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ENGINEERING PROPERTIES OF LAND RESOURCE UNITS IN THE CORPUS CHRISTI AREA

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ENGINEERING PROPERTIES OF LAND RESOURCE UNITS IN THE CORPUS CHRISTI AREA

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INTRODUCTION

Land resource units that are defined by their physical properties can be characterized quantitatively using engineering test data. Information about substrate properties in quantitative terms confirms and augments qualitative statements about the physical characteristics of land resource units. This information should allow a more accurate definition of environmental limits and may reduce the need for preliminary engineering investigations commonly undertaken to assess project feasibility and to estimate costs. Quantitative information should also aid planners in charting utilization of land consistent with its natural suitability or in identifying the approximate level of engineering necessary to render a particular site suitable, thereby maximizing resource use.

Consulting engineering firms, soils[1] testing firms, and many public agencies involved in construction have extensive files of site-specific soils test data necessary to properly assess foundation conditions.

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[1]The term "soil" or "soils" is used in this paper in an engineering sense. "The materials that constitute the earth's crust are rather arbitrarily divided by the civil engineer into two categories, soil and rock. Soil is a natural aggregate of mineral grains that can be separated by such gentle mechanical means as agitation in water" (Terzaghi and Peck, 1967, p. 4). As such, the term "soil" includes more than the material that is subject to the soil-forming processes in a pedological sense, and consequently includes unweathered sediments which are part of the geological substrate.

Rarely are test results extrapolated from previously tested areas because individual test values are considered valid only for the immediate test site.

By considering all soils test values within a given land resource unit, however, the unit can be characterized throughout its extent by a representative value or range of values. Such a characterization can be extended to untested but similar resource areas on a local or, perhaps with some limitations, on a regional scale. This characterization permits immediate maximum use of available data and is an alternative to an expensive, systematic testing program.

Land and water resources were mapped, and certain units were investigated quantitatively as part of a larger multidisciplinary study of the Corpus Christi area (fig. 1) including Nueces, San Patricio, Aransas, and Refugio Counties (Fruh and others, 1972, 1973a, and 1973b). Land and water resource units were defined according to criteria presented by St. Clair and others (1975) as modified from Brown and others (1971). Delineation of the resource units was based on mapping at a scale of 1:24,000 by Brown and others (1976) and McGowen and others (1976) for the Environmental Geologic Atlas of the Texas Coastal Zone. The map _Land and Water Resources, Corpus Christi, Texas_ and the descriptions of the units presented by Kier and others (1974a) will be issued in the Bureau of Economic Geology's Land Resources Laboratory series (Kier and White, in preparation). Included in this report is a generalized land and water resources map of Nueces County (fig. 2).

Preliminary results of the pilot study to quantify land and water resource units in the Corpus Christi area were presented in Fisher and others (1973) and in Kier and Bell (1974). The completed study, based on approximately twice as much data, was published in Kier and others (1974b). Because the availability of this report is limited, it has been modified and is being presented in this research note. Included are (1) a description of the basic data used, (2) the data management system employed, (3) the procedure used to analyze the data, (4) summaries and interpretation of the data, and (5) uses and interpretive limitations of the data.

BASIC DATA AND METHODOLOGY

More than 17,500 engineering test values were obtained from more than 7,000 core samples (fig. 3) representing nearly all the major, physically defined land resource units (table 1) which occur in the Corpus Christi area. Test data collected (table 2) are the types most commonly used by engineering testing laboratories to assess site suitability for commercial buildings, large single- and multiple-family developments, institutional facilities, and industrial plants. Descriptions of these tests are contained in appendix A.

Test values were recorded for each type of engineering test performed on samples from each previously mapped resource unit and grouped into 5-foot increments of depth extending to 50 feet below ground surface. Arithmetic means and standard deviations (one standard deviation) of engineering test values were then calculated for each depth interval. For example, in calculating a mean and standard deviation, the unit dry weight of a sample taken at a depth of 12 feet was combined with other values of unit dry weight determined from samples from the same resource unit taken from a depth interval greater than 10 feet but less than or equal to 15 feet. Arithmetic means of test results characterize depth intervals within each resource unit by a single number. Standard deviations (normal distribution assumed) show probable ranges and variability of test results and, to some extent, allow prediction of future test values.

Numerous other kinds of statistical parameters are available, such as mode, median, mean deviation, and range, each with its own meaning and use. It was assumed that most readers would be familiar with the definitions of arithmetic mean and standard deviation, and that these statistical values were sufficient for the study. No adjustments were made for differences in the numbers of samples used in the calculations nor for skewness of data distribution. In future work, further statistical treatment of the engineering test values will undoubtedly provide additional information.

Assignment of test data to individual resource units was based on core locality in relation to land resource units at the surface, boring log descriptions, and prediction of sediment type at depth considering the interpreted environment of deposition. All core localities were plotted on 7.5- or 15-minute topographic maps, and the Universal Transverse Mercator (UTM) coordinates were determined to facilitate input into a computerized data storage bank. Specific data and core localities are confidential, however, to protect proprietary information.

Several land resource units with differing natural capability but with similar physical properties were considered together in quantifying the engineering parameters. Most of these units could not be confidently distinguished at depth using normal core log descriptions. For example (see table 1), fore-island dunes and vegetated barrier flats (C2), and washover areas (C4) have similar physical properties; differences in natural suitability relate to other characteristics. Consequently, these units were lumped together into the general category of barrier islands (C), and the amount of test data for this resource unit was correspondingly increased.

The 5-foot class interval for depth calculations was chosen as a compromise between (1) the desire to show changes with depth, if any, in results of tests in individual capability units, and (2) the statistical validity of the mean and standard deviation calculations based on the anticipated amount of data to be collected for any one class interval--too few data in each class would lead to both fallacious means and fallacious standard deviations.

Fifty feet was chosen as the maximum average depth for confident prediction of the kinds of depositional environments in which the sediments accumulated. Furthermore, few data are available for soil samples deeper than 50 feet.

All calculations and construction of tables and graphs were performed by automatic data processing techniques (see appendix B for programs); all data are presently stored on magnetic tape. In plotting the graphs, mean values were arbitrarily assigned to the base of each 5-foot interval, and the curves were not smoothed.

INTERPRETATION OF DATA

Tables 3 through 24 contain mean and standard deviation values of the 22 types of engineering tests for which sufficient data were available to justify performing calculations. Over 8,800 statistical calculations were made for the ten 5-foot depth intervals in each of the 20 land resource units. Trends and differences within and among resource units are evident when tabulated mean values are compared. For visual comparison, mean values of the engineering tests are displayed graphically in figures 4 through 17; for quick reference, mean values have been retabulated for the 0- to 5-foot depth interval in table 25. Characteristic ranges of means are shown in table 26.

Lands that are dominantly mud, for example low permeability mud (A-8), have low unit dry weights (96.1 to 100.8 lb/ft^3, table 3, fig. 4), high natural moisture contents (23.9 to 28.1 percent, table 4, fig. 5), high shrink-swell potentials (linear drying shrinkage of 15.9 to 24.2 percent, table 14, fig. 13; plasticity indices of 30.8 to 42.6 percent, table 17, fig. 16), and low foundation strengths (standard penetrometer test values of 10 to 33 blows/ft, table 8, fig. 10).

Lands that are dominantly sand and silt, for example, moderately permeable sand and silt (A-3), have higher unit dry weights (99.0 to 108.6 lb/ft^3, table 3, fig. 4), lower natural moisture contents (16.6 to 26.6 percent, table 4, fig. 5), lower shrink-swell potentials (linear drying shrinkage of approximately 7 percent, table 14, fig. 13; plasticity indices of 9.0 to 31.5 percent, table 17, fig. 16), and higher foundation strengths (standard penetrometer values of 17 blows/ft to 44 blows/ft, table 6, fig. 6; unconfined compression values of 1.7 to 2.4 tons/ft^2, table 8, fig. 10).

Loose, highly permeable sand (A1) has even lower amounts of silt and clay than A3 (7.1 to 12.6 percent passing 200 mesh sieve, table 22, fig. 17). Unit dry weights of the loose sand vary from 94.6 to 107.2 lb/ft^3* at depth (table 3, fig. 4). Standard penetrometer values are approximately 7 blows/ft at the surface increasing to approximately 46 blows/ft at depth (table 6, fig. 6). The high range in mean values of unit dry weight results from an insufficient number of test values to make valid calculations or from compaction with increasing overburden (Krynine and Judd, 1957). Because the unit dry weights increase with depth, compaction of the sand is probably the overriding factor.

Sand-veneered low to moderate permeability sandy mud (A6) is composed of approximately 50 percent sand and 50 percent silt and clay (about 54 percent passing 200 sieve, table 22, fig. 17). The sandy mud is characterized by the highest unit dry weights of all the land resource units in the Corpus Christi area (107.7 to 110.1 lb/ft^3, table 3, fig. 4), by natural moisture contents which are low near the surface but increase with depth (15.4 percent at the surface to 30.5 percent at depth, table 4, fig. 5), and by moderate to high foundation strengths (standard penetrometer values of 18 to 36 blows/ft, increasing with depth, table 6, fig. 6; unconfined compression values of 3.1 to 4.5 tons/ft^2, table 8, fig. 10). The potential for shrink-swell is moderate

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*Calculated from fewer than 10 test values.

(plasticity indices of 19.9 to 22.8 percent, table 17, fig. 16). High unit dry weights and high foundation strengths are to be expected in materials that are about 50 percent silt and clay and thus well graded (Krynine and Judd, 1957). In well-graded soils, fines occupy spaces between the coarser particles that would otherwise be void.

In the Corpus Christi area, made land and subaerial spoil (E) generally has a thickness not exceeding 20 feet; no test values were reported from spoil thicker than 20 feet. The material is characterized by low unit dry weights (94.8 to 102.2 lb/ft^3, table 3, fig. 4), high natural moisture contents (21.5 to 27.0 percent, table 4, fig. 5), low foundation strengths (standard penetrometer values of 8 to 11 blows/ft, table 6, fig. 6; unconfined compression values of 0.8 to 1.2 tons/ft^2, table 8, fig. 10) and high shrink-swell characteristics (plasticity indices of 23 to 31 percent,* table 17, fig. 16).

Data obtained for other land resource units are few, and means and standard deviations calculated from these data are highly variable. Some tentative conclusions can be drawn, however. Barrier island resource units (C) are almost entirely sand (table 19, fig. 17). Foundation strengths on the islands are low at the surface, but increase with depth (standard penetrometer values of 20 blows/ft at the surface to 56 blows/ft at depth, table 6, fig. 6). Physical characteristics of barrier island sand are similar to physical characteristics of loose, highly permeable sand (A1) and engineering parameters should also be similar.

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*Calculated from fewer than 10 test values.

Bay-bottom sediments (F) have high natural moisture contents (37.9 to 53.7 percent,* table 4, fig. 5) as is expected, low shearing strengths (unconfined compression values of 0.1 to 0.5 tons/ft^2, table 8, fig. 10) and high plasticity indices (20.3 to 34.8 percent, table 17, fig. 16). Conversely, bay-margin sands (F11) have lower natural moisture contents (values of 14.0 to 30.0 percent, table 4, fig. 5) because of the higher shell and sand content, but they also have low foundation strengths (standard penetrometer values of 11 to 16 blows/ft, table 6, fig. 6).

Graphs of the mean test values plotted against depth below surface elevation demonstrate several trends and anomalies. In general, foundation strength, as indicated by standard penetrometer values (fig. 6) and by Texas Highway Department cone penetrometer values (fig. 7), increases with depth. This is particularly true of material which has a high sand content (units A1, A3, C). Because the penetrometer indicates shearing strength, which for sands is dependent upon the amount of overburden, the blows per foot in a uniform sandy material should increase with depth (Krynine and Judd, 1957).

The statistical means of the unconfined and the triaxial compression tests (figs. 10, 11, and 12) show no definite trends. Samples of similar material subjected to the triaxial test generally do show increases in strength with increases in lateral confining pressure (Krynine and Judd, 1957), but this is not apparent from data we collected. There are several explanations for the absence of a trend: (1) the

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*Calculated from fewer than 10 test values.

number of samples tested was too small to give valid means and standard deviations; (2) unconfined compression strength values were recorded whether or not failure occurred on slickensided surfaces; and (3) soils engineers generally consider triaxial tests on materials from the Corpus Christi area unreliable because of the difficulty involved in obtaining undisturbed samples and returning them to the laboratory for testing (Joseph Stapp, 1973, personal communication).

Mean hand penetrometer values (fig. 8) also vary widely with depth. This variation is probably due to inaccuracy of the original measurement rather than to lack of test values (see definition in appendix A).

LIMITATIONS OF QUANTITATIVE CHARACTERIZATION

Inherent sources of variability in quantitative characterization of land resource units include (1) imprecise logging and sample description by the testing laboratory, (2) errors in assigning test data to the proper land resource units, (3) differences in methods used by the various agencies and firms and differences in their precision in performing essentially the same kind of test, and (4) lack of sufficient data for valid statistical calculations. Errors in logging or recognizing the proper land resource unit, and differences in test precision among and within the various testing firms can be overcome only by using a sufficient number of test values to statistically eliminate fallacious data. There is no way to compensate for lack of data.

Furthermore, it must be understood that mean values presented for engineering parameters of land resource units are only averages and may not represent actual values at any given locality. The values are a planning tool and should not be construed as a substitute for actual site data; onsite testing will still be required to properly assess foundation requirements. In addition, test results that are outside the limits of one standard deviation will be obtained. Such readings can result from end-member compositions within a unit or scale factor where a land resource substrate penetrated by test core is too small to be shown at the scale at which land resource units are mapped.

Utility and Application

Despite its limitations, quantitative information regarding substrate parameters, such as the data presented in this research, provides basic input for assessing engineering characteristics of mapped land resource units and for estimating the less easily quantified substrate parameters of land resources. Substrate parameters which are difficult to quantify include (1) foundation strength, (2) plasticity, (3) compressibility, (4) slope stability, (5) shrink-swell potential, (6) ease of excavation, (7) fill potential, (8) relative rate of internal drainage, (9) moisture-retention capacity, (10) waste-disposal capability, (11) ability to handle septic tank effluent, (12) corrosion potential, and (13) general suitability for construction purposes.

Such quantitative and nonquantitative data allow a more accurate definition of an area's natural environmental suitability than can be provided by qualitative maps alone. Information provided by the data may reduce the need for preliminary engineering investigations commonly undertaken to assess project feasibility and to estimate costs, and may allow consideration of more sites than is normally possible in preliminary studies. Quantitative information should aid planners in charting land utilization that maximizes resource use without significantly impairing environmental quality.

SUMMARY--QUANTITATIVE ENGINEERING CHARACTERIZATION

A method of quantifying engineering parameters of natural land resource units in the Corpus Christi area has been developed combining engineering test data available from public agencies and private firms with analysis and maps of land and water resources. Statistical means and standard deviations of values from 21 different kinds of engineering tests have been calculated in many resource units as a function of depth. Although there are limitations in the procedure, results from the calculations correlate well with expected characteristics of the natural units. Quantitative knowledge of substrate characteristics should aid planners in charting optimum use of land resources, particularly when placed in a comprehensive environmental data package providing a wide range of natural resource information.

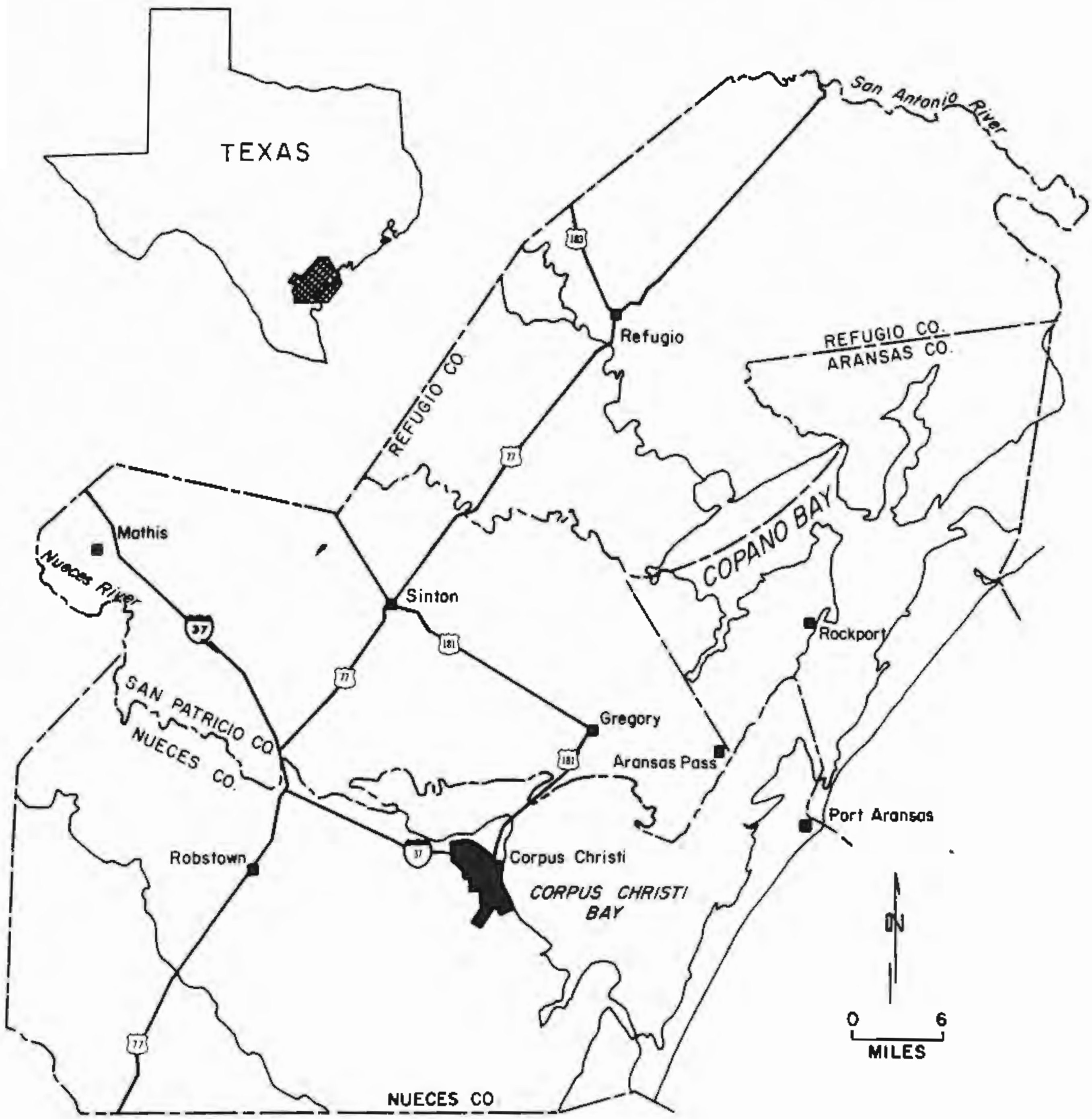

Figure 1. Index map to Corpus Christi area--Nueces, San Patricio, Aransas, and Refugio Counties, Texas.

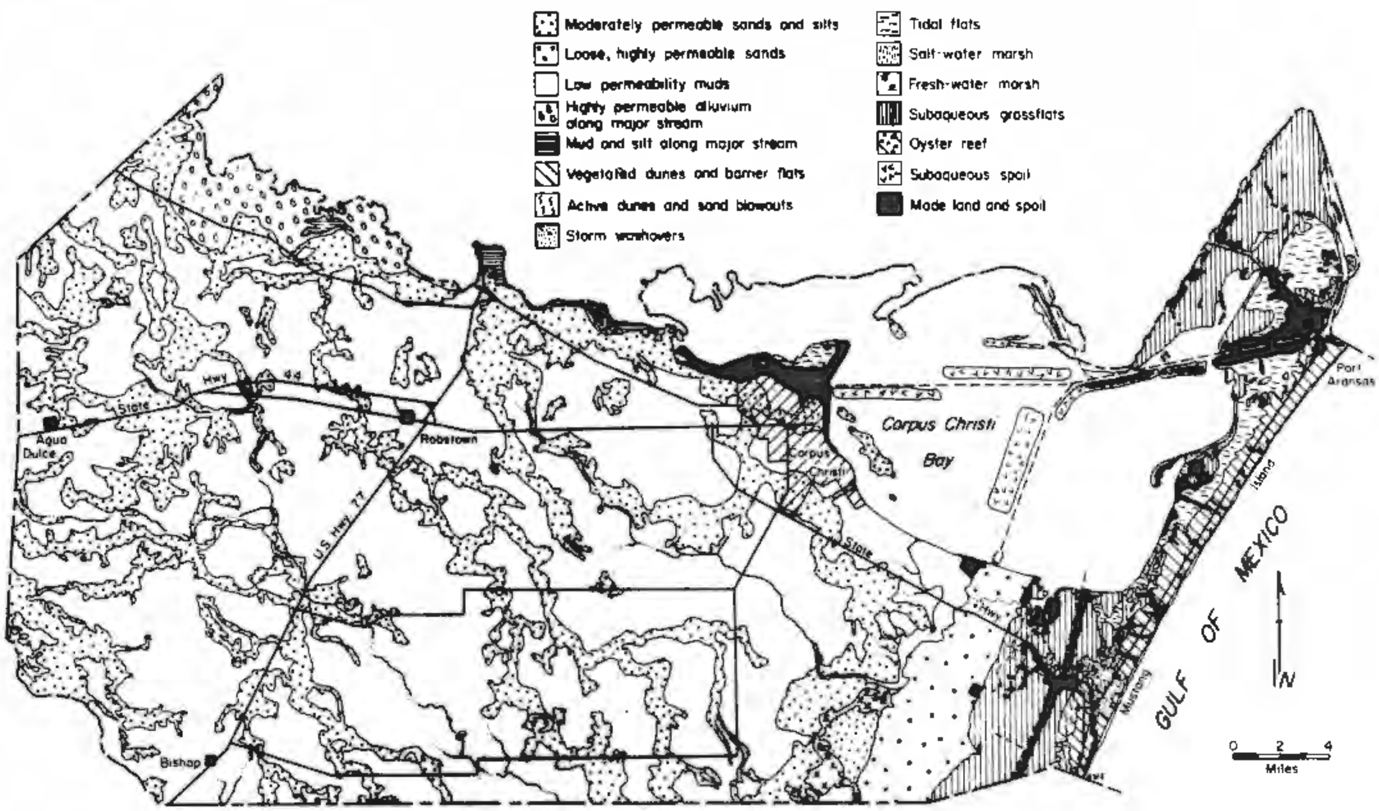

Figure 2. Generalized land and water resources map, Nueces County, Texas.

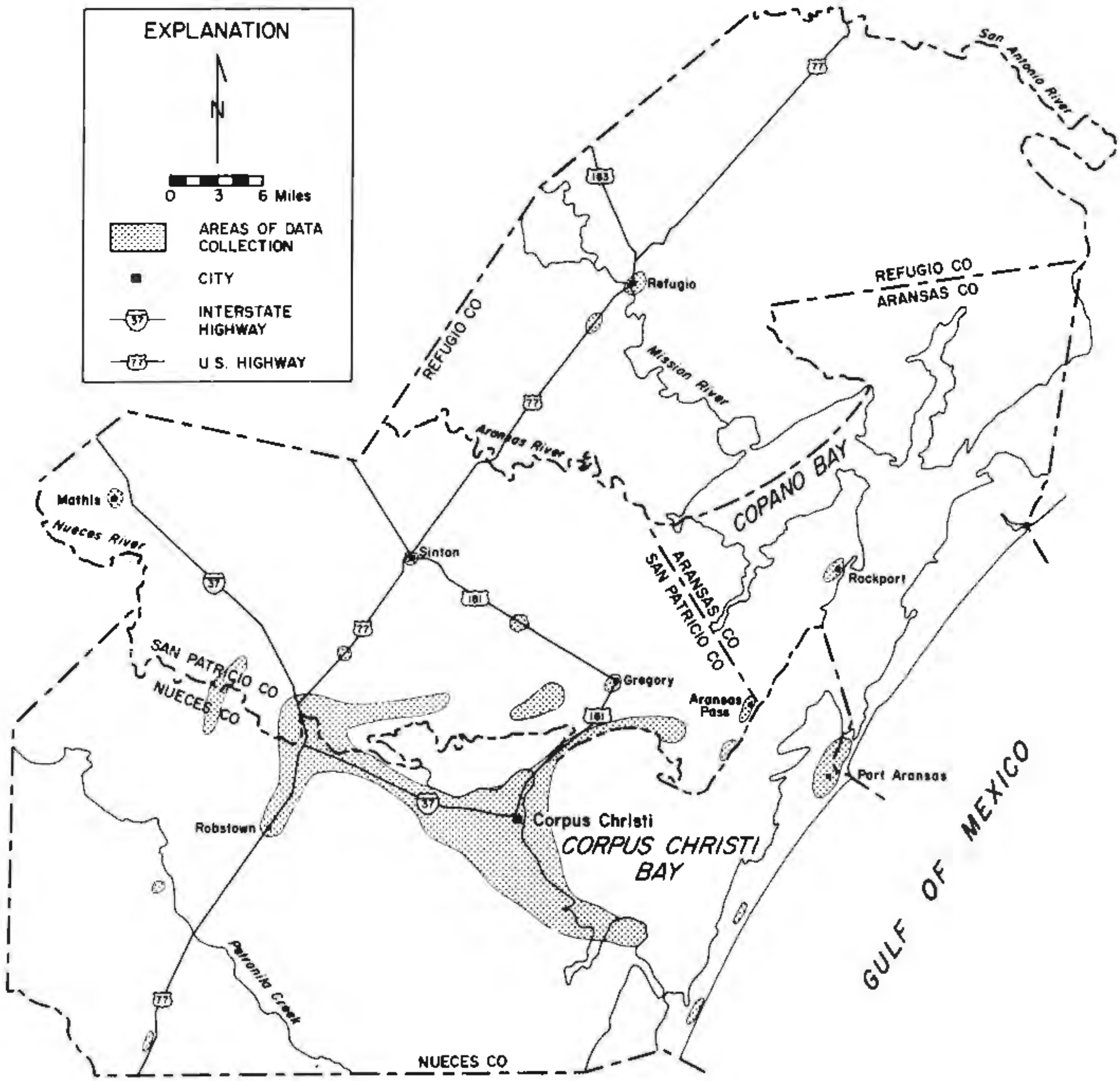

Figure 3. Distribution of engineering test data from the Corpus Christi area.

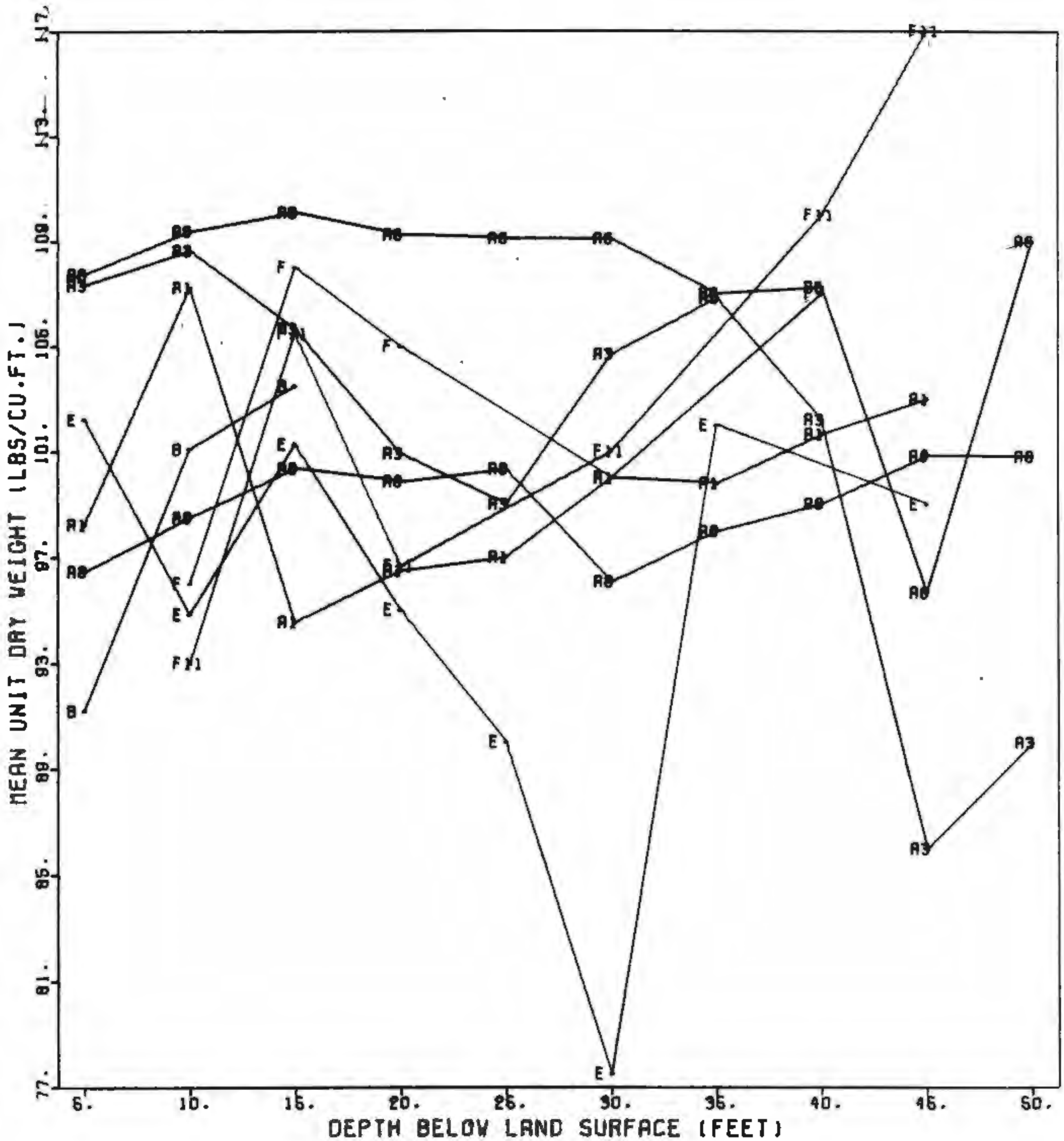

Figure 4. Curves showing variation of mean unit dry weight with depth.

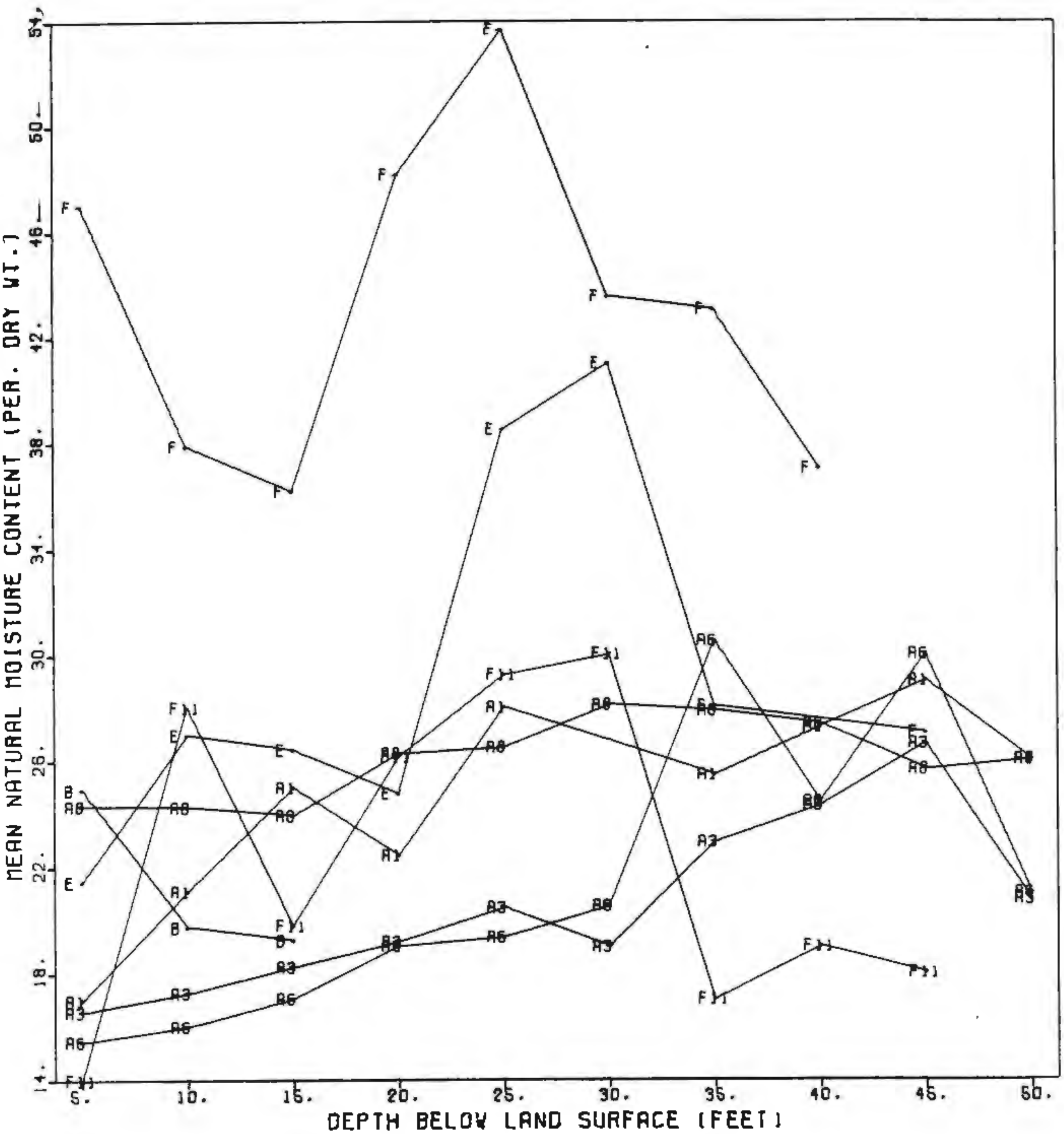

Figure 5. Curves showing variation of mean natural moisture content with depth.

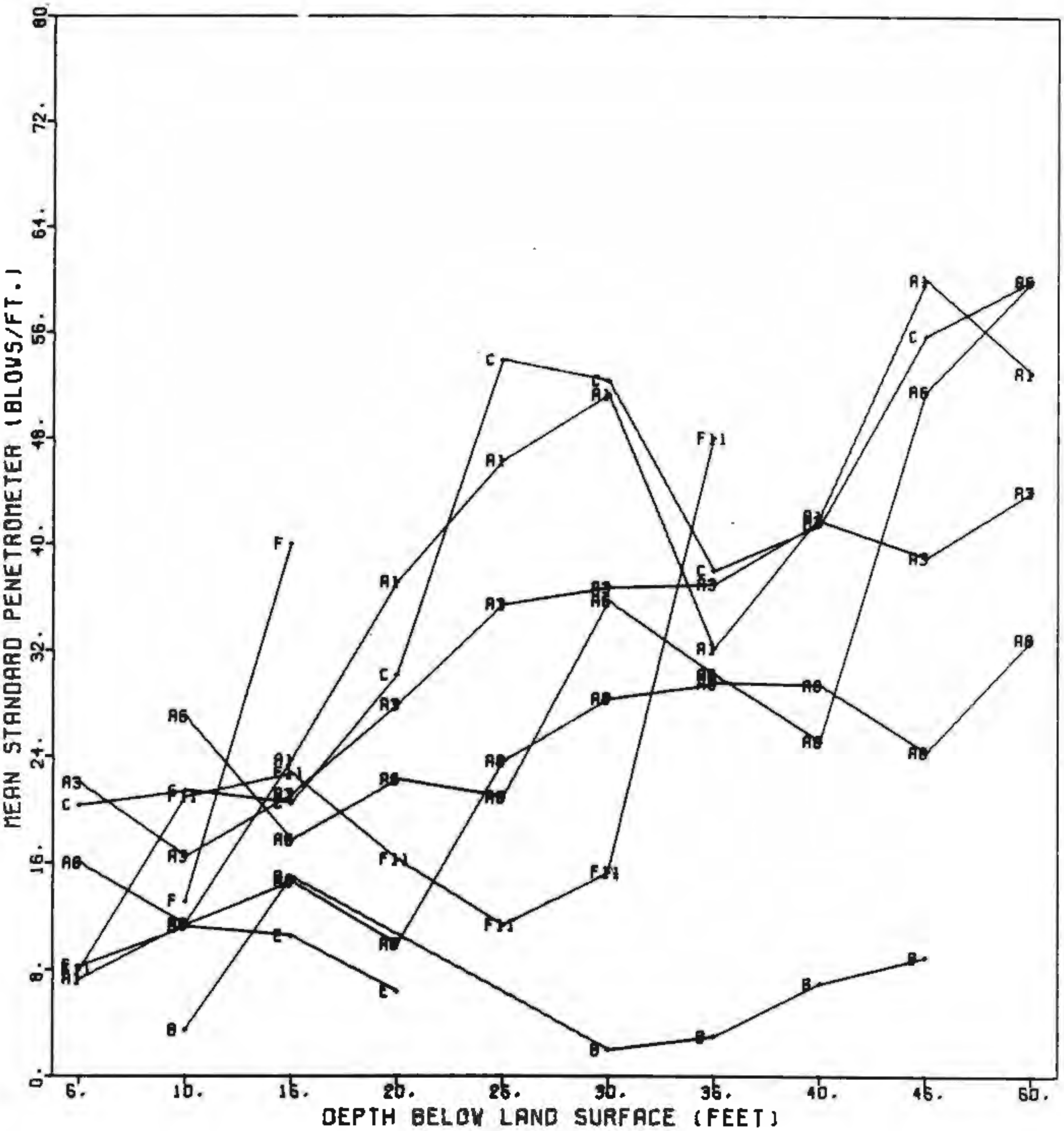

Figure 6. Curves showing variation of mean standard penetrometer values with depth.

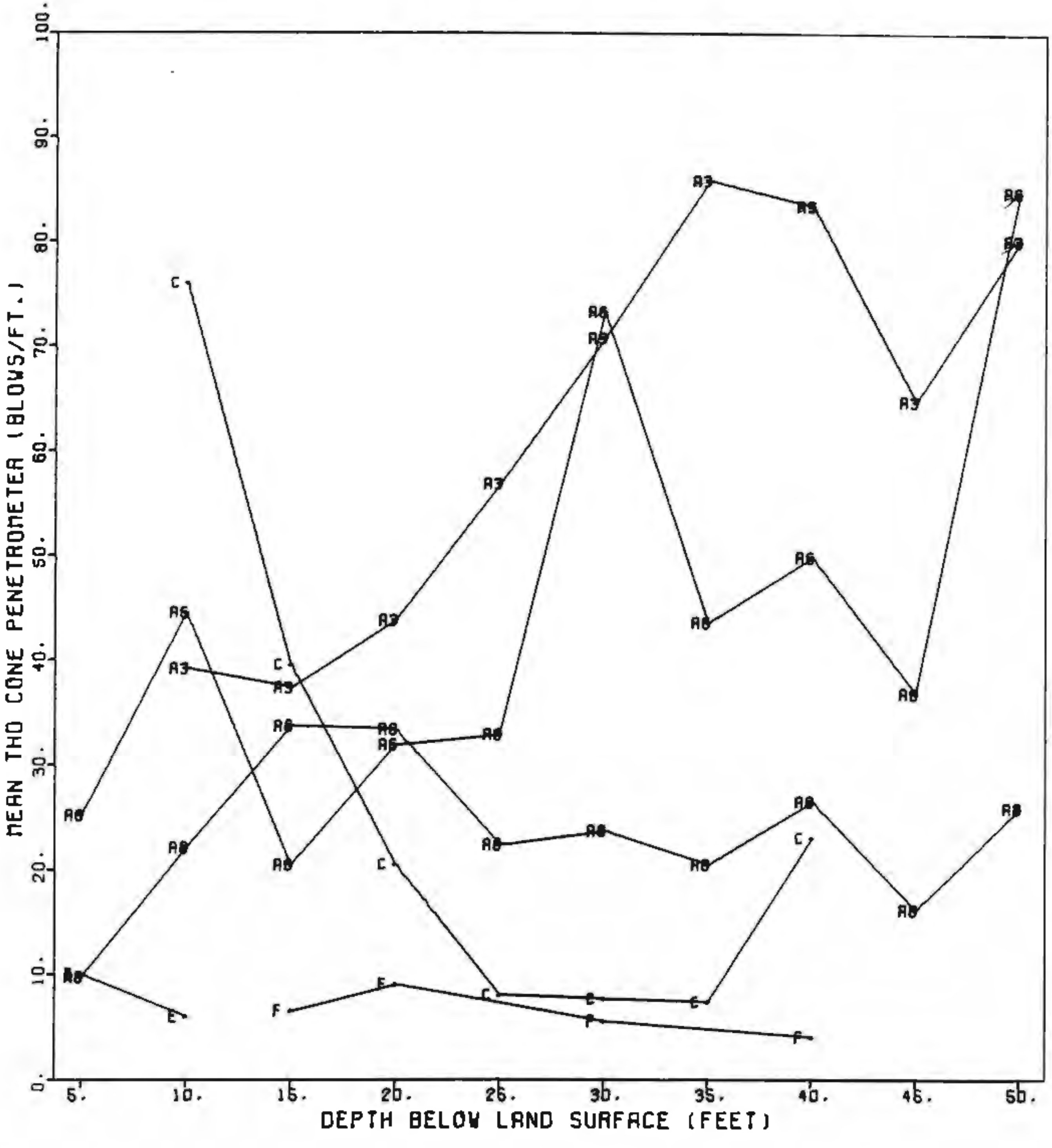

Figure 7. Curves showing variation of mean Texas Highway Department penetrometer values with depth.

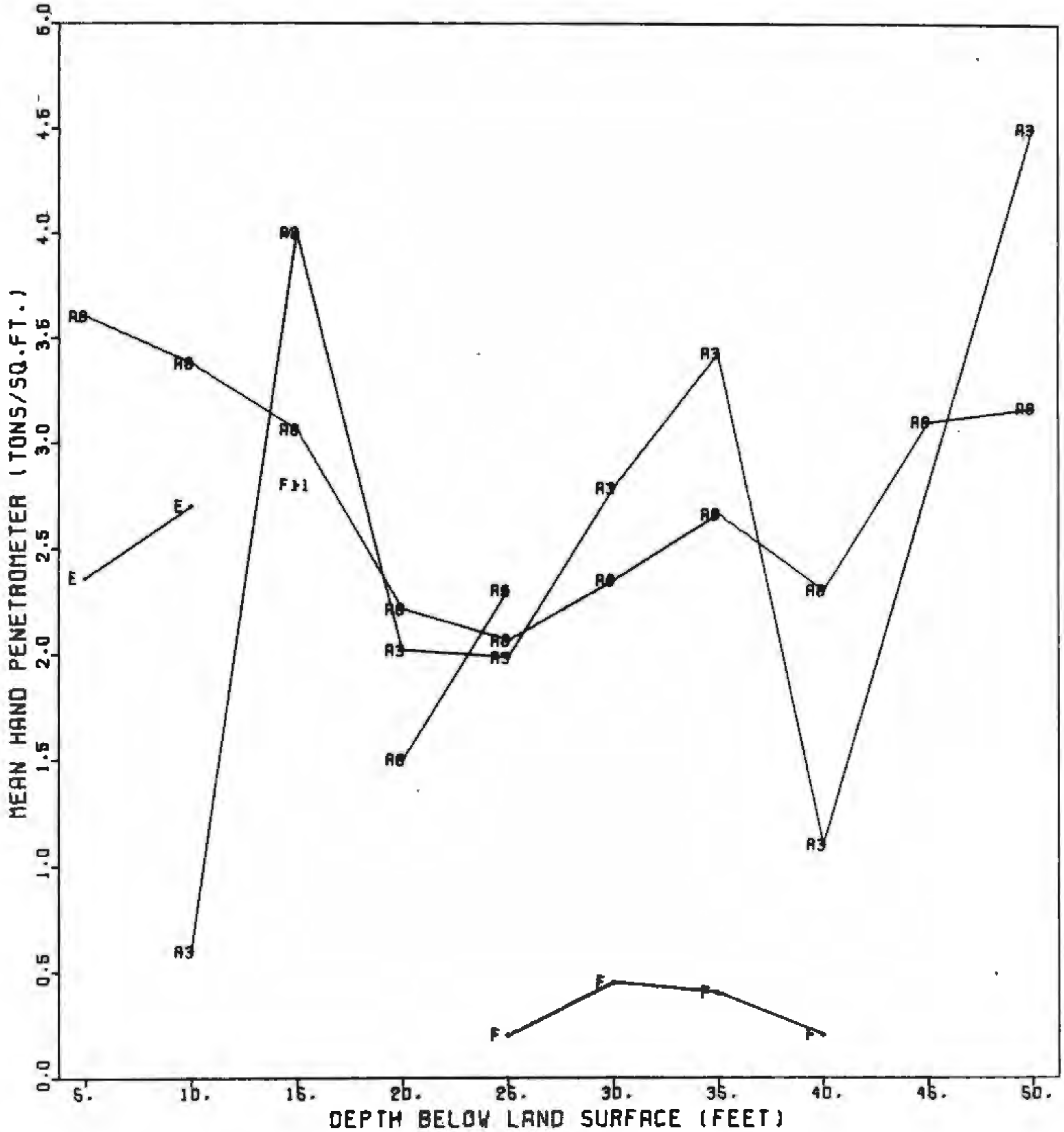

Figure 8. Curves showing variation of mean hand penetrometer values with depth.

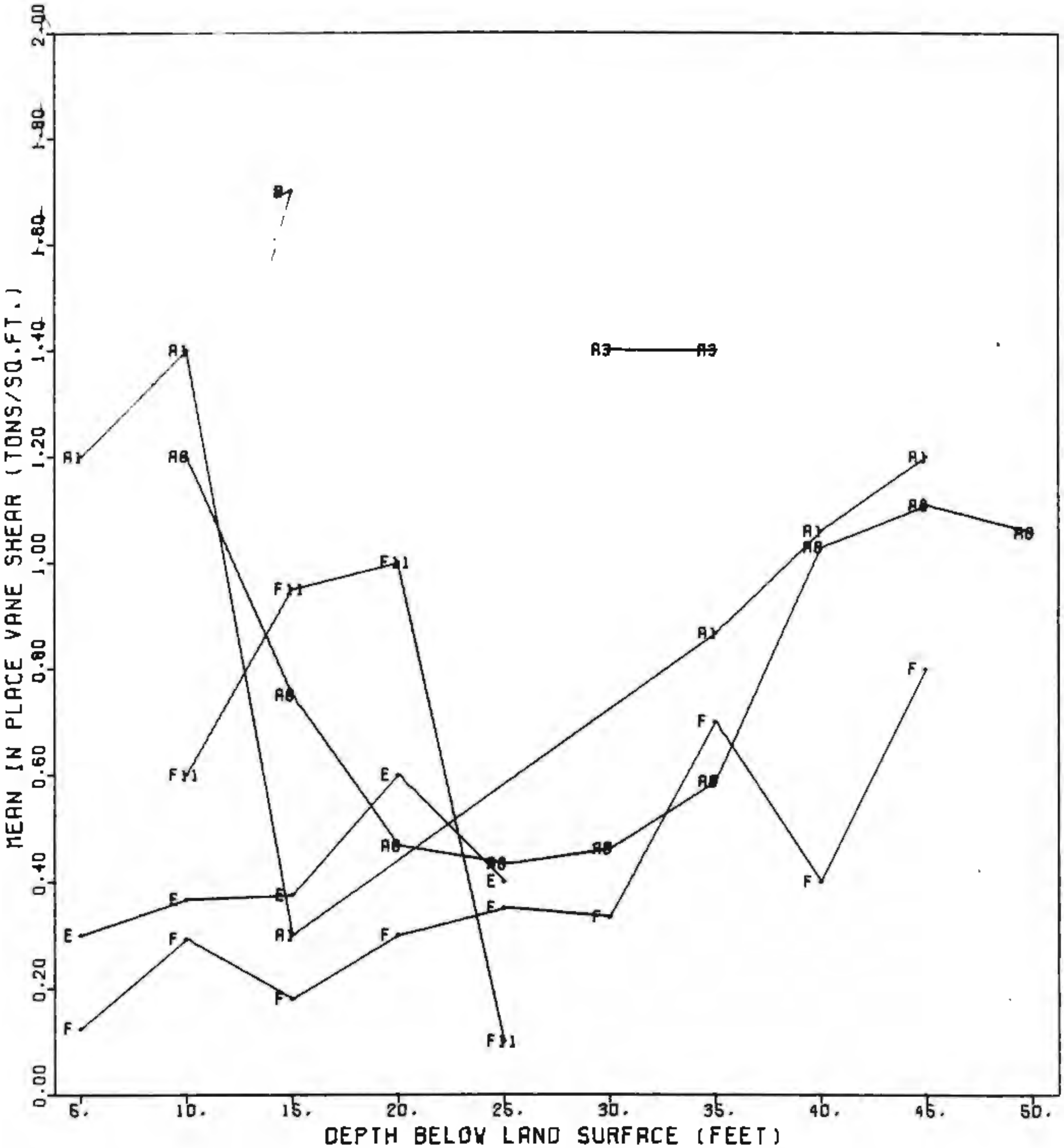

Figure 9. Curves showing variation of mean in-place vane shear values with depth.

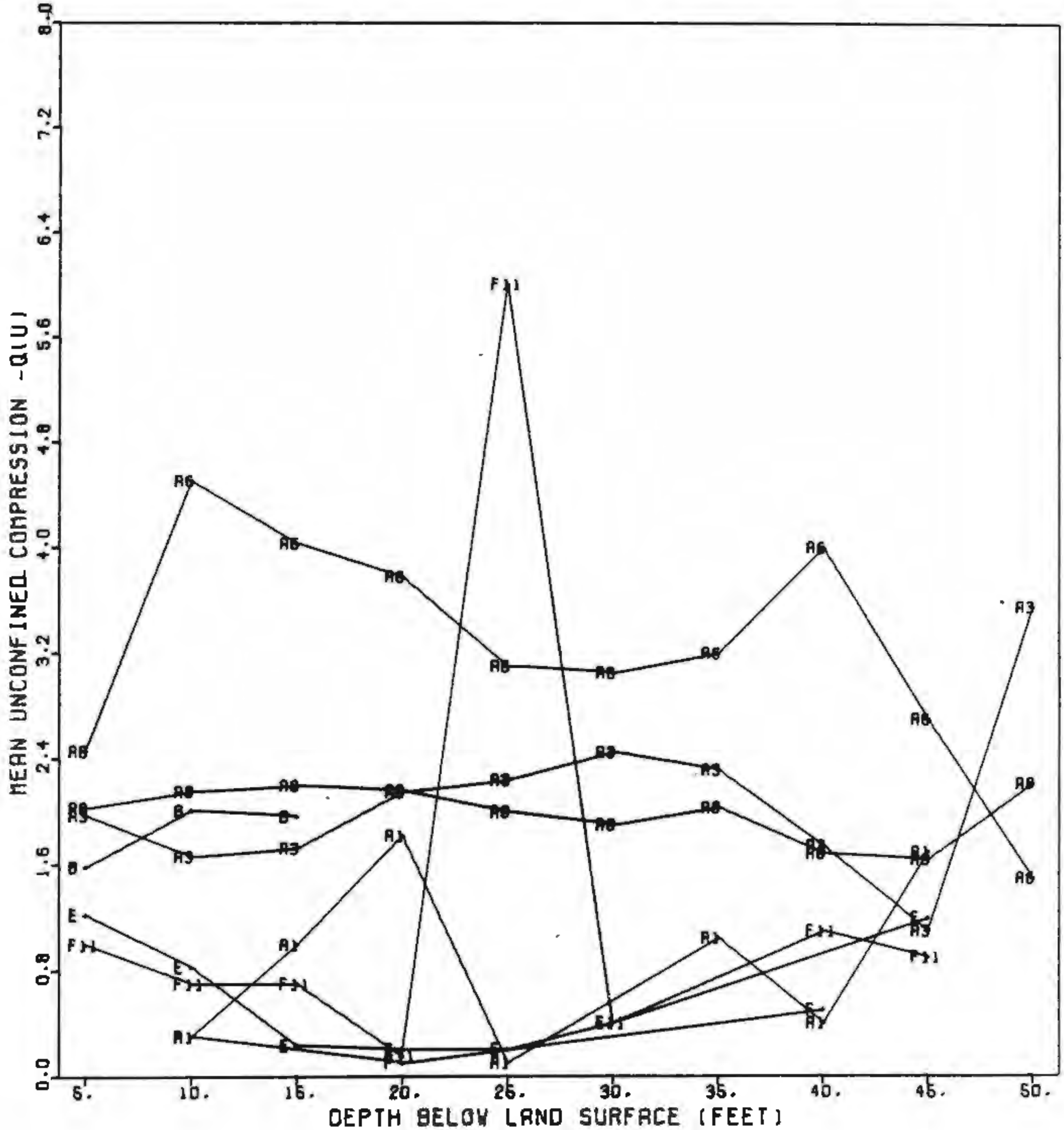

Figure 10. Curves showing variation of mean unconfined compression test values (Q_u) with depth.

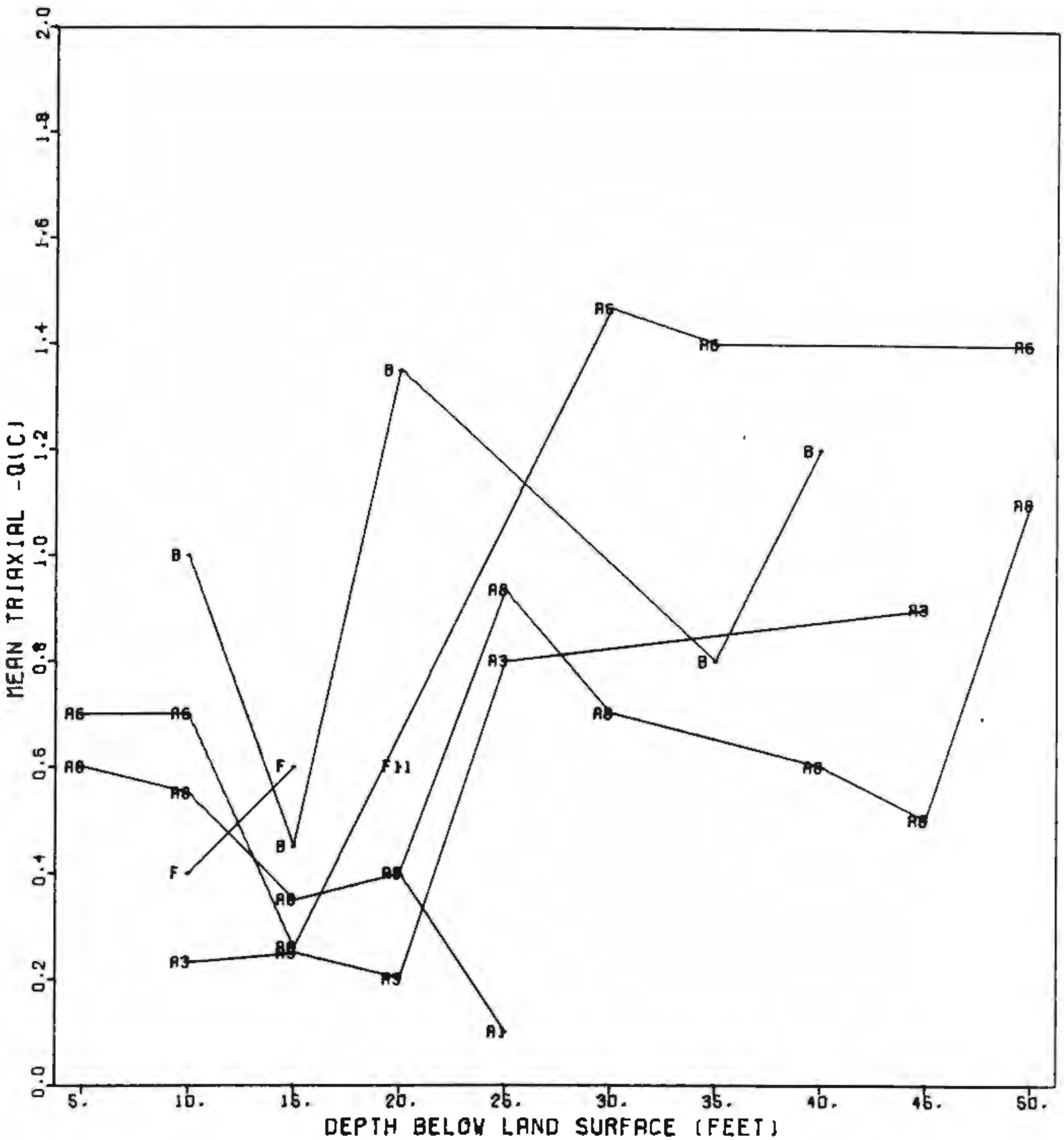

Figure 11. Curves showing variation of mean triaxial test values (Q_c) with depth.

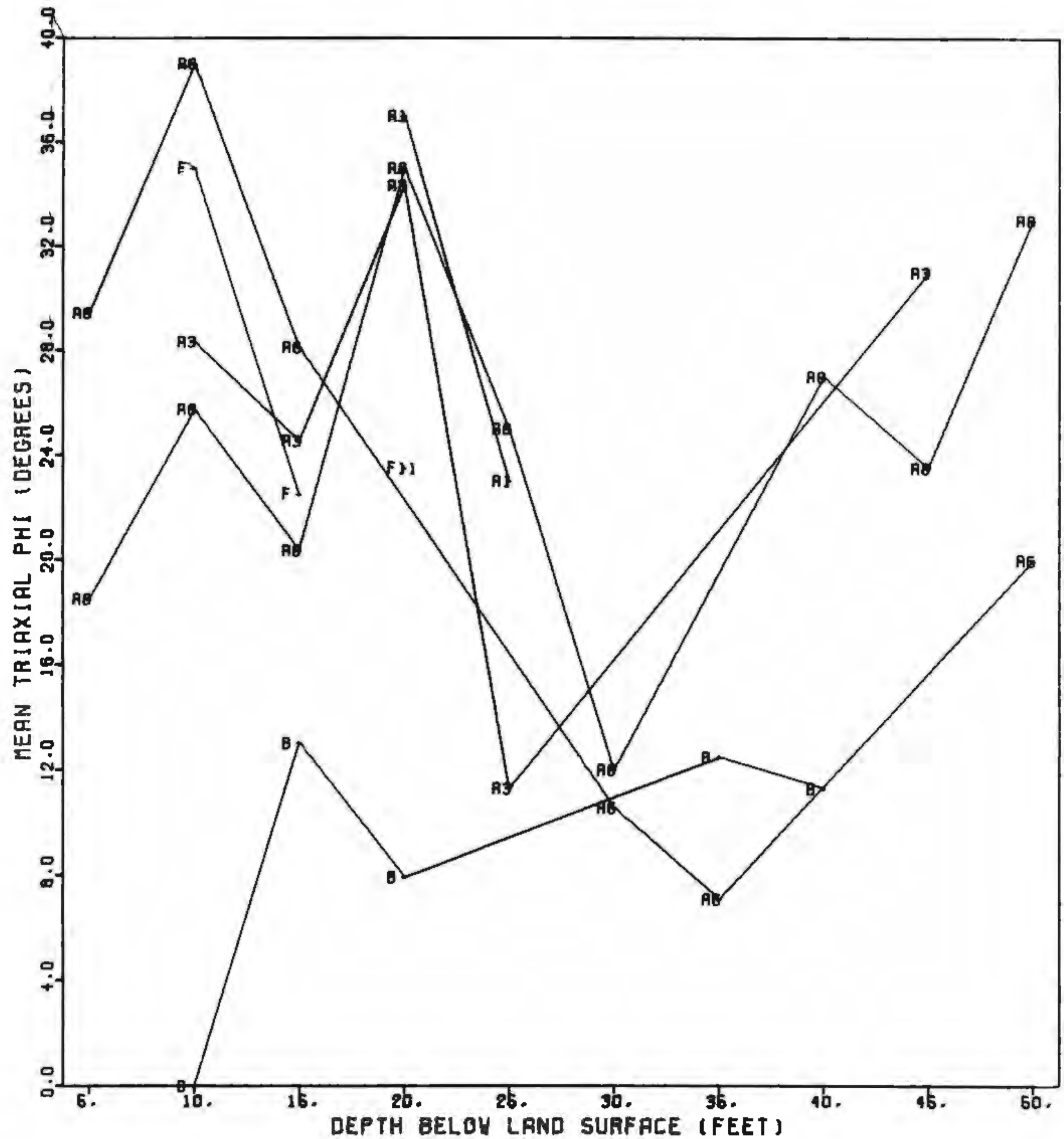

Figure 12. Curves showing variation of mean triaxial phi values (ϕ) with depth.

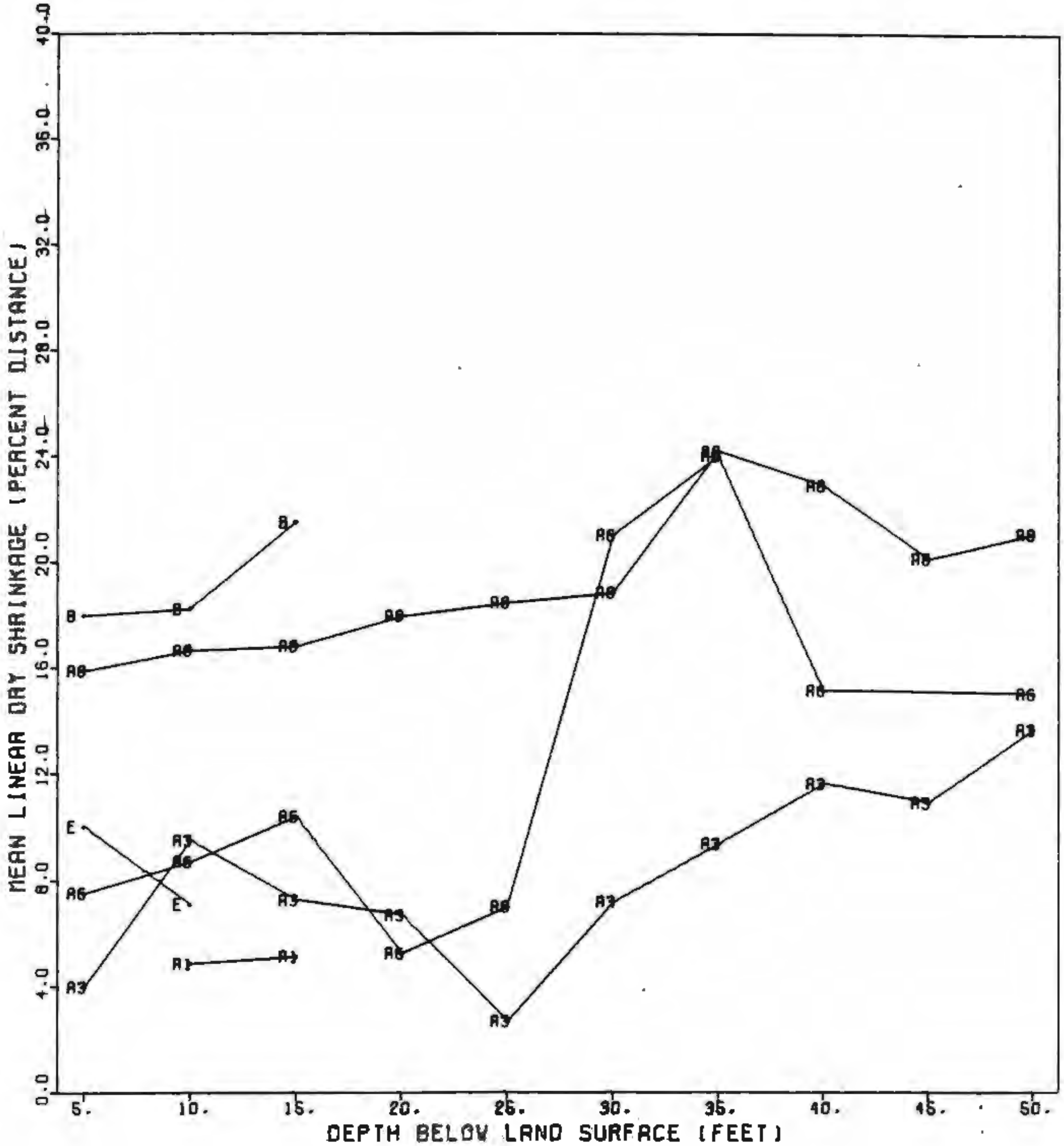

Figure 13. Curves showing variation of mean linear drying shrinkage with depth.

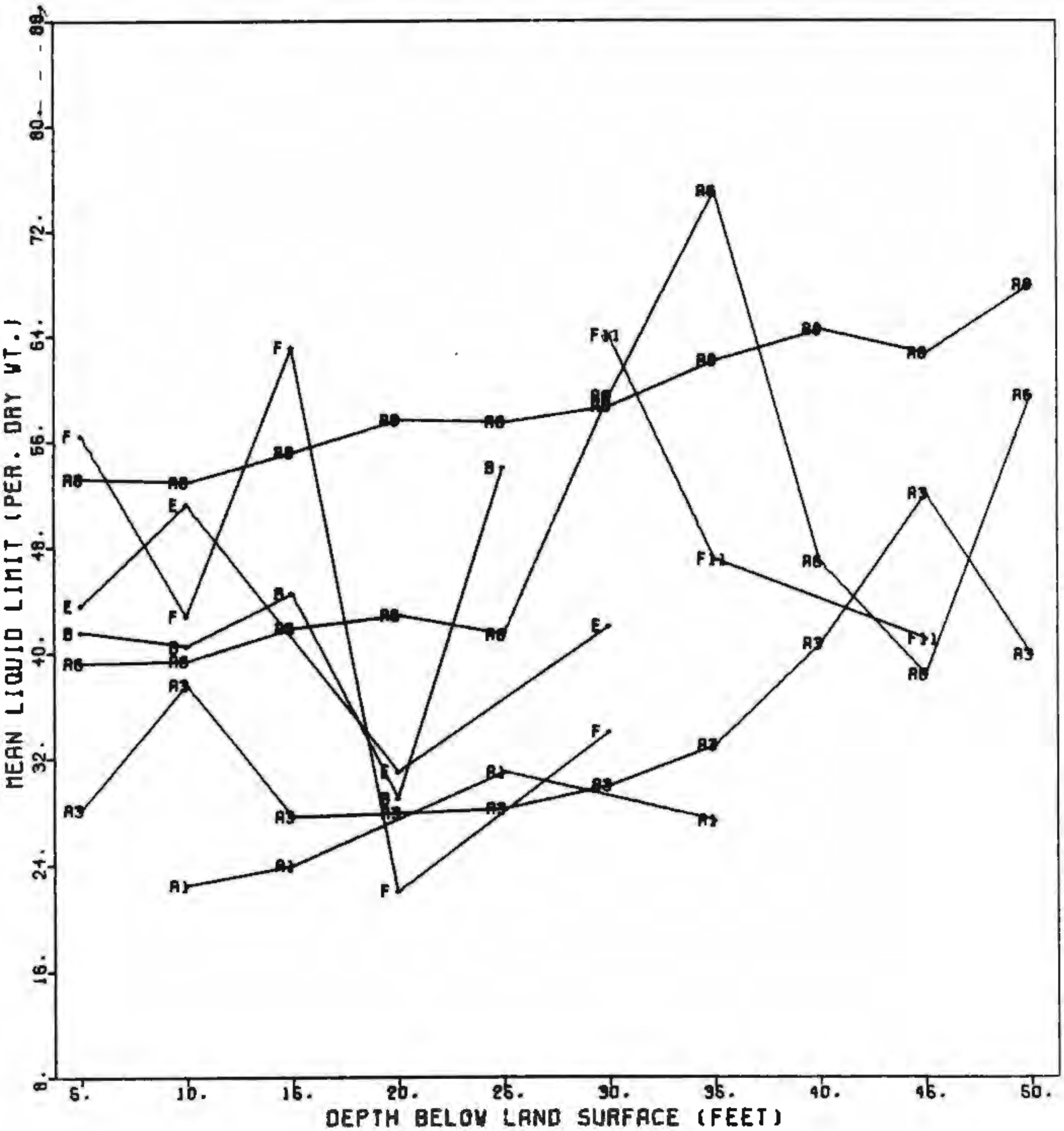

Figure 14. Curves showing variation of mean liquid limit values with depth.

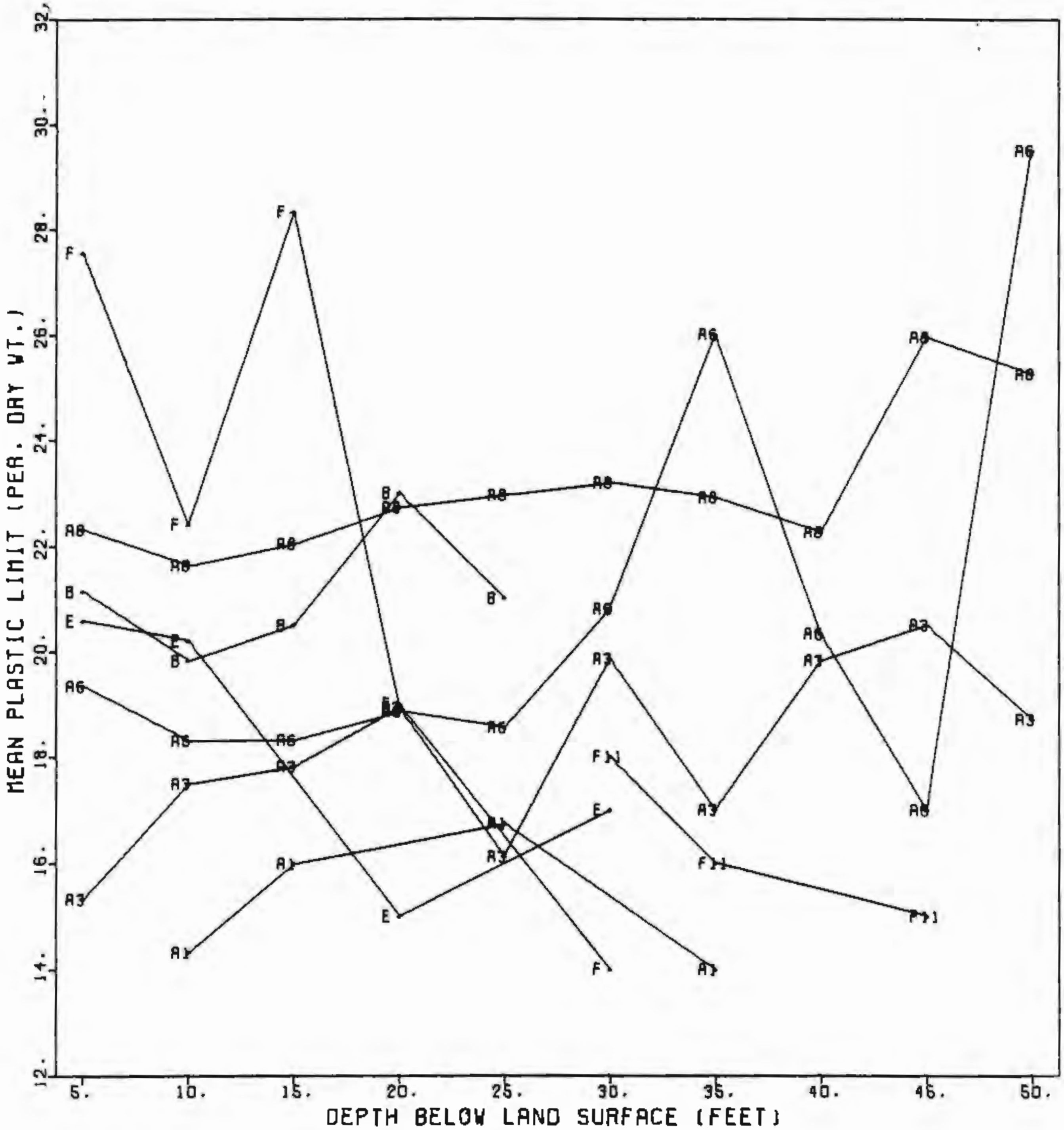

Figure 15. Curves showing variation of mean plastic limit values with depth.

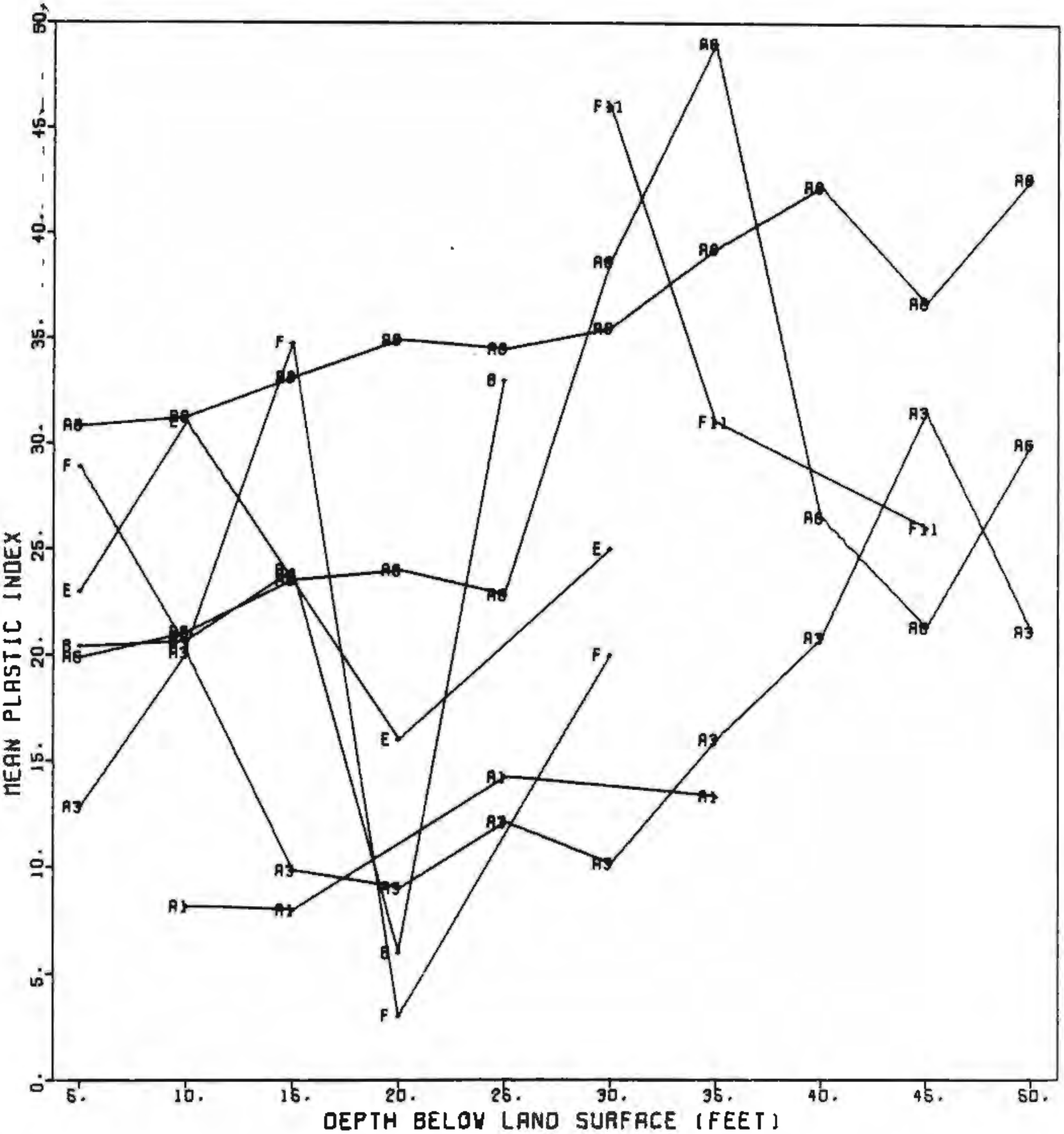

Figure 16. Curves showing variation of mean plasticity index values with depth.

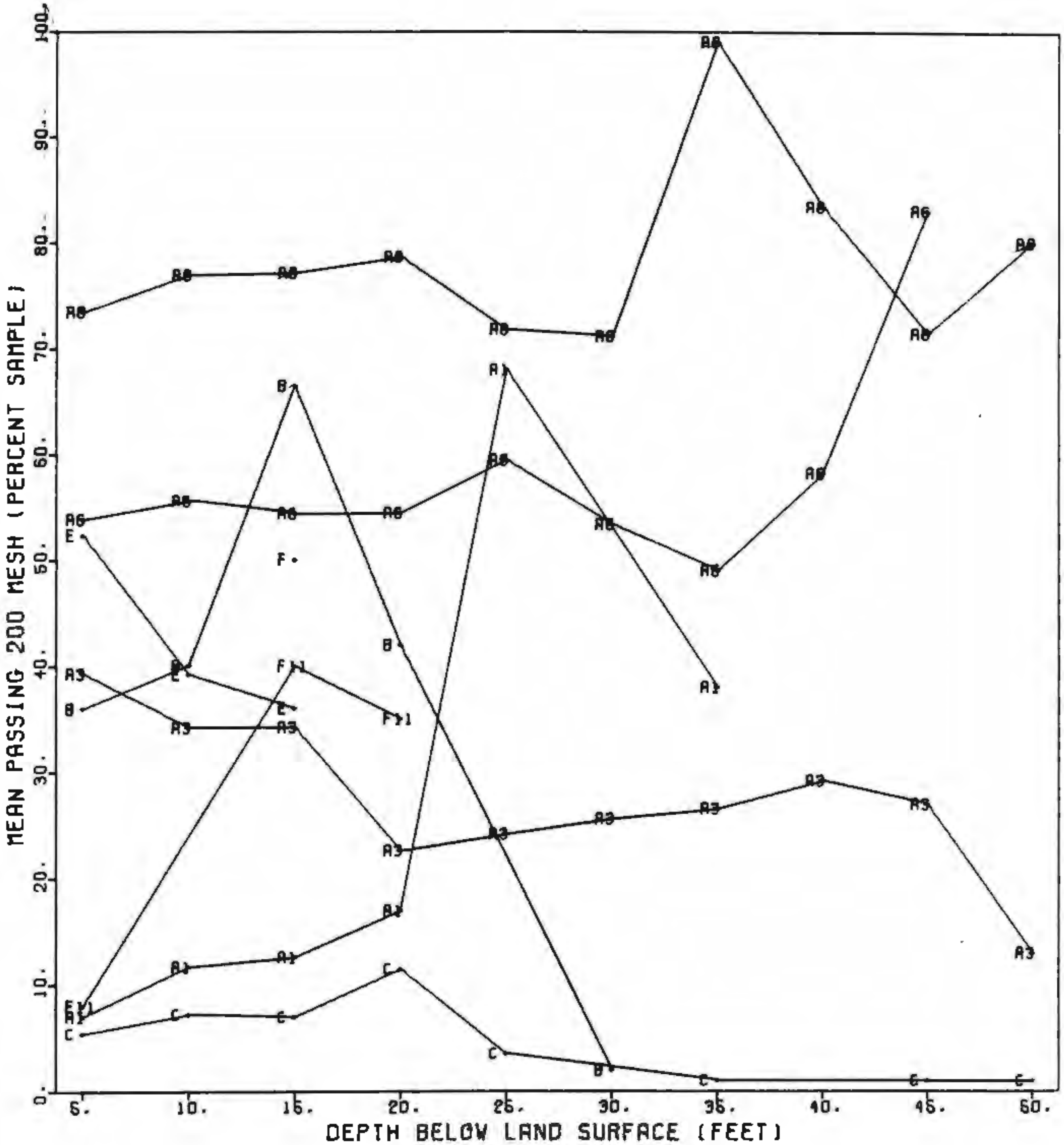

Figure 17. Curves showing variation with depth of mean values for percentage of sample passing 200 mesh sieve.

Table 1. Land resource units—Corpus Christi area.*

COASTAL PLAIN

A1	Sand, recharge, highly permeable: thin, shallow aquifer, maximum thickness approximately 50 feet, high water table, low moisture-retention capacity, poor waste-disposal capability, excavation easy, low shrink-swell potential, high foundation strength, very high corrosion potential, locally tree-covered
A3	Sand and silt, moderately permeable: shallow aquifer, thickness up to 100 feet, low to moderate water-retention capacity, excavation easy, low shrink-swell potential, high foundation strength, high corrosion potential, moderately susceptible to erosion, mostly cropland
A6	Sandy mud, low to moderate permeability, moderately permeable sand veneer: veneer highly variable in thickness, moderate water-retention capacity, moderate to good waste-disposal capability, excavation moderate, moderate to high shrink-swell potential, low to moderate foundation strength, very high corrosion potential, mixed range and cropland
A8	Mud, low permeability: moderate to high water-retention capacity, cracks extensively when dry, good waste-disposal capability, excavation difficult to moderate, high shrink-swell potential, low foundation strength, very high corrosion potential, commonly cropland
A11	Sand, calichified: low to moderate permeability, moderate to low water-retention capacity, poor to moderate waste-disposal capability, excavation moderate, low shrink-swell potential, high foundation strength, low corrosion potential, commonly rangeland

ACTIVE FLOOD PLAINS

B1	Sand and gravel, highly permeable: point bar deposits, highly susceptible to flooding, high water table, poor waste-disposal capability, excavation easy, low shrink-swell potential, generally high foundation strength, high to very high corrosion potential, locally tree-covered, some unmapped mud lenses
B2	Mud and silt, low to moderate permeability: overbank deposits, high susceptibility to flooding, high water table, generally occurs in topographic lows that pond water easily, poor waste-disposal capability, excavation difficult to moderate, high shrink-swell potential, low foundation strength, very high corrosion potential, locally good cropland
B3	Natural levee, elevated: mixed mud and sand, susceptible to flooding during extreme floods, essential for flood protection during lesser floods, poor waste-disposal capability, excavation moderate, variable shrink-swell potential, low to moderate foundation strength, very high corrosion potential, locally tree-covered
B4	Alluvium, small active streams: sand, silt, and mud, highly susceptible to flooding and bank erosion, poor waste-disposal capability, low foundation strength and bank stability, locally tree-covered

BARRIER ISLANDS

C2	Fore-island dunes and vegetation-stabilized barrier flats: sand and shell, highly permeable, perched brackish- to fresh-water aquifer, highly susceptible to flooding and erosion by storm tides, salt-tolerant grasses dominant vegetation, maintenance of vegetation critical in preventing wind and water erosion and providing natural barrier to storm surge, very poor waste-disposal capability, very high corrosion potential, poor to fair construction site, detrimental sand excavation
C4	Storm washover areas, washover channels and fans: loose sand and shell, subject to extensive flooding by storm tides with scour and fill and significant transport of sediment during hurricanes and other storms subject to extensive modification by wind between major floods, very poor waste-disposal capability, very high corrosion potential, extremely poor construction site
C5	Tidal flats: mixed mud, sand, and shell, subject to rapid and sudden inundation by astronomical, storm, and wind-driven tides, moderate wind erosion between floods, poor waste-disposal capability, very high corrosion potential, poor construction site

MAN-MADE FEATURES

E1	Made land and subaerial spoil: mixed mud, silt, sand, and shell, composition and physical properties highly variable, locally steep relief, locally subject to extensive erosion, poor solid waste-disposal capability, very high corrosion potential, construction should be undertaken with caution

BAYS, LAGOONS, ESTUARIES, AND OPEN GULF

F1-5	Bay and estuarine bottom material: mostly mud and sandy mud, local concentrations of sand and shell, high organic content, high water content, overlying water mass varies from restricted or enclosed to tidally influenced, brackish to normal marine salinities, poor waste-disposal capability, low foundation strength
F11	Local shell and sand beaches and berms: thin deposits of sand and shell, commonly flooded and modified by storms, highly susceptible to erosion, poor waste-disposal capability, poor construction site

*Units described in this table are only those for which quantitative data are reported here. Units were not renumbered for this report. B1, B2, B3, and B4 equal B in the tables and graphs; C2, C4, and C5 equal C in the tables and graphs; E1 equals E in the tables and graphs; and F1-5 equals F in the tables and graphs. For more complete descriptions of the units, see Kier and White, in preparation.

Table 2. Physical test data.

1. Unit dry weight (lb/ft^3)
2. Natural moisture content (percentage of dry weight)
3. Foundation strength
    a. Standard penetrometer (blows/foot)
    b. Texas Highway Department cone penetrometer (blows/foot)
    c. Unconfined compressive strength ($tons/ft^2$)
    d. Triaxial shear strength ($tons/ft^2$ or ϕ)
    e. Hand penetrometer ($tons/ft^2$)
    f. In-place vane shear ($tons/ft^2$)
4. Linear drying shrinkage (percentage of distance)
5. Atterburg limits
    a. Liquid limit (percentage of dry weight)
    b. Plastic limit (percentage of dry weight)
    c. Plasticity index
6. Grain size distribution--passing 200 mesh (percentage of sample)
7. Void ratio (volume of voids/volume of solids)

Table 3. Mean unit dry weight (pounds per cubic foot).

Land Resource Units

DEPTH		A1	A3	A6	A8	B	E	F	F11
0- 5	MN	98.2	107.3	107.7	96.5	91.2	102.2		
	SD	1.1	7.4	7.1	7.9	6.7	7.4		
	NO	4	50	104	336	15	38		
5-10	MN	107.2	108.6	109.4	98.5	101.1	94.8	96.0	93.0
	SD	2.9	6.2	7.1	7.2	6.4	7.3	0.0	0.0
	NO	4	59	166	418	11	24	1	1
10-15	MN	94.6	105.7	110.1	100.4	103.5	101.3	108.0	105.5
	SD	6.7	6.2	5.6	7.5	2.1	13.4	2.0	9.5
	NO	9	63	141	326	4	7	2	2
15-20	MN	96.5	100.9	109.2	99.9		95.0	105.0	96.7
	SD	3.1	19.8	6.1	8.0		1.0	13.0	5.7
	NO	6	55	106	218		2	2	3
20-25	MN	97.0	99.0	109.1	100.3		90.0		
	SD	4.2	17.7	5.7	8.5		0.0		
	NO	6	27	51	154		1		
25-30	MN	100.0	104.7	109.1	96.1		77.5	100.0	101.0
	SD	5.0	4.1	4.4	14.9		5.5	0.0	0.0
	NO	2	17	12	103		2	1	1
30-35	MN	99.8	106.8	107.0	98.0		102.0		
	SD	4.8	6.6	3.2	10.0		0.0		
	NO	5	6	4	88		1		
35-40	MN	101.7	102.2	107.2	99.0			107.0	110.0
	SD	8.0	9.5	3.5	11.0			9.0	0.0
	NO	3	5	4	65			2	1
40-45	MN	103.0	86.0	95.7	100.8		99.0		117.0
	SD	0.0	24.8	20.3	9.7		0.0		0.0
	NO	1	3	3	58		1		1
45-50	MN		90.0	109.0	100.8				
	SD		26.0	7.0	7.9				
	NO		2	2	43				

Table 4. Mean natural moisture content (percent dry weight).

		Land Resource Units							
DEPTH		A1	A3	A6	A8	B	E	F	F11
	MN	17.0	16.6	15.4	24.3	24.9	21.5	47.0	14.0
0- 5	SD	4.2	5.6	5.0	6.1	7.5	6.2	7.6	0.0
	NO	8	49	105	362	15	66	6	1
	MN	21.1	17.3	16.0	24.3	19.7	27.0	37.9	28.0
5-10	SD	4.6	6.5	5.5	5.7	6.1	10.5	12.4	0.0
	NO	10	74	170	452	12	45	15	1
	MN	25.0	18.2	17.0	23.9	19.2	26.4	36.2	19.8
10-15	SD	5.7	6.6	7.0	7.3	1.1	8.2	13.9	6.0
	NO	8	111	149	356	4	24	6	5
	MN	22.4	19.2	19.0	26.3		24.7	48.2	26.1
15-20	SD	3.7	6.5	3.9	11.2		1.8	24.0	6.4
	NO	9	123	111	248		4	6	8
	MN	28.0	20.5	19.4	26.5		38.5	53.7	29.2
20-25	SD	5.0	7.0	5.2	11.3		7.5	10.1	13.9
	NO	5	67	55	189		2	3	9
	MN		19.0	20.5	28.1		41.0	43.5	30.0
25-30	SD		6.7	4.9	11.4		8.6	14.5	3.6
	NO		46	17	129		3	4	3
	MN	25.4	22.9	30.5	27.8		28.0	43.0	17.0
30-35	SD	2.5	4.3	11.9	9.5		0.0	13.0	0.0
	ND	9	12	10	119		1	3	1
	MN	27.2	24.3	24.4	27.3			37.0	19.0
35-40	SD	7.4	5.5	10.5	8.0			20.7	0.0
	NO	4	13	9	94			3	1
	MN	29.0	26.6	30.0	25.6		27.0		18.0
40-45	SD	5.0	16.4	15.1	8.4		0.0		0.0
	NO	2	13	4	82		1		1
	MN	26.0	20.7	21.0	26.0				
45-50	SD	0.0	4.1	4.1	6.3				
	NO	1	16	4	68				

Table 5. Mean in-place vane shear (tons per square foot).

Land Resource Units

DEPTH		A1	A3	A8	B	E	F	F11
0- 5	MN	1.2				.3	.1	
	SD	.2				0.0	.0	
	NO	2				2	4	
5-10	MN	1.4		1.2		.4	.3	.6
	SD	0.0		.2		.1	.2	0.0
	NO	1		2		3	15	1
10-15	MN	.3		.7	1.7	.4	.2	.9
	SD	0.0		.7	0.0	.2	.1	.2
	NO	1		2	1	4	10	2
15-20	MN			.5		.6	.3	1.0
	SD			.5		0.0	.1	0.0
	NO			3		1	2	1
20-25	MN			.4		.4	.4	.1
	SD			.5		0.0	.3	0.0
	NO			12		1	4	1
25-30	MN		1.4	.5			.3	
	SD		0.0	.3			.3	
	NO		1	13			3	
30-35	MN	.9	1.4	.6			.7	
	SD	.5	0.0	.4			0.0	
	NO	3	1	16			1	
35-40	MN	1.1		1.0			.4	
	SD	.2		.4			0.0	
	NO	5		17			1	
40-45	MN	1.2		1.1			.8	
	SD	0.0		.3			.4	
	NO	1		12			2	
45-50	MN			1.1				
	SD			.5				
	NO			7				

Table 6. Mean standard penetrometer (blows per foot).

Land Resource Units

DEPTH		A1	A3	A6	A8	B	C	E	F	F11
0- 5	MN	7.3	22.0		16.0		20.4	8.3		8.0
	SD	4.2	19.3		0.0		8.0	7.5		0.0
	NO	31	5		1		14	21		1
5-10	MN	11.5	16.5	27.0	11.4	3.5	21.4	11.3	13.1	21.0
	SD	4.8	14.6	0.0	8.0	1.5	6.3	12.3	7.1	7.7
	NO	39	32	1	10	2	16	20	7	4
10-15	MN	23.8	21.2	17.7	14.6	15.0	20.5	10.6	40.0	22.8
	SD	15.3	14.7	14.0	12.1	0.0	6.6	11.4	0.0	15.5
	NO	33	125	11	20	1	16	18	1	9
15-20	MN	37.2	27.9	22.3	9.9		30.1	6.4		16.3
	SD	16.2	16.4	16.4	5.7		12.3	5.9		13.0
	NO	24	224	15	23		14	8		20
20-25	MN	46.3	35.5	20.9	23.7		53.9			11.4
	SD	17.0	20.2	14.8	14.5		8.3			12.0
	NO	9	155	12	29		13			17
25-30	MN	51.3	36.7	35.7	28.3	2.0	52.3			15.3
	SD	5.7	17.8	16.5	19.3	0.0	7.8			8.1
	NO	7	97	18	26	1	12			3
30-35	MN	32.1	37.0	30.2	29.5	3.0	38.0			48.0
	SD	24.2	17.6	24.4	17.2	0.0	11.0			0.0
	NO	7	60	6	26	1	12			1
35-40	MN	42.2	41.7	25.2	29.4	7.0	41.5			
	SD	14.9	16.2	21.0	18.4	0.0	10.9			
	NO	6	57	6	14	1	11			
40-45	MN	60.0	39.0	51.6	24.4	9.0	55.8			
	SD	0.0	16.7	11.2	15.8	0.0	6.9			
	NO	2	53	5	11	1	11			
45-50	MN	53.0	44.1	60.0	32.9		60.0			
	SD	7.0	41.0	0.0	19.0		0.0			
	NO	2	34	1	11		2			

Table 7. Mean Texas Highway Department cone penetrometer (blows per foot).

Land Resource Units

DEPTH		A3	A6	A8	C	E	F
0- 5	MN		25.2	9.8		10.0	
	SD		14.8	5.5		0.0	
	NO		6	4		1	
5-10	MN	39.2	44.5	22.1	76.0	6.0	
	SD	27.2	26.8	7.4	0.0	0.0	
	NO	6	8	9	1	1	
10-15	MN	37.3	20.4	33.7	39.5		6.5
	SD	24.0	16.4	29.7	1.5		.5
	NO	17	9	6	2		2
15-20	MN	43.7	31.9	33.3	20.5		9.0
	SD	32.5	30.6	27.9	2.5		0.0
	NO	11	9	12	2		1
20-25	MN	56.8	32.9	22.4	8.0		
	SD	40.0	38.6	10.7	.8		
	NO	23	8	11	3		
25-30	MN	70.7	73.2	23.6	7.7		5.5
	SD	38.4	39.6	12.8	3.7		2.5
	NO	13	4	14	3		2
30-35	MN	85.8	43.5	20.5	7.3		
	SD	29.9	43.6	22.5	.5		
	NO	9	8	17	3		
35-40	MN	83.4	49.7	26.4	23.0		4.0
	SD	27.2	40.6	27.9	0.0		0.0
	NO	8	8	15	1		1
40-45	MN	64.7	36.7	16.1			
	SD	30.0	38.1	15.7			
	NO	12	7	16			
45-50	MN	80.1	84.7	25.8			
	SD	28.9	19.3	25.6			
	NO	10	4	11			

Table 8. Mean unconfined compression (Q_u) (tons per square foot).

Land Resource Units

DEPTH		A1	A3	A6	A8	B	E	F	F11
0- 5	MN		2.0	2.5	2.0	1.6	1.2		1.0
	SD		1.4	.9	1.2	.6	.6		0.0
	NO		9	5	156	13	27		1
5-10	MN	.3	1.7	4.5	2.2	2.0	.8	.3	.7
	SD	0.0	1.1	2.9	1.0	.5	.6	0.0	0.0
	NO	1	36	48	229	9	15	2	1
10-15	MN	1.0	1.7	4.0	2.2	2.0	.2		.7
	SD	0.0	1.1	1.8	1.3	.5	.0		.5
	NO	1	72	48	205	3	3		2
15-20	MN	1.8	2.2	3.8	2.2		.2	.1	.1
	SD	.5	1.0	1.4	1.3		0.0	0.0	.1
	NO	4	72	31	135		1	1	2
20-25	MN	.1	2.2	3.1	2.0		.2		6.0
	SD	0.0	1.0	1.1	1.0		0.0		0.0
	NO	1	40	22	85		1		1
25-30	MN		2.4	3.0	1.9		.4		.4
	SD		.9	.2	1.4		0.0		0.0
	NO		30	2	74		1		1
30-35	MN	1.0	2.3	3.2	2.0				
	SD	.8	.9	0.0	1.4				
	NO	2	6	1	61				
35-40	MN	.4	1.7	4.0	1.7		.	.5	1.1
	SD	0.0	1.2	0.0	1.7			.4	0.0
	NO	1	7	1	43			2	1
40-45	MN	1.7	1.1	2.7	1.6		1.2		.9
	SD	0.0	1.0	0.0	1.7		0.0		0.0
	NO	1	5	1	46		1		1
45-50	MN		3.5	1.5	2.2				
	SD		1.3	0.0	1.9				
	NO		6	1	28				

Table 9. Mean triaxial shear (Q_c) (tons per square foot).

Land Resource Units

DEPTH		A1	A3	A6	A8	B	F	F11
0- 5	MN			.7	.6			
	SD			.4	.4			
	NO			3	2			
5-10	MN		.2	.7	.5	1.0	.4	
	SD		.2	0.0	.1	0.0	0.0	
	NO		3	1	4	1	1	
10-15	MN		.3	.3	.3	.4	.6	
	SD		.0	.1	.1	.1	0.0	
	NO		2	5	2	2	1	
15-20	MN	.4	.2		.4	1.3		.6
	SD	0.0	.1		0.0	.1		0.0
	NO	1	3		1	2		1
20-25	MN	.1	.8		.9			
	SD	0.0	0.0		.5			
	NO	1	1		3			
25-30	MN			1.5	.7			
	SD			.8	.2			
	NO			3	2			
30-35	MN			1.4		.8		
	SD			0.0		0.0		
	NO			1		1		
35-40	MN				.6	1.2		
	SD				0.0	0.0		
	NO				1	1		
40-45	MN		.9		.5			
	SD		0.0		.1			
	NO		1		2			
45-50	MN			1.4	1.1			
	SO			0.0	0.0			
	NO			1	1			

Table 10. Mean triaxial phi (degrees).

Land Resource Units

DEPTH		A1	A3	A6	A8	B	F	F11
0- 5	MN			29.4	18.5			
	SD			.6	10.5			
	NO			3	2			
5-10	MN		28.3	39.0	25.7	.0	35.0	
	SD		3.4	0.0	14.7	0.0	0.0	
	NO		3	1	4	1	1	
10-15	MN		24.5	28.1	20.4	13.1	22.5	
	SD		3.6	1.3	3.3	11.1	0.0	
	NO		2	5	2	2	1	
15-20	MN	37.0	34.3		35.0	7.9		23.5
	SD	0.0	3.0		0.0	4.5		0.0
	NO	1	3		1	2		1
20-25	MN	23.0	11.3		25.0			
	SD	0.0	0.0		1.4			
	NO	1	1		3			
25-30	MN			10.6	12.0			
	SD			11.2	3.0			
	NO			3	2			
30-35	MN			7.1		12.5		
	SD			0.0		0.0		
	NO			1		1		
35-40	MN				27.0	11.3		
	SD				0.0	0.0		
	NO				1	1		
40-45	MN		31.0		23.5			
	SD		0.0		5.5			
	NO		1		2			
45-50	MN			20.0	33.0			
	SD			0.0	0.0			
	NO			1	1			

Table 11. Mean hand penetrometer (tons per square foot).
Land Resource Units

DEPTH		A3	A6	A8	E	F	F11
	MN			3.6	2.4		
0- 5	SD			1.0	.8		
	NO			63	5		
	MN	.6		3.4	2.7		
5-10	SD	.1		1.3	0.0		
	NO	3		72	1		
	MN	4.0		3.1			2.8
10-15	SD	0.0		1.4			0.0
	NO	1		53			1
	MN	2.0	1.5	2.2			
15-20	SD	1.3	0.0	1.5			
	NO	6	1	41			
	MN	2.0	2.3	2.1		.2	
20-25	SD	1.1	0.0	1.7		0.0	
	NO	6	1	35		1	
	MN	2.8		2.3		.4	
25-30	SD	1.5		1.6		.4	
	NO	6		29		2	
	MN	3.4		2.7		.4	
30-35	SD	1.3		1.7		.3	
	NO	4		34		2	
	MN	1.1		2.3		.2	
35-40	SD	.1		1.7		0.0	
	NO	2		9		1	
	MN			3.1			
40-45	SD			1.3			
	NO			5			
	MN	4.5		3.2			
45-50	SD	0.0		1.4			
	NO	1		3			

Table 12. Mean absorption swell (percent volume).

Land Resource Units

DEPTH		A3	A6	A8	B
0- 5	MN		3.9	4.0	3.5
	SD		2.1	3.4	0.0
	NO		8	27	1
5-10	MN		2.0	3.5	
	SD		1.5	2.3	
	NO		6	12	
10-15	MN	1.2	1.5	2.5	
	SD	0.0	.4	1.1	
	NO	1	2	3	
15-20	MN			5.0	
	SD			0.0	
	NO			1	
20-25	MN				
	SD				
	NO				
25-30	MN				
	SD				
	NO				
30-35	MN				
	SD				
	NO				
35-40	MN				
	SD				
	NO				
40-45	MN				
	SD				
	NO				
45-50	MN				
	SD				
	NO				

Table 13. Mean absorption pressure (tons per square foot).

Land Resource Units

DEPTH		A3	A6	A8	B
0- 5	MN	.5	2.6	3.2	1.2
	SD	0.0	2.0	3.9	0.0
	NO	1	9	27	1
5-10	MN		1.4	1.2	
	SD		1.2	.9	
	NO		6	12	
10-15	MN	.3	.4	1.2	
	SD	0.0	.2	.5	
	NO	1	3	3	
15-20	MN			1.3	
	SD			.3	
	NO			2	
20-25	MN			.7	
	SD			0.0	
	NO			1	
25-30	MN				
	SD				
	NO				
30-35	MN				
	SD				
	NO				
35-40	MN				
	SD				
	NO				
40-45	MN				
	SD				
	NO				
45-50	MN				
	SD				
	NO				

Table 14. Mean linear drying shrinkage (percent distance).

Land Resource Units

DEPTH		A1	A3	A6	A8	B	E
0- 5	MN		4.0	7.5	15.9	18.0	10.0
	SD		2.3	3.3	3.5	1.9	3.1
	NO		3	5	46	2	11
5-10	MN	4.9	9.5	8.7	16.7	18.2	7.1
	SD	.5	3.8	3.8	4.0	1.8	2.1
	NO	4	4	8	46	2	2
10-15	MN	5.1	7.3	10.4	16.8	21.5	
	SD	.5	3.6	3.6	5.7	0.0	
	NO	2	14	5	29	1	
15-20	MN		6.7	5.3	18.0		
	SD		4.2	4.8	6.3		
	NO		12	2	21		
20-25	MN		2.7	7.0	18.5		
	SD		1.6	0.0	7.2		
	NO		5	1	20		
25-30	MN		7.2	21.0	18.8		
	SD		5.5	6.1	7.8		
	NO		4	4	13		
30-35	MN		9.4	24.0	24.2		
	SD		4.6	0.0	3.5		
	NO		3	1	7		
35-40	MN		11.6	15.1	22.9		
	SD		6.7	5.4	5.3		
	NO		4	4	6		
40-45	MN		10.9		20.1		
	SD		9.7		8.9		
	NO		8		7		
45-50	MN		13.7	15.0	21.0		
	SD		7.6	7.0	6.8		
	NO		6	2	6		

Table 15. Mean liquid limit (percent dry weight).

Land Resource Units

DEPTH		A1	A3	A6	A8	B	E	F	F11
0- 5	MN		28.2	39.2	53.1	41.6	43.6	56.4	
	SD		6.7	6.5	10.6	20.0	11.9	14.7	
	NO		6	20	94	7	19	9	
5-10	MN	22.5	37.6	39.4	52.9	40.5	51.2	42.7	
	SD	3.6	17.1	7.3	12.3	16.3	22.0	10.8	
	NO	6	10	26	86	6	5	15	
10-15	MN	24.0	27.6	41.9	55.2	44.5		63.1	
	SD	3.0	5.7	14.1	16.0	23.5		11.3	
	NO	2	22	22	70	2		9	
15-20	MN		27.9	42.9	57.6	29.0	31.0	22.0	
	SD		9.4	11.5	16.8	0.0	0.0	0.0	
	NO		16	7	47	1	1	1	
20-25	MN	31.0	28.2	41.4	57.4	54.0			
	SD	1.2	6.8	7.4	20.5	0.0			
	NO	4	8	11	44	1			
25-30	MN		30.0	59.4	58.6		42.0	34.0	64.0
	SD		9.8	12.2	23.2		0.0	0.0	0.0
	NO		7	5	38		1	1	1
30-35	MN	27.3	33.0	75.0	62.1				47.0
	SD	4.1	8.9	0.0	20.6				0.0
	NO	3	4	1	31				1
35-40	MN		40.7	46.8	64.4				
	SD		12.9	18.1	19.5				
	NO		6	6	20				
40-45	MN		52.0	38.3	62.6				41.0
	SD		29.1	7.6	20.1				0.0
	NO		10	3	22				1
45-50	MN		39.9	59.5	67.9				
	SD		18.1	15.5	18.0				
	NO		7	2	16				

Table 16. Mean plastic limit (percent dry weight).

Land Resource Units

DEPTH		A1	A3	A6	A8	B	E	F	F11
	MN		15.3	19.3	22.3	21.1	20.6	27.6	
0- 5	SD		1.6	2.6	4.8	5.6	3.4	4.3	
	NO		6	20	94	7	19	9	
	MN	14.3	17.5	18.3	21.6	19.8	20.2	22.4	
5-10	SD	2.7	3.1	2.3	5.0	4.4	7.2	5.0	
	NO	6	10	26	86	6	5	15	
	MN	16.0	17.8	18.3	22.0	20.5		28.3	
10-15	SD	2.0	2.2	5.0	5.1	5.5		2.6	
	NO	2	22	22	70	2		9	
	MN		18.9	18.9	22.7	23.0	15.0	19.0	
15-20	SD		3.6	3.2	5.1	0.0	0.0	0.0	
	NO		16	7	47	1	1	1	
	MN	16.7	16.1	18.5	23.0	21.0			
20-25	SD	.4	5.4	3.2	5.8	0.0			
	NO	4	8	11	44	1			
	MN		19.9	20.8	23.2		17.0	14.0	18.0
25-30	SD		2.9	2.6	8.1		0.0	0.0	0.0
	NO		7	5	38		1	1	1
	MN	14.0	17.0	26.0	22.9				16.0
30-35	SD	.8	3.5	0.0	6.5				0.0
	NO	3	4	1	31				1
	MN		19.8	20.3	22.2				
35-40	SD		5.6	8.3	6.0				
	NO		6	6	20				
	MN		20.5	17.0	26.0				15.0
40-45	SD		8.8	.8	10.0				0.0
	NO		10	3	22				1
	MN		18.7	29.5	25.2				
45-50	SD		5.6	1.5	6.2				
	NO		7	2	16				

Table 17. Mean plasticity index.

Land Resource Units

DEPTH		A1	A3	A6	A8	B	E	F	F11
0- 5	MN		12.8	19.9	30.8	20.4	23.0	28.9	
	SD		5.1	5.5	8.3	15.2	10.6	12.0	
	NO		6	20	94	7	19	9	
5-10	MN	8.2	20.1	21.1	31.2	20.7	31.0	20.3	
	SD	1.2	14.9	7.3	8.8	14.1	18.8	7.7	
	NO	6	10	26	86	6	5	15	
10-15	MN	8.0	9.8	23.5	33.1	24.0		34.8	
	SD	1.0	7.0	9.8	12.5	18.0		12.5	
	NO	2	22	22	70	2		9	
15-20	MN		9.0	24.0	34.9	6.0	16.0	3.0	
	SD		8.2	10.6	13.9	0.0	0.0	0.0	
	NO		16	7	47	1	1	1	
20-25	MN	14.2	12.1	22.8	34.5	33.0			
	SD	1.6	7.2	5.9	16.2	0.0			
	NO	4	8	11	44	1			
25-30	MN		10.1	38.6	35.4		25.0	20.0	46.0
	SD		9.9	13.7	17.4		0.0	0.0	0.0
	NO		7	5	38		1	1	1
30-35	MN	13.3	16.0	49.0	39.2				31.0
	SD	4.6	7.2	0.0	15.7				0.0
	NO	3	4	1	31				1
35-40	MN		20.8	26.5	42.2				
	SD		11.2	10.3	16.1				
	NO		6	6	20				
40-45	MN		31.5	21.3	36.7				26.0
	SD		22.8	7.5	14.1				0.0
	NO		10	3	22				1
45-50	MN		21.1	30.0	42.6				
	SD		13.2	14.0	13.7				
	NO		7	2	16				

Table 18. Mean percent gravel in sample.

Land Resource Units

DEPTH		A1	A3	A6	A8	C	E	F11
	MN	.0			.0	.0		
0- 5	SD	.0			0.0	0.0		
	NO	4			3	2		
	MN	.0			.0	.0	1.0	
5-10	SD	0.0			0.0	0.0	0.0	
	NO	1			3	2	1	
	MN				3.0	.0		
10-15	SD				5.2	0.0		
	NO				4	2		
	MN		.0		1.0			.0
15-20	SD		0.0		1.4			0.0
	NO		1		3			2
	MN					.0		
20-25	SD					0.0		
	NO					1		
	MN		.0					
25-30	SD		0.0					
	NO		2					
	MN		.0			.0		
30-35	SD		0.0			0.0		
	NO		1			2		
	MN		6.0					
35-40	SD		0.0					
	NO		1					
	MN					.0		
40-45	SD					0.0		
	NO					2		
	MN					.0		
45-50	SD					0.0		
	NO					1		

Table 19. Mean percent sand in sample.

Land Resource Units

DEPTH		A1	A3	A6	A8	C	E	F11
	MN	91.3			47.7	99.0		
0- 5	SD	1.1			11.9	0.0		
	NO	4			3	2		
	MN	92.0			55.0	98.0	26.0	
5-10	SD	0.0			5.4	0.0	0.0	
	NO	1			3	2	1	
	MN				32.5	99.0		
10-15	SD				13.4	0.0		
	NO				4	2		
	MN		90.0		32.0			65.0
15-20	SD		0.0		22.6			33.0
	NO		1		3			2
	MN					98.0		
20-25	SD					0.0		
	NO					1		
	MN		75.5					
25-30	SD		3.5					
	NO		2					
	MN		77.0			99.0		
30-35	SD		0.0			0.0		
	NO		1			2		
	MN		77.0					
35-40	SD		0.0					
	NO		1					
	MN					99.0		
40-45	SD					0.0		
	NO					2		
	MN					99.0		
45-50	SD					0.0		
	NO					1		

Table 20. Mean percent silt in sample.

Land Resource Units

DEPTH		A3	A8	E
0- 5	MN		19.3	
	SD		2.9	
	NO		3	
5-10	MN		13.7	28.0
	SD		.9	0.0
	NO		3	1
10-15	MN		20.2	
	SD		4.4	
	NO		4	
15-20	MN		29.7	
	SD		11.3	
	NO		3	
20-25	MN			
	SD			
	NO			
25-30	MN	12.0		
	SD	0.0		
	NO	1		
30-35	MN			
	SD			
	NO			
35-40	MN	13.0		
	SD	0.0		
	NO	1		
40-45	MN			
	SD			
	NO			
45-50	MN			
	SD			
	NO			

Table 21. Mean percent clay in sample.

Land Resource Units

DEPTH		A3	AB	E
0- 5	MN		33.3	
	SD		10.7	
	NO		3	
5-10	MN		31.3	45.0
	SD		4.6	0.0
	NO		3	1
10-15	MN		44.2	
	SD		9.7	
	NO		4	
15-20	MN		37.3	
	SD		13.0	
	NO		3	
20-25	MN			
	SD			
	NO			
25-30	MN	9.0		
	SD	0.0		
	NO	1		
30-35	MN			
	SD			
	NO			
35-40	MN	4.0		
	SD	0.0		
	NO	1		
40-45	MN			
	SD			
	NO			
45-50	MN			
	SD			
	NO			

Table 22. Mean percent of sample passing 200 (mesh) sieve.

Land Resource Units

DEPTH		A1	A3	A6	A8	B	C	E	F	F11
0- 5	MN	7.1	39.3	53.9	73.5	36.0	5.4	52.3		8.0
	SD	2.1	11.7	9.4	13.6	23.2	3.6	24.1		0.0
	NO	15	13	20	49	13	9	12		1
5-10	MN	11.8	34.2	55.6	76.9	40.1	7.3	39.2		
	SD	9.8	18.5	14.2	16.0	56.8	6.5	21.9		
	NO	17	21	24	50	11	4	5		
10-15	MN	12.6	34.2	54.4	77.1	66.5	7.0	36.0	50.0	40.0
	SD	10.4	19.0	20.4	15.4	31.5	5.4	21.7	3.0	0.0
	NO	14	42	20	38	2	5	8	2	1
15-20	MN	17.0	22.6	54.4	78.6	42.0	11.5			35.0
	SD	0.0	17.6	13.8	15.3	0.0	1.5			33.0
	NO	1	54	16	23	1	2			2
20-25	MN	68.0	24.2	59.4	71.7		3.5			
	SD	0.0	16.3	13.0	22.7		1.5			
	NO	1	31	7	16		2			
25-30	MN		25.6	53.3	71.1	2.0				
	SD		18.6	18.9	23.2	0.0				
	NO		19	6	11	1				
30-35	MN	38.0	26.6	49.0	99.0		1.0			
	SD	9.0	10.7	0.0	0.0		0.0			
	NO	2	7	1	2		2			
35-40	MN		29.2	58.2	83.3					
	SD		22.5	19.2	5.0					
	NO		11	5	3					
40-45	MN		27.0	83.0	71.4		1.0			
	SD		11.5	0.0	14.1		0.0			
	NO		6	1	5		2			
45-50	MN		13.0		80.0		1.0			
	SD		4.9		17.1		0.0			
	NO		5		4		1			

Table 23. Mean void ratio (volume voids/volume solids).

Land Resource Units

DEPTH		A3	A6	A8	B
	MN				
0- 5	SD				
	NO				
	MN		.6		
5-10	SD		0.0		
	NO		1		
	MN		.5	.8	
10-15	SD		0.0	0.0	
	NO		1	1	
	MN	.7	.8	.7	
15-20	SD	0.0	0.0	.1	
	NO	1	1	3	
	MN			.8	.7
20-25	SD			.0	0.0
	NO			2	1
	MN			.6	
25-30	SD			0.0	
	NO			2	
	MN			.7	.8
30-35	SD			.1	0.0
	NO			3	1
	MN		.5	.7	
35-40	SD		0.0	0.0	
	NO		1	1	
	MN				.7
40-45	SD				0.0
	NO				1
	MN			.9	
45-50	SD			0.0	
	NO			1	

Table 24. Mean vertical or horizontal permeability (cm/sec).

Land Resource Units

DEPTH		A3	A6	A8	B
0- 5	MN		.0		
	SD		0.0		
	NO		1		
5-10	MN		.0	.0	
	SD		0.0	.0	
	NO		1	3	
10-15	MN			.0	.0
	SD			.0	.0
	NO			5	3
15-20	MN	.0	.0	.0	.0
	SD	0.0	0.0	.0	.0
	NO	1	1	2	2
20-25	MN		.0		.0
	SD		0.0		.0
	NO		1		4
25-30	MN	.0	.0	.0	
	SD	.0	0.0	0.0	
	NO	2	1	1	
30-35	MN				.0
	SD				.0
	NO				2
35-40	MN	.0			.0
	SD	.0			.0
	NO	2			2
40-45	MN	.0	.0		
	SD	0.0	0.0		
	NO	1	1		
45-50	MN			.0	
	SD			0.0	
	NO			1	

Table 25. Quick reference table for all means between 0 and 5 feet; 0.0 indicates no data.

Land Resource Units

	A1	A3	A6	A8	B	C	E	F	F11
UNIT DRY WEIGHT (POUNDS PER CUBIC FOOT)	98.2	107.3	107.7	96.5	91.2	0.0	102.2	0.0	0.0
NATURAL MOISTURE CONTENT (PERCENT D WT)	17.0	16.6	15.4	24.3	24.9	0.0	21.5	47.0	14.0
IN PLACE VANE SHEAR (TONS PER SQ. FT.)	1.2	0.0	0.0	0.0	0.0	0.0	.3	.1	0.0
STANDARD PENETROMETER (BLOWS PER FOOT)	7.3	22.0	0.0	16.0	0.0	20.4	8.3	0.0	8.0
THD CONE PENETROMETER (BLOWS PER FOOT)	0.0	0.0	25.2	9.8	0.0	0.0	10.0	0.0	0.0
UNCONFINED COMPRESSION Q(U) (TONS/SQ.FT)	0.0	2.0	2.5	2.0	1.6	0.0	1.2	0.0	1.0
TRIAXIAL SHEAR Q(C) (TONS PER SQ. FT.)	0.0	0.0	.7	.6	0.0	0.0	0.0	0.0	0.0
TRIAXIAL PHI (DEGREES)	0.0	0.0	29.4	18.5	0.0	0.0	0.0	0.0	0.0
HAND PENETROMETER (TONS PER SQUARE FOOT)	0.0	0.0	0.0	3.6	0.0	0.0	2.4	0.0	0.0
SHRINKAGE LIMIT (PERCENT DRY WEIGHT)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ABSORPTION SWELL (PERCENT VOLUME)	0.0	0.0	3.9	4.0	3.5	0.0	0.0	0.0	0.0
ABSORPTION PRESSURE (TONS PER SQ. FT.)	0.0	.5	2.6	3.2	1.2	0.0	0.0	0.0	0.0
LINEAR DRY SHRINKAGE (PERCENT DISTANCE)	0.0	4.0	7.5	15.9	18.0	0.0	10.0	0.0	0.0
LIQUID LIMIT (PERCENT DRY WEIGHT)	0.0	28.2	39.2	53.1	41.6	0.0	43.6	56.4	0.0
PLASTIC LIMIT (PERCENT DRY WEIGHT)	0.0	15.3	19.3	22.3	21.1	0.0	20.6	27.6	0.0
PLASTIC INDEX (PERCENT DRY WEIGHT)	0.0	12.8	19.9	30.8	20.4	0.0	23.0	28.9	0.0
PERCENT GRAVEL IN SAMPLE	.0	0.0	0.0	.0	0.0	.0	0.0	0.0	0.0
PERCENT SAND IN SAMPLE	91.3	0.0	0.0	47.7	0.0	99.0	0.0	0.0	0.0
PERCENT SILT IN SAMPLE	0.0	0.0	0.0	19.3	0.0	0.0	0.0	0.0	0.0
PERCENT CLAY IN SAMPLE	0.0	0.0	0.0	33.3	0.0	0.0	0.0	0.0	0.0
PERCENT SAMPLE PASSING 200 SIEVE	7.1	39.3	53.9	73.5	36.0	5.4	52.3	0.0	8.0
VERT. OR HORZ. PERMEABILITY (CM/SEC)	0.0	0.0	.0	0.0	0.0	0.0	0.0	0.0	0.0
VOID RATIO (VOLUME VOIDS/VOLUME SOLIDS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 26. Characteristic range[+] of means for engineering properties of land resource units.

	Land Resource Units								
	A1	A3	A6	A8	B	C	E	F	F11
Unit dry weight (pounds per ft^3)	94.6 -107.2*	99.0 -108.6	107.7 -110.1	96.1 -100.8	91.2 -103.5*	---	94.8 -102.2	96.0*-108.0*	93.0*-117.0*
Natural moisture content (percent dry weight)	17.0*- 28.0*	16.6 - 26.6	15.4 - 30.5	23.9 - 28.1	19.7 - 24.9	---	21.5 - 27.0	37.9 - 53.7*	14.0*- 30.0*
In-place vane shear (tons per ft^2)	0.3*- 1.2*	1.4*	---	0.4 - 1.2*	1.7*	---	0.3*- 0.6*	0.1*- 0.8*	0.1*- 1.0*
Standard penetrometer (blows per ft)	7.3 - 46.3	16.5 - 44.1	17.7 - 35.7	9.9 - 32.9	2.0*- 15.0*	20.4 -55.8	8.3 - 11.3	13.1*- 40.0*	11.4*- 16.3*
THD cone penetrometer (blows per ft)	---	37.3 - 85.8	20.4*- 49.7*	9.8*- 33.3	---	7.3*-76.0*	6.0*- 10.0*	4.0*- 9.0*	---
Unconfined compression Q_u (tons per ft^2)	0.1*- 1.8*	1.7 - 2.4	3.1 - 4.5	1.6 - 2.2	1.6 - 2.0	---	0.8 - 1.2	0.1*- 0.5*	0.1*- 1.0*
Triaxial shear Q_c (tons per ft^2)	0.1*- 0.4*	0.2*- 0.9*	0.3*- 1.5*	0.3*- 1.1*	0.4*- 1.2*	---	---	0.4*- 0.6*	0.6*
Triaxial phi (degrees)	23.0*- 37.0*	11.3*- 34.3*	7.1*- 39.0*	12.0*- 25.7*	7.9*- 13.1*	---	---	22.5*- 35.0*	23.5*
Hand penetrometer (tons per ft^2)	---	0.6*- 3.4*	1.5*- 2.3*	2.1 - 3.6	---	---	2.4*- 2.7*	0.2*- 0.4*	2.8*
Absorption swell (percent volume)	---	1.2*	1.5*- 3.9*	3.5 - 4.0	3.5*	---	---	---	---
Absorption pressure (tons per ft^2)	---	0.3*- 0.5*	0.4*- 2.6*	1.2 - 3.2	1.2*	---	---	---	---
Linear dry shrinkage (percent distance)	4.9*- 5.1*	2.7*- 9.5*	5.3*- 21.0*	15.9 - 24.2*	18.0*- 21.5*	---	7.1*- 10.0*	---	---
Liquid limit (percent dry weight)	22.5*- 31.0*	27.6 - 40.7*	38.3*- 59.4*	52.9 - 67.9	29.0*- 54.0*	---	31.0*- 51.2*	42.7 - 63.1	41.0*- 64.0*
Plastic limit (percent dry weight)	14.0*- 16.7*	15.3*- 20.5	18.3 - 20.3*	21.6 - 26.0	19.8*- 23.0*	---	15.0*- 20.6	22.4 - 28.3	15.0*- 18.0*
Plastic index	8.0*- 14.2*	9.0 - 31.5	19.9 - 22.8	30.8 - 42.6	20.4*- 24.0*	---	23.0 - 31.0*	20.3 - 34.8	26.0*- 46.0*
Percent gravel in sample	0.0*	0*- 6.0	---	0*- 3.0*	---	0.0	1.0*	---	0*
Percent sand in sample	91.3*- 92.0*	75.7*- 90.0*	---	32.0*- 47.7*	---	98.0 -99.0*	26.0*	---	65.0*
Percent silt in sample	---	12.0*- 13.0*	13.7*- 29.7*	---	---	---	28.0*	---	---
Percent clay in sample	---	4.0*- 9.0*	31.3*- 44.2*	---	---	---	45.0*	---	---
Percent sample passing 200 sieve	7.1 - 12.6	22.6 - 39.3	53.3 - 59.4*	71.1 - 99.0*	36.0 - 40.1	1.0*-11.5*	36.0*- 52.3	50.0*	8.0*- 40.0*
Vertical or horizontal permeability (cm/sec)	---	---	---	0.0	0.0	---	---	---	---
Void ratio (volume voids/volume solids)	---	0.7*	0.5*- 0.8*	0.6*- 0.9*	0.7*- 0.8*	---	---	---	---

[+]Determined by inspection.

*Indicates means calculated from fewer than 10 test values.

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APPENDIX A

DESCRIPTION OF THE ENGINEERING TESTS

For additional information on these tests, refer to Terzaghi and Peck (1967), and Krynine and Judd, (1957).

UNIT DRY WEIGHT

The unit dry weight is the ratio of the oven-dried sample weight to the volume of the sample expressed in pounds per cubic foot.

$$\text{U. D. W.} = \frac{\text{Dry weight of sample in pounds}}{\text{Volume of sample in cubic feet}}$$

NATURAL MOISTURE CONTENT

The natural moisture content is the ratio of the weight of the water in the sample at the time it was removed from the ground to the oven-dried weight of the sample. The result is expressed as a percentage and is given by the following formula:

$$\text{N. M. C.} = \frac{\text{Weight of sample wet - Weight of sample dry}}{\text{Weight of sample dry}}$$

The natural moisture content will, of course, vary from place to place in similar soils and from time to time even where the same area is sampled repeatedly.

ATTERBURG LIMITS

Liquid Limit

The liquid limit (LL) is the maximum water content of a soil before it changes from the plastic to the liquid state and is expressed as a percentage of the dry weight of the sample.

$$\text{LL} = \frac{\text{Weight of water in sample at liquid state}}{\text{Weight of oven-dried sample}} \times 100$$

Plastic Limit

The plastic limit (PL) is the minimum water content necessary for a soil to change from the solid to the plastic state. Soil is considered in the plastic state when it will rapidly and permanently deform without cracking. The plastic limit is expressed as a percentage of the dry weight of the sample.

$$PL = \frac{\text{Weight of water in sample at plastic state}}{\text{Weight of oven-dried sample}} \times 100$$

Plasticity Index

The plasticity index is a method of expressing the relative range of water content through which the soil will exhibit plasticity (being in a plastic state). The larger the value of the plasticity index of the soil, the smaller the range of resistance of that soil to remolding, and thus the greater the probability that the soil will be less desirable for construction. The plasticity index (PI) is stated as the numerical difference between the liquid limit and the plastic limit of a soil.

$$PI = LL - PL$$

LINEAR DRYING SHRINKAGE

Linear drying shrinkage (LS) is the decrease in one dimension of the soil mass when the water content is reduced from the liquid limit to the shrinkage limit of the soil. The shrinkage limit is the maximum calculated water content at which further loss of water will not cause a decrease in the volume of the soil sample. Linear shrinkage is expressed as the percentage of shrinkage and is calculated as follows:

$$LS = \frac{\text{Length of wet soil bar} - \text{Length of dry soil bar}}{\text{Length of wet soil bar}} \times 100$$

OR

$$LS = \left[1 - \sqrt[3]{1 - \frac{\text{Volumetric shrinkage}}{100}}\right] \times 100$$

TRIAXIAL SHEAR TEST

A triaxial shear test is performed to determine the shear strength of material having a significant sand content or lacking cohesion. The sample is subjected to confining pressure on all sides in addition to an axial load until the sample fails. The shearing strength is found by using Coulomb's equation:

$$s = c + p \tan \phi$$

where

s = Shearing strength expressed as either tons per square foot or pounds per square inch

c = Cohesion constant

p = Normal stress on the surface of sliding

ϕ = Angle of internal friction

and Mohr's diagram.

The values reported in this study are c, expressed in tons per square foot, and phi (ϕ), expressed in degrees.

UNCONFINED COMPRESSION TEST

An unconfined compression test is used to determine the shear strength of materials with significant clay content. The test is performed by increasing the axial load to failure and is run sufficiently fast to prevent significant drainage or consolidation. The axial stress at failure is the unconfined compressive strength (Q_u). The shear strength (C_q) is determined as follows:

$$C_q = \tfrac{1}{2} Q_u$$

Results are reported in tons per square foot.

POCKET OR HAND PENETROMETER

The pocket penetrometer is a direct-reading, hand-held, calibrated, spring-loaded penetrometer. It is pushed with steady vertical pressure into the soil surface until the piston needle reaches the calibration groove (approximately ¼ inch). The readings are unconfined compression strength values and are accurate to approximately ± 20 percent of the reading up to a maximum of 4.5 tons per square foot.

STANDARD PENETROMETER

The standard penetrometer test is the total number of blows a 140-pound hammer falling 30 inches takes to drive a split-spoon sampler to a depth of one foot or to refusal. Refusal is defined as either penetration of less than one foot per 100 blows or penetration of less than six inches per 50 blows. The values are expressed as blows per foot for values less than refusal, and inches per 50 or 100 blows for values greater than refusal.

THD CONE PENETROMETER

The Texas Highway Department (THD) cone penetrometer test consists of driving a 3-inch diameter cone with a 170-pound hammer dropped from a height of two feet. Values are expressed either as blows per foot (up to 100 blows) or as inches per 100 blows, for the same reasons described above.

IN-PLACE VANE SHEAR

The in-place vane test consists of pushing a bladed vane into undisturbed material, rotating the vane, and measuring the torsion (in tons/ft^2) required to fail the cylindrical surface area of soil being sheared by the vanes (Texas Highway Department, 1964).

PASSING 200 MESH

The passing 200 mesh test is a determination (by grain size) of the amount of clay and silt present in the sample. For particles to pass the no. 200 sieve, two dimensions of the grain must be smaller than 0.074 millimeters. The value is expressed as the percentage of the total sample.

$$\text{Pass 200} = 100 - \frac{\text{Dry weight of sample wash}}{\text{Dry weight before sample washing}}$$

VOID RATIO

The void ratio is the ratio of the volume of voids (nonsolid material) to the volume of solid material. It is a dimensionless number.

$$c = \frac{\text{Total volume of voids}}{\text{Total volume of the sample - Total volume of the voids}}$$

APPENDIX B

COMPUTER PROGRAMS FOR QUANTIFICATION OF LAND RESOURCE UNITS

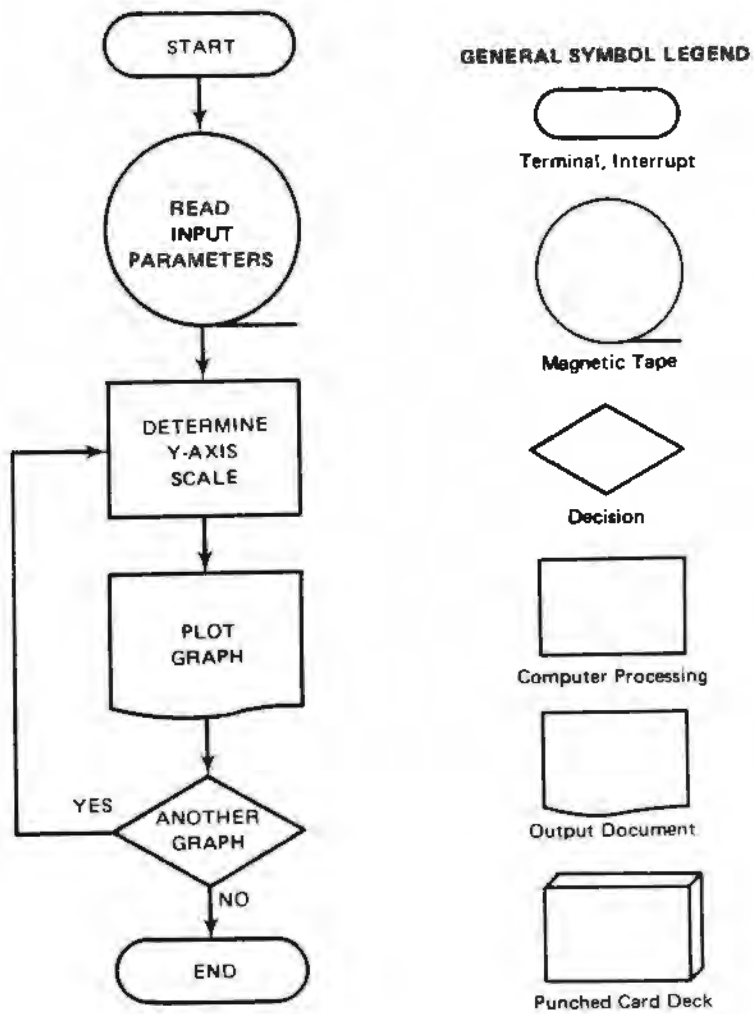

Figure B-1. Generalized flow chart for program EGRAPH.

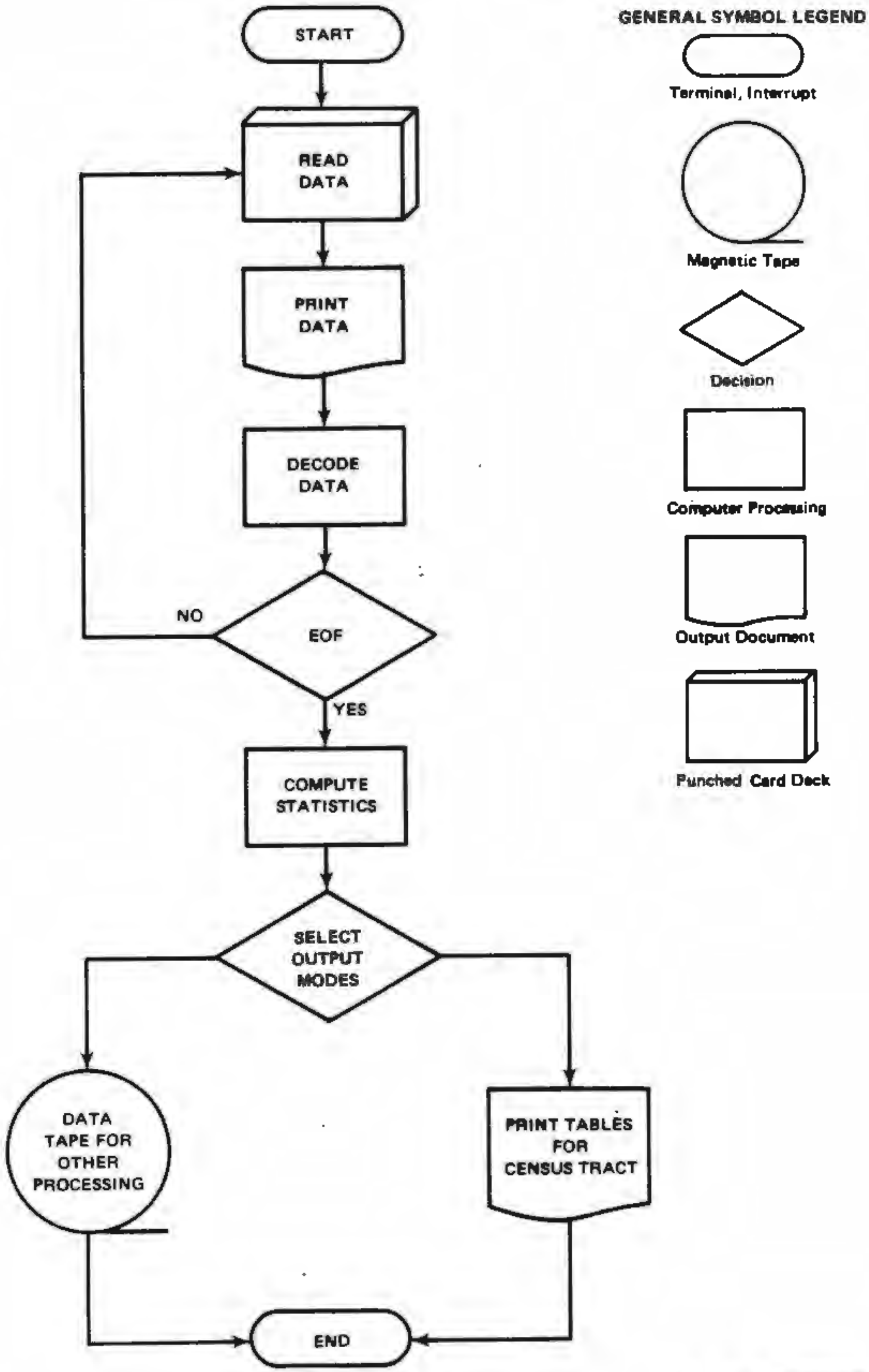

Figure B-2. Generalized flow chart for program ENGTEST.

```
C      -----------------------------------------------------------------
       PROGRAM ENGTEST(INPUT,OUTPUT,TAPE50,TAPE60)
C
C      -----------------------------------------------------------------
C
C         THIS PROGRAM RELATES ENGINEERING TEST PROPERTIES, DEPTH, AND
C         RESOURCE CAPABILITY UNITS.  THE PROGRAM HAS VARIOUS OUTPUT
C         CONTROLLED BY THE DATA HEADER CARD.  THE OUTPUT INCLUDES
C         A BINARY TAPE FOR THE GRAPHICS PROGRAM, A QUICK REFERENCE
C         TABLE FOR ALL VALUES 0-5 FEET, A COMPLETE LISTING OF THE
C         DATA, STATISTICAL TABLES FOR EACH ENGINEERING TEST, INVENTORY
C         SUMMARY OF THE RESOURCE CAPABILITY UNITS AND THE ENGINEERING
C         FOUND IN THE DATA, BCD TAPE FOR INPUT TO BMD CORRELATION
C         MATRIX PROGRAM.
C
C      S1 -- YIELDS MEANS FOR GRAPHING
C      S2 -- YIELDS QUICK REFERECNE TABLE
C      S3 -- YIELDS DATA
C      S4 -- YIELDS TABLES
C      S5 -- YIELDS VARIABLE TOTALS
C      S6 AND S7 -- YIELDS VALUES FROM UNIT 57 FOR CORRELATION MATRIX
C
C         THIS PROGRAM IS DESIGNED TO BE COMPILED BY CDC FORTRAN RUN
C         60.2 COMPILER AND TO RUN ON THE UNIVERSITY OF TEXAS AT AUSTIN
C         CDC 6400/6600 COMPUTER OPERATING UNDER THE UT-2D SYSTEM.
C         SOME CODE MAY BE UNIQUE TO THE SYSTEM.
C
C         TEXAS BUREAU OF ECONOMIC GEOLOGY--DLR--5/31/74.
C
C      -----------------------------------------------------------------
```

```
              C
              C          RESOURCE CAPABILITY UNITS FOUND IN DATA
              C
000002                REAL R(9)
000002                DATA R/2HA1,2HA3,2HA6,2HA8,1HB,1HC,1HE,1HF,3HF11/
              C
              C          VARIABLE FORMATTING DATA
000002                REAL BLANKS,FSPEC,ASPEC,FSPEC2
000002                REAL MNROW,SDROW1,SDROW2,NOROW,FORM(20)
000002                INTEGER K2,K3,K4
000002                DATA MNROW/10H(*0*8X*MN*/
000002                DATA SDROW1,SDROW2/10H(*  *I2*-*,9HI2,2X*SD*/
000002                DATA NOROW/9H* *8X*NO*/
000002                DATA BLANKS,FSPEC,ASPEC,FORM(20)/7H       ,5HF7.1,,3HA7,,1H)/
000002                DATA FSPEC2/9H2X,F4,1X,/
000002                DATA RRR/2H  /
000002                REAL HEAD1(120),PVALUE(17),RR(9)
000002                REAL EP(23)
000002                REAL SUM(9,12,23),SUM2(9,12,23),MEAN(9,12,23),SD(9,12,23)
000002                REAL FOUND1,FOUND2,SSWELL1,SSWELL2,PERM
000002                INTEGER U,D,DD,DDD,T,DCODE,L,K,KOUNT(9,12,23),K1
000002                INTEGER IFLAG,NSGRID,EWGRID,SURELEV,DEPTH,UDRYWT,NMOIST
000002                INTEGER FTEST1,FTEST2,SSTEST1,SSTEST2,LIQUID,PLASTIC,PINDEX
000002                INTEGER GRAVEL,SAND,SILT,CLAY,PCOEF,MASGRID,NOTEST
000002                INTEGER S1,S2,S3,S4,S5,S6
000002                REAL S7
              C
              C          HEADING FOR TABULAR DATA
```

```
      C
000002      DATA (HEAD1(L),L=1,76)/10HUNIT DRY W,10HEIGHT (POU,10HNDS PER CU,
          1      10HBIC FOOT) ,10HNATURAL MO,10HISTURE CON,10HTENT   (PER,
          2      10HCENT D WT),10HIN PLACE V,10HANE SHEAR ,10H (TONS PER,
          3      10H SQ. FT.) ,10HSTANDARD P,10HENETROMETE,10HR  (BLOWS ,
          4      10HPER FOOT) ,10HTHD CONE P,10HENETROMETE,10HR  (BLOWS ,
          5      10HPER FOOT) ,10HUNCONFINED,10H COMPRESSI,10HON Q(U) (T,
          6      10HONS/SQ.FT),10HTRIAXIAL S,10HHEAR Q(C) ,10H (TONS PER,
          7      10H SQ. FT.) ,10HTRIAXIAL P,10HHI  (DEGRE,10HES)       ,
          8      10H          ,10HHAND PENET,10HROMETER (T,10HONS PER SQ,
          9      10HUARE FOOT),10HSHRINKAGE ,10HLIMIT  (PE,10HRCENT DRY ,
          A      10HWEIGHT)   ,10HABSORPTION,10H SWELL  (P,10HERCENT VOL,
          B      10HUME)      ,10HABSORPTION,10H PRESSURE ,10H (TONS PER,
          C      10H SQ. FT.) ,10HLINEAR DRY,10H SHRINKAGE,10H  (PERCENT,
          D      10H DISTANCE),10HLIQUID LIM,10HIT  (PERCE,10HNT DRY WEI,
          E      10HGHT)      ,10HPLASTIC LI,10HMIT  (PERC,10HENT DRY WE,
          F      10HIGHT)     ,10HPLASTIC IN,10HDEX  (PERC,10HENT DRY WE,
          G      10HIGHT)     ,10HPERCENT GR,10HAVEL IN SA,10HMPLE      ,
          H      10H          ,10HPERCENT SA,10HND IN SAMP,10HLE        ,
          I      10H          ,10HPERCENT SI,10HLT IN SAMP,10HLE        ,
          J      10H          /
000002      DATA (HEAD1(L),L=77,92)/10HPERCENT CL,10HAY IN SAMP,10HLE        ,
          1      10H          ,10HPERCENT SA,10HMPLE PASSI,10HNG 200 SIE,
          2      10HVE        ,10HVERT. OR H,10HORZ. PERME,10HABILITY  (,
          3      10HCM/SEC)   ,10HVOID RATIO,10H  (VOLUME ,10HVOIDS/VOLU,
          4      10HME SOLIDS)/
      C
      C         READ DATA HEADER CARD
      C
000002      READ 510, S1,S2,S3,S4,S5,S6,S7
      C
```

```
                C         READ NUMBER OF TEST TO BE CONSIDERED
                C
000024                 READ 520, NOTEST
000032                 K=0
000033                 ITOT=0
000033                 ITOT2=0
000034                 NUM=0
000034                 K1=0
000035                 NUMUNIT=0
                C
                C         VARIABLE ZERO SET
                C
000036                 DO 110 U=1,9
000037                 DO 110 D=1,12
000040                 DO 110 T=1,NOTEST
000051                 SUM(U,D,T)=0.0
000052                 SUM2(U,D,T)=0.0
000052                 KOUNT(U,D,T)=0
000053                 MEAN(U,D,T)=0.0
000053                 SD(U,D,T)=0.0
                C
000053           110   CONTINUE
                C
000061           120   CONTINUE
                C
000061                 DO 130 I=1,NOTEST
000066                 EP(I)=0.0
```

```
         C
000067    130  CONTINUE
         C
         C         READ DATA CARD
         C
000070         READ 530, RUNIT,MASGRID,NSGRID,EWGRID,CORENO,SOURCE,BIBLIO,
              1      SURELEV,DEPTH,UDRYWT,NMOIST,FTEST1,FOUND1,FTEST2,FOUND2,
              2      SSTEST1,SSWELL1,SSTEST2,SSWELL2,LIQUID,PLASTIC,PINDEX,
              3      GRAVEL,SAND,SILT,CLAY,PERM,PCOEF,EP(23)
000165            IF (S3.EQ.0) GO TO 160
000166         K1=K1+1
000170            IF (K1.EQ.1) PRINT 540
000174         IF (K1.EQ.55) K1=0
000177            IF (EWGRID.EQ.0.AND.NSGRID.EQ.0) GO TO 180
         C
         C         PRINT DATA
         C
000205         PRINT 550, RUNIT,MASGRID,NSGRID,EWGRID,CORENO,SOURCE,BIBLIO,
              1      SURELEV,DEPTH
000232            IF (UDRYWT.NE.0) PRINT 560, UDRYWT
000241            IF (NMOIST.NE.0) PRINT 570, NMOIST
000250            IF (FTEST1.NE.0) PRINT 580, FTEST1,FOUND1
000261            IF (FTEST2.NE.0) PRINT 590, FTEST2,FOUND2
000272            IF (SSTEST1.NE.0) PRINT 600, SSTEST1,SSWELL1
000303            IF (SSTEST2.NE.0) PRINT 610, SSTEST2,SSWELL2
000314         IF (LIQUID.NE.0.OR.PLASTIC.NE.0) PRINT 620, LIQUID,PLASTIC,PINDEX
000333            IF (.NOT.CLAY.AND.CLAY.LT.7) GO TO 140
000340            IF (GRAVEL.NE.0) PRINT 630, GRAVEL
000347            IF (SAND.NE.0) PRINT 640, SAND
000356            IF (SILT.NE.0) PRINT 650, SILT
000365            IF (CLAY.NE.0) PRINT 660, CLAY
```

```
       C
000374           GO TO 150
       C
000375  140   CONTINUE
       C
000375        PRINT 670, GRAVEL,SAND,SILT,CLAY
       C
000411  150   CONTINUE
       C
000411           IF (PERM.NE.0) PRINT 680, PERM,PCOEF
000422           IF (EP(23).NE.0.) PRINT 690, EP(23)
000431           IF (LIQUID-PLASTIC.NE.PINDEX) PRINT 700
       C
000437  160   CONTINUE
       C
       C         DECODE DATA
       C
000437        DO 170 I=1,2
000445        IF (FTEST1.GT.0.AND.FOUND1.EQ.0.0) FOUND1=.0000000001
000455        IF (FTEST1.EQ.1) EP(3)=FOUND1
000460        IF (FTEST1.EQ.3) EP(4)=FOUND1
000463        IF (FTEST1.EQ.4) EP(5)=FOUND1
000466        IF (FTEST1.EQ.6) EP(6)=FOUND1
000471        IF (FTEST1.EQ.7) EP(8)=FOUND1
000474        IF (FTEST1.EQ.8) EP(9)=FOUND1
000477        FTEST1=FTEST2
000500        FOUND1=FOUND2
```

```
000501          IF (EP(6).GT.0.0.AND.EP(8).GT.0.0) EP(7)=EP(6)
000511          IF (EP(7).GT.0.0) EP(6)=0.0
000514          IF (SSTEST1.EQ.1) EP(10)=SSWELL1
000517          IF (SSTEST1.EQ.3) EP(11)=SSWELL1
000522          IF (SSTEST1.EQ.4) EP(12)=SSWELL1
000525          IF (SSTEST1.EQ.5) EP(13)=SSWELL1
000530          SSTEST1=SSTEST2
000531          SSWELL1=SSWELL2
          C
000532      170 CONTINUE
          C
000533          IF
               1      (.NOT.GRAVEL.AND..NOT.SAND.AND..NOT.CLAY.AND.GRAVEL.LT.1
               2      .AND.SAND.LT.1.AND.CLAY.LT.1) EP(21)=SILT
000552          IF (SAND.NE.0.AND..NOT.CLAY.AND.CLAY.LT.1) EP(21)=SILT
000563          IF (EP(21).GT.0.0) SILT=0
000566          EP(1)=UDRYWT
000567          EP(2)=NMOIST
000571          EP(14)=LIQUID
000572          EP(15)=PLASTIC
000574          EP(16)=PINDEX
000575          IF (LIQUID-PLASTIC.EQ.0.AND.LIQUID.NE.0) EP(16)=.0000000001
000604          EP(17)=GRAVEL
000605          IF (GRAVEL.EQ.0.AND.SAND.NE.0) EP(17)=.0000000001
000614          EP(18)=SAND
000615          EP(19)=SILT
000617          EP(20)=CLAY
000620          IF (EP(19)+EP(20).GT.0.0.AND.EP(21).EQ.0.0) EP(21)=EP(19)+EP(20)
000631          PMULT=10.**(-1*PCOEF)
000637          EP(22)=PERM*PMULT
```

```
              C
000641    180 CONTINUE
              C
              C      CHECK FOR EOD
              C
000641               IF (EWGRID.EQ.0.AND.NSGRID.EQ.0) GO TO 250
000647            DO 190 U=1,9
000654               IF (RUNIT.EQ.R(U)) GO TO 200
000656    190 CONTINUE
000660            PRINT 710, RUNIT
000665               GO TO 240
000666    200 CONTINUE
              C
              C      CLASSIFY DEPTHS INTO 5 FOOT CLASSES
              C
000666            DO 210 DCODE=5,60,5
000673               IF (DEPTH.GE.(DCODE-5).AND.DEPTH.LT.DCODE) GO TO 220
000702    210 CONTINUE
000703            PRINT 720
000707               GO TO 240
000710    220 CONTINUE
000710            D=DCODE/5
000713               IF (S6.EQ.0) GO TO 230
000715               IF (RUNIT.NE.S7) GO TO 230
000717            DEEP=FLOAT(DEPTH)
              C
              C      WRITE VALUES FOR CORRELATION MATRIX
              C
```

```
000720          WRITE (60,730) DEEP,(EP(K9),K9=1,NOTEST)
000731          NUMUNIT=NUMUNIT+1
000733     230  CONTINUE
000733             IF (S1.EQ.0.AND.S2.EQ.0.AND.S4.EQ.0) GO TO 240
          C
          C        CALCULATE MEAN, NUMBER OF SAMPLES AND STANDARD DEVIATION
          C
000743          DO 240 T=1,NOTEST
000744          SUM(U,D,T)=SUM(U,D,T)+EP(T)
000752          SUM2(U,D,T)=SUM2(U,D,T)+EP(T)**2
000756             IF (EP(T).EQ.0.0) GO TO 240
000763          NUM=NUM+1
000765          KOUNT(U,D,T)=KOUNT(U,D,T)+1
000766          MEAN(U,D,T)=SUM(U,D,T)/KOUNT(U,D,T)
000770             IF (KOUNT(U,D,T).EQ.1) GO TO 240
000775          ZCHECK=(FLOAT(KOUNT(U,D,T))*SUM2(U,D,T))-(SUM(U,D,T)*SUM(U,D,T))
001010             IF (ZCHECK.LT.0.) GO TO 240
001011          SD(U,D,T)=(SQRT(ZCHECK))/FLOAT(KOUNT(U,D,T))
001025     240  CONTINUE
001030             IF (EWGRID.NE.0.AND.NSGRID.NE.0) GO TO 120
001036     250  CONTINUE
001036             IF (S5.EQ.0) GO TO 280
          C
          C        PRINT DATA INVENTORY SUMMARIES
          C
001037          PRINT 740
001043          PRINT 750, NUM
001051          DO 280 T=1,NOTEST
001053          PRINT 760, HEAD1(4*T-3),HEAD1(4*T-2),HEAD1(4*T-1),HEAD1(4*T)
001072          DO 270 U=1,9
001074          ITOT=0
001075          DO 260 D=1,12
001105          ITOT=ITOT+KOUNT(U,D,T)
```

```
001106     260  CONTINUE
001107          PRINT 770, R(U),ITOT
001117          ITOT2=ITOT2+ITOT
001121     270  CONTINUE
001123          PRINT 780, ITOT2
001130          ITOT2=0
001131     280  CONTINUE
001134             IF (S1.EQ.0) GO TO 300
          C
          C        WRITE MEANS FOR GRAPHICS PROGRAM
          C
001135          CALL IOP (2HWB,50,R,9)
001140          CALL IOP (2HWB,50,NOTEST,1)
001143          DO 290 U=1,9
001145          DO 290 D=1,12
001146          DO 290 T=1,NOTEST
001147          CALL IOP (2HWB,50,MEAN(U,D,T),1)
001156     290  CONTINUE
001165          CALL IOP (2HWF,50)
001167     300  CONTINUE
001167             IF (S4.EQ.0) GO TO 470
          C
          C        PRINT STATISTICAL TABLES
          C
001170          DO 460 T=1,NOTEST
```

```
001172          DO 310 KK=1,9
001177          RR(KK)=RRR
001177    310   CONTINUE
001200          K2=1
001201          DO 330 U=1,9
001203          DO 330 D=1,12
001204             IF (KOUNT(U,D,T).EQ.0) GO TO 330
001211             IF (K2.EQ.1) GO TO 320
001213             IF (RR(K2).EQ.R(U).OR.RR(K2-1).EQ.R(U)) GO TO 330
001223    320   CONTINUE
001223          RR(K2)=R(U)
001226          K2=K2+1
001227    330   CONTINUE
001233          K2=K2-1
001235          PRINT 790, T,HEAD1(4*T-3),HEAD1(4*T-2),HEAD1(4*T-1),HEAD1(4*T)
001256          PRINT 800, (RR(J),J=1,K2)
001265          DO 460 D=1,12
001267          K3=1
001270          DO 340 U=1,9
001271             IF (RR(K3).NE.R(U)) GO TO 340
001300          FORM(K3+1)=FSPEC
001301          PVALUE(K3)=MEAN(U,D,T)
001303          IF (MEAN(U,D,T).EQ.0.0) FORM(K3+1)=ASPEC
001311          IF (MEAN(U,D,T).EQ.0.0) PVALUE(K3)=BLANKS
001317          K3=K3+1
001321    340   CONTINUE
001323          IF (K3.GT.20) STOP 1
001330             IF (K3.LT.17) GO TO 350
001333             GO TO 370
001333    350   CONTINUE
```

```
001333          DO 360 K4=K3,17
001341          PVALUE(K4)=BLANKS
001342          FORM(K4+1)=ASPEC
001342    360   CONTINUE
001343    370   CONTINUE
001343          FORM(1)=MNROW
001345          FORM(19)=BLANKS
001346          PRINT FORM, PVALUE
001356          K3=1
001357          DD=(D*5)-5
001360          DDD=D*5
001362          DO 380 U=1,9
001363             IF (RR(K3).NE.R(U)) GO TO 380
001372          FORM(K3+2)=FSPEC
001373          PVALUE(K3)=SD(U,D,T)
001375          IF (SD(U,D,T).EQ.0.0.AND.KOUNT(U,D,T).EQ.0) FORM(K3+2)=ASPEC
001413          IF (SD(U,D,T).EQ.0.0.AND.KOUNT(U,D,T).EQ.0) PVALUE(K3)=BLANKS
001432          K3=K3+1
001434    380   CONTINUE
001436          IF (K3.GT.20) STOP 2
001443             IF (K3.LT.17) GO TO 390
001446             GO TO 410
001446    390   CONTINUE
001446          DO 400 K4=K3,17
001454          PVALUE(K4)=BLANKS
001455          FORM(K4+2)=ASPEC
001455    400   CONTINUE
001456    410   CONTINUE
```

```
001456          FORM(1)=SDROW1
001460          FORM(2)=SDROW2
001461          PRINT FORM, DD,DDD,PVALUE
001473          K3=1
001474          DO 420 U=1,9
001476             IF (RR(K3).NE.R(U)) GO TO 420
001505          FORM(K3+1)=FSPEC2
001506          PVALUE(K3)=KOUNT(U,D,T)
001510          IF (KOUNT(U,D,T).EQ.0) FORM(K3+1)=ASPEC
001516          IF (KOUNT(U,D,T).EQ.0) PVALUE(K3)=BLANKS
001524          K3=K3+1
001526    420   CONTINUE
001530          IF (K3.GT.20) STOP 3
001535             IF (K3.LT.17) GO TO 430
001540             GO TO 450
001540    430   CONTINUE
001540          DO 440 K4=K3,17
001546          PVALUE(K4)=BLANKS
001547          FORM(K4+1)=ASPEC
001547    440   CONTINUE
001550    450   CONTINUE
001550          FORM(1)=NOROW
001552          FORM(19)=BLANKS
001553          PRINT FORM, PVALUE
001561    460   CONTINUE
001566    470   CONTINUE
001566             IF (S2.EQ.0) GO TO 490
        C
        C          PRINT QUICK REFERENCE TABLE
        C
```

```
001567          PRINT 810
001573          PRINT 820, R
001601          DO 480 T=1,NOTEST
001603          PRINT 830, HEAD1(4*T-3),HEAD1(4*T-2),HEAD1(4*T-1),HEAD1(4*T),
               1       (MEAN(U,1,T),U=1,9)
001626     480  CONTINUE
001631     490  CONTINUE
001631             IF (S6.EQ.0) GO TO 500
001632          PRINT 840, NUMUNIT,S7
001642     500  CONTINUE
001642          CALL IOP (2HWF,50)
          C
001644     510  FORMAT  (6I1,A3)
001644     520  FORMAT  (I2)
001644     530  FORMAT  (A3,I1,I6,I5,A5,A1,A2,I4,2I3,I2,4(I1,F4.1),3I3,4I2,F4.2,
               1  I1,F3.1)
001644     540  FORMAT  (*1RES  M   N-S*5X*E-W    CORE  S  B   ELEV  DPT  UDW  NM
               1 -FOUNDATION--   -SHRNK-SWELL-   ATERBERG   -GRAIN-SIZE-  PERM   V
               2OID*/* UNIT G   CORD    CORD     NO   R  RF*22X*C TEST C TEST   C T
               3EST C TEST   LL PL PI   GR SD ST CL*10X*RAT*)
001644     550  FORMAT  (* *A3,2X,I1,2X,I6,2X,I5,2X,A5,2X,A1,2X,A2,2X,I4,2X,I3)
001644     560  FORMAT  (*+*48X,I3)
001644     570  FORMAT  (*+*53X,I2)
001644     580  FORMAT  (*+*57X,I1,1X,F4.1)
001644     590  FORMAT  (*+*64X,I1,1X,F4.1)
001644     600  FORMAT  (*+*73X,I1,1X,F4.1)
001644     610  FORMAT  (*+*80X,I1,1X,F4.1)
001644     620  FORMAT  (*+*88X,3I3)
```

```
001644    630  FORMAT  (*+*100X,I2)
001644    640  FORMAT  (*+*103X,I2)
001644    650  FORMAT  (*+*106X,I2)
001644    660  FORMAT  (*+*109X,I2)
001644    670  FORMAT  (*+*100X,4(I2,1X))
001644    680  FORMAT  (*+*113X,F4.2*-*I1)
001644    690  FORMAT  (*+*122X,F3.1)
001644    700  FORMAT  (*+*127X*PI ERROR*)
001644    710  FORMAT  (*+*128X*RCU *A3)
001644    720  FORMAT  (*+*128X*DEPTH ER*)
001644    730  FORMAT  (3(8G10.3/))
001644    740  FORMAT  (*1*20X*PROGRAM STATISTICS*//)
001644    750  FORMAT  (*0    TOTAL ENGINEERING TEST VALUES CONSIDERED*I9)
001644    760  FORMAT  (*1 STATISTICS FOR *4A10//9X*RCU*6X*TOTALS*/)
001644    770  FORMAT  (10X,A3,I10)
001644    780  FORMAT  (*0  TOTAL VALUES FOR THIS TEST*I7)
001644    790  FORMAT  (*1*60X*TABLE *I2 /* *40X*MEAN *4A10)
001644    800  FORMAT  (*0*48X*RFSOURCE CAPABILITY UNITS*/*  DEPTH* 6X,17(2X,A3,2
              1X))
001644    810  FORMAT  (*1*20X*QUICK REFERENCE TABLE FOR ALL MEANS BETWEEN 0-5 FE
              1ET*)
001644    820  FORMAT   (*0*44X,9(3X,A3,2X))
001644    830  FORMAT   (*0 *4A10,3X,9F8.1)
001644    840  FORMAT  (*1*I8* VALUES FOR UNIT *A3* WRITTEN ON TAPE 60)
001644         END
```

PROGRAM LENGTH INCLUDING I/O BUFFERS
043142

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

120	-	000062	140	-	000376	150	-	000412	160	-	000440
180	-	000642	190	-	000657	200	-	000667	220	-	000711
230	-	000734	240	-	001026	250	-	001037	280	-	001132
300	-	001170	320	-	001224	330	-	001230	340	-	001322
350	-	001334	370	-	001344	380	-	001435	390	-	001447
410	-	001457	420	-	001527	430	-	001541	450	-	001551
470	-	001567	490	-	001632	500	-	001643	510	-	001705
520	-	001707	530	-	001711	540	-	001721	550	-	001752
560	-	001761	570	-	001764	580	-	001767	590	-	001773
600	-	001777	610	-	002003	620	-	002007	630	-	002012
640	-	002015	650	-	002020	660	-	002023	670	-	002026
680	-	002031	690	-	002035	700	-	002040	710	-	002044
720	-	002047	730	-	002053	740	-	002056	750	-	002063
760	-	002072	770	-	002100	780	-	002103	790	-	002110
800	-	002115	810	-	002125	820	-	002135	830	-	002141
840	-	002145									

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS

ASPEC	-	002226	BIBLIO	-	033023	BLANKS	-	002224	CLAY	-	033000
CORENO	-	033021	D	-	026063	DCODE	-	026067	DD	-	026064
DDD	-	026065	DEEP	-	033025	DEPTH	-	032763	EP	-	002506
EWGRID	-	032761	FORM	-	002234	FOUND1	-	026055	FOUND2	-	026056

FSPEC	-	002225	FSPEC2	-	002227	FTEST1	-	032766	FTEST2	-	032767
GRAVEL	-	032775	HEAD1	-	002264	I	-	033017	IFLAG	-	032757
ITOT	-	033013	ITOT2	-	033014	J	-	033031	K	-	026071
KK	-	033030	KOUNT	-	026072	K1	-	032756	K2	-	002260
K3	-	002261	K4	-	002262	K9	-	033026	L	-	026070
LIQUID	-	032772	MASGRID	-	033002	MEAN	-	014305	MNROW	-	002230
NMOIST	-	032765	NOROW	-	002233	NOTEST	-	033003	NSGRID	-	032760
NUM	-	033015	NUMUNIT	-	033016	PCOEF	-	033001	PERM	-	026061
PINDEX	-	032774	PLASTIC	-	032773	PMULT	-	033024	PVALUE	-	002454
R	-	002213	RR	-	002475	RRR	-	002263	RUNIT	-	033020
SAND	-	032776	SD	-	021171	SDROW1	-	002231	SDROW2	-	002232
SILT	-	032777	SOURCE	-	033022	SSTEST1	-	032770	SSTEST2	-	032771
SSWELL1	-	026057	SSWELL2	-	026060	SUM	-	002535	SUM2	-	007421
SURELEV	-	032762	S1	-	033004	S2	-	033005	S3	-	033006
S4	-	033007	S5	-	033010	S6	-	033011	S7	-	033012
T	-	026066	U	-	026062	UORYWT	-	032764	ZCHECK	-	033027

START OF CONSTANTS
001647

START OF TEMPORARIES
002153

START OF INDIRECTS
002177

UNUSED COMPILER SPACE
000400

```
       C      ----------------------------------------------------------------------
              PROGRAM EGRAPH(INPUT,OUTPUT,TAPE50=INPUT)
       C
       C      ----------------------------------------------------------------------
       C
       C         THIS PROGRAM PLOTS THE MEANS OF ENGINEERING TESTS FOR EACH
       C         RESOURCE CAPABILITY UNIT AS CALCULATED BY THE PROGRAM ENGTEST.
       C         EACH MEAN IS PLOTTED AS A FUNCTION OF DEPTH WITH ALL VALUES
       C         FOR ONE TYPE ENGINEERING TEST PLOTTED ON A SINGLE GRAPH.
       C         THE PLOTS ARE PRODUCED ON 12 - INCH WIDE PAPER ON THE CALCOMP
       C         PLOTTER.
       C
       C         THIS PROGRAM IS DESIGNED TO BE COMPILED BY CDC FORTRAN RUN
       C         60.2 COMPILER AND TO RUN ON THE UNIVERSITY OF TEXAS AT AUSTIN
       C         CDC 6400/6600 COMPUTER OPERATING UNDER THE UT-2D SYSTEM.
       C         SOME CODE MAY BE UNIQUE TO THE SYSTEM.
       C
       C
       C         TEXAS BUREAU OF ECONOMIC GEOLOGY--DLB--5/31/74.
       C
       C      ----------------------------------------------------------------------
       C
000002        REAL Y(242),XA,YA(3),MEAN(9,12,28)
000002        INTEGER U,D,T,R(9)
       C
       C         READ RCU SYMBOLS
       C
000002        CALL IOP (2HRB,50,R,9)
       C
```

```
                C         READ NUMBER OF ENGINEERING TESTS
                C
000005                 CALL IOP (2HRB,50,NOTEST,1)
000010                 DO 110 U=1,9
000012                 DO 110 D=1,12
000013                 DO 110 T=1,NOTEST
                C
                C         READ MEANS
                C
000014                 CALL IOP (2HRB,50,MEAN(U,D,T),1)
000023           110   CONTINUE
                C
                C         INITIALIZE PLOTTER
                C
000032                 CALL BGNPLT
                C
                C         DETERMINE Y-SCALE FOR GRAPH
                C
000033                 DO 160 T=1,NOTEST
000035                 I=1
000036                 DO 120 U=1,9
000037                 DO 120 D=1,10
000050                    IF (MEAN(U,D,T).EQ.0.) GO TO 120
000051                 Y(I)=MEAN(U,D,T)
000051                 I=I+1
000052           120   CONTINUE
000057                 I=I-1
000060                 DO 130 K=1,I
000066                    IF (Y(K).NE.0.) GO TO 140
```

```
000067     130  CONTINUE
000071             GO TO 150
000071     140  CONTINUE
000071          CALL PLT (1.,0.55,-3)
000074          CALL SCALE (Y,10.0,I,1)
          C
          C        LABEL Y-AXIS
          C
000077          IF (I.EQ.1) CALL AXIS (-0.25,0.,33HMEAN UNIT DRY WEIGHT (LBS/CU.FT
               1.),33,10.,90.0,Y(I+1),Y(I+2),.14,.105,0)
000120          IF (I.EQ.2) CALL AXIS (-0.25,0.,44HMEAN NATURAL MOISTURE CONTENT (
               1PER. DRY WT.),44,10.,90.0,Y(I+1),Y(I+2),.14,.105,0)
000141          IF (I.EQ.3) CALL AXIS (-0.25,0.,38HMEAN IN PLACE VANE SHEAR (TONS/
               1SQ.FT.),38,10.,90.0,Y(I+1),Y(I+2),.14,.105,2)
000162          IF (I.EQ.4) CALL AXIS (-0.25,0.,38HMEAN STANDARD PENETROMETER (BLO
               1WS/FT.),38,10.,90.0,Y(I+1),Y(I+2),.14,.105,0)
000203          IF (I.EQ.5) CALL AXIS (-0.25,0.,38HMEAN THD CONE PENETROMETER (BLO
               1WS/FT.),38,10.,90.0,Y(I+1),Y(I+2),.14,.105,0)
000224          IF (I.EQ.6) CALL AXIS (-0.25,0.,33HMEAN UNCONFINED COMPRESSION -Q(
               1U),33,10.,90.0,Y(I+1),Y(I+2),.14,.105,1)
000245          IF (I.EQ.7) CALL AXIS (-0.25,0.,19HMEAN TRIAXIAL -Q(C),19,10.,90.0
               1,Y(I+1),Y(I+2),.14,.105,1)
000266          IF (I.EQ.8) CALL AXIS (-0.25,0.,27HMEAN TRIAXIAL PHI (DEGREES),27,
               110.,90.0,Y(I+1),Y(I+2),.14,.105,1)
000307          IF (I.EQ.9) CALL AXIS (-0.25,0.,36HMEAN HAND PENETROMETER (TONS/SQ
               1.FT.),36,10.,90.0,Y(I+1),Y(I+2),.14,.105,1)
000330          IF (I.EQ.10) CALL AXIS (-0.25,0.,35HMEAN SHRINKAGE LIMIT (PER. DRY
               1 WT.),35,10.,90.0,Y(I+1),Y(I+2),.14,.105,1)
000351          IF (I.EQ.11) CALL AXIS (-0.25,0.,38HMEAN ABSORPTION SWELL (PERCENT
               1 VOLUME),38,10.,90.0,Y(I+1),Y(I+2),.14,.105,1)
000372          IF (I.EQ.12) CALL AXIS (-0.25,0.,38HMEAN ABSORPTION PRESSURE (TONS
```

```
                    1/SQ.FT.),38,10.,90.0,Y(I+1),Y(I+2),.14,.105,1)
000413               IF (T.EQ.13) CALL AXIS (-0.25,0.,44HMEAN LINEAR DRY SHRINKAGE (PER
                    1CENT DISTANCE),44,10.,90.0,Y(I+1),Y(I+2),.14,.105,1)
000434               IF (T.EQ.14) CALL AXIS (-0.25,0.,32HMEAN LIQUID LIMIT (PER. DRY WT
                    1.),32,10.,90.0,Y(I+1),Y(I+2),.14,.105,0)
000455               IF (T.EQ.I5) CALL AXIS (-0.25,0.,33HMEAN PLASTIC LIMIT (PER. DRY W
                    1T.),33,10.,90.0,Y(I+1),Y(I+2),.14,.105,0)
000476               IF (T.EQ.16) CALL AXIS (-0.25,0.,33HMEAN PLASTIC INDEX (PER. DRY W
                    1T.),33,10.,90.0,Y(I+1),Y(I+2),.14,.105,0)
000517               IF (T.EQ.17) CALL AXIS (-0.25,0.,28HMEAN GRAVEL (PERCENT SAMPLE),2
                    18,10.,90.0,Y(I+1),Y(I+2),.14,.105,0)
000540               IF (T.EQ.18) CALL AXIS (-0.25,0.,26HMEAN SAND (PERCENT SAMPLE),26,
                    110.,90.0,Y(I+1),Y(I+2),.14,.105,0)
000561               IF (T.EQ.19) CALL AXIS (-0.25,0.,26HMEAN SILT (PERCENT SAMPLE),26,
                    110.,90.0,Y(I+1),Y(I+2),.14,.105,0)
000602               IF (T.EQ.20) CALL AXIS (-0.25,0.,26HMEAN CLAY (PERCENT SAMPLE),26,
                    110.,90.0,Y(I+1),Y(I+2),.14,.105,0)
000623               IF (T.EQ.21) CALL AXIS (-0.25,0.,38HMEAN PASSING 200 MESH (PERCENT
                    1 SAMPLE),38,10.,90.0,Y(I+1),Y(I+2),.14,.105,0)
000644               IF (T.EQ.22) CALL AXIS (-0.25,0.,41HMEAN HORZ. OR VERT. PERMEABILI
                    1TY (CM/SEC),41,10.,90.0,Y(I+1),Y(I+2),.14,.105,1)
000665               IF (T.EQ.23) CALL AXIS (-0.25,0.,44HMEAN VOID RATIO (VOLUME VOIDS/
                    1VOLUME SOLIDS),44,10.,90.0,Y(I+1),Y(I+2),.14,.105,1)
              C
              C         LABEL X-AXIS
              C
000706               CALL AXIS (0.,0.,31HDEPTH BELOW LAND SURFACE (FEET),-31,09.,0.,5.,
```

```
                C         PLOT SYMBOL
                C
001014                CALL PLT (XPAGE,YPAGE,3)
001017                ICODE=-2
001020          150   CONTINUE
001024                CALL PLT (0.,0.,999)
                C
                C         CHECK FOR SYSTEM DEPENDENT PAPER ALLOCATION
                C
001027                IF (T.EQ.7.OR.T.EQ.14.OR.T.EQ.21) CALL ENDPLT
001043                IF (T.EQ.7.OR.T.EQ.14.OR.T.EQ.21) CALL BGNPLT
001057          160   CONTINUE
001062                CALL ENDPLT
001063                RETURN
                C
001065          170   FORMAT  (*  XPAGE1 = *F9.5* YPAGE1 = *F9.5* R(*I2*) = *A3)
001065                END
```

```
PROGRAM LENGTH INCLUDING I/O BUFFERS
014030

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
120     -  000053     130     -  000070     140     -  000072     150     -  001021
160     -  001060     170     -  001413
```

```
                15.,.14,.105,0)
          C
          C        DRAW BORDER
          C
000721           CALL PLT (-0.25,10.,3)
000724           CALL PLT (09.25,10.,2)
000727           CALL PLT (09.25,0.,2)
000732           CALL PLT (-0.25,0.,2)
000735           DO 150 U=1,9
000737           ICODE=-1
000740           DO 150 D=1,10
000741           YA(1)=MEAN(U,D,T)
000746              IF (YA(1).EQ.0.) GO TO 150
000750           YA(2)=Y(I+1)
000751           YA(3)=Y(I+2)
000752           XA=D*5
          C
          C        DETERMINE PLOTTER COORDINATES
          C
000755           XPAGE=(XA-5.)/5.
000757           YPAGE=(YA(1)-YA(2))/YA(3)
          C
          C        DRAW LINE TO NEXT POINT
          C
000763           CALL SYMBOL (XPAGE,YPAGE,.04,9,0.,ICODE)
000767           XPAGE1=XPAGE-.15
000771           YPAGE1=YPAGE-.05
000773           PRINT 170, XPAGE1,YPAGE1,U,R(U)
001007           CALL SYMBOL (XPAGE1,YPAGE1,.1,R(U),0.,3)
          C
```

```
BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
D       -  007741    I       -  007755    ICODE   -  007757    K       -  007756
MEAN    -  002020    NOTEST  -  007754    R       -  007743    T       -  007742
U       -  007740    XA      -  002014    XPAGE   -  007760    XPAGE1  -  007762
Y       -  001432    YA      -  002015    YPAGE   -  007761    YPAGE1  -  007763

START OF CONSTANTS
001070

START OF TEMPORARIES
001422

START OF INDIRECTS
001430

UNUSED COMPILER SPACE
004100
```