SSCL-SR-1086

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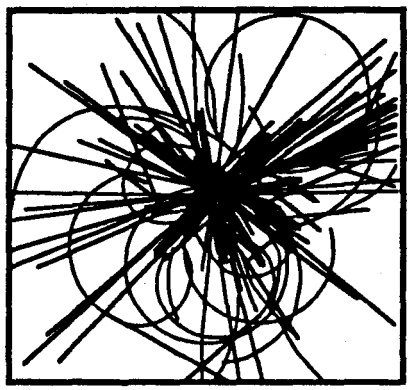
Project No. 87-888-0017

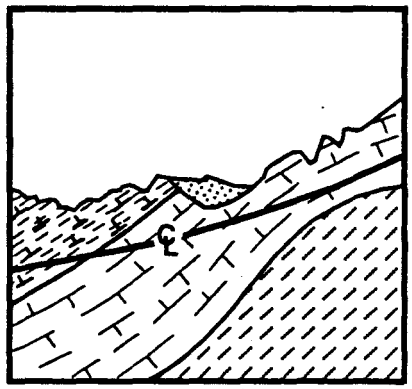
Report No. SSC-GR-27

June 1990

GR-27

Data Report for Corehole BF 9





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
- Structure-specific data
- Global data

This is one in a series of data reports prepared for the global data phase of geotechnical characterization at the SSC site. Data collection for this study phase focused on drillhole-based geological, geohydrological, geophysical, and geotechnical tests in the near vicinity of the E and F access shaft sites. The global data set has three key attributes: (1) uniform geographic distribution over the site footprint, (2) complete coverage of all of the strata through which the SSC tunnels and shafts will pass, and (3) consistency of the data from sampling site to sampling site throughout the SSC site. In combination with data from the other phases, these data will allow conceptual designs of construction methods. Each data report includes the results of both field and laboratory tests for specific drilling and sampling site(s).

DATA REPORT

Site Designator: BF 9

Objective: Drill a corehole at the proposed shaft location and determine geotechnical conditions through in-situ hydrologic testing and laboratory geomechanical testing. The corehole extends at least 35 feet below tunnel depth.

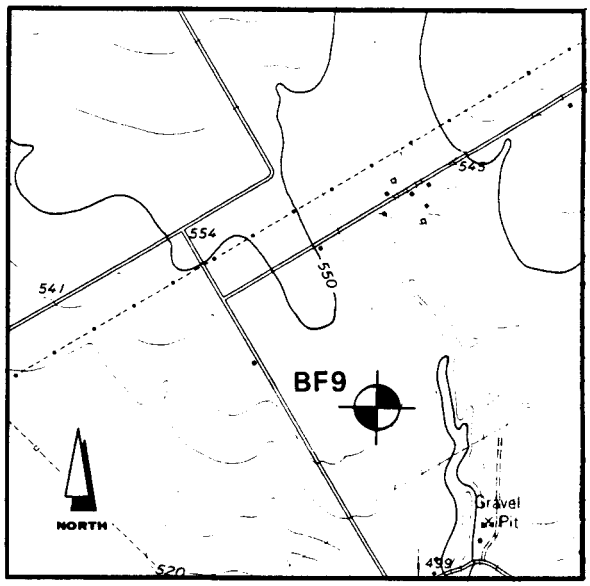
Location:

North 214,885 feet

East 2,189,515 feet

Surface Elevation 543.3 feet

BF 9 is located on the southwestern portion of the proposed tunnel alignment, about 2 miles west of Interstate 35.



SCALE 1:24,000

0 1000 2000 3000 4000 Feet

CONTOUR INTERVAL 10 FEET

Scope and Schedule:		
	Coring (full depth)	January 15 to 23, 1990
	Wire-line Logging	January 16 and 23, 1990
	Hydrologic Testing	January 24, 1990
	Laboratory Testing	January 19 to 30, 1990
	Well Construction	January 24 to 25, 1990

Conditions Encountered: (see lithologic log, Appendix A)

Total Hole Depth:	167.5 feet
Soil:	0.0 to 16.0 feet
Weathered Austin Chalk:	16.0 to 28.8 feet
Fresh Austin Chalk:	28.8 to 167.5 feet (bottom of hole)
Fault Zone:	134.0 to 140.0 feet (approximately 60 feet of offset)
Static Water Level:	Measured at 527.4 feet above MSL (15.9 feet below ground surface) on April 2, 1990, 8 days after the well had been bailed to 504.0 feet above MSL. The static water level is estimated to be 9.5 feet below ground surface based on the static water level in other wells.

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

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

*Wire-line logs were run on January 16, 1990, and again on January 23, 1990, after the boring was deepened from 138 feet to 167.5 feet to determine the extent of a fractured zone at the bottom of the boring as initially completed. Only the later set of logs is presented in Appendix B.

Hydrologic Test Results Summary: (see also Appendix C).

Vertical Depth (ft)	Packer Pressure (psi)	Gauge Pressure (psi)	Formation/ Lithology	Hydraulic Conductivity (cm/sec)
91.3-112.4	125	20	Austin Chalk	5.8×10^{-7}
127.3-148.4	125	25.5	Austin Chalk (fractured)	3.1×10^{-5}

Laboratory Geomechanical Test Results Summary: (see also Appendix D)

Depth (ft)	Formation/ Lithology	Moisture Content (%)	Dry Density (pcf)	*Compressive Strength (psi)	Tangent Young's Modulus E_{50} (psi x 10^5)
40-41	Austin Chalk	8	138-139	2975	6.41
57-58	Austin Chalk	9	133-134	2406	
65-66	Austin Chalk	9	134-135	2748	22.73
91-92	Austin Chalk	9-12	128-137	3478 (100)	8.33
95	Austin Chalk	10-11	128-130	3491 (200)	7.64
103-104	Austin Chalk	15	118		
105-106	Austin Chalk	10-13	125-130	1751	1.72
129	Austin Chalk	13-14	119-120	1485	

*UU triaxial test indicated by confining pressure in parentheses.

Hole Status: An observation well was constructed in the boring on January 25, 1990 (see Appendix E).

APPENDIX A

LITHOLOGIC LOG

LOG OF BORING

BORING NO: BF 9 PG 1 OF 5

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 17

LOCATION: N 214,885 feet
E 2,189,515 feet

GROUND EL: 543.3 feet

DATE: 1/15/90 TYPE: Nx Core CASED TO: 16.0' 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
5									CLAY, silty, dark brown (CH) 7.5g
10									SAND, coarse, gravelly, sli. clayey, light brown, primarily composed of limestone (SC/SM) 13.2g
15									CLAY, silty, brown and tan (CH/CL) 16.0g
20		C1	16.5	23.5	100	56			LIMESTONE (Austin Chalk), mod. to highly weathered, soft to medium hard, tan to lt. brown, sli. fossil., fractures of various orientations w/iron-stained surfaces, w/0.7 to 1.2 ft. thick mod. argill. interbeds 2.8 to 3.3 ft. apart 20.0g-21.2g Med. thick, mod. argill., soft, brown bed
25		C2	23.5	33.5	95	50			24.5g-25.2g Thin, mod. argill., soft, brown bed 28.0g-28.75s Thin, mod. argill., soft, brown bed 28.75s
30									LIMESTONE (Austin Chalk), fresh, med. to mod. hard, lt. gray, sli. fossil., w/0.8 to 1.6 ft. thick sli. argill.-v. argill. & occ. shaly interbeds, 0.5 to 2.6 ft. apart 28.75s-30.0g Med.thick,sli.argill.,dark gray bed 30.9g-31.7g Thin,v.argill./shaly,soft,dk.gray bed
35		C3	33.5		100	100			34.3g-35.5g Med.thick,mod.-v.argill.,soft to med.hd.,dk. gray bed 36.0g-37.2g Med.thick,sli.-mod.argill.,med.hd.,dk.gray bed 38.0g-39.6g Med.thick,sli.-mod.argill.,med.hard.dk. gray bed
40									40.5g-41.6g Med.thick,sli.-mod.argill.,med.hard,dk. gray bed 43.0g-44.4g Med.thick,sli.-mod.argill.,med.hard,dk. gray bed

SAMPLE LEGEND

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

WATER INFORMATION

Approx. 24-32 gal/min temporary water loss from 7.5' to 13.2'; Set Nx casing to 16.0'
Wet Rotary Core Hole
Water level not determinable
Observation well installed for continued monitoring of water level

DRILLING GEOLOGIST Scott E. Lesikar ASSISTANT Mark Thomas CHECKED BY W. D. Flanigan

Rev. 3/22/90

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BF 9 PG 2 OF5

LOCATION: N 214,885 feet E 2,189,515 feet

GROUND EL: 543.3 feet

DATE: 1/15/90 TYPE: Nx Core CASED TO: 16.0' CONTRACTOR: MJA

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 5

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
		C3		43.5	100	100				LIMESTONE (Austin Chalk), fresh, med. to mod. hard, lt. gray, sli. fossiliferous, w/0.3 to 2.9 ft. thick sli. argill. to v. argill. & occ. shaly interbeds 0.6 to 4.6 ft. apart
45		C4	43.5	53.5	100	100				49.5g-50.0g Thin, sli. to mod. argill., dark gray bed 52.0g-53.0g Thin, sli. to mod. argill., dk. gray bed
50										
55		C5	53.5	63.5	100	100				56.5g-57.2g Thin, sli. to mod. argill., dk. gray bed 59.0g-59.8g Thin, mod. argill., dk. gray bed 62.5g-63.5g Thin, sli. to mod. argill., dk. gray bed
60										
65		C6	63.5	73.0	100	100				64.0-65.0 75° incipient fracture, non-slickensided, rough, closed, fresh, w/v. small (~.1mm) pyrite crystals 64.4g-65.5g Med.thick,v.argill./shaly,soft to med.hd., dk.gray bed 67.3g-68.4g Med.thick,sli.to mod.argill.,med.gray bed
70										73.0g-73.4g Thin, sli. to mod. argill., dk. gray bed
75		C7	73.0		100	100				77.6g-80.5g Med.thick,sli.to mod.argill.,dk.gray bed
80										81.6g-81.9g Thin, sli. to mod. argill., dk. gray bed 82.5g-84.0g Med.thick,sli.to mod.argill.,dk.gray bed

DRILLING GEOLOGIST Scott E. Lesikar ASSISTANT Mark Thomas CHECKED BY W. D. Flanigan

Rev. 3/22/90

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BF 9 PG 3 OF 5

LOCATION: N 214,885 feet
E 2,189,515 feet

GROUND EL: 543.3 feet

DATE: 1/15/90 TYPE: Nx Core CASED TO: 16.0' CONTRACTOR: MJA

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 5

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
		C7		83.0	100	100				LIMESTONE (Austin Chalk), fresh, med. to mod. hard, lt. gray, sli. fossiliferous, w/0.2 to 1.7 ft. thick sli. to v. argill. & occ. shaly interbeds 0.75 to 5.1 ft. apart
85		C8	83.0	93.0	100	100				86.2g-87.9g Med.thick,sli.to mod.argill.,dk.gray bed 88.65s-88.85s Thin, shaly, soft, dk. gray bed 89.9g-90.6g Thin, v. argill./shaly, soft to med. hard, dk. gray bed 93.0g-94.0g Thin, mod. argill., dk. gray bed
90										
95		C9	93.0	103.0	100	100				96.5g-97.5g Thin, mod. argill., dk. gray bed 98.45g-99.8g Med.thick,mod.argill.,dk.gray bed 101.0g-101.7g Thin, sli.-mod. argill., dk. gray bed
100										
105		C10	103.0	113.0	100	100	Stopped Drilling 1/15/90			105.6g-106.0g Thin, mod. argill., dk. gray bed 109.25s-109.75s Thin, shaly, soft, dk. gray bed 111.0g-111.2g Thin, mod. argill., dk. gray bed 113.7g-114.7g Thin, sli.-mod. argill., dk. gray bed
110										
115		C11	113.0		100	100	Started Drilling 1/16/90			114.7g-115.0g Thin, shaly, soft, dk. gray bed 120.1g-120.9g Thin, shaly/bentonitic shaly (~1/2"), v. soft to soft, dk. gray bed 123.8g-125.0g Med.thick,mod.argill.,dark gray bed
120										

DRILLING GEOLOGIST Scott E. Lesikar ASSISTANT Mark Thomas CHECKED BY W. D. Flanigan

Rev. 3/22/90

LOG OF BORING

BORING NO: BF 9 PG 4 OF 5

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 17

LOCATION: N 214,885 feet
E 2,189,515 feet

GROUND EL: 543.3 feet

DATE: 1/16/90 TYPE: Nx Core CASED TO: 16.0' CONTRACTOR: MJA

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 5

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.
		C11		123.0	100	100			
125		C12	123.0	133.0	100	99			
130									
135		C13	133.0	138.0	100	100	Stopped Drilling 1/16/90		
140		C14	138.0	147.5	100	94	Started Drilling 1/23/90		
145									
150		C15	147.5	157.5	100	100			
155									
160		C16	157.5		100	100			

DESCRIPTION OF STRATUM

LIMESTONE (Austin Chalk), fresh, med. to mod. hd., lt. gray, sli. fossil., w/0.1 to 2.6 ft. thick, sli.argill. to very argill. and shaly interbeds 0.2 to 3.1' apart

128.05 17° fracture, slks., rough, planar, up to 1/16" calcite filling, fresh surface

127.8g-128.6g Thin, mod. argill., dk. gray bed

130.85g-131.65g Thin, mod. argill., dk. gray bed

130.9 50° fracture, slks., smooth to sli. rough, sli. undulatory, closed, clean, fresh

131.45 20° fracture, slks., sli. rough, sli. undulatory, closed, clean, fresh

132.2 23° fracture, slks., rough, sli. undulatory, closed, clean, fresh

133.45-141.3 Fracture Zone: rock, within this zone is intensely fractured in various orientations in addition to the main fractures listed below

134.6g-134.7g Very thin, mod. argill., dk. gray bed

134.65 20° fracture, slks., rough to v. rough, planar, up to 1/4" calcite filling, fresh

137.2 30° fracture, slks., rough to v. rough, undulatory, closed, fresh

137.2g-138.0g Thin, v. argill., dk. gray bed

137.35 65° fracture, slks., up to 1/16" calcite filling, fresh

137.5 70° fracture, slks., up to 1/16" calcite filling, fresh

138.2 45° fracture, slks., pu to 1/16" calcite filling, fresh

138.2-139.1 85° fracture, slks., up to 1/16" calcite filling, fresh

140.6g-141.3g Thin, mod. to v. argill., dk. gray bed

141.5g-143.3g Med. thick, sli. to v. argill., dk. gray bed

142.45 25° fracture, rough to sli. rough, planar, clean, closed, fresh

142.55 15° fracture, rough to sli. rough, planar, clean, closed, fresh

143.3 15° fracture, slickensided along fossil parting, pyrite crystals (< 1mm) along fracture surface, narrow separation, sli. rough, planar

145.0 50° fracture, slks., sli. rough, planar, clean, closed, fresh

145.3g-146.3g Med. thick, mod. to v. argill., dk. gray bed

146.2 45° fracture, slks., sli. rough, sli. undulatory, clean, closed, fresh

146.9 30° fracture, slks., sli. rough, undulatory, clean, closed, fresh

149.4g-152.0g Med. thick, sli. to mod. argill., dk. gray bed

152.6g-152.85s Thin, shaly, soft, dk. gray bed

152.9 50° fracture, slks., sli. rough, planar, clean, closed, fresh

154.5g-154.7s Thin, shaly, soft, dk. gray bed

155.3g-157.0g Med. thick, sli. to mod. argill., dk. gray bed

159.6g-161.0g Med. thick, v. argill., dk. gray bed

162.0g-162.2s Thin, fossiliferous bed

162.2s-163.2g Med. thick, mod. argill., dk. gray bed

DRILLING GEOLOGIST Scott E. Lesikar ASSISTANT Mark Thomas CHECKED BY W. D. Flanigan

Rev. 3/22/90

LOG OF BORING

BORING NO: BF 9 PG 5 OF 5

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 17

LOCATION: N 214,885 feet
E 2,189,515 feet

GROUND EL: 543.3 feet

DATE: 1/23/90 TYPE: Nx Core CASED TO: 16.0' CONTRACTOR: MJA

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 5

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		C16		167.5	100	100				LIMESTONE (Austin Chalk), fresh, med. to mod. hd., lt. gray, sli. fossil., w/0.8 to 1.4 ft. thick mod. to v. argill. interbeds 1.1 to 1.7 ft. apart 164.3g-165.1g Thin, v. argill., dk. gray bed 166.8g-167.5 Mod. argill., dk. gray bed
170 175 180 185 190 195 200										Total Depth: 167.5' 1/23/90 (1) Wash bored to 16.5' w/o sampling (2) Wireline Logged: 1/16/90; Re-logged 1/23/90 (3) Total depth extended due to fracture zone (4) Hydrotested: 1/24/90 (5) Borehole reamed to 6 3/4" down to 153.0' 1/24/90 & 1/25/90 (6) Well construction completed 1/25/90

DRILLING GEOLOGIST Scott E. Iesikar ASSISTANT Mark Thomas CHECKED BY W. D. Flanigan

APPENDIX B

WIRE-LINE LOGS

WIRE-LINE LOGGING PARAMETERS

Hole No. BF 9 **Log Measured From:** Ground Level

Drilling Parameters

Depth 167.5 feet

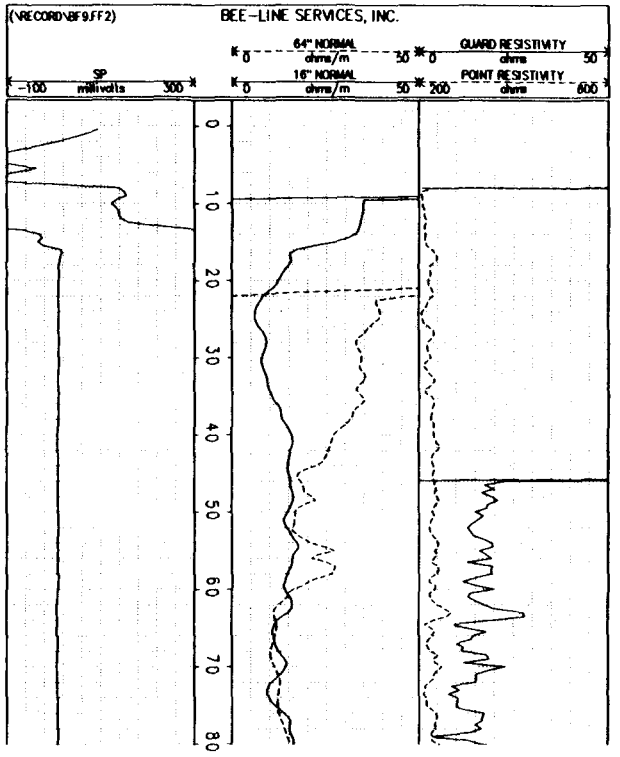
Bit Diameter 3.125 inches

Logging Parameters	Electrical Log	Gamma Log	Sonic Log
Date	January 23, 1990	January 23, 1990	January 23, 1990
Bottom Log Interval	166.5 feet	166.5 feet	161.9 feet
Top Log Interval	surface	surface	surface
Type of Fluid in Hole	drilling fluid	drilling fluid	drilling fluid
Time Since Circulation Stop	30 min.	30 min.	30 min.
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 foot	0.5 foot	0.5 foot

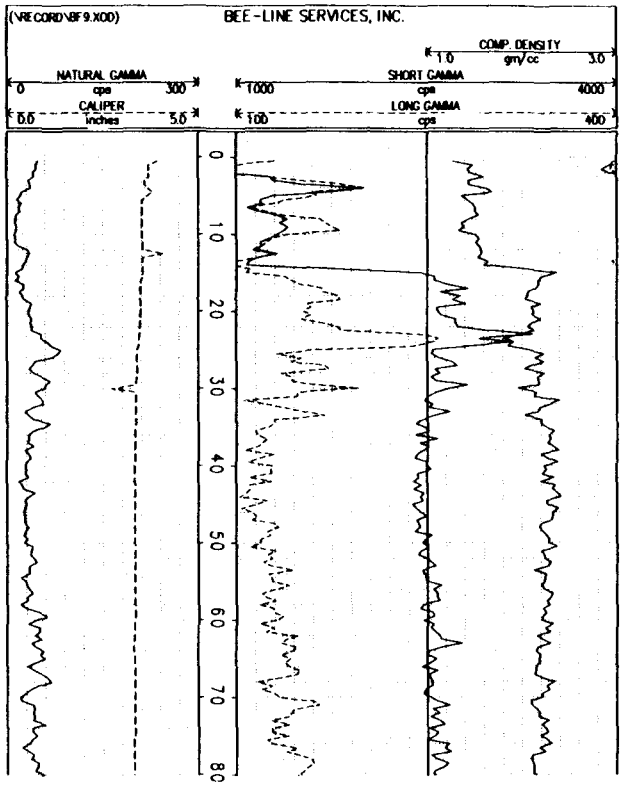
Logged by: **BEE-LINE SERVICES, INC.**
P. O. Box 2096
Corsicana, TX 75151

BF 9 Wire-line logs run January 23, 1990. Surface elevation 543.3 feet.

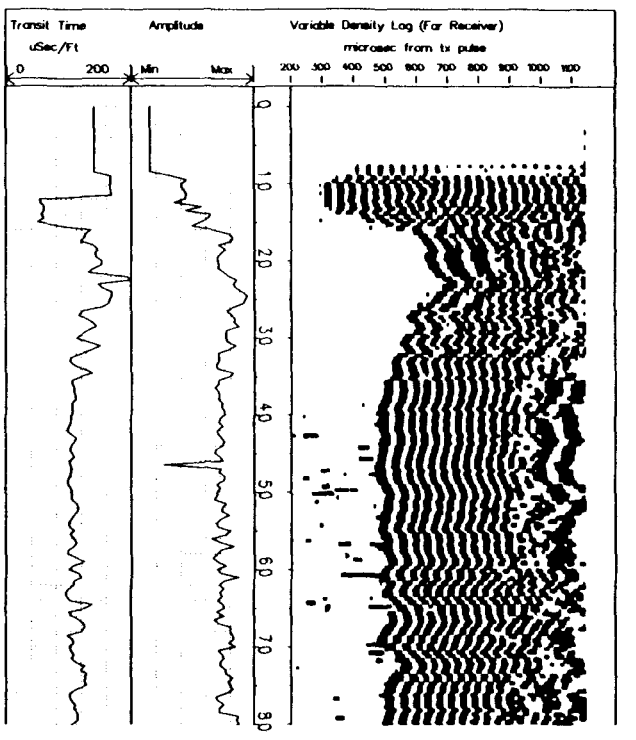
ELECTRICAL LOG



GAMMA LOG

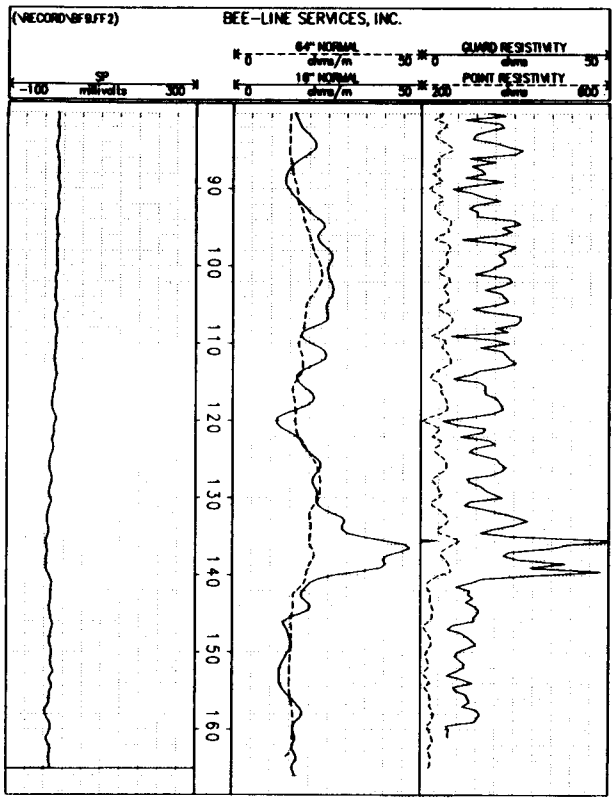


SONIC LOG

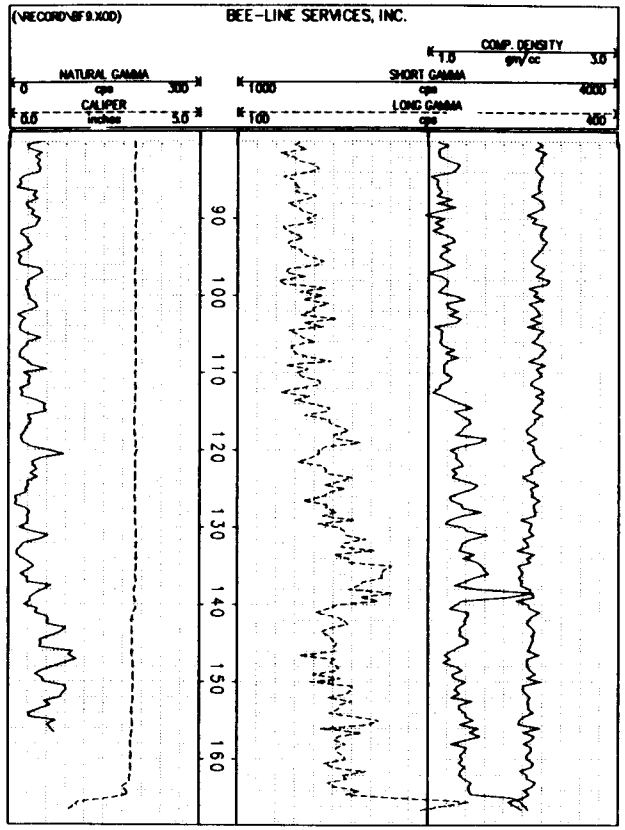


BF 9 Wire-line logs run January 23, 1990 (Continued). Surface elevation 543.3 feet.

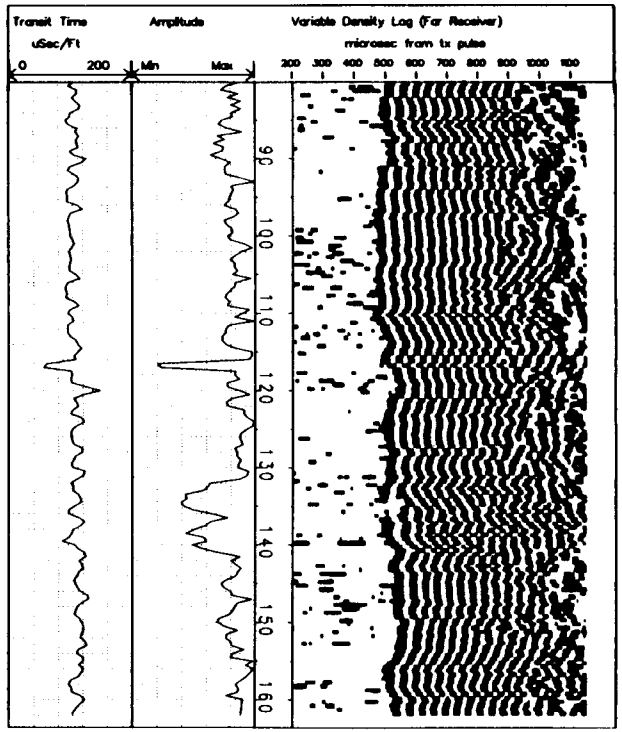
ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED



SONIC LOG CONTINUED



APPENDIX C

HYDROLOGIC TEST RESULTS

APPENDIX C

The overall objectives of the hydrologic (packer) tests were to provide estimates of the hydraulic conductivity within the Taylor Marl, Austin Chalk, and Eagle Ford Shale formations in unfractured zones, fractured or other suspected water-bearing zones, at the formation contacts, and at the tunnel elevation. 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 low flow rates, water was 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

Test Depth (feet)	Packer Pressure (psi)	Gauge Pressure (psi)	Formation/ Lithology	Hydraulic Conductivity (cm/sec)	Estimated Depth to Static Water Level* (feet)
91.3-112.4	125	20	Austin Chalk	5.8×10^{-7}	9.5
127.3-148.4	125	25.5	Austin Chalk (fractured)	3.1×10^{-5}	9.5

At boring BF 9, two test intervals were selected based on an inspection of the rock core and a review of the lithologic and wire-line logs. The upper test interval was selected to provide hydrologic conductivity data for unfractured Austin Chalk containing several thin slightly to moderately argillaceous beds. The lower test interval encompassed part of an area of Austin Chalk with numerous fractures which occurred from 128 feet to 153 feet. These hydrologic (packer) tests followed the general procedures outlined above. Packer and gauge pressures are listed in the table above along with the calculated hydraulic conductivity based on an approximate static water level. A monitoring well, built in the boring, is screened at the lower, fractured test interval.

* The hydraulic conductivity values presented are based on an estimated static water level 9.5 feet below the ground surface. When last measured, the water level was 15.9 feet below ground surface. Hydraulic conductivity values calculated from the test data would be lower for a static water level less than the estimated value.

APPENDIX D

LABORATORY RESULTS

GEOMECHANICAL TEST RESULTS – BORING BF 9

GENERAL LITHOLOGY	BORING DEPTH	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	ATTERBERG LIMITS		FRACTION FINER THAN	CARBONATE CONTENT	SAMPLE DIMENSION RATIO	SAMPLE FAILURE MODE/	UNCONFINED COMPRESSIVE STRENGTH	TRIAXIAL COMPRESSION		FAILURE STRAIN	TANGENT YOUNG'S MODULUS			POISSON'S RATIO	BRAZIL TENSILE STRENGTH	2ND CYCLE SLAKE DURABILITY INDEX	MODIFIED TABER ABRASION INDEX	SWELL PRESSURE INDEX	COMMENTS
					LL	PI	# 200 SIEVE		L/D	DEGREES *		CONFINING PRESSURE σ_3	DEVIATOR STRESS $\sigma_1-\sigma_3$		E50	UNLOAD/ RELOAD	σ_3						
	feet	percent	pcf				percent	percent			psi	psi	psi	percent	(psi)x10E5	(psi)x10E5	psi		psi	percent		psi	
AUSTIN CHALK	40.5	8.0	138.5	2.66																			
AUSTIN CHALK	40.9	7.7	139.0						2.3	D	2975			0.66	6.41		0						NOTE 1
AUSTIN CHALK	57.3	9.3	133.4						2.2	D	2406			0.67									
AUSTIN CHALK	57.7	8.9	134.3																				
AUSTIN CHALK	65.5	9.2	134.7																				
AUSTIN CHALK	65.9	8.9	134.5						2.3	D	2748			0.35	22.73		0						
AUSTIN CHALK	90.6	11.7	128.0																				
AUSTIN CHALK	90.8																				0.553		
AUSTIN CHALK	91.8	10.3	131.3						2.3	A		100	3478	0.43	8.33		100						NOTE 2
AUSTIN CHALK	92.2	9.3	136.6	2.69																			
AUSTIN CHALK	95.0	11.0	128.1																				
AUSTIN CHALK	95.4	10.1	129.8						2.3	A		200	3491	0.43	7.64		200						NOTE 2
AUSTIN CHALK	103.5	14.9	118.0																				
AUSTIN CHALK	103.7																				0.537		
AUSTIN CHALK	105.4	12.9	124.7																				
AUSTIN CHALK	105.8	10.3	130.2						2.2	D	1751			0.97	1.72		0						
AUSTIN CHALK	129.1	13.5	120.5						2.2	D	1485			1.46									
AUSTIN CHALK	129.5	14.4	118.7																				
PROCEDURE		ASTM-D2216		ASTM-D854	ASTM-D4318		ASTM-D422				ASTM-D2938	ASTM-D2664			ASTM-D3148			ASTM-D3148	ASTM-D3967	ISRM	ISRM	ISRM	

BF9PRT21.WK1
REVISION: 2.1
DATE: 06/05/90

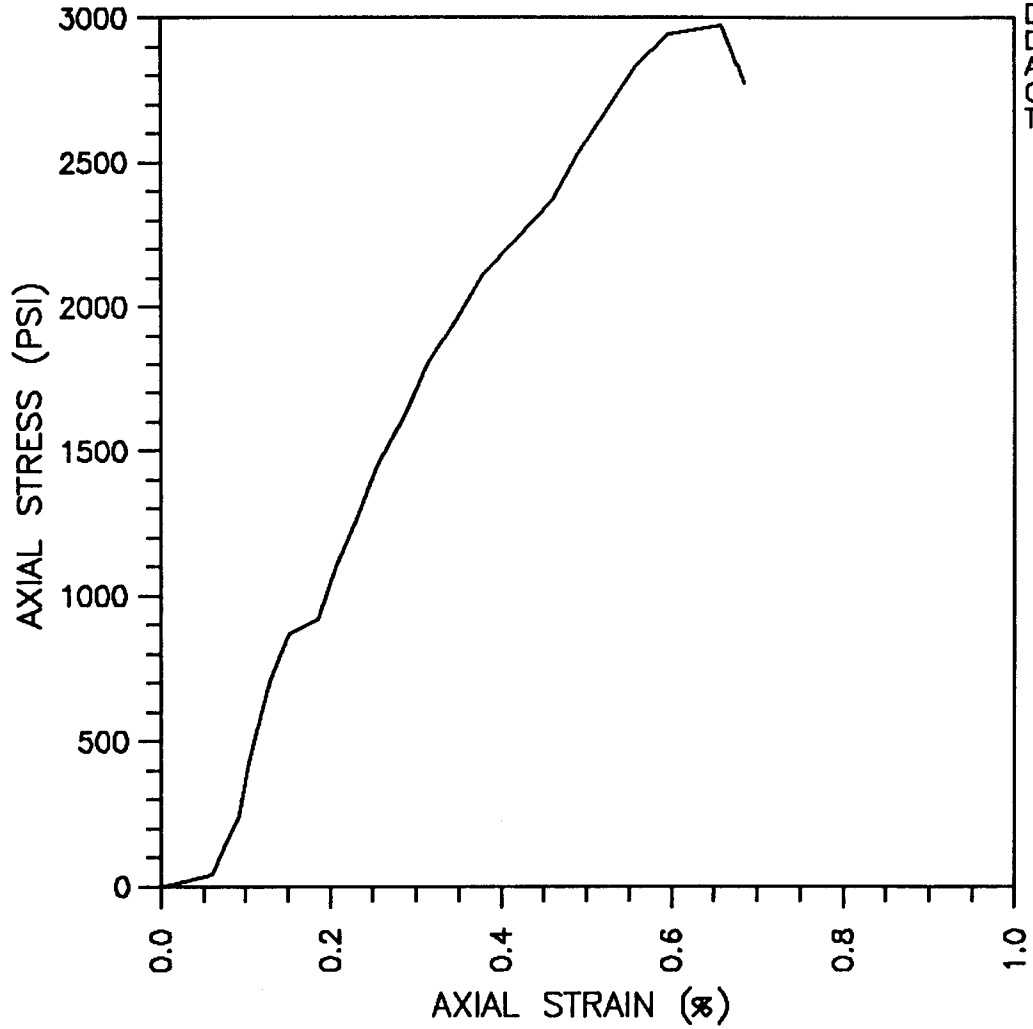
* EXPLANATION OF SAMPLE FAILURE MODE AS FOLLOWS.

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 pre–existing fracture, shear zone, etc.	F	No information

NOTES: 1) All moduli calculated from axial strains using a dial micrometer except where noted. Axial gage length is the sample length.

2) Load frame capacity exceeded. Sample not taken to failure. Modulus taken at 50 % of maximum stress.

BORING NO.: BF9
DEPTH (FT): 40.9
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 7.7
DRY UNIT WEIGHT (PCF): 139.0
DEG. OF SATURATION (%): 97.5
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

FILE: BF90409 DATE: 05-29-90 CAL: MCU3

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
6.410 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

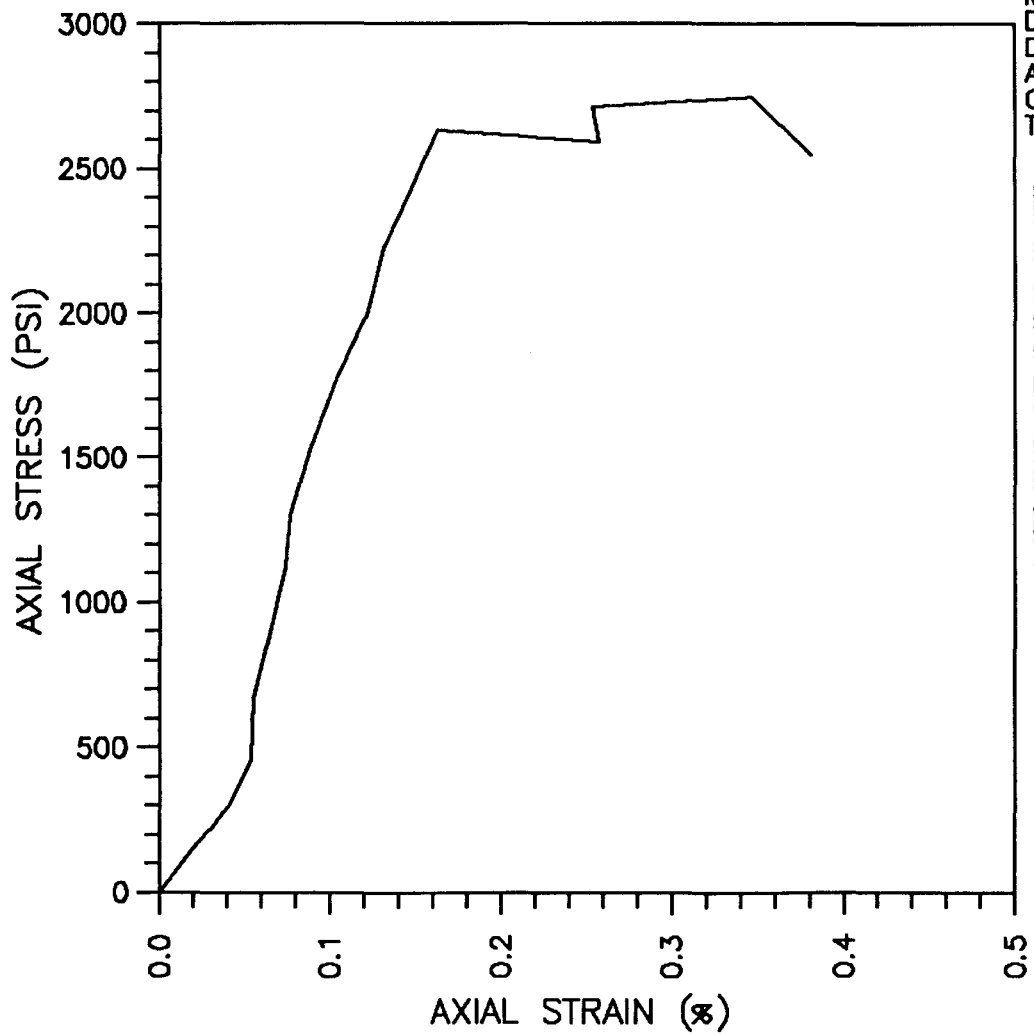
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.17

FIGURE

BORING NO.: BF9
DEPTH (FT): 65.9
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 8.9
DRY UNIT WEIGHT (PCF): 134.5
DEG. OF SATURATION (%): 95.3
ASSUMED SPECIFIC GRAVITY: 2.70
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

BFILE: BF90859 DATE: 05-29-90 CAL: MCU3

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
22.727 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

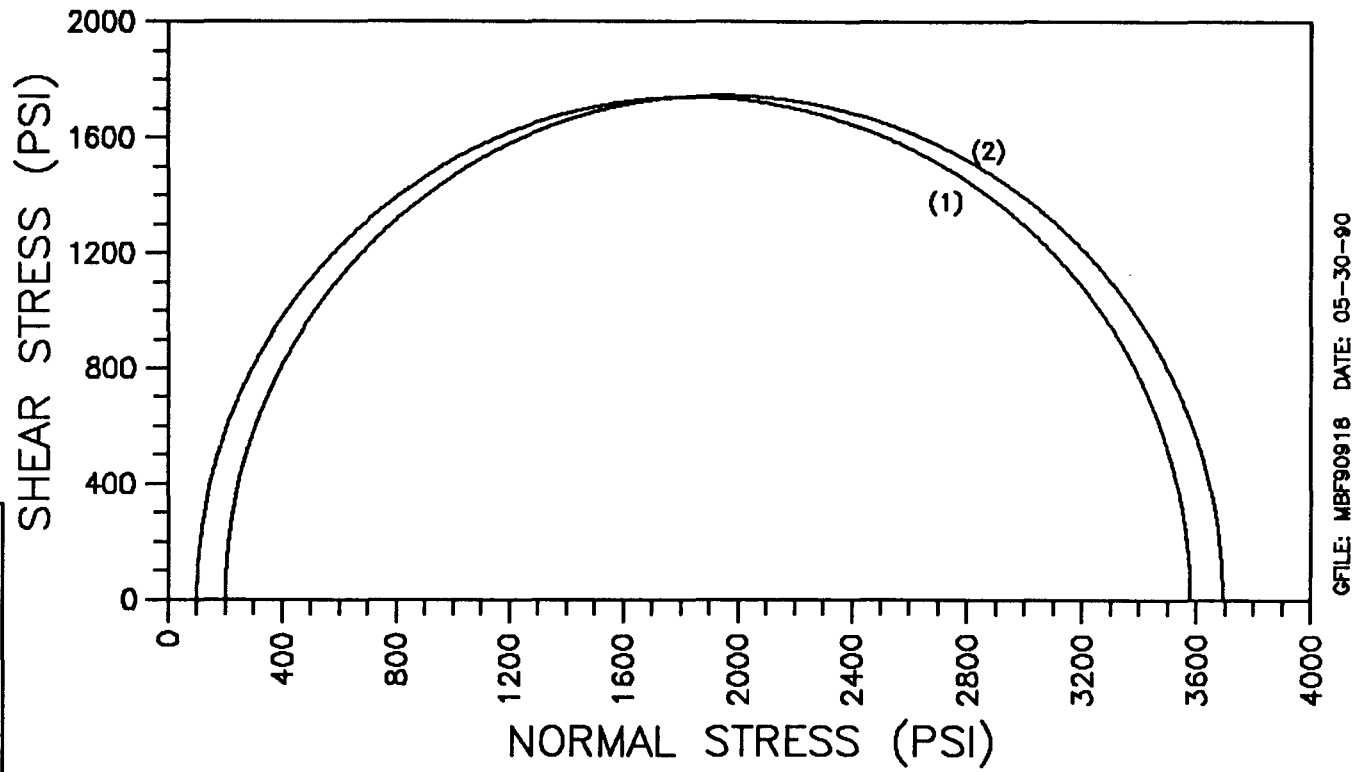
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.17

FIGURE

BORING NO.: BF9
DEPTH RANGE (FT): 91.8–95.8
AUSTIN CHALK LIMESTONE



GFILE: MBF90918 DATE: 05-30-90

SEE STRESS-STRAIN PLOTS
FOR INDIVIDUAL SAMPLE DATA

(1) DEPTH (FT): 91.8
(2) DEPTH (FT): 95.4

INCLINATION (DEG): VERTICAL
TEST TYPE: TRIAXIAL COMPRESSION (ASTM D2664)

TEXAS SSC SITE

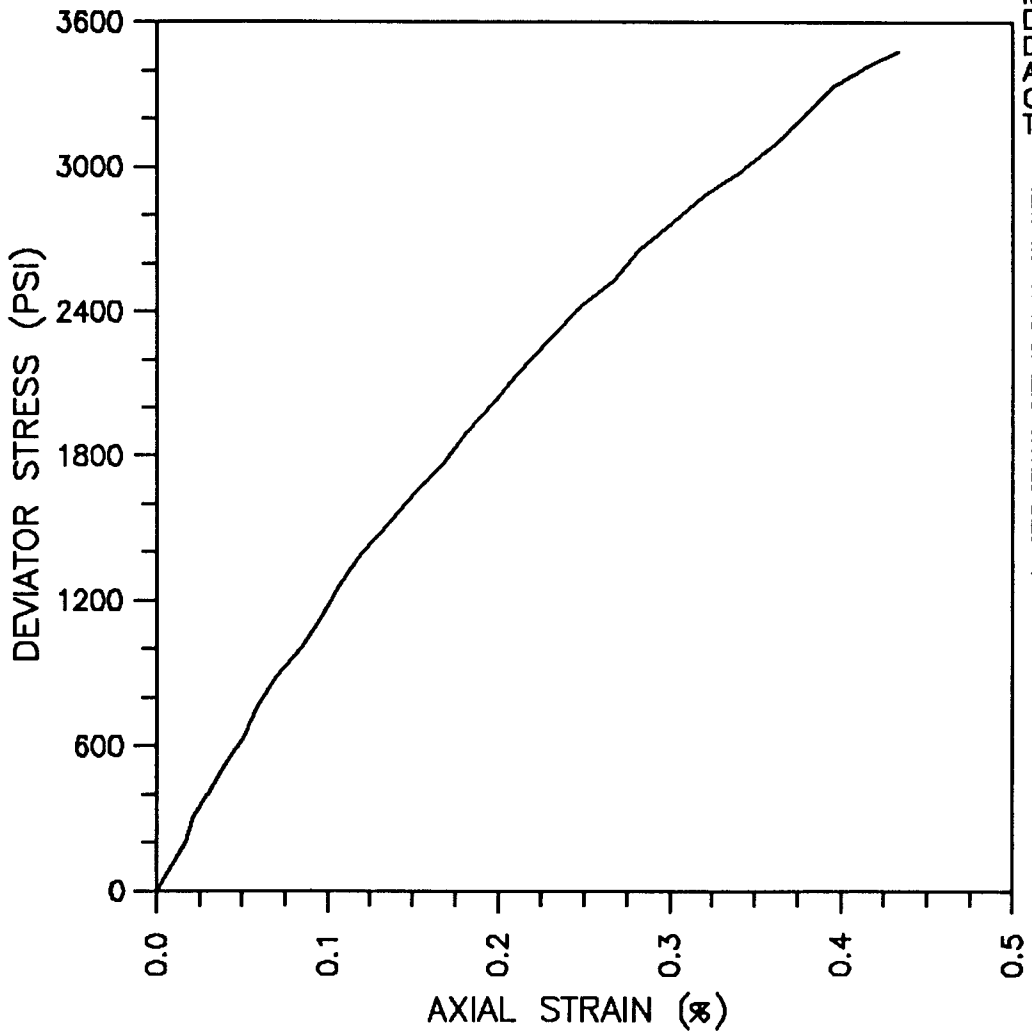
MOHR CIRCLE PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.17

FIGURE

BORING NO.: BF9
DEPTH (FT): 91.8
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 10.3
DRY UNIT WEIGHT (PCF): 131.3
DEG. OF SATURATION (%): 98.2
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 100
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

DFILE: BF90918 DATE: 05-31-90 CAL: MCT4

TANGENT MODULUS AT 50%
MAXIMUM STRESS:
8.333 x10E5 PSI

FAILURE MODE:
LOADED TO 3478 PSI
W/O FAILURE

TEXAS SSC SITE

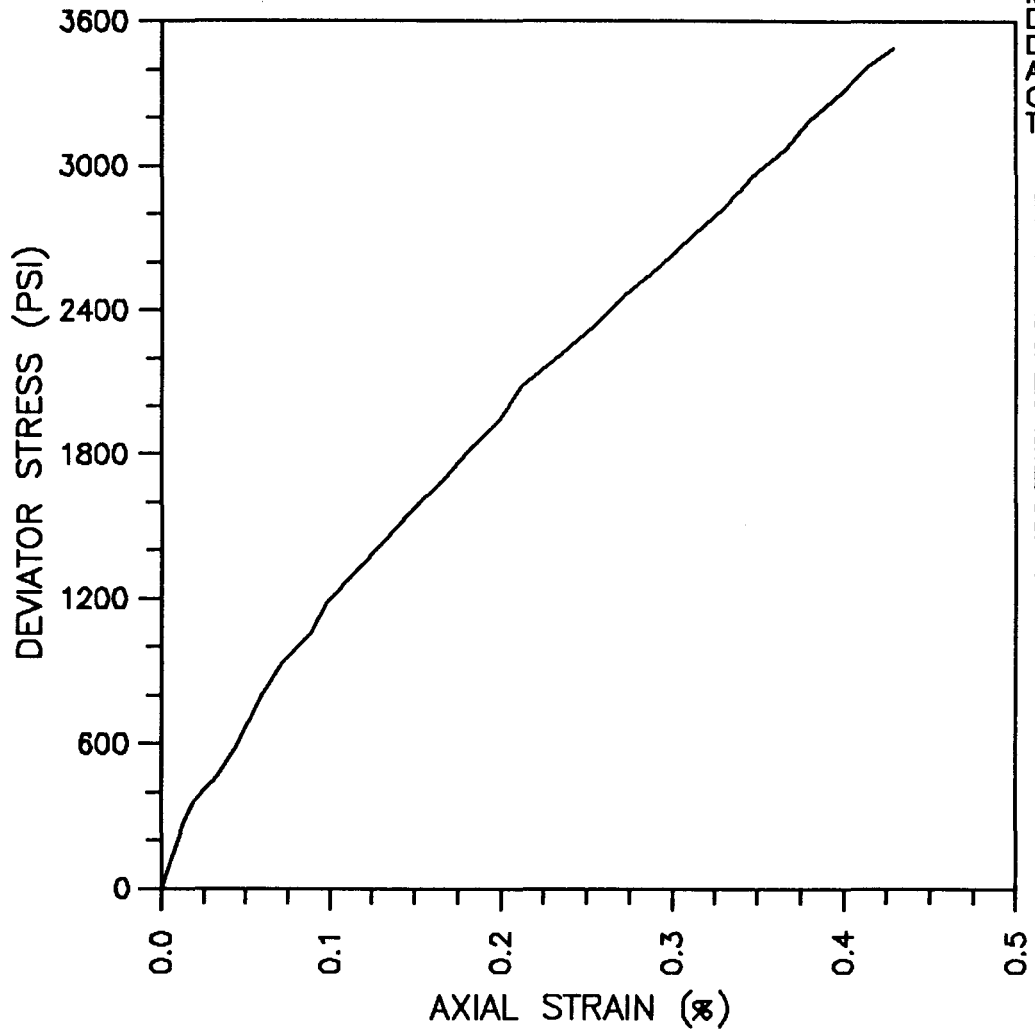
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.17

FIGURE

BORING NO.: BF9
DEPTH (FT): 95.4
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 10.1
DRY UNIT WEIGHT (PCF): 129.8
DEG. OF SATURATION (%): 91.3
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 200
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

FILE: BF90954 DATE: 05-31-90 CAL: MCT4

TANGENT MODULUS AT 50%
MAXIMUM STRESS:
7.643 x10E5 PSI

FAILURE MODE:
LOADED TO 3491 PSI
W/O FAILURE

TEXAS SSC SITE

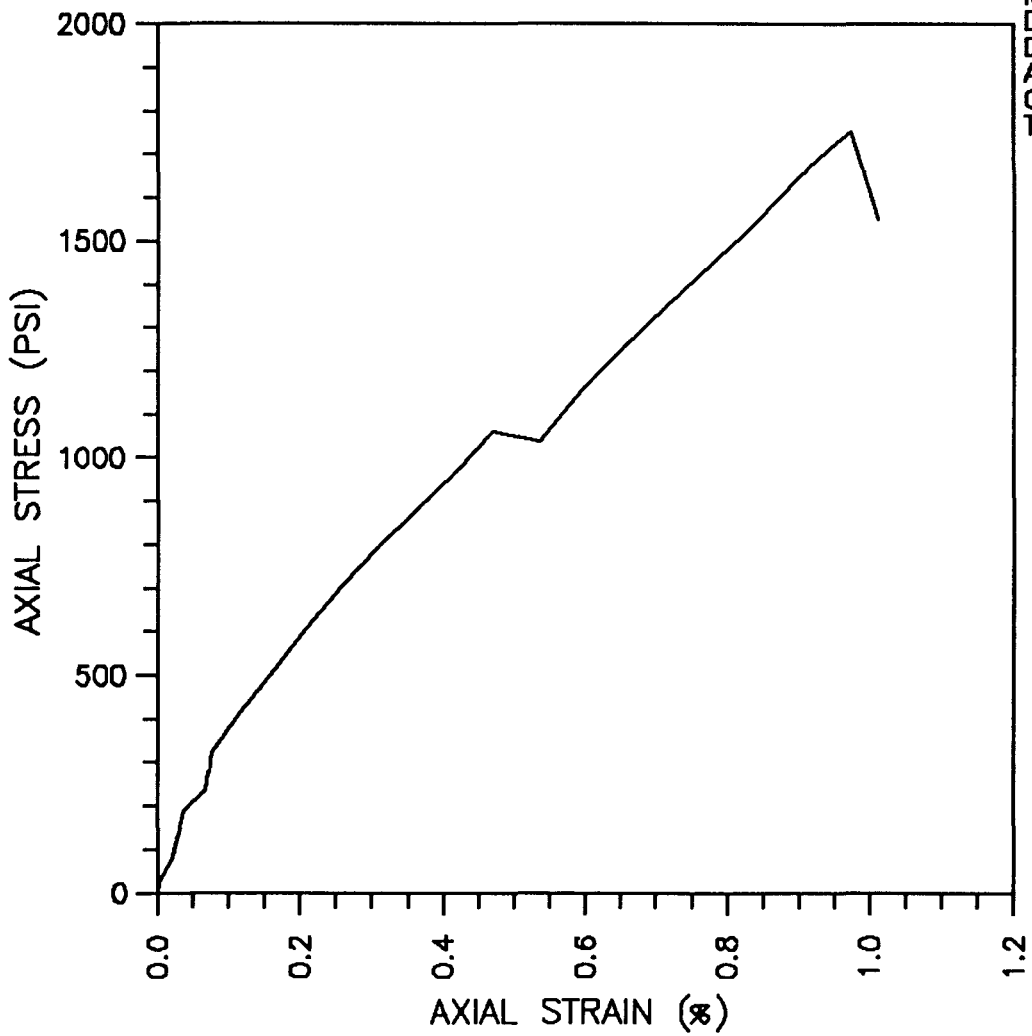
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.17

FIGURE

BORING NO.: BF9
DEPTH (FT): 105.8
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 10.3
DRY UNIT WEIGHT (PCF): 130.2
DEG. OF SATURATION (%): 95.1
ASSUMED SPECIFIC GRAVITY: 2.70
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

FILE: BF91058 DATE: 05-31-90 CAL: MCU3

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
1.724 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

STRESS-STRAIN PLOT

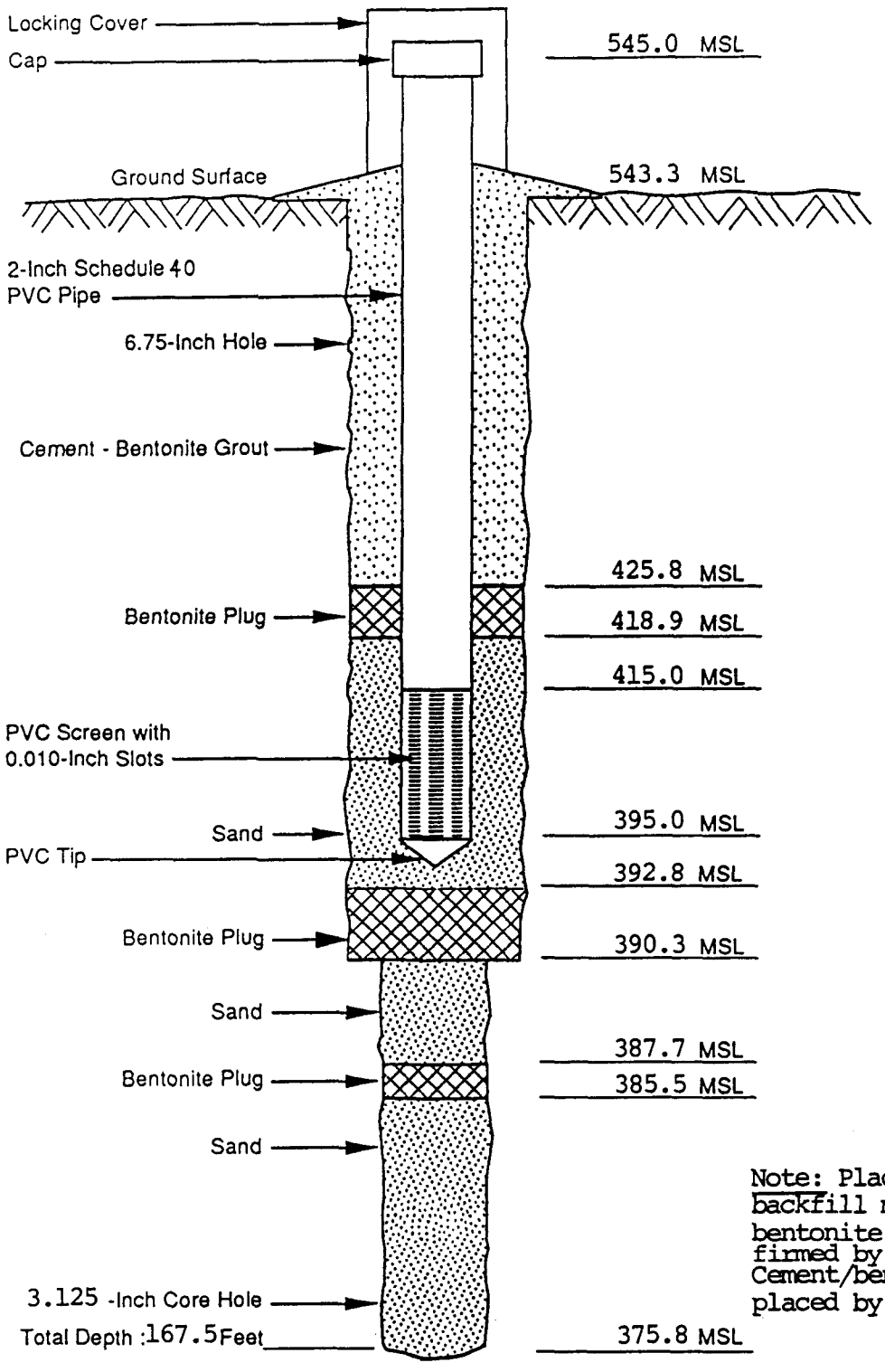
MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.17

FIGURE

APPENDIX E

WELL AS-BUILT DIAGRAM



Note: Placement depths of backfill materials (sand & bentonite pellets) were confirmed by manual measurement. Cement/bentonite slurry was placed by tremie.

NOT TO SCALE

Boring: BF 9
Location: N 214,885
E 2,189,515
Date(s) Installed: 1/24/90-1/25/90
Well Construction
Supervising Geologist: Scott E. Lesikar
Approved By: W.D. Flanigan Date: 5/15/90

Observation Well
No. BF 9

5/90 Figure