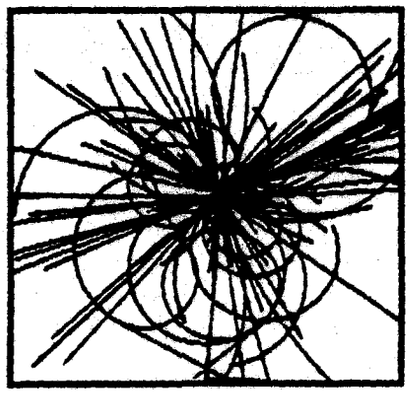
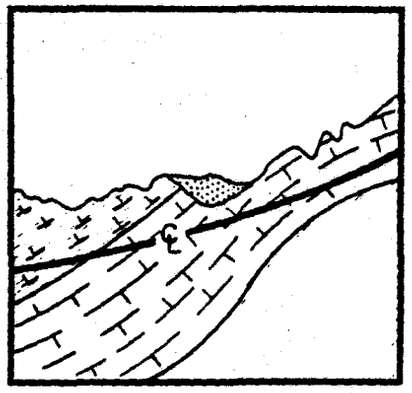
SSCL-SR-1070

SSCL-SR-1070
Project No. 87-888-0015
December 1989
GR-10

Data Report for Structure Study Zone SE 10.9 and Coreholes BE 10.9, SE 10.9A, and SE 10.8





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 (the present phase)
- Global data (planned)
- Structure-specific data (planned).

The primary purpose of the present footprint location phase is to quickly assess whether individual components of the collider footprint, or the entire footprint, need to be relocated because of geotechnical constraints. Accordingly, the following areas have been assessed:

- Areas on the western side of the footprint where the geologic structure brings the Eagle Ford Shale close to the depth of the tunnel and experimental halls, thus presenting potential constraints due to weak, deformable rock.
- Areas where the tunnel placement is shallow and/or there are nearby sources of vibration such as major highways and railroads that may represent a problem due to unacceptable vibrations at tunnel depth.
- Zones of potentially poor rock quality and high water inflow in the rock that should be avoided for the experimental hall excavations.

This is one in a series of data reports prepared for the footprint phase of geotechnical characterization at the SSC site. Each data report includes the results of both field and laboratory tests for a specific drilling and sampling site. Interpretations of these data will be covered in topical reports, including three planned reports, as follows:

- Train- , traffic-, and quarry-caused vibrations
- Geomechanical properties of the Eagle Ford Shale
- Structure and stratigraphy of the near-cluster.

Future planned program phases--global and structure-specific data collection--will concentrate on (1) evaluating ring areas where few geotechnical data are currently available and (2) conducting more detailed studies at the sites of the injector and experimental halls.

DATA REPORT

Site Designators: SE10.9, BE10.9, SE10.9A, and SE10.8

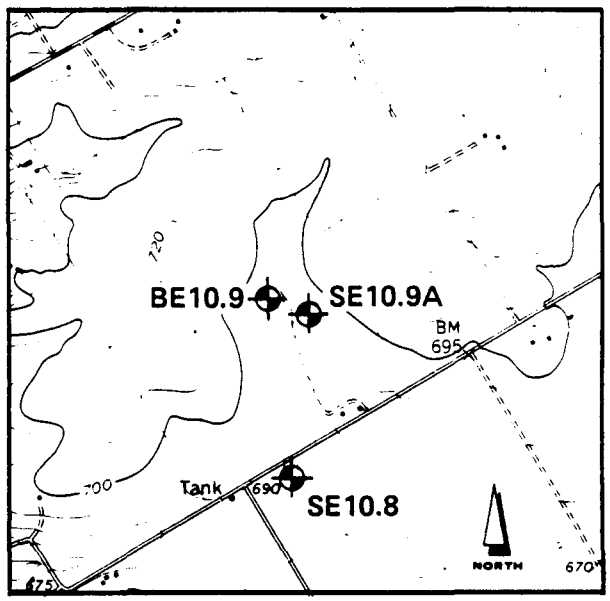
Objective: To determine the existence and constrain the locations of geologic structures based on geologic mapping. To assess the elevation of the top of the Eagle Ford Shale based on stratigraphic correlations between coreholes (determined by evaluations of the rock core and wire-line logs).

Hole No. BE10.9
Location: North 242,387 feet
East 2,174,878 feet
Surface Elevation 689.3 feet

Hole No. SE10.9A
Location: North 242,170 feet
East 2,175,210 feet
Surface Elevation 685.8 feet

Hole No. SE10.8
Location: North 240,750 feet
East 2,174,960 feet
Surface Elevation 678.6 feet

BE10.9, SE10.9A, and SE10.8 are located approximately 1 mile north of Boz, Texas, where the western side of the SSC tunnel alignment is proposed.



SCALE 1:24,000

1000 0 1000 2000 3000 FEET

CONTOUR INTERVAL 10 FEET

Scope and Schedule:	**Geologic Mapping**	July 24 to 29, 1989
BE10.9:	**Rotary Wash Drilling**	July 24 to 25, 1989
	Wire-line Logging	July 25, 1989
	Plugging and Abandonment	July 26, 1989
SE10.9A:	**Rotary Wash and Core Drilling**	July 26 to 27, 1989
	Wire-line Logging	July 27, 1989
	Laboratory Testing	July 27 and 28, 1989
	Plugging and Abandonment	July 28, 1989
SE10.8:	**Rotary Wash and Core Drilling**	July 28 to 29, 1989
	Wire-line Logging	July 29, 1989
	Plugging and Abandonment	July 31, 1989

Geologic Mapping: A northeast-trending lineament on the aerial photograph, coincident with the drainage, was ground checked by mapping outcropping bedrock. A fault trending N28°E was mapped along the drainage. Calcite-filled veins and highly fractured and sheared zones were also found. (see Structure Zone Map, Appendix A)

<u>Hole No. BE10.9</u>
Conditions Encountered:

Total Hole Depth 241.0 feet

Soil 0.0 to 6.5 feet

Austin Chalk 6.5 to 191.0 feet

Eagle Ford Shale 191.0 to 241.0 feet
(see lithologic log, Appendix B)

BE10.9 penetrated a calcite-filled normal fault (18 feet of down-drop to the southeast) at 88 feet. The 20-foot interval above the fault is highly weathered, and capable of taking water at a rate of 10 to 15 gallons per minute. The water level in the hole continually subsided to 13 feet below ground surface, suggesting connection to nearby surface drainages.

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

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

Hole Status: Cemented in and abandoned.
(see plugging report, Appendix D)

<u>Hole No. SE10.9A</u>
Conditions Encountered:

Total Hole Depth 254.0 feet

Soil 0.0 to 4.0 feet

Austin Chalk 4.0 to 219.0 feet

Eagle Ford Shale 219.0 to 254.0 feet
(see lithologic log, Appendix B)

Elevations of correlative strata in SE10.9A and SE10.8, when compared with elevations in borings BE10.9 and BK1' (drilled previously), suggest that the area of SE10.9A and SE10.8 is dragged by the down-to-the-southeast normal fault identified in structure zone SE10.9.

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

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

Hole Status: Cemented in and abandoned.
(see plugging report, Appendix D)

Hole No. SE10.8
Conditions Encountered:

Total Hole Depth 246.0 feet

Soil 0.0 to 0.5 feet

Austin Chalk 0.5 to 211.0 feet

Eagle Ford Shale 211.0 to 246.0 feet
(see lithologic log, Appendix B)

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

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

TABLE 1. GEOMECHANICAL TEST RESULTS - COREHOLE BE10.9

Lithology	Depth	Moisture Content	Dry Density	Sample Dimension Ratio L/D	Unconfined Compressive Strength	Failure Strain	Brazil Tensile Strength
	feet	percent	pcf		psi	Percent	psi
Austin Chalk Limestone	213.8			2.3	3790	1.7	
Austin Chalk Limestone	218.1	12.3	122.3				
Austin Chalk Limestone	218.4						221
Eagle Ford Shale	237.0	16.2	117.0				
Eagle Ford Shale	247.6	16.0	118.9				
Eagle Ford Shale	247.7			2.3	340	0.6	
Procedure		ASTM-D2216			ASTM-D2938		ISRM

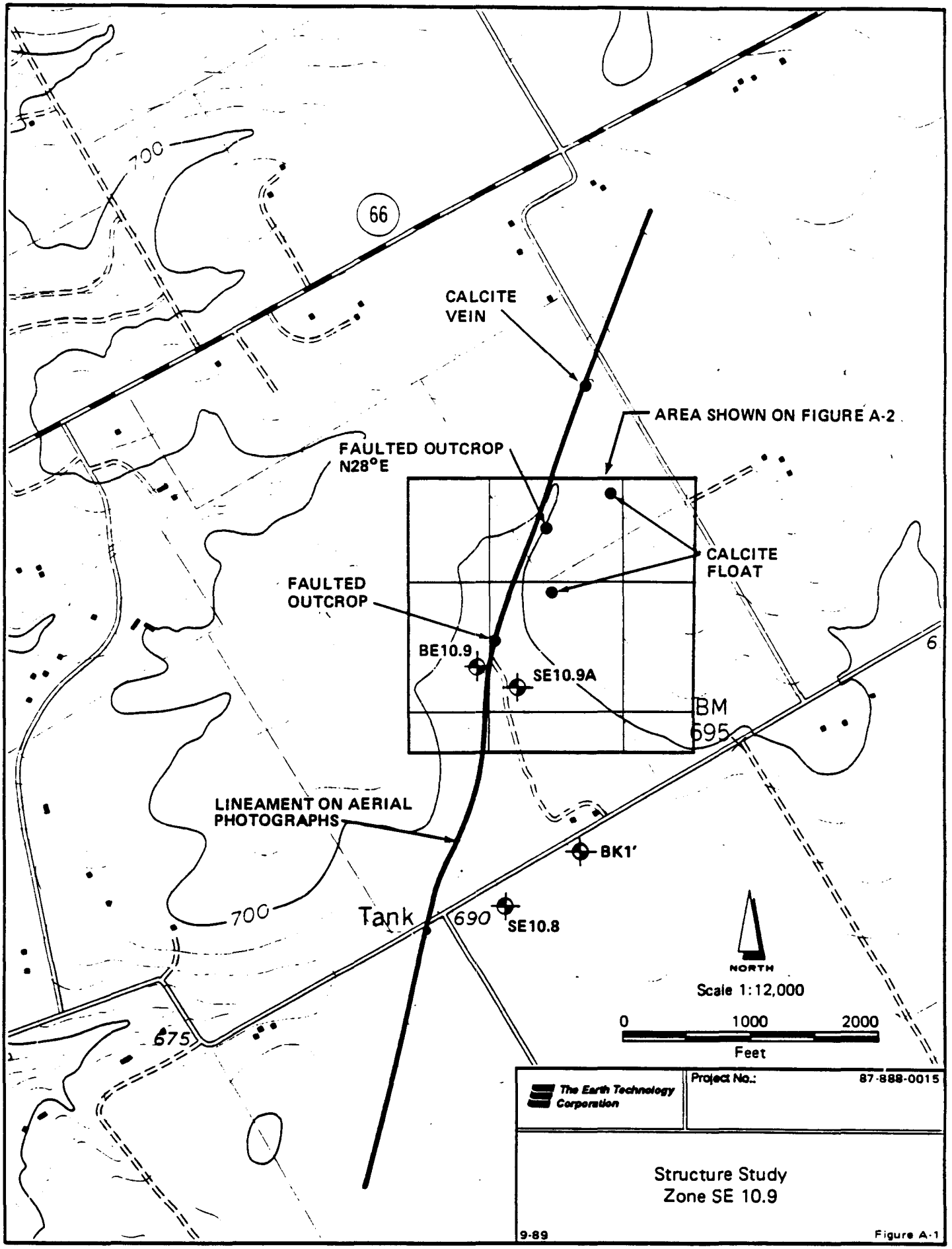
APPENDIX A

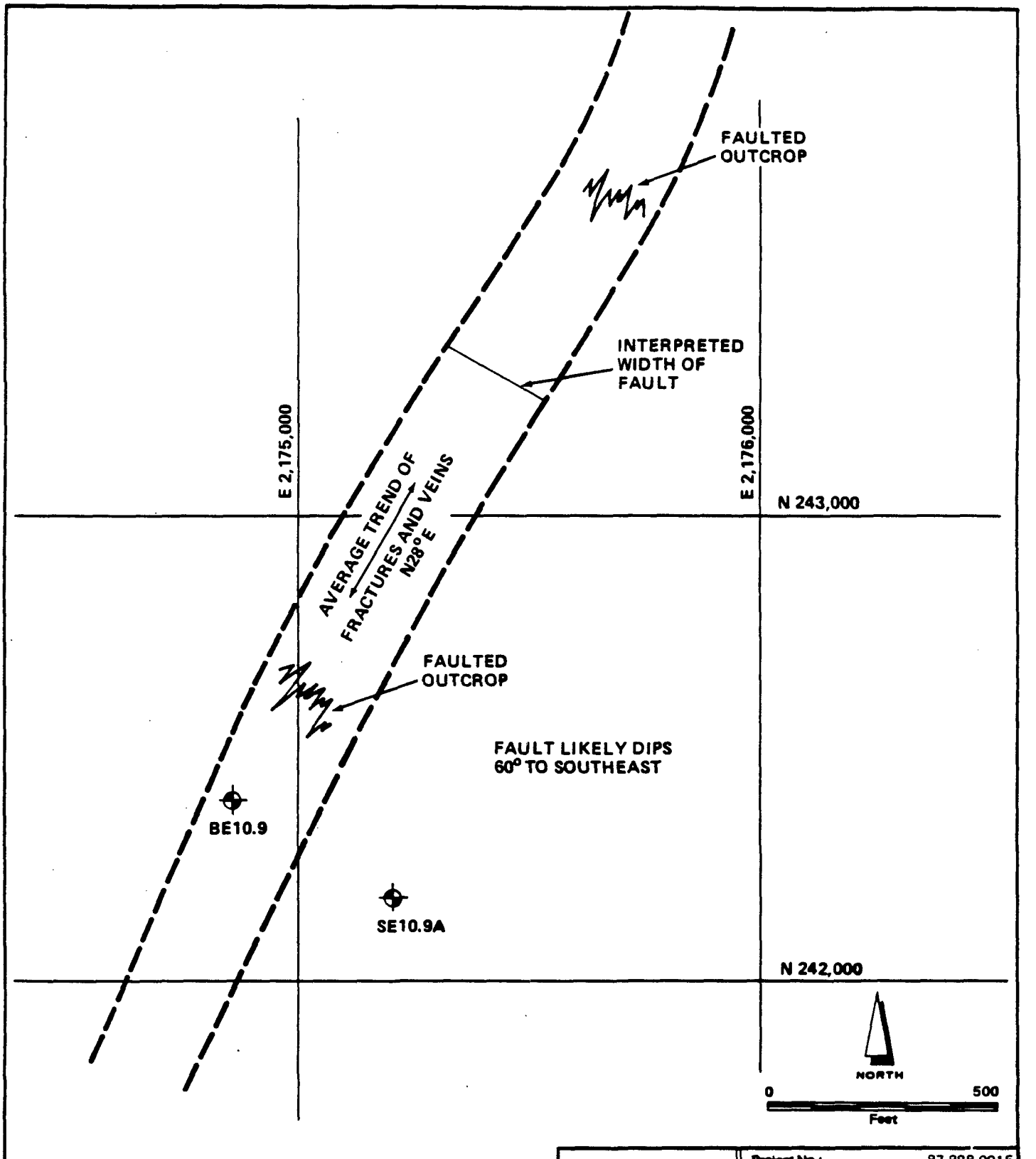
STRUCTURE ZONE MAP

STRUCTURE STUDY ZONE SE 10.9

STRUCTURE ZONE SE10.9

- **Surface expression:** 8,000 ft-long aerial photograph lineament comprising aligned drainage segments and tonal linears; calcite mineralization noted in float (see Figure A-1).
- **Trend:** N20-25°E
- **Width:** based on mapping of outcrops, the fault appears to be a zone of shears, faults, and closely-spaced fractures about 300 feet wide (see Figure A-2).
- **Faults in outcrop:** faults are generally calcite filled, with slickensides and have an average trend of N27°E. The faults comprise a broad zone of close-fractured, locally sheared and weathered chalk.
- **Slickensides and mineralization:** frequent polyphase calcite mineralization; slickensides are dip-slip.
- **Fracturing:** fractures have an average strike of N29°E and are subvertical. Fracture spacings average 10 inches.
- **Offset in borings:** Boring BE10.9 encountered a normal fault, resulting in shortening of the lower Austin Chalk section by 18 feet. Chalk 20 feet above the calcite-filled fault plane is highly weathered, as in outcrops of the fault zone nearby. BE10.9 is interpreted to be within the fault zone. Borings SE10.9A and SE10.8, to the southeast of the fault, encountered Austin Chalk and Eagle Ford Shale strata at elevations that suggest another 15 to 25 feet of down-drop to the southeast (compared with elevations in prior boring BK1'). The overall structure is a down-to-the-southeast normal fault with drag in the downdropped block.


700
66
CALCITE
VEIN
AREA SHOWN ON FIGURE A-2
FAULTED OUTCROP
N28°E
CALCITE
FLOAT
FAULTED
OUTCROP
BE10.9
SE10.9A
BM
695
6
LINEAMENT ON AERIAL
PHOTOGRAPHS
BK1'
700
Tank
690
SE10.8
675
NORTH
Scale 1:12,000
0
1000
2000
Feet
The Earth Technology Corporation
Project No.:
87-888-0015
Structure Study
Zone SE 10.9
9-89
Figure A-1



The Earth Technology Corporation

Project No.: 87-888-0015

Interpreted Location of Fault SE10.9

9-89

Figure A-2

APPENDIX B

LITHOLOGIC LOGS

LOG OF BORING

PROJECT: TEXAS SSC PROJECT

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BE 10.9 PG 1 OF 6

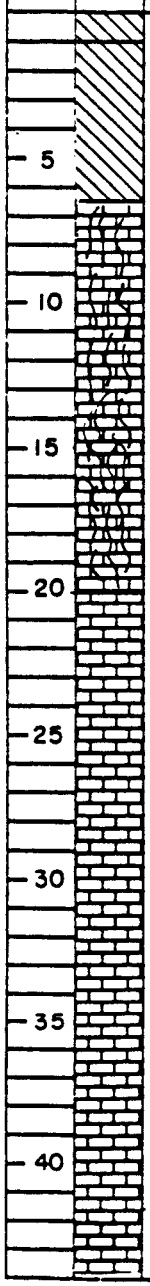
LOCATION: N 242,387 feet
E 2,174,878 feet

GROUND EL: 689.3 feet

DATE: 7/24-25/89 TYPE: Air/Water Rotary CASED TO: 10.0' CONTRACTOR: SWL (89-192)

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.	SAMPLE LEGEND	WATER INFORMATION
									S= SPLIT SPOON T= 2" THIN WALL TUBE U= 3" THIN WALL TUBE C= NX ROCK CORE	Drilled with Air Rotary to 10.0', no seepage encountered, switched to Water Rotary at 10.0', began coring below 122.0' (lost circulation below 68.0')

DESCRIPTION OF STRATUM



1.0 CLAY, traces of roots, dark brown

CLAY, embedded fine gravel, tan and brown

6.5

LIMESTONE (Austin Chalk), soft, severely weathered, occasional clay layers, tan

20.0

LIMESTONE (Austin Chalk), medium, fresh, occasional shaly limestone layers, light gray to dark gray

-shale seams at 30.0'

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC PROJECT

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BE 10.9PG 2 OF 6

LOCATION: N 242,387 feet
E 2,174,878 feet

GROUND EL: 689.3 feet

DATE: 7/24-25/89 TYPE: Air/Water Rotary CASED TO: 10.0' CONTRACTOR: SWL (89-192)

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.	SAMPLE LEGEND	WATER INFORMATION
									S= SPLIT SPOON T= 2" THIN WALL TUBE U= 3" THIN WALL TUBE C= NX ROCK CORE	See p. 1 of 6

DESCRIPTION OF STRATUM

45
50
55
60
65
70
75
80

LIMESTONE (Austin Chalk), medium, fresh, occasional shaly limestone layers, light gray to dark gray

-fossiliferous at 45'

-¼" calcite seams at 55'

68.0

LIMESTONE (Austin Chalk), soft, severely weathered, occasional calcite and clay layers, tan

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC PROJECT

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BE 10.9 PG 3 OF 6

LOCATION: N 242,387 feet
E 2,174,878 feet

GROUND EL: 689.3 feet

DATE: 7/24/89 TYPE: Nx Core CASED TO: 10.0' 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
85										LIMESTONE (Austin Chalk), soft, severely weathered, occasional calcite and clay layers, tan
										88.0
90										SHALY LIMESTONE (Austin Chalk), medium to moderately hard, fresh, occasional chalky limestone layers, dark gray to light gray
95										
100										
105										
110										
115										
120										
										120.0
			122.0							LIMESTONE (Austin Chalk), medium, fresh, sound, occasional shaly limestone layers, light gray to dark gray -shaly limestone, dark gray at 122.5'-123.5'

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC PROJECT

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BE 10.9 PG 4 OF 6

LOCATION: N 242,387 feet
E 2,174,878 feet

GROUND EL: 689.3 feet

DATE: 7/24-25/89 TYPE: Nx Core CASED TO: 10.0' 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
125		C1		127.5	100	100				LIMESTONE (Austin Chalk), medium, fresh, sound, occasional shaly limestone layers, light gray to dark gray -¼" calcite seam at 125.0' -shaly limestone, dark gray at 126.25'-127.0'
130										
135										
140										
145										
150										
155										
160										

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC PROJECT

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BE 10.9 PG 5 OF 6

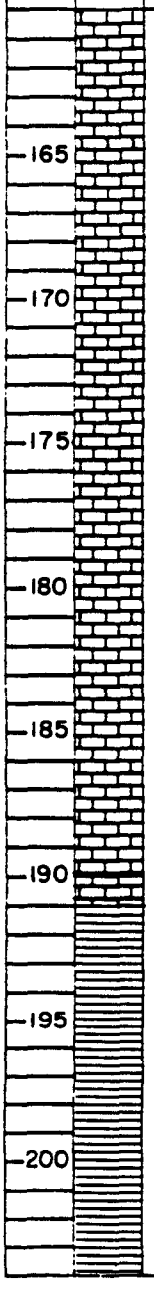
LOCATION: N 242,387 feet
E 2,174,878 feet

GROUND EL: 689.3 feet

DATE: 7/24-25/89 TYPE: Air/Water Rotary CASED TO: 10.0' CONTRACTOR: SWL (89-192)

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.	SAMPLE LEGEND	WATER INFORMATION
									S= SPLIT SPOON T= 2" THIN WALL TUBE U= 3" THIN WALL TUBE C= NX ROCK CORE	See p. 1 of 6

DESCRIPTION OF STRATUM



LIMESTONE (Austin Chalk), medium, fresh, occasional shaly limestone layers, light gray to dark gray

-pyrite nodule below 165.0'

190.0

191.0 SHALY LIMESTONE (transition), medium fresh, extremely argillaceous, abundant fossil fragments, dark gray

SHALE (Eagle Ford), medium, fresh, fissile, occasional thin carbonate layers, dark gray

-chalky limestone layer at 202.5'-203.5'

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC PROJECT

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BE 10.9 PG 6 OF 6

LOCATION: N 242,387 feet
E 2,174,878 feet

GROUND EL: 689.3 feet

DATE: 7/24-25/89 TYPE: Air/Water Rotary CASED TO: 10.0' CONTRACTOR: SWL (89-192)

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), medium, fresh, fissile, occasional thin carbonate layers, dark gray
205										
210										
215										
220										
225										
230										
235										-chalky limestone layer at 238.5' to 239.0'
240										
										Bottom of Exploration at 241.0' NOTE: Boring grouted upon completion

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

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.9 PG 1 OF 7

LOCATION: N 242,170 feet
E 2,175,210 feet

GROUND EL: 685.8 feet

DATE: 7/26-27/89 TYPE: Air/Water Rotary CASED TO: 5.0 CONTRACTOR: SwL (89-192)

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
									CLAY, silty, trace of roots, dark brown
									3.5 / 4.0 CLAY, silty, tan and brown
5									LIMESTONE (Austin Chalk), soft, moderately weathered, occasional clay layers, tan and gray
									8.0
10									LIMESTONE (Austin Chalk), moderately hard, fresh, moderately argillaceous, slightly fossiliferous, light gray to dark gray
15									
20									
25									
30									
35									-shaly limestone parting, dark gray at 35.0'
40									

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 5.0', no seepage encountered, drilled with fluid injection to 160.0', switched to Water Rotary and began coring below 160.0'

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.9 PG 2 OF 7

LOCATION: N 242,170 feet
E 2,175,210 feet

GROUND EL: 685.8 feet

DATE: 7/26-27/89 TYPE: Air/Water Rotary CASED TO: 5.0 CONTRACTOR: SwL (89-192)

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), moderately hard, fresh, moderately argillaceous, slightly fossiliferous, light gray to dark gray
45									
50									
55									-shaly limestone parting, dark gray at 55.0'
60									
65									
70									
75									
80									-shaly limestone, dark gray at 80.0'-85.0'

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 7

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO. SE 10.9APG 3 OF 7

LOCATION: N 242,170 feet
E 2,175,210 feet

GROUND EL: 685.8 feet

DATE: 7/26-27/89 TYPE: Air/Water Rotary CASED TO: 5.0 CONTRACTOR: SwL (89-192)

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.	SAMPLE LEGEND	WATER INFORMATION
									S= SPLIT SPOON T= 2" THIN WALL TUBE U= 3" THIN WALL TUBE C= NX ROCK CORE	See p. 1 of 7

DESCRIPTION OF STRATUM

85
90
95
100
105
110
115
120

LIMESTONE (Austin Chalk), moderately hard, fresh, moderately argillaceous, slightly fossiliferous, light gray to dark gray

-shaly limestone parting, dark gray at 95.0'

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.9 PG 4 OF 7

LOCATION: N 242,170 feet, E 2,175,210 feet

GROUND EL: 685.8 feet

DATE: 7/26-27/89 TYPE: Air/Water Rotary CASED TO: 5.0 CONTRACTOR: SwL (89-192)

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), moderately hard, fresh, moderately argillaceous, slightly fossiliferous, light gray to dark gray
125										-shaly limestone, dark gray at 125.0'-130.0'
130										
135										
140										
145										
150										-bentonitic shale, dark gray at 151.0'-152.5'
155										
160			160.0							

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 7

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.9APG 5 OF 7

LOCATION: N 242,170 feet
E 2,175,210 feet

GROUND EL: 685.8 feet

DATE: 7/26-27/89 TYPE: Nx Core CASED TO: 5.0 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 7

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), moderately hard, fresh, sound, moderately argillaceous, slightly fossiliferous, light gray to dark gray -shaly limestone, dark gray at 160.0'-160.4' -fossil parting at 160.8' -shaly limestone, dark gray at 161.8'-162.5' -fossil parting at 163.5' -pyrite nodule at 164.1' -shaly limestone, dark gray at 167.5'-168.1' -pyrite nodule at 169.8' -60° healed calcite filled shear at 173.2'-173.4' -60° smooth, tight shear at 173.7'-173.8' -40° smooth, tight shear at 173.8'-174.0'
165		C1			99	96				
170				170.0						
		C2	170.0		99	94				-40° smooth, tight shear at 174.9'-175.1' -shale, medium, dark gray at 178.4'-178.6'
175										
180				180.0						-pyrite nodules at 180.6' -shaly limestone, dark gray at 181.4'-181.6' -pyrite nodule at 182.4' -shaly limestone, dark gray at 183.9'-184.1' -shaly limestone, dark gray at 184.5'-185.6'
		C3	180.0		100	100				
185										-shaly limestone, dark gray at 187.3'-188.4'
190				190.0						-shaly limestone, dark gray at 190.9'-191.0'
		C4	190.0		100	99				-shaly limestone, dark gray at 193.3'-193.4'
195										-shaly limestone, dark gray at 196.1'-196.7'
200				200.0						-35° smooth, tight shear at 199.6'-199.8' -shale, dark gray at 199.6'-200.1'
			200.0							

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.9 PG 6 OF 7

LOCATION: N 242,170 feet
E 2,175,210 feet

GROUND EL: 685.8 feet

DATE: 7/26-27/89 TYPE: Nx Core CASED TO: 5.0 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 7

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
			200.0							LIMESTONE (Austin Chalk), moderately hard, fresh, sound, slightly argillaceous, slightly fossiliferous, light gray to dark gray
205		C5			99	99				-shaly limestone, fossiliferous, dark gray at 204.4'-204.8' -shaly limestone, dark gray at 206.4'-206.9
210				210.0						
			210.0							-fossil parting at 211.4' -fossil parting at 212.6' -shaly limestone, pyrite nodules, dark gray at 212.6'-214.4'
215		C6			94	56				
										217.1
										219.0 SHALY LIMESTONE (transition), moderately hard, fresh, sound, extremely argillaceous, abundant fragments of fish bones and fossil debris, gray
220				220.0						
			220.0							SHALE (Eagle Ford), medium, fresh, fissile, slightly fossiliferous, occasional pyrite and carbonate nodules, dark gray
225		C7			0	0				
230				230.0						
			230.0							-20° smooth, tight shear at 233.5'
235		C8			100	94				-carbonate nodule at 235.5' -1/8" carbonate seam at 236.5' -1/8" carbonate seam at 237.2' -30° shear, tight at 238.4'-238.5' -60° shear, tight at 238.8'-240.0'
240				240.0						
			240.0							(shears from 233.5'-240.0' all smooth, tight)
		C9								

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.9 PG 7 OF 7

LOCATION: N 242,170 feet, E 2,175,210 feet

GROUND EL: 685.8 feet

DATE: 7/26-27/89 TYPE: Nx Core CASED TO: 5.0 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 7

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
245		C9			100	91			SHALE (Eagle Ford), moderately hard, fresh, fissile, slightly fossiliferous, occasional pyrite and carbonate nodules, dark gray -carbonate seam at 240.9'-241.0' -fossil parting at 241.3' -fossil parting at 241.4' -fossil parting at 241.9' -fossil parting at 242.2' -fossil parting at 242.4' -fossil parting at 242.9' -carbonate nodule at 243.3'
250				250.0					-fossil parting at 250.6' -fossil parting at 251.1' -30° smooth, tight shear at 251.9'-252.0' -carbonate layer at 252.3'-252.4' -fossil parting at 252.7'
		C10	250.0	254.0	90	78			
255									Bottom of Exploration at 254.0'
260									NOTE: Borehole grouted after completion
265									
270									
275									
280									

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.8 PG 1 OF 7

LOCATION: N 240,750 feet
E 2,174,960 feet

GROUND EL: 678.6 feet

DATE: 7/28-29/89 TYPE: Air/Water Rotary CASED TO: 5.0' CONTRACTOR: SWL (89-192)

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, trace of roots, dark brown
5									LIMESTONE (Austin Chalk), soft, highly weathered, occasional tan clay layers, tan
									8.0
10									LIMESTONE (Austin Chalk), medium, fresh, occasional shaly limestone layers, light gray to dark gray
15									
20									
25									
30									
35									
40									

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 5', no seepage encountered, drilled with Water Injection to 145.0', cored with Water Rotary to bottom of exploration

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.8PG 2 OF 7

LOCATION: N 240,750 feet
E 2,174,960 feet

GROUND EL: 678.6 feet

DATE: 7/28-29/89 TYPE: Air/Water Rotary CASED TO: 5.0' CONTRACTOR: SWL (89-192)

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.	SAMPLE LEGEND	WATER INFORMATION
									S= SPLIT SPOON T= 2" THIN WALL TUBE U= 3" THIN WALL TUBE C= NX ROCK CORE	See p. 1 of 7
									DESCRIPTION OF STRATUM	
45									LIMESTONE (Austin Chalk), medium, fresh, occasional shaly limestone layers, light gray to dark gray	
50										
55										
60										
65										
70										
75										
80										

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.8 PG 3 OF 7

LOCATION: N 240,750 feet
E 2,174,960 feet

GROUND EL: 678.6 feet

DATE: 7/28-29/89 TYPE: Air/Water Rotary CASED TO: 5.0' CONTRACTOR: SWL (89-192)

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, occasional shaly limestone layers, light gray to dark gray
85										
90										
95										
100										
105										
110										
115										
120										

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 7

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.8 PG 4 OF 7

LOCATION: N 240,750 feet
E 2,174,960 feet

GROUND EL: 678.6 feet

DATE: 7/28-29/89 TYPE: Nx Core CASED TO: 5.0' 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 7

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, occasional shaly limestone layers, light gray to dark gray
125									
130									
135									-bentonite, light gray, 139.0'-140.0'
140									
145			145.0						
150		C1			100	97			-shaley limestone, dark gray 147.5'-148.3' -fossil parting at 152.4' -pyrite nodule at 152.9' -shaly limestone, fossiliferous, dark gray at 153.8-153.9'
155				155.0					-fossil parting at 154.7'
			155.0						-shaly limestone, dark gray at 157.5'-158.6'
160		C2			99	99			-fossil parting at 160.2' -pyrite nodule at 161.1' -fossil parting at 162.1' -shaly limestone, dark gray at 163.5'-163.8'

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.8PG 5 OF 7

LOCATION: N 240,750 feet
E 2,174,960 feet

GROUND EL: 678.6 feet

DATE: 6/28-29/89 TYPE: Nx Core CASED TO: 5.0' 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 7

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
		C2		165.0	99	99				LIMESTONE (Austin Chalk), medium to moderately hard, fresh, sound, moderately argillaceous, slightly fossiliferous, light gray to dark gray -shaly limestone, dark gray at 164.5'-164.6'
165		C3	165.0	175.0	100	100				-pyrite nodule at 165.6' -pyrite nodule at 167.9' -shaly limestone, dark gray at 168.7'-169.3' -shale parting at 174.3'
170										
175		C4	175.0	185.0	98	98				-shaly limestone, dark gray at 178.7'-179.0' -shale parting at 180.0'
180										
185		C5	185.0	195.0	100	100				-shale parting at 186.9' -shaly limestone, dark gray at 186.9'-187.5' -shaly limestone, dark gray at 190.2'-191.0' -shale parting at 191.0'
190										
195		C6	195.0	205.0	97	97				-shaly limestone, dark gray at 195.5'-195.7' -shaly limestone, dark gray at 197.0'-197.9' -shaly limestone, dark gray at 202.0'-203.0'
200										

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.8 PG 6 OF 7

LOCATION: N 240,750 feet, E 2,174,960 feet

GROUND EL: 678.6 feet

DATE: 7/28-29/89 TYPE: Nx Core CASED TO: 5.0' 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 7

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
		C6		205.0	97	97			LIMESTONE (Austin Chalk), medium to moderately hard, fresh, sound, moderately argillaceous, slightly fossiliferous, light gray to dark gray -shaly limestone at 203.6'-208.0'
205		C7	205.0	210.0	80	80			208.0 SHALY LIMESTONE (transition), soft to medium, fresh, sound, extremely argillaceous, abundant fragments of fish bones, teeth and fossil debris, dark gray
210		C8	210.0	220.0	65	65			211.1 SHALE (Eagle Ford), medium, fresh, moderately fractured, slightly fissile, fossiliferous, occasional pyrite nodules and septarian concretions, dark gray -30° smoooth, slickensided, shear at 217.3'-217.4'
215									
220		C9	220.0	230.0	90	90			-carbonate seam at 225.2' -pyrite nodule at 228.7' and 228.9' -25° smooth, tight shear at 229.3'-229.4'
225									
230		C10	230.0	240.0	100	100			-carbonate seam at 230.9' -30° smooth, tight shear at 232.3'-232.4' -carbonate seam at 232.6' -carbonate seam at 233.6'
235									
240		C11	240.0						

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

LOG OF BORING

PROJECT: TEXAS SSC SITE

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: SE 10.8 PG 7 OF 7

LOCATION: N 240,750 feet
E 2,174,960 feet

GROUND EL: 678.6 feet

DATE: 7/28-29/89 TYPE: Nx Core CASED TO: 5.0' 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 7

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
		C11	240.0	246.0	83	36				SHALE (Eagle Ford), medium, fresh, fissile, slightly fossiliferous, occasional pyrite nodules, dark gray -shale partings at 240.3', 240.4', 240.6', 240.7', 241.0' -15° slickensided, smooth, shear at 244.4'
245										
250										Bottom of Exploration at 246.0' NOTE: Boring grouted upon completion
255										
260										
265										
270										
275										
280										

DRILLING GEOLOGIST David Hartsfield ASSISTANT Wayne Cowan CHECKED BY C. Bommarito

APPENDIX C

WIRE-LINE LOGS

WIRE-LINE LOGGING PARAMETERS

Hole No. BE10.9 **Log Measured From:** Ground level

Drilling Parameters

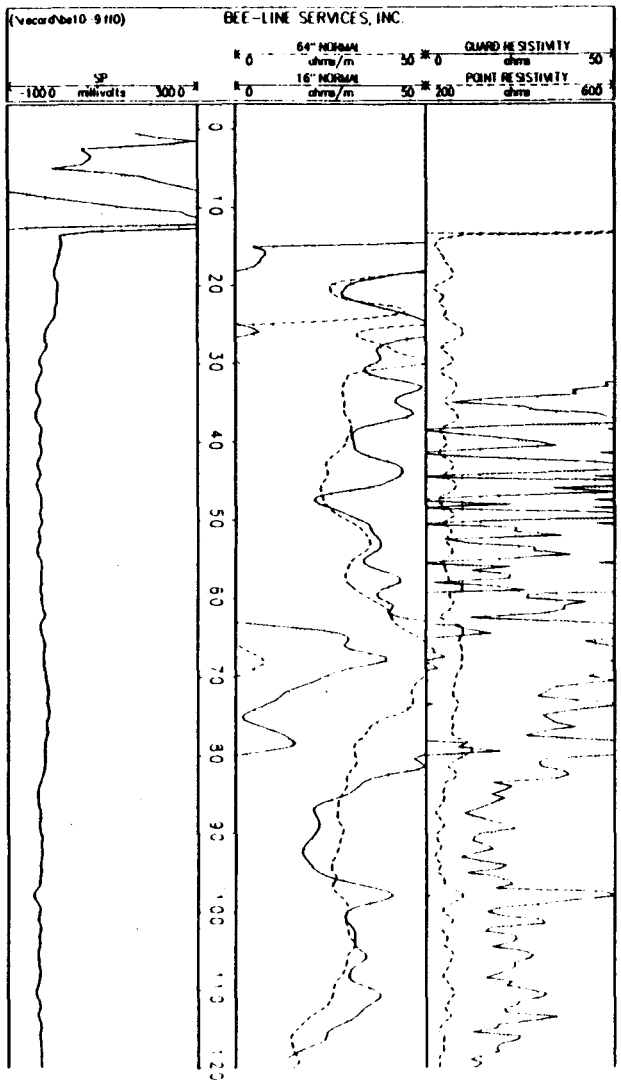
Depth	241.0 feet
Bit Diameter	4.75 inches

Logging Parameters	**Electrical Log**	**Gamma Log**	**Sonic Log**
Date	July 25, 1989	July 25, 1989	July 25, 1989
Bottom Log Interval	240.0 feet	238.0 feet	233 feet
Top Log Interval	surface	surface	surface
Type of Fluid in Hole	drilling fluid	drilling fluid	drilling fluid
Time Since Circulation Stop	2.5 hours	2.5 hours	2.5 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

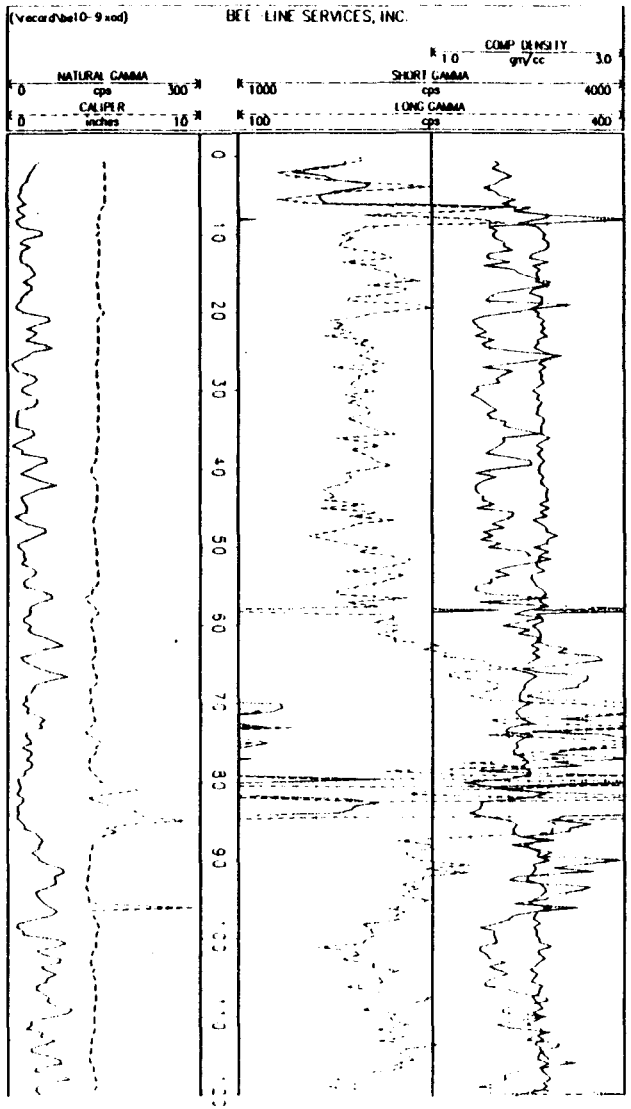
Logged by: BEE-LINE SERVICES, INC.
P.O. Box 2096
Corsicana, TX 75151

BE10.9 Wire-line logs run July 25, 1989. Surface elevation 689.3 feet.

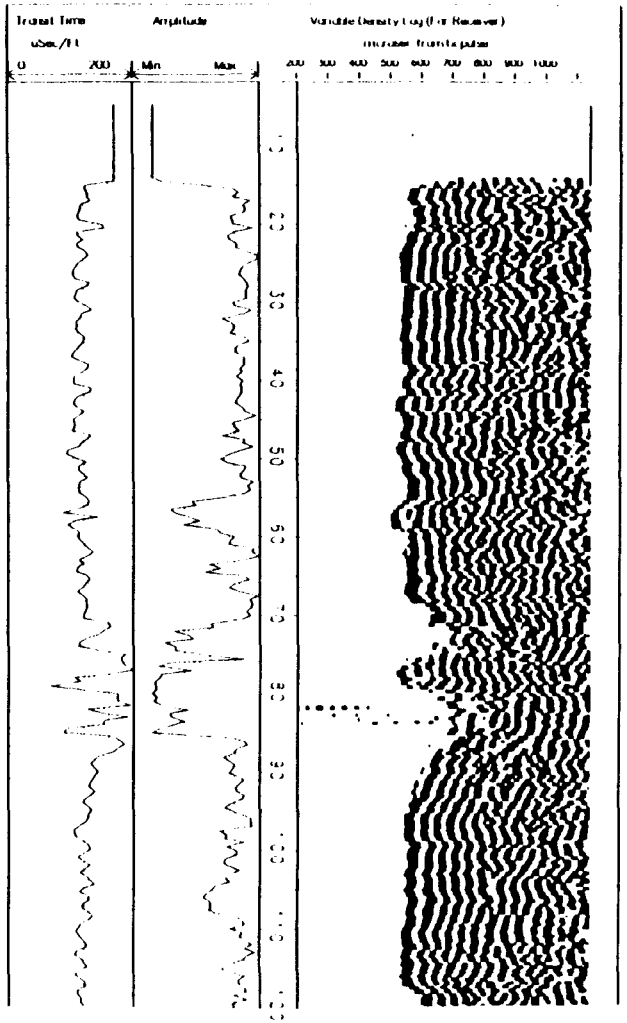
ELECTRICAL LOG



GAMMA LOG

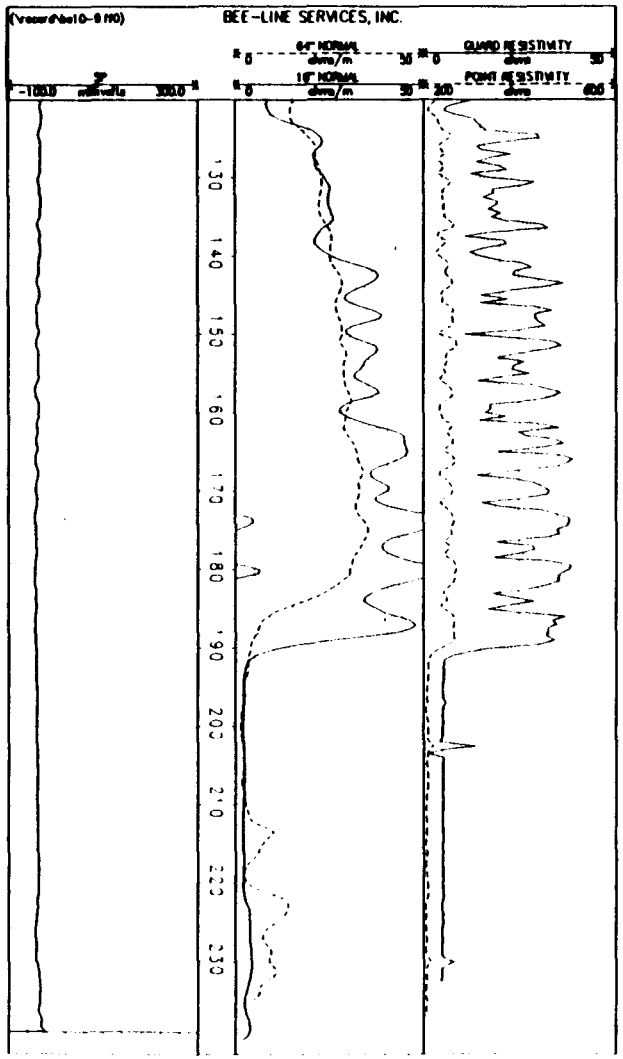


SONIC LOG

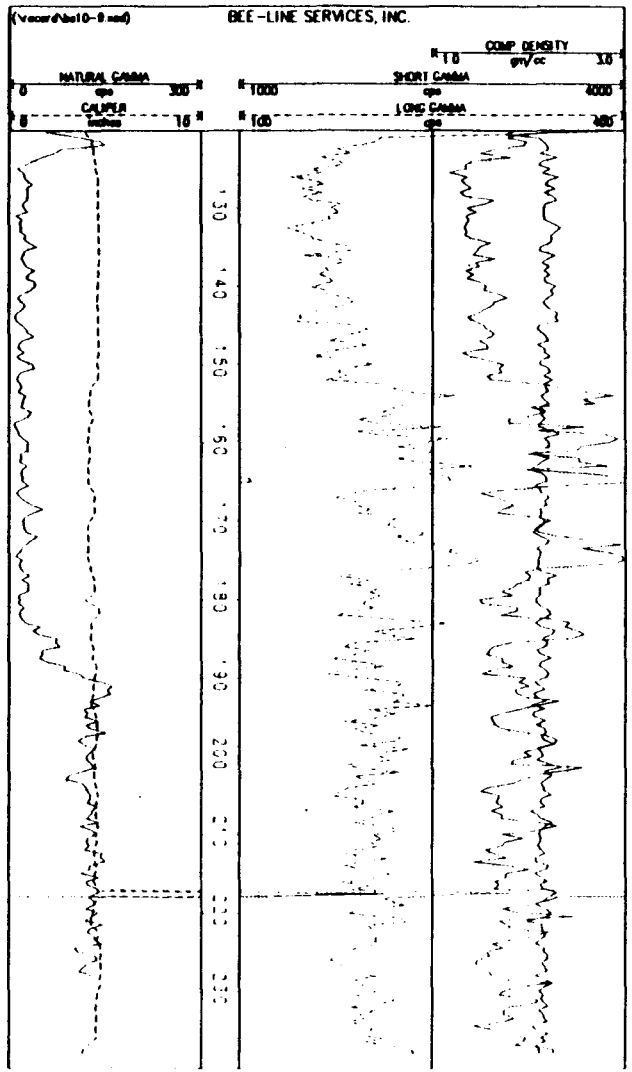


BE 10.9 Wire-line logs run July 25, 1989. Surface elevation 689.3 feet

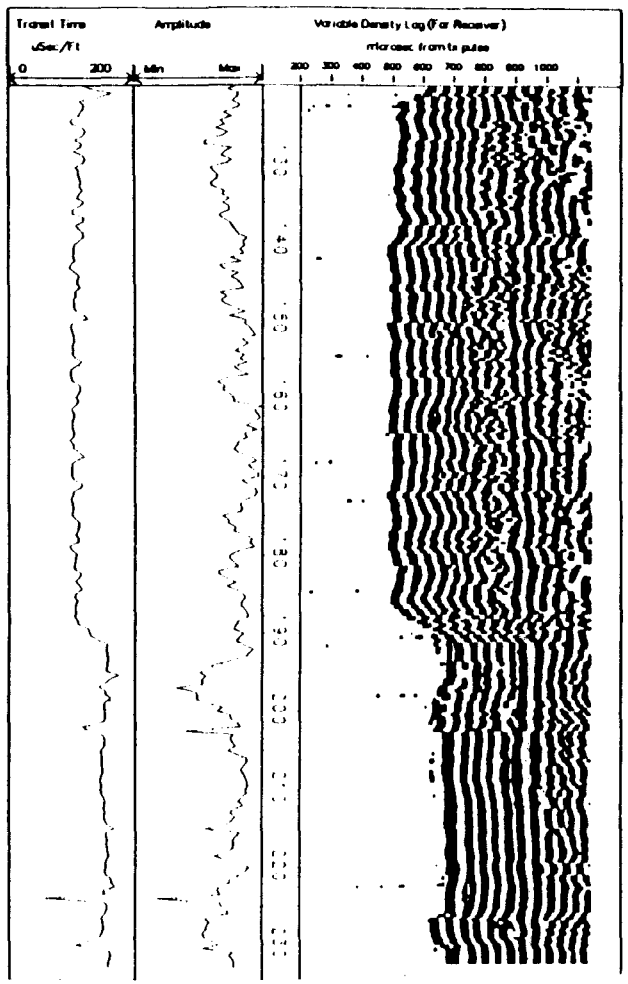
ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED



SONIC LOG CONTINUED



WIRE-LINE LOGGING PARAMETERS

Hole No. SE10.9A **Log Measured From:** Ground level

Drilling Parameters

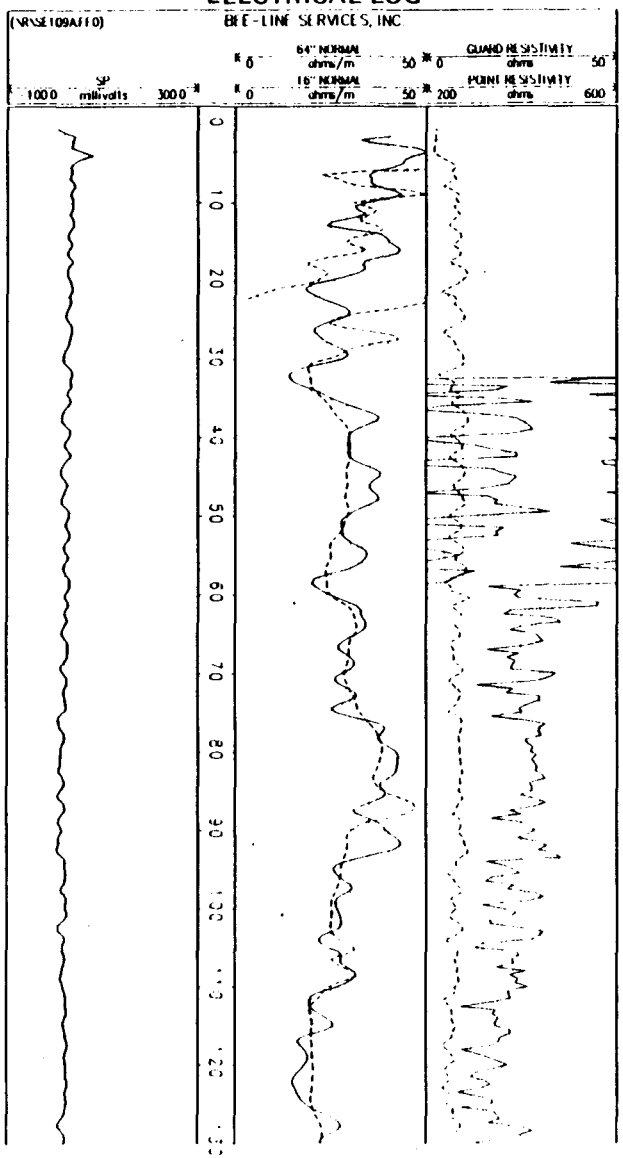
Depth	254.0 feet
Bit Diameter	4.5 inches

Logging Parameters	**Electrical Log**	**Gamma Log**	**Sonic Log**
Date	July 27, 1989	July 27, 1989	July 27, 1989
Bottom Log Interval	252.0 feet	252.0 feet	247.6 feet
Top Log Interval	surface	surface	surface
Type of Fluid in Hole	drilling fluid	drilling fluid	drilling fluid
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

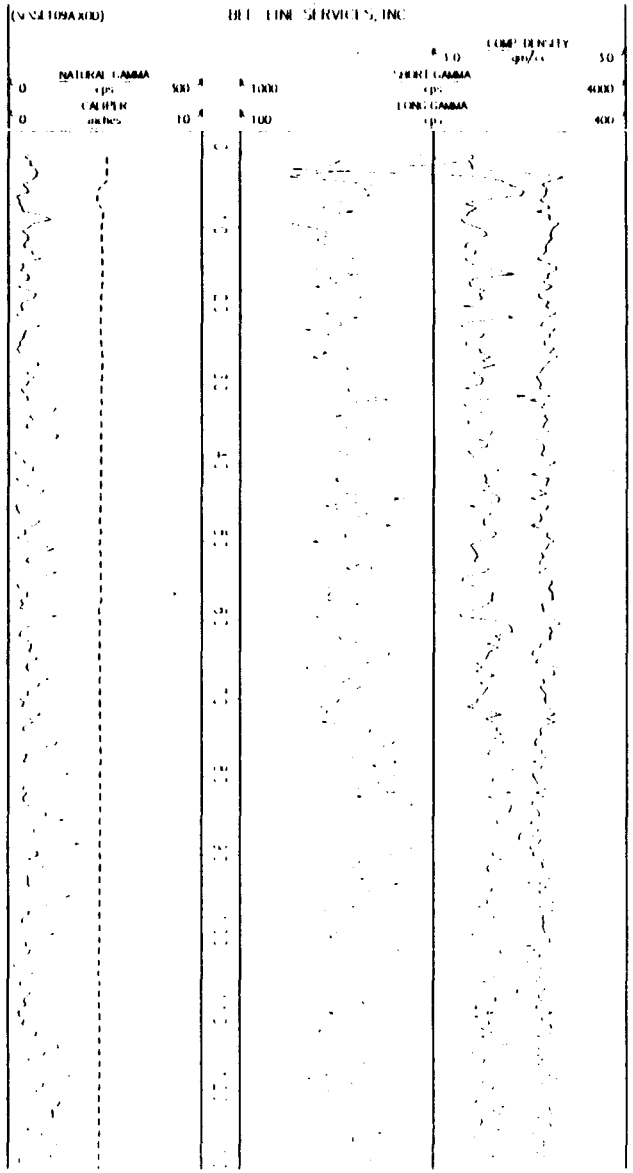
Logged by: BEE-LINE SERVICES, INC.
P.O. Box 2096
Corsicana, TX 75151

SE 10.9A Wire-line logs run July 27, 1989. Surface elevation 685.8 feet.

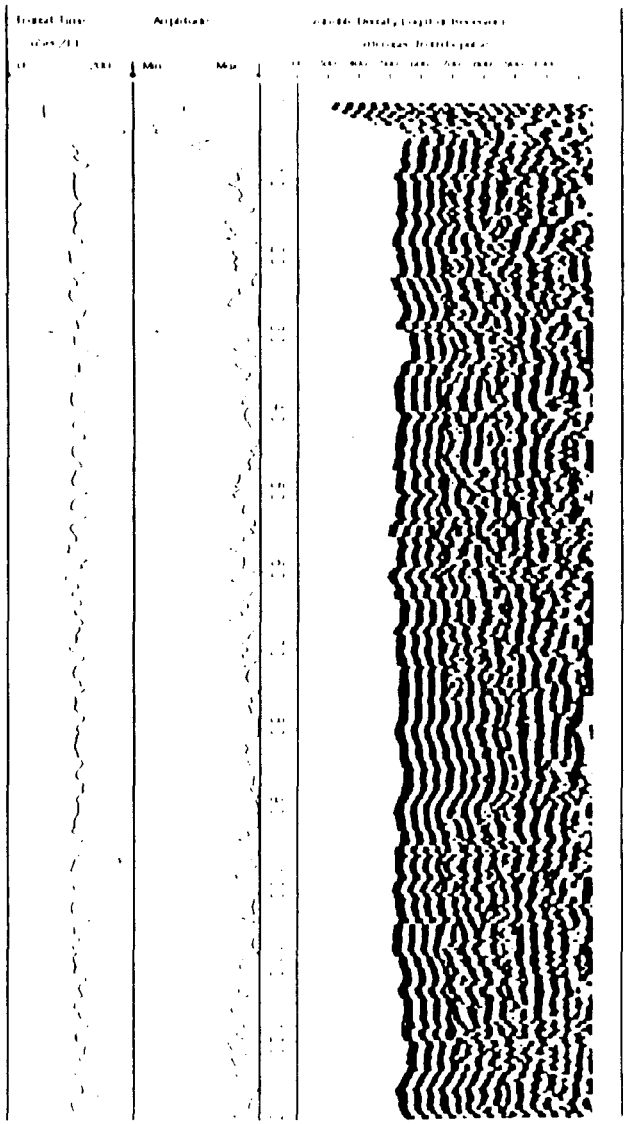
ELECTRICAL LOG



GAMMA LOG

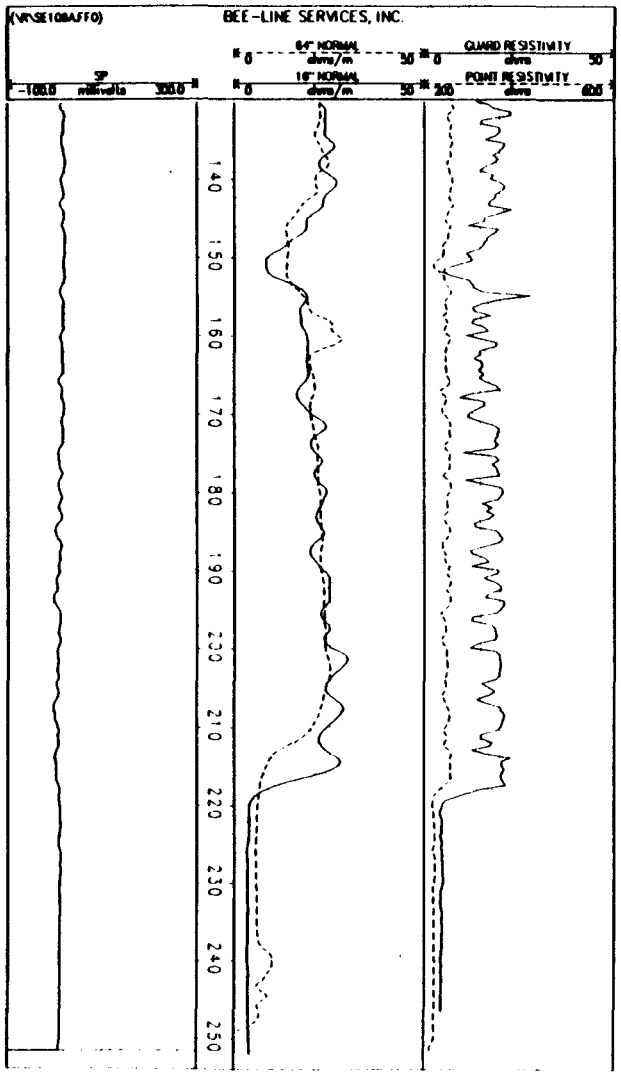


SONIC LOG

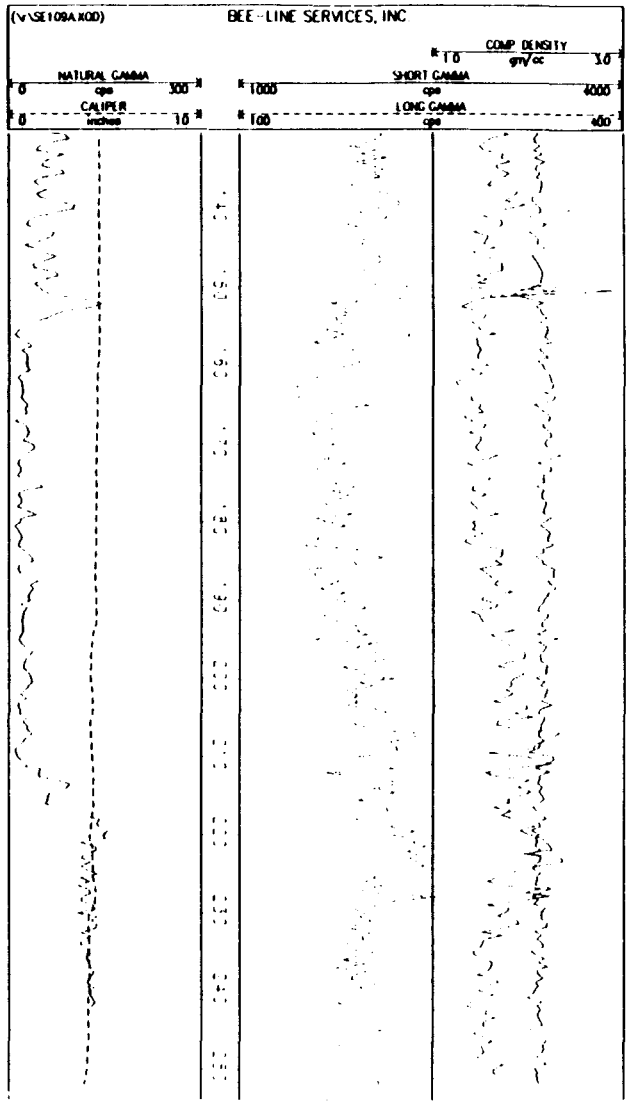


BE10.9A Wire-line logs run July 27, 1989. Surface elevation 685.8 feet.

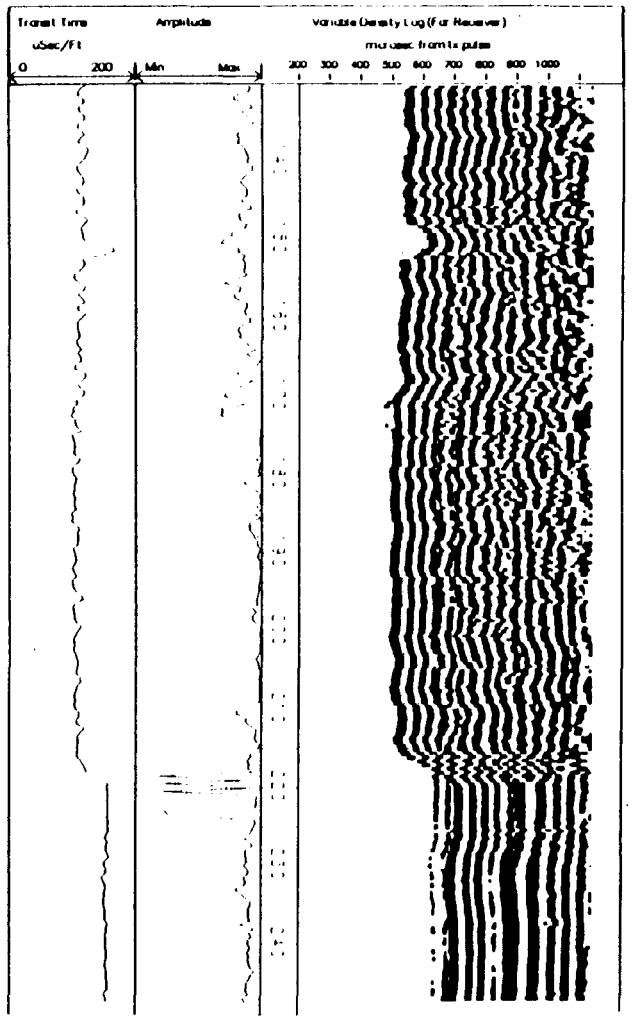
ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED



SONIC LOG CONTINUED



WIRE-LINE LOGGING PARAMETERS

Hole No. SE10.8 **Log Measured From:** Ground level

Drilling Parameters

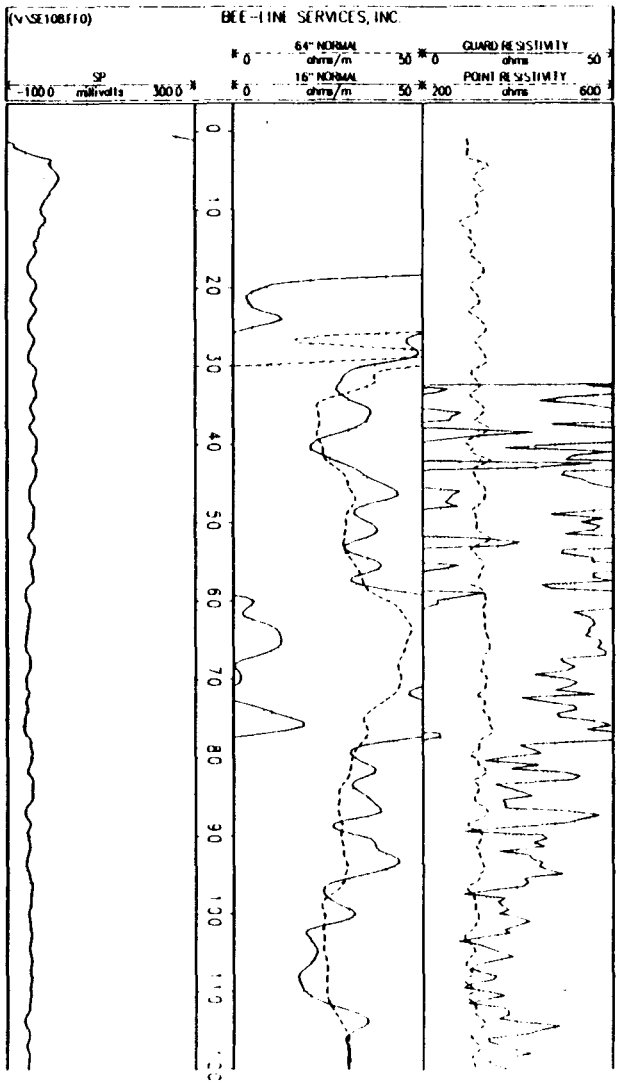
Depth	246.0 feet
Bit Diameter	4.5 inches

Logging Parameters	**Electrical Log**	**Gamma Log**	**Sonic Log**
Date	July 29, 1989	July 29, 1989	July 29, 1989
Bottom Log Interval	244.0 feet	243.5 feet	239.1 feet
Top Log Interval	surface	surface	surface
Type of Fluid in Hole	drilling fluid	drilling fluid	drilling fluid
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

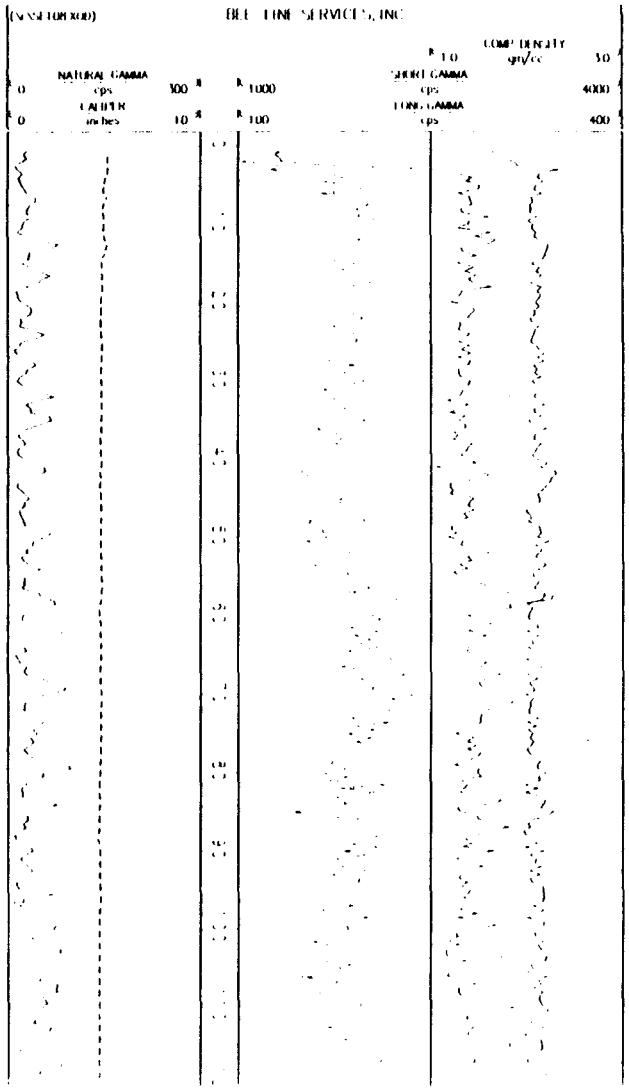
Logged by: BEE-LINE SERVICES, INC.
P.O. Box 2096
Corsicana, TX 75151

SE 10.8 Wire-line logs run July 29, 1989. Surface elevation 678.6 feet.

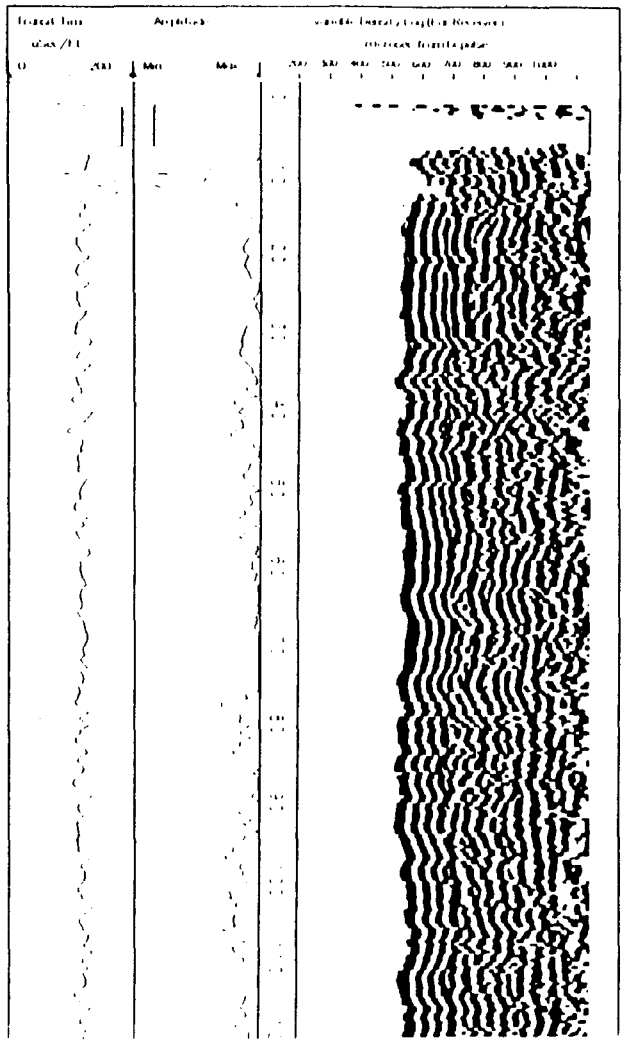
ELECTRICAL LOG



GAMMA LOG

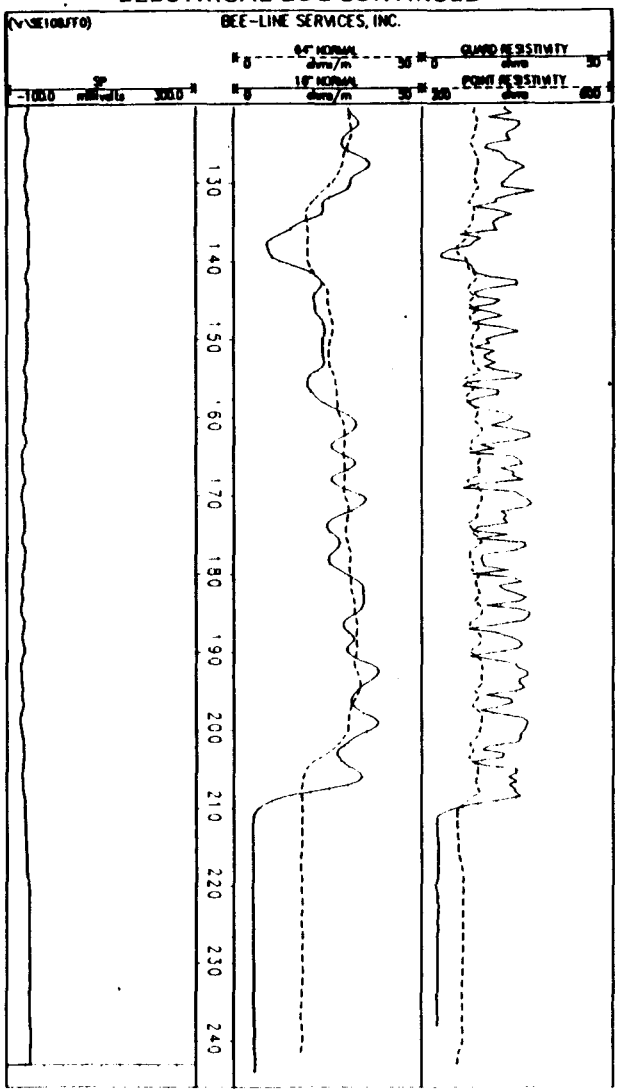


SONIC LOG

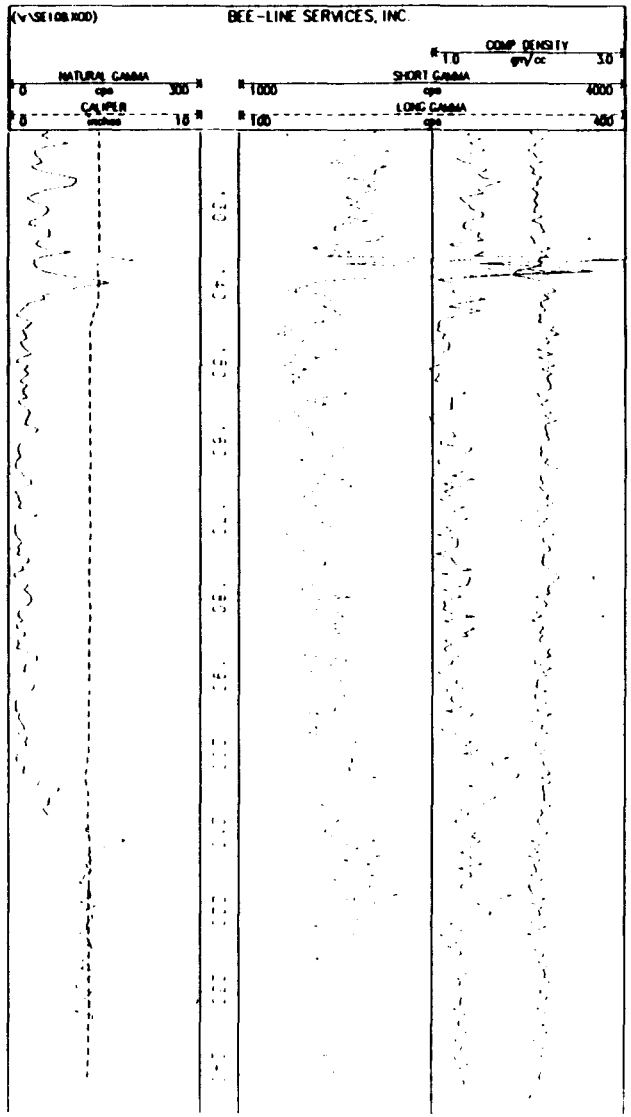


SE10.8 Wire-line logs run July 29, 1989. Surface elevation 678.6 feet.

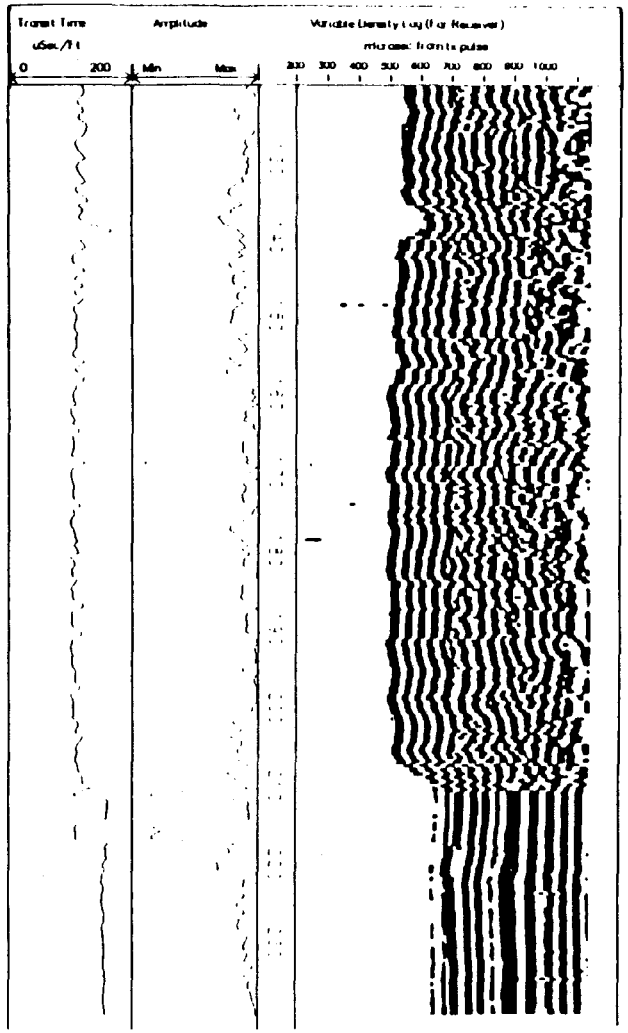
ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED



SONIC LOG CONTINUED



APPENDIX D

PLUGGING REPORTS

SSC BOREHOLE PLUGGING REPORT

Project No. 87-88-0015

Task No. 15

Boring No. BE 10.9

Texas Coordination Location: N 242,387 feet
E 2,174,878 feet

Surface Elevation: 689.3 feet

Total Boring Depth: 241.0 ft.

Date Drilled: 7-24/7-25-89

Date Plugged: 7-26-89

Time Completed: 10:45 AM

Remarks:

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

Drilling geologist: Shawn D. Wood
Coordinator: Bruce Bailey
SwL Report No. 89-192

SSC BOREHOLE PLUGGING REPORT

Project No. 87-88-0017

Task No. 17

Boring No. SE 10.9A

Texas Coordination Location: N 242,170 feet
E 2,175,210 feet

Surface Elevation: 685.8 feet

Total Boring Depth: 254.0 ft.

Date Drilled: 7-26/7-27-89

Date Plugged: 7-28-89

Time Completed: 11:10 AM

Remarks:

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

Drilling geologist: David Hartsfield
Coordinator: Bruce Bailey
SwL Report No. 89-192

SSC BORHOLE PLUGGING REPORT

TETC Project No. 87-888-0017

Task No. 17

Boring No. SE 10.8

Texas Coordination Location: N 240,750 feet
E 2,174,960 feet

Surface Elevation: 678.6 feet

Total Boring Depth: 246.0 ft.

Date Drilled: 7-28/7-29-89

Date Plugged: 7-31-89

Time Completed: 9:15 AM

Remarks:

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

Drilling Geologist: David Hartsfield
SwL Coordinator: Bruce Bailey
SwL Report No. 89-192