SANDERSON, TEXAS

IMMIGRATION AND NATURALIZATION SERVICE
BORDER PATROL STATION

FOUNDATION AND PAVEMENT DESIGN ANALYSIS

PREPARED BY

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FORT WORTH DISTRICT

ENGINEERING AND CONSTRUCTION DIVISION
DESIGN BRANCH

GEOTECHNICAL SECTION

CESWF-EC-DG

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1. General. – This report provides subsurface information, and foundation and pavement design recommendations for a new Border Patrol Station at Sanderson, Texas. The 1,310 GSM single-story structure will incorporate 2 x 6 wood framing supporting wood trusses, except at the detention area, where non-load bearing exterior CMU walls will be used. The architectural finish systems include an EIFS (exterior insulating finish system) façade and standing seam metal roofing. Support features include parking areas, access drives, a Sallyport, Fuel Islands (future), utilities, landscaping, and site improvements.

The project site is located east of Sanderson, Texas and at the northwest corner of the intersection of U.S. Highway 90 and Highland Plaza Avenue. Currently, the 13.6-hectare parcel is void of any obstacles to construction, other than dense growths of scrub brush. Topographically, the ground surface slopes gently downward from the northwest to the southeast at an approximate rate of 1 percent. Existing grades within the proposed building footprint vary from approximate elevations 865.0 to 868.0 meters (NGVD). A finish floor elevation of 866.75 meters (NGVD) was established at the time of this report.

2. Subsurface Investigation. – A total of eleven (11) test holes were performed during October 2000 by the U.S. Army Corps of Engineers, Fort Worth District. Borings 3ST-1 to 10A-11 were drilled to determine subsurface conditions and to obtain representative soil and rock samples for laboratory testing. The test holes were advanced using 8- and 10-inch diameter short-flight augers, a nominal 3-inch diameter Shelby-tube sampler, and a 4-inch diameter core barrel sampler. Samples recovered from selective borings were sealed in airtight containers and taken to the laboratory of TEAM Consultants, Incorporated (Arlington, Texas) for testing. The borings were drilled to depths ranging from 85.3 centimeters to 7.62 meters below existing grade at the time of drilling.

Groundwater conditions were monitored immediately upon completion of the test holes and 18 hours after drilling was completed. All of the holes remained dry after the respective observation period. It should be noted, however, that groundwater conditions are relative to the time of drilling, annual precipitation, and drainage conditions at the site.

The field investigation was performed using a conventional truck-mounted drilling rig and drilling attachments. Logging of the test holes was done in English units; however, results of the field investigation, as presented in this report, have been converted to the metric equivalent. Logs of borings and boring locations are shown on Plates LB1 and LB2 (Appendix A).

a. Dynamic Cone Penetrometer Testing. – Dynamic cone penetrometer (DCP) testing was performed within borings 3ST-1, 8A-6, 10A-7, and 8A-10. DCP test results are presented in Appendix D at the end of this report.

b. Soil Resistivity Testing. – One (1) soil resistivity test was performed near the location of test hole 8A4C-2. The resistivity value measured in the field is 37,342 ohms-cm. Soil resistivity test results are provided in the 'Remarks' column of the aforementioned boring (Appendix A).

3. Subsurface Conditions.

a. General Geology. – Sanderson, Texas lies within the western margin of the Edwards plateau. The area is characterized topographically by a moderately flat to gently sloping surface with some low hills and benches. Sanderson is underlain with limestone and marl, all belonging to the Segovia Group and Cretaceous in age.

b. Site Conditions. – Currently, the project site is a vacant parcel and void of any major obstacles to construction. This area is blanketed with small, dense growths of mesquite shrubs. Topographically, existing grades within the proposed building footprint vary from approximate elevations 865 meters to 868 meters (NGVD) in a southeast to northwest direction. Subsurface conditions encountered during the field investigation consist of low to medium plasticity clays (CL) and clayey sands (SC), all above limestone marl primary materials.

A dark brown clay was encountered at ground surface and to depths varying from 21.3 centimeters to 2.13 meters. The clays are mostly low plastic but contain some medium plastic zones. These soils are loose, very sandy (SC), silty, and slightly gravelly.

Beneath the overburden materials is a formation of limestone primary that extends to the total depth investigated, 7.62 meters. Initially, the primary is an interbedded limestone and marl that is weathered to a nodular cobble consistency. With depth, the primary becomes less weathered, jointed, and massive. Physically, the limestone is mottled red-yellow, white and red-brown, hard to very hard (Rock Classification), silty, arenaceous, and clastic.

Subsurface conditions representative of the project site are shown on the boring logs, Plate LB2, and on the Subsurface Profiles, Plates LB3 and LB4. The actual interface between material types may be far more gradual or abrupt than represented; therefore, actual subsurface conditions in areas not sampled may differ form those predicted. The nature and extent of variations across the site may not become evident until construction commences, and the actual construction process may alter subsurface conditions as well. If variations become evident at the time of construction, CESWF-EC-DG should be contacted to determine if the recommendations presented in this report need to be reevaluated.

4. <u>Testing.</u>

a. <u>Laboratory Testing.</u> – Representative soil and rock samples were subjected to laboratory testing for identification, moisture content, grain-size distribution, Atterberg limits, density, and strength. The accumulative test results are presented in English units in Appendix C. Results of identification and moisture content testing are shown on the individual boring logs, Plate LB2 (Appendix A).

The laboratory test results are also presented graphically in Appendix B as follows: Plasticity characteristics are shown on Plate 1, Plasticity Chart. Moisture content values are shown with respect to depth on Plate 2. Atterberg limits test results are shown with respect to depth on Plate 3. Dry density values of representative undisturbed samples and their corresponding moisture contents are shown with respect to depth on Plate 4.

Shear strength characteristics of the limestone primary were analyzed using unconfined compression testing. Selected for analysis were two samples of the weathered primary collected from borings 8A4C-2 and 8A4C-5 at approximate depths of 7.45 meters and 4.38 meters, respectively. Undrained shear strengths measured from these samples are 21.1 kPa and 38.8 kPa. Shear strength test results are presented in Appendix C.

b. <u>Field Testing.</u> - Dynamic Cone Penetrometer (DCP) testing was performed in borings 3ST-1, 8A-6, 10A-7, and 8A-10. A DCP consists of a steel rod with a steel cone attached to one end and a sliding single-mass hammer. The DCP test was performed by driving the steel cone into the soil using a 10.1-pound sliding hammer dropped from a height of 22.6 inches. The number of blows required for each 0.4 inch (10-mm) or higher of penetration is recorded as the "penetration per blow set"; therefore, the more penetration achieved per blow indicates that a "weaker" soil layer was encountered. Typically, penetration measurements are taken to a depth of 39.4 inches (1000 milimeters) or when refusal is achieved. Refusal is defined as the point when the cone cannot penetrate the soil more than 0.4 inches (10 millimeters). DCP test results are presented in Appendix D and are summarized in the table below.

Depth, mm	CBR, %	k, kPa
0 - 150	1 - 6	51 - 140
150 - 305	2 - 38	78 – 307
>305	7 - 100	160 - 504

5. Discussions. - The following discussions are provided in support of the foundation and pavement design recommendations made for the new Border Patrol Station.

a. Soil Activity Considerations. – Subsurface conditions at the building site consist of an upper stratum of low to moderately plastic clays that transition to clayey sand and silt deposits. These soils are present to approximate depths ranging from 0.30 to 1.52 meters below the existing grade. Moisture content testing indicates that the upper 30 centimeters of overburden is moisture deficient, but below this depth, the in situ materials become moisture satisfied. Atterberg limits testing performed on representative soil and rock samples indicate that liquid limits vary from 34 to 41 percent, plastic limits range from 16 to 25 percent (P.I.s = 10 to 23 percent), and moisture contents vary from 4.3 to 23.2 percent. Based on the laboratory test results, the soil and rock features are of low activity and will not be susceptible to shrink-swell effects when subjected to changing moisture conditions.

b. Foundation Design Considerations. – Preliminary foundation design guidance recommended a reinforced concrete ribbed mat slab or spot spread and/or continuous spread footings for supporting the proposed Border Patrol Station. Of the two systems, the ribbed mat slab is considered the best alternative because of the significant amount of fill that will have to be placed below the building floor slab. Placing footings in dissimilar materials or at different elevations is not desirable from a performance standpoint. The monolithic nature of the ribbed mat slab will allow the foundation to span or cantilever areas where a loss of support may occur. At this site, a loss of support condition corresponds to the potential for long-term consolidation within the fill materials. Adequate stiffness will be provided if interior ribs are spaced no further than 6 meters center-to-center and diagonal stiffener ribs are placed at each corner of the mat slab. In addition, interior and exterior beams should bottom at a uniform depth and at least 610 millimeters below outside finish grade. An allowable bearing capacity of 96 kPa (net) should not be exceeded when sizing the beams.

The ribbed mat foundation should be analyzed and designed as if the bearing materials will be active to limit the impact soil related movements will have on the building superstructure. Although the in situ conditions are nonexpansive, the ribbed mat slab should be designed to resist at least 25 millimeters of long-term settlement. As stated, differential settlement of the foundation is quite possible because of the magnitude of the fill that will be placed below the building floor slab.

c. Subgrade Preparation and Backfill Requirements. – Existing grades within the proposed building footprint vary from approximately elevations 865.00 meters to 868.00 meters (NGVD). The planned finish floor elevation is 866.75 meters (NGVD); therefore, both cut and fill operations will have to be performed to achieve the final subgrade elevation below the building floor slab. To this end, subgrade preparation should consist of removing all existing materials to elevation 865.75 meters (NGVD) and replacing with compacted nonexpansive backfill. Any additional fill required to achieve the final subgrade elevation below the building floor slab should be nonexpansive material as well. Prior to fill placement, the top 150 millimeters of exposed subgrade should be scarified and recompacted to the same density as required for nonexpansive fill.

d. Pavement Design Considerations. – There are seven (7) pavement structures being considered for this project. New flexible pavement will be provided for privately-owned (POV), government-owned and visitor parking areas, and access drives. Rigid pavement will be provided for entry aprons, the Sallyport, Fuel Islands (future), an apron around the maintenance shop, and a concrete apron in front of trash dumpster pads. Types of vehicles expected to occupy these pavements are light- to medium- duty passenger cars and trucks, two- and three-axle trucks, trash trucks, and fire/emergency medical vehicles.

The in situ strength of the lean clays was evaluated for pavement design considerations using dynamic cone penetrometer (DCP) testing. The DCP test takes blow counts measured in the field and correlates this data with the type of material tested to derive at CBR and modulus of subgrade reaction values. Based on DCP test results, the lean clays will be assigned a CBR value of 4 percent and a modulus of subgrade reaction (k) of 20.4 kPa/mm when compacted to 90 percent of laboratory maximum density (ASTM D 1557).

Laboratory test results indicate that the in situ soils are of low activity and should not be difficult to work. Therefore, the raw subgrade beneath new pavement structures will not have to be lime-stabilized to reduce the plasticity level of the soil.

6. Recommendations. – The following foundation and pavement design recommendations are based on results of the field investigation, laboratory testing, and engineering studies.

a. Foundation Design Recommendations. – The proposed Border Patrol Station should be supported on a reinforced concrete ribbed mat slab. The mat slab should consist of a floor slab and a network of interior and exterior beams constructed to interact monolithically. The ribbed mat should be analyzed and designed in accordance with the SWD Engineering Instruction Manual (AEIM) – Chapter IV, **Engineering Technical Letter 1110-3-471**, and the following recommendations.

Interior and exterior beams should bottom a minimum of 610 millimeters below outside finished grade. Interior beams should be placed at intervals not to exceed 6 meters, should intersect beneath columns, and should be placed beneath all load-bearing and masonry walls. Diagonal stiffener beams should be placed at each corner of the mat slab. An allowable bearing capacity of 96 kPa (net) should be used to size the beams. For this phase of design, it should be noted that (1) the structural load is supported solely on the beam and the beam intersections, (2) load transfer occurs over the effective beam width, and (3) the beam and soil remain in contact. Beam intersections should be widened at column locations to accommodate the above allowable bearing value for the anticipated load condition. The load used to size the beams should consist of full dead load plus that portion of the live load that acts more or less continuously, usually 50 percent.

The ribbed mat slab should incorporate adequate stiffness such that the deformations do not exceed the structural tolerance of any elements in the foundation or superstructure. Analyses should consider a vertical separation of the foundation slab and beams from the subgrade of 25 millimeters at the outside of all perimeter beams, with a loss of support beneath the foundation over a horizontal distance of not less than 2.0 meters. This loss of support condition corresponds to long-term consolidation of the fill materials.

A modulus of subgrade reaction equal to 54.3 kPa/mm should be used when analyzing the ribbed mat slab to determine in-service deformations. This value, however, should be factored to account for width effects such that $k_{design}=k_1(.3048B_{eff})$, where B_{eff} is the effective beam width in meters. Design of the ribbed mat slab may use the SWD-AEIM sections as a minimum stiffness "first approximation".

The mat slab will, by design, be supported on-grade. A polyethylene vapor barrier (6-mil) and a minimum 150-millimeter capillary water barrier should be placed beneath the mat slab.

(1) Subgrade Preparation and Fill Requirements. - Subgrade preparation should consist of removing all existing materials to elevation 865.75 meters (NGVD) and replacing with compacted nonexpansive backfill material. Any additional fill needed to raise the subgrade to the final elevation below the building floor slab should be nonexpansive material as well. The upper 150 millimeters of subgrade exposed after excavation operations should be scarified and recompacted to the same density as required for nonexpansive fill. Nonexpansive fill should be placed in controlled lifts not exceeding 205 millimeters in loose thickness and compacted to not less than 92 percent maximum density as determined in accordance with ASTM D 1557. It should be noted that on-site materials can be used as nonexpansive fill if they meet the material definition provided in this report.

(2) Below-Grade Structures. – The following information is provided for the design of all below-grade structures. An at-rest lateral earth pressure coefficient (k_0) of 0.55, an angle of internal friction (ϕ) of 28°, a cohesion value (c) of 4.8 kPa, and an allowable bearing capacity of 96 kPa (net) should be used. The backfill material should be assumed to have a moist unit weight of 2000 kg/m^3 and all backfill should be nonexpansive material.

(3) Drainage and Landscaping. – Proper drainage is an important design consideration to ensure satisfactory long-term foundation performance. Exterior grading

adjacent to the completed building should be sloped away from the structure a minimum of 5 percent for the first 3 meters. Runoff from the roof should be adequately discharged away from foundation edges. In no case shall water be allowed to pond adjacent to or beneath the building, both during and after construction.

Landscaping adjacent to the building should be kept to a minimum. Large trees and bushes should not be placed closer to the foundation than its mature "umbrella" width. Maintaining a growth of grass around the facility is recommended. Installing an irrigation system adjacent to the foundation is not advisable unless this system and the drainage conditions around the building are maintained over the life of the structure.

(4) Mechanical Connections. – All exterior mechanical connections should be of the flexible type. Flexible connections should be capable of resisting a minimum of 25 millimeters of both vertical and horizontal movements. All condensate lines should drain away from foundation edges.

(5) Foundation Material Definitions.

(a) Satisfactory Materials. - Satisfactory Materials include materials classified in ASTM D 2487 as GW, GM, GC, GP, SW, SP, SC, CL, and CH and shall be free of trash, debris, roots, or other organic matter, or stones larger than 76 millimeters in any dimension.

(b) Unsatisfactory Materials. - Unsatisfactory Materials include materials classified in ASTM D 2487 as Pt, OH, OL, ML, MH and any other materials not defined as satisfactory.

(c) Nonexpansive Soils. - Nonexpansive Soils shall be satisfactory material having a plasticity index not less than 4 nor greater than 12 when tested in accordance with ASTM D 4318.

(d) Cohesionless and Cohesive Materials. - Cohesionless Materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive Materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

(e) Capillary Water Barrier. - Capillary Water Barrier shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 38 millimeters and no more than 2 percent by weight shall pass the 4.75-millimeter (No. 4) size sieve.

b. Pavement Design Recommendations. - The following pavement sections are based on criteria contained in Army Technical Manuals *TM 5-822-2/AFM 88-7, Chapter 5* and *TM 5-822-5/AFM 88-7, Chapter 1*.

(1) Rigid Pavement. – The pavement section presented below is recommended for the entry aprons, Sallyport, Fuel Islands, an apron around the Maintenance Shop, and for a minimum distance of 4.5 meters in front of trash dumpster pad(s). It is based on a Design Index of 4 (Category IV, Class E), a modulus of subgrade reaction equal to 20.4 kPa/mm, and a concrete flexural strength of 4.48 MPa at 28 days.

150mm Portland Cement Concrete reinforced with No. 13 bars spaced 406 millimeters o.c.e.w.

150mm Aggregate Base Course compacted to at least 95 percent of maximum laboratory density (ASTM D 1557)

150mm Raw Subgrade compacted to at least 90 percent of maximum laboratory density (ASTM D 1557)

(2) Flexible Pavement. – The following pavement section should be used for the parking areas and access drives. It is based on Category III Traffic and a Class D Street (DI=3), and a CBR value of 4 percent for the raw subgrade when compacted to 90 percent of laboratory maximum laboratory density.

50mm Hot-Mix Surface Course

205mm Aggregate Base Course compacted to at least 100 percent of maximum laboratory density (ASTM D 1557)

180mm Subbase Course compacted to at least 95 percent of maximum laboratory density (ASTM D 1557)

150mm Raw Subgrade compacted to at least 90 percent of maximum laboratory density (ASTM D 1557)

(3) Pavement Material Definitions.

(a) Hot-Mix Surface Course. - Aggregates and asphaltic materials shall conform to the requirements of the Texas Department of Transportation, Standard Specifications for Construction of Highways, Streets and Bridges, (TXDOT, Std Spec), Items 300 and 340. The paving mixture shall conform to the requirements for type "D" (Fine-Graded surface course) grading. Asphaltic material for the paving mixture should be asphaltic cement, viscosity grade AC-20. Edit Fort Worth District copy of CEGS-02741.

(b) Prime and Tack Coats. - Asphaltic material for the prime coat shall be cut-back asphalt, grade MC-30, or emulsified asphalt, grade SS-1, conforming to the requirements of TXDOT, Std Spec, Item 300, Asphalts, Oils, Emulsions. Prime coat should be applied to the surface of the aggregate base coarse. Asphaltic material for the tack coat shall be cut-back asphalt, grade RC-250, or emulsified asphalt, grade SS-1, conforming to the requirements of TXDOT, Std Spec, Item 300, Asphalts, Oils, Emulsions. Tack coat should be applied to all surfaces that contact new asphalt pavement. Edit CEGS-02748.

(c) Aggregate Base Course. - Aggregates shall conform to the requirements of the Fort Worth District copy of CEGS-02722. The gradation should conform to the requirements of TXDOT, Std Spec, Item 247 for Type “A”, Grade 1 Material.

(d) Subbase Course. – The material shall meet the requirements of CEGS-2721, having a minimum CBR value of 20 percent.

(e) Raw Subgrade. – Material should conform to the requirements of CEGS-02300.

References.

- Laboratory Test Results - TEAM Consultants, Incorporated, Report No. 002070C
- TM 5-822-5/AFM 88-7, Chapter 1 - Pavement Design for Roads, Streets, Walks, and Open Storage Areas
- TM 5-822-5/AFM 88-7, Chapter 5 - General Provisions and Geometric Design For Roads, Streets, Walks, and Open Storage Areas
- TM 5-818-5/AFM 88-3, Chapter 7 - Soils and Geology Procedures for Foundation Design of Buildings and Other Structures (Except Hydraulic Structures)
- ETL 1110-3-471 Design and Construction of Conventionally Reinforced Ribbed Mat Slabs

APPENDIX A

BORDER PATROL STATION
SUBSURFACE PROFILE

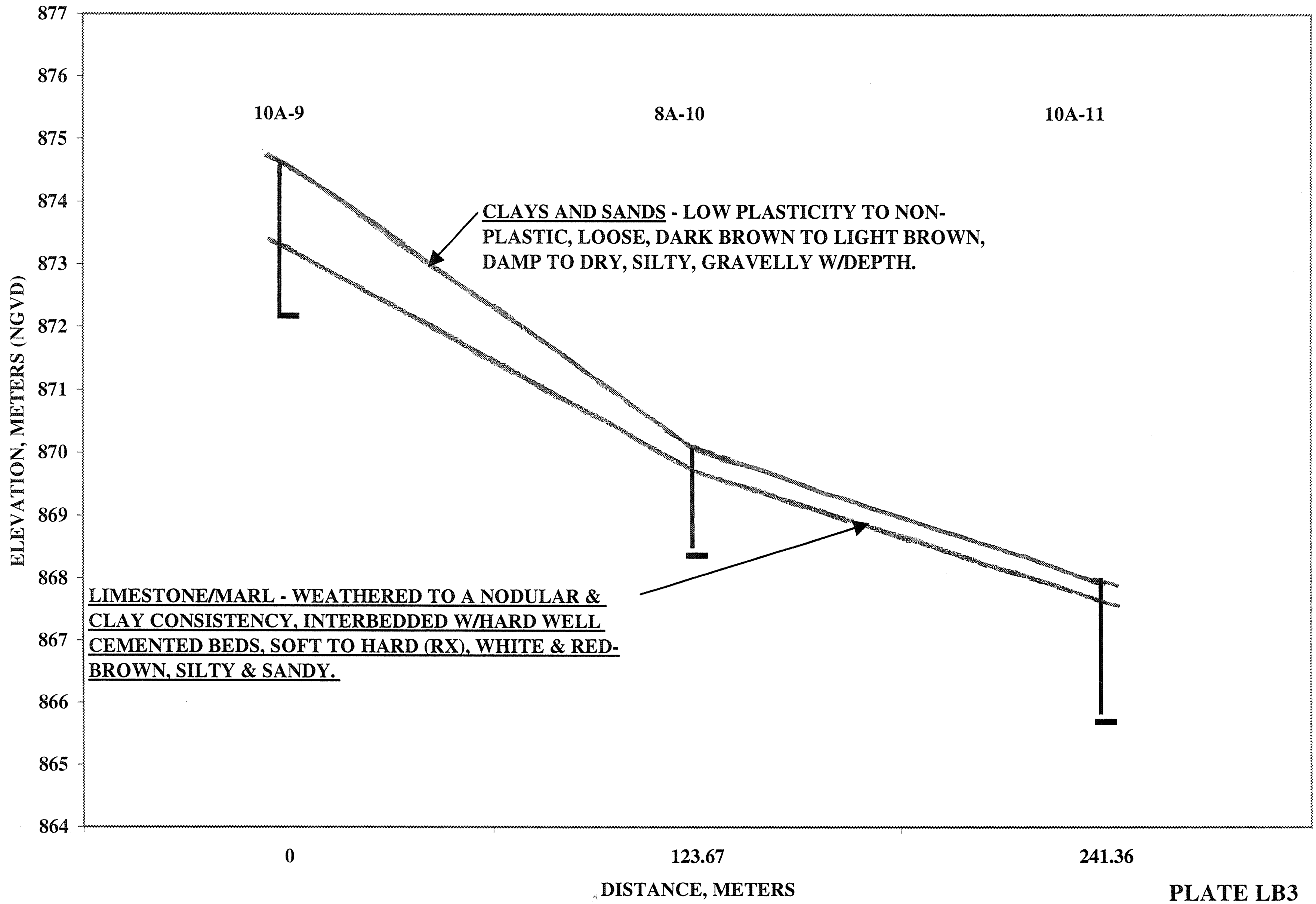


PLATE LB3

BORDER PATROL STATION
SUBSURFACE PROFILE

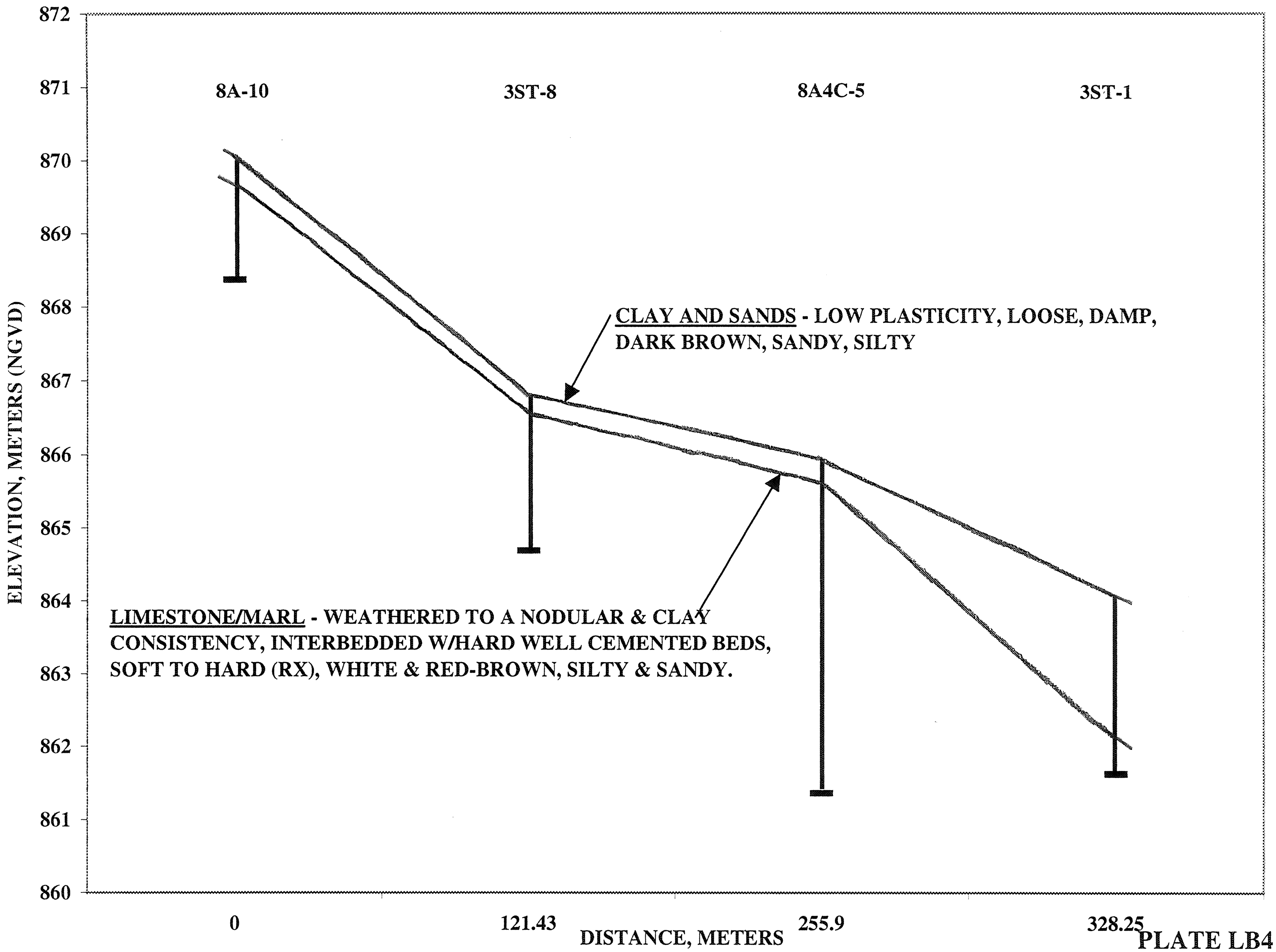


PLATE LB4

APPENDIX B

BORDER PATROL STATION
PLASTICITY CHART

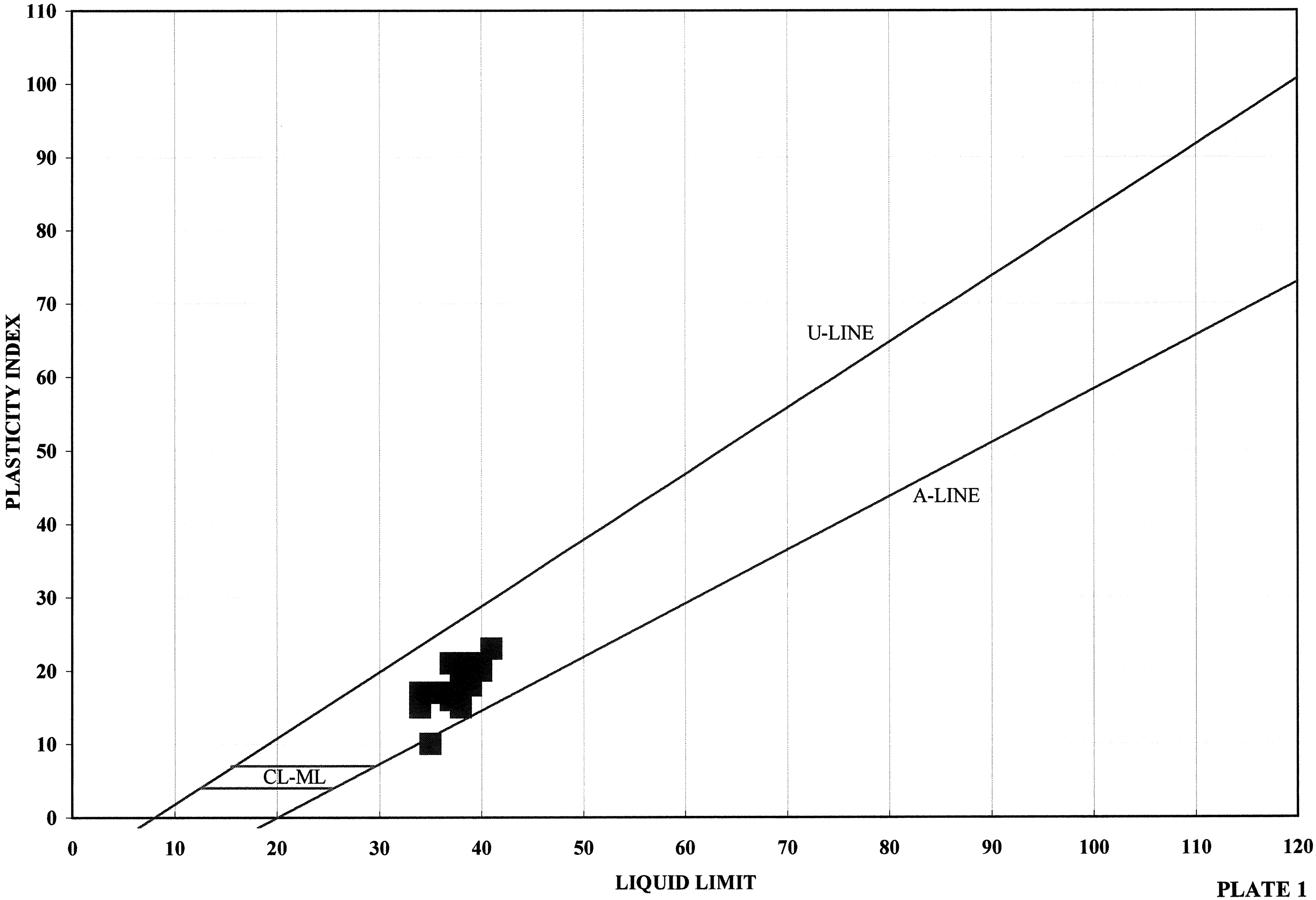


PLATE 1

BORDER PATROL STATION
MOISTURE CONTENT VS. DEPTH

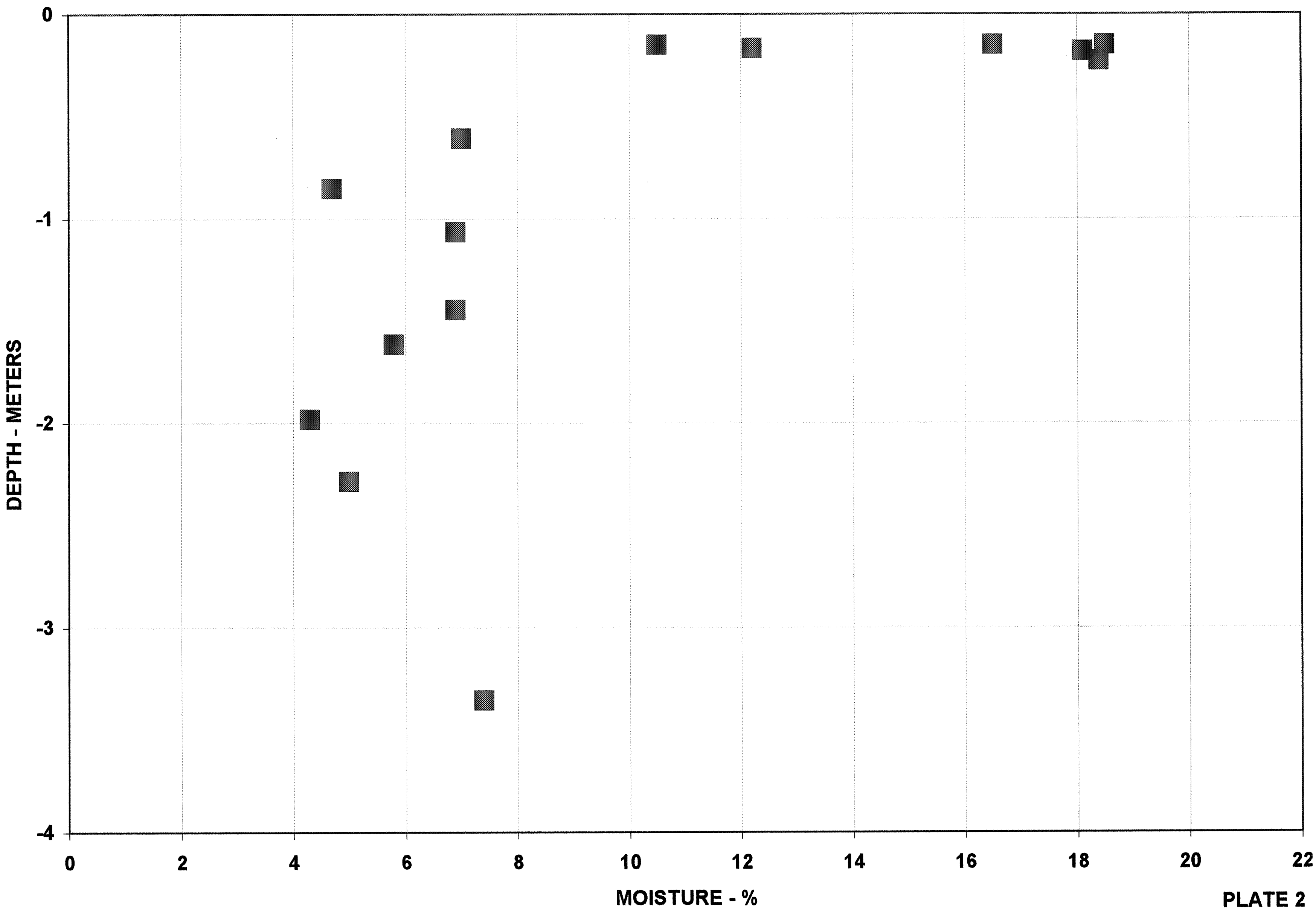


PLATE 2

BORDER PATROL STATION
ATTERBERG LIMITS VS. DEPTH

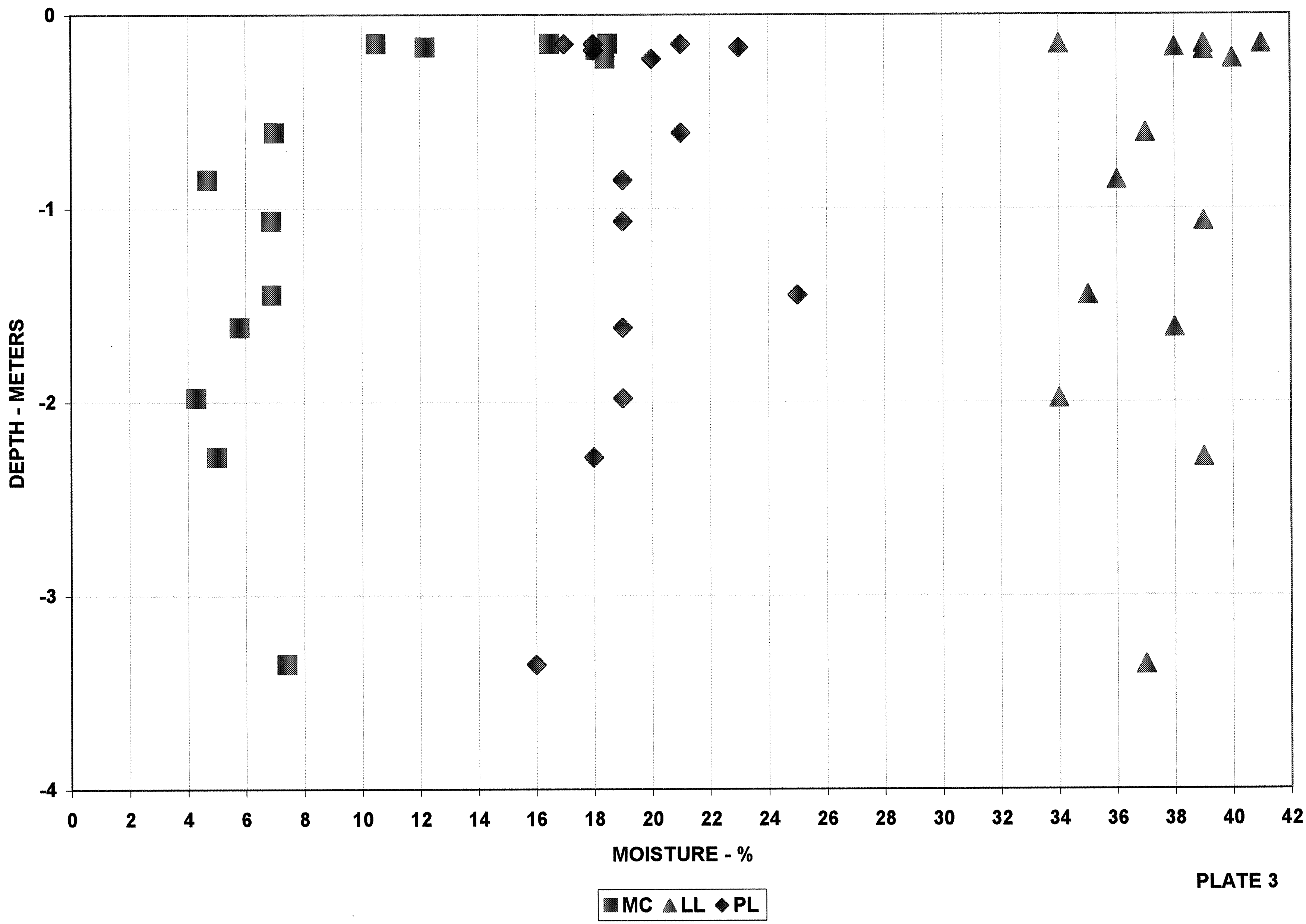


PLATE 3

BORDER PATROL STATION
MOISTURE CONTENT-DRY DENSITY VS. DEPTH

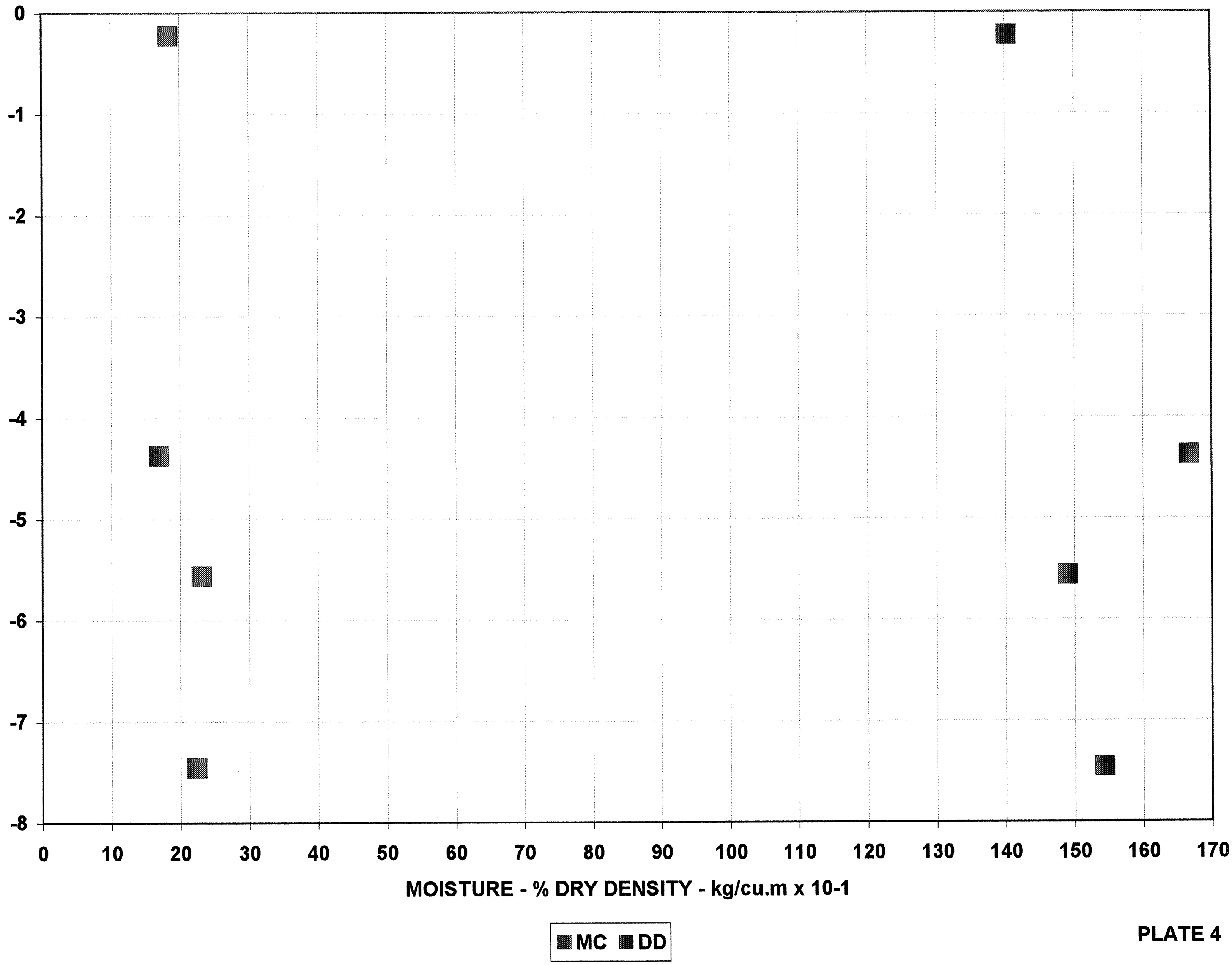


PLATE 4

APPENDIX C

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
INS BORDER PATROL STATION
SANDERSON, TEXAS

Boring No.	Sample No.	Sample Depth, (ft.)	Visual Description & Unified Soil Classification (ASTM D-2488)		Percent Passing Sieve #4	#10	#20	#40	#60	#80	#100	#200
3ST-1	ST - 1	0.0 - 1.5	Brown Sandy Clay	CL	-----	-----	-----	-----	-----	-----	-----	-----
	JAR A	3.0 - 6.5	Light Brown Sandy Silt	ML	86.9	77.9	71.5	66.5	62.3	58.6	56.9	50.6
8A4C-2	JAR A	0.0 - 1.0	Brown Clay w/sand	CL	98.0	93.1	90.3	88.7	87.2	85.8	85.3	82.2
	JAR B	1.0 - 5.0	Tan Clay w/sand	CL	93.3	89.8	87.6	86.5	85.8	85.1	84.7	81.8
	JAR C *	5.0 - 10.0	Tan Sandy Clay w/gravel	CL	72.3	62.6	58.1	56.2	54.8	53.8	53.3	50.9
	C - 1	18.0 - 18.5	Light Brown Clay	CH	-----	-----	-----	-----	-----	-----	-----	-----
	C - 2	24.1 - 24.8	Light Brown Clay	CH	-----	-----	-----	-----	-----	-----	-----	-----
8A-3	JAR A	0.0 - 1.2	Brown Clay w/sand	CL	91.5	81.1	75.6	72.3	70.7	69.5	68.8	65.8
	JAR B	1.2 - 7.0	Light Brown Clay w/sand	CL	89.6	75.7	69.9	68.1	67.3	66.6	66.3	64.5
	JAR C	7.0 - 15.0	Light Brown Clay w/sand	CL	91.9	82.3	78.5	76.9	75.9	75.1	74.7	73.2
8A4C-5	JAR A *	0.0 - 1.0	Brown Clayey Sand w/gravel	SC	66.4	45.6	37.4	34.9	33.6	32.6	32.2	30.1
	C - 1	14.0 - 14.7	Light Brown Clay	CL	-----	-----	-----	-----	-----	-----	-----	-----
3ST-8	JAR A	0.0 - 1.0	Brown Sandy Clay	CL	89.1	78.6	72.8	68.9	66.8	65.5	64.8	62.1
	JAR B	1.0 - 3.0	Light Brown Sandy Clay	CL	93.4	84.5	79.6	77.7	76.5	75.6	75.2	72.8
10A-9	JAR A *	0.0 - 1.1	Brown Clayey Sand w/gravel	SC	75.0	51.3	39.1	35.1	33.2	32.0	31.5	29.5
	JAR B *	1.1 - 4.5	Light Brown Clayey Sand w/gravel	SC	81.8	57.2	47.0	43.0	42.5	41.6	41.2	39.5
	JAR C *	6.0 - 7.0	Light Brown Clayey Sand w/gravel	SC	68.3	54.9	50.0	48.0	46.9	46.1	45.8	44.5

*** Due to particle size in the samples delivered to the laboratory and the limited volume of the sample, the gradation analysis may not be representative of in-situ field conditions.**

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
INS BORDER PATROL STATION
SANDERSON, TEXAS

Boring No.	Sample No.	Sample Depth, (ft.)	Visual Description & Unified Soil Classification (ASTM D-2488)		Moisture Content, (%)	Unit Dry Weight, (pcf)	Atterberg Limits			Remarks
							LL	PL	PI	
3ST-1	ST - 1	0.0 - 1.5	Brown Sandy Clay	CL	18.4	87.7	40	20	20	
	JAR A	3.0 - 6.5	Light Brown Sandy Silt	ML	6.9	-----	35	25	10	
8A4C-2	JAR A	0.0 - 1.0	Brown Clay w/sand	CL	18.5	-----	41	18	23	
	JAR B	1.0 - 5.0	Tan Clay w/sand	CL	6.9	-----	39	19	20	
	JAR C	5.0 - 10.0	Tan Sandy Clay w/gravel	CL	5.0	-----	39	18	21	
	C - 1	18.0 - 18.5	Light Brown Clay	CH	23.2	93.2	-----	-----	-----	
	C - 2	24.1 - 24.8	Light Brown Clay	CH	22.4	96.5	-----	-----	-----	
8A-3	JAR A	0.0 - 1.2	Brown Clay w/sand	CL	18.1	-----	39	18	21	
	JAR B	1.2 - 7.0	Light Brown Clay w/sand	CL	5.8	-----	38	19	19	
	JAR C	7.0 - 15.0	Light Brown Clay w/sand	CL	7.4	-----	37	16	21	
8A4C-5	JAR A	0.0 - 1.0	Brown Clayey Sand w/gravel	SC	10.5	-----	39	21	18	
	C - 1	14.0 - 14.7	Light Brown Clay	CL	17.0	104.2	-----	-----	-----	
3ST-8	JAR A	0.0 - 1.0	Brown Sandy Clay	CL	16.5	-----	34	17	17	
	JAR B	1.0 - 3.0	Light Brown Sandy Clay	CL	7.0	-----	37	21	16	
10A-9	JAR A	0.0 - 1.1	Brown Clayey Sand w/gravel	SC	12.2	-----	38	23	15	
	JAR B	1.1 - 4.5	Light Brown Clayey Sand w/gravel	SC	4.7	-----	36	19	17	
	JAR C	6.0 - 7.0	Light Brown Clayey Sand w/gravel	SC	4.3	-----	34	19	15	

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
INS BORDER PATROL STATION
SANDERSON, TEXAS

Boring No.	Sample No.	Sample Depth, (ft.)	Visual Description & Unified Soil Classification (ASTM D-2488)		Moisture Content, (%)	Unit Dry Weight, (pcf)	Confining Pressure (tsf)	Q_u (tsf)	Strain @ Failure (%)	Type Failure
3ST-1	ST - 1	0.0 - 1.5	Brown Sandy Clay	CL	18.4	87.7	-----	-----	-----	-----
	JAR A	3.0 - 6.5	Light Brown Sandy Silt	ML	6.9	-----	-----	-----	-----	-----
8A4C-2	JAR A	0.0 - 1.0	Brown Clay w/sand	CL	18.5	-----	-----	-----	-----	-----
	JAR B	1.0 - 5.0	Tan Clay w/sand	CL	6.9	-----	-----	-----	-----	-----
	JAR C	5.0 - 10.0	Tan Sandy Clay w/gravel	CL	5.0	-----	-----	-----	-----	-----
	C - 1 *	18.0 - 18.5	Light Brown Clay	CH	23.2	93.2	*	*	*	*
	C - 2	24.1 - 24.8	Light Brown Clay	CH	22.4	96.5	0	0.44	2.4	Multiple Vertical
8A-3	JAR A	0.0 - 1.2	Brown Clay w/sand	CL	18.1	-----	-----	-----	-----	-----
	JAR B	1.2 - 7.0	Light Brown Clay w/sand	CL	5.8	-----	-----	-----	-----	-----
	JAR C	7.0 - 15.0	Light Brown Clay w/sand	CL	7.4	-----	-----	-----	-----	-----
8A4C-5	JAR A	0.0 - 1.0	Brown Clayey Sand w/gravel	SC	10.5	-----	-----	-----	-----	-----
	C - 1	14.0 - 14.7	Light Brown Clay	CL	17.0	104.2	0	0.81	1.8	Multiple Vertical
3ST-8	JAR A	0.0 - 1.0	Brown Sandy Clay	CL	16.5	-----	-----	-----	-----	-----
	JAR B	1.0 - 3.0	Light Brown Sandy Clay	CL	7.0	-----	-----	-----	-----	-----
10A-9	JAR A	0.0 - 1.1	Brown Clayey Sand w/gravel	SC	12.2	-----	-----	-----	-----	-----
	JAR B	1.1 - 4.5	Light Brown Clayey Sand w/gravel	SC	4.7	-----	-----	-----	-----	-----
	JAR C	6.0 - 7.0	Light Brown Clayey Sand w/gravel	SC	4.3	-----	-----	-----	-----	-----

*** This sample not suitable for unconfined compression testing as received at the laboratory - an unconfined compression test was performed on Sample No. C-2 instead.**

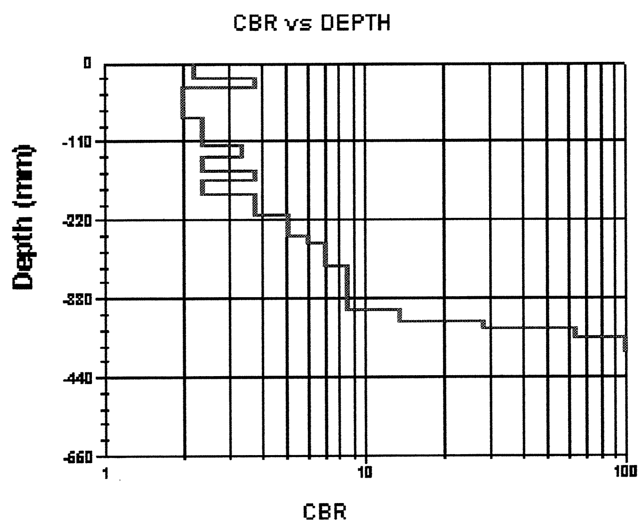
APPENDIX D

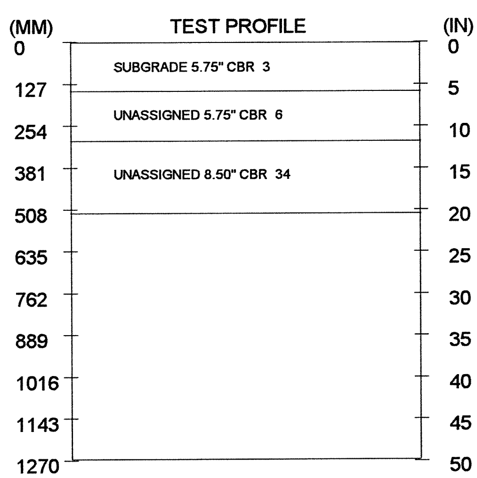
SANDERSON , TEXAS
BORDER PATROL STATION

DCP TEST DATA

Project: Border Patrol Station — Date: 10/18/2000

Feature: 3ST-1 — Station: 3ST-1





SANDERSON , TEXAS
BORDER PATROL STATION

DCP TEST DATA

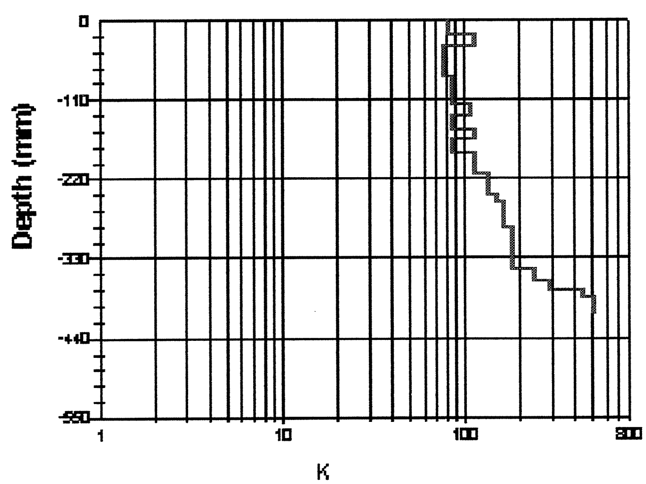
Project: Border Patrol Station

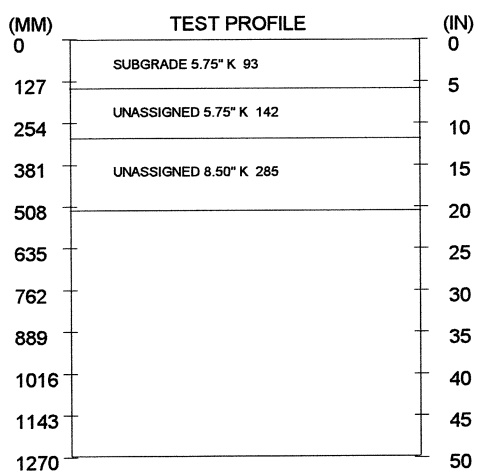
Date: 10/18/2000

Feature: 3ST-1

Station: 3ST-1

SUBGRADE MODULUS vs DEPTH





SANDERSON , TEXAS
BORDER PATROL STATION

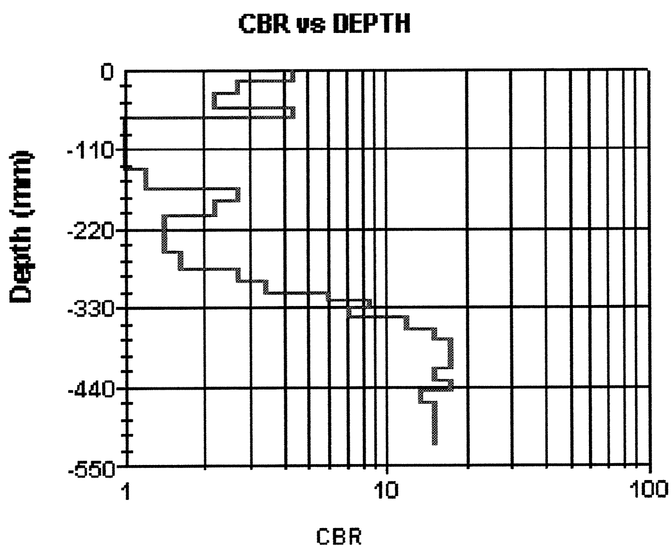
DCP TEST DATA

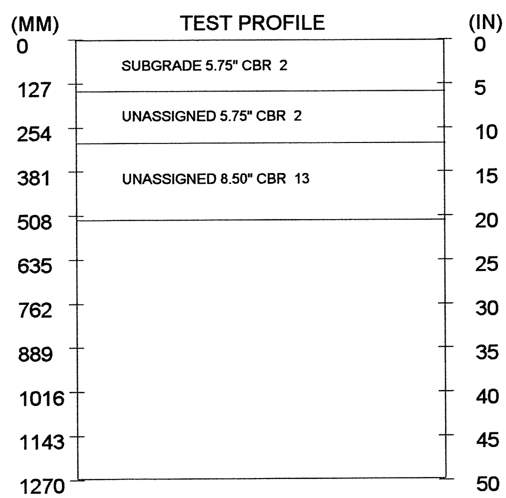
Project: Border Patrol Station

Date: 10/18/2000

Feature: 8A-6

Station: 8A-6





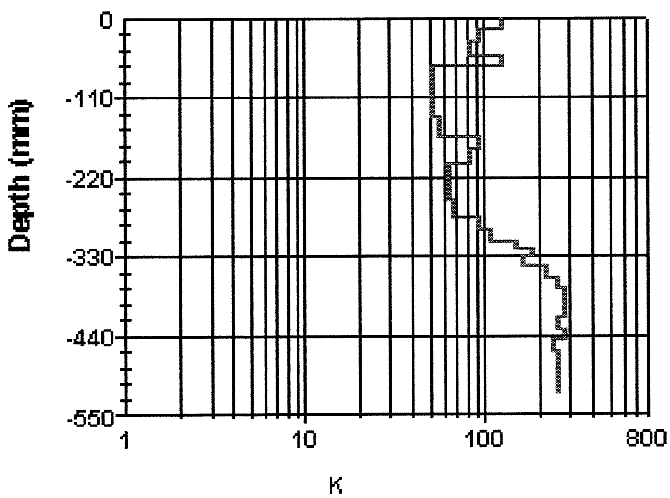
SANDERSON , TEXAS
BORDER PATROL STATION

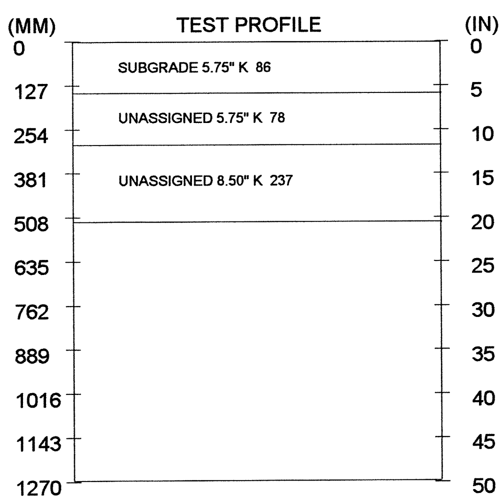
DCP TEST DATA

Project: Border Patrol Station — Date: 10/18/2000

Feature: 8A-6 — Station: 8A-6

SUBGRADE MODULUS vs DEPTH





SANDERSON , TEXAS
BORDER PATROL STATION

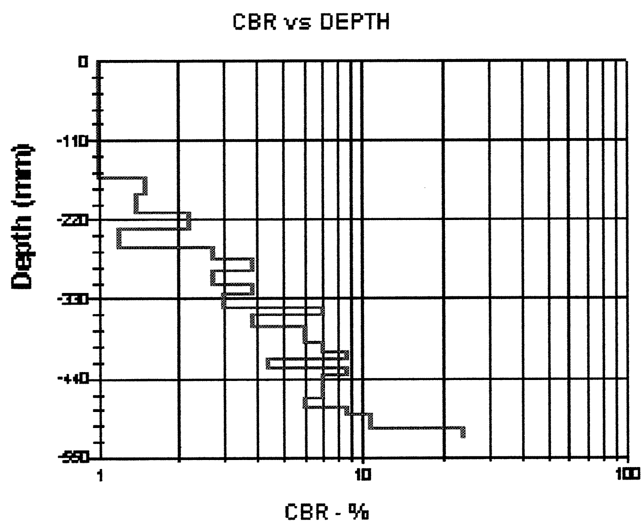
DCP TEST DATA

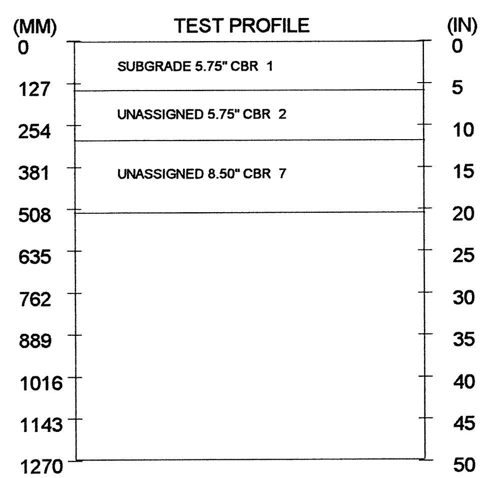
Project: Border Patrol Station

Date: 10/18/2000

Feature: 10A-7

Station: 10A-7



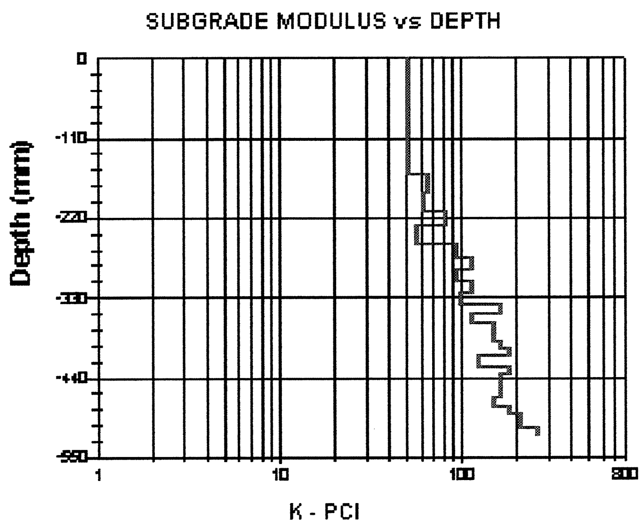


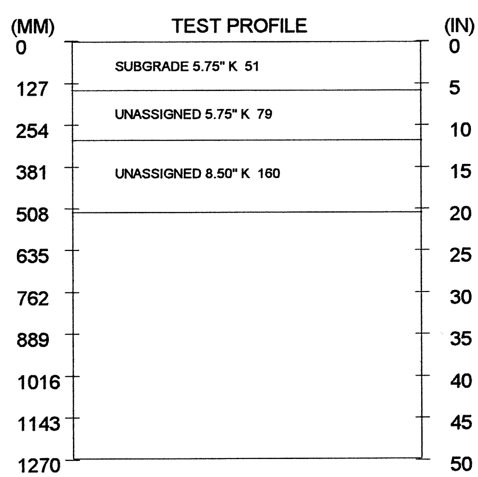
SANDERSON , TEXAS
BORDER PATROL STATION

DCP TEST DATA

Project: Border Patrol Station — Date: 10/18/2000

Feature: 10A-7 — Station: 10A-7





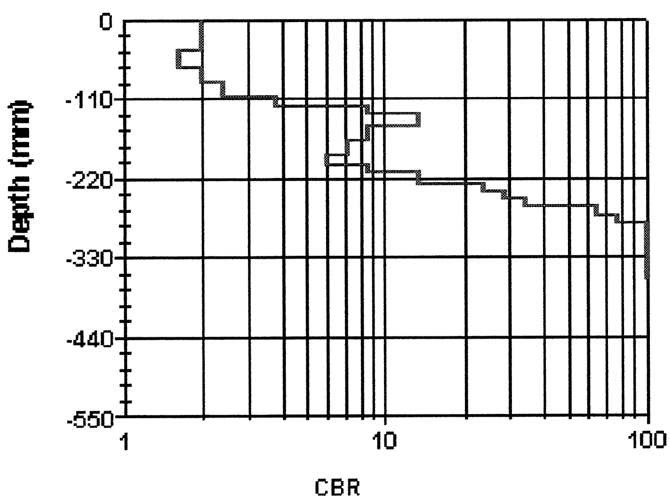
SANDERSON , TEXAS
BORDER PATROL STATION

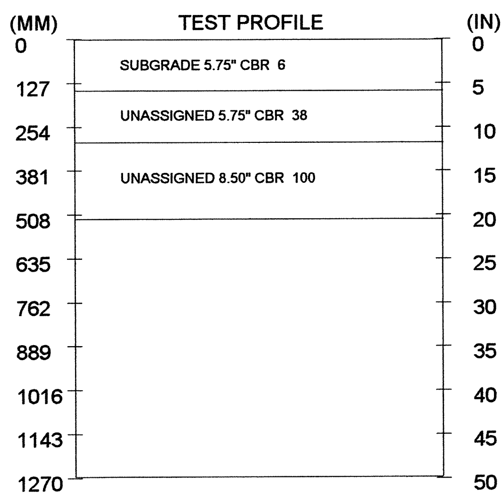
DCP TEST DATA

Project: Border Patrol Station — Date: 10/18/2000

Feature: 8A-10 — Station: 8A-10

CBR vs DEPTH





SANDERSON , TEXAS
BORDER PATROL STATION

DCP TEST DATA

Project: Border Patrol Station

Date: 10/18/2000

Feature: 8A-10

Station: 8A-10