426.7
Christensen	C 4	5.000	12.70	1,400-1,820	426.7-554.7

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
54 sk (50 lb/22.68 kg ea.)	Quik Gel
1 sk (50 lb/22.68 kg ea.)	Soda Ash
1 sk (50 lb/22.68 kg ea.)	Caustic Soda
1 sk (2 lb/0.91 kg ea.)	Dril Trol
2 sk (50 lb/22.68 kg ea.)	Cotton Seed Hulls
2 sk (50 lb/22.68 kg ea.)	Cedar Fiber
5 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

800 feet (243.8 m)	6°
1,200 feet (365.8 m)	6°

Geophysical Logs

Gamma
Neutron
Resistivity

Spontaneous Potential
Vertical Deviation

SWB-14

Location: SWNE, sec. 20, T. 7 N., R. 95 W.

Total depth: 1,509 feet (459.9 m)

Spud date: July 31, 1979

Completion date: August 10, 1979

Rig: Portadrill 524, Camp Rig No. 1

Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)

Core interval(s): 1,499-1,509 feet (456.9-459.9 m) Recovered 10 feet (3.05 m)

Percent core recovery: 100%

Borehole history: SWB-14 was rotary drilled to a depth of 15 feet (4.6 m) with a 7.875-inch (20.00 cm) bit, and 15 feet (4.6 m) of 6.625-inch (16.83 cm) steel casing was set and cemented.

A 5.000-inch (12.70 cm) borehole was drilled from below the casing to 1,460 feet (445.0 m) where the hole diameter was reduced to 4.750 inches (12.07 cm). Drilling continued to 1,499 feet (456.9 m). The hole was then cored with a 3.875-inch (9.86 cm) diamond core bit to a total depth of 1,509 feet (459.9 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with additives to control fluid loss.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-15	0-4.6
Varel	V 1	5.000	12.70	15-640	4.6-195.1
Varel	V 1	5.000	12.70	640-1,220	195.1-371.9
Varel	QM 7	5.000	12.70	1,220-1,420	371.9-432.8
Varel	QM 7	5.000	12.70	1,420-1,460	432.8-445.0
Hughes	M	4.750	12.07	1,460-1,499	445.0-456.9
Christensen	Diamond	3.875	9.84	1,499-1,509	456.9-459.9
	Core	x 2.125	x 5.40		

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
34 sk (50 lb/22.68 kg ea.)	Quik Gel
2 sk (2 lb/0.91 kg ea.)	Dril Trol
1 sk (50 lb/22.68 kg ea.)	Soda Ash
1 sk (50 lb/22.68 kg ea.)	Caustic Soda
5 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

400 feet (121.9 m)	2.5°
1,200 feet (365.8 m)	9°

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Spectral Gamma (KUT)
Resistivity	Vertical Deviation

SWB-15

Location: NESE, sec. 10, T. 6 N., R. 95 W.
 Total depth: 171 feet (52.1 m)
 Spud date: August 14, 1979
 Completion date: August 15, 1979
 Rig: Portadrill 524, Camp Drilling Rig No. 1
 Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
 Core interval(s): 162-171 feet (49.4-52.1 m) Recovered 9 feet (2.74 m)
 Percent core recovery: 100%

Borehole history: SWB-15 was rotary drilled to a depth of 15 feet (4.6 m) with a 7.875-inch (20.00 cm) bit, and 15 feet (4.6 m) of 6.625-inch (16.83 cm) steel casing was set and cemented.

A 5.000-inch (12.70 cm) borehole was drilled from below the casing to 162 feet (49.4 m). Circulation was lost shortly after drilling commenced but was restored when lost circulation material was added to the drilling fluid. The hole was cored from 162 feet (49.4 m) to the total depth of 171 feet (52.1 m) with a 3.875-inch (9.84 cm) diamond core bit.

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with lost circulation material and additives.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-15	0-4.6
Christensen	C 4	5.000	12.70	15-155	4.6-47.2
Christensen	C 4	5.000	12.70	155-162	47.2-49.4
Christensen	Diamond	3.875	9.84	162-171	49.4-52.1
	Core	x 2.125	x 5.40		

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
20 sk (50 lb/22.68 kg ea.)	Quik Gel
1 sk (50 lb/22.68 kg ea.)	CMC
1 sk (50 lb/22.68 kg ea.)	Soda Ash
1 sk (50 lb/22.68 kg ea.)	Caustic Soda
2 sk (50 lb/22.68 kg ea.)	Cotton Seed Hulls
2 sk (50 lb/22.68 kg ea.)	Cedar Fiber
4 sk (94 lb/42.64 kg ea.)	Cement

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Spectral Gamma (KUT)
Resistivity	Vertical Deviation

SWB-16

Location: NWSW sec. 31, T. 6 N., R. 95 W.

Total depth: 1,210 feet (368.8 m)

Spud date: October 18, 1979

Completion date: October 25, 1979

Rig: Gardner-Denver 1500, American Drilling Rig No. 409

Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)

Core interval(s): 300-310 feet (91.4-94.5 m) Recovered 0 feet
445-465 feet (135.6-141.7 m) Recovered 0 feet
660-670 feet (201.2-204.2 m) Recovered 0 feet
790-800 feet (240.8-243.8 m) Recovered 0.5 feet (0.15 m)
1,140-1,150 feet (347.5-350.5 m) Recovered 2 feet (0.61 m)
1,200-1,210 feet (365.8-368.8 m) Recovered 4 feet (1.22 m)

Percent core recovery: 9%

Borehole history: SWB-16 was rotary drilled to a depth of 20 feet (6.1 m) with a 8.750-inch (22.23 cm) bit and 20 feet (6.1 m) of 6.625-inch (16.83 cm) casing was set and cemented.

A 5.125-inch (13.02 cm) borehole was drilled from below the casing to a depth of 300 feet (91.4 m) where the first of six cores was taken to 310 feet (94.5 m). (See core interval(s), above, for the samples taken from the remainder of the borehole). In general, core recovery was poor and necessitated additional coring that was not originally planned. A 5.125-inch (13.02 cm) bit was used for all rotary drilling, and the borehole was eventually completed to a total depth of 1,210 feet (368.8 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,500 gallons (28,388 dm³). Funnel viscosity and mud weight averaged 36 seconds and 10 pounds (4.54 kg)/gallon, respectively with a gel-based mud containing polymer additives.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		8.750	22.23	0-20	0-6.1
Walker	WM 3	5.125	13.02	20-300	6.1-91.4
MacDonald					
Christensen	Diamond	3.875	9.84	300-310	91.4-94.5
	Core	x 2.125	x 5.40		
Walker	WM 3	5.125	13.02	310-445	94.5-135.6
MacDonald					
Christensen	Diamond	3.875	9.84	445-465	135.6-141.7
	Core	x 2.125	x 5.40		
Walker	WM 3	5.125	13.02	465-660	141.7-201.2
MacDonald					
Christensen	Diamond	3.875	9.84	660-670	201.2-204.2
	Core	x 2.125	x 5.40		
Walker	WM 3	5.125	13.02	670-790	204.2-240.8
MacDonald					
Christensen	Diamond	3.875	9.84	790-800	240.8-243.8
	Core	x 2.125	x 5.40		
Walker	WM 3	5.125	13.02	800-1,140	243.8-347.5
MacDonald					
Christensen	Diamond	3.875	9.84	1,140-1,150	347.5-350.5
	Core	x 2.125	x 5.40		
Walker	WM 3	5.125	13.02	1,150-1,200	350.5-365.8
MacDonald					
Christensen	Diamond	3.875	9.84	1,200-1,210	365.8-368.8
	Core	x 2.125	x 5.40		

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
24 sk (50 lb/22.68 kg ea.)	Quik Gel
1/2 sk (50 lb/22.68 kg ea.)	CMC
6 sk (94 lb/42.64 kg ea.)	Cement

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Vertical Deviation
Resistivity	

SWB-18

Location: SE, sec. 16, T. 7 N., R. 93 W.

Total depth: 1,050 feet (320.0 m)

Spud date: October 17, 1979

Completion date: October 24, 1979

Rig: Gardner-Denver 1500, American Drilling Rig No. 409

Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)

Core interval(s): 110-120 feet (33.5-36.6 m) Recovered 1.5 feet (0.46 m)
420-430 feet (128.0-131.1 m) Recovered 3.5 feet (1.07 m)
535-545 feet (163.1-166.1 m) Recovered 8.0 feet (2.44 m)
975-985 feet (297.2-300.2 m) Recovered 5.5 feet (1.68 m)
1,040-1,050 feet (317.0-320.0 m) Recovered 10.0 feet
(3.05 m)

Percent core recovery: 57%

Sidewall samples: 400-450 feet (121.9-137.2 m)

Borehole history: SWB-18 was rotary drilled to a depth of 20 feet (6.1 m) with a 8.750-inch (22.23 cm) bit, and 20 feet (6.1 m) of 6.625-inch (16.83 cm) casing was set and cemented.

A 5.625-inch (14.29 cm) borehole was drilled from below the casing to 110 feet (33.5 m) where the first of five cores was taken to 120 feet (36.6 m). (See core interval(s) above for the samples taken from the remainder of the borehole). The borehole size, at 5.625 inches (14.29 cm), was maintained to a depth of 420 feet (128.0 m) where the hole size was reduced to 5.125 inches (13.02 cm). Coring continued to the total depth of 1,050 feet (320.0 m). At the completion of drilling, sidewall samples were taken from an interval between 400 and 450 feet (121.9 and 137.2 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with lost circulation material added to control water loss.

After the completion of drilling, the borehole flowed small amounts of water which was mostly contained in the existing mud pits. As a precaution, cement plugs and a marked steel post were installed in conformance with state regulations.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		8.750	22.23	0-20	0-6.1
Varel	V 3	5.625	14.29	20-110	6.1-33.5
Christensen	Diamond	3.875	9.84	110-120	33.5-36.6
	Core	x 2.125	x 5.40		
Varel	V 3	5.625	14.29	120-420	36.6-128.0
Christensen	Diamond	3.875	9.84	420-430	128.0-131.1
	Core	x 2.125	x 5.40		
Varel	V 3	5.125	13.02	430-535	131.1-163.1
Christensen	Diamond	3.875	9.84	535-545	163.1-166.1
	Core	x 2.125	x 5.40		
Varel	V 3	5.125	13.02	545-975	166.1-297.2
Christensen	Diamond	3.875	9.84	975-985	297.2-300.2
	Core	x 2.125	x 5.40		
Varel	V 1	5.125	13.02	985-1,040	300.2-317.0
Christensen	Diamond	3.875	9.84	1,040-1,050	317.0-320.0
	Core	x 2.125	x 5.40		

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
24 sk (50 lb/22.68 kg ea.)	Quik Gel
61 sk (94 lb/42.64 kg ea.)	Cement

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Spectral Gamma (KUT)
Resistivity	Vertical Deviation

SWB-19

Location: CNW, sec. 22, T. 7 N., R. 93 W.
Total depth: 490 feet (149.4 m)
Spud date: September 10, 1979
Completion date: September 13, 1979
Rig: Ingersoll Rand 1500, American Drilling Rig No. 409
Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
Core interval(s): 180-190 feet (54.9-57.9 m) Recovered 10 feet (3.05 m)
 250-260 feet (76.2-79.2 m) Recovered 9 feet (2.74 m)
 480-490 feet (146.3-149.4) Recovered 9 feet (2.74 m)

Percent core recovery: 93%

Sidewall samples: 130-135 feet (39.6-41.1 m)
 195-205 feet (59.4-62.5 m)
 215-220 feet (65.5-67.1 m)
 285-290 feet (86.9-88.4 m)
 300-310 feet (91.4-94.5 m)
 405-410 feet (123.4-125.0 m)
 420-423 feet (128.0-128.9 m)

Borehole history: SWB-19 was rotary drilled to a depth of 80 feet (24.4 m) with a 7.875-inch (20.00 cm) bit, and 80 feet (24.4 m) of 6.625-inch (16.83 cm) steel casing was set and cemented. A blowout preventer was mounted to the casing head.

After a two day delay due to an engine failure, a 5.125-inch (13.02 cm) borehole was drilled from below the casing to 180 feet (54.9 m). The hole was then cored to 190 feet (57.9 m) with a 3.750-inch (9.53 cm) diamond core bit.

Rotary drilling was resumed with a 5.125-inch (13.02 cm) rock bit, and it continued to 250 feet (76.2 m) where the second 3.750-inch (9.53 cm) core was taken to 260 feet (79.2 m). The hole was rotary drilled with a 5.125-inch (13.02 cm) bit to 480 feet (146.3 m) whereupon coring was resumed. The final core was taken to the total depth of 490 feet (149.4 m) with a 3.750-inch (9.53 cm) diamond core bit. At the conclusion of drilling, sidewall samples were taken from the above intervals.

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud having a funnel viscosity of 28 seconds and weighing 9.6 pounds (4.36 kg)/gallon.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-80	0-24.4
Walker	WM 3	5.125	13.02	80-180	24.4-54.9
MacDonald					
Christensen	NCD	3.750	9.53	180-190	54.9-57.9
Walker	WM 3	5.125	13.02	190-250	57.9-76.2
MacDonald					
Christensen	NCD	3.750	9.53	250-260	76.2-79.2
Christensen	C 2	5.125	13.02	260-400	79.2-121.9
Christensen	C 2	5.125	13.02	400-480	121.9-146.3
Christensen	NCD	3.750	9.53	480-490	146.3-149.4

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
5 sk (50 lb/22.70 kg ea.)	Quik Gel
20 sk (94 lb/42.68 kg ea.)	Cement

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Spectral Gamma (KUT)
Resistivity	Vertical Deviation

SWB-20

Location: NWSE, sec. 36, T. 7 N., R. 94 W.
 Total depth: 503 feet (153.3 m)
 Spud date: October 22, 1979
 Completion date: October 24, 1979
 Rig: Portadrill 524, Camp Drilling Rig No. 1
 Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
 Core interval(s): 470-478 feet (143.3-145.7 m) Recovered 7.5 feet (2.29 m)
 Percent core recovery: 94%

Borehole history: SWB-20 was rotary drilled to a depth of 20 feet (6.1 m) with a 7.875-inch (20.00 cm) bit, and 20-feet (6.1 m) of 6.625-inch (16.83 cm) steel casing was set and cemented.

A 5.000-inch (12.70 cm) borehole was rotary drilled from below the casing to 470 feet (143.3 m). The hole was then cored to 478 feet (145.7 m) with a 3.875-inch (9.84 cm) diamond core bit. Rotary drilling was resumed with a 5.000-inch (12.70 cm) bit and continued 25 feet to the total depth of 503 feet (153.3 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with lost circulation material added to control fluid loss.

Bit Record

Make	Type	Size		Footage	
		in.	cm	ft	m
Retip		7.875	20.00	0-20	0-6.1
Walker	WM 1	5.000	12.70	20-400	6.1-121.9
MacDonald					
Walker	WM 1	5.000	12.70	400-470	121.9-143.3
MacDonald					
Christensen	Diamond	3.875	9.84	470-478	143.3-145.7
	Core	x 2.125	x 5.40		
Walker	WM 1	5.000	12.70	478-503	145.7-153.3
MacDonald					

Mud Additives & Consumables

Quantity	Material
43 sk (50 lb/22.68 kg ea.)	Quik Gel
1/2 sk (50 lb/22.68 kg ea.)	CMC
3 sk (50 lb/22.68 kg ea.)	Cotton Seed Hulls
6 sk (50 lb/22.68 kg ea.)	Cedar Fiber
4 sk (94 lb/42.68 kg ea.)	Cement

Geophysical Logs

Gamma
Neutron
Resistivity

Spontaneous Potential
Vertical Deviation

SWB-24

Location: SESE, sec. 8, T. 7 N., R. 91 W.
 Total depth: 982 feet (299.3 m)
 Spud date: October 25, 1979
 Completion date: November 4, 1979
 Rig: Portadrill 524, Camp Drilling Rig No. 1
 Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m).
 Core interval(s): 510-520 feet (155.4-158.5 m) Recovered 8 feet (2.44 m)
 570-580 feet (173.7-176.8 m) Recovered 8 feet (2.44 m)
 870-880 feet (265.2-268.2 m) Recovered 8 feet (2.44 m)
 Percent core recovery: 80%

Borehole history: SWB-24 was rotary drilled to a depth of 20 feet (6.1 m) with a 9.875-inch (25.08 cm) bit, and 20 feet (6.1 m) of 8.625-inch (21.91 cm) casing was set and cemented.

A 5.000-inch (12.70 cm) borehole was drilled from below the casing to a depth of 510 feet (155.4 m) where the first of three cores was taken to 520 feet (158.5 m). (See core interval(s) above for the samples taken from the remainder of the boreholes). At 520 feet (158.5 m) the borehole size was increased to 5.125 inches (13.02 cm), and drilling continued to the total depth of 982 feet (299.3 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with polymer additives. The funnel viscosity and mud weight were maintained at 35 seconds and less than 10 pounds (4.54 kg)/gallon, respectively.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		9.875	25.08	0-20	0-6.1
Smith-Gruner	SR 1	5.000	12.70	20-51	6.1-155.4
Christensen	Diamond	3.875	9.84	510-520	155.4-158.5
	Core	x 2.125	x 5.40		
Christensen	C 2	5.125	13.02	520-570	158.5-173.7
Christensen	Diamond	3.875	9.84	570-580	173.7-176.8
	Core	x 2.125	x 5.40		
Christensen	C 2	5.125	13.02	580-870	176.8-265.2
Christensen	Diamond	3.875	9.84	870-880	265.2-268.3
	Core	x 2.125	x 5.40		
Christensen	C 2	5.125	13.02	880-982	268.3-299.3

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
27 sk (50 lb/22.68 kg ea.)	Quik Gel
1/2 sk (50 lb/22.68 kg ea.)	CMC
4 sk (94 lb/42.64 kg ea.)	Cement

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Vertical Deviation
Resistivity	

SWB-25

Location: SENW, sec. 10, T. 10 N., R. 87 W.

Total depth: 290 feet (88.4 m)

Spud date: September 22, 1979

Completion date: September 26, 1979

Rig: Portadrill 524, Camp Drilling Rig No. 1

Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)

Cored interval(s): 100-106 feet (30.5-32.3 m) Recovered 5.2 feet (1.58 m)

268-278 feet (81.7-84.7 m) Recovered 10 feet (3.05 m)

280-290 feet (85.3-88.4 m) Recovered 10 feet (3.05 m)

Percent core recovery: 97%

Borehole history: SWB-25 was rotary drilled to a depth of 10 feet (3.05 m) with a 9.875-inch (25.08 cm) bit, and 10 feet (3.05 m) of 8.625-inch (21.91 cm) steel casing was set and cemented.

A 5.125-inch (13.02 cm) borehole was drilled from below the casing to 100 feet (30.5 m) where the hole was cored to 106 feet (32.3 m). A second core was taken from 268 to 278 feet (81.7-84.7 m). The borehole was continued to 280 feet (85.3 m) with a 5.125-inch (13.02 cm) bit where the third core was taken to the total depth of 290 feet (88.4 m).

The circulation system consisted of two 400 gallon (1,514.0 dm³) steel mud tanks with overflow pits. The drilling fluid was composed of gel-based mud having a funnel viscosity of 35 seconds and a weight of 9.5 pounds (4.31 kg)/gallon.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		9.875	25.08	0-10	0-3.05
Walker	WM 3	5.125	13.02	10-60	3.05-18.3
MacDonald					
Rockmaster	3/W Step	5.125	13.02	60-100	18.3-30.5
Christensen	Diamond	3.875	9.84	100-106	30.5-32.3
	Core	x 2.125	x 5.40		
Walker	WM 3	5.125	13.02	106-268	32.3-81.7
MacDonald					
Christensen	Diamond	3.875	9.84	268-278	81.7-84.7
	Core	x 2.125	x 5.40		
Walker	WM 3	5.125	13.02	278-280	84.7-85.3
MacDonald					
Christensen	Diamond	3.875	9.84	280-290	85.3-88.4
	Core	x 2.125	x 5.40		

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
2 sk (50 lb/22.68 kg ea.)	Quik Gel
1 sk (50 lb/22.68 kg ea.)	Cedar Fiber
8 sk (94 lb/42.64 kg ea.)	Cement

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Vertical Deviation
Resistivity	

SWB-26

Location: SW, sec. 25, T. 10 N., R. 87 W.
 Total depth: 110 feet (33.5 m)
 Spud date: September 19, 1979
 Completion date: September 21, 1979
 Rig: Portadrill 524, Camp Drilling Rig No. 1
 Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
 Core interval(s): 100-110 feet (30.5 - 33.5 m) Recovered 10 feet (3.05 m)
 Percent core recovery: 100%

Borehole history: SWB-26 was rotary drilled to a depth of 10 feet (3.05 m) with a 9.875-inch (25.08 cm) bit, and 10 feet (3.05 m) of 8.625-inch (21.91 cm) steel casing was set and cemented.

A 5.000-inch (12.70 cm) borehole was drilled from below the casing to 90 feet (27.4 m). Drilling was continued with a 4.750-inch (12.07 cm) bit to 100 feet (30.5 m) where the hole was cored with a 3.875-inch (9.84 cm) bit to the total depth of 110 feet (33.5 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with lost circulation material added to control fluid loss.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		9.875	25.08	0-10	0-3.05
Varel	V 1	5.000	12.70	10-90	3.05-27.4
Rockmaster	3/W Step	4.750	12.07	90-100	27.4-30.5
Christensen	Diamond	3.875	9.84	100-110	30.5-33.5
	Core	x 2.125	x 5.40		

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
25 sk (50 lb/22.68 kg ea.)	Quik Gel
3 sk (50 lb/22.68 kg ea.)	Cedar Fiber
3 sk (94 lb/42.64 kg ea.)	Cement

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Vertical Deviation
Resistivity	

SWB-26A

Location: NWNE, sec. 36, T. 10 N., R. 87 W.

Total depth: 1,648 feet (502.3 m)

Spud date: October 3, 1979

Completion date: October 9, 1979

Rig: Portadrill 524, Camp Drilling Rig No. 1

Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)

Core interval(s): 500-510 feet (152.4-155.4 m) Recovered 10 feet (3.05 m)

1,100-1,104 feet (335.3-336.5 m) Recovered 1 foot (0.31 m)

1,638-1,648 feet (499.3-502.3 m) Recovered 10 feet (3.05 m)

Percent core recovery: 88%

Borehole history: SWB-26A was rotary drilled to a depth of 22 feet (6.7 m) with a 9.875-inch (25.08 cm) bit, and 22 feet (6.7 m) of 8.625-inch (21.91 cm) steel casing was set and cemented.

A 6.750-inch (17.15 cm) borehole was drilled from beneath the casing to a depth of 500 feet (152.4 m) where a 3.875-inch (9.84 cm) core was taken to 510 feet (155.4 m). Rotary drilling continued to 675 feet (205.7 m) with a 4.750-inch (12.07 cm) bit. The hole was then reamed to a 5.125-inch (13.02 cm) diameter and drilled to 1,100 feet (335.3 m). A second core was then taken to 1,104 feet (336.5 m). The 5.125-inch (13.02 cm) hole was continued to 1,450 feet (442.0 m) where the hole size was reduced to 5.000 inches (12.70 cm). Rotary drilling continued to 1,630 feet (496.8 m). The hole was further reduced in diameter to 4.750 inches (12.07 cm), and drilling continued to 1,638 feet (499.3 m) with a button bit. The final core completed the hole to 1,648 feet (502.3 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had a capacity of approximately 8,000 gallons (30,280 dm³). The drilling fluid was composed of a gel-based mud with small amounts of lost circulation material added to prevent fluid loss.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		9.875	25.08	0-22	0-6.7
Christensen	C 2	6.750	17.15	22-500	6.7-152.4
Christensen	Diamond	3.875	9.84	500-510	152.4-155.4
	Core	x 2.125	x 5.40		
Hughes		4.750	12.07	510-675	155.4-205.7
Rockmaster	3/W Step	5.125	13.02	675-1,100	205.7-335.3
Christensen	Diamond	3.875	9.84	1,100-1,104	335.3-336.5
	Core	x 2.125	x 5.40		
Rockmaster	3/W Step	5.125	13.02	1,104-1,210	336.5-368.8
Rockmaster	3/W Step	5.125	13.02	1,210-1,450	368.8-442.0
Christensen	C 4	5.000	12.70	1,450-1,630	442.0-496.8
Varel	QM 7	4.750	12.07	1,630-1,638	496.8-499.3
Christensen	Diamond	3.875	9.84	1,638-1,648	499.3-502.3
	Core	2.125	x 5.40		

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
15 sk (50 lb/22.68 kg ea.)	Quik Gel
2 sk (50 lb/22.68 kg ea.)	Cotton Seed Hulls
2 sk (50 lb/22.68 kg ea.)	Cedar Fiber
5 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

400 feet (121.9 m) 4°

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Vertical Deviation
Resistivity	

SWB-27

Location: N1/2, sec. 8, T. 10 N., R. 85 W.

Total depth: 250 feet (76.2 m)

Spud date: August 24, 1979

Completion date: August 25, 1979

Rig: Portadrill 524, Camp Drilling Rig No. 1

Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)

Core interval(s): 140-149 feet (42.7-45.4 m) Recovered 8 feet (2.44 m)
240-250 feet (73.2-76.2 m) Recovered 10 feet (3.05 m)

Percent core recovery: 95%

Borehole history: SWB-27 was rotary drilled to a depth of 16 feet (4.9 m) with a 9.875-inch (25.08 cm) bit, and 16 feet (4.9 m) of 8.625-inch (21.91 cm) steel casing was set and cemented.

A 5.000-inch (12.70 cm) borehole was rotary drilled from below the casing to 110 feet (33.5 m) where the hole size was reduced to 4.750 inches (12.07 cm) and drilling continued to 140 feet (42.7 m). The hole was then cored from 140 feet (42.7) to 149 feet (45.4 m) with a 3.875-inch (9.84 cm) diamond core bit. Rotary drilling was resumed with a 4.750-inch (12.07 cm) bit to 240 feet (73.2 m). The hole was then cored to the total depth of 250 feet (76.2 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with lost circulation material added to control fluid loss.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		9.875	25.08	0-16	0-4.9
Christensen	C 4	5.000	12.70	16-110	4.9-33.5
Varel	QM 7	4.750	12.07	110-140	33.5-42.7
Christensen	Diamond	3.875	9.84	140-149	42.7-45.4
	Core	x 2.125	x 5.40		
Varel	QM 7	4.750	12.07	149-209	45.4-63.7
Hughes		4.750	12.07	209-240	63.7-73.2
Christensen	Diamond	3.875	9.84	240-250	73.2-76.2
	Core	x 2.125	x 5.40		

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
58 sk (50 lb/22.68 kg ea.)	Quik Gel
4 sk (2 lb/0.91 kg ea.)	Dril Trol
1/2 sk (50 lb/22.68 kg ea.)	CMC
1 sk (50 lb/22.68 kg ea.)	Cotton Seed Hulls
2 sk (50 lb/22.68 kg ea.)	Cedar Fiber
4 sk (94 lb/42.64 kg ea.)	Cement

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Vertical Deviation
Resistivity	

SWB-28

Location: NE, sec. 32, T. 10 N., R. 86 W.
 Total depth: 1,660 feet (506.0 m)
 Spud date: August 23, 1979
 Completion date: August 30, 1979
 Rig: Ingersoll Rand 1500, American Drilling Rig No. 409
 Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
 Sidewall samples: 650-655 feet (198.1-199.6 m)
 698-704 feet (212.8-214.6 m)
 700-715 feet (213.4-217.9 m)
 715-720 feet (217.9-219.5 m)
 750-755 feet (228.6-230.1 m)
 1,040-1,060 feet (317.0-323.1 m)

Borehole history: SWB-28 was rotary drilled to a depth of 17 feet (5.2 m) with a 7.875-inch (20.00 cm) bit, and 17 feet (5.2 m) of 6.625-inch (16.83 cm) steel casing was set and cemented.

A 5.250-inch (13.34 cm) borehole was rotary drilled to 200 feet (61.0 m) where the hole size was reduced to 5.125 inches (13.02 cm). Drilling continued to the total depth of 1,660 feet (506.0 m). The depth capability of the drilling rig was close to being exceeded at this depth thus causing early termination of the borehole. Sidewall samples were taken from the above-listed intervals.

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had a capacity of approximately 8,000 gallons (30,280 dm³). The drilling fluid was composed of a gel-based mud having an average funnel viscosity of 40 seconds and weighing approximately 9.8 pounds (4.45 kg)/gallon. Lost circulation material was added to aid in the prevention of water loss.

Bit Record

Make	Type	Size		Footage	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-17	0-5.2
Rockmaster	3/W Step	5.250	13.34	17-200	5.2-61.0
Christensen	C 2	5.125	13.02	200-563	61.0-171.6
Christensen	C 2	5.125	13.02	563-881	171.6-268.5
Christensen	C 1	5.125	13.02	881-960	268.5-292.6
Christensen	C 2	5.125	13.02	960-1,090	292.6-332.2
Christensen	C 2	5.125	13.02	1,090-1,345	332.2-410.0
Christensen	C 2	5.125	13.02	1,345-1,500	410.0-457.2
Christensen	C 2	5.125	13.02	1,500-1,520	457.2-463.3
Rockmaster	3/W Step	5.125	13.02	1,520-1,630	463.3-496.8
Walker	WM 2	5.125	13.02	1,630-1,660	496.8-506.0
MacDonald					

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
41 sk (50 lb/22.68 kg ea.)	Quik Gel
1 sk (50 lb/22.68 kg ea.)	CMC
5 sk (50 lb/22.68 kg ea.)	Cedar Fiber
1 sk (80 lb/33.29 kg ea.)	Calcium Chloride
32 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

800 feet (243.8 m)	2°
940 feet (286.5 m)	3.5°
1,400 feet (426.7 m)	4°

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Vertical Deviation
Resistivity	

SWB-28A

Location: NE, sec. 32, T. 10 N., R. 86 W.
Total depth: 1,995 feet (608.1 m)
Spud date: September 20, 1979
Completion date: October 8, 1979
Rig: Gardner-Denver 1400, American Drilling Rig No. 413
Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
Core interval(s): 640-768 feet (195.1-234.1 m) Recovered 93.1 feet (28.38 m)
1,040-1,060 feet (317.0-323.1 m) Recovered 12.5 feet
(3.81 m)
1,587-1,597 feet (483.7-486.8 m) Recovered 5 feet (1.52 m)

Percent core recovery: 70%

Borehole history: SWB-28A was rotary drilled to a depth of 19 feet (5.8 m) with a 7.875-inch (20.00 cm) bit, and 19 feet (5.8 m) of 6.625-inch (16.83 cm) steel casing was set and cemented.

A 5.125-inch (13.02 cm) borehole was drilled from below the casing to 640 feet (195.1 m) where coring commenced with a 3.875-inch (9.84 cm) diamond core bit and continued to 768 feet (234.1 m). The borehole was then rotary drilled with a 5.125-inch (13.02 cm) bit to 1,040 feet (317.0 m) where coring operations were reconvened. Coring continued to 1,060 feet (323.1 m); from 1,060 feet (323.1 m) to 1,587 feet (483.7 m) the hole was rotary drilled with a 5.125-inch (13.02 cm) bit. The final core interval was then taken from 1,587 feet (483.7 m) to 1,597 feet (486.8 m). The hole was completed to the total depth of 1,995 feet (608.1 m) with a 5.125-inch (13.02 cm) bit.

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had a capacity of approximately 8,000 gallons (30,280 dm³). The drilling fluid was composed of a gel-based mud with polymer additives. Lost circulation was a considerable problem while drilling below 1,600 feet (487.7 m). Consequently, large amounts of cedar fiber and bran were added to the mud. Funnel viscosity and mud weight averaged 47 seconds and 9.6 pounds (4.36 kg)/gallon, respectively.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		7.875	20.00	0-19	0-5.8
Christensen	C 2	5.125	13.02	19-331	5.8-100.9
Rockmaster	3/W Step	5.125	13.02	331-640	100.9-195.1
Christensen	Diamond	3.875	9.84	640-658	195.1-200.6
	Core	x 2.125	x 5.40		
Christensen	Diamond	3.875	9.84	658-768	200.6-234.1
	Core	x 2.125	x 5.40		
Christensen	C 2	5.125	13.02	768-1,040	234.1-317.0
Christensen	Diamond	3.875	9.84	1,040-1,060	317.0-323.1
	Core	x 2.125	x 5.40		
Christensen	C 2	5.125	13.02	1,060-1,400	323.1-426.7
Christensen	C 2	5.125	13.02	1,400-1,587	426.7-483.7
Christensen	Diamond	3.875	9.84	1,587-1,597	483.7-486.8
	Core	x 2.125	x 5.40		
Christensen	C 2	5.125	13.02	1,597-1,676	486.8-510.8
Varel	QMC 9	5.125	13.02	1,676-1,785	510.8-544.1
Christensen	C 2	5.125	13.02	1,785-1,902	544.1-579.7
Christensen	C 2	5.125	13.02	1,902-1,995	579.7-608.1

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
165 sk (50 lb/22.68 kg ea.)	Quik Gel
4 sk (50 lb/22.68 kg ea.)	CMC
62 sk (50 lb/22.68 kg ea.)	Cedar Fiber
19 sk (50 lb/22.68 kg ea.)	Bran
10 sk (2 lb/0.91 kg ea.)	Dril Trol
8 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

400 feet (121.9 m)	1.5°
1,000 feet (304.8 m)	1.5°
1,200 feet (365.8 m)	2°
1,580 feet (481.6 m)	5°

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Spectral Gamma (KUT)
Resistivity	Vertical Deviation

SWB-29

Location: NENE, sec. 12, T. 4 N., R. 85 W.
 Total depth: 1,327 feet (404.5 m)
 Spud date: August 29, 1979
 Completion date: September 6, 1979
 Rig: Portadrill 524, Camp Drilling Rig No. 1
 Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
 Core interval(s): 1,317-1,327 feet (401.4-404.5 m) Recovered 10 feet (3.05 m)
 Percent core recovery: 100%

Borehole history: SWB-29 was rotary drilled to a depth of 15.75 feet (4.8 m) with a 9.875-inch (25.08 cm) bit, and 16 feet (4.9 m) of 8.625-inch (21.91 cm) steel casing was set and cemented.

A 5.000-inch (12.70 cm) borehole was rotary drilled from below the casing to 845 feet (257.6 m), whereupon the borehole was reduced to 4.750 inches (12.07 cm) and drilling continued to 1,080 feet (329.2 m). Then, the borehole was reamed to 5.125 inches (13.02 cm) and drilled to 1,317 feet (401.4 m). The hole was cored with a 3.875-inch (9.84 cm) diamond core bit to the total depth of 1,327 feet (404.5 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drilling fluid was composed of a gel-based mud with polymer additives.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		9.875	25.08	0-15.75	0-4.8
Christensen	C 4	5.000	12.70	15.75-845	4.8-257.6
Hughes		4.750	12.07	845-1,080	257.6-329.2
Rockmaster	3/W Step	5.125	13.02	1,080-1,317	329.2-401.4
Christensen	Diamond	3.875	9.84	1,317-1,327	401.4-404.5
	Core	x 2.125	x 5.40		

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
43 sk (50 lb/22.68 kg ea.)	Quik Gel
4 sk (2 lb/0.91 kg ea.)	Dril Trol
1 sk (50 lb/22.68 kg ea.)	CMC
6 sk (50 lb/22.68 kg ea.)	Cedar Fiber
2 sk (94 lb/42.64 kg ea.)	Cement

Deviation Tests

550 feet (167.6 m)	1.5°
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Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Spectral Gamma (KUT)
Resistivity	Vertical Deviation

SWB-30

Location: N1/2, sec. 6, T. 2 N., R. 84 W.
 Total depth: 267.5 feet (81.5 m)
 Spud date: September 9, 1979
 Completion date: September 12, 1979
 Rig: Portadrill 524, Camp Drilling Rig No. 1
 Drill pipe: 2.875-inch (7.30 cm) I.F. x 20 feet (6.1 m)
 Cored interval(s): 260-267.5 feet (79.2-81.5 m) Recovered 7.5 feet (2.28 m)
 Percent core recovery: 100%

Borehole history: SWB-30 was rotary drilled to a depth of 15.75 feet (4.8 m) with a 9.875-inch (25.08 cm) bit, and 16 feet (4.9 m) of 8.625-inch (21.91 cm) steel casing was set and cemented.

A 5.000-inch (12.70 cm) borehole was rotary drilled from below the casing to 110 feet (33.5 m) where the borehole was reduced to 4.750 inches (12.07 cm) and drilling continued to 260 feet (79.2 m). The hole was then cored with a 3.875-inch (9.84 cm) diamond core bit to a total depth of 267.5 feet (81.5 m).

The circulation system consisted of earthen pits (lined with 6 mil plastic) that had an approximate capacity of 7,000 gallons (26,495 dm³). The drillingfluid was composed of a gel-based mud having a funnel viscosity of 36 seconds and weighing 9.5 pounds (4.31 kg)/gallon.

Bit Record

<u>Make</u>	<u>Type</u>	<u>Size</u>		<u>Footage</u>	
		<u>in.</u>	<u>cm</u>	<u>ft</u>	<u>m</u>
Retip		9.875	25.08	0-15.75	0-4.8
Christensen	Rock	5.000	12.70	15.75-110	4.8-33.5
Varel	QMC 7	4.750	12.07	110-195	33.5-59.4
Hughes		4.750	12.07	195-260	59.4-79.2
Christensen	Diamond	3.875	9.84	260-267.5	79.2-81.5
	Core	x 2.125	x 5.40		

Mud Additives & Consumables

<u>Quantity</u>	<u>Material</u>
20 sk (50 lb/22.68 kg ea.)	Quik Gel
8 sk (94 lb/42.64 kg ea.)	Cement

Geophysical Logs

Gamma	Spontaneous Potential
Neutron	Vertical Deviation
Resistivity

RIG 409

SWB-3

RIG 409

SWB-4

A-63

OCTOBER

RIG 1

SWB-11A

RIG 1

SWB-12

RIG 1

SWB-13

AUGUST

RIG 1

SWB-14

RIG 1

SWB-15

RIG 409

SWB-19

RIG 1

SWB-24

RIG 1

SWB-26A

OCTOBER

RIG 1

SWB-27

RIG 409

SWB-28

AUGUST

RIG 413

SEPTEMBER

OCTOBER

SWB-28A

RIG 1

SWB-29

RIG I

SWB - 30

SEPTEMBER