Engineers, Geologists, Chemists, Water Planners, Hygienists and Environmental Scientists

Raba-Kistner Consultants, Inc.

12821 W. Golden Lane
P.O. Box 690287, San Antonio, TX 78269-0287
(512) 699-9090 FAX (512) 699-6426

Project No. ASA91-020-00
July 8, 1991

Mr. Charles Daugherty
The PB/MK Team
Redbird Business Center, Building 5
5610 Redbird Center Drive, Suite 400
Dallas, Texas 75237

Re.: Geotechnical Report
N15 (E1) Loop/Connector Roadways and MTL Parking
Superconducting Super Collider

Dear Mr. Daugherty:

Submitted here is a report of shallow subsurface conditions along the Loop/Connector Roadways and in the MTL Parking area of the E1 Site of the Superconducting Super Collider in Ellis County, Texas. At the request of The PB/MK Team, our study was limited to field drilling activities and laboratory analyses of soil specimens gathered from the test borings. Engineering analyses and design recommendations concerning pavement sections for the proposed roadway/parking areas were not included within the scope of work for this study and, therefore, are not addressed in this report. This work was conducted under PB/MK Subcontract No. SC-A43-1013, dated February 4, 1991.

FIELD EXPLORATION AND LABORATORY TESTS

Borings Subsurface conditions at the sites were evaluated by six borings drilled at the locations shown on the Plans of Borings, Plates 1 and 2. Boring designations for the various study areas are tabulated below:

Study Area	Boring Designations
Loop Road	P-6, P-7, P-8
MTL Parking	P-9, P-10
Connector Road	P-11

The number of borings included in this study, their field locations, and their termination depths were selected by The PB/MK Team. Grid coordinates and surface elevations for the boring locations were provided by PB/MK, and are shown on the individual boring logs. The

borings were drilled in accordance with ASTM D 420 procedures to depths ranging from 5 to 6 ft below existing grades using a rotary drilling rig.

A field log was prepared for each boring by a staff geologist. Each log contains information concerning the boring method, drill crew, time of drilling, samples attempted and recovered, indications of the presence of various materials such as silt, clay, gravel, sand or rock, and observations of ground water.

The final logs represent our interpretation of the contents of the field logs for the purpose delineated by our client. The final logs are included in the Illustrations section of this report, Plates 3 through 8. A key to classification terms and symbols used on the logs appears on Plate 9.

Sampling The following samples were collected as a part of our subsurface exploration procedures:

Type of Sample	ASTM Procedure	Number Collected
Auger	D 1452	1
Split-Spoon		8
Undisturbed Shelby Tube	D 1587	8

Representative portions of all auger, split-spoon and tube samples were sealed to reduce moisture loss, placed in protective containers, and transported to our laboratory for testing.

Laboratory Testing In the laboratory, each sample was inspected and classified by a geotechnical engineer. The geotechnical engineering properties of the strata were evaluated by the following tests selected by PB/MK:

Type of Test	Procedure	Number Conducted
Atterberg Limits	ASTM D 2217 ASTM D 4318	6
Sieve Analysis	ASTM D 422	4

The results of all laboratory tests are presented in graphical or numerical form on the appropriate boring log.

GENERAL SITE AND SUBSURFACE CONDITIONS

Existing Conditions The project sites generally consist of open, grass-covered tracts of land most recently used for agricultural purposes and livestock grazing. The topography in the vicinity of the E1 Site is described as gently rolling, with the ground surface at these sites sloping downward in an east-southeasterly direction. Existing site drainage is considered to be fair to poor.

Stratigraphy The soils/rock underlying the proposed pavement areas can be divided into three generalized strata that possess similar physical and engineering characteristics, as described below.

Stratum I consists of light to dark brown clays and extends to depths ranging from 0.9 to 3.8 ft below existing grades in the test borings. These clays are indicated to be plastic to highly plastic, with measured liquid limits varying from 62 to 77 percent and corresponding plasticity indices varying from 35 to 44. Sieve analyses performed on specimens from this stratum indicate fines contents (soil particles passing the U.S. No. 200 sieve) ranging from 88 to 98 percent. Designated as CH soils under the Unified Soil Classification System (USCS), clays of this plasticity are generally recognized to possess moderate to high shrink/swell potential. Based on the results of hand penetrometer tests performed on undisturbed specimens, these clays exhibit very stiff to hard consistencies.

Stratum II consists of tan and yellow, calcareous, silty clays and extends to depths of 3 to 6 ft below existing grades in several of the test borings. These silty clays are visually assessed to be moderately plastic. Penetration resistance values recorded in these soils are typically in excess of 50 blows per 12 in. of sampler penetration, indicating hard clay consistencies.

Stratum III consists of tan, weathered limestone of the Austin Chalk Formation and extents to the 5 to 6 ft termination depths of the borings. Argillaceous seams are common on an intermittent basis within this formation.

Ground Water Ground water was not encountered either during or immediately upon completion of the drilling operations. Ground water seepage may exist on a transient basis within the weathered upper reaches of the Stratum III limestone, particularly following periods of heavy precipitation.

* * * * *

The following illustrations are attached and complete this report:

Plates 1 and 2	Plan of Borings
Plates 3 through 8	Logs of Borings
Plate 9	Key to Terms and Symbols

We appreciate the opportunity to be of service to you on this project. Please call should you have questions concerning the contents of this report, or other aspects of the project.

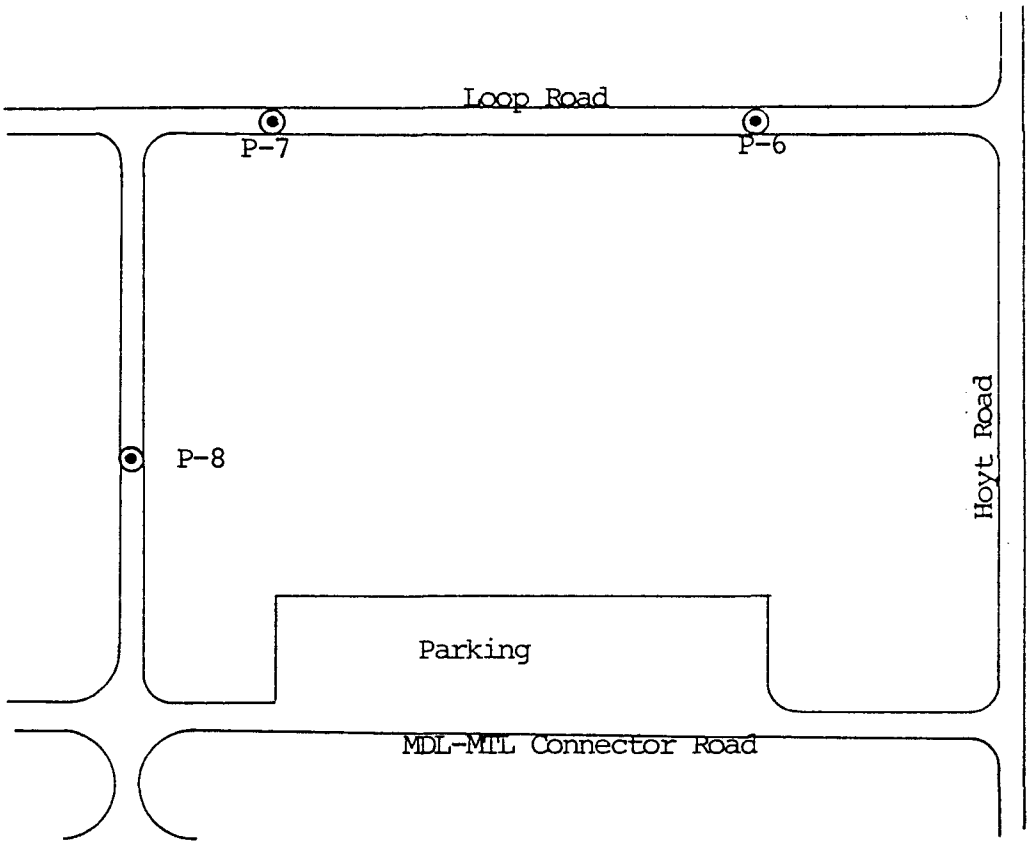
Very truly yours,

RABA-KISTNER CONSULTANTS,

A. Scot Harrell, P.E.
Project Manager

ASH/cad
Copies submitted: Above (4)

I L L U S T R A T I O N S



PLAN OF BORINGS

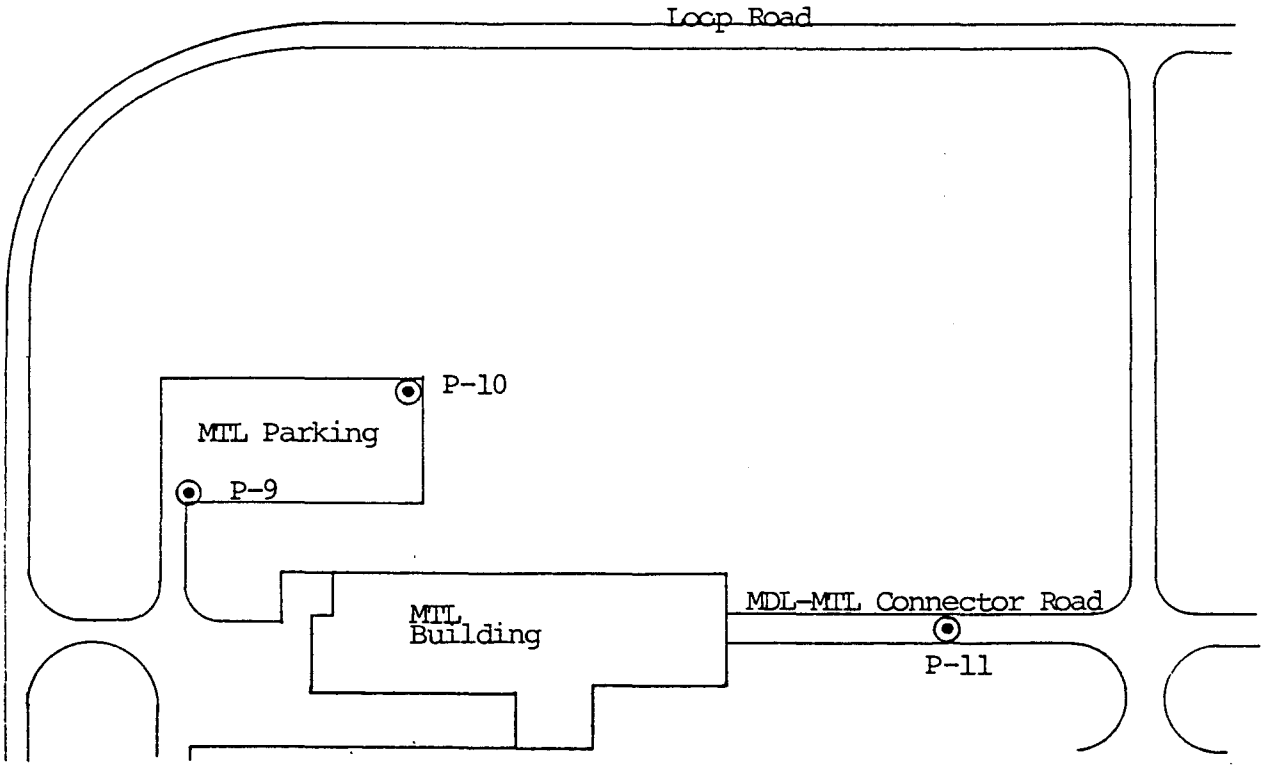
0 200 400

scale feet

Raba-Kistner Consultants, Inc.

Proj.No.ASA91-020-00

Plate 1



PLAN OF BORINGS

0 200 400

scale feet

Raba-Kistner Consultants, Inc.

Proj.No.ASA91-020-00

Plate 2

LOG OF BORING NO. P-6

(E1) LOOP/CONNECTOR ROADWAYS AND MTL PARKING - SSC PROJECT
WAXAHACHIE, TEXAS

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger

LOCATION: N6818860.00 / E2448765.00

SURFACE ELEVATION: 761.00'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	COHESION, TON/SQ FT (0.3 0.6 0.9 1.2 1.5 1.8 2.1) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	%-200
0			CLAY, Hard, Highly Plastic, Moist, Dark Brown with calcareous fragments	*			96
0.9'			LIMESTONE, Weathered, Soft to Moderately Hard, White to Tan - extremely weathered, very argillaceous from 0.9' to 2.4'				
5							
10							
15			START: 10:15 AM END: 10:30 AM				
20			GEOLOGIST: MICHAEL A. GILES				
25			DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON				
30							
35			BLOW COUNTS RECORDED: * = 22/13/37/4"				
40							
45							
50							

DEPTH DRILLED:	5.0'	DEPTH TO WATER:	Dry	PROJ. No.	ASA91-020-00
DATE DRILLED:	6-13-91	DATE MEASURED:	6-13-91	PLATE	3

LOG OF BORING NO. P-7

(E1) LOOP/CONNECTOR ROADWAYS AND MTL PARKING - SSC PROJECT
WAXAHACHIE, TEXAS

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger

LOCATION: N6819890.00 / E2448494.00

SURFACE ELEVATION: 761.00'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	COHESION, TON/SQ FT (⊗ ⊖) 0.3 0.6 0.9 1.2 1.5 1.8 2.1 / PLASTIC LIMIT + WATER CONTENT ● LIQUID LIMIT + / 10 20 30 40 50 60 70	%-200
0			CLAY, Very Stiff, Highly Plastic, Moist, Dark Brown with calcareous fragments				
2.8'				*			
5			LIMESTONE, Weathered, Soft to Moderately Hard, White to Tan with argillaceous seams				
10							
15			START: 10:30 AM END: 10:45 AM				
20			GEOLOGIST: MICHAEL A. GILES				
25			DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON				
30							
35			BLOW COUNTS RECORDED: * = 32/50/3"				
40							
45							
50							

DEPTH DRILLED:	5.0'	DEPTH TO WATER:	Dry	PROJ. No.	ASA91-020-00
DATE DRILLED:	6-13-91	DATE MEASURED:	6-13-91	PLATE	4

LOG OF BORING NO. P-8

(E1) LOOP/CONNECTOR ROADWAYS AND MTL PARKING - SSC PROJECT
WAXAHACHIE, TEXAS

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger

LOCATION: N6819503.00 / E2448542.00

SURFACE ELEVATION: 761.40'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	COHESION, TON/SQ FT (0.3 0.6 0.9 1.2 1.5 1.8 2.1) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	%-200
0	CLAY, Very Stiff, Highly Plastic, Moist, Dark Brown with calcareous fragments	*			96
1.2'	CLAY, Silty, Calcareous, Hard, Moderately Plastic, Slightly Moist, Tan and Yellow with limestone fragments (extremely weathered limestone)	**			
3.0'	LIMESTONE, Weathered, Soft to Moderately Hard, White to Tan				
5	START: 10:45 AM END: 11:05 AM				
10	GEOLOGIST: MICHAEL A. GILES				
15	DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON				
20	BLOW COUNTS RECORDED: * = 9/15/16 ** = 50/3"				
25					
30					
35					
40					
45					
50					

DEPTH DRILLED: 5.0'	DEPTH TO WATER: Dry	PROJ. No. ASA91-020-00
DATE DRILLED: 6-13-91	DATE MEASURED: 6-13-91	PLATE 5

LOG OF BORING NO. P-9

(E1) LOOP/CONNECTOR ROADWAYS AND MTL PARKING - SSC PROJECT
WAXAHACHIE, TEXAS

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger

LOCATION: N6818804.00 / E2447810.00

SURFACE ELEVATION: 767.10'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	COHESION, TON/SQ FT (0.3 0.6 0.9 1.2 1.5 1.8 2.1) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	%-200
0			CLAY, Hard, Highly Plastic, Moist, Dark Brown with weathered limestone inclusions	*			
2.0			LIMESTONE, Weathered, Soft to Moderately Hard, White to Tan with argillaceous seams				
5							
10							
15			START: 11:50 AM END: 12:10 PM				
20			GEOLOGIST: MICHAEL A. GILES				
25			DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON				
30							
35			BLOW COUNTS RECORDED: * = 50/6"				
40							
45							
50							

DEPTH DRILLED:	5.0'	DEPTH TO WATER:	Dry	PROJ. No.	ASA91-020-00
DATE DRILLED:	6-13-91	DATE MEASURED:	6-13-91	PLATE	6

LOG OF BORING NO. P-10

(E1) LOOP/CONNECTOR ROADWAYS AND MTL PARKING - SSC PROJECT
WAXAHACHIE, TEXAS

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger

LOCATION: N6819013.00 / E2447952.00

SURFACE ELEVATION: 767.50'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	COHESION, TON/SQ FT (0.3 0.6 0.9 1.2 1.5 1.8 2.1) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	%-200
0			CLAY, Hard, Highly Plastic, Moist, Dark Brown, 1.3'	*			98
5			LIMESTONE, Weathered, Soft, White to Tan with intermittent argillaceous seams and layers	**			
10							
15			START: 11:30 AM END: 11:45 AM				
20			GEOLOGIST: MICHAEL A. GILES				
25			DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON				
30							
35			BLOW COUNTS RECORDED: * = 50/5" ** = 17/50/2"				
40							
45							
50							

DEPTH DRILLED:	5.5'	DEPTH TO WATER:	Dry	PROJ. No.	ASA91-020-00
DATE DRILLED:	6-13-91	DATE MEASURED:	6-13-91	PLATE	7

LOG OF BORING NO. P-11

(E1) LOOP/CONNECTOR ROADWAYS AND MTL PARKING - SSC PROJECT
WAXAHACHIE, TEXAS

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger

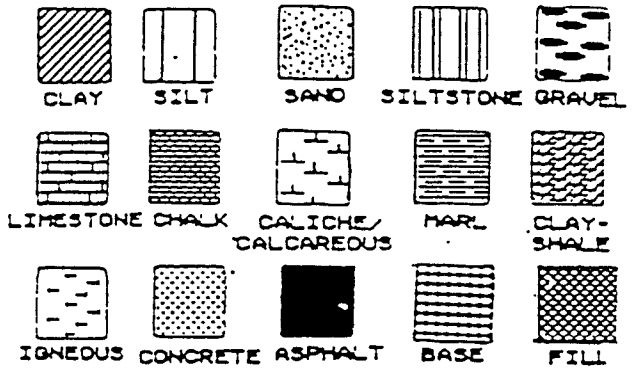
LOCATION: N6819029.55 / E2448481.75

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	COHESION, TON/SQ FT (0.3 0.6 0.9 1.2 1.5 1.8 2.1) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	%-200
			SURFACE ELEVATION: 761.40'				
			CLAY, Very Stiff, Plastic, Moist, Dark Brown to Light Brown with calcareous fragments				88
			3.8'	*			
5			CLAY, Silty, Calcareous, Hard, Moderately Plastic, Dry, Light Tan (extremely weathered limestone)				
10							
15			START: 11:15 AM END: 11:30 AM				
20			GEOLOGIST: MICHAEL A. GILES				
25			DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON				
30							
35			BLOW COUNTS RECORDED: * = 10/32/18/0.5"				
40							
45							
50							

DEPTH DRILLED:	6.0'	DEPTH TO WATER:	Dry	PROJ. No.	ASA91-020-00
DATE DRILLED:	6-13-91	DATE MEASURED:	6-13-91	PLATE	8

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL OR ROCK TYPES
(shown in symbols column)



SAMPLER TYPES
(shown in sample column)

STRENGTH TEST RESULTS

- Pocket Penetrometer
- Torvane
- Unconfined Compression

TRIAXIAL COMPRESSION

- Unconsolidated-undrained
- Consolidated-undrained
- C Cohesion (Total)
- ① Angle of Internal Friction (Total)
- C′ Cohesion (Effective)
- ① Angle of Internal Friction (Effective)

NOTE: Values symbolized on boring logs represent shear strengths unless otherwise noted.

TERMS DESCRIBING CONSISTENCY, CONDITION OR TEXTURE

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOIL MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc. 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided	having inclined planes of weakness that are slick and glossy in appearance
Fissured	containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical
Laminated	composed of thin layers of varying colors and texture
Interbedded	composed of alternate layers of different soil types
Calcareous	containing appreciable quantities of calcium carbonate
Well graded	having wide range in grain sizes and substantial amounts of all intermediate particle sizes
Poorly graded	predominantly of one grain size, or having a range of sizes with some intermediate size missing

TERMS DESCRIBING CONSISTENCY OR CONDITION

RELATIVE DENSITY		COHESIVE STRENGTH			PLASTICITY	
Penetration Resistance, blows per ft	Relative Density	Penetration Resistance, blows per ft	Consistency	Cohesion TSF	Plasticity Index	Degree of Plasticity
0-4	Very loose	0-2	Very Soft	0-0.125	0-5	None
4-10	Loose	2-4	Soft	0.125-0.25	5-10	Low
10-30	Medium Dense	4-8	Firm	0.25-0.5	10-20	Moderate
30-50	Dense	8-15	Stiff	0.5-1.0	20-40	Plastic
>50	Very Dense	15-30	Very Stiff	1.0-2.0	>40	Highly Plastic
		>30	Hard	>2.0		

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.