SSCL-SR-1095

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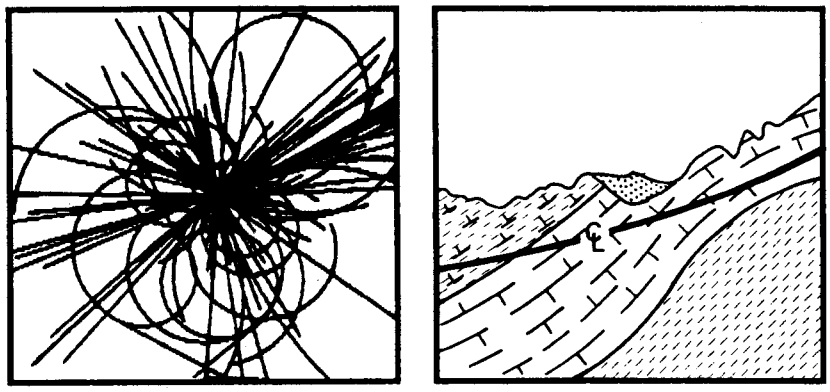
Project No. 87-888-0015
March 1990

GR-36

Data Report for Interaction Region 2 and Coreholes BIR 21, BIR 22, and BIR 23



Prepared by: The Earth Technology Corporation
Long Beach, California

Prepared for: RTk a joint venture
Oakland, California

FOREWORD

The goal of the geotechnical studies at the Texas Superconducting Super Collider (SSC) site is to allow the geologist and engineer to build their level of knowledge and confidence about the geologic structures and geotechnical properties of the site materials to the point at which there remains only a realistically small risk of encountering geotechnical conditions during construction that would significantly increase construction costs or delay construction schedules. To do this, a characterization program has been designed to meet the following objectives:

- To confirm the site's suitability and optimize the ring location (the "footprint") and hall positions on the ring
- To provide data for a preliminary structural design
- To provide a rational framework within which construction contracts and schedules can be formulated
- To maximize the use of the site-specific data already gathered by the proposer.

The geotechnical program to meet these objectives has been divided into the following three phases of study:

- Footprint location data (completed)
- Structure-specific data (the present phase)
- Global data (in progress).

This is one in a series of data reports prepared for the structure-specific phase of geotechnical characterization at the SSC site. Data collection for this study phase focused on drillhole-based geological, geohydrological, geophysical, and geotechnical tests at the locations of experimental halls and the injector. In combination with data from the other phases, these data will allow conceptual designs of construction methods and structural supports for key underground structures. Each data report includes the results of both field and laboratory tests for specific drilling and sampling site(s).

DATA REPORT

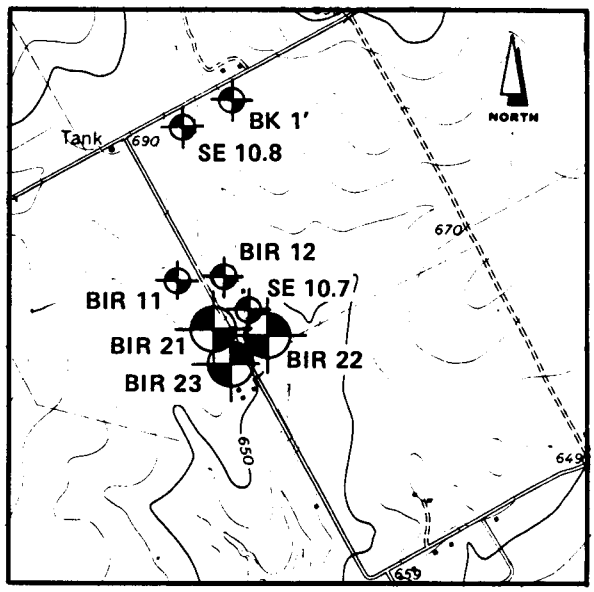
Site Designator: Interaction Region (IR) 2

Objective: Drill coreholes, two vertical and one inclined approximately 46° from horizontal; excavate one trench to a maximum depth of 4.5 feet; characterize fractures; obtain samples for geomechanical testing; and do in situ geohydrological and geophysical testing to characterize the conditions at the IR.

Interaction Region 2 is located on the western side of the ring, approximately 0.8 mile north of Boz, Texas.

BIR 21 and BIR 23 are vertical core holes.

BIR 22 is an angled boring with a bearing of approximately N67°W, angled 46.5° from horizontal.



		BIR 21	BIR 22	BIR 23
Boring Locations:	**North**	238,620 feet	238,494 feet	238,320 feet
	East	2,175,708 feet	2,175,935 feet	2,175,840 feet
	Surface Elevation	665.3 feet	658.4 feet	659.9 feet

Scope and Schedule:	**Geologic Mapping**	Sept. 26 to Oct. 2, 1989
	Trenching	October 2, 1989
BIR 21	**Coring (full depth)**	September 11 to 15, 1989
	Wire-line Logging	September 15, 1989
	Hydrologic Testing	September 18, 1989
	Laboratory Testing	September 11 to 23, 1989
	Well Construction	September 15, 1989
	Downhole Velocity Survey	November 22 and 27, 1989

BIR 22	**Coring (full depth)**	September 12 to 19, 1989
	Wire-line Logging	September 19, 1989
	Hydrologic Testing	September 20 and 21, 1989
	Laboratory Testing	September 23 to Oct. 19, 1989
	Plugging and Abandonment	September 21, 1989
BIR 23	**Coring (full depth)**	September 15 to 19, 1989
	Wire-line Logging	September 19, 1989
	Laboratory Testing	September 24 to Oct. 9, 1989
	Plugging and Abandonment	September 20, 1989

Geologic Mapping: Field mapping identified exposed bedrock approximately 650 feet west-southwest of the IR. The exposure was large enough to provide representative fracture data in the area of the IR. Analysis of boring logs for BIR 21, BIR 22, and BIR 23 as well as logs of adjacent borings indicates that no major faults cross IR 2. See Appendix A and drawings GP-1 and GS-4 (in pocket).

Trenching: One "L"-shaped trench, with each arm approximately 30 feet in length, was excavated to further characterize the fractures at IR 2 (see Drawing GP-1).

Hole BIR 21

Conditions Encountered:

Total Hole Depth:	312.6 feet
Soil:	0.0 to 1.0 feet silty clay
Weathered Austin Chalk:	1.0 to 4.0 feet
Austin Chalk:	4.0 to 212.6 feet
Eagle Ford Shale:	212.6 to 312.6 feet (bottom of hole)
Static Water Level:	Measured at 654.7 feet above MSL on January 20, 1990, 62 days after bailing to about 639.1 feet above MSL. Water level may not have reached equilibrium.

Comparison of wire-line and lithologic logs shows no evidence of faulting between boring BIR 21 and borings BIR 11, BIR 12, BIR 22, BIR 23, SE 10.7, SE 10.8, and BK1' (see Drawing GS-4, in pocket).

Geophysical Logging: (see wire-line logs, Appendix C)

Spontaneous Potential
Point Resistivity
Normal Resistivity (short and long)
Guard Resistivity
Natural Gamma
Compensated Density (caliper)
Sonic Velocity (full wave)
Neutron

Hole Status: A monitoring well was installed on September 15, 1989 (see Appendix G).

Hole BIR 22

Conditions Encountered: (BIR 22 is angled approximately 46.5° from horizontal; depths below are inclined.)

Total Hole Depth:	357.0 feet
Soil:	0.0 to 0.5 feet silty clay (vertical depth 0.0 to 0.5 feet)
Weathered Austin Chalk:	0.5 to 18.2 feet (vertical depth 0.5 to 14.8 feet)
Austin Chalk:	18.2 to 286.0 feet (vertical depth 14.8 to 208.5 feet)
Eagle Ford Shale:	286.0 to 357.0 feet (vertical depth 208.5 to 260.4 feet) (bottom of hole)

Comparison of wire-line and lithologic logs shows no evidence of faulting between boring BIR 22 and borings BIR 11, BIR 12, BIR 21, BIR 23, SE 10.7, SE 10.8, and BK1' (see Drawing GS-4, in pocket).

Geophysical Logging: (see wire-line logs, Appendix C)

Spontaneous Potential
Point Resistivity
Normal Resistivity (short and long)
Guard Resistivity
Natural Gamma
Compensated Density (caliper)
Sonic Velocity (full wave)
Deviation

Hole Status: Plugged with cement grout and abandoned on September 21, 1989 (see plugging report, Appendix G).

Hole BIR 23

Conditions Encountered:

Total Hole Depth:	241.0. feet
Soil:	0.0 to 2.0 feet silty clay
Weathered Austin Chalk:	2.0 to 14.4 feet
Austin Chalk:	14.4 to 208.5 feet
Eagle Ford Shale:	208.5 to 241.0 feet

Comparison of wire-line and lithologic logs shows no evidence of faulting between boring BIR 23 and borings BIR 11, BIR 12, BIR 21, BIR 22, SE 10.7, SE 10.8, and BK1' (see Drawing GS-4, in pocket).

Geophysical Logging: (see wire-line logs, Appendix C)

Spontaneous Potential
Point Resistivity
Normal Resistivity (short and long)
Guard Resistivity
Natural Gamma
Compensated Density (caliper)
Sonic Velocity (full wave)

Hole Status: Plugged with cement grout and abandoned on September 20, 1989 (see plugging report, Appendix G).

Straddle Packer Test Results Summary: BIR 21 was hydrotested on September 18, 1989; BIR 22 was hydrotested on September 20 and 21, 1989 (see Hydrologic Test Results, Appendix D).

Boring	Vertical Test Depth (feet)	Packer Pressure (psi)	Gauge Pressure (psi)	Formation/ Lithology	Hydraulic Conductivity (cm/sec)
BIR 21	30.0-50.0	200	10-20	Austin Chalk	$< 5 \times 10^{-8}$
BIR 21	200-220.0	200	10-20	Austin Chalk/Eagle Ford Shale Contact	$< 4 \times 10^{-8}$
BIR 22	37.5-260.2	160-200	18-35	Austin Chalk	$< 4 \times 10^{-8}$

Bulk and Clay Mineralogy Test Results Summary: (see also Appendix E)

Formation: Austin Chalk

Whole Rock Composition:

Mineral	Percent
quartz	2-4
calcite	93-97
dolomite	0-1
pyrite	1-2
clay	0

Relative Clay Abundance:

Mineral	Percent
Not Analyzed	

Formation: Eagle Ford Shale

Whole Rock Composition:

Mineral	Percent
quartz	22
K-feldspar	1
plagioclase	1
calcite	1
siderite	0
pyrite	5
total clay	58-70

Relative Clay Abundance:

Mineral	Percent
illite	14-19
kaolinite	34-51
chlorite	< 1
mixed layer (illite/smectite)	30-50

Laboratory Geomechanical Test Results Summary: in borings BIR 21 and BIR 23 (see also Appendix E)

Vertical Depth (ft)	Formation/ Lithology	Moisture Content (%)	Dry Density (pcf)	Uniaxial Compressive Strength (psi)	Tangent Young's Modulus E_{50} (psi x 10^5)	Brazil Tensile Strength (psi)
5.0-7.2	Austin Chalk Limestone	10.8-15.1	120.7-125.9	1923		314
23.5-24.3	Austin Chalk Limestone	12.6-13.6	123.2	2569		301
45.0-51.7	Austin Chalk Limestone	9.7-15	118.0-132.6	2626	1.38-2.14	286
103.1-108.0	Austin Chalk Limestone	11.5-16.3	117.9-124.3	2231		285
151.0-154.4	Austin Chalk Limestone	10.9-14.9	119.1-126.8	2758		305
198.7-201.0	Austin Chalk Limestone	11.3-15.4	122.8-123.7	2007		199
204.9-205.3	Austin Chalk Limestone	11.9-13.4	122.3-123.0		9.90	
214.6-217.1	Eagle Ford Shale	16.0-17.7	116.2			
218.3-222.5	Eagle Ford Shale	13.9-17.0	111.9-126.4	194	1.45	
224.3-228.8	Eagle Ford Shale	16.3-17.2	116.2	217		
232.4-237.4	Eagle Ford Shale	16.3-17.2	111.6-117.0		0.17	
252.3-255.8	Eagle Ford Shale	16.0-16.9	114.7-117.5	251		
273.0-273.8	Eagle Ford Shale	13.8-14.2	117.7-122.1			
275.7-278.2	Eagle Ford Shale	13.9-15.2	120.5-121.1	481	0.90	
287.8-290.1	Eagle Ford Shale	14.1-15.5	118.5-120.0	465		

Downhole Velocity Survey Summary: in boring BIR 21 (see Appendix F)

Depth (feet)	V_P (feet/second)	V_S (feet/second)	Poisson's Ratio	Shear Modulus (x 10^5 psi)	Constrained Modulus (x 10^5 psi)
Austin Chalk					
0-15	9400	2700	0.46	2.20	26.59
15-206	9400	3400	0.43	3.49	26.59
Eagle Ford Shale					
206-310	5900	1700	0.46	0.86	10.32

APPENDIX A

SITE GEOLOGY

SITE GEOLOGY – INTERACTION REGION 2

Field mapping at IR 2 consisted primarily of locating and measuring the bearing of joints and locating and identifying the presence of faults within the area. Over 100 joints were measured at a drainage nearby and in an L-shaped trench excavated at the site. Three joint sets were recognized and each was characterized according to the roughness of the joint surfaces and the degree of alteration. Faults were identified by photo interpretation and the presence of crystalline or slickensided calcite along joints and in float. The nearest mappable faults are over 550 feet to the southeast of the IR 2 site.

- **Setting:** See Drawing GP-1 (in pocket).
- **Location and Topographic Setting:** IR 2 is approximately 0.8 mile north of Boz, Texas, on gently sloping, slightly undulating, topography.
- **Surface Slope:** Approximately 1^{o} to 1.5^{o} down to the southeast.
- **Current and Prior Use:** Current use is cropland and pastureland; prior use was probably cultivated cropland and pastureland. Two-thirds of the IR is within pastureland, one-third is within cultivated cropland.
- **Cultural Features and Structures within 50 feet of the IR:** See Drawing GP-1 (in pocket). IR 2 is situated astride a rural asphalt road approximately 14 feet wide. The road is followed by overhead power lines on the southwestern side and by underground telephone cables (Southwestern Bell) along both sides. A buried water line may also be adjacent to the road, although no signs are posted to indicate this. A water line is suspected because the site is southeast of a metered livestock watering tank and a municipal water storage tank and northwest of a currently occupied residence. Four-strand barbed-wire fences parallel both sides of the road. Approximately 50 feet west of the northwestern corner of the Hall is an unoccupied farmhouse. Approximately 60 feet north of the northwestern corner of the Hall is a livestock watering tank. The water is metered and believed to be provided by a municipal water main that parallels the road. The southwestern section of the site is within a cultivated field.
- **Surface Soil Type:** The topsoil is approximately 0.6 foot thick and consists of dark brown clayey sand with gravel, the fine fraction having low to medium plasticity. Approximately 2 feet of weathered chalk is present below the soil.
- **Erosional and Drainage Features:** One primary drainage is located approximately 500 feet east of the site. There are no incised drainages at the site.
- **Vegetation:** Vegetation is dominated by short grasses and wildflowers. There are scattered trees in the fields and dense rows of trees along fencelines separating pastures and cropland and along drainages.

- **Surface Geology:** IR 2 is in the Austin Chalk. The formation is exposed in a drainage 650 feet west of the site and consists of beds of slightly fossiliferous, white chalk (beds 0.1 to 0.9 feet thick) interbedded with thin argillaceous limestone beds 0.1 to 0.5 foot thick. Bedding is locally smooth and undulating but planar overall. At the drainage, the soil is approximately 4.0 feet thick. Trench IR2, approximately in the center of the IR, had 0.6 foot of soil overlying Austin Chalk. The chalk is moderately to intensely fractured at both sites.

- **Subsurface Geology:** Drawing GP-4 (Geologic Profiles, in pocket) illustrates the subsurface geologic conditions that are expected to be encountered at the IR. These profiles were compiled using data collected from the borings around IR.

- **Joint Characterization (in Austin Chalk):** (based on surface exposures)

Joint Set	I	II	III
Orientation[1]	Principally N38° to N46°E, dips 76°-90°SE	N35°-N45°W dips 4°NW to 16°SE	N40° to N50°W dips 58° to 88°SW
Joint Spacing[2]	1.5 ft ($\pm$ 0.94) n=54	0.22 ft ($\pm$ 0.13) n=17	5.1 ft ($\pm$ 2.0) n=23
Joint Roughness[3]	smooth, planar; JRC[4] = 8-20	irregular to rough, undulating; JRC[4] = 6-20	irregular, undulating; JRC[4] = 6-14
Joint Alteration	wall rock to wall rock contact; unaltered joint walls, surface staining only	wall rock to wall rock contact; unaltered joint walls, surface staining only	wall rock to wall rock contact; unaltered joint walls, surface staining only
Comments		bedding	

1. See stereographic plots of poles to joints on Drawing GP-1, in pocket.
2. n = the number of fracture spacing measurements made in the field for that fracture set.
3. Descriptions refer to small-scale features and intermediate scale features, in that order.
4. JRC = Joint Roughness Coefficient.

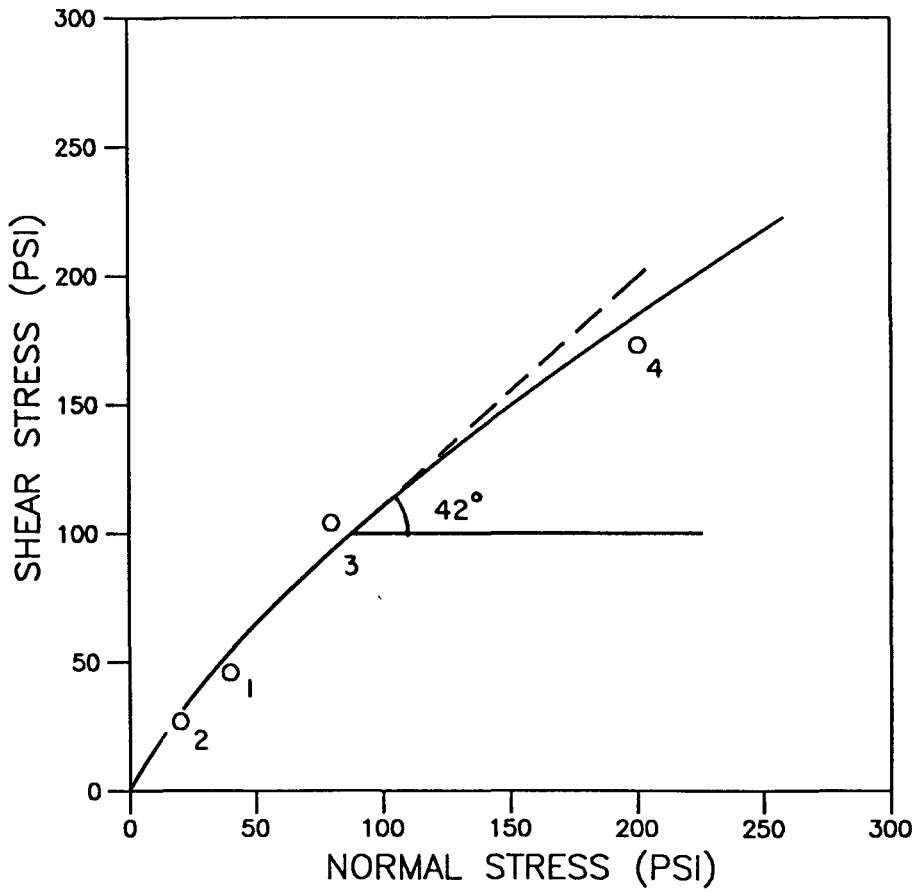
Direct Shear Test Results Summary:

TEST NUMBER	NORMAL LOAD (lbs.)	AREA ($in.^2$)	SHEAR FORCE (lbs.)		DISPLACEMENT (in.)		NORMAL STRESS (psi)		SHEAR STRESS (psi)		TEST FRICTION ANGLE* (deg)		FRICTION ANGLE** (deg)
			PEAK	MIN.	PEAK SHEAR STRESS	MINIMUM SHEAR STRESS	PEAK	MIN.	PEAK	MIN.	PEAK	MIN.	
IR2B1CN1	319	7.98	381	---	0.228	---	40	---	47.7	---	50	---	42
IR2B1AX2	160	7.98	215	---	0.4	---	20	---	27	---	53.5	---	
IR2B1AX3	638	7.98	828	---	0.323	---	80	---	102.8	---	52	---	
IR2B1AX4	1596	7.98	1380	---	0.377	---	200	---	173	---	40.9	---	

Please note that
- These direct shear tests do not exhibit peak and residual shear stresses. These tests generally demonstrate a relationship where an increase in shear stress accompanies increasing shear displacement.
- Samples were cut and aligned so that a constant shear area was maintained during the tests.
- Shear and normal loads have been corrected for piston packing friction.

* Friction angle calculated as Arc Tan (shear stress/normal stress).

** Friction angle at 100 psi as derived from combined plot.

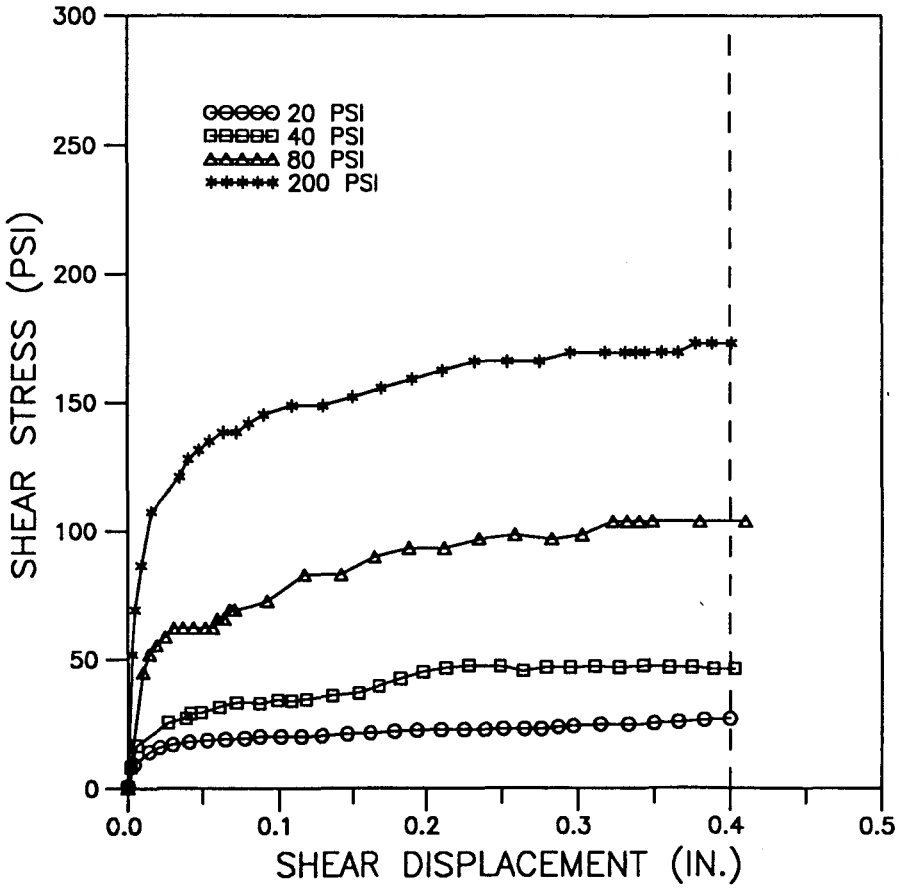


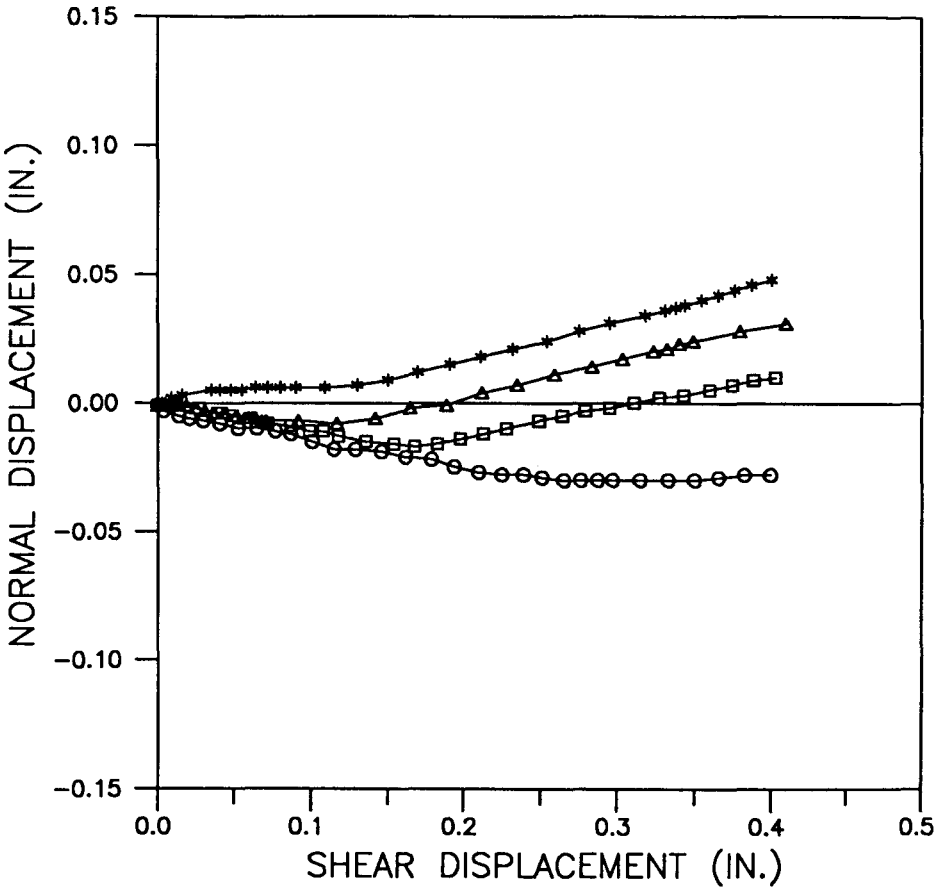
SAMPLE NO.: IR2B1
DEPTH: SURFACE
SHEAR AREA (SQ. IN.): 7.98
LITHOLOGY: AUSTIN CHALK LIMESTONE
DESCRIPTION: SURFACE IS WEATHERED AND IS ROUGH

STAGE:	1	2	3	4
NORMAL STRESS (PSI)	40	20	80	200

TEST PROCEDURE: ISRM

TEXAS SSC SITE	
DISCONTINUITY SHEAR	
MASON–JOHNSTON & ASSOCIATES, INC. GEOLOGISTS–ENGINEERS	
JOB NO.: 5530.15	FIGURE





SAMPLE NO.: IR2B1
DEPTH: SURFACE
SHEAR AREA (SQ. IN.): 7.98
LITHOLOGY: AUSTIN CHALK LIMESTONE
DESCRIPTION: SURFACE IS WEATHERED AND IS ROUGH

STAGE:	1	2	3	4
NORMAL STRESS (PSI)	40	20	80	200

TEST PROCEDURE: ISRM

TEXAS SSC SITE

DISCONTINUITY SHEAR

MASON–JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS–ENGINEERS

JOB NO.: 5530.15 | FIGURE

APPENDIX B

LITHOLOGIC LOGS

LOG OF BORING

BORING NO: BIR 21 PG 1 OF 8

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

LOCATION: N 238,620 feet
E 2,175,708 feet

GROUND EL: 665.3 feet

DATE: 9/11-9/15/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT ROD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
									1.0 CLAY, silty, traces of lime and organic debris, tan
5									4.0 LIMESTONE (Austin Chalk) moderately to severely weathered, moferately fractured, tan with occasional interbedded clay layers
		C1	5.0	10.0	100	98			LIMESTONE (Austin Chalk) medium, fresh, sound, light gray to dark gray with occasional argillaceous and soft shaly layers and fossil partings
10		C2	10.0	15.0	100	100			-1/8" bentonite seam, very soft, light gray at 13.3'
15		C3	15.0	25.0	96	96			-1/8" bentonite seam, very soft, light gray at 17.0'
20									-shale layer, soft, dark gray at 22.8'-23.0'
25		C4	25.0	35.0	100	97			-shale layer, soft, dark gray at 27.5'-28.3' -20° smooth, open slickensided fracture at 28.0' -very argillaceous layer at 29.5'-30.0'
30									-very argillaceous layer at 31.0'-32.0'
35		C5	35.0		100	100			-fossil partings at 38.7' and 39.6' -fossil partings at 38.7', 39.6'
40									-very argillaceous layer at 41.7'-43.0'

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

Drilled with air rotary to 25.0', no groundwater encountered; switched to water rotary at 25.0'

DRILLING GEOLOGIST R. Randall ASSISTANT S. Stevens CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 21 PG 2 OF 8

LOCATION: N 238,620 feet
E 2,175,708 feet

GROUND EL: 665.3 feet

DATE: 9/11-9/15/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION
See p. 1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT ROD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
				45.0					LIMESTONE (Austin Chalk) medium, fresh, sound, light gray to dark gray with occasional argillaceous and soft shaly layers and fossil partings
45			45.0						
		C6			95	95			-very argillaceous layer at 47.7'-48.3'
50									-45° calcite filled healed fracture at 50.8'
									-fossil parting at 54.4'
				55.0					-moderately fossiliferous at 55.0'-57.0'
55			55.0						-very argillaceous layer at 58.2'-59.0'
		C7			95	95			-shale layer, soft, dark gray at 61.3'-61.5'
60									
				65.0					
65			65.0						-2" shale layers, soft, dark gray at 66.0' and 70.0'
		C8			100	100			-fossil parting at 69.0'
70									-30° joint at 70.1'
									-very argillaceous layer at 73.0'-74.0'
				75.0					
75			75.0						
		C9			100	100			-very argillaceous layer at 79.0'-80.0', 82.0'-83.0'
80									-fossil parting at 83.5'

DRILLING GEOLOGIST R. Randall ASSISTANT S. Stevens CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 21 PG 3 OF 8

LOCATION: N 238,620 feet
E 2,175,708 feet

GROUND EL: 665.3 feet

DATE: 9/11-9/15/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

See p. 1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
85				85.0					LIMESTONE (Austin Chalk) medium, fresh, sound, light gray to dark gray with occasional argillaceous and soft shaly layers and fossil partings
90		C10	85.0	95.0	100	100			-fossil partings at 85.8', 87.0', 88.0', 89.5', 91.5', 92.1' -very argillaceous layer at 88.5'-89.5' with ½" shale layer at 88.8' -shale layer, soft, dark gray at 90.4'-90.7' -very argillaceous layer at 93.2'-93.7'
95									
100		C11	95.0	105.0	99.5	99.5			-shale layers, soft, dark gray at 96.65'-96.85' -fossil partings at 98.2', 98.6', 99.0', 100.1', 101.75', 102.2', 103.0', 105.0'
105									-very argillaceous layer at 104.0'-104.4' -very argillaceous layer at 105.5'-115.0' -1/4" bentonite seam, very soft, light gray at 106.0'
110		C12	105.0	115.0	100	100			-fossil partings at 107.8', 111.5', 111.9', 112.8'
115									-very argillaceous layer from 115.0'-121.0' -shale layer, soft, dark gray at 116.8'-117.0' with interbedded bentonite seams -shale layer, soft, dark gray at 118.7'-118.9' -15° smooth, tight slickensided fracture
120		C13	115.0		100	100			-fossil parting at 123.3' -very argillaceous layer from 123.3'-124.7'

DRILLING GEOLOGIST R. Randall ASSISTANT S. Stevens CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 21 PG 4 OF 8

LOCATION: N 238,620 feet
E 2,175,708 feet

GROUND EL: 665.3 feet

DATE: 9/11-9/15/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION
See p. 1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES		HAND PEN. TSF.	DESCRIPTION OF STRATUM
125				125.0						LIMESTONE (Austin Chalk) medium, fresh, sound, light gray to dark gray with occasional argillaceous and soft shaly layers and fossil partings
130		C14	125.0	135.0	100	100				-fossil partings at 126.2', 128.2', 131.0' and 133.3' -very argillaceous layer at 132.0'-133.5'
135										
140		C15	135.0	145.0	92	92				-very argillaceous layer at 135.0'-136.7' and 137.5'-139.2' -shale layer, soft, dark gray at 139.0'-139.2' -fossil partings at 137.5', 137.6', 141.0' and 141.6' -60° smooth, tight slickensided fracture at 143.6' -30° smooth, tight slickensided fracture at 145.6' -very argillaceous layer at 140.6'-141.6' and 143.0'
145										
150		C16	145.0	154.0	100	100				-very argillaceous layers at 145.4', 147.0', 148.3'-149.7', 150.3'-151.3' and 152.0'-152.8' -NOTE: lost 144.2'-145.0' of possible bentonite layers, traces of bentonite at 145.0'
155										
160		C17	154.0	164.0	100	100				-very argillaceous layer at 154.0'-±64.0' -pyrite nodules at 154.0'-164.0' -shale layer, soft, dark gray at 159.8'-160.2'

DRILLING GEOLOGIST R. Randall ASSISTANT S. Stevens CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider
CLIENT: The Earth Technology Corporation
TASK NO.: 15

BORING NO: BIR 21 PG 5 OF 8
LOCATION: N 238,620 feet
E 2,175,708 feet
GROUND EL: 665.3 feet

DATE: 9/11-9/15/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION
See p. 1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
									LIMESTONE (Austin Chalk) medium, fresh, sound, light gray to dark gray with occasional argillaceous and soft shaly layers and fossil partings
									-pyrite nodules at 164.2', 164.3', and 164.9'
-165		C18	164.0	174.0	100	100			-shale layers, soft, dark gray at 168.3'-169.8'
-170									
-175		C19	174.0	184.0	100	100			-15° and 45° transverse slickensided fractures at 177.5'
-180									-1" shale layers, soft, dark gray at 178.3' and 181.1'
-185		C20	184.0	194.0	100	100			-very argillaceous layers and 189.5'-190.5' and 193.0'-193.7'
-190									
-195		C21	194.0	204.0	100	100			-½" shale seam, soft, dark gray at 198.0'
-200									-very argillaceous layers at 199.5'-201.1'

DRILLING GEOLOGIST R. Randall ASSISTANT S. Stevens CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 21 PG 6 OF 8

LOCATION: N 238,620 feet
E 2,175,708 feet

GROUND EL: 665.3

DATE: 9/11-9/15/89 TYPE: Nx core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

See p. 1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
									LIMESTONE (Austin Chalk) medium, fresh, sound, light gray to dark gray with occasional argillaceous and soft shaly layers and fossil partings -pyrite nodules at 204.5', 210.0' and 211.0' -very argillaceous layer at 204.0'-211.0'
205		C22	204.0	214.0	84	84			210.0 SHALY LIMESTONE (Transition) medium, fresh, sound, very argillaceous, dark gray with abundant fragments of fish bones, teeth and other fossil debris, traces of pyrite 212.6
210									
215		C23	214.0	224.0	98	98			SHALE (Eagle Ford) soft, fresh, sound, slightly fossiliferous, fissile, dark gray with occasional pyrite nodules and septarian concretions -30° smooth, open slickensided fracture at 215.6' -70° smooth, tight slickensided fracture at 215.7' -1" limestone layers at 219.1', 224.7', 227.1' and 229.0'
220									
225		C24	224.0	234.0	100	100			-60° smooth, tight slickensided fractures at 231.8' and 232.2'
230									
235		C25	234.0	235.0	60	60			-10° smooth, tight slickensided fractures at 236.8'
240		C26	235.0	244.0	80	80			

DRILLING GEOLOGIST R. Randall ASSISTANT S. Stevens CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 21 PG 7 OF 8

LOCATION: N 238,620 feet
E 2,175,708 feet

GROUND EL: 665.3 feet

DATE: 9/11-9/15/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

See p. 1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES		HAND PEN. TSF.
245		C27	244.0	251.0	100	100			
250									
255		C28	251.0	261.0	98	98			
260									
265		C29	261.0	271.0	98.5	98.5			
270									
275		C30	271.0	281.0	100	100			
280									
		C31	281.0	283.0	100	100			

DESCRIPTION OF STRATUM

SHALE (Eagle Ford) soft, fresh, soumd, slightly fossiliferous, fissile, dark gray with occasional pyrite nodules and septarian concretious,
-60° smooth, tight at 242.3', 242.4', 242.5' and 242.8'
-10° smooth, open slickensided fractures at 243.0'
-30° smooth, open slickensided fractures at 2442.'
-70° smooth, tight slickensided fractures at 244.5'
-45° smooth, open slickensided fractures at 245.5'
-60° smooth, tight slickensided fractures at 246.3'
-20° smooth, open slickensided fractures at 247.3' and 247.8'
-pyrite nodule at 249.0'
-limestone layer, hard, light gray at 251.6'-252.2'
-2" pyrite at 252.2'
-20° smooth, open slickensided fractures at 252.7'
-70° smooth, tight, slickensided fractures at 252.6' and 253.1'
-very fossiliferous layer at 260.3'-260.8'
-20° and 30° smooth, open transverse slickensided fractures at 261.3'
-70° smooth, tight slickensided fractures at 263.4'
-10° smooth, open slickensided fractures at 264.0'
-trace pyrite at 266.0'-270.0'

-very fossiliferous layer at 270.0'-270.8'
-fossil parting at 270.1'

-4" septarian concretion at 272.6'

DRILLING GEOLOGIST R. Randall ASSISTANT S. Stevens CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 21PG 8 OF 8

LOCATION: N 238,620 feet
E 2,175,708 feet

GROUND EL: 665.3 feet

DATE: 9/11-9/15/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

See p. 1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES		HAND PEN. TSF.	DESCRIPTION OF STRATUM
										SHALE (Eagle Ford) soft, fresh, sound, slightly fossiliferous, fissile, dark gray with occasional pyrite nodules and septarian concretions
285		C32	283.0	293.0	83	83				
290										
295		C33	293.0	303.0	25	25				
300										
305		C34	303.0	312.6	74	74				
310										
315										Bottom of Exploration at 312.6' NOTE: Monitor well installed upon completion
320										

DRILLING GEOLOGIST R. Randall ASSISTANT S. Stevens CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

BORING NO: BIR22 PG 1 OF 9

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

LOCATION: N 238,494 E 2,175,935

TASK NO.: 15

GROUND EL: 658.4

DATE: 9/12/89 TYPE: Nx Angle Core(1) CASED TO: 3.45' CONTRACTOR: MJA

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
									0.5 CLAY (Residual Soil), silty, brown
									LIMESTONE (Austin Chalk), 3.5-5.0 highly weathered, 5.0-18.2 moderately weathered, med. hard, white to tan, fractures mostly parallel to bedding, w/0.4 to 0.8 ft. thick argill. interbeds 2.1 to 9.5' apart
5		C1	3.5	8.5	90	28			
10		C2	8.5	15.5	100	90			10.0g-10.4s Thin argill. lt. brown bed Core predominately tan below 10.0'
15									15.8s-16.6g Thin argill. lt. brown bed, fractures along bedding plane, clean and closed
									18.2
20		C3	15.5	25.5	98	97			18.3g-18.4g Very thin argill. dk. gray bed 21.6g-22.0g Thin argill. med. gray bed LIMESTONE (Austin Chalk), fresh, mod. hard, lt. gray to gray, slightly fossiliferous, w/0.1 to 2.3' thick mod. argill. interbeds
25									
30		C4	25.5	35.2	100	70			30.2g-32.2g Med. thick, very argill. dk. gray bed 33.2g-34.2g Thin,mod. argill., med. gray bed
35							Stopped Drilling 9/12/89		35.4g-37.4g Med. thick, mod. argill., med. gray bed
		C5	35.2		100	100	Started Drilling 9/14/89		
40									41.5g-43.8g Med. thick, mod. argill., med. gray bed

SAMPLE LEGEND	WATER INFORMATION
S= SPLIT SPOON T= 2" THIN WALL TUBE U= 3" THIN WALL TUBE C= NX ROCK CORE	Wet Rotary Core Hole Water level not determinable Slight water loss in weathered limestone only

DRILLING GEOLOGIST Jim Sansom ASSISTANT Gary Kincaid CHECKED BY W. D. Flanigan

LOG OF BORING

BORING NO: BIR22 PG 2 OF 9

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

LOCATION: N 238,494 E 2,175,935

TASK NO.: 15

GROUND EL: 658.4

DATE: 9/14/89 TYPE: Nx Angle Core(1) CASED TO: 3.45' CONTRACTOR: MJA

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable
Slight water loss in weathered limestone only

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES		HAND PEN. TSF.	DESCRIPTION OF STRATUM
45				45.2						LIMESTONE (Austin Chalk), fresh, mod. hard, lt. gray to gray, sli. fossiliferous w/0.3 to 1.5' thick mod. to very argill. interbeds 1.0 to 4.6' apart 45.2-55.2 Fossils common
50		C6	45.2	55.2	100	100				50.5g-51.7g Thin mod. argill. med. gray bed
55										55.3s-56.0g Thin mod. argill. dk. gray bed
60		C7	55.2	65.2	100	100				59.2g-60.0g Thin very argill. dk. gray bed 60.0g-60.3g Thin mod. argill. med. gray bed 63.5g-63.9g Thin mod. argill. med. gray bed
65										
70		C8	65.2	75.2	97	97				67.5g-68.4g Thin very argill. med. to mod. hd., dk. gray bed 68.4g-69.1g Thin mod. argill. med. gray bed 70.8g-72.3g Med. thick very argill. dk. gray bed 73.3g-73.9g Thin very argill. dk. gray bed
75										
80		C9	75.2		100	100				78.5g-79.0g Thin very argill. dk. gray bed 79.0g-80.0g Thin mod. argill. med. gray bed

DRILLING GEOLOGIST Jim Sansom ASSISTANT Gary Kincaid CHECKED BY W. D. Flanigan

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR22 PG 3 OF 9

LOCATION: N 238,494
E 2,175,935

GROUND EL: 658.4

DATE: 9/14/89 TYPE: Nx Angle Core(1) CASED TO: 3.45' CONTRACTOR: MJA

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT ROD.	STANDARD PENETRATION TEST PER 6 INCHES		HAND PEN. TSF.	DESCRIPTION OF STRATUM
85				85.2						LIMESTONE (Austin Chalk), fresh, mod. hard, lt. gray to gray, sli. fossiliferous, w/0.4 to 2.8' thick mod. to very argill. interbeds 1.1 to 5.2' apart 84.7g-85.2g Thin very argill. dk. gray bed 85.2g-87.1g Med. thick mod. argill. med. gray bed
90		C10	85.2	95.2	100	100				89.4g-91.0s Thin very argill. dk. gray bed 94.5g-95.2g Thin mod. argill. med. gray bed 95.2g-97.2g Med. thick very argill. dk. gray bed
100		C11	95.2	105.2	85	70				102.4g-105.2g Med. thick claystone, soft, dk. gray bed
110		C12	105.2	115.2	100	100				107.2g-108.7g Med. thick very argill. dk. gray bed 111.3g-112.0g Thin mod. argill. med. gray bed
120		C13	115.2		100	100				116.6g-117.5g Thin very argill. dk. gray bed 117.5g-117.9g Thin mod. argill. med. gray bed 119.0g-119.6g Thin mod. argill. med. gray bed

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable
Slight water loss in weathered limestone only

DRILLING GEOLOGIST Jim Sansom ASSISTANT Gary Kincaid CHECKED BY W. D. Flanigan

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR22 PG 4 OF 9

LOCATION: N 238,494
E 2,175,935

GROUND EL: 658.4

DATE: 9/14/89 TYPE: Nx Angle Core(1) CASED TO: 3.45' CONTRACTOR: MJA

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable
Slight water loss in weathered limestone only

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT ROD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
125				125.2					LIMESTONE (Austin Chalk), fresh, mod. hard, lt. gray to gray, sli. fossiliferous w/0.2 to 8.6' thick mod. to shaly and bentonitic interbeds 1.2 to 6.8 ft. apart 126.1g-127.2g Med. thick mod. argill. med. gray bed
130		C14	125.2	135.2	100	100			130.3s-130.8g Thin very argill. to shaly, sli. bentonitic dk. gray bed 133.9g-134.4g Thin very argill. dk. gray bed
135									
140		C15	135.2	145.2	100	98			141.2g-141.7g Thin very argill. dk. gray bed with soft clay layers 141.4-141.6 142.5-142.8 Fracture zone (3), 40°, calcite filled 1/8-1/4", med. rough, slickensided Strike: ~N25°W, Dip ~50°NE
145									144.1g-145.2g Med. thick mod. argill. med. gray bed 145.2g-145.9g Thin very argill. dk. gray bed 145.9g-154.5g Thick mod. argill. med. gray bed
150		C16	145.2	155.2	97	97			
155									154.5g-154.8g Thin very argill. bentonitic dk. gray bed 154.8g-155.0g Very thin mod. argill. med. gray bed 156.2g-156.4g Very thin shaly dk. gray bed 157.8g-160.1g Med. thick mod. argill. med. gray bed
160		C17	155.2		100	100			

DRILLING GEOLOGIST Jim Sansom ASSISTANT Gary Kincaid CHECKED BY W. D. Flanigan

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR22 PG 5 OF 9

LOCATION: N 238,494
E 2,175,935

GROUND EL: 658.4

DATE: 9/14/89 TYPE: Nx Angle Core(1) CASED TO: 3.45' CONTRACTOR: MJA

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable
Slight water loss in weathered limestone only

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES		HAND PEN. TSF.	DESCRIPTION OF STRATUM
165				165.2						LIMESTONE (Austin Chalk), fresh, mod. hard, lt. gray to gray, sli. fossiliferous w/0.1 to 2.1' thick mod. to very argill. and bentonitic interbeds 0.6 to 3.9 ft. apart 163.9g-164.6g Thin mod. argill. med. gray bed
		C18	165.2		100	100				167.3g-168.3g Med. thick mod. argill. med. gray bed
170										170.1g-170.8g Thin very argill. dk. gray bed 172.9g-173.0g Very thin mod. argill. med. gray bed 174.6g-175.0g Thin mod. argill. med. gray bed
							Stopped 9/14/89	Drilling		
175				175.2						175.6g-176.4g Thin very argill. dk. gray bed 176.4g-177.7g Med. thick mod. argill. med. gray bed
			175.2				Started 9/15/89	Drilling		
180		C19			100	100				181.0g-182.5g Med. thick mod. argill. med. gray bed 183.8g-184.8g Thin mod. argill. med. gray bed
										184.8g-185.2g Thin very argill. dk. gray bed 185.2g-185.8g Thin mod. argill. med. gray bed
185				185.2						
			185.2							187.0g-187.9g Thin mod. argill. med. gray bed 187.9g-188.1g Thin very argill. dk. gray bed
190		C20			100	100				191.0g-191.7g Thin very argill. dk. gray bed 191.7 Fracture, slickensided, clean, closed, sli. rough Strike: ~ N85°E, Dip: ~ 58°SE 192.5g-193.7g Med. thick bentonitic claystone bed, soft, lt.-med. gray, w/fine grained pyrite crystals and in places fissile
195				195.2						195.2g-195.7g Thin mod. argill. med. gray bed
			195.2							
200		C21			100	100				199.6g-200.9g Med. thick mod. argill. med. gray bed

DRILLING GEOLOGIST Jim Sansom ASSISTANT Gary Kincaid CHECKED BY W. D. Flanigan

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR22 PG 6 OF 9

LOCATION: N 238,494 E 2,175,935

GROUND EL: 658.4

DATE: 9/15/89 TYPE: Nx Angle Core(1) CASED TO: 3.45' CONTRACTOR: MJA

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
				205.2					LIMESTONE (Austin Chalk), fresh, mod. hard, lt. gray to gray, sli. fossiliferous, w/0.2 to 2.7' thick mod. to very argill. interbeds 1.0 to 6.5 ft. apart 201.8g-203.4g Med. thick mod. argill. med. gray bed w/abundant pyrite crystals 205.2g-205.4g Thin mod. argill. med. gray bed 207.2g-208.9g Med. thick mod. argill. med. gray bed
205									
210		C22	205.2	215.2	98	97			210.4g-213.1g Med. thick mod. argill. med. gray bed 205.2-215.2 Occasional pyrite/marcasite nodules up to 1/2" diameter 214.8s-215.2g Thin very argill., soft, dk. gray bed (claystone) 215.2g-215.4g Thin very argill. dk. gray bed
215									
220		C23	215.2	225.2	100	100			217.4g-218.8g Med. thick mod. argill. med. gray bed with cluster of marcasite crystals 217.9-218.2 218.2 Fracture, slickensided, clean, closed Strike: ~N80°E, Dip: ~26°NW
225									225.3g-225.9g Thin mod. argill. med. gray bed 226.9g-227.2g Thin very argill. dk. gray bed with claystone lamination at 227.1
230		C24	225.2	234.2	100	98			232.2g-232.7g Thin mod. argill. med. gray bed
235		C25	234.2		99	99			236.0g-236.2g Thin mod. argill. med. gray bed 239.2g-239.8g Thin very argill. dk. gray bed 239.5-239.6 Multiple fractures, closed, clean Strike: ~ N25°E, Dip: ~ 20°SE
240									

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable
Slight water loss in weathered limestone only

DRILLING GEOLOGIST Jim Sansom ASSISTANT Gary Kincaid CHECKED BY W. D. Flanigan

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR22 PG 7 OF 9

LOCATION: N 238,494 E 2,175,935

GROUND EL: 658.4

DATE: 9/15/89 TYPE: Nx Angle Core(1) CASED TO: 3.45' CONTRACTOR: MJA

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable
Slight water loss in weathered limestone only

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
				244.2					LIMESTONE (Austin Chalk), fresh, mod. hard, lt. gray to gray, sli. fossiliferous with 0.3 to 6.3 ft. thick mod. to very argill. interbeds 0.4 to 9.1 ft. apart
245			244.2						241.0g-241.5g Thin very argill. dk. gray bed 244.8g-245.6g Thin mod. argill. med. gray bed
250		C26			100	100			
				254.4		Stopped Drilling 9/15/89			254.7g-255.3g Thin mod. argill. med. gray bed
255			254.4			Started Drilling 9/16/89			
260		C27			100	100			259.0g-259.7g Thin mod. argill. med. gray bed 259.7g-260.2s Thin very argill. dk. gray bed 260.2s-260.7g Thin mod. argill. med. gray bed
				264.4					265.5g-266.4g Thin mod. argill. med. gray bed
265			264.4						266.4g-266.7g Thin very argill. dk. gray bed 267.2 Fracture, 45°, slickensided, smooth, v. narrow, w/med. grained calcite crystals along surface Strike: ~ N30°E, Dip: ~Vertical 268.0g-268.3g Thin mod. argill. med. gray bed 268.7g-274.4g Thick very argill. dk. gray bed, fossiliferous, occ. pyrite
270		C28			60	43			
				274.4					
275			274.4						275.1g-282.4g Thick mod. argill. med. gray bed with occasional fossils and pyrite/marcasite crystal nodules
280		C29			100	100			

DRILLING GEOLOGIST Jim Sansom ASSISTANT Gary Kincaid CHECKED BY W. D. Flanigan

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR22 PG 8 OF 9

LOCATION: N 238,494 E 2,175,935

GROUND EL: 658.4

DATE: 9/16/89 TYPE: Nx Angle Core(1) CASED TO: 3.45' CONTRACTOR: MJA

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable
Slight water loss in weathered limestone only

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT ROD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
285		C29	284.4	284.4	100	100			LIMESTONE (Austin Chalk), fresh, mod. hd., lt. gray to gray, sli. fossiliferous w/1.2 ft. thick mod. argill. med. gray bed from 283.4g to 284.6g 283.5 Fracture, 45°, non-slickensided, smooth, closed, w/med. grained calcite crystals along face 284.6g Strike:~N30°E, Dip:~Vertical
290		C30	284.4	290.4	100	100		286.6s	Transition Zone, v. argill., arenaceous, fossil., bioclastics, mod. hd., w/brown calc. concretions up to 1/2", med. to dk. gray SHALE (Eagle Ford), fresh, med. hard, very thinly bedded, dark gray, sli. calcareous, w/occ. pyrite nodules up to 1/4" dia., thin soft non-laminated claystone beds and mod. hd. siltstone inclusions 286.7 Very thin soft interbeds 287.8 Very thin claystone, soft, non-calcareous
295		C31	290.4	297.7	100	100			
300		C32	297.7	305.0	100	100			301.7g-302.1g Thin claystone, soft, sli. calc. 304.5s-304.8s Thin siltstone, sli. calc., mod. hd.,gray
305		C33	305.0	307.8	100	97			306.3g-306.8g Thin claystone, soft 308.7s-309.0s Thin siltstone, sli. calc., mod.hd., gray
310		C34	307.8	315.0	100	83			
315		C35	315.0		100	35			Very thin siltstone inclusions, mod. hard, sli. calc., lt. gray @ 315.8, 316.0, 317.0, 319.2, and 322.3
320									

DRILLING GEOLOGIST Jim Sansom ASSISTANT Gary Kincaid CHECKED BY W. D. Flanigan

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR22 PG 9 OF 9

LOCATION: N 238,494
E 2,175,935

GROUND EL: 658.4

DATE: 9/16/89 TYPE: Nx Angle Core(1) CASED TO: 3.45' CONTRACTOR: MJA

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable
Slight water loss in weathered limestone only

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT ROD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
		C35		325.0	100	35	Stopped Drilling		SHALE (Eagle Ford), fresh, med. hard, v. thinly bedded, dark gray, sli. calcareous, w/occ. pyrite nodules up to 1/4" dia., arenaceous beds and siltstone inclusions
-325									
		C36	325.0	333.0	98	55	Started Drilling 9/19/89		
-330									
		C37	333.0	343.0	100	60			340.8-341.4 Siltstone, mod. hard to hard, calc., arenaceous, fossiliferous, w/pyrite
-335									
-340									
		C38	343.0	351.5	100	100			349.5-351.5 Med. thick arenaceous dk. gray bed 351.5-353.2 Soft
-345									
-350									
		C39	351.5	357.0	70	70			353.9-354.7 Arenaceous, calcareous, w/pyrite crystals
-355									
-360									Total Depth: 357.0 9/19/89 (1) Angle hole field azimuth ~N65°W, Plunge ~ 45° (2) Fractures: First angle is measured normal to core axis, strike and dip trends approximated from (1) (3) Wireline Logged 9/19/89 (4) Hydrotested 9/20/89 & 9/21/89 (5) Boring Plugged 9/21/89 Log Revised 1/22/90

DRILLING GEOLOGIST Jim Sansom ASSISTANT Gary Kincaid CHECKED BY W. D. Flanigan

LOG OF BORING

BORING NO: BIR 23 PG 1 OF 6

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

LOCATION: N 238,320 feet
E 2,175,840 feet

TASK NO.: 15

GROUND EL: 659.9 feet

DATE: 9/15-9/19/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

Drilled to 63.0' with air rotary, no seepage encountered, switched to water rotary

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
									2.0
		C1	2.0	4.0	75	0			CLAY, silty, traces of organic matter, weathered limestone fragments dark brown to 0.5', tan from 0.5'-2.0'
5		C2	4.0	6.0	85	71			LIMESTONE (Austin Chalk) soft, weathered, moderately fractured, tan and gray with occasional interbedded tan clay layers.
		C3	6.0	8.0	95	84			
10		C4	8.0	13.0	86	63			
			13.0		100	100			14.4
15		C5			95	95			LIMESTONE (Austin Chalk) medium, fresh, sound, slightly to moderately argillaceous, light gray with occasional shaly limestone layers, slightly fossiliferous.
20				23.0					
			23.0						
25		C6			100	100			-very argillaceous layers from 26.0'-29.0', 30.2'-30.6' and 32.5'-33.0'
30				33.0					
			33.0						
35		C7			99	99			-shaly layers, soft, dark gray at 36.1'-37.0'and 38.5'-39.3'
40				43.0					-shaly layers, soft, dark gray at 42.2' to 43.0'

DRILLING GEOLOGIST E.C. Nicholas ASSISTANT M. Granger CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 23PG 2 OF 6

LOCATION: N 238,320 feet
E 2,175,840 feet

GROUND EL: 659.9 feet

DATE: 9/15-9/19/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

See p. 1 of 6

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES		HAND PEN. TSF.	DESCRIPTION OF STRATUM
										LIMESTONE (Austin Chalk) medium, fresh, slightly to moderately argillaceous, light gray to dark gray with occasional shaly limestone layers, slightly fossiliferous
-45		C8	43.0	53.0	100	100				-shaly layer, soft, dark gray at 48.5'-49.5' -very argillaceous layer, dar gray at 53.4'-54.0' and 56.0'-57.0'
-50										
-55		C9	53.0	63.0	100	100				-shaly layer, soft, dark gray at 59.0'-59.5' -shaly layer, soft, dark gray at 63.4'-64.4', 67.3'-68.4'
-60										
-65		C10	63.0	73.0	100	100				-shaly layer, soft, dark gray at 73.0'-74.0'
-70										
-75		C11	73.0	83.0	98	98				-very argillaceous layer, dark gray at 76.1'-77.1'
-80										

DRILLING GEOLOGIST E.C. Nicholas ASSISTANT M. Granger CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 23 PG 3 OF 6

LOCATION: N 238,320 feet
E 2,175,840 feet

GROUND EL: 659.9 feet

DATE: 9/15-9/19/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

See p. 1 of 6

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
									LIMESTONE (Austin Chalk) medium, fresh, sound, slightly to moderately argillaceous, light gray to dark gray with occasional shaly limestone layers, slightly fossiliferous
85		C12	83.0	93.0	95	95			-shaly layer, soft, dark gray from 83.0'-83.6' and from 87.0'-87.6'
90									
95		C13	93.0	103.0	94	95			-shaly layer, soft, dark gray from 95.1'-95.5' -bentonite layer, soft, light gray at 99.7'-99.9' -bentonite layer, soft, light gray at 102.4'
100									
105		C14	103.0	113.0	100	100			9-15-89 9-18-89 -very argillaceous layer, dark gray from 104.9'-105.8' and from 108.6'-109.6'
110									-shaly layer, soft, dark gray at 113.1'-113.2'
115		C15	113.0	123.0	100	100			
120									

DRILLING GEOLOGIST E.C. Nicholas ASSISTANT M. Granger CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 23 PG 4 OF 6

LOCATION: N 238,320 feet
E 2,175,840 feet

GROUND EL: 659.9 feet

DATE: 9/15-9/19/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION
See p. 1 of 6

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
									LIMESTONE (Austin Chalk) medium, fresh, sound, slightly to moderately argillaceous, light gray to dark gray with occasional shaly limestone layers
125		C16	123.0	133.0	100	100			-very argillaceous layers, dark gray from 124.3'-125.2', 126.0'-127.8' and from 130.0'-131.4'
130									-very argillaceous layers, dark gray from 133.0'-133.8' and from 135.2'-136.0'
135		C17	133.0	143.0	100	100			-bentonite layer, soft, light gray from 137.0'-137.1' -bentonitic shaly layer, soft, gray from 138.9'-139.9'
140									-60° smooth, tight slickensided fracture at 139.6' and 139.8'
145		C18	143.0	153.0	98	98			
150									
155		C19	153.0	163.0	100	100			-shaly layer, soft, dark gray at 155.0' to 155.2' -pyrite nodules at 156.8'
160									

DRILLING GEOLOGIST E.C. Nicholas ASSISTANT M. Granger CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 23 PG 5 OF 6

LOCATION: N 238,320 feet
E 2,175,840 feet

GROUND EL: 659.9

DATE: 9/15-9/19/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

See p. 1 of 6

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES		HAND PEN. TSF.	DESCRIPTION OF STRATUM
										LIMESTONE (Austin Chalk) medium, fresh, sound, slightly to moderately argillaceous, light gray to dark gray with occasional shaly limestone layers, slightly fossiliferous -very argillaceous layer, dark gray from 163.3'-163.5'
-165		C20	163.0	173.0	100	100				-45° smooth, tight slickensided fractures at 172.4' -very argillaceous layer, dark gray from 172.9'-173.3', and from 179.1'-180.3'
-170										
-175		C21	173.0	183.0	100	100				-occasional fossil fragments at 177.0'
-180										
-185		C22	183.0	193.0	100	100				9-18-89 9-19-89 -very argillaceous layers, dark gray from 184.5'-185.5' and 188.5'-189.5'
-190										
-195		C23	193.0	203.0	100	100				-very argillaceous layers, dark gray from 193.2'-193.5', 193.5'-195.6', 199.8'-200.4' and 201.0'
-200										

DRILLING GEOLOGIST E.C. Nicholas ASSISTANT M. Granger CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 23 PG 6 OF 6

LOCATION: N 238,320 feet
E 2,175,840 feet

GROUND EL: 659.9 feet

DATE: 9/15-9/19/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

See p. 1 of 6

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT ROD.	STANDARD PENETRATION TEST PER 6 INCHES		HAND PEN. TSF.	DESCRIPTION OF STRATUM
										LIMESTONE (Austin Chalk) medium, fresh, sound, slightly to moderately argillaceous, light gray to dark gray with occasional shaly limestone layers, slightly fossiliferous
205		C24	203.0		78	78				
										207.7
210				213.0						208.5 SHALY LIMESTONE (Transition) medium, fresh, sound, dark gray with fragments of fish bones, teeth and other fossil debris, scattered pyrite nodules
215		C25	213.0		100	100				SHALE (Eagle Ford) soft, moderately fractures slightly fossiliferous, fissile, dark gray with occasional pyrite nodules and septarian concretions
220				221.0						
225		C26	221.0		88	88				-60° smooth, tight slickensided fracture at 224.5'
230				231.0						
235		C27	231.0		100	100				-extremely fractured at 234.0'
240				241.0						
			241.0							Bottom of Exploration at 241.0' NOTE: Borehole grouted upon completion

DRILLING GEOLOGIST E.C. Nicholas ASSISTANT M. Granger CHECKED BY C. Bommarito

APPENDIX C

WIRE-LINE LOGS

WIRE-LINE LOGGING PARAMETERS

Hole No. BIR 21 **Log Measured From:** Ground Level

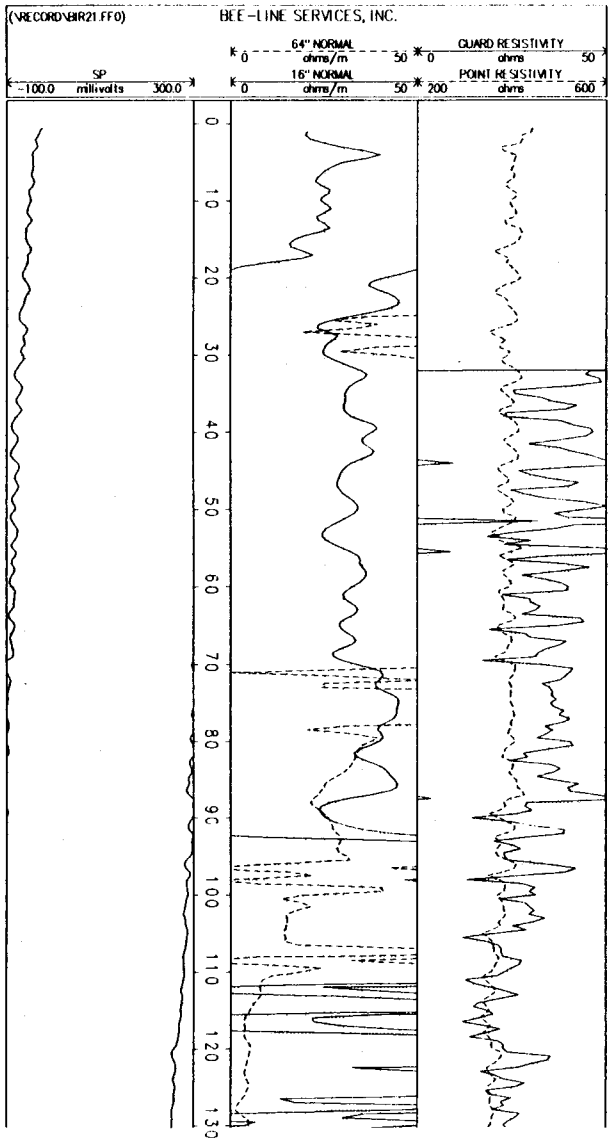
Drilling Parameters
Depth 312.6 feet
Bit Diameter 3.125 inches

Logging Parameters	Electrical Log	Gamma and Neutron Logs	Sonic Log
Date	September 15, 1989	September 15, 1989	September 15, 1989
Bottom Log Interval	309 feet	309 feet	302.9 feet
Top Log Interval	surface	surface	surface
Type of Fluid in Hole	drilling mud	drilling mud	drilling mud
Time Since Circulation Stop	30 minutes	30 minutes	30 minutes
Probe Type/S.N.	ALP-4979	XAP-4383	CLP-4877A
Module Type/S.N.	ALM-4979	XAM-4383	CLM-4877A
Logging Speed	40 feet/min.	20 feet/min.	20 feet/min.
Sample Interval	0.5 feet	0.5 feet	0.5 feet

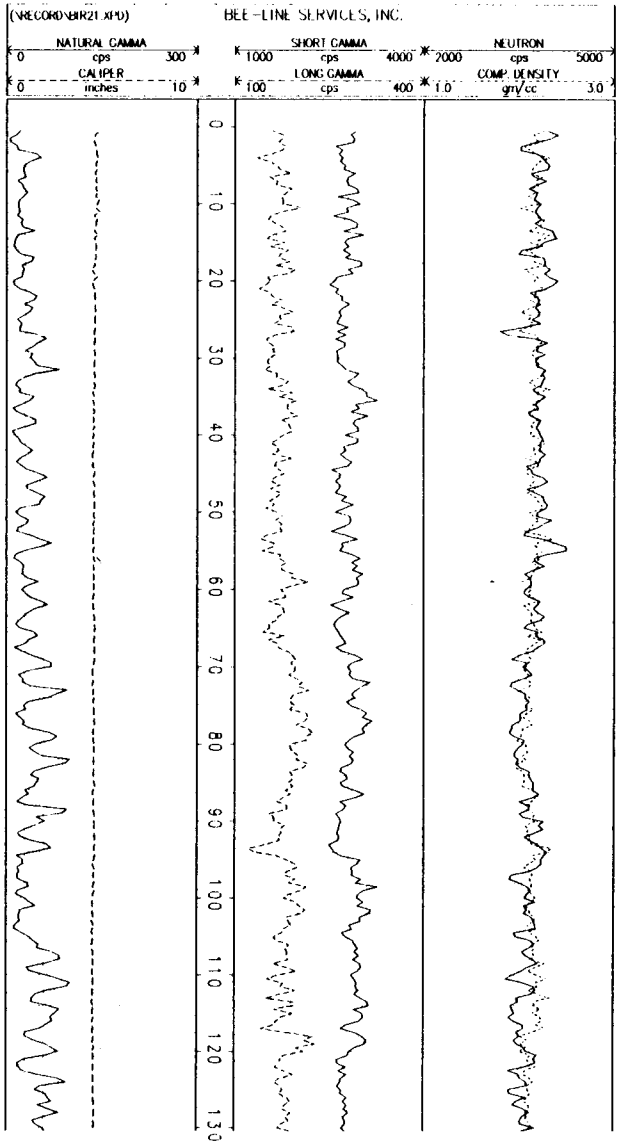
Logged by: BEE-LINE SERVICES, INC.
P. O. Box 2096
Corsicana, TX 75151

BIR 21 Wire-line logs run September 15, 1989. Surface elevation 665.3 feet.

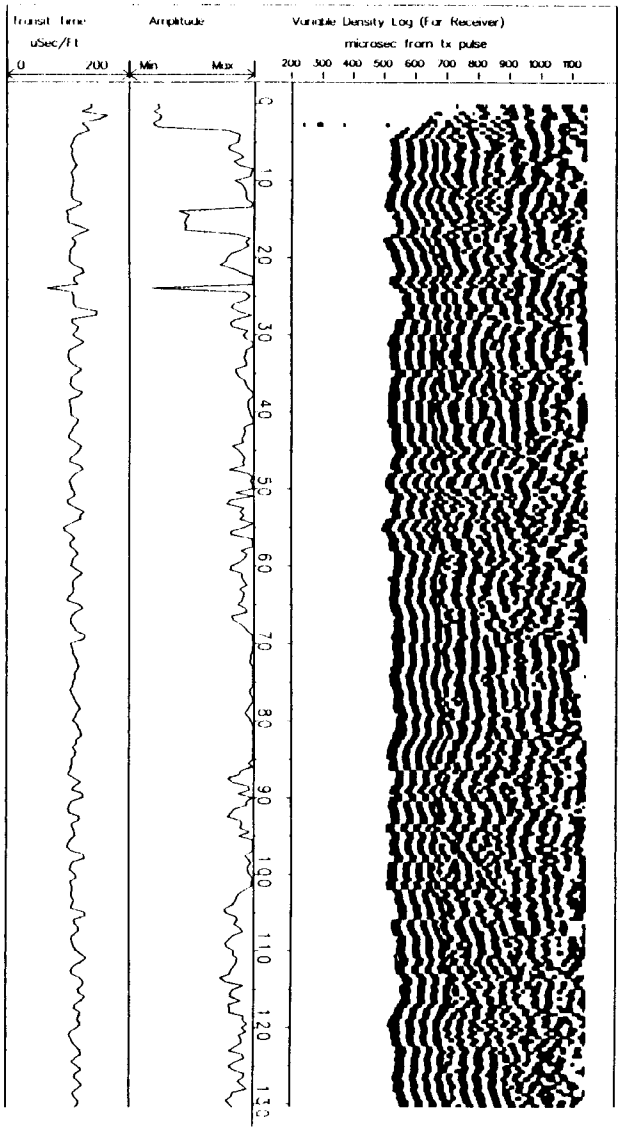
ELECTRICAL LOG



GAMMA AND NEUTRON LOGS

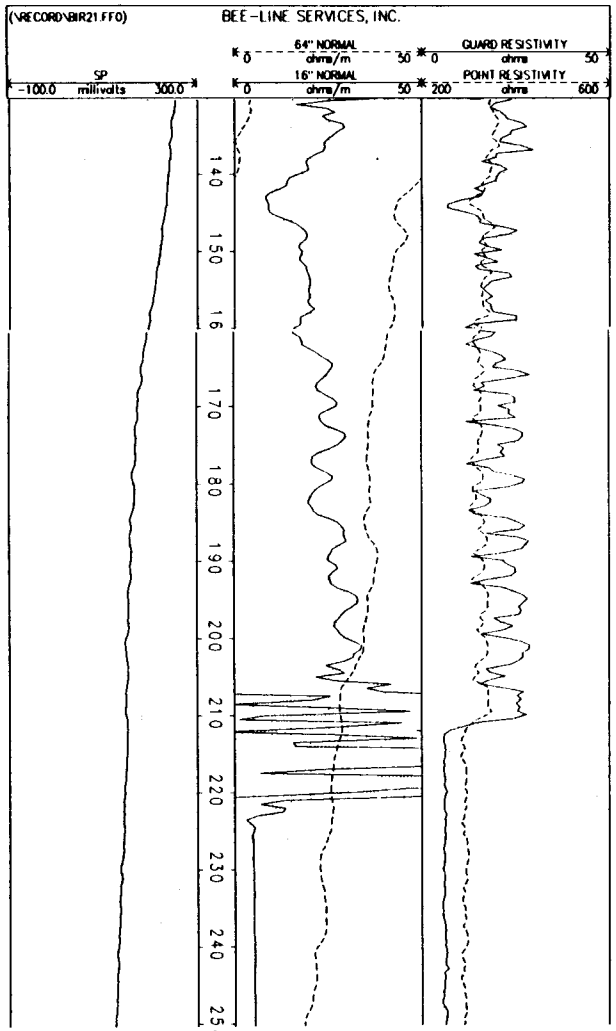


SONIC LOG

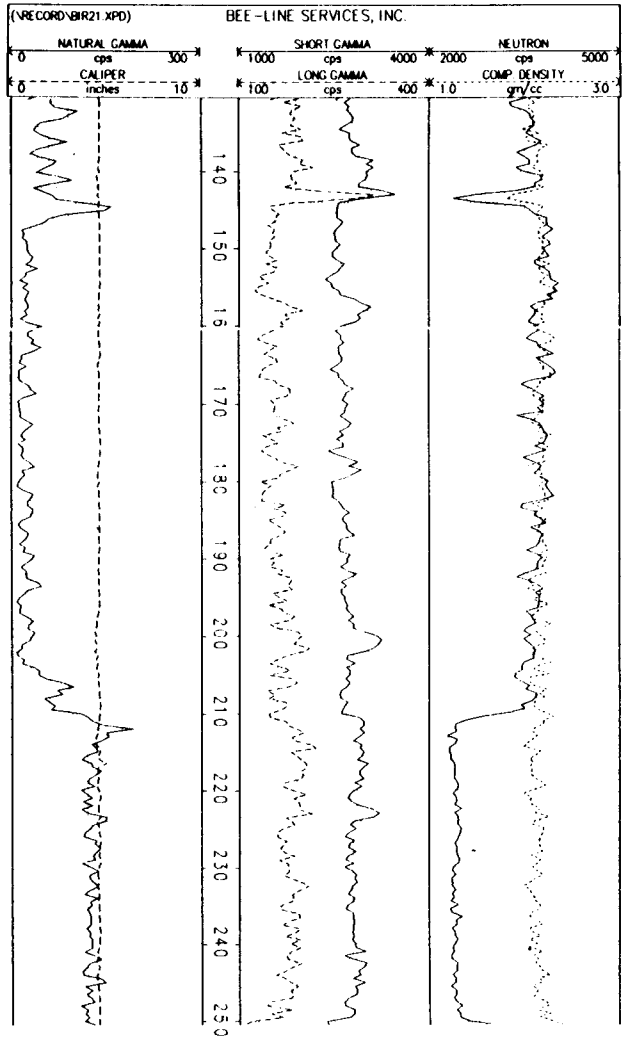


BIR 21 Wire-line logs run September 15, 1989 (Continued). Surface elevation 665.3 feet.

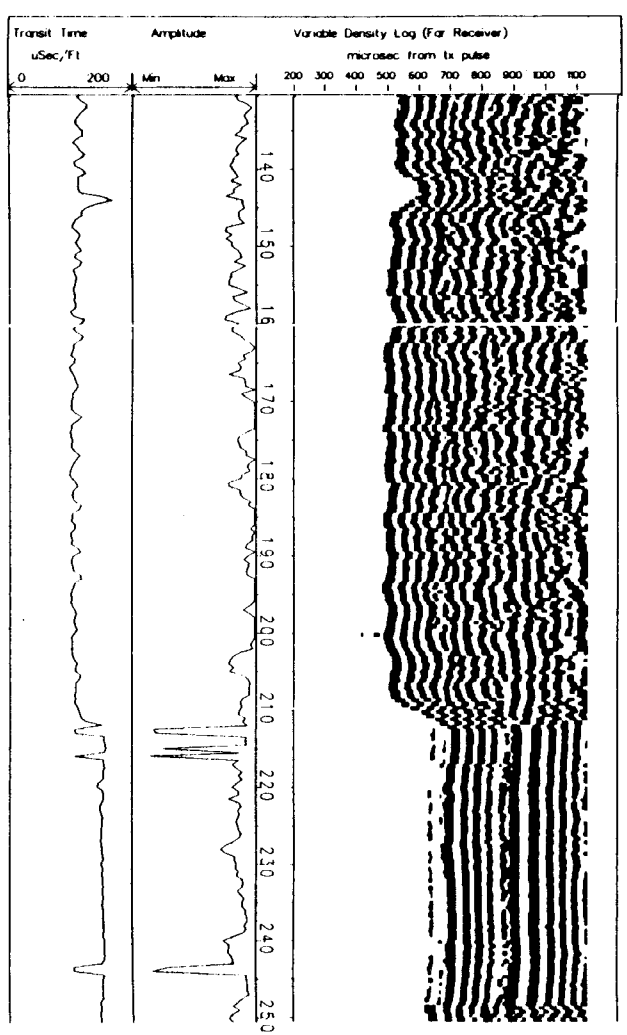
ELECTRICAL LOG CONTINUED



GAMMA AND NEUTRON LOGS CONTINUED

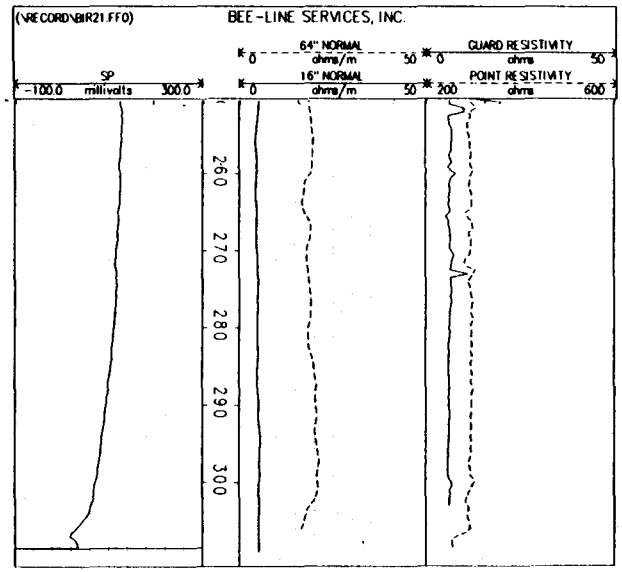


SONIC LOG CONTINUED

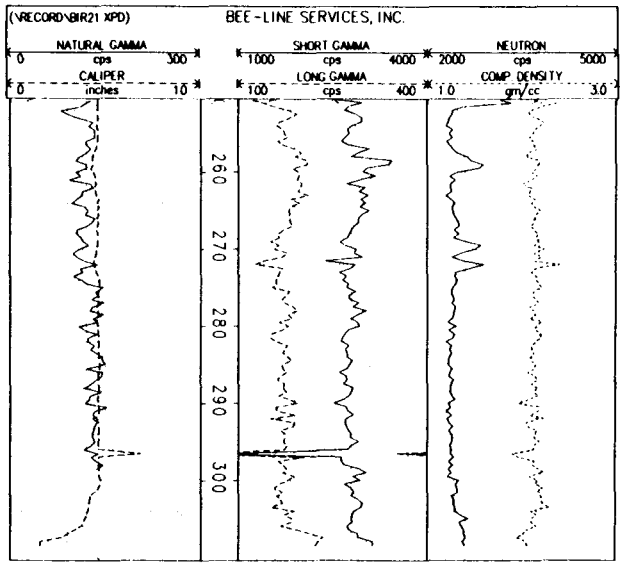


BIR 21 Wire-line logs run September 15, 1989 (Continued). Surface elevation 665.3 feet.

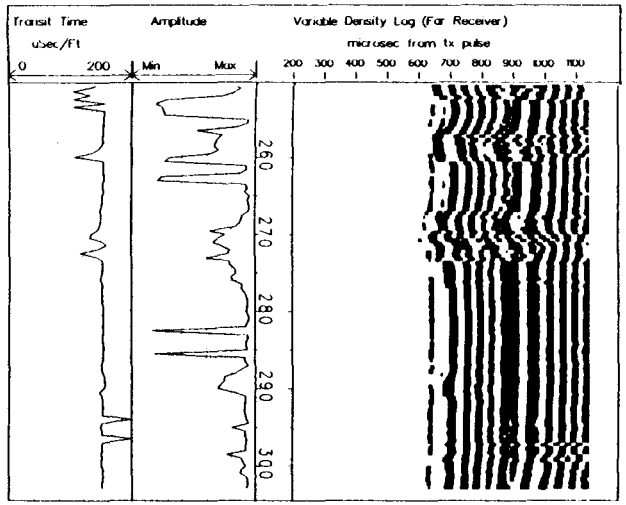
ELECTRICAL LOG CONTINUED



GAMMA AND NEUTRON LOGS CONTINUED



SONIC LOG CONTINUED



WIRE-LINE LOGGING PARAMETERS

Hole No. BIR 22 **Log Measured From:** Ground Level

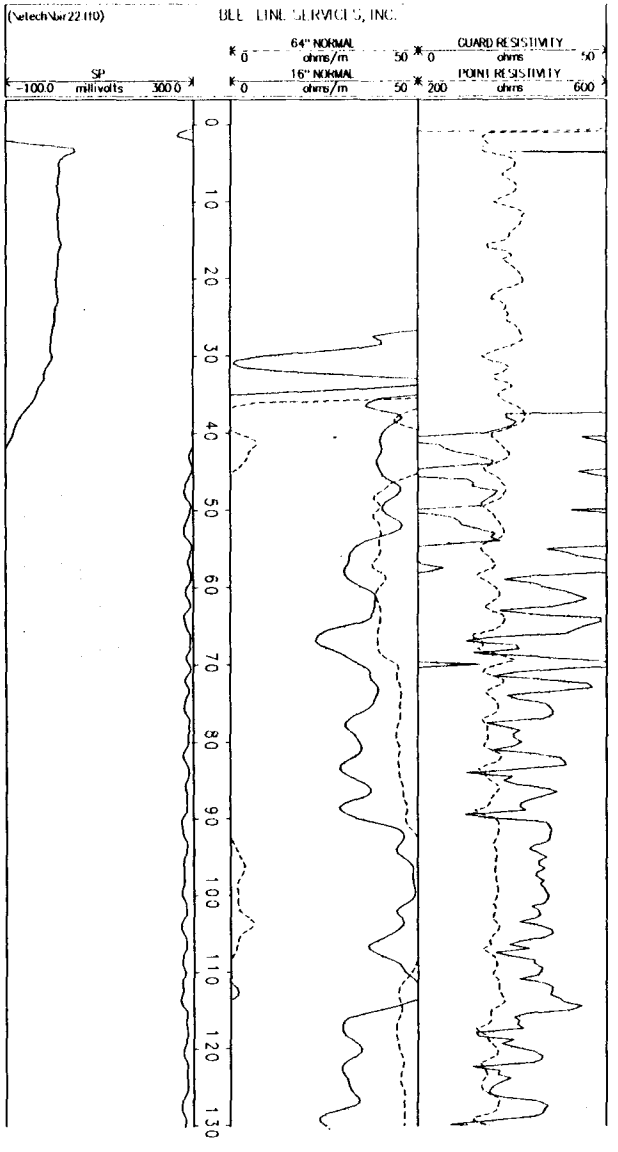
Drilling Parameters
Depth 357.0 feet, inclined boring
Bit Diameter 3.125 inches

Logging Parameters	Electrical Log	Gamma Log	Sonic Log
Date	September 19, 1989	September 19, 1989	September 19, 1989
Bottom Log Interval	355.5 feet	355.5 feet	351.5 feet
Top Log Interval	surface	surface	surface
Type of Fluid in Hole	drilling mud	drilling mud	drilling mud
Time Since Circulation Stop	30 minutes	30 minutes	30 minutes
Probe Type/S.N.	ALP-4979	XAP-4383	CLP-4877A
Module Type/S.N.	ALM-4979	XAM-4383	CLM-4877A
Logging Speed	40 feet/min.	20 feet/min.	20 feet/min.
Sample Interval	0.5 feet	0.5 feet	0.5 feet

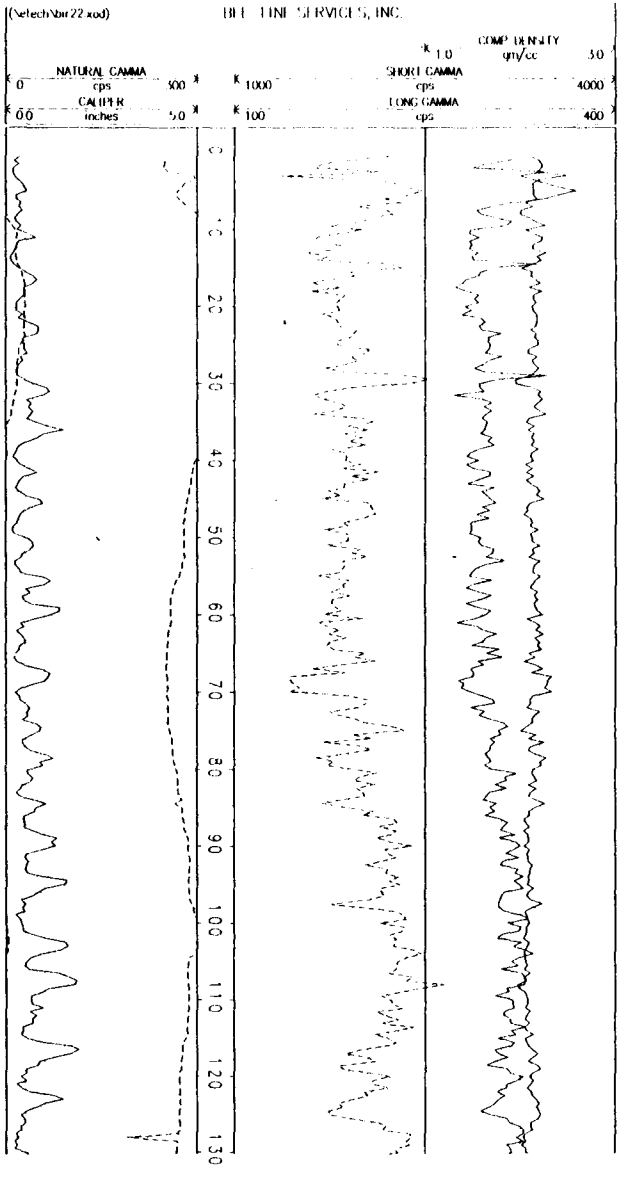
Logged by: BEE-LINE SERVICES, INC.
P. O. Box 2096
Corsicana, TX 75151

BIR 22 Wire-line logs run September 19, 1989. Surface elevation 658.4 feet.

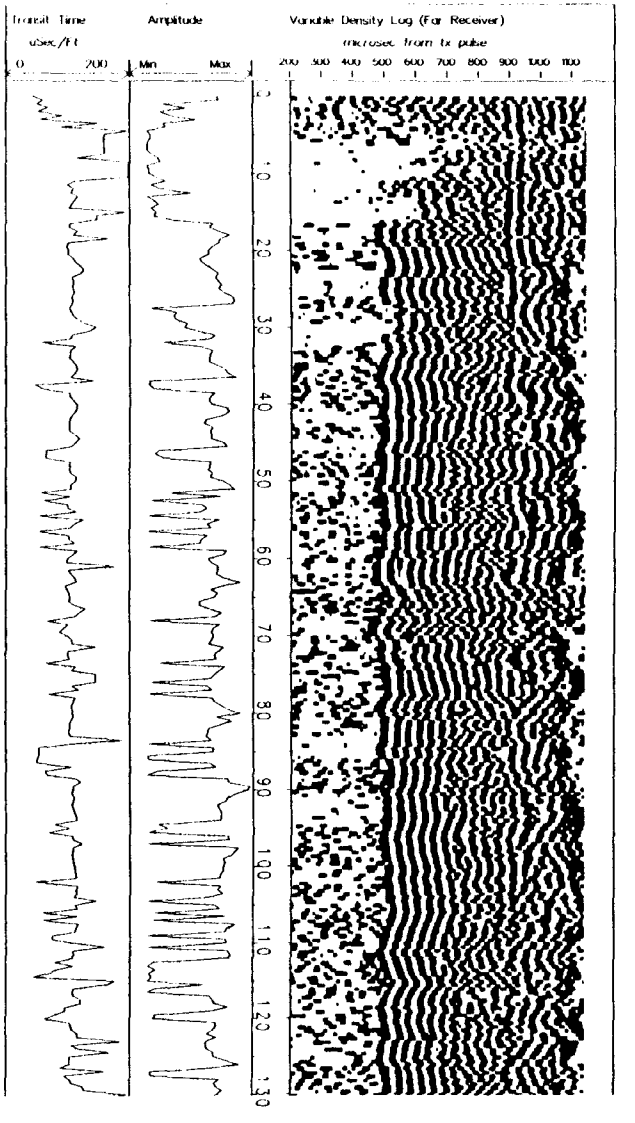
ELECTRICAL LOG



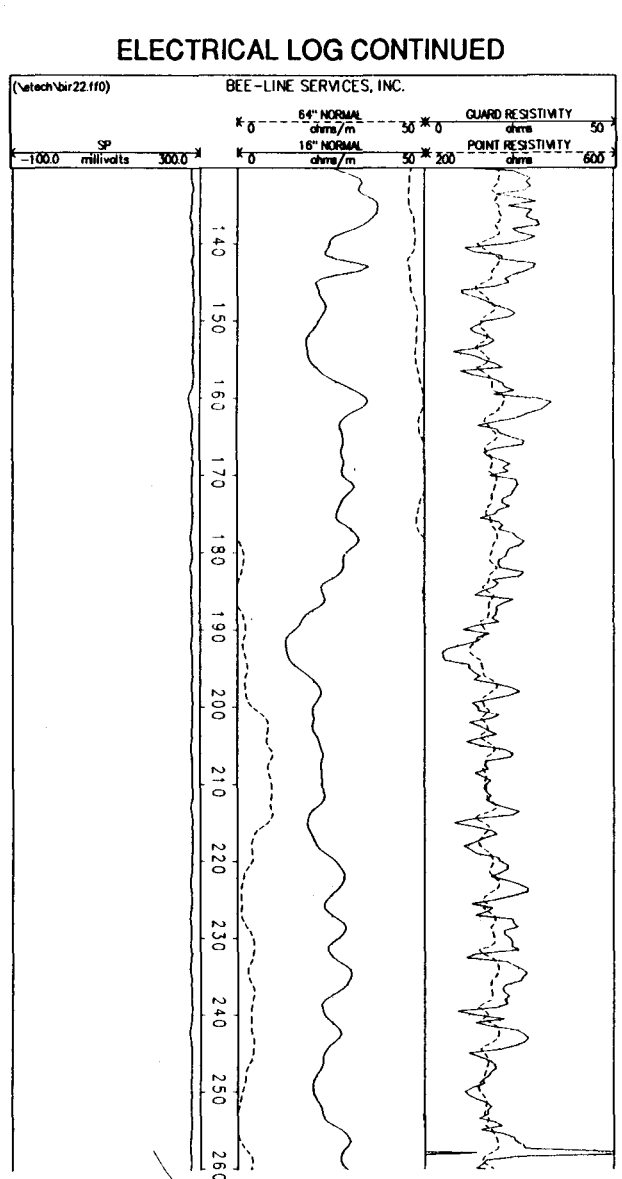
GAMMA LOG

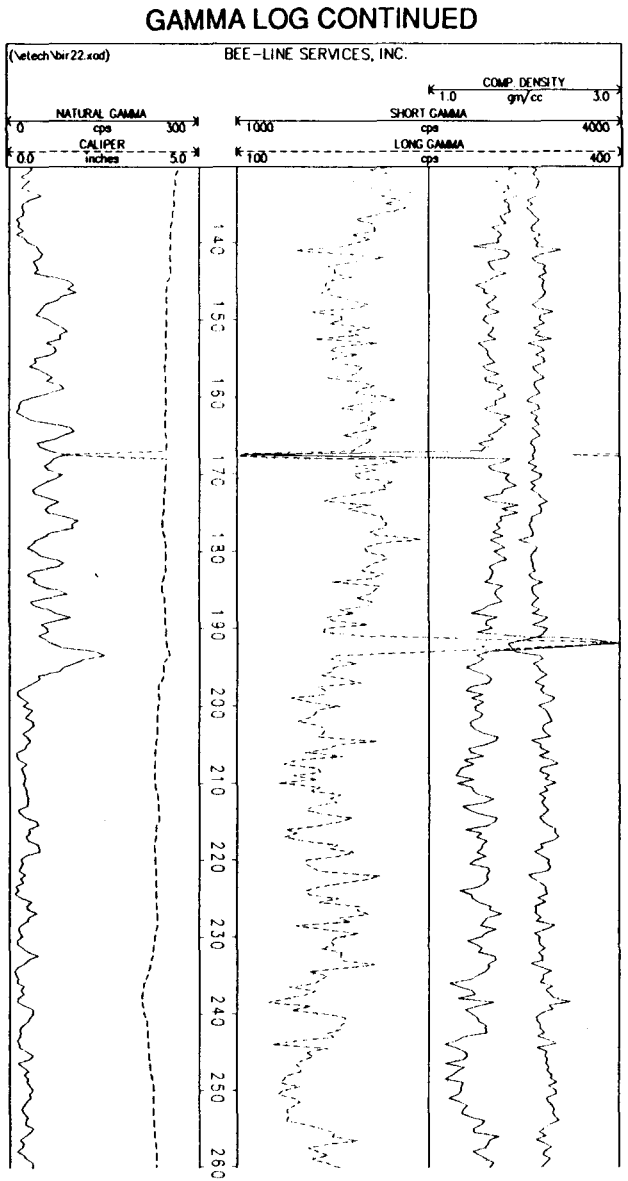


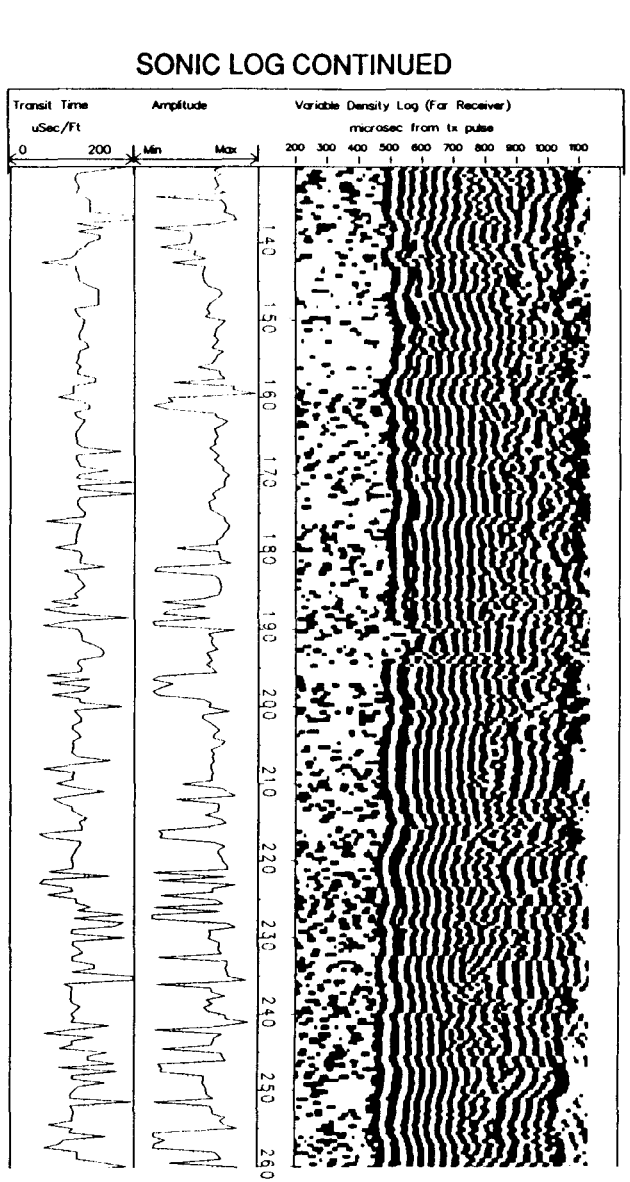
SONIC LOG



BIR 22 Wire-line logs run September 19, 1989 (Continued). Surface elevation 658.4 feet.

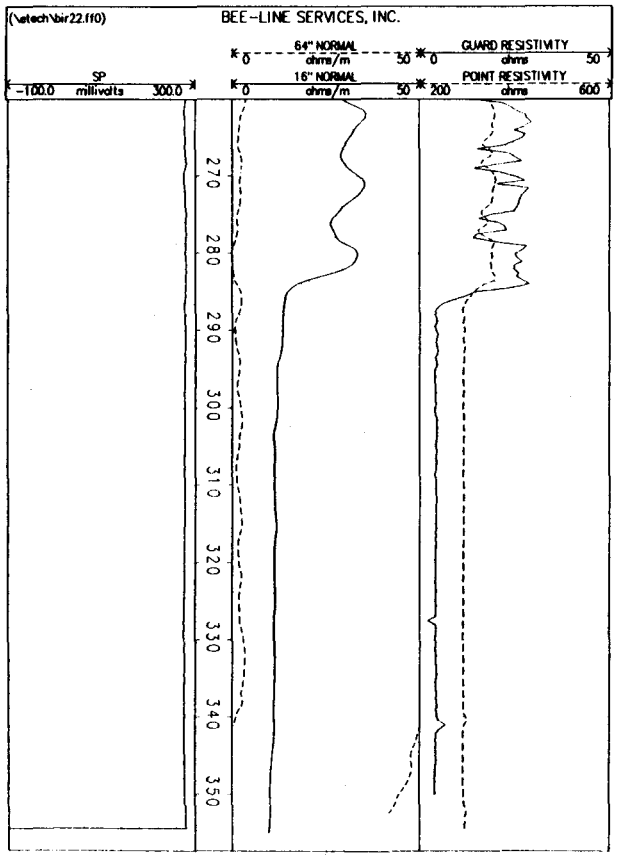




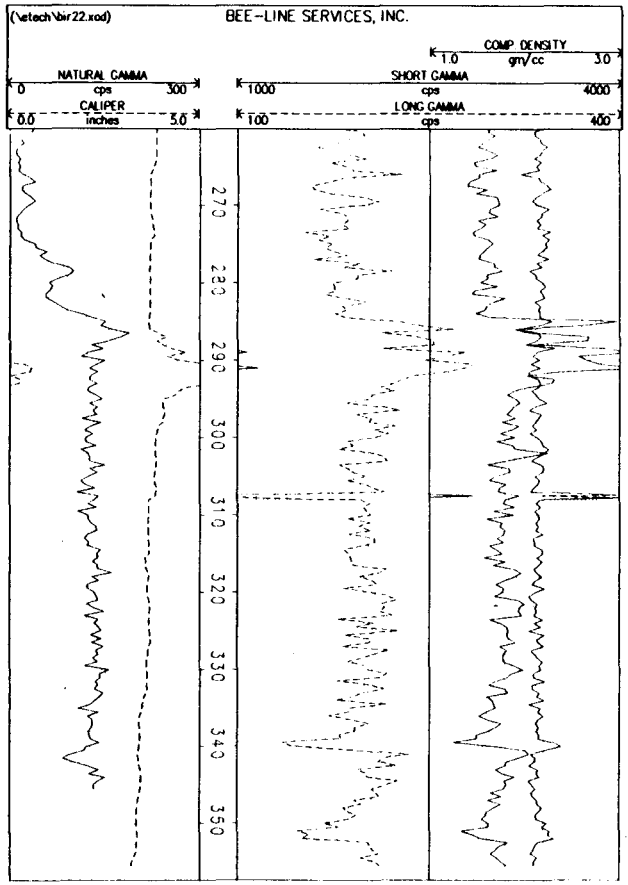


BIR 22 Wire-line logs run September 19, 1989 (Continued). Surface elevation 658.4 feet.

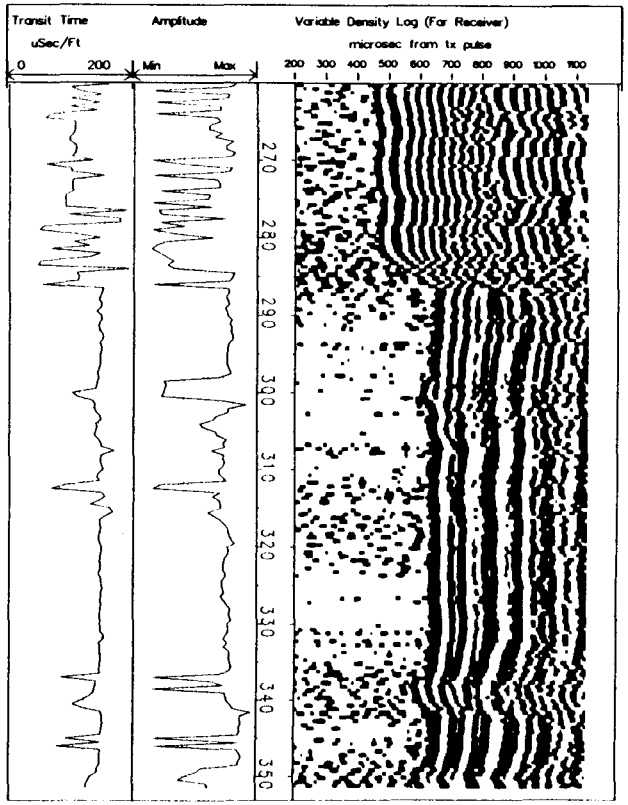
ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED



SONIC LOG CONTINUED



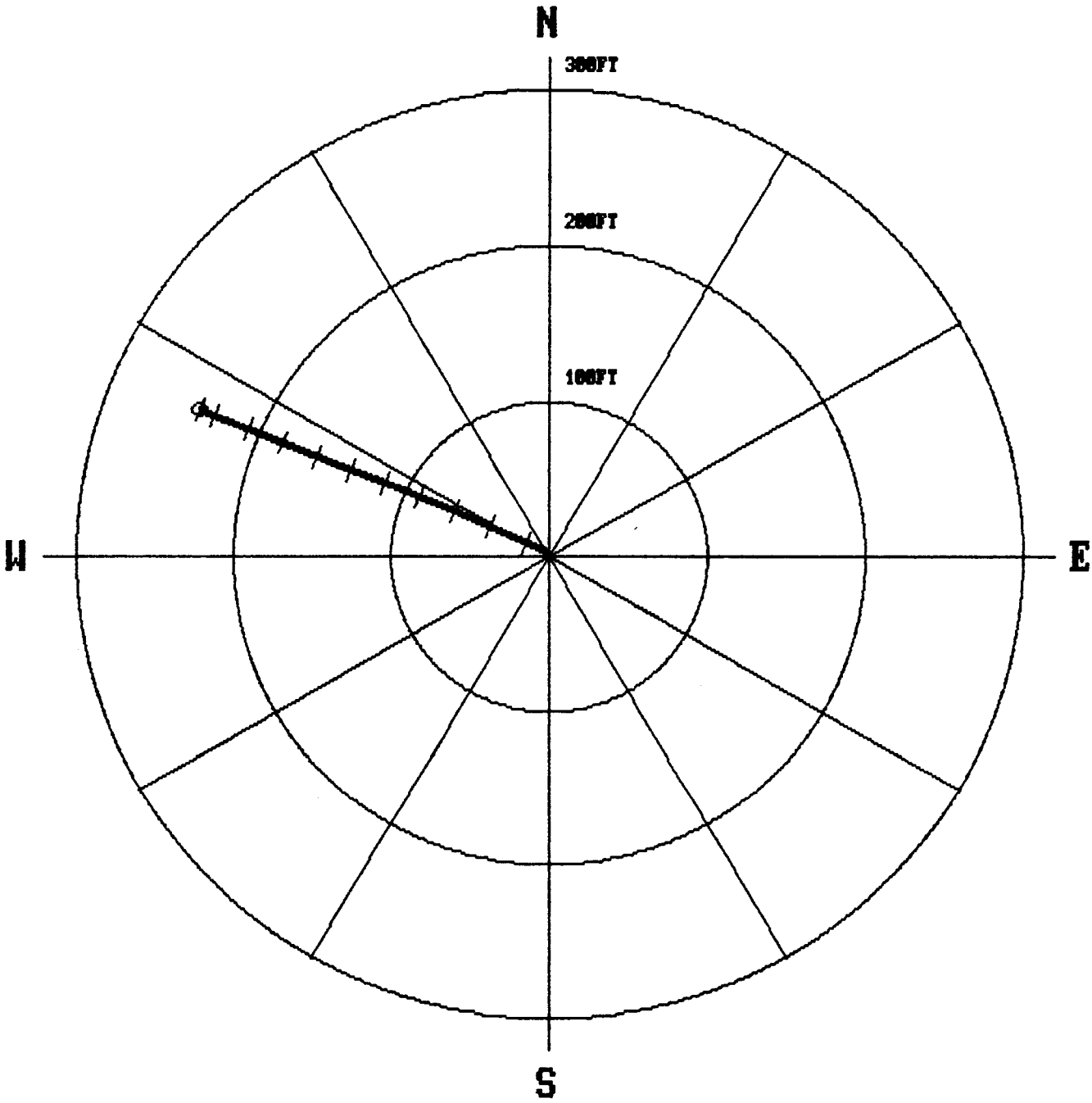
PLAN VIEW

COMPU-LOG DEVIATION

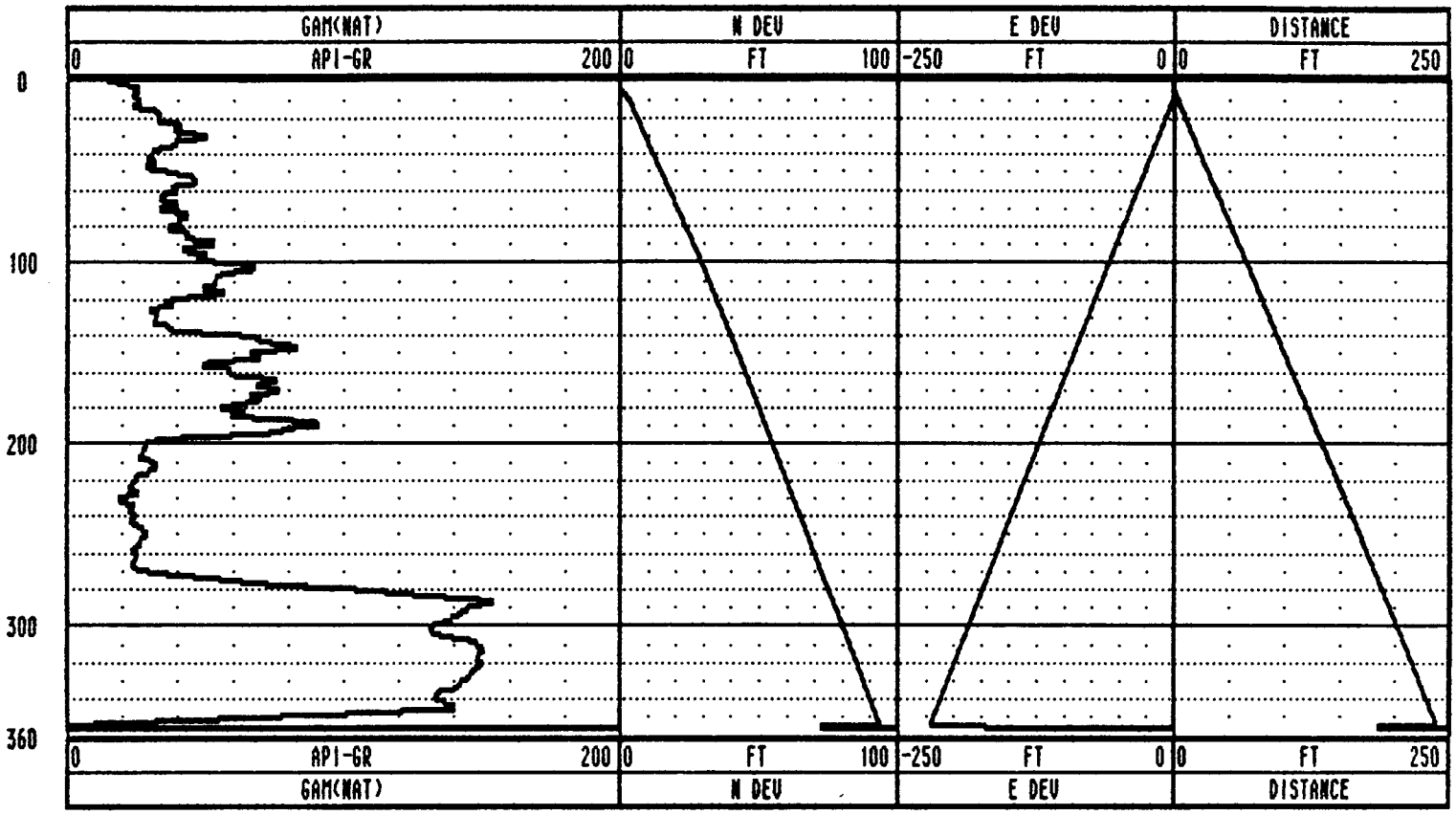
CLIENT: TEXAS SSC SITE
LOCATION: PROJECT #87-888 TASK #15
HOLE ID: BIR 22
DATE OF LOG: 09/19/89
PROBE: 9055A 135

MAG DECL: 7.0

SCALE: 100 FT/IN
TRUE DEPTH: 260.73 FT
AZIMUTH: 293.0
DISTANCE: 240.0 FT
+ = 25 FT INCR
○ = BOTTOM OF HOLE



Profile View
Compu-Log Deviation Survey
BIR 22



BIR 22 wire-line logs run September 19,1989 (continued).
Deviation survey log.

* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 22
DATE OF LOG : 09/19/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 6

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
1.0	1.00	0.00	0.00	0.0	0.0	0.0	0.0
2.0	2.00	0.00	0.00	0.0	0.0	0.0	0.0
3.0	3.00	0.00	0.00	0.0	0.0	0.0	0.0
4.0	4.00	0.00	0.00	0.0	0.0	0.0	0.0
5.0	5.00	0.00	0.00	0.0	0.0	0.0	0.0
6.0	5.94	0.12	-0.06	0.1	334.0	44.0	355.3
7.0	6.66	0.20	-0.30	0.4	303.6	44.1	195.5
8.0	7.37	0.42	-0.57	0.7	306.3	44.3	350.2
9.0	8.10	1.10	-0.50	1.2	335.3	43.5	15.5
10.0	8.82	1.76	-0.58	1.9	341.9	43.5	337.2
11.0	9.55	2.23	-1.06	2.5	334.6	43.3	302.2
12.0	10.28	2.78	-1.43	3.1	332.8	43.2	323.7
13.0	11.01	3.23	-1.93	3.8	329.1	42.9	301.2
14.0	11.74	3.57	-2.52	4.4	324.8	43.1	298.3
15.0	12.47	3.88	-3.13	5.0	321.1	43.1	295.6
16.0	13.20	4.19	-3.75	5.6	318.1	43.4	296.3
17.0	13.92	4.48	-4.37	6.3	315.7	43.3	295.6
18.0	14.65	4.78	-4.99	6.9	313.8	43.5	295.4
19.0	15.38	5.07	-5.61	7.6	312.1	43.4	295.2
20.0	16.10	5.36	-6.23	8.2	310.7	43.6	295.4
21.0	16.83	5.65	-6.85	8.9	309.5	43.4	294.8
22.0	17.56	5.94	-7.48	9.6	308.5	43.5	294.5
23.0	18.28	6.23	-8.11	10.2	307.5	43.5	294.5
24.0	19.01	6.51	-8.73	10.9	306.7	43.8	294.9
25.0	19.73	6.80	-9.36	11.6	306.0	43.3	293.8
26.0	20.45	7.08	-9.99	12.2	305.3	43.4	293.3
27.0	21.18	7.36	-10.62	12.9	304.7	43.4	293.8
28.0	21.90	7.65	-11.25	13.6	304.2	44.0	295.5
29.0	22.62	7.93	-11.88	14.3	303.7	44.1	294.9
30.0	23.34	8.22	-12.51	15.0	303.3	43.9	293.6
31.0	24.06	8.50	-13.14	15.7	302.9	43.6	292.9
32.0	24.78	8.78	-13.78	16.3	302.5	44.1	294.9
33.0	25.50	9.06	-14.41	17.0	302.2	44.1	294.0
34.0	26.23	9.33	-15.05	17.7	301.8	44.1	294.5
35.0	26.94	9.62	-15.68	18.4	301.5	44.7	295.1
36.0	27.66	9.92	-16.32	19.1	301.3	44.5	294.3
37.0	28.37	10.21	-16.96	19.8	301.1	44.7	295.5
38.0	29.07	10.51	-17.60	20.5	300.8	45.0	294.8
39.0	29.79	10.80	-18.24	21.2	300.6	44.5	294.2
40.0	30.50	11.09	-18.88	21.9	300.4	44.6	293.9
41.0	31.21	11.37	-19.52	22.6	300.2	44.5	293.7
42.0	31.92	11.65	-20.16	23.3	300.0	44.4	294.0
43.0	32.64	11.94	-20.80	24.0	299.9	44.7	294.7
44.0	33.35	12.23	-21.44	24.7	299.7	44.4	293.8
45.0	34.07	12.51	-22.08	25.4	299.5	44.2	292.8
46.0	34.78	12.80	-22.72	26.1	299.4	44.7	294.5
47.0	35.49	13.09	-23.36	26.8	299.3	44.5	293.9
48.0	36.20	13.37	-24.00	27.5	299.1	44.8	294.4
49.0	36.91	13.66	-24.65	28.2	299.0	45.0	294.6
50.0	37.62	13.95	-25.29	28.9	298.9	44.7	294.5
51.0	38.33	14.25	-25.93	29.6	298.8	44.8	294.0
52.0	39.03	14.54	-26.57	30.3	298.7	43.8	291.1

* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 22
DATE OF LOG : 09/19/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 6

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
53.0	39.75	14.82	-27.21	31.0	298.6	44.1	293.1
54.0	40.46	15.10	-27.85	31.7	298.5	44.2	293.3
55.0	41.18	15.38	-28.49	32.4	298.4	44.4	293.9
56.0	41.90	15.67	-29.13	33.1	298.3	44.5	297.4
57.0	42.61	15.96	-29.77	33.8	298.2	44.6	294.9
58.0	43.31	16.26	-30.41	34.5	298.1	44.9	294.1
59.0	44.02	16.56	-31.05	35.2	298.1	47.4	298.8
60.0	44.73	16.86	-31.69	35.9	298.0	44.3	294.0
61.0	45.43	17.17	-32.33	36.6	298.0	45.3	295.5
62.0	46.14	17.47	-32.97	37.3	297.9	45.8	295.1
63.0	46.85	17.76	-33.61	38.0	297.8	44.3	292.7
64.0	47.56	18.03	-34.25	38.7	297.8	44.2	293.6
65.0	48.27	18.32	-34.89	39.4	297.7	44.6	295.6
66.0	48.99	18.60	-35.54	40.1	297.6	44.5	293.4
67.0	49.70	18.90	-36.18	40.8	297.6	45.7	296.2
68.0	50.40	19.20	-36.82	41.5	297.5	44.8	295.1
69.0	51.11	19.50	-37.46	42.2	297.5	45.5	295.3
70.0	51.81	19.81	-38.10	42.9	297.5	45.0	295.3
71.0	52.52	20.09	-38.75	43.6	297.4	45.5	292.9
72.0	53.23	20.38	-39.39	44.3	297.4	44.5	294.2
73.0	53.94	20.66	-40.03	45.0	297.3	44.8	294.2
74.0	54.65	20.95	-40.67	45.7	297.3	44.8	294.0
75.0	55.37	21.24	-41.31	46.5	297.2	44.5	294.0
76.0	56.08	21.53	-41.95	47.2	297.2	44.5	294.4
77.0	56.79	21.82	-42.59	47.9	297.1	44.7	294.9
78.0	57.50	22.11	-43.23	48.6	297.1	44.5	294.2
79.0	58.22	22.39	-43.87	49.3	297.0	44.3	292.9
80.0	58.93	22.68	-44.51	50.0	297.0	44.6	293.6
81.0	59.64	22.96	-45.15	50.7	297.0	44.7	294.5
82.0	60.35	23.25	-45.79	51.4	296.9	44.6	294.1
83.0	61.06	23.54	-46.43	52.1	296.9	44.7	294.3
84.0	61.77	23.83	-47.07	52.8	296.9	44.7	294.6
85.0	62.49	24.12	-47.71	53.5	296.8	44.7	294.3
86.0	63.20	24.41	-48.35	54.2	296.8	44.5	292.9
87.0	63.91	24.71	-48.99	54.9	296.8	45.5	295.9
88.0	64.61	25.01	-49.63	55.6	296.7	45.2	295.7
89.0	65.32	25.31	-50.27	56.3	296.7	45.0	295.0
90.0	66.03	25.61	-50.91	57.0	296.7	44.9	294.9
91.0	66.74	25.91	-51.55	57.7	296.7	45.1	295.1
92.0	67.44	26.20	-52.20	58.4	296.7	45.2	293.8
93.0	68.15	26.49	-52.84	59.1	296.6	44.9	294.4
94.0	68.86	26.77	-53.48	59.8	296.6	44.5	293.9
95.0	69.58	27.06	-54.12	60.5	296.6	44.6	294.1
96.0	70.29	27.35	-54.76	61.2	296.5	44.8	294.6
97.0	71.00	27.64	-55.40	61.9	296.5	44.7	294.7
98.0	71.70	27.94	-56.05	62.6	296.5	44.8	294.5
99.0	72.41	28.23	-56.69	63.3	296.5	44.7	294.6
100.0	73.12	28.52	-57.33	64.0	296.4	45.1	297.3
101.0	73.84	28.80	-57.97	64.7	296.4	44.5	294.6
102.0	74.55	29.07	-58.62	65.4	296.4	44.4	293.6
103.0	75.27	29.35	-59.26	66.1	296.3	43.7	292.1
104.0	75.99	29.61	-59.90	66.8	296.3	43.8	292.3

* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 22
DATE OF LOG : 09/19/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 6

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
105.0	76.71	29.88	-60.54	67.5	296.3	44.2	293.2
106.0	77.43	30.15	-61.18	68.2	296.2	44.3	293.5
107.0	78.14	30.43	-61.82	68.9	296.2	44.3	293.2
108.0	78.86	30.71	-62.46	69.6	296.2	44.1	293.1
109.0	79.58	30.98	-63.10	70.3	296.2	44.3	293.3
110.0	80.29	31.26	-63.74	71.0	296.1	44.4	293.4
111.0	81.00	31.54	-64.38	71.7	296.1	44.3	293.1
112.0	81.72	31.80	-65.03	72.4	296.1	43.5	289.5
113.0	82.45	32.05	-65.67	73.1	296.0	43.5	291.7
114.0	83.17	32.33	-66.31	73.8	296.0	44.2	293.3
115.0	83.89	32.60	-66.95	74.5	296.0	44.2	292.2
116.0	84.60	32.86	-67.59	75.2	295.9	44.3	293.5
117.0	85.32	33.13	-68.23	75.9	295.9	44.0	292.7
118.0	86.04	33.41	-68.87	76.5	295.9	44.2	294.0
119.0	86.76	33.69	-69.51	77.2	295.9	44.3	293.1
120.0	87.47	33.96	-70.15	77.9	295.8	44.3	293.1
121.0	88.19	34.22	-70.80	78.6	295.8	43.7	292.6
122.0	88.91	34.49	-71.44	79.3	295.8	44.0	292.5
123.0	89.63	34.76	-72.08	80.0	295.7	44.0	292.8
124.0	90.35	35.02	-72.72	80.7	295.7	43.9	292.4
125.0	91.07	35.28	-73.36	81.4	295.7	43.6	291.9
126.0	91.80	35.54	-74.00	82.1	295.7	43.6	292.5
127.0	92.52	35.81	-74.63	82.8	295.6	43.8	294.0
128.0	93.24	36.08	-75.27	83.5	295.6	44.0	294.2
129.0	93.96	36.36	-75.91	84.2	295.6	43.8	291.9
130.0	94.68	36.62	-76.55	84.9	295.6	43.9	292.7
131.0	95.40	36.88	-77.19	85.5	295.5	43.5	291.9
132.0	96.13	37.14	-77.83	86.2	295.5	43.6	292.2
133.0	96.85	37.41	-78.47	86.9	295.5	43.8	292.0
134.0	97.57	37.67	-79.11	87.6	295.5	43.9	292.1
135.0	98.30	37.93	-79.75	88.3	295.4	43.4	291.8
136.0	99.02	38.18	-80.39	89.0	295.4	43.7	292.7
137.0	99.75	38.45	-81.02	89.7	295.4	43.6	292.5
138.0	100.47	38.71	-81.66	90.4	295.4	43.7	291.6
139.0	101.19	38.98	-82.30	91.1	295.3	43.8	291.6
140.0	101.92	39.24	-82.94	91.8	295.3	44.0	292.2
141.0	102.64	39.50	-83.58	92.4	295.3	43.5	292.2
142.0	103.36	39.76	-84.22	93.1	295.3	43.7	292.7
143.0	104.09	40.02	-84.85	93.8	295.3	43.6	292.3
144.0	104.81	40.30	-85.49	94.5	295.2	43.9	293.9
145.0	105.53	40.56	-86.13	95.2	295.2	43.8	292.4
146.0	106.25	40.83	-86.77	95.9	295.2	44.0	292.3
147.0	106.97	41.09	-87.41	96.6	295.2	43.6	292.0
148.0	107.70	41.35	-88.05	97.3	295.2	43.6	292.2
149.0	108.43	41.61	-88.69	98.0	295.1	43.8	292.3
150.0	109.15	41.87	-89.32	98.6	295.1	43.7	292.7
151.0	109.87	42.13	-89.96	99.3	295.1	43.9	292.8
152.0	110.59	42.41	-90.60	100.0	295.1	44.1	293.4
153.0	111.31	42.68	-91.24	100.7	295.1	43.9	292.1
154.0	112.03	42.94	-91.88	101.4	295.0	43.3	291.4
155.0	112.76	43.19	-92.52	102.1	295.0	43.0	290.9
156.0	113.49	43.44	-93.16	102.8	295.0	42.9	290.6

* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 22
DATE OF LOG : 09/19/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 6

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
157.0	114.22	43.69	-93.79	103.5	295.0	43.0	290.2
158.0	114.95	43.94	-94.43	104.2	295.0	42.9	290.4
159.0	115.67	44.19	-95.07	104.8	294.9	41.8	288.7
160.0	116.39	44.45	-95.71	105.5	294.9	43.8	292.4
161.0	117.12	44.72	-96.35	106.2	294.9	43.9	292.6
162.0	117.84	44.98	-96.99	106.9	294.9	43.5	291.9
163.0	118.56	45.24	-97.63	107.6	294.9	43.7	292.6
164.0	119.29	45.50	-98.27	108.3	294.8	43.6	293.1
165.0	120.02	45.75	-98.90	109.0	294.8	43.6	293.1
166.0	120.74	46.02	-99.54	109.7	294.8	44.8	295.2
167.0	121.47	46.28	-100.18	110.3	294.8	43.1	291.0
168.0	122.20	46.52	-100.81	111.0	294.8	43.1	291.2
169.0	122.92	46.77	-101.45	111.7	294.8	43.1	290.9
170.0	123.66	47.01	-102.09	112.4	294.7	42.8	290.0
171.0	124.39	47.25	-102.73	113.1	294.7	43.0	290.8
172.0	125.12	47.50	-103.36	113.8	294.7	42.4	289.7
173.0	125.85	47.74	-104.00	114.4	294.7	42.9	290.9
174.0	126.58	47.99	-104.64	115.1	294.6	42.9	290.9
175.0	127.31	48.24	-105.27	115.8	294.6	43.1	291.3
176.0	128.04	48.48	-105.91	116.5	294.6	43.0	290.4
177.0	128.77	48.73	-106.55	117.2	294.6	43.1	291.0
178.0	129.50	48.97	-107.18	117.8	294.6	42.5	290.0
179.0	130.23	49.23	-107.82	118.5	294.5	42.0	289.1
180.0	130.96	49.48	-108.46	119.2	294.5	42.7	290.1
181.0	131.69	49.72	-109.09	119.9	294.5	42.6	290.0
182.0	132.42	49.96	-109.73	120.6	294.5	41.4	285.9
183.0	133.16	50.19	-110.36	121.2	294.5	42.6	290.1
184.0	133.90	50.42	-111.00	121.9	294.4	42.6	290.6
185.0	134.63	50.67	-111.63	122.6	294.4	43.1	291.4
186.0	135.36	50.91	-112.27	123.3	294.4	43.0	291.5
187.0	136.10	51.16	-112.90	124.0	294.4	43.4	292.4
188.0	136.83	51.41	-113.53	124.6	294.4	43.4	292.8
189.0	137.56	51.66	-114.17	125.3	294.3	43.2	291.8
190.0	138.29	51.91	-114.81	126.0	294.3	43.2	292.0
191.0	139.02	52.16	-115.44	126.7	294.3	42.9	291.1
192.0	139.75	52.39	-116.08	127.4	294.3	42.7	290.8
193.0	140.50	52.63	-116.70	128.0	294.3	42.1	288.8
194.0	141.23	52.86	-117.34	128.7	294.3	42.9	291.0
195.0	141.97	53.10	-117.97	129.4	294.2	43.1	292.3
196.0	142.70	53.35	-118.60	130.0	294.2	42.7	290.9
197.0	143.44	53.59	-119.24	130.7	294.2	42.9	291.8
198.0	144.17	53.83	-119.87	131.4	294.2	42.4	289.3
199.0	144.91	54.07	-120.51	132.1	294.2	42.4	290.5
200.0	145.64	54.31	-121.14	132.8	294.1	42.9	291.0
201.0	146.37	54.56	-121.77	133.4	294.1	43.0	291.0
202.0	147.10	54.80	-122.41	134.1	294.1	42.5	289.6
203.0	147.84	55.04	-123.05	134.8	294.1	43.2	292.1
204.0	148.57	55.26	-123.68	135.5	294.1	42.0	290.0
205.0	149.31	55.52	-124.32	136.2	294.1	42.0	289.0
206.0	150.04	55.75	-124.95	136.8	294.0	42.8	290.8
207.0	150.77	56.00	-125.59	137.5	294.0	42.7	290.3
208.0	151.51	56.24	-126.22	138.2	294.0	42.9	291.3

* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 22
DATE OF LOG : 09/19/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 6

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
209.0	152.24	56.48	-126.86	138.9	294.0	42.8	290.7
210.0	152.97	56.73	-127.49	139.5	294.0	43.3	291.8
211.0	153.71	56.97	-128.13	140.2	294.0	43.0	290.4
212.0	154.44	57.21	-128.77	140.9	294.0	42.1	289.5
213.0	155.17	57.46	-129.40	141.6	293.9	43.7	292.0
214.0	155.89	57.71	-130.04	142.3	293.9	42.7	289.5
215.0	156.62	57.95	-130.68	143.0	293.9	43.1	291.1
216.0	157.35	58.20	-131.32	143.6	293.9	43.1	291.4
217.0	158.08	58.45	-131.95	144.3	293.9	43.2	291.0
218.0	158.81	58.70	-132.59	145.0	293.9	40.2	286.8
219.0	159.54	58.97	-133.23	145.7	293.9	44.0	293.6
220.0	160.26	59.24	-133.86	146.4	293.9	43.9	293.2
221.0	160.98	59.51	-134.50	147.1	293.9	43.9	292.6
222.0	161.70	59.76	-135.14	147.8	293.9	43.1	287.1
223.0	162.43	60.03	-135.78	148.5	293.9	43.4	291.8
224.0	163.16	60.26	-136.42	149.1	293.8	44.4	293.4
225.0	163.89	60.50	-137.05	149.8	293.8	43.9	293.9
226.0	164.63	60.75	-137.68	150.5	293.8	43.8	292.5
227.0	165.35	61.02	-138.32	151.2	293.8	43.7	293.2
228.0	166.07	61.29	-138.96	151.9	293.8	43.8	293.6
229.0	166.80	61.55	-139.60	152.6	293.8	43.5	295.5
230.0	167.52	61.80	-140.23	153.2	293.8	44.0	293.0
231.0	168.25	62.05	-140.87	153.9	293.8	42.5	290.1
232.0	168.98	62.29	-141.50	154.6	293.8	42.7	290.4
233.0	169.72	62.53	-142.14	155.3	293.7	42.9	290.8
234.0	170.45	62.78	-142.77	156.0	293.7	43.0	291.7
235.0	171.18	63.04	-143.41	156.6	293.7	43.0	291.5
236.0	171.91	63.28	-144.04	157.3	293.7	42.8	290.9
237.0	172.64	63.53	-144.68	158.0	293.7	43.0	291.6
238.0	173.38	63.78	-145.31	158.7	293.7	44.6	295.9
239.0	174.10	64.05	-145.94	159.4	293.7	43.4	292.2
240.0	174.83	64.31	-146.58	160.1	293.7	43.2	291.8
241.0	175.55	64.59	-147.21	160.8	293.7	44.0	292.7
242.0	176.28	64.86	-147.84	161.4	293.7	44.4	293.8
243.0	177.00	65.13	-148.48	162.1	293.7	42.4	289.7
244.0	177.74	65.36	-149.11	162.8	293.7	42.3	289.5
245.0	178.47	65.61	-149.74	163.5	293.7	42.9	291.4
246.0	179.21	65.84	-150.38	164.2	293.6	41.4	287.3
247.0	179.95	66.08	-151.00	164.8	293.6	42.7	290.2
248.0	180.69	66.33	-151.63	165.5	293.6	42.8	291.1
249.0	181.43	66.57	-152.26	166.2	293.6	42.7	292.0
250.0	182.16	66.82	-152.89	166.9	293.6	42.9	292.0
251.0	182.90	67.07	-153.52	167.5	293.6	42.3	290.6
252.0	183.63	67.31	-154.15	168.2	293.6	42.6	291.5
253.0	184.37	67.56	-154.78	168.9	293.6	42.6	291.3
254.0	185.10	67.80	-155.41	169.6	293.6	42.4	291.3
255.0	185.84	68.05	-156.04	170.2	293.6	42.7	291.8
256.0	186.58	68.30	-156.67	170.9	293.6	42.7	291.7
257.0	187.31	68.55	-157.30	171.6	293.5	42.8	291.7
258.0	188.05	68.80	-157.93	172.3	293.5	42.8	292.4
259.0	188.78	69.05	-158.56	172.9	293.5	42.8	291.5
260.0	189.51	69.30	-159.19	173.6	293.5	43.1	292.2

* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 22
DATE OF LOG : 09/19/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 6

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
261.0	190.25	69.55	-159.83	174.3	293.5	42.7	291.4
262.0	190.98	69.80	-160.46	175.0	293.5	42.6	291.1
263.0	191.72	70.05	-161.09	175.7	293.5	42.7	291.6
264.0	192.45	70.29	-161.72	176.3	293.5	42.6	290.7
265.0	193.19	70.54	-162.35	177.0	293.5	42.6	291.5
266.0	193.93	70.79	-162.98	177.7	293.5	42.6	291.1
267.0	194.66	71.03	-163.61	178.4	293.5	42.7	291.4
268.0	195.40	71.28	-164.24	179.0	293.5	42.6	290.8
269.0	196.13	71.53	-164.88	179.7	293.5	42.9	292.2
270.0	196.86	71.78	-165.51	180.4	293.4	42.8	291.6
271.0	197.59	72.03	-166.14	181.1	293.4	43.1	291.9
272.0	198.33	72.28	-166.78	181.8	293.4	43.2	291.9
273.0	199.06	72.52	-167.41	182.4	293.4	42.8	290.8
274.0	199.80	72.77	-168.04	183.1	293.4	42.7	291.2
275.0	200.53	73.01	-168.68	183.8	293.4	42.9	291.2
276.0	201.26	73.26	-169.31	184.5	293.4	42.9	291.5
277.0	201.99	73.51	-169.94	185.2	293.4	43.1	291.2
278.0	202.72	73.76	-170.58	185.8	293.4	43.1	291.3
279.0	203.46	74.01	-171.21	186.5	293.4	42.9	291.6
280.0	204.18	74.27	-171.85	187.2	293.4	43.9	293.9
281.0	204.91	74.54	-172.48	187.9	293.4	43.9	294.1
282.0	205.63	74.81	-173.12	188.6	293.4	43.9	292.8
283.0	206.35	75.08	-173.76	189.3	293.4	43.9	292.8
284.0	207.07	75.35	-174.40	190.0	293.4	43.9	294.4
285.0	207.79	75.62	-175.04	190.7	293.4	43.5	292.7
286.0	208.51	75.89	-175.67	191.4	293.4	44.0	293.7
287.0	209.23	76.17	-176.31	192.1	293.4	44.0	293.6
288.0	209.95	76.45	-176.95	192.8	293.4	44.0	293.7
289.0	210.66	76.73	-177.58	193.5	293.4	44.2	294.6
290.0	211.38	77.01	-178.22	194.2	293.4	43.6	294.6
291.0	212.11	77.27	-178.86	194.8	293.4	43.5	293.0
292.0	212.83	77.54	-179.49	195.5	293.4	43.8	294.0
293.0	213.56	77.83	-180.12	196.2	293.4	41.0	287.0
294.0	214.27	78.10	-180.74	196.9	293.4	43.2	293.0
295.0	215.02	78.31	-181.38	197.6	293.4	41.3	286.8
296.0	215.76	78.54	-182.01	198.2	293.3	43.3	292.9
297.0	216.49	78.79	-182.64	198.9	293.3	42.9	290.6
298.0	217.22	79.04	-183.28	199.6	293.3	36.9	282.0
299.0	217.94	79.32	-183.90	200.3	293.3	43.0	291.4
300.0	218.67	79.58	-184.54	201.0	293.3	43.3	293.6
301.0	219.40	79.83	-185.17	201.6	293.3	43.0	290.4
302.0	220.13	80.08	-185.81	202.3	293.3	43.1	292.1
303.0	220.86	80.33	-186.44	203.0	293.3	43.4	293.9
304.0	221.61	80.55	-187.07	203.7	293.3	43.2	293.9
305.0	222.33	80.80	-187.71	204.4	293.3	43.1	291.2
306.0	223.07	81.04	-188.35	205.0	293.3	43.2	292.0
307.0	223.80	81.29	-188.98	205.7	293.3	43.3	291.7
308.0	224.53	81.54	-189.62	206.4	293.3	43.3	291.6
309.0	225.26	81.79	-190.25	207.1	293.3	43.0	292.1
310.0	225.99	82.03	-190.89	207.8	293.3	43.2	291.0
311.0	226.72	82.27	-191.53	208.5	293.2	42.5	290.9
312.0	227.45	82.54	-192.17	209.1	293.2	43.0	291.4

* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 22
DATE OF LOG : 09/19/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 6

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
313.0	228.17	82.80	-192.80	209.8	293.2	43.3	291.8
314.0	228.90	83.05	-193.44	210.5	293.2	43.4	290.9
315.0	229.62	83.31	-194.08	211.2	293.2	43.3	291.9
316.0	230.34	83.59	-194.72	211.9	293.2	44.5	296.1
317.0	231.06	83.84	-195.36	212.6	293.2	43.1	291.1
318.0	231.80	84.09	-195.99	213.3	293.2	42.8	294.1
319.0	232.52	84.34	-196.63	214.0	293.2	45.2	294.8
320.0	233.27	84.55	-197.26	214.6	293.2	43.1	292.2
321.0	234.00	84.81	-197.89	215.3	293.2	43.1	291.9
322.0	234.73	85.05	-198.53	216.0	293.2	42.3	290.5
323.0	235.47	85.30	-199.16	216.7	293.2	43.0	293.0
324.0	236.20	85.55	-199.79	217.3	293.2	42.5	290.3
325.0	236.94	85.78	-200.42	218.0	293.2	43.1	292.5
326.0	237.68	86.02	-201.05	218.7	293.2	41.4	289.2
327.0	238.41	86.27	-201.68	219.4	293.2	42.2	290.9
328.0	239.15	86.52	-202.31	220.0	293.2	43.4	294.5
329.0	239.88	86.79	-202.94	220.7	293.2	42.7	291.6
330.0	240.62	87.03	-203.57	221.4	293.1	42.3	290.0
331.0	241.36	87.27	-204.20	222.1	293.1	42.4	289.9
332.0	242.09	87.52	-204.83	222.7	293.1	42.8	290.3
333.0	242.83	87.75	-205.47	223.4	293.1	42.6	290.9
334.0	243.57	87.99	-206.10	224.1	293.1	42.6	291.6
335.0	244.30	88.24	-206.73	224.8	293.1	43.0	291.5
336.0	245.03	88.48	-207.36	225.5	293.1	43.0	291.5
337.0	245.77	88.72	-207.99	226.1	293.1	42.0	290.6
338.0	246.51	88.97	-208.62	226.8	293.1	42.9	291.1
339.0	247.24	89.22	-209.25	227.5	293.1	42.5	290.6
340.0	247.98	89.47	-209.89	228.2	293.1	42.7	291.8
341.0	248.71	89.72	-210.52	228.8	293.1	42.7	292.1
342.0	249.44	90.00	-211.14	229.5	293.1	43.7	295.6
343.0	250.17	90.28	-211.77	230.2	293.1	43.1	292.6
344.0	250.90	90.53	-212.40	230.9	293.1	42.9	290.2
345.0	251.63	90.78	-213.04	231.6	293.1	42.4	293.3
346.0	252.36	91.03	-213.67	232.3	293.1	46.9	297.6
347.0	253.10	91.25	-214.30	232.9	293.1	43.2	291.5
348.0	253.84	91.48	-214.93	233.6	293.1	43.0	291.9
349.0	254.58	91.72	-215.56	234.3	293.0	42.6	292.1
350.0	255.32	91.97	-216.19	234.9	293.0	42.3	291.6
351.0	256.06	92.24	-216.81	235.6	293.0	44.0	299.1
352.0	256.79	92.48	-217.44	236.3	293.0	42.8	291.5
353.0	257.53	92.74	-218.07	237.0	293.0	41.5	289.9
354.0	258.25	93.01	-218.70	237.7	293.0	43.6	291.3
355.0	258.98	93.26	-219.33	238.3	293.0	43.0	292.0
356.0	259.71	93.52	-219.96	239.0	293.0	43.3	290.6
357.0	260.44	93.79	-220.60	239.7	293.0	43.5	292.8
357.7	260.83	93.90	-220.85	240.0	293.0	0.0	0.0

WIRE-LINE LOGGING PARAMETERS

Hole No. BIR 23 **Log Measured From:** Ground Level

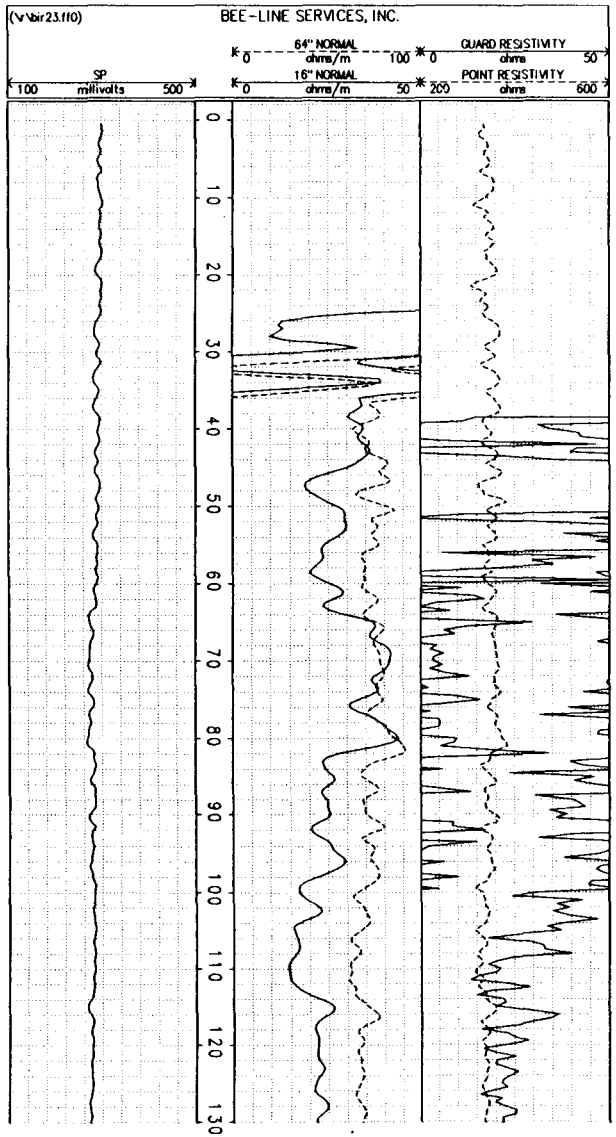
Drilling Parameters
Depth 241.0 feet
Bit Diameter 3.125 inches

Logging Parameters	Electrical Log	Gamma Log	Sonic Log
Date	September 19, 1989	September 19, 1989	September 19, 1989
Bottom Log Interval	238.5 feet	238.5 feet	234.5 feet
Top Log Interval	surface	surface	surface
Type of Fluid in Hole	drilling mud	drilling mud	drilling mud
Time Since Circulation Stop	6 hours	6 hours	1.5 hours
Probe Type/S.N.	ALP-4979	XAP-4383	CLP-4877A
Module Type/S.N.	ALM-4979	XAM-4383	CLM-4877A
Logging Speed	40 feet/min.	20 feet/min.	20 feet/min.
Sample Interval	0.5 feet	0.5 feet	0.5 feet

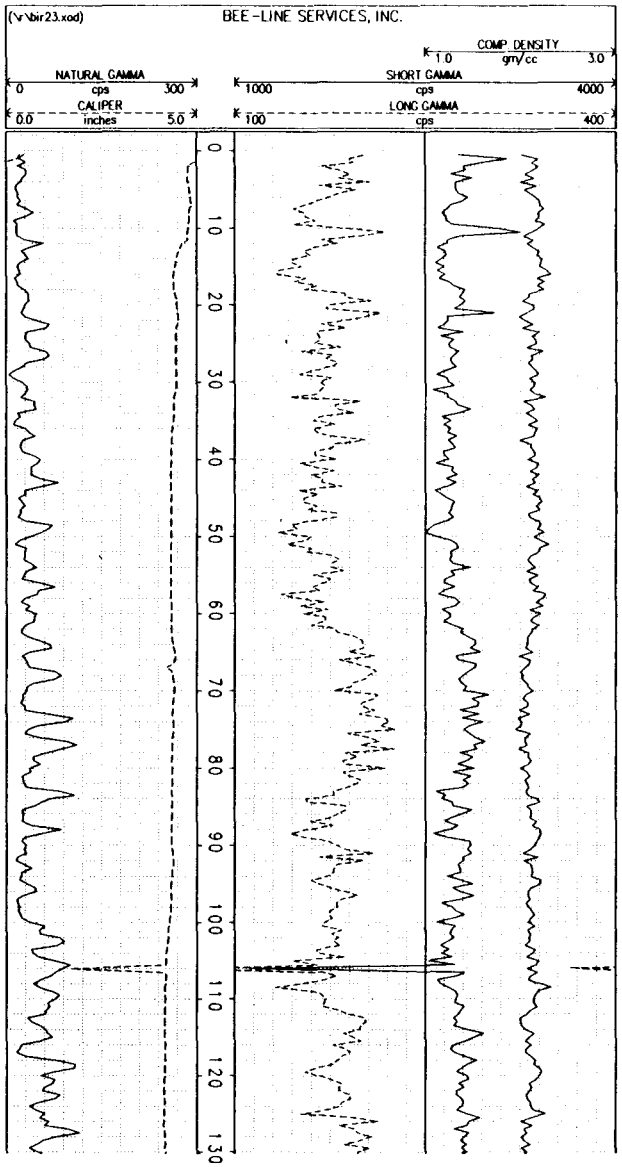
Logged by: BEE-LINE SERVICES, INC.
P. O. Box 2096
Corsicana, TX 75151

BIR 23 Wire-line logs run September 19, 1989. Surface elevation 659.9 feet.

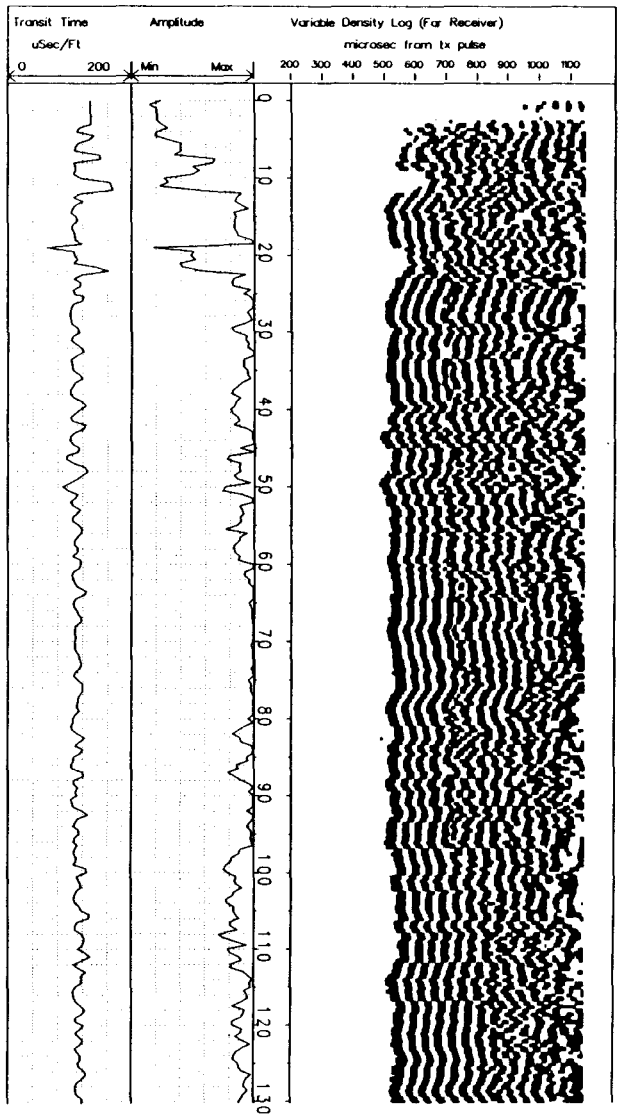
ELECTRICAL LOG



GAMMA LOG

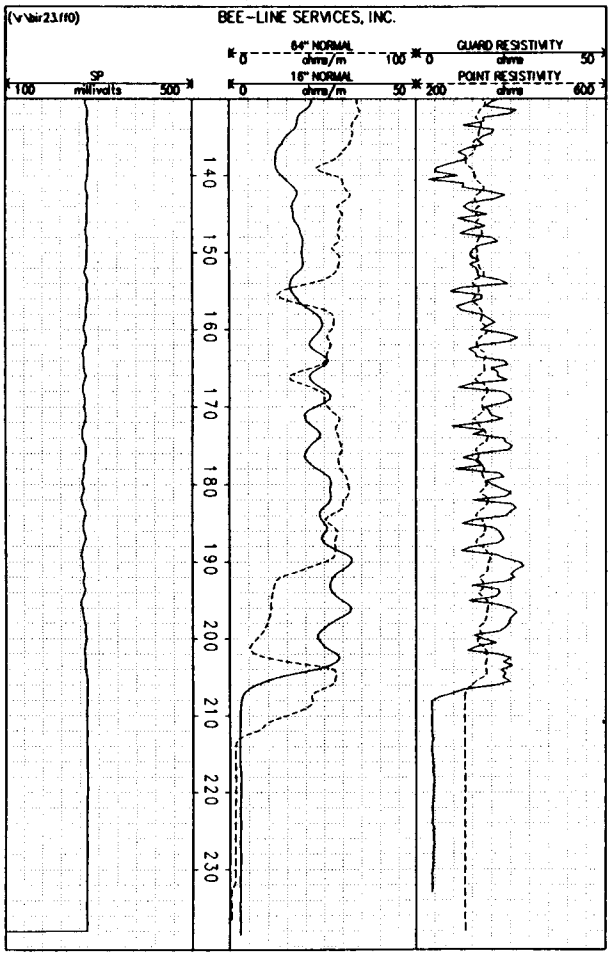


SONIC LOG

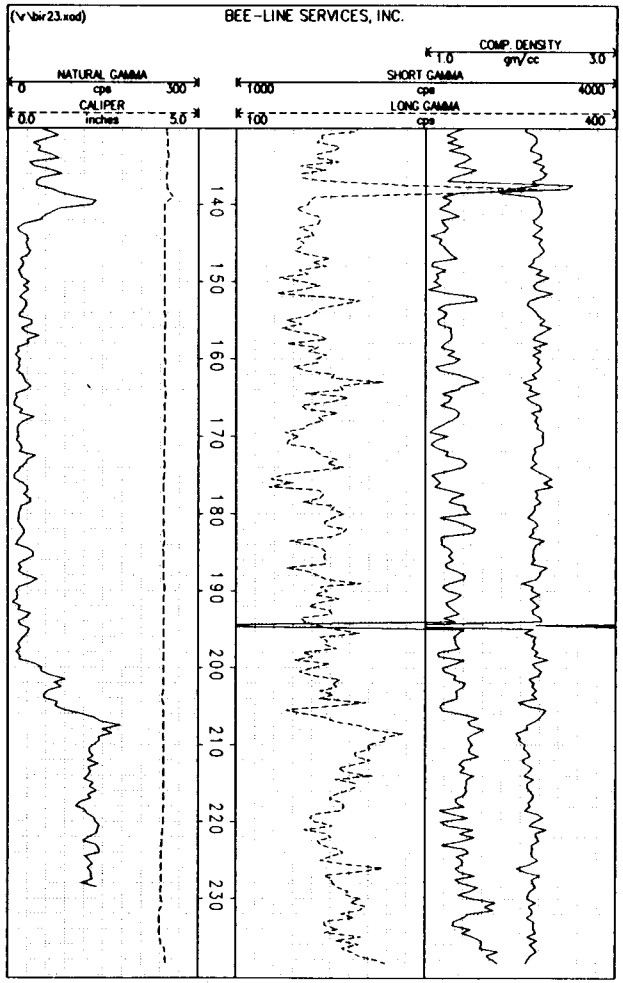


BIR 23 Wire-line logs run September 19, 1989 (Continued). Surface elevation 659.9 feet.

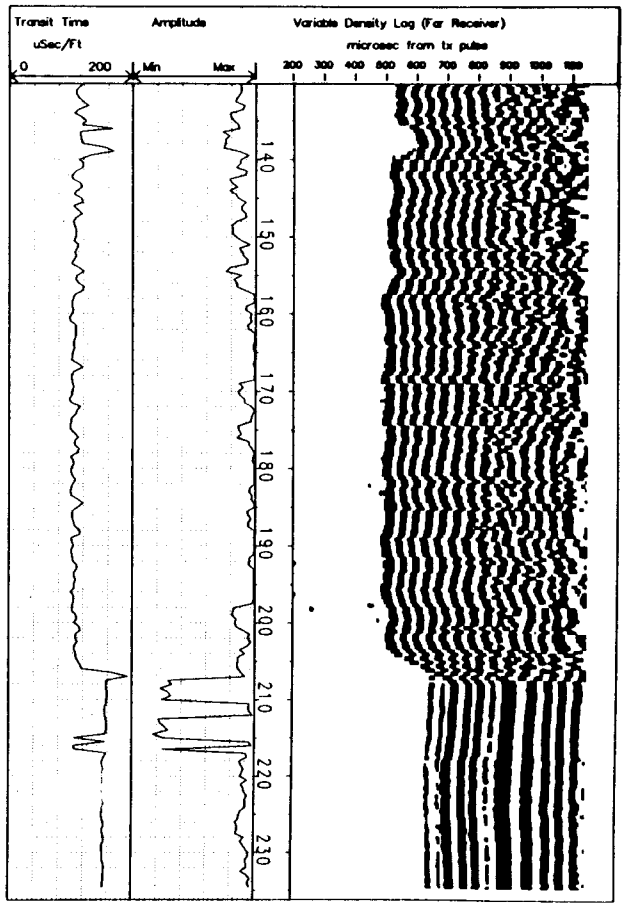
ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED



SONIC LOG CONTINUED



APPENDIX D

HYDROLOGIC TEST RESULTS

APPENDIX D

The objectives of the hydrogeologic (packer) tests were to provide estimates of the hydraulic conductivity at the Austin Chalk/Eagle Ford Shale contact and within fractured or other suspected water-bearing zones. Intervals within boreholes were selected for packer testing based on visual inspections of rock cores and the results of borehole geophysical testing. Sections of a borehole that exhibited increased frequency of fractures or bedding plane parting were commonly packer tested.

Standard procedures used to conduct these tests included lowering a pair of pneumatically operated rubber packers (in straddle-packer configuration) separated by a known length of perforated pipe into the drill hole to a predetermined depth. The packer interval was approximately 20 feet. The packers were then inflated to a precalculated pressure to seal against the rock side walls and water was pumped into the test interval at a selected pressure while the flow rate was measured with a cumulative flow meter. To improve the accuracy of measurements at the low flow rates encountered in most of these tests, the water was often pumped from a large container (e.g., a drum or section of casing) and the volume removed was recorded. In addition to monitoring the water pressure and flow rate at appropriate intervals, the height of the water pressure gauge above ground surface, as well as the diameter and length of water pipe used, was recorded. The tests were continued until five consecutive readings indicated a stabilization of the flow rate but for a minimum of at least 10 minutes. Standard forms were used for data records and the hydraulic conductivity was calculated using standard Bureau of Reclamation procedures.

STRADDLE PACKER TEST RESULTS

Boring	Test Depth * (feet)	Packer Pressure (psi)	Gauge Pressure (psi)	Formation/ Lithology	Hydraulic Conductivity (cm/sec)	Assumed Static Water Level*
BIR 21	30.0-50.0	200	10-20	Austin Chalk	$<5\times10^{-8}$ $<3\times10^{-8}$	Case 1 Case 2
	200.0-220.0	200	10-20	Austin Chalk/ Eagle Ford Shale Contact	$<5\times10^{-8}$ $<1.0\times10^{-8}$	Case 1 Case 2
BIR 22	51.5-357.0 (vertical depth 37.5-260.2)	160-200	18-35	Austin Chalk	$<4\times10^{-8}$ $<1\times10^{-8}$	Case 1 Case 2

* Case 1 - Static water level assumed at base of tan weathered limestone.
Case 2 - Static water level assumed at midpoint of test interval.

BIR 21 was hydrogeologically (packer) tested at two intervals based on an inspection of the rock core and a review of the boring and wire-line logs. The first interval (Test 1) was from 200 to 220 feet and encompassed the contact between the Austin Chalk and the Eagle Ford Shale. Only one or two fractures were observed within this zone. No other zones with potentially increased permeability were apparent. The second interval (Test 2) was set from 30 to 50 feet and encompassed unweathered and apparently unfractured Austin Chalk. Hydrogeologic (packer) testing in BIR 21 followed the standard test procedures outlined above. The deeper zone was tested first (Test 1) followed by the shallower zone (Test 2). Packer and gauge pressures used during testing are listed in the table above. Flow volumes were derived from flow meter readings and beginning/end readings from a calibrated container (an approximately 3-foot length of 8-inch steel casing).

No restricted interval was selected for hydrogeologic (packer) testing at boring BIR 22 (inclined). Conditions and horizons tested at several nearby borings (BIR 11, BIR 12, and BIR 21) are the same as those at BIR 22. Alternatively, a packer test (Test 1) was run for the entire depth of the boring below the weathered zone (51.5 to 357 feet)(vertical depth 37.5 to 260.2 feet). Hydrogeologic (packer) testing in BIR 22 followed the standard test procedures outlined above except that a single packer assembly was used to isolate the lower portion of the boring. Packer and gauge pressures used during testing are listed in the table. Flow volumes were derived from flow meter readings. A calibrated container was not used for this test.

APPENDIX E

LABORATORY RESULTS

TABLE E-1. BULK AND CLAY MINERALOGY TEST RESULTS - BIR 21

Formation: Austin Chalk **Depth:** 152.8 feet

Whole Rock Composition:

Mineral	Percent
quartz	2
calcite	97
dolomite	<1
pyrite	1
total clay	0
Total	100

Relative Clay Abundance:

Mineral	Percent
Not Analyzed	

Formation: EagleFord Shale **Depth:** 252.4 feet

Whole Rock Composition:

Mineral	Percent
non-clay*	42
clay	58
Total	100

Relative Clay Abundance:

Mineral	Percent
illite	16
kaolinite	34
chlorite	<1
mixed layer (illite/smectite)	50
Total	100

Formation: Eagle Ford Shale **Depth:** 276.4 feet

Whole Rock Composition:

Mineral	Percent
quartz	22
K-feldspar	1
plagioclase	1
calcite	1
pyrite	5
Total Clay	70
Total	100

Relative Clay Abundance:

Mineral	Percent
illite	19
kaolinite	51
chlorite	<1
mixed layer (illite/smectite)	30
Total	100

Formation: Eagle Ford Shale **Depth:** 288.9 feet

Whole Rock Composition:

Mineral	Percent
non-clay*	37
clay	63
Total	100

Relative Clay Abundance:

Mineral	Percent
illite	14
kaolinite	48
chlorite	<1
mixed layer (illite/smectite)	38
Total	100

* Specific composition not analyzed.

TABLE E-2. GEOMECHANICAL TEST RESULTS - BIR 21

Geologic Formation and General Lithology	Vertical Depth	Moisture Content	Dry Density	Specific Gravity	Atterberg Limits		Sample Dimension Ratio L/D	Sample Failure Mode	Uniaxial Compressive Strength	Triaxial Compression		Failure Strain	Tangent Young's Modulus		Poisson's Ratio	Brazil Tensile Strength	2nd Cycle Slake-Durability Index	Modified Tabor Abrasion/ Hardness Index	Swell Pressure Index	Carbonate Content
					Liquid Limit	Plasticity Index				σ_c	σ_1-σ_3		E_{50}	σ_3						
	feet	percent	pcf						psi	psi	psi	percent	psi x 10^5	psi		psi	percent		psi	percent
Austin Chalk Limestone	5.0	15.1																		
Austin Chalk Limestone	5.2	14.0	123.6				2.2	B-2/90°	1923			0.96								
Austin Chalk Limestone	5.5	10.8					0.52									314				
Austin Chalk Limestone	6.5	12.0	125.9				1.9	D		50	1646	0.84								
Austin Chalk Limestone	7.2	13.5	120.7				1.9	A		500	2726									
Austin Chalk Limestone	23.5	12.6																		
Austin Chalk Limestone	23.6	13.8					0.50									301				
Austin Chalk Limestone	24.3	12.8	123.2				2.1	D	2569			1.35								
Austin Chalk Limestone	45.0	13.0																		
Austin Chalk Limestone	45.1	13.6															96.3			
Austin Chalk Limestone	45.2	13.7					0.50									286				
Austin Chalk Limestone	45.3																	0.568		
Austin Chalk Limestone	46.3	15.0	118.0				2.2	D	2626			0.89								
Austin Chalk Limestone	48.0	12.0	124.8				1.9	B-1/20°		300	1309	1.03	1.38	300						
Austin Chalk Limestone	48.4	12.0	123.2				1.9	B-1/12°		50	2189	1.20	2.14	50	0.29					
Austin Chalk Limestone	103.1	16.3	124.3																	
Austin Chalk Limestone	151.0	14.0																		
Austin Chalk Limestone	152.7						0.50									305				
Austin Chalk Limestone	152.8	14.9	119.1				2.2	D	2758			0.79								
Austin Chalk Limestone	154.0	10.9	131.3				1.9	D		100	2336	1.46								
Austin Chalk Limestone	154.4	11.5	126.8				1.9	B-1/10°		500	3228	0.99								
Austin Chalk Limestone	200.2	13.6	122.8																	
Eagle Ford Shale	214.6	17.7			109	71														
Eagle Ford Shale	215.5	16.9	116.2																	
Eagle Ford Shale	232.4	16.3			110	70														
Eagle Ford Shale	233.2	16.3	117.0																	
Eagle Ford Shale	252.3	16.2																		
Eagle Ford Shale	253.3	16.2	117.5				2.2	B-1/30°	251			0.28								4.9
Eagle Ford Shale	253.7	16.0															12.8			
Eagle Ford Shale	254.3	16.6																	43	
Eagle Ford Shale	254.6	16.6																	22	
Eagle Ford Shale	254.8	16.5																	15	
Eagle Ford Shale	255.0	16.9			94	62														
Eagle Ford Shale	255.8																	0.575		
Eagle Ford Shale	273.0	15.1																	36	
Eagle Ford Shale	273.0	14.6																	58	
Eagle Ford Shale	273.0	14.4																	43	
Procedure		ASTM-D2216		ASTM-D854	ASTM-D4318				ASTM-D2938	ASTM-D2664			ASTM-D3148		ASTM-D3148	ASTM-D3967	ISRM	ISRM	ISRM	

Symbol	Failure Type
A	No discernible failure plane
(B)	Well defined shear plane @ "X" angle (deg) to vertical or to long axis of core
B-1	Shear plane
B-2	Bedding plane shear
B-3	Shear plane along preexisting fracture, shear zone, etc.
B-4	Combination
C	Barreling/Bulging
D	Longitudinal (axial) splitting
E	Conical
F	No information

TABLE E-2. GEOMECHANICAL TEST RESULTS - BIR 21 (cont'd)

Geologic Formation and General Lithology	Vertical Depth	Moisture Content	Dry Density	Specific Gravity	Atterberg Limits		Sample Dimension Ratio L/D	Sample Failure Mode	Uniaxial Compressive Strength	Triaxial Compression		Failure Strain	Tangent Young's Modulus		Poisson's Ratio	Brazil Tensile Strength	2nd Cycle Slake-Durability Index	Modified Tabor Abrasion/ Hardness Index	Swell Pressure Index	Carbonate Content
					Liquid Limit	Plasticity Index				σ_c	σ_1-σ_3		E_{50}	σ_3						
	feet	percent	pcf						psi	psi	psi	percent	psi x 10^5	psi		psi	percent		psi	percent
Eagle Ford Shale	273.8			2.74																
Eagle Ford Shale	275.7	14.5			75	46														
Eagle Ford Shale	276.3	15.2																		
Eagle Ford Shale	276.7	14.3	120.8				2.1	D	481			0.71								
Eagle Ford Shale	277.0	14.7																		
Eagle Ford Shale	277.1	14.3	121.0				2.2	D		100	403	1.12								
Eagle Ford Shale	277.7	13.9	121.1				2.2	B-1/30°		500	850	1.34								
Eagle Ford Shale	278.2	14.3	120.5				2.0	B-1/40°		250	436	0.91	0.90	250	0.16					
Eagle Ford Shale	287.8	15.1																		
Eagle Ford Shale	287.9	14.8	120.0				2.3	D	465			0.76								9.3
Eagle Ford Shale	288.4																	0.697		
Eagle Ford Shale	289.0	15.2															31.0			
Eagle Ford Shale	289.9	15.1																	16	
Eagle Ford Shale	290.0	15.4																	36	
Eagle Ford Shale	290.1	15.5																	43	
Eagle Ford Shale	293.3	14.8	118.4				2.0	B-2/30°		100	251	1.06								
Eagle Ford Shale	294.4	14.5	119.1				2.1	B-1/40°		500	506	1.16								
Procedure		ASTM-D2216		ASTM-D854	ASTM-D4318				ASTM-D2938	ASTM-D2664			ASTM-D3148		ASTM-D3148	ASTM-D3967	ISRM	ISRM	ISRM	

Symbol	Failure Type
A	No discernible failure plane
(B)	Well defined shear plane @ "X" angle (deg) to vertical or to long axis of core
B-1	Shear plane
B-2	Bedding plane shear
B-3	Shear plane along preexisting fracture, shear zone, etc.
B-4	Combination
C	Barreling/Bulging
D	Longitudinal (axial) splitting
E	Conical
F	No information

TABLE E-3. GEOMECHANICAL TEST RESULTS - BIR 22

(Inclined Boring)

Geologic Formation and General Lithology	Boring Depth	Vertical Depth	Moisture Content	Dry Density	Atterberg Limits		Sample Dimension Ratio L/D	Sample Failure Mode	Uniaxial Compressive Strength	Triaxial Compression		Failure Strain	Tangent Young's Modulus		Poisson's Ratio	Carbonate Content
					Liquid Limit	Plasticity Index				σ_c	$\sigma_1 - \sigma_3$		E_{50}	σ_3		
	feet	feet	percent	pcf					psi	psi	psi	percent	psi x 10^5	psi		percent
Austin Chalk Limestone	67.7	50.2	12.8	123.3			2.1	D		50	819	0.75				
Austin Chalk Limestone	68.1	50.5	12.3	122.7			2.1	D		300	1948	0.40				
Austin Chalk Limestone	68.6	50.8	12.2	123.8			2.2	B-1/35°	350			0.14	2.0	0		
Austin Chalk Limestone	69.0	51.1	14.2													
Austin Chalk Limestone	107.8	78.7	17.4	96.8												
Austin Chalk Limestone	144.1	104.9	11.7	126.4				D	2301			0.40	4.6	0		
Austin Chalk Limestone	144.6	105.2	12.4				2.2									
Bentonite Shale	192.6	140.2	39.9													
Bentonite Shale	193.3	140.7	39.4		103	53										
Austin Chalk Limestone	252.7	184.1	9.3	132.7												
Austin Chalk Limestone	281.0	204.9	13.0	123.4			2.3	B-1/30°	1833			0.25	6.7	0		
Austin Chalk Limestone	281.4	205.2	14.7													
Eagle Ford Shale	287.8	209.8	16.3													
Eagle Ford Shale	288.0	209.9	15.9	116.0			2.3	B-2/45°	98			0.61	0.24	0		
Eagle Ford Shale	308.0	224.5	16.0													
Eagle Ford Shale	308.2	224.7	14.7	121.1			2.2	B-3/20°	10			0.13	0.17	0		
Eagle Ford Shale	326.3	237.9	16.7													
Eagle Ford Shale	326.5	238.0	15.4	104.6			2.4	B-2/55°	9			0.14	0.11	0		
Eagle Ford Shale	326.9	238.3														6.9
Eagle Ford Shale	334.1	243.6	15.2	118.2			2.2	B-2/45°		500	706	0.85				
Eagle Ford Shale	334.5	243.9	15.1	118.4			2.2	B-2/45°		100	152	0.27	0.60	100	0.22	
Procedure			ASTM-D2216		ASTM-D4318				ASTM-D2938	ASTM-D2664			ASTM-D3148		ASTM-D3148	

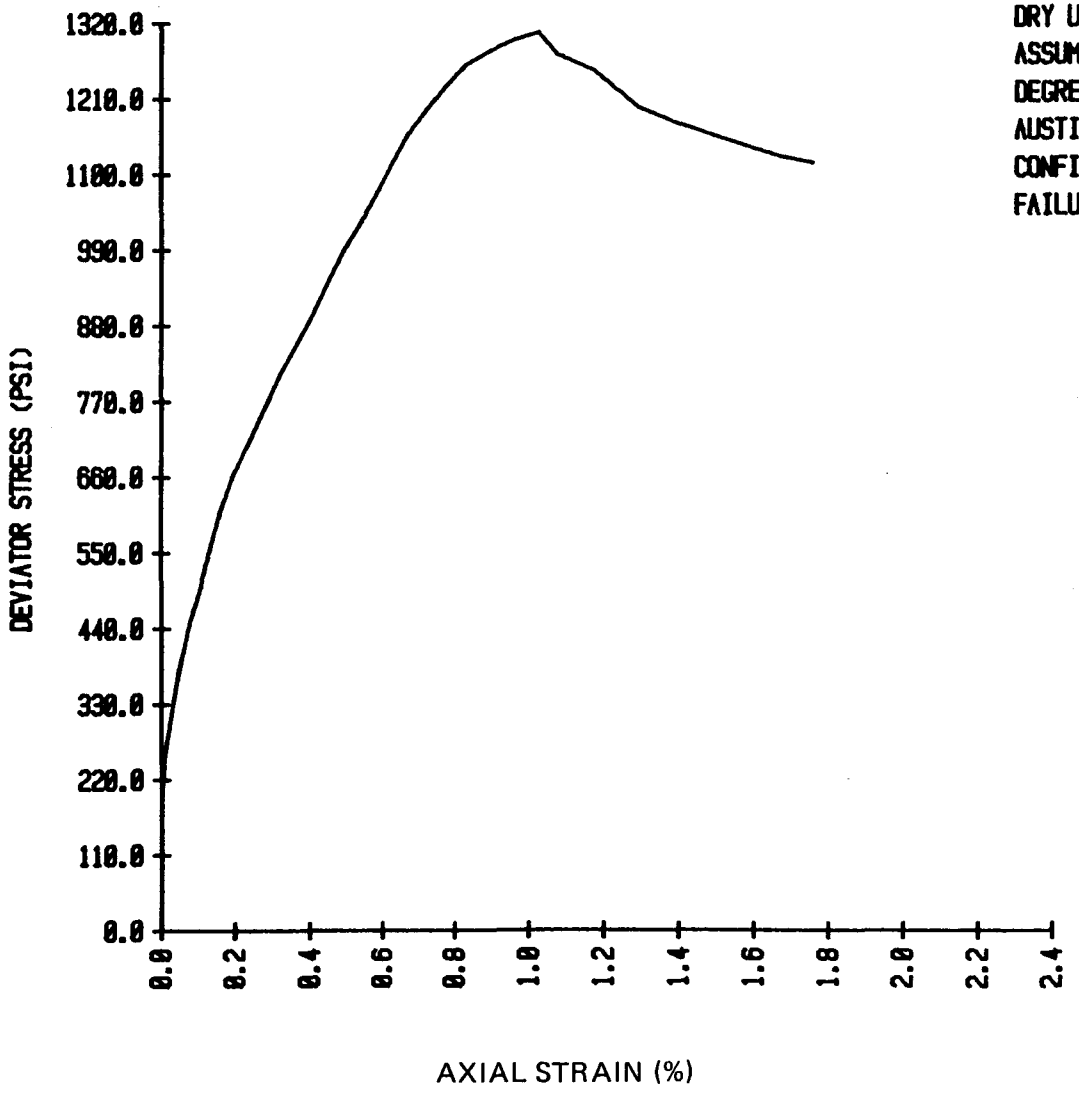
Symbol	Failure Type	Symbol	Failure Type
A	No discernible failure plane	B-4	Combination
(B)	Well defined shear plane @ "X" angle (deg) to vertical or to long axis of core	C	Barreling/Bulging
		D	Longitudinal (axial) splitting
B-1	Shear plane	E	Conical
B-2	Bedding plane shear	F	No information
B-3	Shear plane along preexisting fracture, shear zone, etc.		

TABLE E-4. GEOMECHANICAL TEST RESULTS - BIR 23

Geologic Formation and General Lithology	Vertical Depth	Moisture Content	Dry Density	Specific Gravity	Atterberg Limits		Sample Dimension Ratio L/D	Sample Failure Mode	Uniaxial Compressive Strength	Triaxial Compression		Failure Strain	Tangent Young's Modulus		Poisson's Ratio	Brazil Tensile Strength	2nd Cycle Slake-Durability Index	Swell Pressure Index
					Liquid Limit	Plasticity Index				σ_c	$\sigma_1 - \sigma_3$		E_{50}	σ_3				
	feet	percent	pcf						psi	psi	psi	percent	psi x 10^5	psi		psi	percent	psi
Austin Chalk Limestone	51.7	9.7	132.6															
Austin Chalk Limestone	103.0	15.0																
Austin Chalk Limestone	104.4	11.5															96.8	
Austin Chalk Limestone	106.2	13.2					0.47									285		
Austin Chalk Limestone	106.3	14.9	117.9				2.2	E	2331			0.69						
Austin Chalk Limestone	107.4	14.2																
Austin Chalk Limestone	107.4	13.1	123.6				2.0	B-1/20°		100	2121	0.76						
Austin Chalk Limestone	108.0	13.8	120.8				2.0	B-1/25°		500	2604	0.28						
Bentonite Shale	139.8	39.1	85.4				1.9	D	170			1.72						
Austin Chalk Limestone	151.8	11.8	126.6															
Austin Chalk Limestone	198.7	15.4																
Austin Chalk Limestone	199.9	11.3					0.49									199		
Austin Chalk Limestone	201.0	12.7	123.7	2.69			2.0	D	2007			1.17						
Austin Chalk Limestone	204.9	11.9															97.4	
Austin Chalk Limestone	204.9	13.3																
Austin Chalk Limestone	204.9	13.4	122.3				2.0	D		100	2594	0.31	9.9	100	0.41			
Austin Chalk Limestone	205.3	12.9	123.0				2.0	B-1/20°		500	3324	0.74						
Eagle Ford Shale	216.0	17.1																
Eagle Ford Shale	216.4	16.5																29
Eagle Ford Shale	216.6	17.0																29
Eagle Ford Shale	217.1	16.0															29.5	
Eagle Ford Shale	218.3	16.0			109	70												
Eagle Ford Shale	219.2			2.70														
Eagle Ford Shale	219.3	16.0	119.1				2.0	D	194			0.61						
Eagle Ford Shale	222.0	15.8			85	55												
Eagle Ford Shale	222.0	15.0	119.8				2.1	B-1		100	310	0.25	1.45	100	0.52			
Eagle Ford Shale	222.5	13.9	126.4				2.1	B-1/45°		500	494	0.68						
Eagle Ford Shale	224.3	16.6															28.0	
Eagle Ford Shale	225.6	16.5																43
Eagle Ford Shale	225.6	16.7																29
Eagle Ford Shale	225.6	16.3																29
Eagle Ford Shale	228.3	17.2																
Eagle Ford Shale	228.8	16.5	116.2				2.0	B-1	217			0.70						
Eagle Ford Shale	236.4	17.2																
Eagle Ford Shale	236.4	16.4	111.6				1.9	B-1/40°		100	211	1.55	0.17	100				
Eagle Ford Shale	237.4	16.5	114.3				2.1	A		500	362	1.72						
Procedure		ASTM-D2216		ASTM-D854	ASTM-D4318				ASTM-D2938	ASTM-D2664			ASTM-D3148		ASTM-D3148	ASTM-D3967	ISRM	ISRM

Symbol	Failure Type	Symbol	Failure Type
A	No discernible failure plane	B-4	Combination
(B)	Well defined shear plane @ "X" angle (deg) to vertical or to long axis of core	C	Barreling/Bulging
B-1	Shear plane	D	Longitudinal (axial) splitting
B-2	Bedding plane shear	E	Conical
B-3	Shear plane along preexisting fracture, shear zone, etc.	F	No information

BORING #: BIR21
DEPTH: 48.0 FEET
INCLINATION : VERTICAL
MC TRIMMINGS, (%) =
MC AS TESTED (%) = 12.0
DRY UNIT WEIGHT (PCF) = 124.8
ASSUMED SPECIFIC GRAVITY, Gs = 2.7
DEGREE OF SATURATION, (%) = 92.7
AUSTIN CHALK LIMESTONE
CONFINING PRESSURE PSI = 300
FAILURE MODE : SHEAR PLANE



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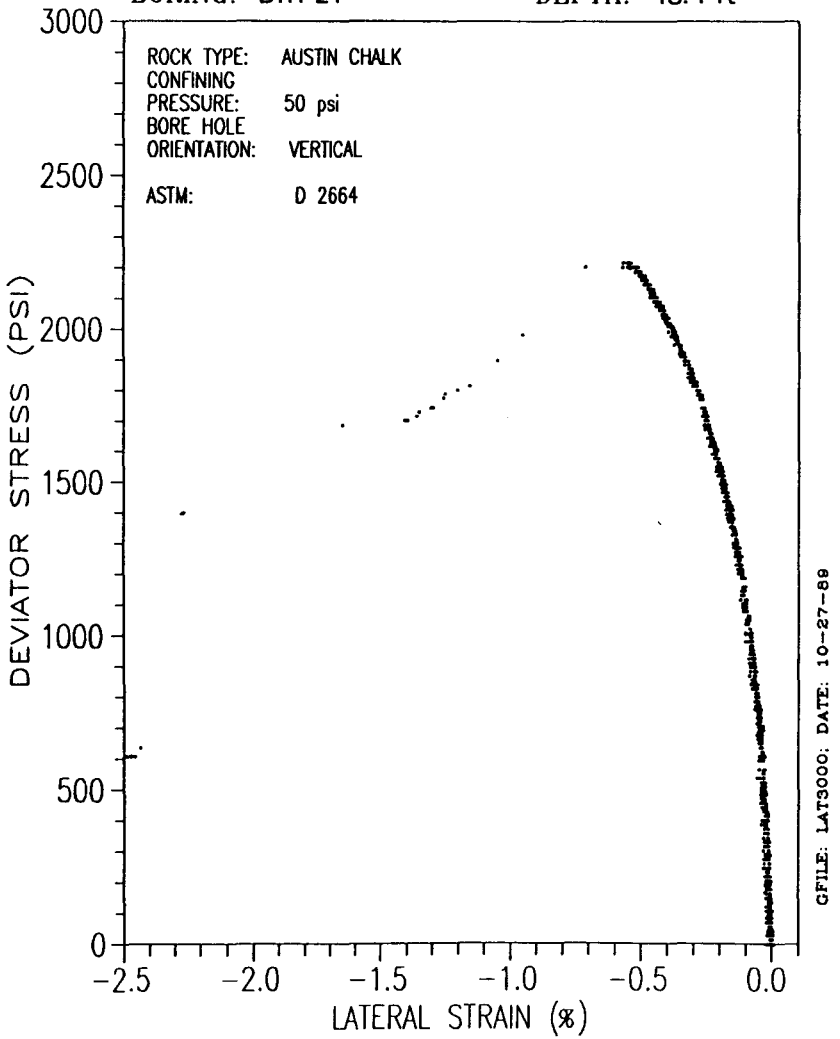
DEVIATOR STRESS vs LATERAL STRAIN

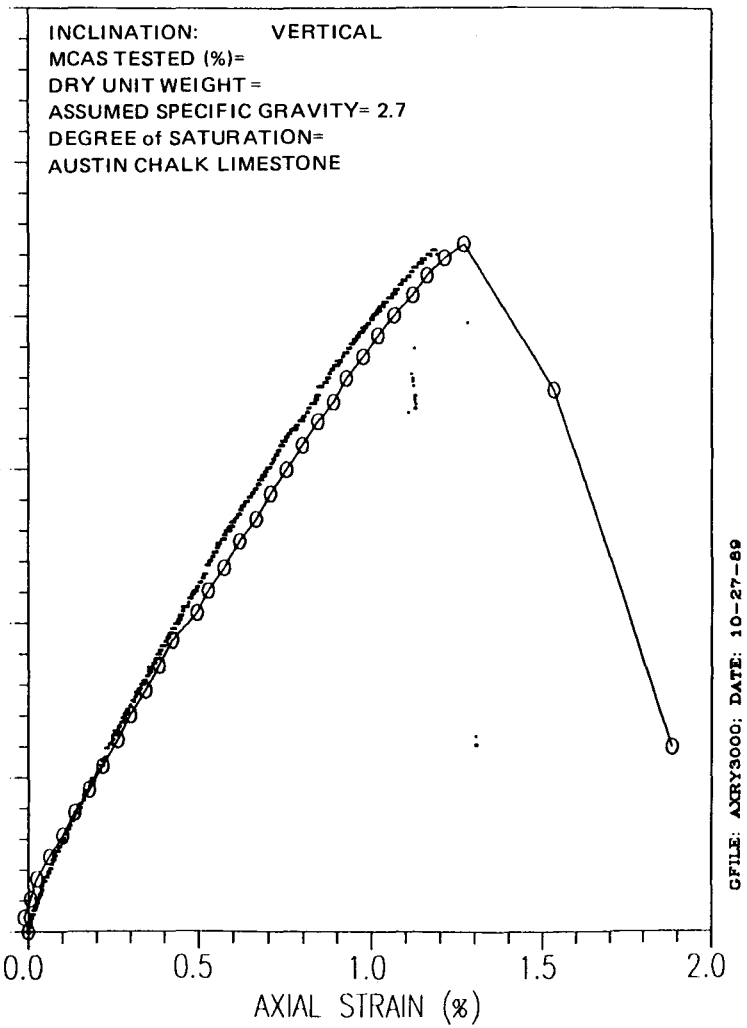
BORING: BIR 21 DEPTH: 48.4 ft



····· JACKET-LVDT (3)

DEVIATOR STRESS vs AXIAL STRAIN

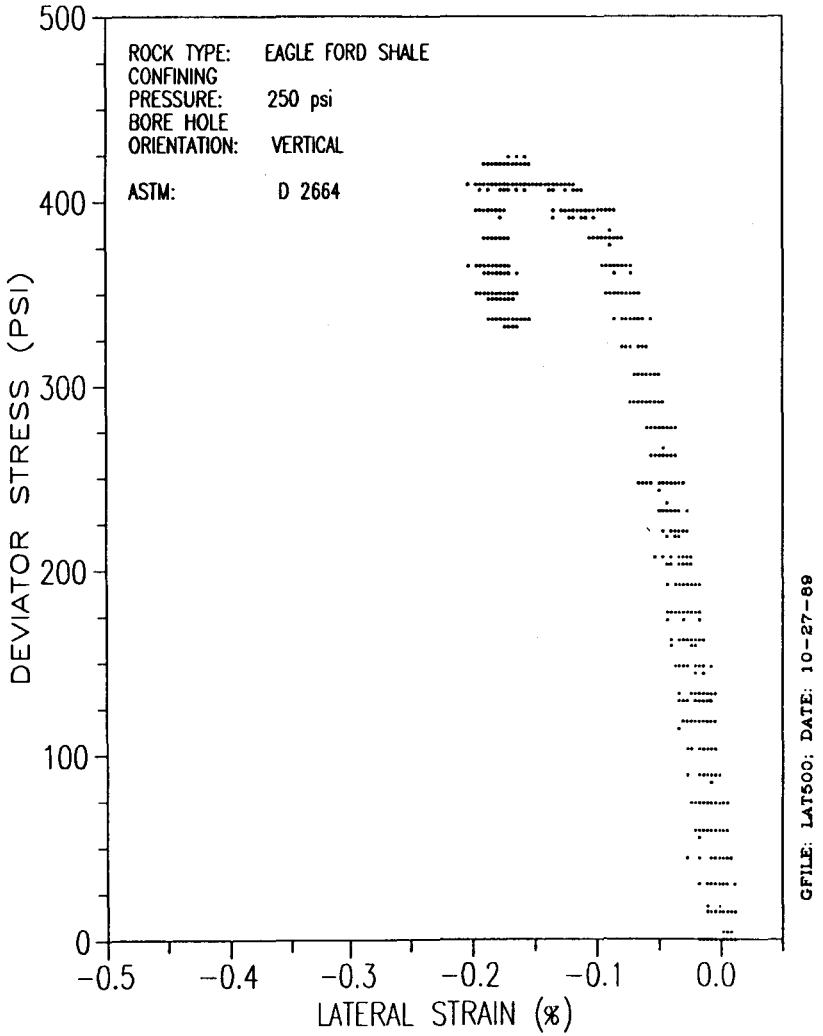
BORING: BIR 21 DEPTH: 48.4 ft



····· JACKET-LVDT (2) ○○○○○ PLATEN-DAIL GAUGE

DEVIATOR STRESS vs LATERAL STRAIN

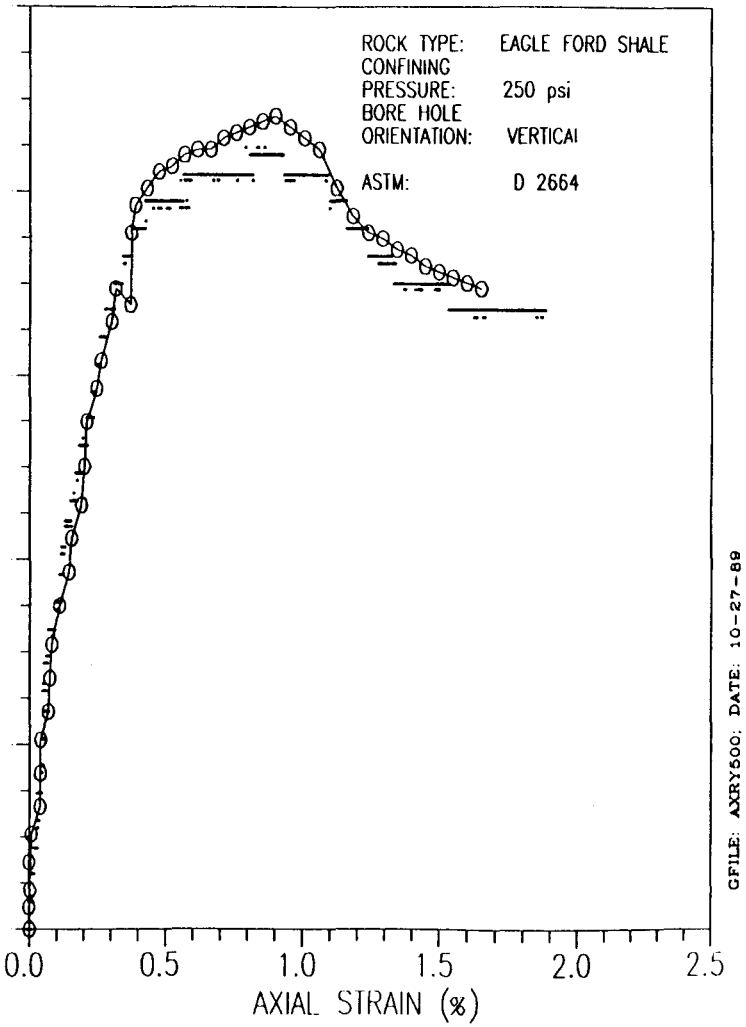
BORING: BIR 21 DEPTH: 278.2 ft



····· JACKET-LVDT (3)

DEVIATOR STRESS vs AXIAL STRAIN

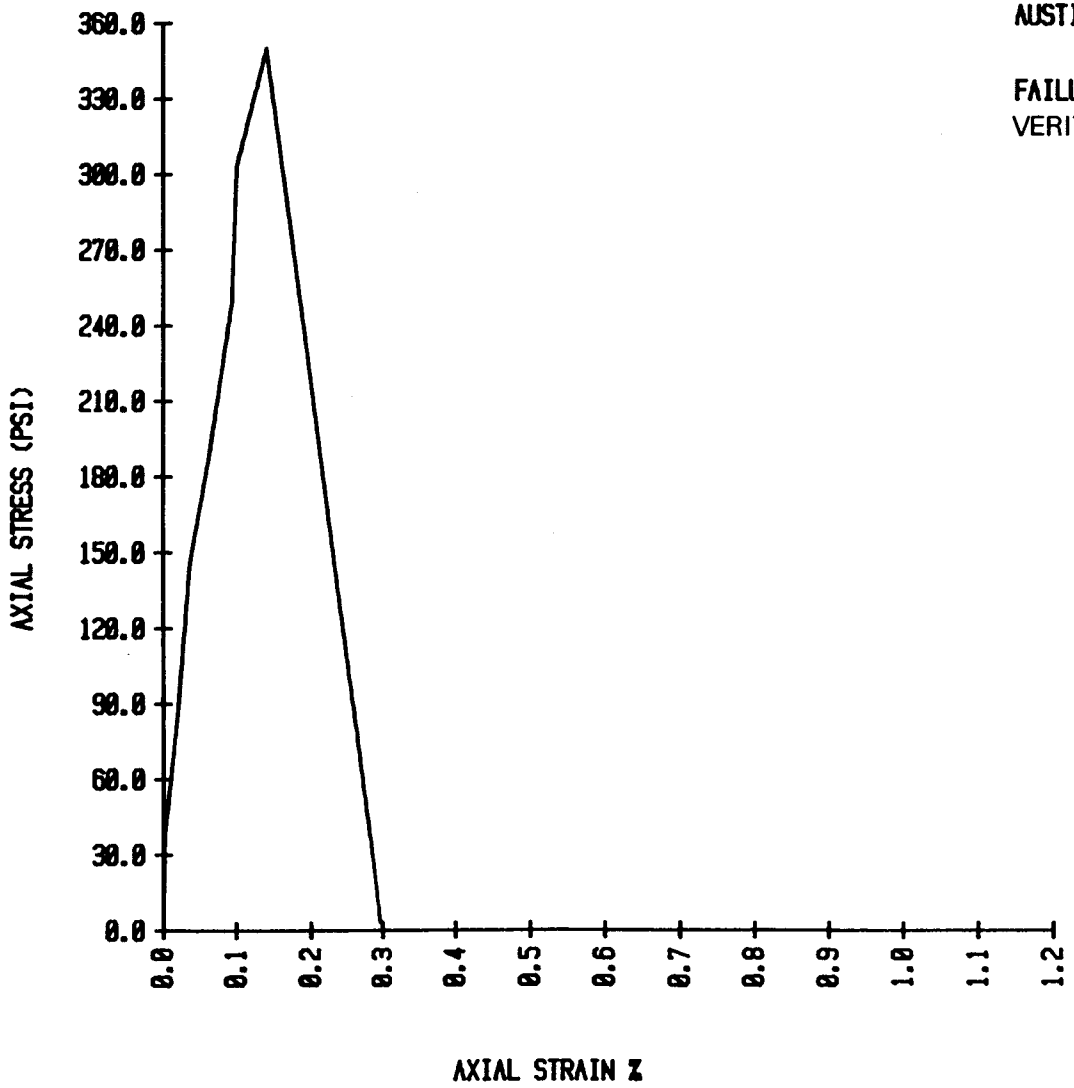
BORING: BIR 21 DEPTH: 278.2 ft



····· JACKET-LVDT (2) ○○○○○ PLATEN-DAIL GAUGE

BORING #: BIR 22
BORING DEPTH: 68.6 FEET
INCLINATION: APPROX. 45 DEGREES
DRY UNIT WEIGHT (PCF) = 123.8
MOISTURE CONTENT % = 12.2
AUSTIN CHALK LIMESTONE

FAILURE MODE : SHEAR PLANE AT 35 DEG.
VERITCAL DEPTH : 50.8 FEET



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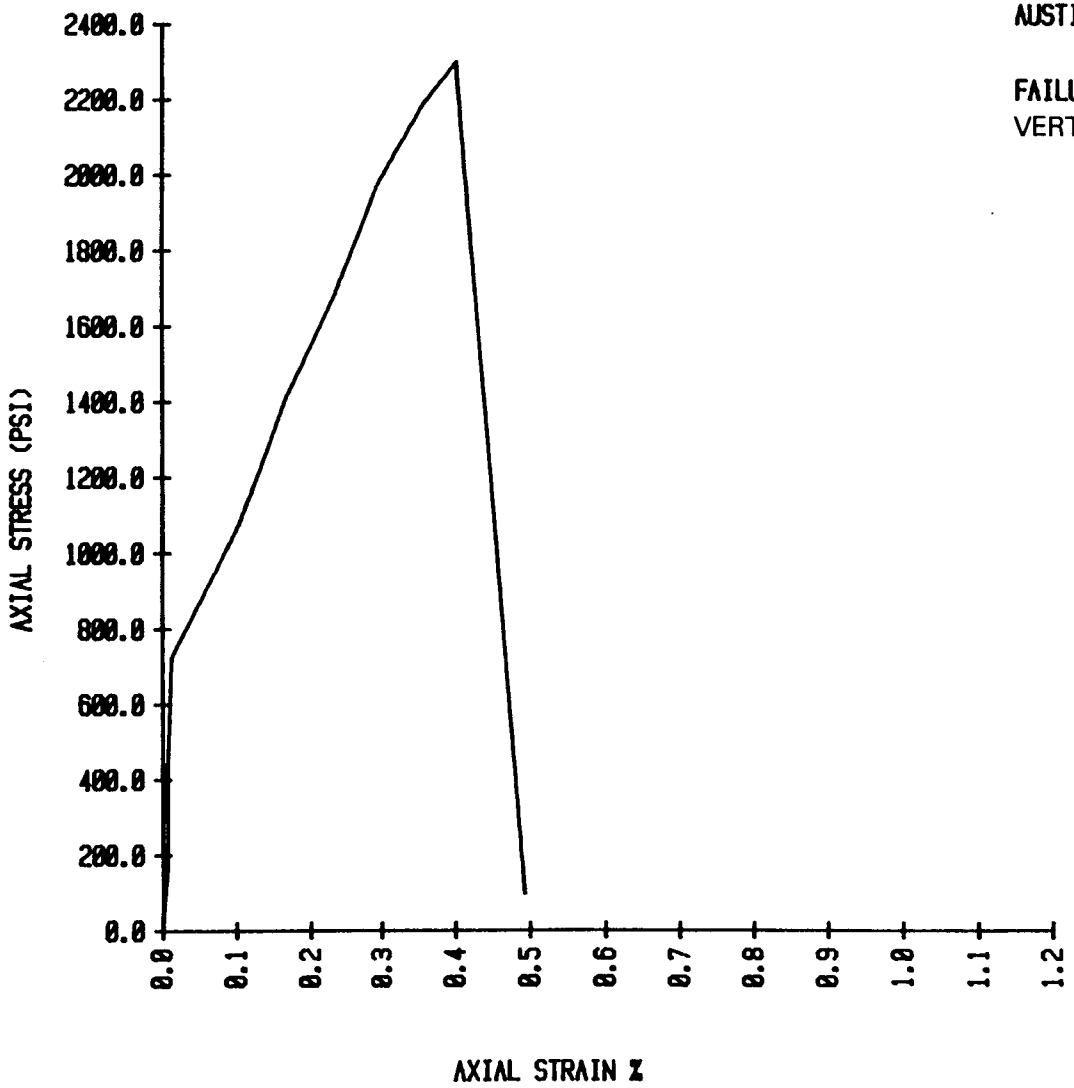
BORING #: BIR 22
BORING DEPTH: 144.1 FEET
INCLINATION: APPROX. 45 DEGREES
DRY UNIT WEIGHT (PCF) = 126.4
MOISTURE CONTENT % = 11.7
AUSTIN CHALK LIMESTONE

FAILURE MODE : AXIAL SPLITTING
VERTICAL DEPTH: 104.9 FEET



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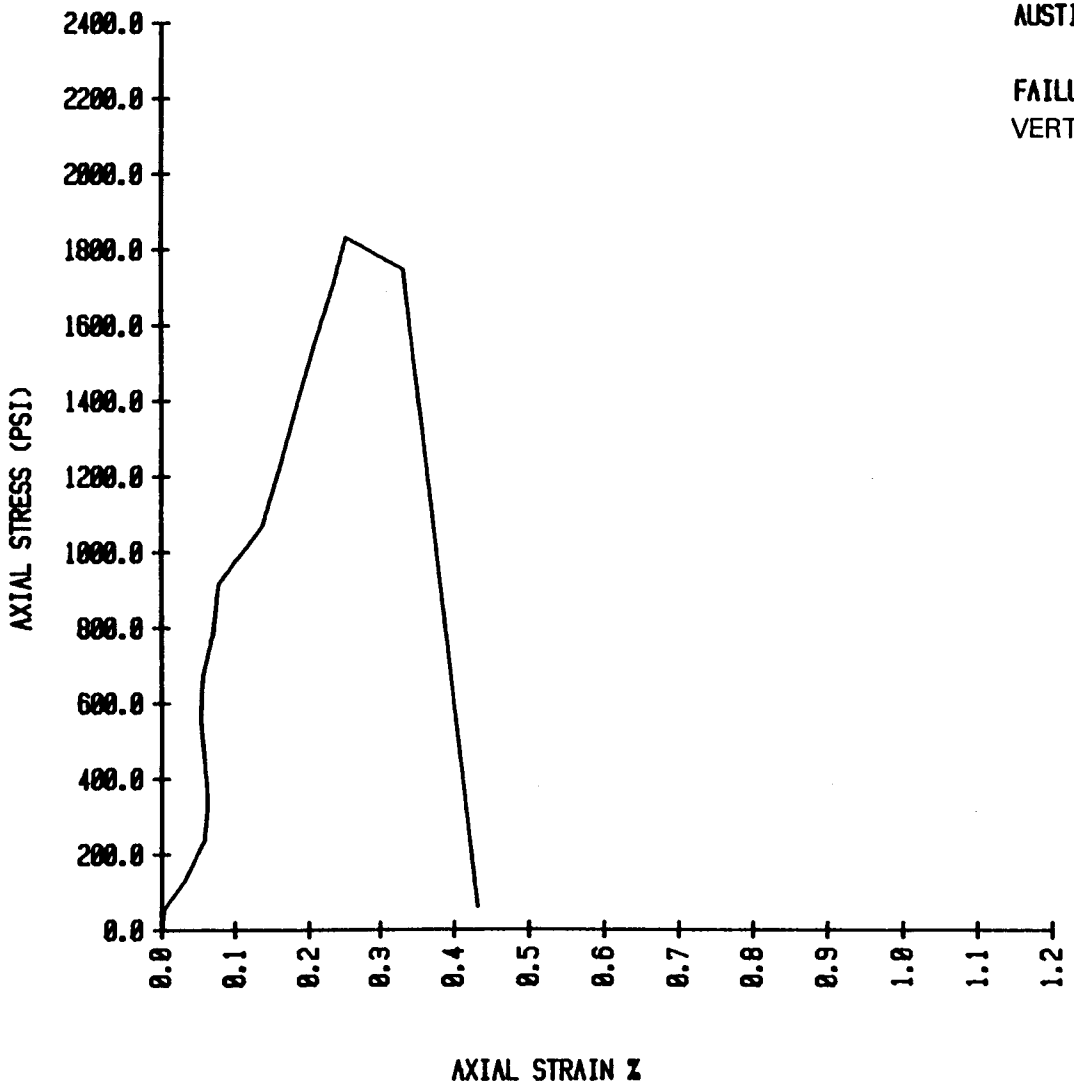
DATE: 9-24-89 | JOB # 5530.15

BORING #: BIR 22
BORING DEPTH: 281.0 FEET
INCLINATION: APPROX. 45 DEGREES
DRY UNIT WEIGHT (PCF) = 123.4
MOISTURE CONTENT % = 13.0
AUSTIN CHALK LIMESTONE

FAILURE MODE : SHEAR PLANE AT 30 DEG.
VERTICAL DEPTH: 204.9 FEET



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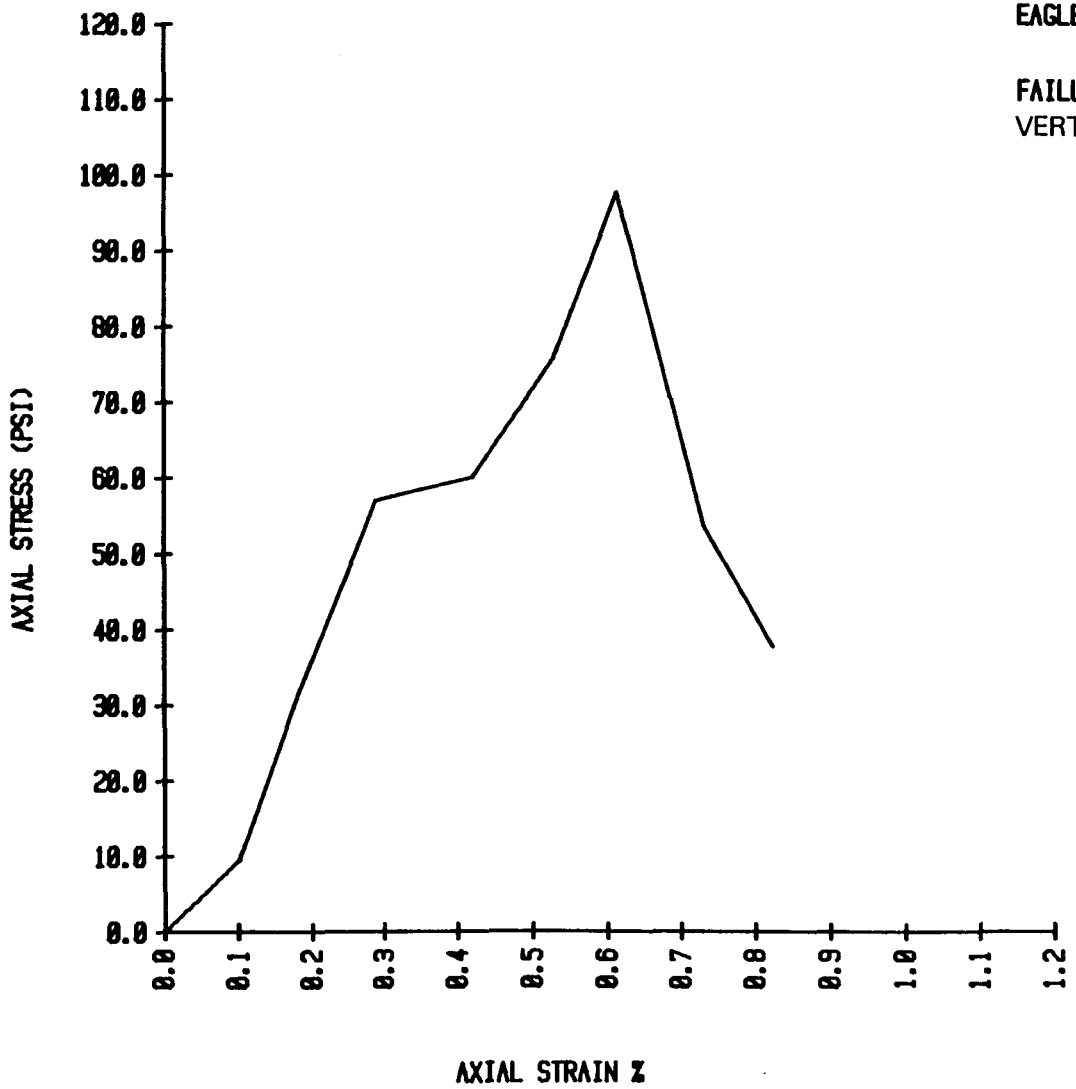
DATE: 9-24-89 | JOB # 5530.15

BORING #: BIR 22
BORING DEPTH: 288.0 FEET
INCLINATION: APPROX. 45 DEGREES
DRY UNIT WEIGHT (PCF) = 116.0
MOISTURE CONTENT % = 15.9
EAGLE FORD SHALE

FAILURE MODE : BEDDING PLANE SHEAR AT 45 DEG.
VERTICAL DEPTH: 209.9 FEET



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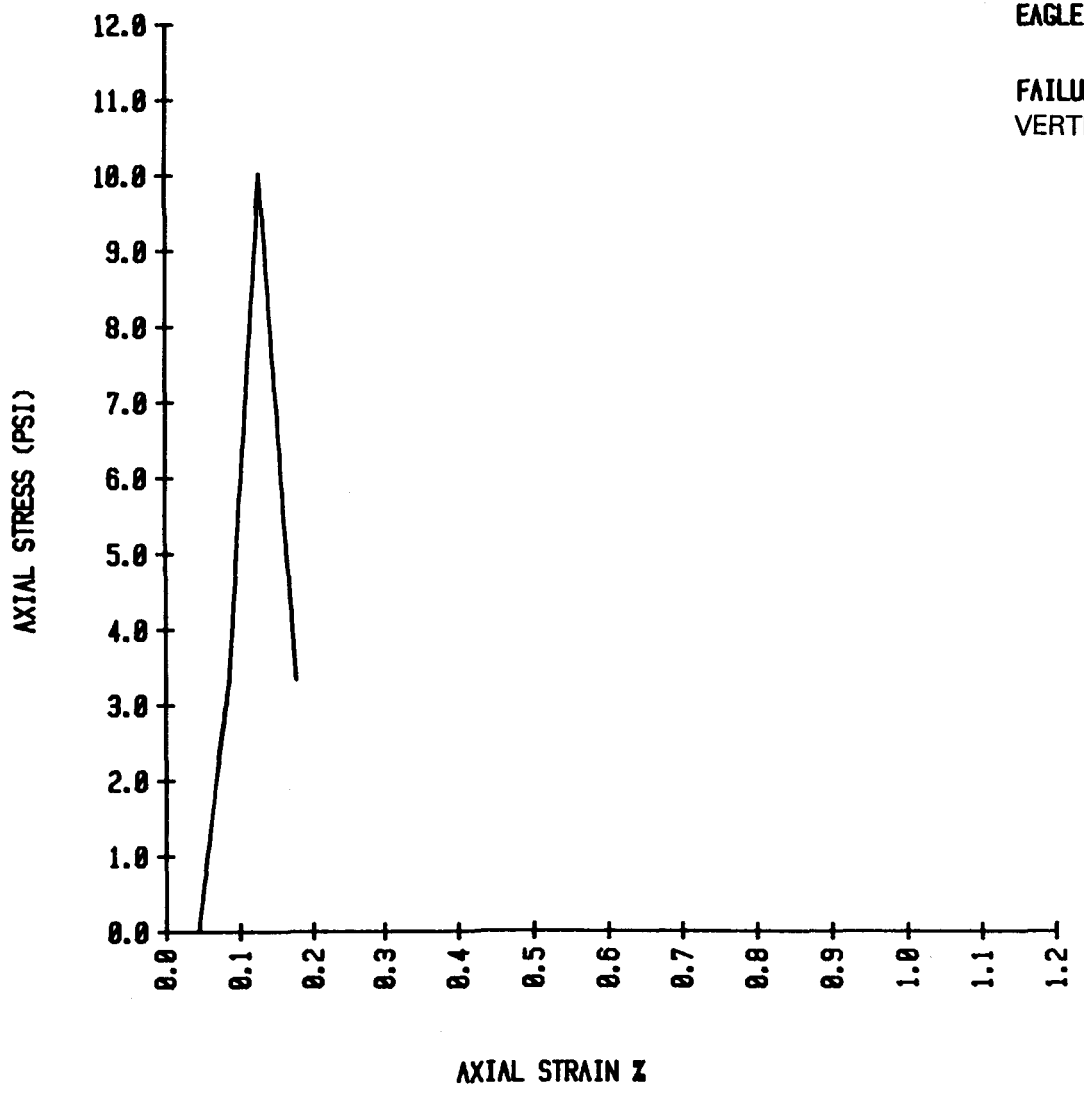
DATE: 9-20-89 | JOB # 5530.15

BORING #: BIR 22
BORING DEPTH: 308.2 FEET
INCLINATION: APPROX. 45 DEGREES
DRY UNIT WEIGHT (PCF) = 121.1
MOISTURE CONTENT % = 14.7
EAGLE FORD SHALE

FAILURE MODE : ON PRE-EXISTING SHEAR 20 DEG.
VERTICAL DEPTH: 224.7 FEET



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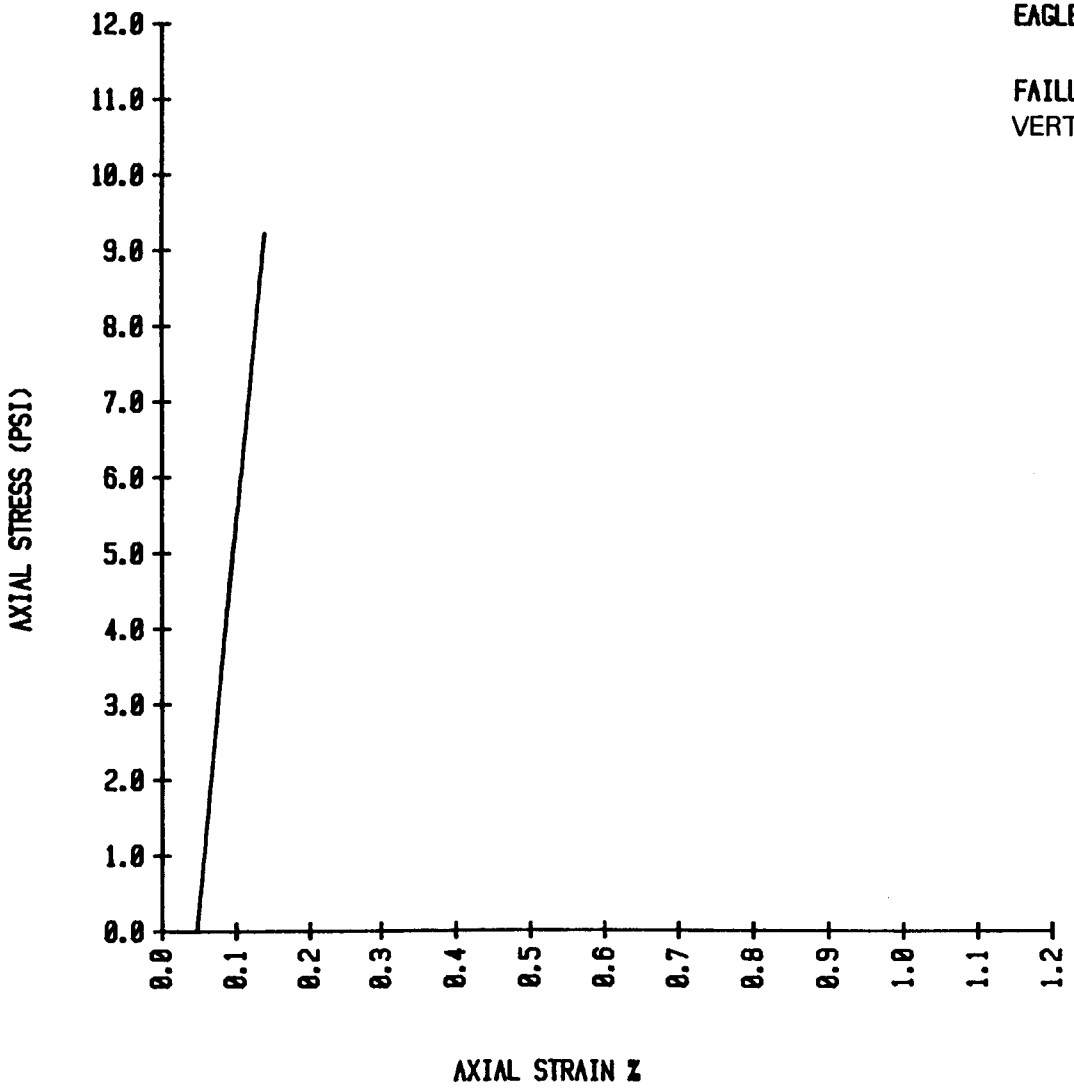
TEXAS SSC SITE

UNCONFINED COMPRESSIVE STRENGTH ASTM D-2938

DATE: 9-20-89 | JOB # 5530.15

BORING #: BIR 22
BORING DEPTH: 326.5 FEET
INCLINATION: APPROX. 45 DEGREES
DRY UNIT WEIGHT (PCF) = 104.6
MOISTURE CONTENT % = 15.4
EAGLE FORD SHALE

FAILURE MODE : BEDDING PLANE SHEAR AT 55DEG.
VERTICAL DEPTH: 238.0 FEET

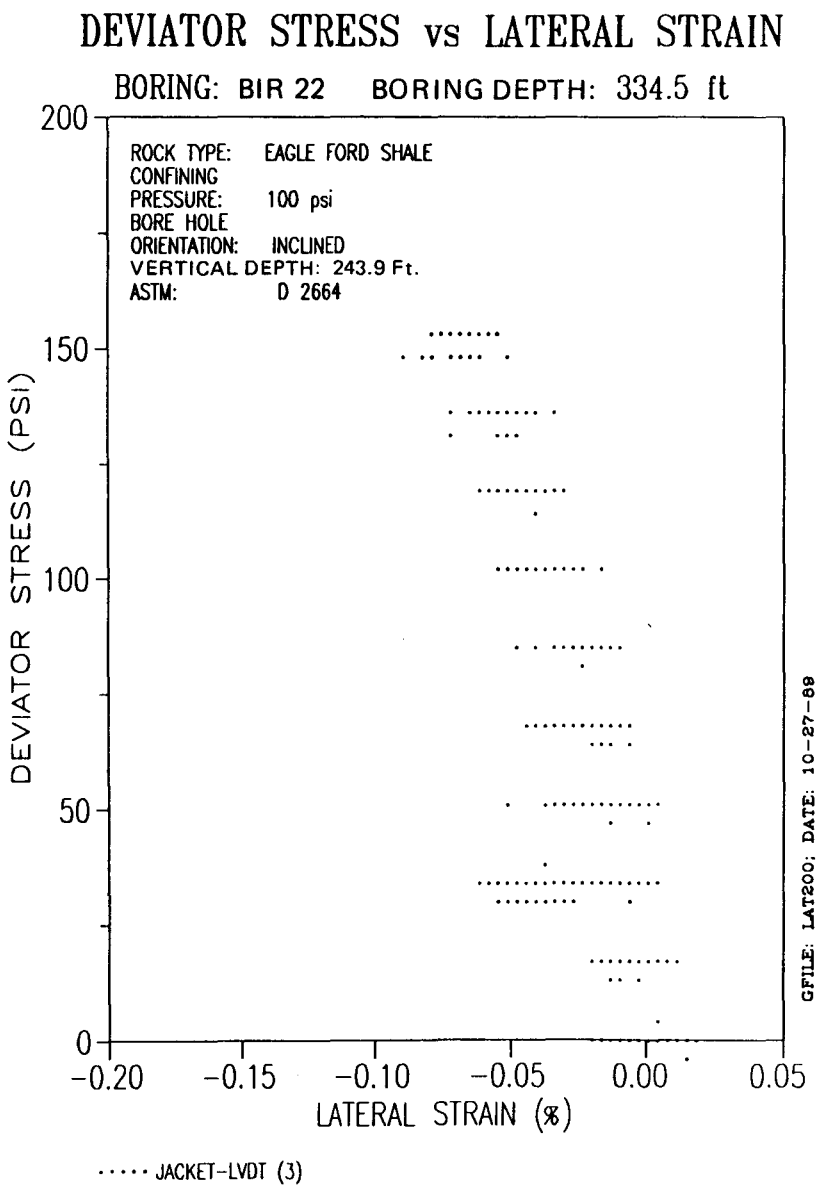


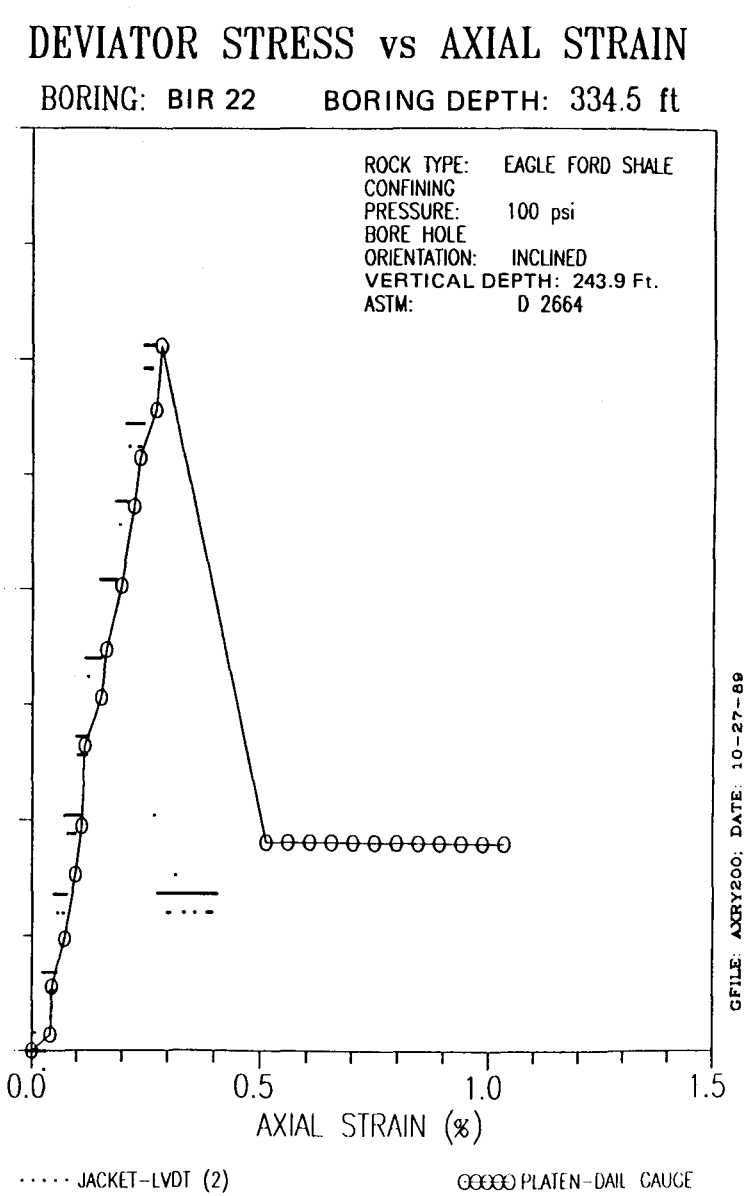
MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS
DALLAS, TEXAS

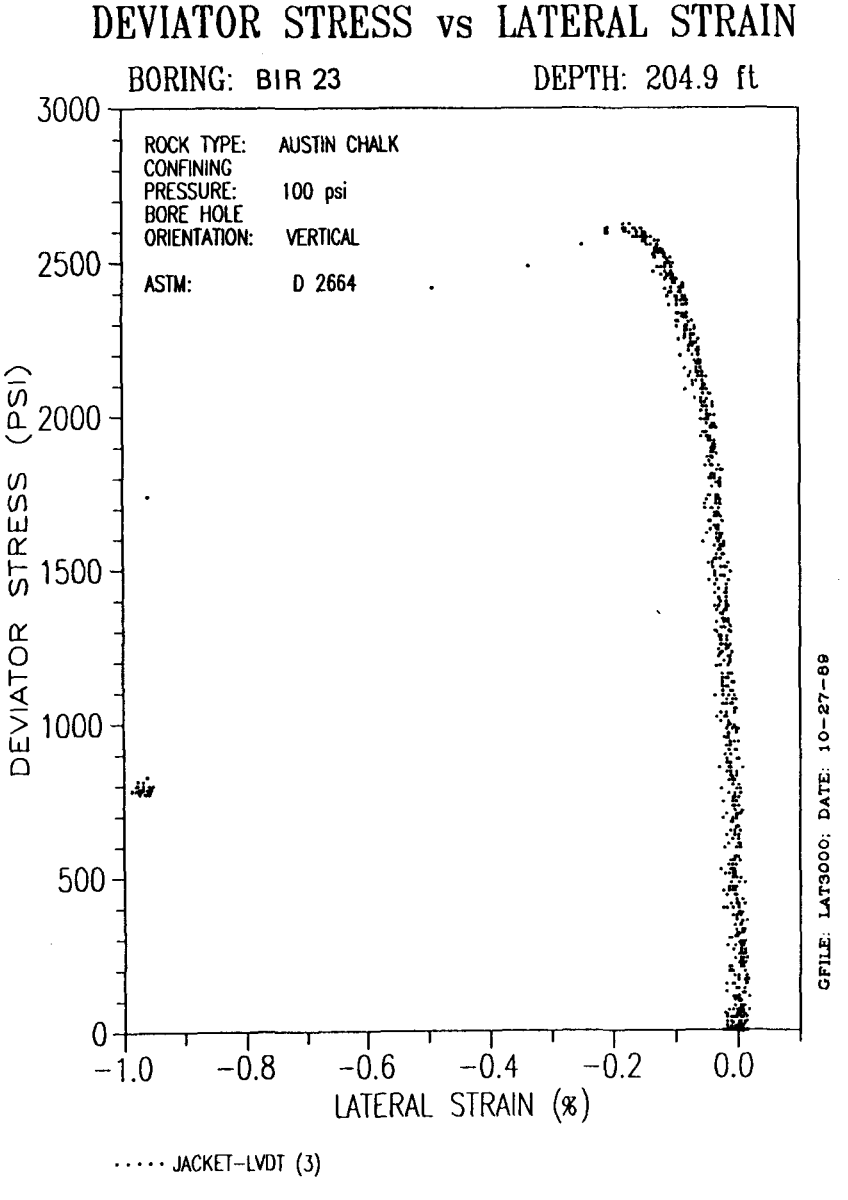
TEXAS SSC SITE

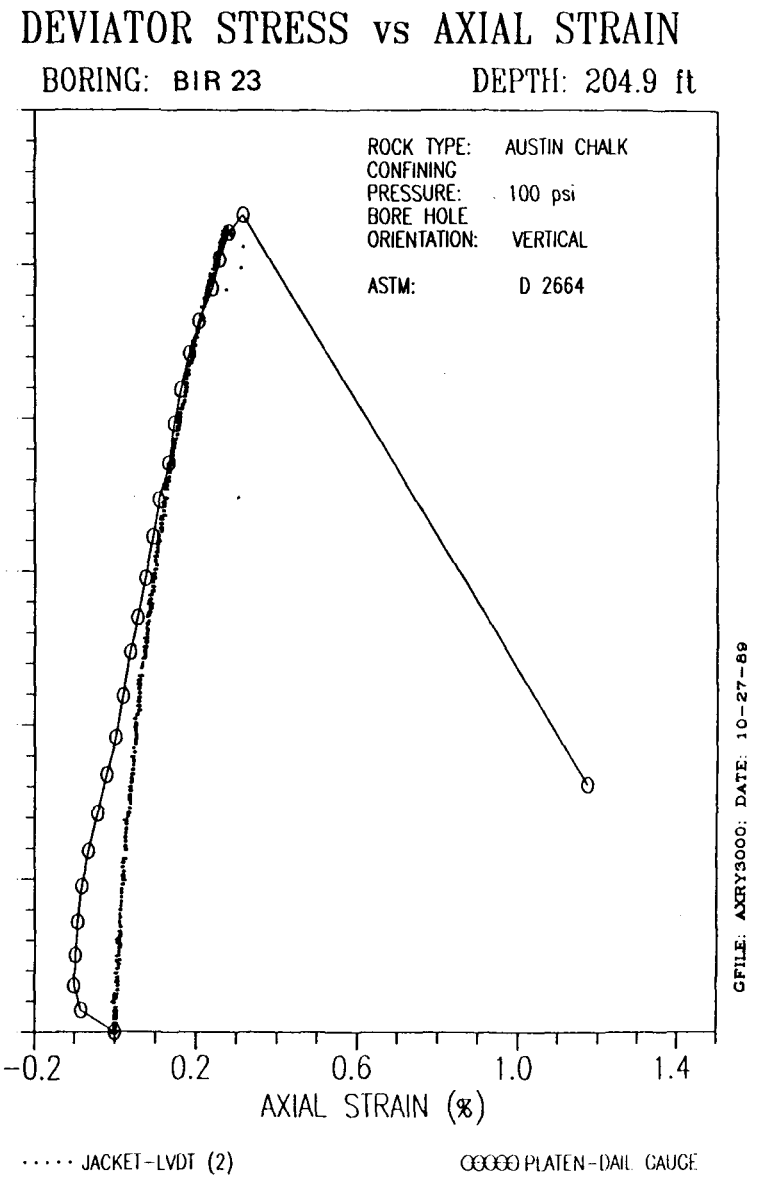
UNCONFINED COMPRESSIVE STRENGTH ASTM D-2938

DATE: 9-20-89 | JOB # 5530.15


DEVIATOR STRESS vs LATERAL STRAIN
BORING: BIR 22 BORING DEPTH: 334.5 ft
ROCK TYPE: EAGLE FORD SHALE
CONFINING PRESSURE: 100 psi
BORE HOLE ORIENTATION: INCLINED
VERTICAL DEPTH: 243.9 Ft.
ASTM: D 2664
DEVIATOR STRESS (PSI)
200
150
100
50
0
-0.20
-0.15
-0.10
-0.05
0.00
0.05
LATERAL STRAIN (%)
GFILE: LAT200; DATE: 10-27-89
..... JACKET-LVDT (3)

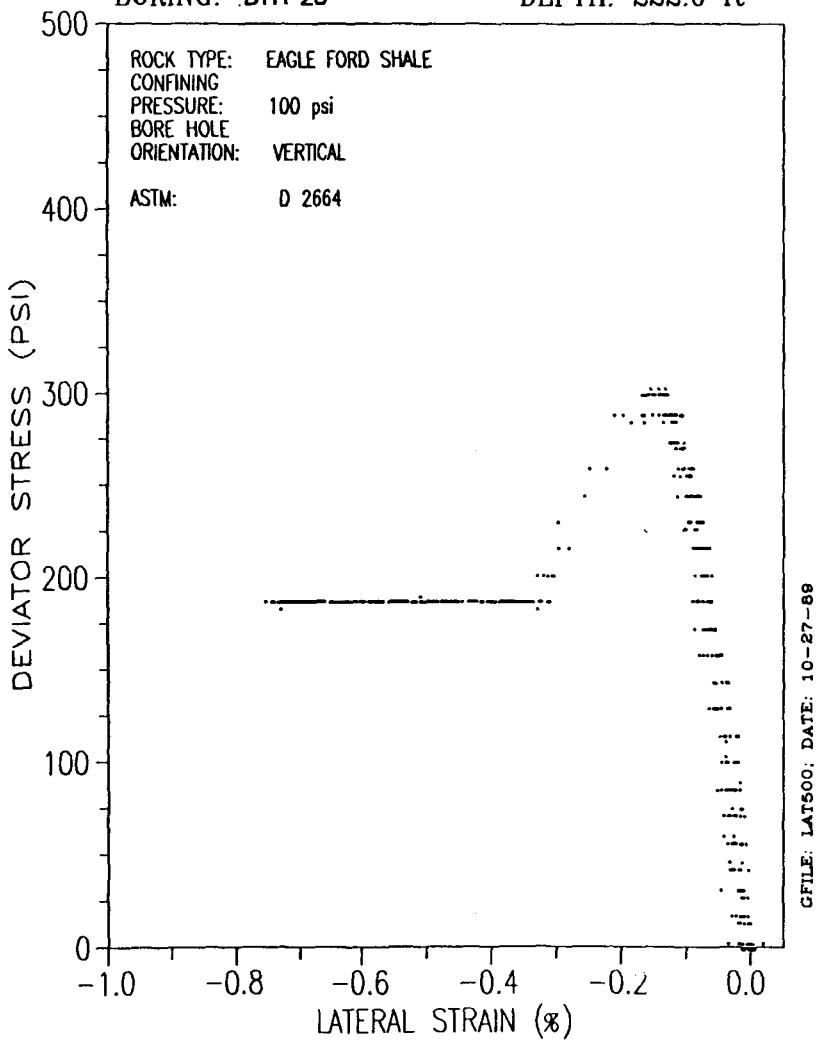

DEVIATOR STRESS vs AXIAL STRAIN
BORING: BIR 22 BORING DEPTH: 334.5 ft
ROCK TYPE: EAGLE FORD SHALE
CONFINING PRESSURE: 100 psi
BORE HOLE ORIENTATION: INCLINED
VERTICAL DEPTH: 243.9 Ft.
ASTM: D 2664
0.0
0.5
1.0
1.5
AXIAL STRAIN (%)
GFILE: AXRY200; DATE: 10-27-89
..... JACKET-LVDT (2)
OOOOO PLATEN-DAIL GAUGE


DEVIATOR STRESS vs LATERAL STRAIN
BORING: BIR 23
DEPTH: 204.9 ft
ROCK TYPE: AUSTIN CHALK
CONFINING PRESSURE: 100 psi
BORE HOLE ORIENTATION: VERTICAL
ASTM: D 2664
DEVIATOR STRESS (PSI)
3000
2500
2000
1500
1000
500
0
-1.0
-0.8
-0.6
-0.4
-0.2
0.0
LATERAL STRAIN (%)
GFILE: LAT3000; DATE: 10-27-89
····· JACKET-LVDT (3)


DEVIATOR STRESS vs AXIAL STRAIN
BORING: BIR 23
DEPTH: 204.9 ft
ROCK TYPE: AUSTIN CHALK
CONFINING PRESSURE: 100 psi
BORE HOLE ORIENTATION: VERTICAL
ASTM: D 2664
-0.2
0.2
0.6
1.0
1.4
AXIAL STRAIN (%)
GFILE: AXRY3000; DATE: 10-27-89
····· JACKET-LVDT (2)
ooooo PLATEN-DAIL GAUGE

DEVIATOR STRESS vs LATERAL STRAIN

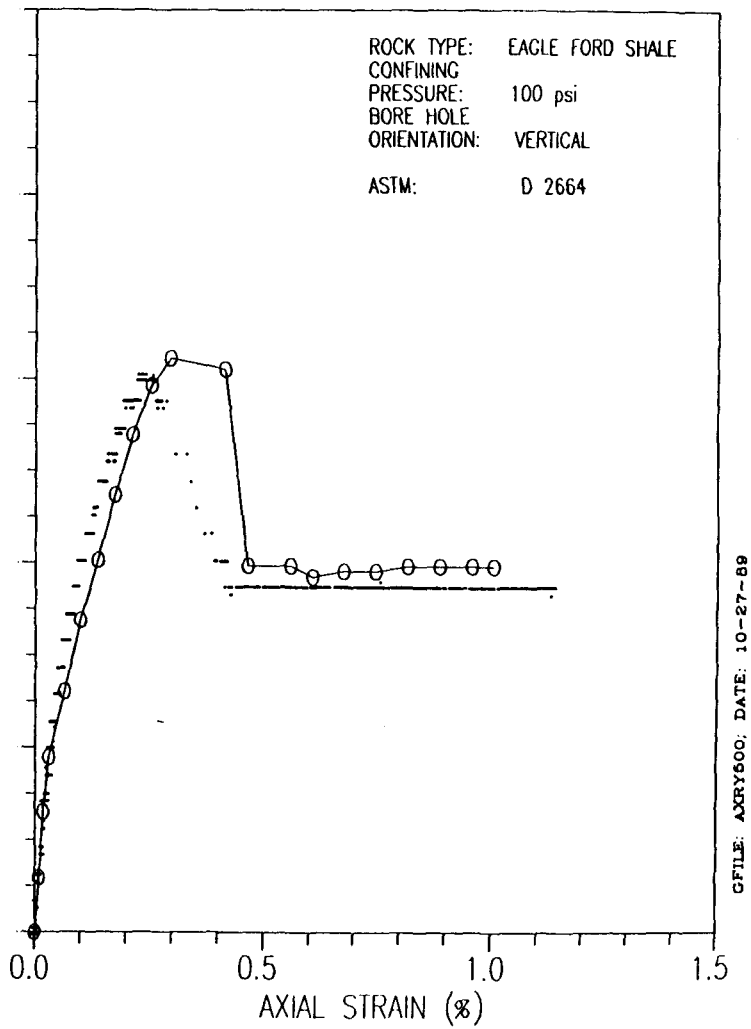
BORING: BIR 23 DEPTH: 222.0 ft



····· JACKET-LVDT (3)

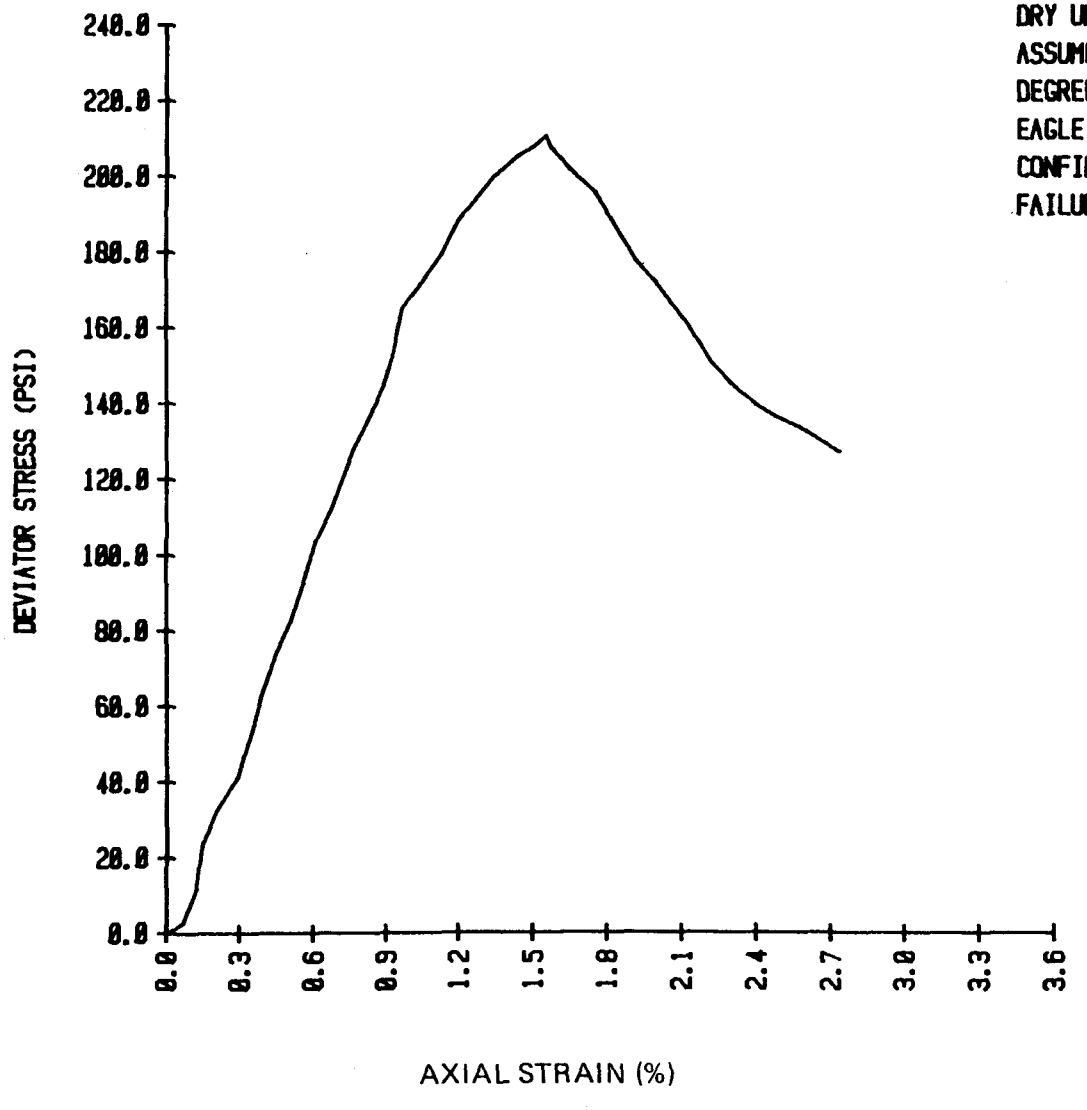
DEVIATOR STRESS vs AXIAL STRAIN

BORING: BIR 23 DEPTH: 222.0 ft



····· JACKET-LVDT (2) ○○○○○ PLATEN-DIAL GAUGE

BORING #: BIR 23
DEPTH: 236.4 FEET
INCLINATION : VERTICAL
MC TRIMMINGS, (%) = 17.2
MC AS TESTED (%) = 16.4
DRY UNIT WEIGHT (PCF) = 111.6
ASSUMED SPECIFIC GRAVITY, G_s = 2.7
DEGREE OF SATURATION, (%) = 87.2
EAGLE FORD SHALE
CONFINING PRESSURE PSI = 100
FAILURE MODE : SHEAR PLANE AT 40 DEG.



MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS
DALLAS, TEXAS

TEXAS SSC SITE
TRIAXIAL COMPRESSION ASTM D-2664

DATE: 9-25-89 | JOB # 5530.15

APPENDIX F

DOWNHOLE VELOCITY SURVEYS

APPENDIX F

Downhole seismic velocity surveys at boring BIR21 were completed between November 22 and 27, 1989. The survey objectives were to determine the in-situ compressional (P) and shear (S) wave velocity profiles of subsurface materials. Dynamic elastic moduli were estimated from interpreted velocities and densities obtained from laboratory analysis of boring samples.

Seismic waves were generated at the surface and recorded at a number of depths in the boring. Seismic waves were detected with a downhole package of three mutually perpendicular geophones (Mark Products model L-10-3WD, 28 Hz resonant frequency) with one geophone vertically oriented. Spring-loaded steel wedges were used to press the geophone package against the casing. The package diameter was increased with duct tape until a tight fit was obtained. The tape also minimized mechanical resonance of the spring.

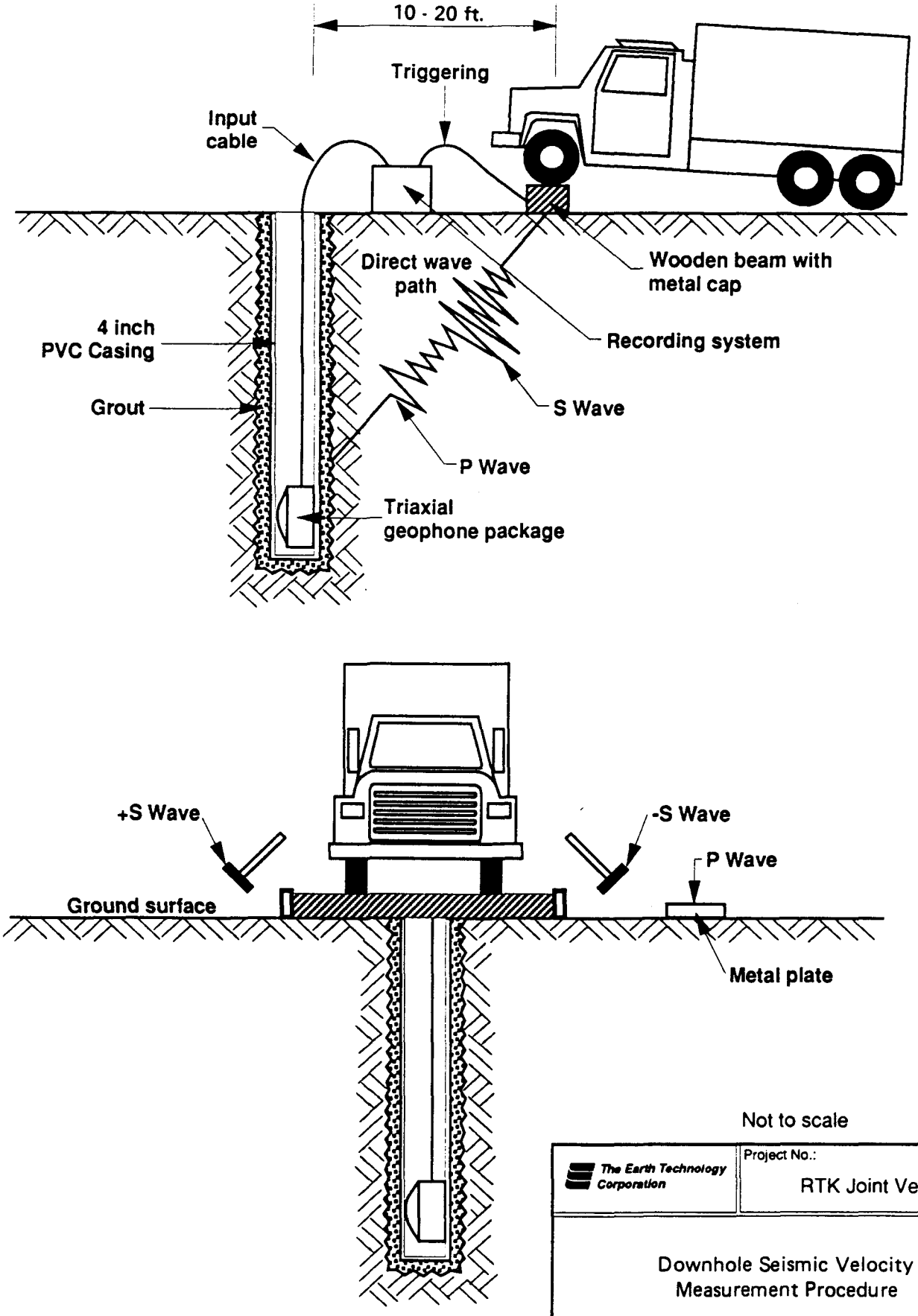
Geophone output signals were recorded with a twelve-channel, signal enhancement seismograph (EG&G Geometrics model ES-1210F, S/N 19186). The seismograph was triggered at the instant of energy generation by a transistor switch attached to the source. For a given measurement depth, waveforms from several impacts were stacked (added together) and the sum stored in memory. Often, stacking permits building a weak seismic waveform to a recognizable level even in 'noisy' environments. No filtering was used in recording the data. During acquisition, seismic waves were displayed on an oscilloscope. When the proper sequence of data traces was developed, a hard copy record was made with full-width timing lines (0.5 millisecond intervals). Travel times have an uncertainty of $\pm$0.25 milliseconds.

The layout for measuring seismic velocity is shown in Figure F-1. Measurement depths have an uncertainty of $\pm$ 0.1 foot. The quality of P and S wave arrivals was judged to be generally good to fair.

RESULTS

Downhole velocity survey results at boring BIR 21 (Figure F-2) agree well with conditions described by boring and wireline logs. Interpreted subsurface velocity zones are similar to those determined by the velocity survey at boring BIR 11 (482 feet to the north). Dynamic elastic moduli and Poisson's ratio were calculated using the equations listed in the following table. Densities were measured in the laboratory on boring samples. All P wave arrivals and the S wave arrivals to a depth of 150 feet were judged to have good to very good clarity. The S wave arrivals below 150 feet are of only fair quality and produce scatter on the data graph. No data were recorded within the screened interval, at depths of 202.5 to 222.5 feet. The interpreted velocities and moduli are thought to have an uncertainty of $\pm$ 10 percent.

The boring log describes surficial clayey overburden (1 foot thick) underlain by weathered Austin Chalk (3 feet thick). Seismic velocities were not determined for these thin layers. Austin Chalk was identified between depths of 3 and 210 feet. The average P velocity of the chalk as interpreted from full-wave sonic logging is 9,600 fps (feet/second). The downhole velocity survey identified a P velocity of 9,400 fps



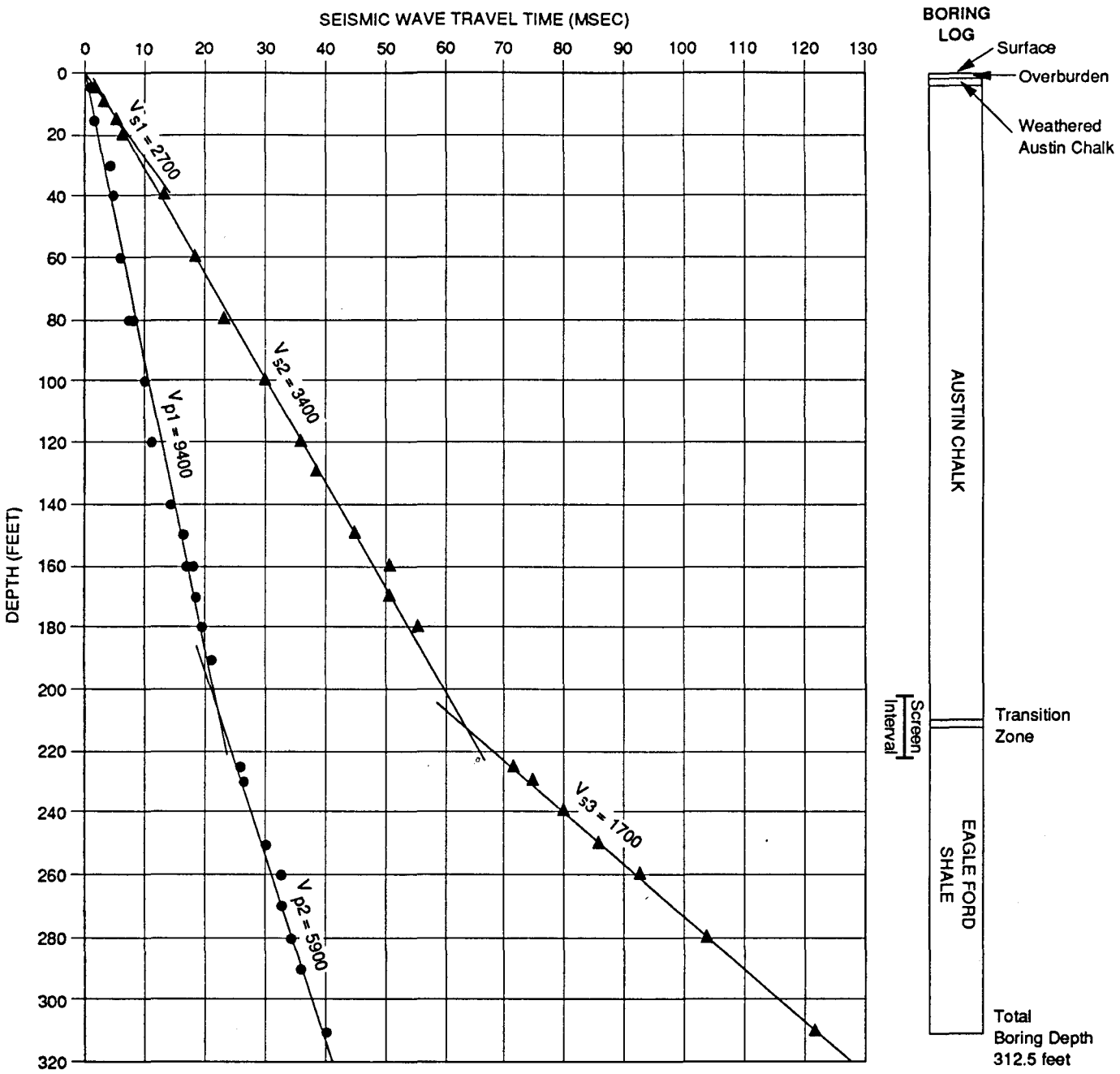
Not to scale

The Earth Technology Corporation	Project No.: 87-888-0015
	RTK Joint Venture

Downhole Seismic Velocity Measurement Procedure

12-89

Figure F-1



EXPLANATION

- ● P WAVE ARRIVAL TIMES
- ▲ S WAVE ARRIVAL TIMES

ENERGY SOURCE TO BORING DISTANCE IS 20 FEET
SEISMIC VELOCITIES IN FEET/SECOND

The Earth Technology Corporation

Project No. 87-888-0015

RTK Joint Venture

Boring BIR 21
Downhole Velocity Survey
Data and Interpreted Results

1-90

Figure F-2

(2 percent less than the sonic logging value) and two S wave velocity zones, 2,700 fps and 3,400 fps. The 25 percent increase in S velocity below a depth of 15 feet probably indicates the more competent fresh Austin Chalk. This S velocity change is the result of stiffness and density changes within the chalk; it is not a formation change because the P velocity is constant.

The boring log describes Eagle Ford Shale from depths of 213 to 312 feet (boring termination). The measured sonic logging P velocity for the shale is 6,500 fps. The downhole velocity survey identified a large P and S wave velocity inversion below an average interpreted depth of 206 feet (3 percent shallower than described in the boring log). Wave arrivals are relatively unaffected by the sand-packed boring annulus at and below the screened interval. The shale P velocity is 5,900 fps (9 percent less than the sonic logging value) and the S velocity is 1,700 fps. Both shale velocities are about 40 percent lower than velocities in the overlying chalk. All shale moduli are about one-third the corresponding chalk values.

SUMMARY OF SEISMIC VELOCITIES AND ELASTIC MODULI FOR BORING BIR21

Depth (ft)	Vp (fps)	Vs (fps)	Average Bulk Density (pcf)	Poisson's Ratio*	Shear Modulus* ($x10^5$ psi)	Constrained Modulus* ($x10^5$ psi)	Young's Modulus* ($x10^5$ psi)	Bulk Modulus* ($x10^5$ psi)
0-15	9400	2700	139.6	0.46	2.20	26.59	6.40	23.71
15-206	9400	3400	139.6	0.43	3.49	26.59	9.93	22.00
206-310	5900	1700	137.5	0.46	0.86	10.32	2.50	9.19

* Equations used to calculate Poisson's ratio and dynamic elastic moduli are listed below.

Poisson's Ratio, u (dimensionless) $u = \frac{Vp^2 - 2Vs^2}{2(Vp^2 - Vs^2)}$

Shear Modulus, G (psi) $G = CDVs^2$

Constrained Modulus, M (psi) $M = CDVp^2$

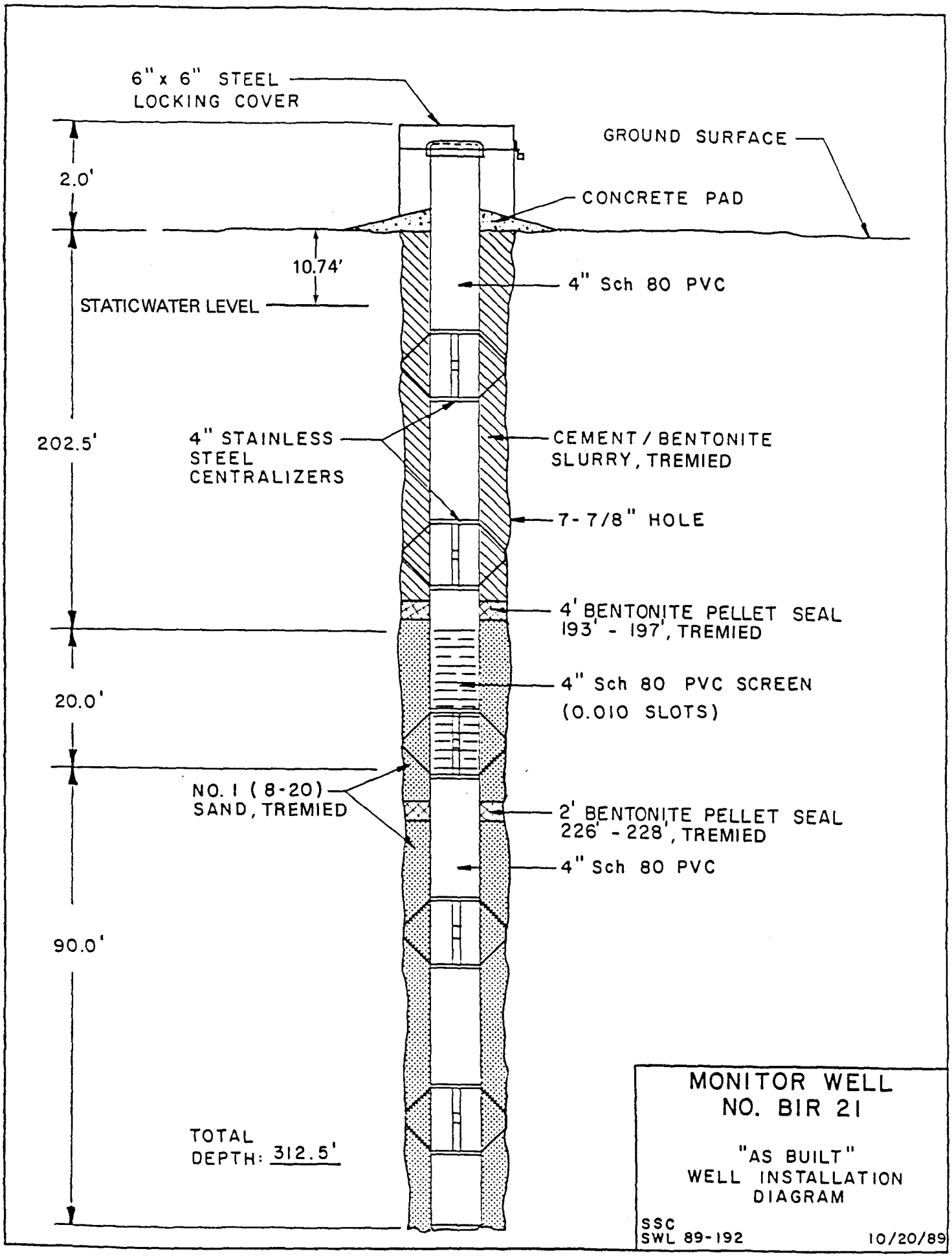
Young's Modulus, E (psi) $E = 2G(1 + u)$

Bulk Modulus, K (psi) $K = CD(Vp^2 - 4/3Vs^2)$

where: Vp = P wave velocity (fps)
Vs = S wave velocity (fps)
D = Bulk (wet) density (pcf)
C = 2.156×10^{-4} (units conversion)

APPENDIX G

WELL CONSTRUCTION AND ABANDONMENT



MONITOR WELL NO. BIR 21

"AS BUILT" WELL INSTALLATION DIAGRAM

SSC
SWL 89-192

10/20/89

SSC BOREHOLE PLUGGING REPORT

TETC Project No. 87-888-0015

Task No. 15

Boring No. BIR-22

Texas Coordinate Location: N 238,494 feet E 2,175,935 feet

Surface Elevation: 658.4 feet

Total Boring Depth: 357.0 feet

Plugging Remarks:

Utilized grout with 10 to 1 ratio of water to cement and added one shovel of bentonite drilling mud to each two sacks of cement. Grout placed through PVC tremie pipe. All surface casing removed from borehole. Soil backfill placed in upper 2 feet.

Date Plugged: 9-21-89

Time Completed: 2:00 pm

Drilling Geologist: Jim Sansom

MJA Coordinator: W. D. Flanigan

MJA No.: 5530.15

SSC BOREHOLE PLUGGING REPORT

Project No. 87-88-0017

Task No. 15

Boring No. BIR 23

Texas Coordination Location: N 238,320 feet E 2,175,840 feet

Surface Elevation: 659.9 feet

Total Boring Depth: 241.0 feet

Date Drilled: 9/15-9/19/89

Date Plugged: 9/20/89

Time Completed: 12:30 P.M.

Remarks:

Grout mixture was placed with PVC tremie pipe.

283 gallons of grout was used to completely cement boring from bottom to top. Water/cement ratio was approximately 7 gallons per sack.

Drilling geologist: Mike Granger
Coordinator: Bruce Bailey
SwL Report No. 89-192