Results of:

Hillsborough County
Southeast County Landfill Capacity Expansion Area
Hydrogeological / Geotechnical Investigation

Prepared for:

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HILLSBOROUGH COUNTY
SOUTHEAST COUNTY LANDFILL CAPACITY EXPANSION AREA
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TABLE OF CONTENTS

Results of:
HILLSBOROUGH COUNTY
SOUTHEAST COUNTY LANDFILL CAPACITY EXPANSION AREA
HYDROGEOLOGICAL / GEOTECHNICAL INVESTIGATION

TABLE OF CONTENTS
(Continued)

TABLES

FIGURES

Results of:
HILLSBOROUGH COUNTY
SOUTHEAST COUNTY LANDFILL CAPACITY EXPANSION AREA
HYDROGEOLOGICAL / GEOTECHNICAL INVESTIGATION

TABLE OF CONTENTS
(Continued)

FIGURES (Continued)

APPENDICES

SECTION 1
INTRODUCTION

1.0 INTRODUCTION

1.1 General Background

The Hillsborough County Solid Waste Management Department (County) is planning construction of a disposal expansion area at the Southeast County Facility. Figure 1 depicts a regional facility location map and Figure 2 indicates the approximate limits of the existing and proposed disposal areas). The proposed expansion area, designated as Southeast Capacity Expansion Area (SCEA), lies north-northeast of the existing disposal area. Figure 3 shows a site photograph looking north at the proposed SCEA. The site is situated within the northern half of Section 23 and the southern half of Section 14 of Township 31 South, Range 21 East.

The perimeter outline of SCEA encompasses approximately 140 acres in total but the hydrogeological and geotechnical investigation focuses on establishing parameters for construction design of the 11-acre parcel located in the lower southeastern end of SCEA. The 11-acre parcel is designated as Section 1, the initial development area.

1.2 Purpose and Scope

Barnes, Ferland and Associates, Inc. (BFA) conducted a hydrogeological and geotechnical investigation to evaluate the subsurface conditions at the site and develop related design and construction criteria. This work was performed under a Sub-Consultant Agreement with SCS Engineers. The geotechnical explorations and laboratory testing were performed by Ardaman and Associates, Inc., through an Agreement with the County.

The scope of the hydrogeological/geotechnical investigation includes the following:

1) Review of selected existing hydrogeological studies and related literature;

2) Field explorations including standard penetration test borings, cone penetration tests, piezometer installations, collecting water level measurements and slug testing;

3) Geotechnical laboratory testing of soils;

4) Hydrogeological analyses consisting of regional and site hydrogeology, regional and site hydrology, and existing well inventory;

5) Geotechnical analysis consisting of a description of subsurface conditions, a sinkhole evaluation, and foundation evaluations;

6) Preparation of this report with results of the literature review, field explorations, laboratory testing, hydrogeological and geotechnical analyses.

1.3 Previous Studies

Several hydrogeological investigations have been completed in the past that include the SCEA. The Southwest Florida Water Management District (SWFWMD) evaluated the regional water resources including this area in their 1993, "Eastern Tampa Bay Water Resource Assessment Project", and also their 1988 "Groundwater Resource Availability Inventory for Hillsborough County". These reports contain a compiled inventory of reports and data pertaining to the hydrology and hydrogeology of this region. Hydrogeological/geotechnical evaluations have previously been conducted at the Southeast County Facility for purposes of designing and permitting the sanitary landfill. They include Ardaman and Associates, Inc., 1983, Ardaman and Associates, Inc. 1994, Jammal and Associates, Inc., 1990, and CH2M Hill, 1995. This information was also used as part of this investigation.

SECTION 2
FIELD INVESTIGATION

2.0 FIELD INVESTIGATION

2.1 General

The proposed SCEA encompasses approximately 140-acres in total but most of the explorations concentrate on an 11-acre parcel known as Section 1 (Figure 2). The proposed SCEA, and the existing disposal area, were formerly used during phosphate mining operations. Waste clays, mining spoils, and sand tailings from excavation operations were deposited within bermed settling ponds. Underlying the waste clay is a light brown silty sand which identifies the lower limits of the waste clay. A silty sand generally extends to a greenish-gray clayey sand (Bone Valley Formation). The clayey sands generally extend from the Bone Valley Formation to a light brown clayey sand with silt and phosphate (Hawthorn Formation).

Figure 2 shows the locations where standard penetration tests (SPTs), cone penetrating tests (CPTs) and piezometers were performed. The geotechnical explorations and soils testing were conducted by Ardaman and Associates, Inc. and results are presented in Appendix A. The following is a description of the exploration program.

2.2 Soil Boring Program

Eight SPT borings were made at the locations shown on Figure 2. The purpose of these borings was to identify stratigraphy of soil types beneath the proposed SCEA and obtain soil samples for geotechnical laboratory testing to evaluate their engineering properties. Continuous sampling (split spoon or thin walled tube) were performed through the sand tailings, waste phosphatic clays and earthen berms and then sampling was performed at five foot intervals thereafter. Five borings were made within Section 1 which extended through the surficial aquifer and Bone Valley Formation and into the underlying Hawthorn Formation. Three borings were made outside Section 1 which extended through the overlying sand tailing and waste clay layer and into the surficial aquifer. Split spoon and thin walled tube sampling was carried out in accordance with ASTM Standard Method D-1586 and ASTM Standard Method D-1587, respectively. Samples were logged in the field and then sent to the soils laboratory for further testing. Each soil boring was grouted to land surface upon completion with a five percent bentonite cement mixture.

2.3 Cone Penetrating Test Program

Thirteen CPT borings were performed at locations shown on Figure 2. Eight of these borings were performed within Section 1 and the remaining borings were performed outside of Section 1 limits. The purpose of the CPT borings is to determine the engineering properties of shallow soils beneath the proposed SCEA. CPT borings penetrated through the sand tailings and waste clay soil layers approximately five feet into the Bone Valley formation. CPT borings were performed in accordance with the ASTM D-3441 Standard Methods.

2.4 Piezometer Installation

Ten piezometers were constructed within the surficial aquifer system at the locations shown in Figure 2. The purpose of these piezometers is to obtain water level measurements and define the water table elevation, flow directions and gradients and to conduct slug testing to estimate the horizontal hydraulic conductivity of the surficial aquifer materials.

Eight piezometers were constructed outside the limits of Section 1. Five were placed below the waste clay layer and above the Bone Valley Formation to monitor the local water table conditions. Three were placed above the waste clay layer to monitor seasonal or perched conditions. Two piezometers (P-1S and P-1D) were constructed within Section 1 limits to monitor both seasonal/perched and local water table conditions.

Each piezometer was constructed in accordance with requirements of the Southwest Florida Water Management District (40D-3). Table 1 and Appendix A summarize piezometer construction details. The piezometers were constructed using hollow stem auger drilling methods and were subsequently developed.

2.5 Horizontal Hydraulic Conductivity Testing

Slug tests were performed by BFA within six of the piezometers to collect data on horizontal hydraulic conductivity. The piezometers include P-1D, P-2D, P-2S, P-4D, P-4S and P-6D. The slug tests consisted of rapidly adding or removing a volume of water into/from the well and collecting water levels until static conditions returned. The change in head over time was monitored using an electronic water level indicator. The data were evaluated using the Bouwer and Rice Method of analysis to estimate horizontal hydraulic conductivity (Appendix B).

SECTION 3
HYDROGEOLOGIC ANALYSES

3.0 HYDROGEOLOGICAL ANALYSES

3.1 Regional Hydrogeologic Setting

The geologic units underlying the Southeast County Facility consist of both unconsolidated and consolidated materials that range in age from Holocene to Paleocene and older. These units, shown in Table 2, are generally described below.

The youngest deposits are surficial sands, clays and related materials of Holocene to Pleistocene age, which occur from land surface to maximum depths of about 25 feet. These surficial materials are primarily terrace deposits and are immediately underlain by remnants of the Bone Valley Formation (the undifferentiated deposits of Table 2), of Pliocene age, which may vary in thickness from about 25 to 50 feet in the project area. The Bone Valley is composed largely of phosphatic sands and clays in many areas, and is commonly referred to as the "matrix" or "ore zone". The surficial materials and the Bone Valley Formation, at some areas of the Southeast County Facility, have been highly disturbed by mining, with most of the native materials having been removed and replaced during the course of mining and subsequent land reclamation.

Sediments of Miocene age in the project area consist of the Hawthorn Formation and the Tampa Limestone. The top of the Hawthorn Formation occurs at depths of approximately 40 to 75 feet bls (below land surface) and the included sediments vary in thickness from about 75 to 100 feet. The upper part of the Miocene sediments is composed of clayey sands, silt, clay, shell, marl and phosphatic materials. In the lower part, the Tampa Limestone consists of limestone and sandy limestone with lenses of sand and clay. The Tampa Limestone occurs at a depth of about 150 to 160 feet bls and extends to a depth of some 300 feet.

The materials that underlie the Miocene sediments are primarily limestones and dolomitic limestones that range in age from Oligocene to Paleocene and are designated, in downward order, as the Suwannee Limestone, Ocala Limestone, Avon Park Formation, Oldsmar Formation, and the Cedar Keys Formation. The Suwannee Limestone, primarily composed of fossiliferous limestone and lenticular interbedded dolomitic limestone of Oligocene age, immediately underlies the Tampa Limestone. The Suwannee is in turn underlain by the Ocala Limestone, of Eocene age, composed of fossiliferous limestone which is generally cream-to-tan in color and relatively soft. Next, the Avon Park Formation is composed of limestone and dolomitic limestone; the limestone usually being medium hard to hard and tan-to-brown in color and the dolomitic units tending to be hard and brown-to-dark brown in color. The basal Eocene unit is the Oldsmar Formation, composed of limestone and dolomitic limestone with intergranular gypsum in many areas. Total thickness of the Eocene carbonate rocks in the project area is not known. The Oldsmar is, in turn, underlain by the Cedar Keys formation which consists of limestone and dolomitic limestone with beds of anhydrite. This Paleocene age unit is seldom penetrated by wells and its total thickness in unknown.

Three aquifer systems are present in the geologic section described above. These are, in downward order, the surficial aquifer, the intermediate aquifer, and the Floridan aquifer system. General characteristics for each aquifer, typical of Southeast Hillsborough County, are discussed below.

The surficial aquifer occurs in the sands of the terrace deposits, which are grouped in Table 2 as Holocene and Pleistocene surficial materials. This is basically an unconfined aquifer, that is it contains groundwater under atmospheric pressure. The water table is usually within a few feet of land surface and the hydraulic gradient and flow direction generally conform to the land surface topography of the area. The base of the surficial aquifer is usually the less permeable materials of the underlying Pliocene or Miocene sediments. Yields from this aquifer are relatively low and its general lack of confinement leaves it vulnerable to any pollutants that may be present at land surface. Transmissivity and storativity (specific yield) in the vicinity of the Southeast County Landfill were estimated, respectively, as 1,800 ft^2/d and 0.12 (CH2M Hill, 1995).

The water bearing zone, or zones, that compose the intermediate aquifer usually consist of discontinuous beds of shell, gravel, limestone and dolomitic limestone within the Hawthorn Formation sediments. These may occur in both the upper and lower parts of the Hawthorn Formation and may be separated by beds of lower permeability; and although the intermediate aquifer contains some production zones, the host sediments of the Hawthorn, collectively, function as a confining unit to retard movement of groundwater in either vertical direction. The intermediate aquifer contains groundwater under semi-confined to confined conditions. It yields low to moderately high quantities of groundwater, its transmissivity being highly variable due to its discontinuous and lenticular nature. Reported transmissivity values throughout the extent of the intermediate aquifer may range from about 200 to 13,000 ft^2/d (SWFWMD, 1988); those for the vicinity of the Southeast County Facility may range from about 170 to 740 ft^2/d (CH2M Hill, 1995).

The Floridan aquifer, a major regional aquifer system, occurs in the mainly carbonate rocks that range in age from basal Miocene through Eocene age rocks. In Southeast Hillsborough County, its top is generally considered to be in limestones of the Tampa Limestone, and its base in the Oldsmar Limestone. The aquifer system is commonly subdivided into the Upper Floridan aquifer, and the Lower Floridan aquifer, both of which contain water under confined conditions and are usually highly transmissive. The Upper Floridan aquifer is composed of rocks of the Tampa Limestone, Suwannee Limestone, Ocala Limestone, and the upper part of the Avon Park Formation. It yields fresh groundwater and is the principal source of water throughout most of the SWFWMD area. Thickness of the Upper Floridan aquifer is approximately 1,200 feet at the project area (CH2M Hill, 1995, SWFWMD, 1993) Aquifer tests in the vicinity of Southeast County Facility indicate transmissivity on the order of 100,000 ft^2/d (CH2M Hill, 1995).

The Upper Floridan aquifer is underlain by the middle semi-confining unit, which in turn is underlain by another highly transmissive zone designated as the Lower Floridan aquifer which occurs in the Oldsmar Limestone. Little, however, is specifically known of the Lower Floridan in most of the area; it is generally not penetrated by wells because of its depth and the likelihood that it contains brackish to saline groundwater. Paleocene age rocks of the Cedar Keys Limestone function as the lower confining unit for the Floridan aquifer system.

3.2 Site Hydrology and Drainage

The proposed SCEA lies within the Alafia River drainage basin, which eventually drains into Tampa Bay. The major drainage features, located in the immediate vicinity of the proposed SCEA, include the South Prong of the Alafia River, Hurrah Creek, and Lewis Branch to the south and east; and Doe Branch, Long Flat Creek, and Chito Branch to the north and west of the site (Figure 1).

Prior to mining, surface-water drainage from the southeast and east area of the Southeast County Facility was southeast to Hurrah Creek and northeast to Chito Branch, tributaries of the South Prong of the Alafia River; and drainage from the remainder of the Southeast County Facility was to the northwest to Long Flat Creek, a tributary of the Alafia River (Figure 1). Thus, under pre-mining conditions, a surface water drainage divide apparently occurred at the Southeast County Facility.

Historical drainage patterns have been altered by past phosphate mining activities and development of Southeast County Facility. Surface drainage now is controlled by berms, ditches and structures which channel runoff to stormwater detention/filtration basins that exist along the perimeter of the Southeast County Facility. Figure 4 shows the major drainage patterns at the Southeast County Facility. Generally runoff from the Southeast County Landfill and the proposed SCEA discharges into a stream tributary, along the western property boundary, that leads to Long Flat Creek. Basins B and C contain spillways that may overflow east into the Central Pond Complex during rainy periods. From the Central Pond Complex, flow travels north and subsequently west, through perimeter ditches leading to a stream tributary of Long Flat Creek. Basins A, D and E also outfall to this stream.

3.3 Groundwater Movement

Under pre-mining conditions, the water table at the Southeast County Facility probably approximated the land surface topography and groundwater movement in the surficial aquifer generally followed the pattern of pre-mining movement of surface waters on the site, as described above. However, mining and land reclamation activities have resulted in changes to both site topography and permeability of some of the materials in the shallow subsurface. Discontinuous perched water table conditions may occur at the proposed SCEA above the shallow confining lenses (waste clay layers). This was apparent at piezometer locations P-2S, P-3S and P-4S, and may be more significant during the rainy season (June - September). Perched water table levels may occur greater than 10 - 15 feet above the local water table depending on the presence of waste clay layers. It is expected that this condition will not exist once the waste clay layers are removed.

Figures 5 and 6 present the local water level elevations of the surficial aquifer observed during the study period on 6/13/97 and 8/18/97. The water levels were determined from piezometers that penetrated into native, unmined surficial aquifer materials. Water table elevations ranged from 121 to 110 feet NGVD across the proposed SCEA on 6/13/97 and from 124 to 112 feet NGVD on 8/18/97. Water level elevations appear to be highest along the southeastern and eastern perimeter of the proposed SCEA, most likely as a result of mounding effects from the adjacent surface water bodies. The lowest water level elevations were located in the western portion of the proposed SCEA, most likely as a result of drainage by the stream tributary. Based on the water table contours, groundwater flow in the surficial aquifer is primarily in a west to northwesterly direction. A prominent feature of the water table contours in the western part of the proposed SCEA (Figures 5 and 6) are their closer spacing, which may indicate a lower transmissivity. Piezometer P-5S was not included in development of the localized water table maps (Figures 5 and 6) due to the apparent perched water level conditions.

The average groundwater flow velocity (v) in the surficial aquifer was calculated using the following equation:

$$v = \frac{K\Delta h}{n}$$

where: v = groundwater flow velocity
K = hydraulic conductivity
Δh = hydraulic gradient
n = effective porosity

Slug test data for four (4) piezometers (P-1D, P-2D, P-4D and P-6D) were used to obtain an average hydraulic conductivity (K) of about 1.34 ft/d. (see Appendix B). The average hydraulic gradient along a groundwater flow line from the vicinity of monitor well P-3D to the west end of the porosity is about 11.5 ft/3,000 ft (or 3.8 x 10^{-3}). The effective porosity SCEA for surficial aquifer sand material is expected to range from 10 to 30 percent. The ground water flow velocity within the surficial aquifer was calculated as follows:

v = 0.05 ft/d, if n is assumed to be 10 percent;

v = 0.025 ft/d, if n is assumed to be 20 percent; and

v = 0.017 ft/d, if n is assumed to be 30 percent.

The median value (20 percent) assumed for effective porosity is believed to be the most representative value, and the range assumed (10 to 30 percent) should cover the actual range for the relatively fine materials that comprise the surficial aquifer at the proposed SCEA. Average groundwater velocities, for lateral flow, are quite small anywhere within the range of probable effective porosities.

There is a downward gradient from the surficial to the intermediate aquifers, so there is also the potential for vertical movement of groundwater from the surficial aquifer downward to the intermediate aquifer. Actual movement is limited, however, by low permeability strata at the base of the surficial aquifer and in the Pliocene sediments which restrict vertical movement of groundwater from the surficial aquifer to the underlying intermediate aquifer. Vertical hydraulic conductivity of these low permeability units is on the order of 1.5 x 10^{-4} ft/d (SWFWMD, 1988).

The direction of lateral flow for groundwater in the intermediate aquifer is indicated by reference to regional maps of the potentiometric surface for this aquifer. Figures 7 and 8 show, respectively, the potentiometric surface for the intermediate aquifer for May 1996 (low pressure conditions) and September 1996 (high pressure conditions). The general direction of lateral flow in the intermediate aquifer is just north-of-west at the Southeast County Facility.

There is the potential for downward movement of groundwater from the intermediate aquifer to recharge the Upper Floridan aquifer. However, leakance values for basal units of the Hawthorn Formation, determined from aquifer tests in the area, are reported to range from about 1.0×10^{-7} ft/d/ft to 4.0×10^{-5} ft/d/ft (SWFWMD, 1988). These low leakance values verify the confining nature of the intermediate aquifer/confining system. These confining characteristics are further supported by the large head differences between the intermediate and Upper Floridan shown in Figures 7 through 11.

The direction of lateral flow for groundwater in the Upper Floridan aquifer is indicated by reference to regional maps of the potentiometric surface for the intermediate aquifer for May and September, 1996 (Figures 10 and 11). In May, near the end of the annual dry season, flow direction in the Upper Floridan in the project area has a small south-of-west component related to the large cone of depression which primarily results from agricultural withdrawals to the southwest. By September, groundwater levels have largely recovered in this depression, and the direction of flow in the Upper Floridan aquifer has a west direction.

3.4 Well Inventory

A well inventory was performed to determine water use within the study area. No potable wells exist within 500 feet of the proposed SCEA. The County uses bottled water for drinking purposes at the Southeast County Facility. Appendix C contains a listing of Southwest Florida Water Management District well construction permits within Sections 23 and 14 of Township 31 and Range 21. These sections encompass the proposed SCEA and a 500 foot buffer zone. Some of these wells may be more than one mile from the proposed SCEA since well construction permits identify locations by sections and do not provide exact locations. Two wells are classified as public supply and the remaining wells are used for groundwater monitoring purposes (see Appendix C).

Three supply wells exist at the Southeast County Facility near the Administration and Scale House Building, Equipment Maintenance Building and the Leachate Treatment Facility. These wells are used for washdown and cleaning purposes and are located more than 500 feet from Section 1 Expansion Area.

SECTION 4
GEOTECHNICAL ANALYSES

4.0 GEOTECHNICAL ANALYSES

4.1 Subsurface Conditions

The Southeast Capacity Expansion Area, and the existing Southeast County Landfill were formerly used during phosphate mining operations. Waste clays, mining spoils, and sand tailings from excavation operations were deposited within bermed settling ponds. The upper few feet of the mining waste was removed from the area within the Section 1. As described earlier, several CPT tests and SPT borings were performed by Ardaman & Associates within the Section 1, and the boring logs and the test results are presented in Appendix A. The following generalized soil profile description at Section 1 is primarily based on the CPT test results, SPT boring logs, and several geotechnical laboratory tests conducted on the site soils. The laboratory test results are given in the next section. The ground surface elevations at the SPT boring locations are presented along the boring logs (see Appendix A).

As shown along the two hydrogeological cross-sections (Figures 12 - 14), the site soils within the depth of investigation consist of four strata. The upper Stratum 1 consists of five to 17 feet of grayish brown sand tailings (SP-SM to SM) interlayered with greenish gray phosphatic waste clay (CH to CH-CL). The only exception to this is at SPT-2A where this stratum extends to El. 97 ft (i.e., to a depth of 32 feet below ground surface). SPT-2A is located approximately 250 feet east of the Section 1. The least thickness of the stratum is five feet at SPT-7A at northern end of the site. The bottom of this stratum varies from El. 113 ft at SPT-4A (center of the site) to El. 120 ft at SPT-6A and SPT-8A approximately 200 to 300 ft away from the western and northern boundaries of the site. The highest elevation of the stratum within the site is El. 119 ft at SPT-7A. The bottom of this stratum at SPT-2A is at El. 97 ft. The uppermost water table was located in this stratum, perched above the waste clay layers. The standard penetration resistance (N) for this stratum ranged from one to 27 blows per foot with most soils having an N value of less than 10 blows per foot. The fines content of this stratum ranged from three percent to 100 percent. The sand tailings and the mixtures have fines contents in the range of three to 41 percent. The phosphatic clays and the mixtures have fines contents in the range of 19 to 100 percent with most prevailing range of 65 to 95 percent fines.

Stratum 2 soils consist of brownish gray to brown undifferentiated silty sand (SM) to sand with silt (SP-SM) deposits ranging in thickness from 12 ft at SPT-8A to 20 ft at SPT-5A. The median thickness of this stratum within Section 1 is approximately 15.5 ft. This stratum is absent at SPT-2A. The Stratum 2 conformably underlies the Stratum 1. The local water table conditions were found to exist within this stratum. The N values for this layer varied from 2 to 82 with a number of N values exceeding 50 blows per six-inches of penetration. The fines contents for this stratum ranged between six and 32 percent.

Stratum 3 soils primarily consist of 11 ft (at SPT-4A) to 22 ft (at SPT-1A) thick Bone Valley Formation deposits conformably underlying the Stratum 2 deposits at the site. The deposits primarily consist of gray clayey sand (SC) with sandy clay (CH), sand and cemented sand (SP), and silty sand with clay (SM-SC). The median thickness of the stratum encountered at the site is approximately 17.5 ft. The N values for this stratum ranged between 2 and 22 with common occurrence of an N value less than 10. The fines contents for this stratum varied from 20 to 64 percent.

Stratum 4 soils consist of light brown clayey sand with silt and phosphate (SC) deposits of Hawthorn Formation. The depth of investigation was limited to only five to ten feet of penetration into this stratum. This stratum forms the rigid base for the geotechnical analyses. The auger refusal occurred at depths within this stratum. The typical N values for this stratum ranged from greater than 50 to 50 per two-inches of penetration.

4.2 Sinkhole Evaluation

Sinkhole potential studies have previously been conducted by Ardaman & Associates (1983) for the adjacent Southeast County Landfill and by CH2MHill (1995) for a site approximately one mile east of the proposed SCEA. These evaluations were applied to the proposed SCEA and are presented below in their entirety.

The development of sinkholes can not be reliably predicted with the current state of knowledge. However, certain areas are known to be more susceptible to sinkhole development than others due to favorable hydrogeologic conditions. There are three distinct types of sinkholes which have developed in Florida. They are collapse sink, doline or solution sink, and erosion sink. A description of each follows.

- A collapse sink is generally steep-sided and rocky. It occurs when a cavity can no longer support the weight of the overlying soil and rock. This type of sink generally occurs when the limestone is at or near the surface and solution weathering is still very active.

- A doline or solution sink is more common in Florida though not as dramatic as the collapse sink. There is no physical disturbance of the soluble rock beneath a doline. Subsidence of the overlying soil occurs due to gradual dissolution and/or lowering of the rock surface (rock surface doline) and/or gradual dissolution or leaching of soluble materials (calcium carbonate) from the overlying calcareous soil and rock (overburden doline). The Florida Geological Survey estimates that this type of subsidence occurs at the rate of one foot every five to six thousand years. Because water flows radially to the intersection of vertical joints where it enters the rock mass, the surface expression is a shallow and nearly circular depression located over the intersection of the joints.

- The erosion sink is the most common type of sink occurring in Florida. This type of sinkholes frequently occur in an environment characterized by:

  - Limestones overlain by relatively pervious unconsolidated sediments, e.g., sandy soils.
  - Cavity systems present in the limestone.
  - A water table higher than the potentiometric surface in the underlying limestone.
  - A breach of the limestone into the cavernous zone creating a point of high recharge to the artesian aquifer.

Under these circumstances, water moving down into the limestone may take large amounts of sediment into the cavernous system, creating a void and/or raveled zone in the overlying sediments. When the void or loose zone in the overlying sediments reaches a size where the roof is no longer stable, the overburden suddenly collapses. Alternatively, the cavern roof may collapse under a subsequent increase in supported weight due, for example, to a lowering of the ground water table. In many cases, the overburden is visible after the collapse, but for some sinks of this type, the collapsed overburden disappears into the cavity system. In other cases, the sudden subsidence of the ground surface is only six inches to one foot deep. A study of the recent and prehistoric locations of the erosion-type sinkholes, which have occurred in the Hillsborough County, indicated that the proposed SCEA is located in an area of low sinkhole activity.

In addition to the historic occurrences, lineament analysis indicating the presence of linear surface features is an important factor in determining the potential for sinkhole development. Because solutioning is most active along fractures in the limestone, the location of these features, especially those which may be exposed at the surface of the limestone, should be identified and evaluated for patterns of fracture intersections. It is difficult to map these features when the limestone surface is buried under overlying sediments. However, they are often inferred from linear surface features, such as stream segments, alignment of sinkholes, etc. These linear surface features are lineaments. A lineament map of the study area discerned from aerial photographs indicated that relatively few lineaments are apparent in the area of the Southeast County Facility, and that predominant pattern of primary and/or secondary direction of lineaments is not obvious at the subject site.

The other factors that should be considered in evaluation of sinkhole potential include thickness of cohesive clayey sediments of low permeability above the limestone layers, relationship between elevations of water table and potentiometric surface in artesian aquifers, ground water withdrawal, etc. The hydrogeological investigation for the existing Southeast County Landfill, conducted by Ardaman & Associates, indicated that the nearest limerock layer to the land surface is greater than 100 feet below land surface. The clastic overburden consists of clay, sandy clay, and clayey sand. The relative vertical gradient of the site ground water is expected to be downward from the water table to the potentiometric surface. Based on the above factors, it is concluded that the proposed SCEA is located in an area with a low probability of sinkhole occurrence.

4.3 Foundation Analyses

4.3.1 Assumption and Recommendation

The Hawthorn Formation (Stratum 4) is considered a rigid base for all foundation analyses for this study. The in-situ soils strata above the rigid base that are critical for the analyses include, from bottom to top, Bone Valley Formation (Stratum 3), silty sand stratum (Stratum 2), sand tailings and waste phosphatic clay (Stratum 1). Based on the bearing capacity analyses presented in Section 4.3.3, the phosphatic clay underneath the proposed Section 1 Landfill should be completely removed and replaced by compacted sand fill and/or sand tailings without the waste clay and with fines contents no more than five percent. Based on experience and previous studies in the site vicinity, the sand tailings contain less than five percent fines content. The tests conducted during this study showed greater then five percent fines content. The difference can be attributed to sample horizon and mixture of the waste clays and sandtails. The in-situ soils or natural materials used for backfill may contain higher than five percent fines, if the geotechnical engineer determines through tests and evaluations during construction that the backfill materials are acceptable. The removal of waste clay is necessary in order to achieve a factor of safety greater than 1.5. This will constitute the new Stratum 1. The other material types involved in the analyses include compacted subbase, liner system, final cover system, and ash refuse. The various properties of these materials are given in the next subsection. The foundation analyses are based on the data collected from the limits of Section 1 and the evaluation was extended to the SCEA with the assumptions that the site conditions within SCEA are identical to those of Section 1.

4.3.2 Materials Properties

The following materials properties are based on the geotechnical laboratory tests performed by Ardaman & Associates for this investigation and the previous nearby studies conducted by Ardaman (1983, 1994) and CH2MHill (1995). The results of geotechnical laboratory testings conducted during this study are included in Appendix D-1.

- Sand Tailings (Stratum 1). The samples recovered during this study showed fines contents similar to the soils representing mixture of sand tailings and waste clay. Therefore, strength tests on the sand tailings could not be performed. Based on our experience at other similar sites and the results presented in the previous studies by others in the site vicinity, the following properties are assigned for this material group.

  Total Unit Weight: Y_t = 120 pcf

  Shear Strength: $\varnothing'$ = 34° (range 33° to 37°); c' = 0 psf

- Waste Phosphatic Clay (Stratum 1). A significant amount of test data is available for the waste clay from the previous studies and also during this investigation. The following properties have been used in the analyses.

  Total Unit Weight: Y_t = 85 pcf

  Shear Strength: $\varnothing'$ = 0°; c' = 700 psf

- Fill Sand (Stratum 1). Based on the experience and widely used published literatures, the following properties of the fill sand are used in the analyses.

  Total Unit Weight: Y_t = 120 pcf

  Shear Strength: $\varnothing'$ = 32°; c' = 0 psf

- Silty Sand (Stratum 2). Based on the experience in similar soils in the area, the following properties are used in the analyses for this soil layer.

Total Unit Weight: γ_t = 118 pcf

Shear Strength: Ø' = 30°; c' = 0 psf

- Bone Valley Formation (Stratum 3). Based on the test results, the following parameters are used in the foundation analyses.

  Total Unit Weight: γ_t = 118 pcf

  Shear Strength: Ø' = 30°; c' = 0 psf

- Refuse (Ash). No tests were performed on refuse samples. Based on the previous studies (Ardaman, 1983 and CH2MHill, 1995) and discussion with SCS Engineers, the following properties were used for the ash refuse in the analyses.

  Total Unit Weight: γ_t = 74 pcf

  Shear Strength: Ø' = 30°; c' = 0 psf

- Liner System. The properties of the compacted subbase and the protective soil layer are similar to that of the fill sands of Stratum 1 or the silty sands of Stratum 2. For the analyses, lower values have been used. For sliding between the liner and the frictional materials, such as the geomembrane and subbase and the geotextile and protective soil layer, a friction angle of 15° was selected (Ardaman, 1983 and CH2MHill, 1995).

- Final Cover System. The properties of the sand bedding and the protective soil cover are similar to that of the sand tailings or the fill sands of Stratum 1. For the analyses, lower values have been used. For sliding between the liner and the frictional materials, such as the geomembrane and sand bedding, a friction angle of 26° was selected (Ardaman, 1983 and CH2MHill, 1995).

4.3.3 Bearing Capacity

The bearing capacity of Section 1 was evaluated by analyzing the potential for a base failure into underlying foundation materials. The proposed sections, provided by SCS Engineers, were used to perform the failure surface analyses. A minimum factor of safety of 1.5 was sought for the satisfactory design sections. The computer program GEOSLOPE/STABL4 was used to perform the analyses. The computer output for analyses along two profiles, Sections A and B of drawings provided by SCS Engineers, are included in Appendix D. A summary of the results is given below.

The profile Section A runs across the proposed Section 1 and SCEA along southwest-northeast. The profile Section B runs across the Section 1 and SCEA along northwest-southeast. The bearing capacity evaluation was performed along southwest face of Section A and southeast face of Section B for the Section 1. The evaluation was extended to the SCEA with the assumptions that the site conditions within SCEA are identical to that of Section 1. The northeast and northwest faces of the Sections A and B are approximately identical to the opposite faces; and therefore, the calculations along these faces were neither necessary nor performed. Figures 15 and 16 present the design sections of the southwest and southeast faces of the Section 1 and SCEA respectively, which were utilized for the bearing capacity evaluation. The waste phosphatic clay is expected to be removed and filled with fill sand. The analyses of the long-term conditions at full height of the landfill are critical. All analyses were performed at high seasonal water table conditions, which is approximated at El 124 ft (Section 3.3). The materials properties presented in Section 4.3.2 were used for the stability analyses.

Sliding block (horizontal shear) and circular arc (rotational) stability analyses were performed for the critical case of failure surfaces along the interface of the geomembrane and the compacted subbase, and through the compacted subbase, the fill sands, Stratum 2 silty sands, and Bone Valley Formation. The following assumptions were used for bearing capacity caluculations. The overall side slope of the SCEA can be maintained at 3:1 to an elevation of El 280 ft with a 15-foot bench at an interval of 30-foot loading followed by a 20:1 slope to the maximum height of El 307 ft at the center of the SCEA.

Case A   Stratum 1 Contains Phosphatic Clay

The factor of safety was estimated for a case with no removal of waste clay, i.e., leaving the existing waste clay materials inplace as currently present within Stratum 1. The minimum safety factor for circular arc failures for the southwest face (Figure 15) was estimated at 1.57 with failure surface passing through the Stratum 1. The minimum safety factor for sliding block failures for this face was estimated at about 1.0 with failure surface passing through the Stratum 1. The graphical plots of the results are shown on Figures 17A and 17B. The computer output of the computations including the input data is included in Appendix D-2. The estimated factor of safety for sliding block failure was not satisfactory and could not be accepted for design purposes. Therefore, no further calculations were performed using this scenario. All further evaluations were conducted with the assumption that the phosphatic waste clay materials will be removed and replaced with compacted fill sands in Stratum 1.

Case B   Southwest Face

The minimum factor of safety for circular arc failure along southwest face (Figure 15) was estimated at 1.82 with the failure surface passing through the textured geomembrane immediately above the compacted subbase. The minimum factor of safety for failure surfaces passing through the Stratum 3 Bone Valley Formation was estimated at 2.85. The results are graphically presented on Figures 18A and 18B, and the computer output is included in Appendix D-3. The horizontal shear stability analyses of the face were also performed and the results are graphically shown on Figure 19A and 19B, and the computer output is given in Appendix D-3. As shown on these figures, the estimated results indicated that the minimum factor of safety is expected to be 1.61 with the failure surface passing along the interface of the geomembrane and the compacted subbase. The deep failure surface passing through the Stratum 3 soils indicated a minimum factor of safety of 2.76.

The horizontal shear stability and circular arc analyses were also performed for the case with maximum height of El 198 ft. The minimum factors of safety for circular arc and sliding block analyses were estimated at 1.93 and 1.56, respectively. SW face

Based on the estimated minimum factors of safety for various failure surfaces, the design sections presented in Figure 15 with Stratum 1 containing fill sands as replacement of phosphatic clay has been determined to be safe.

Case C Southeast Face

The minimum factor of safety for circular arc failure along southeast face (Figure 16) was estimated at 1.98 with the failure surface passing through the refuse along the slope of the Section1 and SCEA. The minimum factor of safety for failure surfaces passing through the Stratum 3 Bone Valley Formation was estimated at 2.80. The results are graphically presented on Figures 20A and 20B, and the computer output is included in Appendix D-4. The horizontal shear stability analyses of the face were also performed and the results are graphically shown on Figure 21A and 21B, and the computer output is given in Appendix D-4. As shown on these figures, the estimated results indicated that the minimum factor of safety is expected to be 1.61 with the failure surface passing along the interface of the geomembrane and the compacted subbase. The deep failure surface passing through the Stratum 3 soils indicated a minimum factor of safety of 2.65.

The horizontal shear stability and circular arc analyses were also performed for the case with maximum height of El 198 ft. The minimum factors of safety for circular arc and sliding block analyses were estimated at 1.92 and 1.56, respectively. SE face

Based on the estimated minimum factors of safety for various failure surfaces, the design sections presented in Figure 16 with Stratum 1 containing fill sands as replacement of phosphatic clay has been determined to be safe.

4.3.4 Final Cover Stability

The stability of the final cover against sliding along the slope was also computed using the computer program GEOSLOPE/STABL4. For conservative estimation of the safety factor against sliding along the geomembrane, the computation was performed for a case with one foot (half of layer thickness) of saturation of the protective soil layer in the final cover. The minimum factor of safety was estimated at 1.46 for the textured geomembrane interface as shown on Figure 22. The computer output for this scenario is included in Appendix D-5.

4.3.5 Settlement

The primary concern of settlements in subgrade soils at a landfill site relates to strains or angular distortion caused in the liner system. The magnitude of the tensile strain must be within a tolerable limit specified by manufacturer of the geomembrane. The distortion is normally caused by the differential settlements at a landfill which may be caused by the differences in the loading from the side slopes to the top of the landfill, or by variable soil conditions. The magnitude of the strain on the liner system depends on both the magnitude of the differential settlement and the length over which it occurs. Total settlement for the study was estimated by adding elastic compression (immediate settlement) and consolidation (long term settlement). For the purpose of estimating maximum differential settlement, the maximum total settlement at the center of the SCEA was calculated and then the total settlement was assumed to be the maximum differential settlement over a distance from the toe of the landfill side slope to the top of the side slope.

The materials properties used in the calculations were based on the results of the field exploration and laboratory testings conducted during this study, published data (Ardaman, 1983 and 1994, CH2MHill, 1995), and recommended foundation conditions (removal of waste clay beneath Section 1 disposal area and replacing with fill sands or sand tailings). The results summarized in Section 4.3.2 were used for all calculations.

Immediate Settlement

For immediate settlement analyses of the foundation soils, a Poisson's ratio of 0.33 and a Young's modulus of 720,000 psf were used (NAVFAC, Soil Mechanics Design Manual 7.1, May 1982). The calculations were based on the linear theory of elasticity for compressible soils overlying a rigid base. The rigid base was assumed to be the top of Hawthorn Formation, approximately 40 feet below the bottom of the refuse. The maximum elastic settlement at the center of the SCEA was estimated to be less than four inches for the final case with top of the landfill reaching El 307 ft. The corresponding value of settlement for the case with maximum landfill height of El 198 ft was estimated at less than two inches. The supporting calculations along with the references are included in Appendix D-6.

Long Term Settlement

The long term settlement analyses for the clayey sand layer of Stratum 3 (Bone Valley Formation) were performed using one-dimensional consolidation theory (see Appendix D-6). For these analyses, the compression index was estimated using the relationship given by Terzaghi and Peck (1967). Based on the recommendations presented in Section 4.3.1, the fill sand layer of Stratum 1 is not likely to have significant settlement. Therefore, the long term settlements were calculated for the Stratum 2 and Stratum 3 only. The liquid limits 35 and 39 percent were used for the analyses of Strata 2 and 3, respectively. The void ratio was calculated at approximately 1.01 and 1.09 for the Strata 2 and 3, respectively. The maximum consolidation settlement at the center of the SCEA was estimated to be less than 29 inches for the final case with top of the SCEA reaching El 307 ft. The supporting calculations along with the references are included in Appendix D-6.

Total and Differential Settlements

The total maximum settlement at the center of the SCEA is expected to be approximately 32 inches. As discussed earlier, the maximum differential settlement was assumed to be equal to the estimated total settlement value over the horizontal distance between the top and toe of the side slope. Based on the design consideration provided by SCS Engineers, the distances between the top and toe of the side slopes for the final case is 500 ft. This condition results in maximum angular distortion (= 32 inches / 500 ft) of 0.5 percent for the case with final height reaching El 307 ft. The calculations along with the references are included in Appendix D-6. Based on the methodology in Murphy and Gilbert (1985), these angular distortions will result in less than 0.1 percent tensile strain in the geomembranes within the liner system. This strain is well below the allowable of 5 to 10 percent. Therefore, the estimated maximum differential settlement of the foundation soils at the proposed SCEA, after waste clay removal and fill sand replacement, will not affect performance of the liner system.

SECTION 5
CONCLUSIONS AND RECOMMENDATIONS

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

1. The stratigraphy beneath the Southeast County Facility, in descending order, consists of the unconsolidated and undifferential deposits of the Recent, Holocene, Pleistocene, and Pliocene series; followed by the Hawthorn Group; the Suwannee Limestone of the Oligocene series; the Ocala Limestone, Avon Park Formation, the Oldsmar Formation of the Eocene series; and the Cedar Keys Formation of the Paleocene series. Three aquifer systems are present within these above formations. They are, in descending order, the surficial, intermediate and Floridan aquifers.

2. The surficial aquifer is most vulnerable to pollutants that may be present at the land surface due to its general lack of confinement above. The sand portion of the unconsolidated deposits contains the surficial aquifer, which is an unconfined water table aquifer. Use of the surficial aquifer is limited due to its low yield. Water table elevations ranged from 121 to 110 feet NGVD across the proposed SCEA on 6/13/97 and from 124 to 112 feet NGVD on 8/18/97. Flow is primarily towards the west and northwest at an estimated gradient of approximately 0.004 feet per foot. The average horizontal hydraulic conductivity of Stratum 2 was estimated to be 1.34 ft./day and the average flow velocity was calculated to be 0.025 ft/day.

3. The Hawthorn Formation varies in thickness from 75 to 100 feet at the Southeast County Facility. Isolated permeable beds within the Hawthorn Group form the intermediate aquifer. It yields low to moderately high quantities of groundwater due to its variable transmissivity and discontinuous nature. The Hawthorn Formation overall is considered a confining unit for the underlying Upper Floridan aquifer, and a significant (about 45-foot) head difference exists between the two aquifer units. The potentiometric surface of the intermediate aquifer at the Southeast County Facility ranged from elevation 70 - 75 feet NGVD during 1996. Flow direction, at the Southeast County Facility, is just north of west.

4. The Upper Floridan aquifer is by far the most utilized aquifer throughout central Florida due to its high quality and yield. The potentiometric surface of the Upper Floridan aquifer at the Southeast County Facility ranged from elevation 20 to 35 feet NGVD during 1996. The Upper Floridan Aquifer flow direction in the Southeast County Facility is towards the west.

5. The results of the field exploration and laboratory testing program are used to describe shallow depth stratigraphy at the proposed SCEA. The shallow-depth stratigraphy has been generalized into four strata at the proposed SCEA. Stratum 1 materials consists of 5 to 17 feet of sand tailings and phosphate waste clay found at the ground surface which are a result of phosphate mining activities. Stratum 2 material consists of silty sand deposits ranging in thickness from about 12 - 20 feet at the proposed SCEA. Stratum 3 soils primarily consists of 11 - 22 feet thick deposits of clayey sand (Bone Valley Formation) that conformably underlie Stratum 2. Stratum 4 consists of clayey sand with silt and phosphate (Hawthorn Formation). The depth of the soil borings was limited to 5 - 10 feet of penetration into this stratum.

6. The Southeast County Facility lies within the Alafia River Basin which eventually drains into Tampa Bay. Historical drainage patterns have been altered by past phosphate mining activities. Surface drainage is now controlled by berms, ditches and structures which channel runoff to stormwater detention/filtration basins that exist along the perimeter of the Southeast County Facility. Drainage generally exits the Southeast County Facility through a stream along the western boundary off the property to Long Flat Creek, a tributary of the Alafia River.

7. No potable supply wells exist within 500 feet of the proposed SCEA perimeter.

8. Based on the information contained in this report, the proposed SCEA Facility is located in an area with a low probability of sinkhole occurrence.

9. The Hawthorn Formation (Stratum 4) was considered a rigid base for all foundation analyses for this study.

10. Based on the bearing capacity analyses presented in Section 4.3.3, the phosphatic clay underneath the proposed Section 1 expansion area should be completely removed and replaced by compacted sand and/or sand tailings without the waste clay and with fines contents no more than five percent. This is necessary in order to achieve a factor of safety greater than 1.5.

11. The design side slope of 3:1 (horizontal to vertical) for the proposed SCEA as presented in Figures 15 and 16 is considered safe with a minimum factor of safety greater than 1.5.

12. Based on the preliminary hydrogeological and geotechnical analysis and the following recommendations, the proposed SCEA is suitable for development of landfill facilities to dispose of municipal solid waste.

5.2 Recommendations

1. Review of the hydrologic data associated with this evaluation indicate natural water levels very close (within 2 feet) of the proposed base of the bottom liner system. Because the period of record and frequency of measurements is not comprehensive, it is recommended that the County continue monitoring the network of piezometers listed in Table 3 to obtain additional high water table data during wet periods. Depending upon the results of that new information modifications may be warranted during final design. The additional water level monitoring should be performed during the first week of September at locations P-2D, P-4D, P-6D, TH-30, TH-32, TH-35, TH-36, TH-38, TH-56, TH-22 and TH-28 and continuously (using strip charts) at locations TH-32 and P-1D. Staff gages S6-3C2, 3B2B and SMITH LAKE should also be recorded.

2. It is recommended that the phosphatic clay underneath the proposed SCEA be completely removed and replaced with compacted sand fill and/or sand tailings without the waste clay

and with fines contents no more than five percent. This will constitute the new Stratum 1 immediately below the landfill area.

SECTION 6
REFERENCES

6.0 REFERENCES

Ardaman and Associates, Inc., March 1994, Geotechnical investigation at the Southeast Landfill Hillsborough County, Florida.

Ardaman and Associates, Inc., February, 1983, Hydrogeological Investigation Southeast County landfill Hillsborough County, Florida.

CH2M Hill, January 13, 1995; Hydrogeological/Geotechnical Investigation, New Class I Landfill, Hillsborough County, Florida, Vol. I.

SWFWMD, 1988; Ground-Water Resource Availability Inventory: Hillsborough County, Florida.

SWFWMD, March 1993; Eastern Tampa Bay Water Resource Assessment Project.

TABLES

TABLE 1

PIEZOMETER CONSTRUCTION DETAILS

WELL NO.	DATE INSTALLED	DIAMETER (INCHES)	SCREEN LENGTH (FEET)	ELEVATION (FEET)	SCREENED INTERVAL (FT BLS)	TOTAL DEPTH (FT BLS)
P - 1S *	4/24/97	2.00	3	129.85	3.48 - 6.48	6.48
P - 1D **	4/24/97	2.00	5	129.45	12.54 - 17.54	17.54
P - 2S *	4/24/97	2.00	5	138.82	5.10 - 10.10	10.10
P - 2D **	4/25/97	2.00	5	138.73	23.54 - 28.54	28.54
P - 3S *	4/25/97	2.00	5	143.20	4.44 - 9.44	9.44
P - 3D **	4/29/97	2.00	5	143.19	18.08 - 23.08	23.08
P - 4S *	4/25/97	2.00	5	141.98	5.36 - 10.36	10.36
P - 4D **	4/25/97	2.00	5	141.80	23.34 - 28.34	28.34
P - 5S *	4/29/97	2.00	5	156.84	22.80 - 27.80	27.80
P - 6D **	5/1/97	2.00	5	159.10	43.20 - 48.20	48.20

* Perched water table piezometer
** Water table piezometer

System	Series	Stratigraphic unit		General lithology	Major lithologic unit	Hydrogeologic unit	
Quaternary	Holocene and Pleistocene	Surficial sand, terrace sand, phosphorite		Predominantly fine sand; interbedded clay, marl, shell, phosphorite	Sand	Surficial aquifer	
Tertiary	Pliocene						
	Miocene	Hawthorn Group	Peace River Formation	Clayey and pebbly sand; clay, marl, shell, phosphatic.	Clastic	Confining bed	INTERMEDIATE AQUIFER AND CONFINING BEDS
			Arcadia Formation	Dolomite, sand, clay, and limestone; silty, phosphatic.	Carbonate and clastic	Aquifer	
			Tampa Member	Limestone, sandy, phosphatic, fossiliferous; sand and clay in lower part in some areas		Confining bed	
	Oligocene	Suwannee Limestone		Limestone, sandy limestone, fossiliferous	Carbonate	Suwannee zone	FLORIDAN AQUIFER SYSTEM
	Eocene	Ocala Limestone		Limestone, chalky, foraminiferal, dolomitic near bottom.		Upper Floridan aquifer	
		Avon Park Formation		Limestone and hard brown dolomite; intergranular evaporite in lower part in some areas.		Avon Park zone	
					Carbonate with evaporites	Middle confining unit	
		Oldsmar Formation		Dolomite and limestone, with intergranular gypsum in most areas.		Lower Floridan aquifer	
	Paleocene	Cedar Keys Formation		Dolomite and limestone with beds of anhydrite.		Lower confining unit	

Source: modified from Wilson and Gerhart, 1982; Ryder, 1985; Scott, 1988; and Swancar and Hutchinson, 1992.

TABLE 2

Hydrogeologic Framework of the Study Area

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TABLE 3

WATER LEVEL MEASUREMENTS

PIEZOMETER	TOTAL DEPTH (FT BLS)	MEASURING POINT ELEVATION TOP PVC (FT NGVD)	WATER-LEVEL DATA									
			5/2/97		5/15/97		5/29/97		6/13/97		8/18/94	
			DEPTH TO WATER (FT)	ELEV. (FT NGVD)	DEPTH TO WATER (FT)	ELEV. (FT NGVD)	DEPTH TO WATER (FT)	ELEV. (FT NGVD)	DEPTH TO WATER (FT)	ELEV. (FT NGVD)	DEPTH TO WATER (FT)	ELEV. (FT NGVD)
P - 1S	6.48	129.85	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	2.94	126.91
P - 1D	17.54	129.45	7.94	121.51	8.06	121.39	7.90	121.55	8.14	121.31	5.36	124.09
P - 2S	10.10	138.82	7.56	131.26	7.70	131.12	7.56	131.26	7.74	131.08	6.71	132.11
P - 2D	28.54	138.73	18.14	120.59	18.32	120.41	18.42	120.31	18.60	120.13	16.89	121.84
P - 3S	9.44	143.20	7.98	135.22	7.84	135.36	7.74	135.46	8.00	135.20	6.29	136.91
P - 3D	23.08	143.19	22.08	121.11	22.00	121.19	22.02	121.17	22.04	121.15	19.58	123.61
P - 4S	10.36	141.98	8.22	133.76	8.08	133.90	7.94	134.04	8.06	133.92	4.67	137.31
P - 4D	28.34	141.80	22.98	118.82	22.90	118.90	22.88	118.92	22.88	118.92	21.78	120.02
P - 5S	27.80	156.84	27.64	129.20	Dry	Dry	Dry	Dry	Dry	Dry	21.03	135.81
P - 6D	48.20	159.10	37.40	121.70	37.52	121.58	37.54	121.56	37.60	121.50	34.90	124.20
TH - 30	37.12	128.37	NR	NR	24.20	104.17	24.14	104.23	24.14	104.23	23.90	104.47
TH - 32	26.50	129.25	NR	NR	15.54	113.71	15.42	113.83	15.54	113.71	14.12	115.13
TH - 35	42.90	145.19	NR	NR	28.20	116.99	28.14	117.05	28.32	116.87	27.35	117.84
TH - 36	49.32	152.70	NR	NR	32.38	120.32	32.36	120.34	32.48	120.22	31.65	121.05
TH - 38	13.10	131.20	NR	NR	10.24	120.96	10.14	121.06	10.30	120.90	8.62	122.58
TH - 56	20.00	131.69	NR	NR	NR	NR	NR	NR	NR	NR	14.27	117.42
TH-28	30.00	130.60	NR	NR	NR	NR	NR	NR	NR	NR	26.20	104.40
TH-22	25.00	128.82	NR	NR	NR	NR	NR	NR	NR	NR	4.65	124.82

NR - No Reading

FIGURES

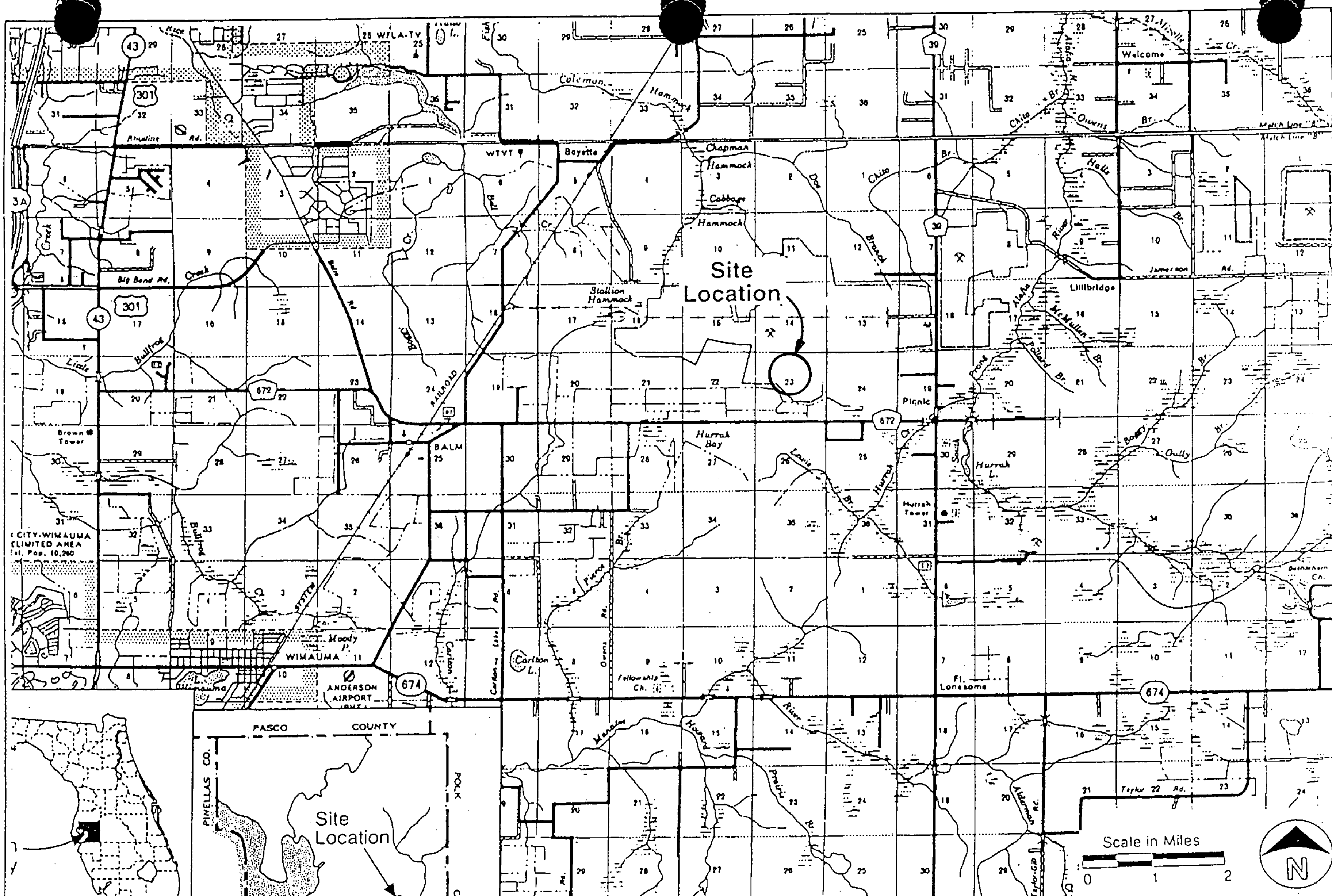


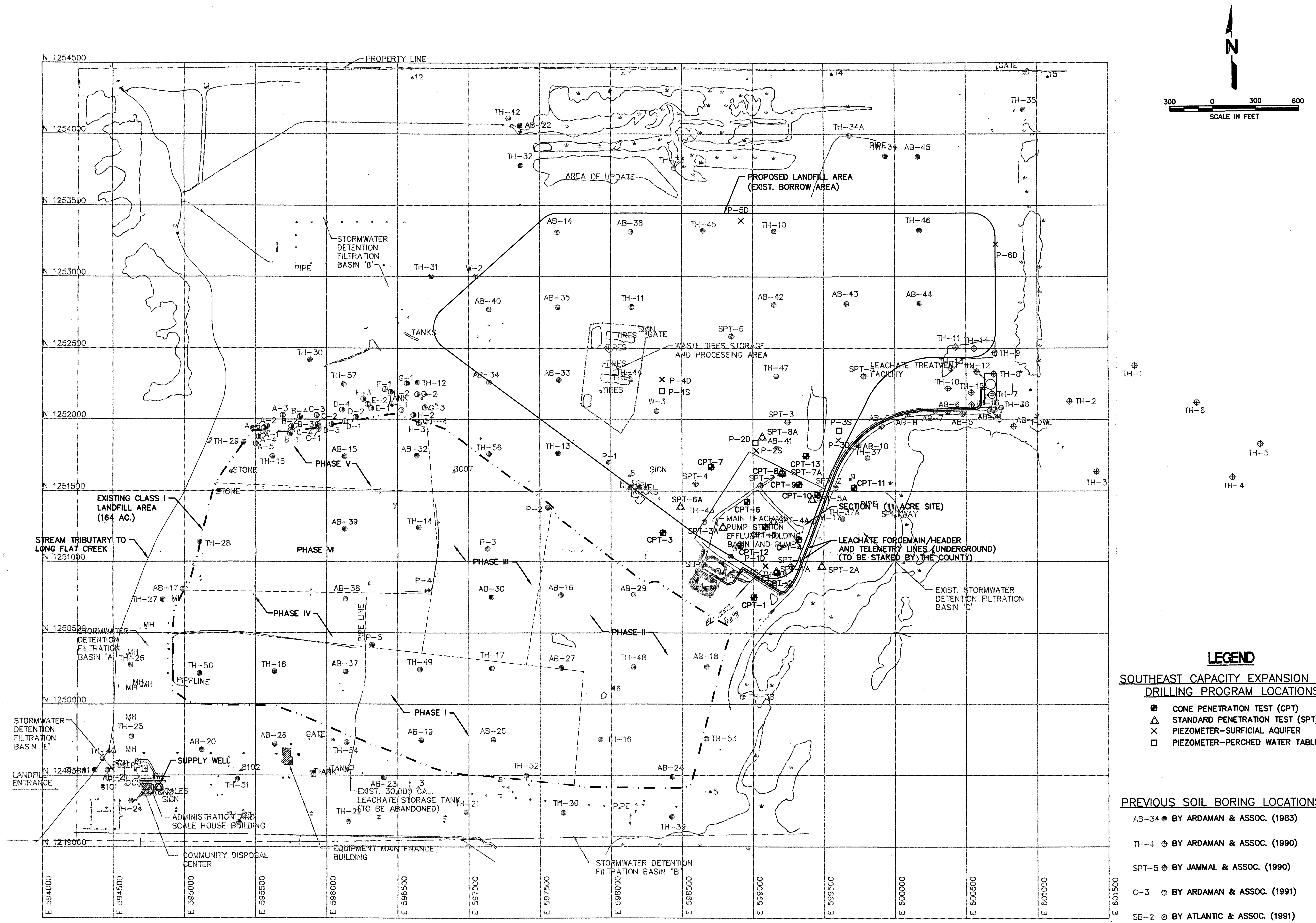
FIGURE 1

Site Location Map

BFA Environmental Consultants
Barnes, Ferland and Associates, Inc.

1565509

(1)



LEGEND

SOUTHEAST CAPACITY EXPANSION AREA
DRILLING PROGRAM LOCATIONS

- CONE PENETRATION TEST (CPT)
- △ STANDARD PENETRATION TEST (SPT)
- × PIEZOMETER-SURFICIAL AQUIFER
- □ PIEZOMETER-PERCHED WATER TABLE

PREVIOUS SOIL BORING LOCATIONS

- AB-34 BY ARDAMAN & ASSOC. (1983)
- TH-4 BY ARDAMAN & ASSOC. (1990)
- SPT-5 BY JAMMAL & ASSOC. (1990)
- C-3 BY ARDAMAN & ASSOC. (1991)
- SB-2 BY ATLANTIC & ASSOC. (1991)

REV.	DATE	DESCRIPTION	CK. BY

DRAWING TITLE
DRILLING PROGRAM LOCATIONS

PROJECT TITLE
SOUTHEAST
CAPACITY EXPANSION AREA

CLIENT
**HILLSBOROUGH COUNTY
SOLID WASTE MANAGEMENT
DEPARTMENT
TAMPA, FLORIDA**

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
3012 U.S. HWY. 301 NORTH, SUITE 700, TAMPA, FL 33619
PH (813) 621-0080 FAX NO. (813) 623-6757

PROJ. NO. 09995029.42

CADD FILE: PBORSITE.DWG
DATE: SEPTEMBER 2, 1997
SCALE: 1"=300'

FIGURE NO.2

FIGURE 3	**Southeast Capacity Expansion Area - Looking North**	BFA Environmental Consultants Barnes, Ferland and Associates, Inc.

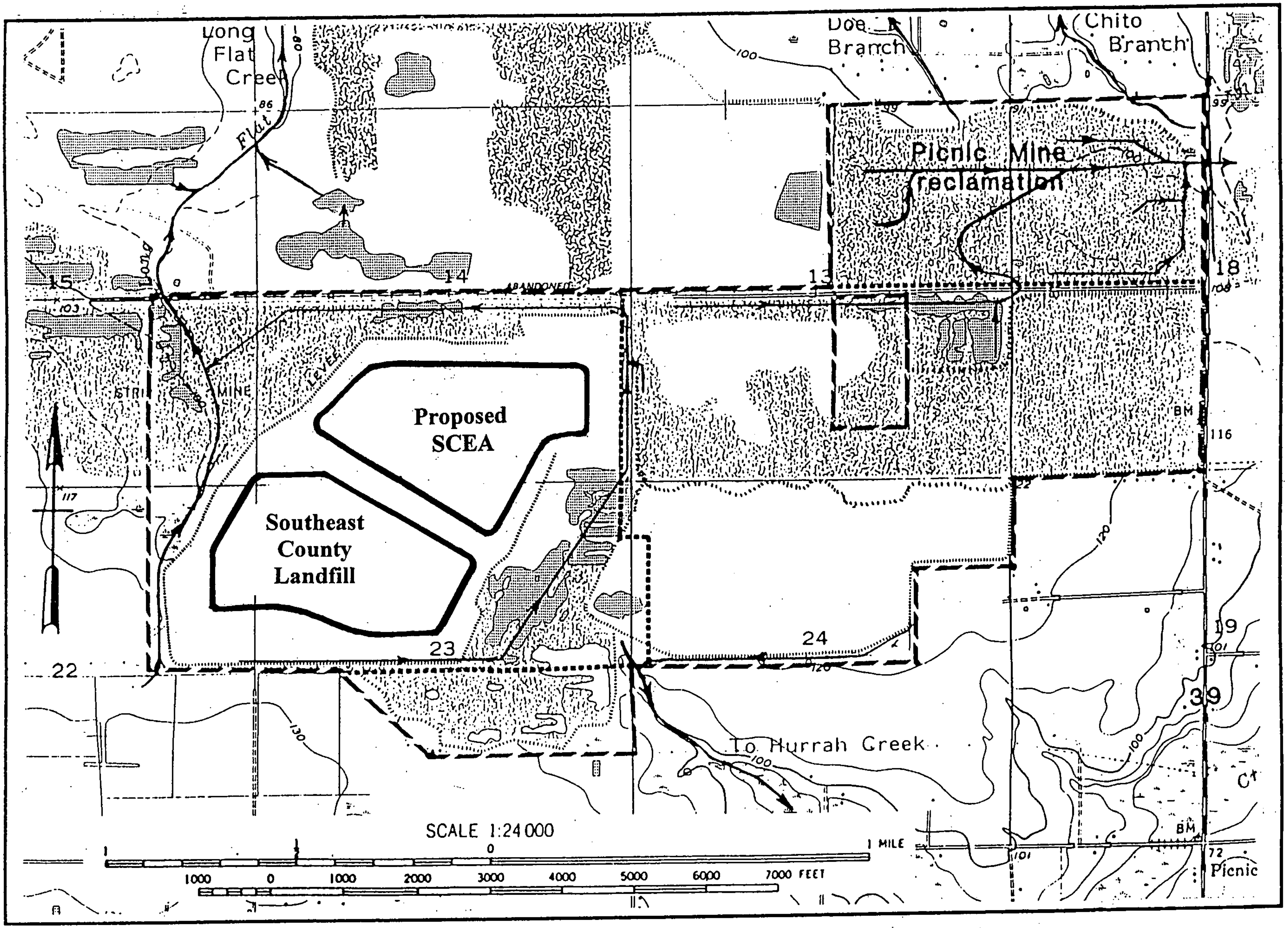
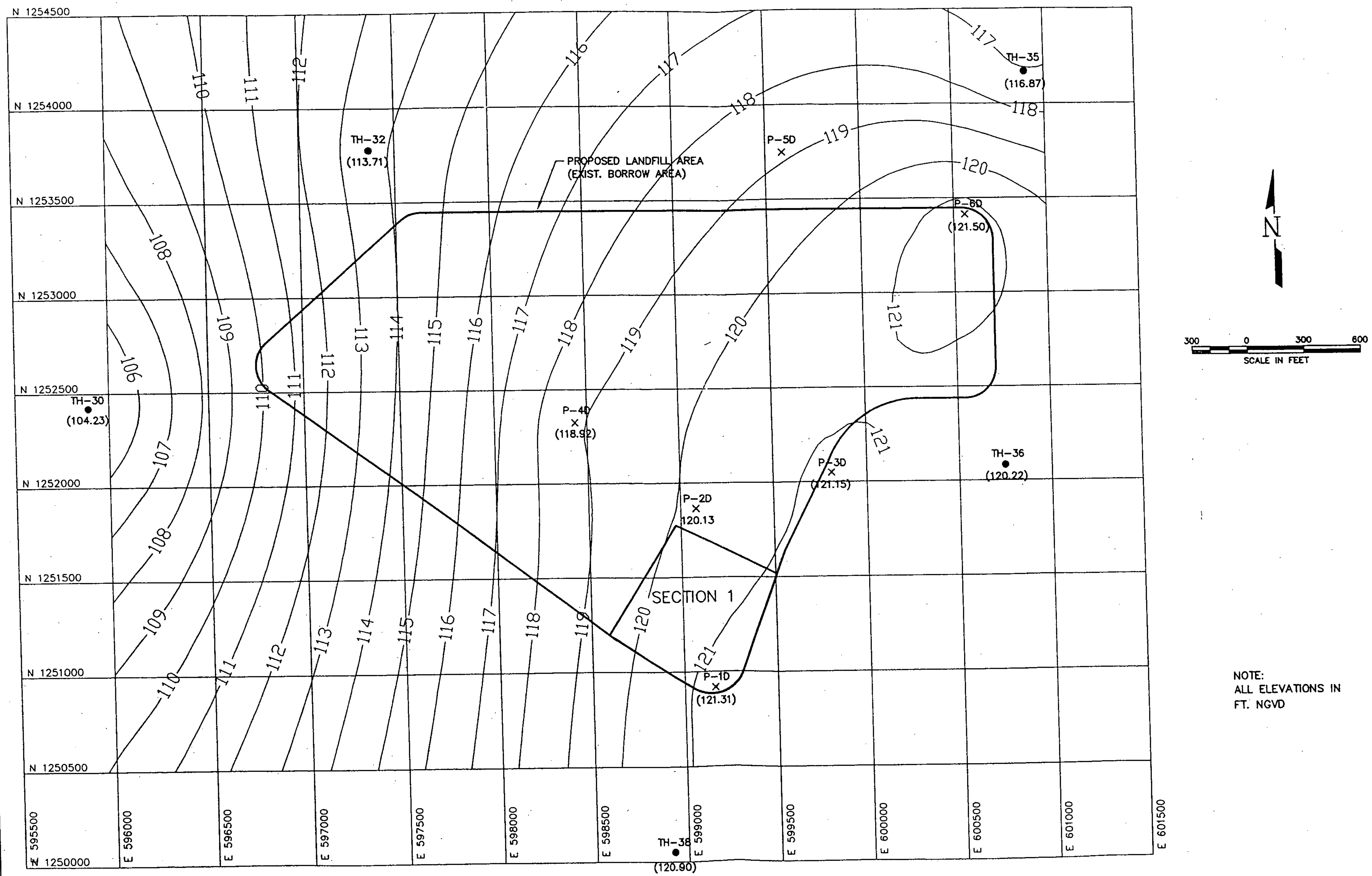


Figure 4 – Major Drainage Patterns



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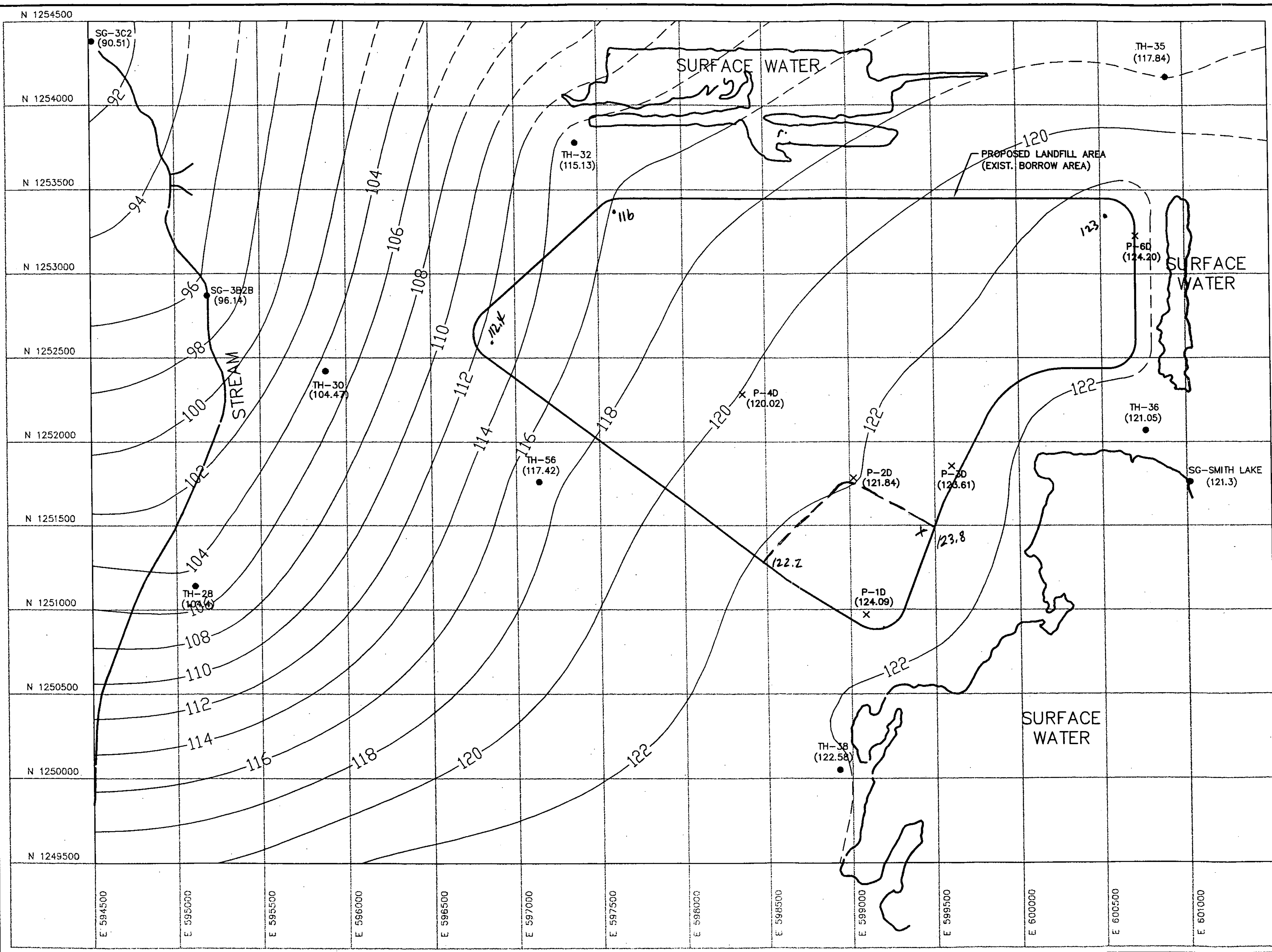
HILLSBOROUGH COUNTY
SOUTHEAST LANDFILL
WATER TABLE (6/13/97)

FIGURE 5



N

300 0 300 600
SCALE IN FEET

NOTES:

1. ALL ELEVATIONS IN FT NGVD.
2. PERCHED WATER TABLE CONDITIONS MAY EXIST 10 – 15 FEET ABOVE THE LOCAL WATER TABLE.

WTRTABL2.DWG

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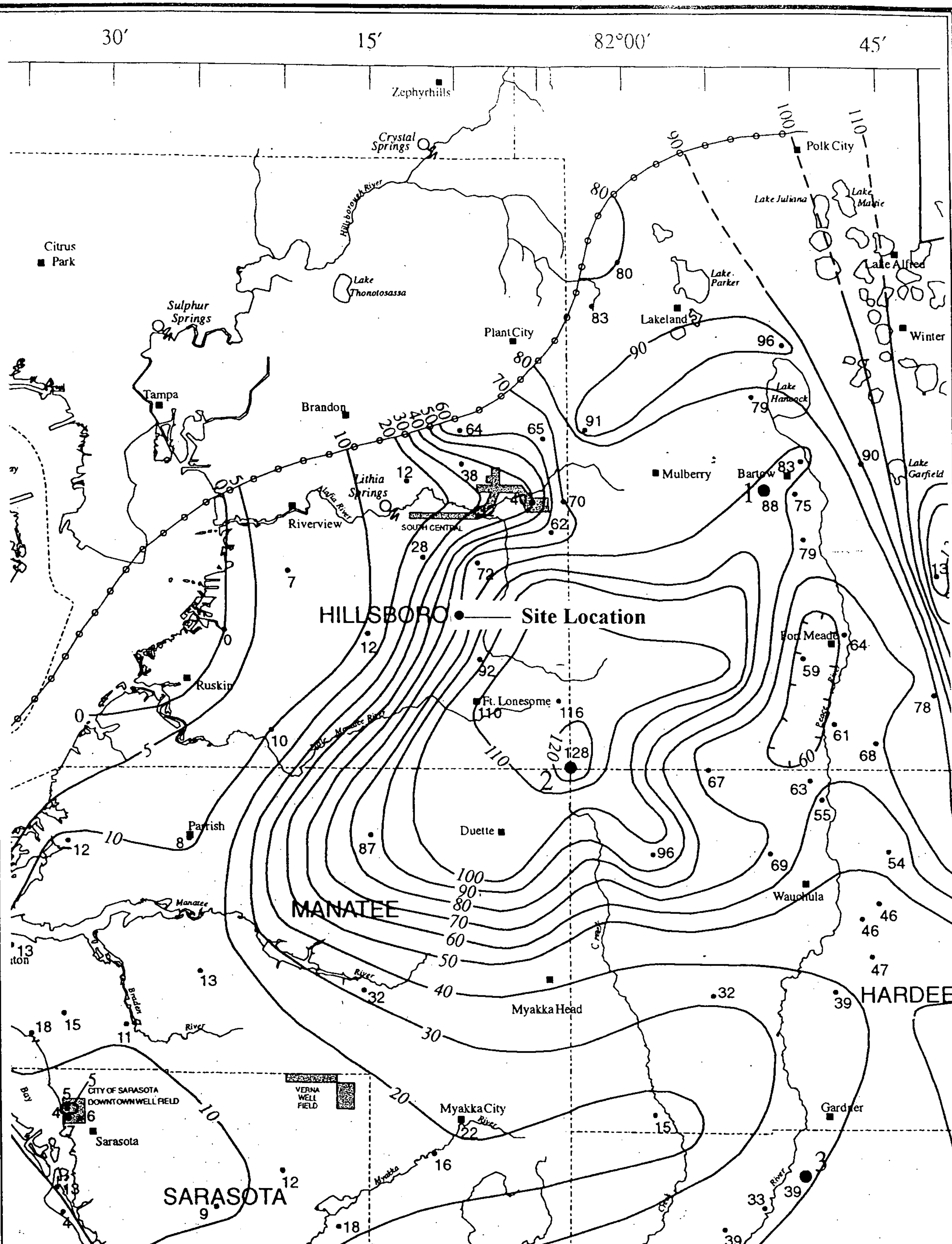
3655 Maguire Blvd. Suite 150, Orlando, FL 32803
PH: (407) 896-8608 FAX: (407) 896-1822

WATER TABLE ON 8/18/97
SOUTHEAST CAPACITY
EXPANSION AREA

PROJECT NO.: 95-009
DATE: AUGUST 1997
SCALE: 1"=600'
FIGURE 6



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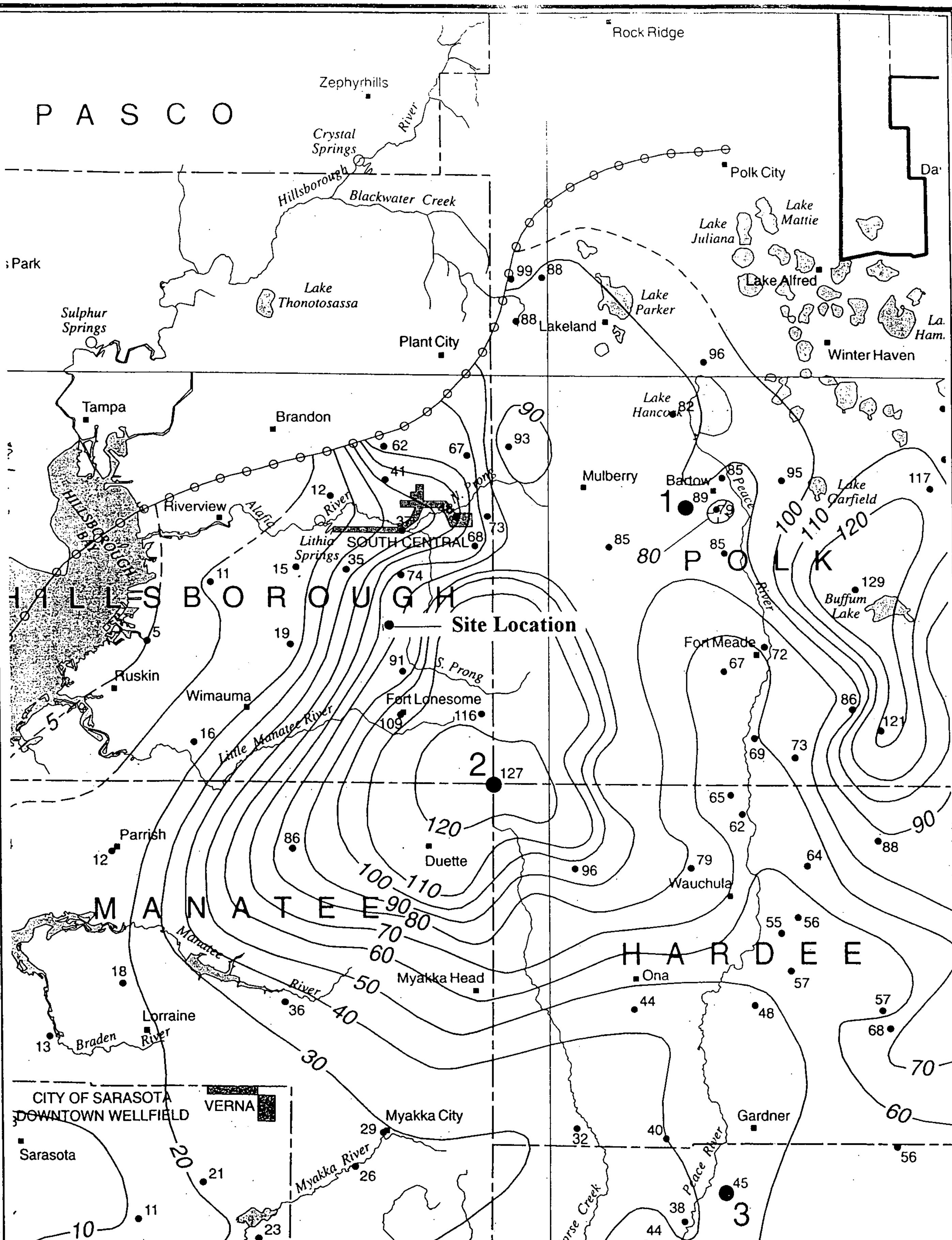
POTENTIOMETRIC SURFACES OF THE INTERMEDIATE AQUIFER SYSTEM, WEST- CENTRAL FLORIDA, MAY 1996

By J.A. Mattie, P. A. Metz, and A.E. Torres

FIGURE 7



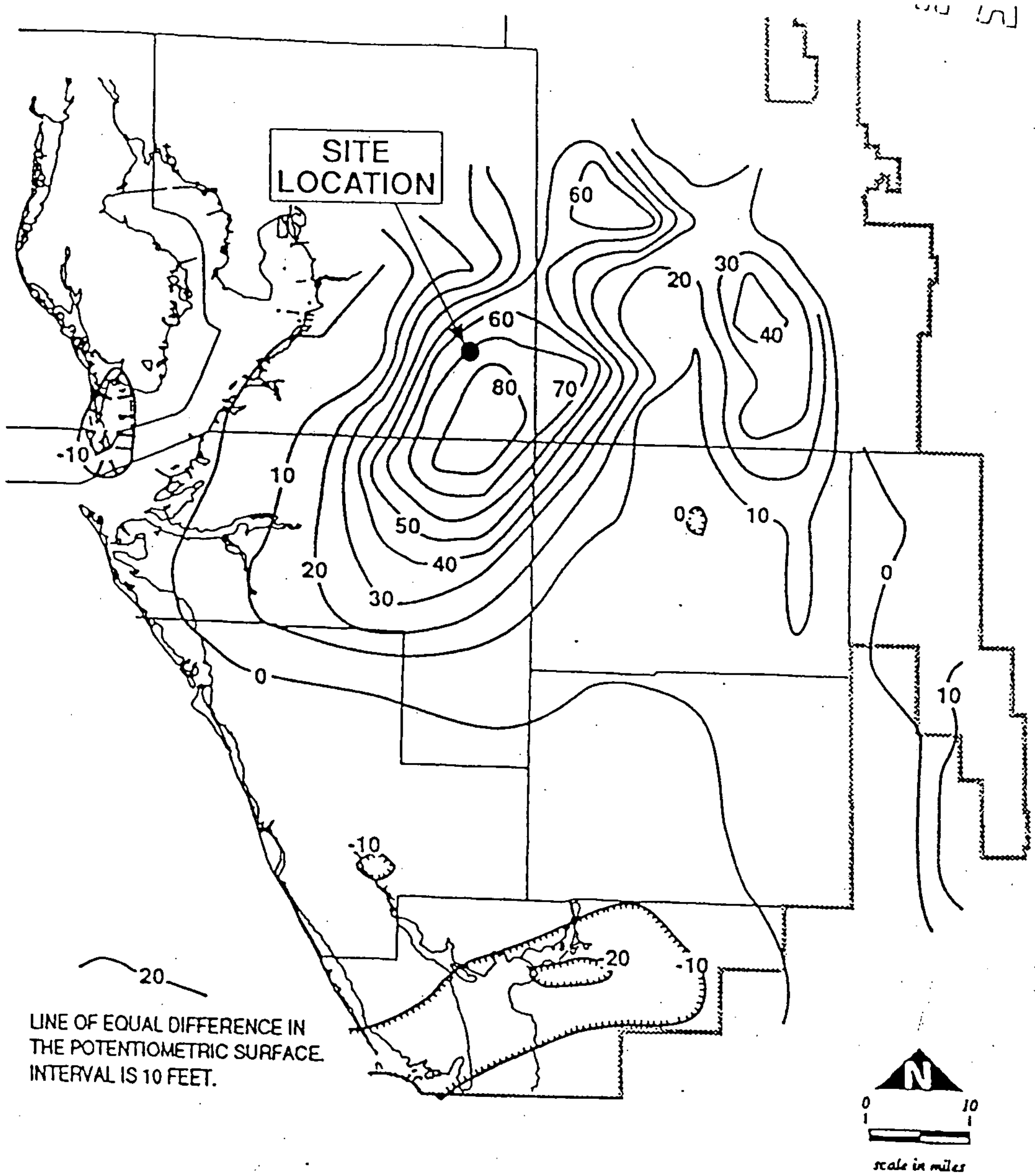
BFA Environmental Consultants

Barnes, Ferland and Associates, Inc.

POTENTIOMETRIC SURFACES OF THE INTERMEDIATE AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, SEPTEMBER 1996

By P.A. Metz, J.A. Mattie, and M. A. Corral

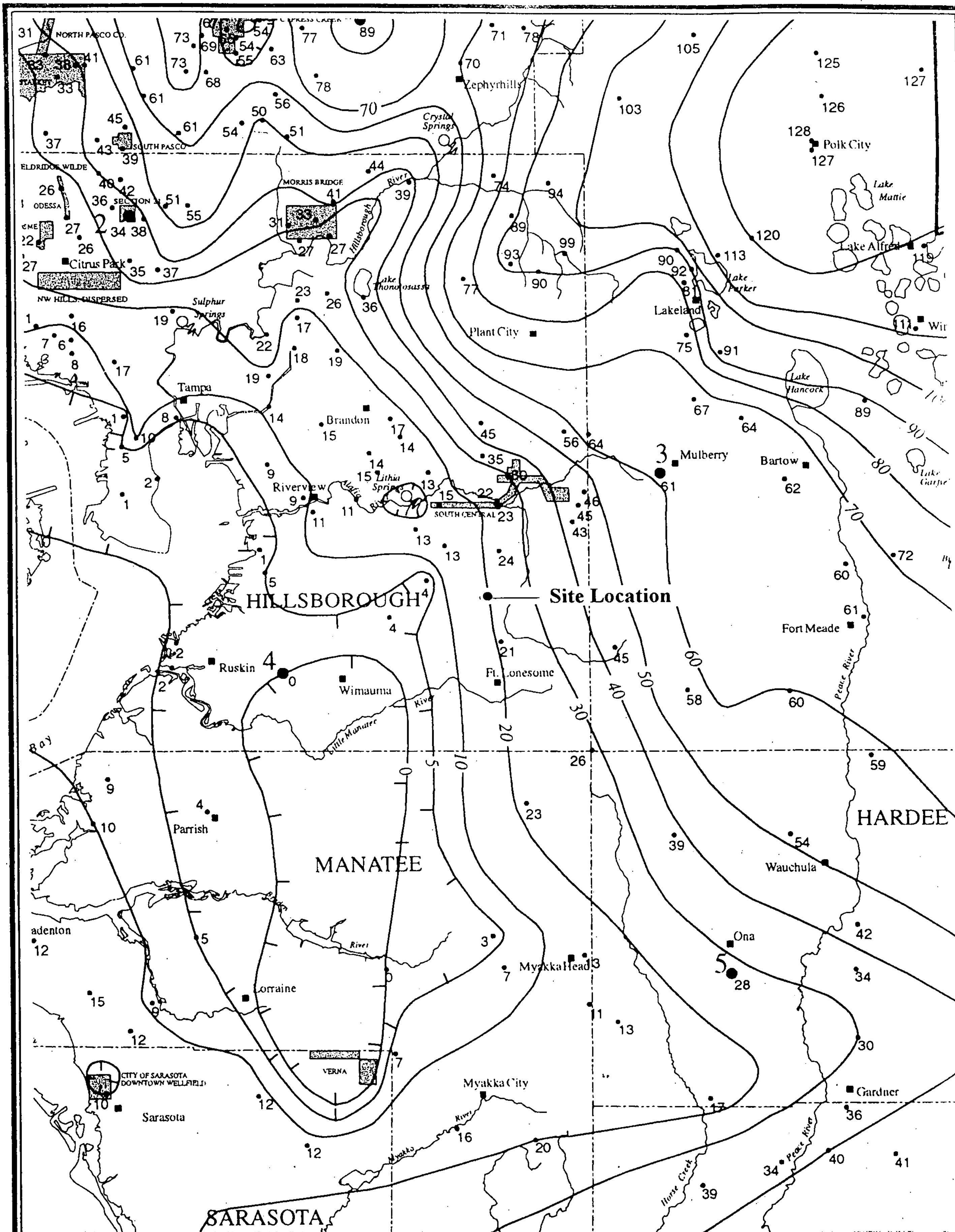
FIGURE 8



NOTE: NEGATIVE VALUES INDICATE A HIGHER POTENTIOMETRIC SURFACE IN THE UPPER FLORIDAN AQUIFER THAN THE INTERMEDIATE AQUIFER. CONTOURS ARE BASED UPON AN AVERAGE OF MAY AND SEPTEMBER USGS POTENTIOMETRIC SURFACE MAPS FOR EACH AQUIFER SYSTEM.

Modified from SWFWMD, 1993

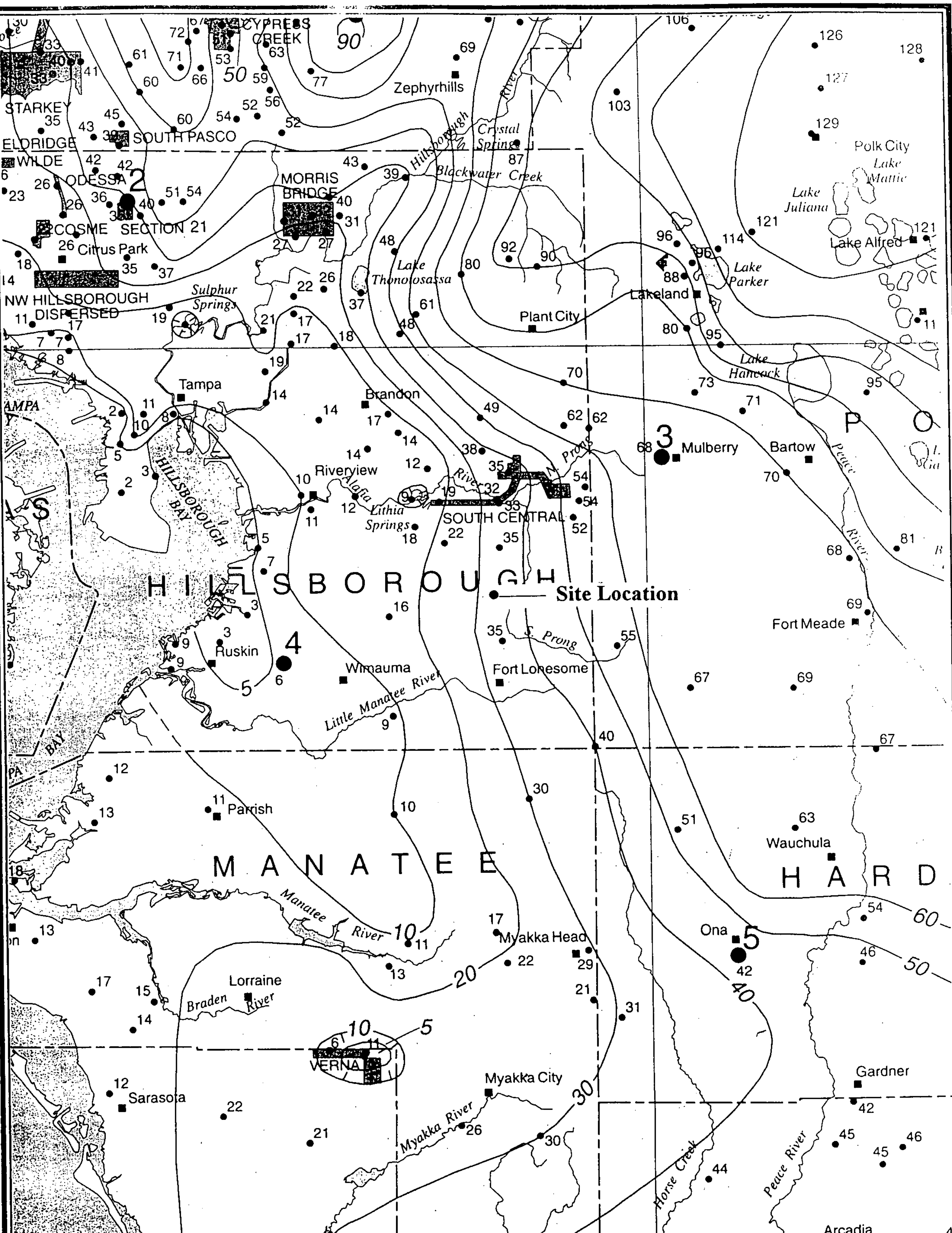
BFA Environmental Consultants Barnes, Ferland and Associates, Inc.	1989 Annual Average Head Difference Between the Intermediate and Upper Floridan Aquifers	FIGURE 9



BFA Environmental Consultants
Barnes, Ferland and Associates, Inc.

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER
WEST-CENTRAL FLORIDA, MAY 1996
By J.A. Mattie, P.A. Metz, and A.E. Torres

Figure 10

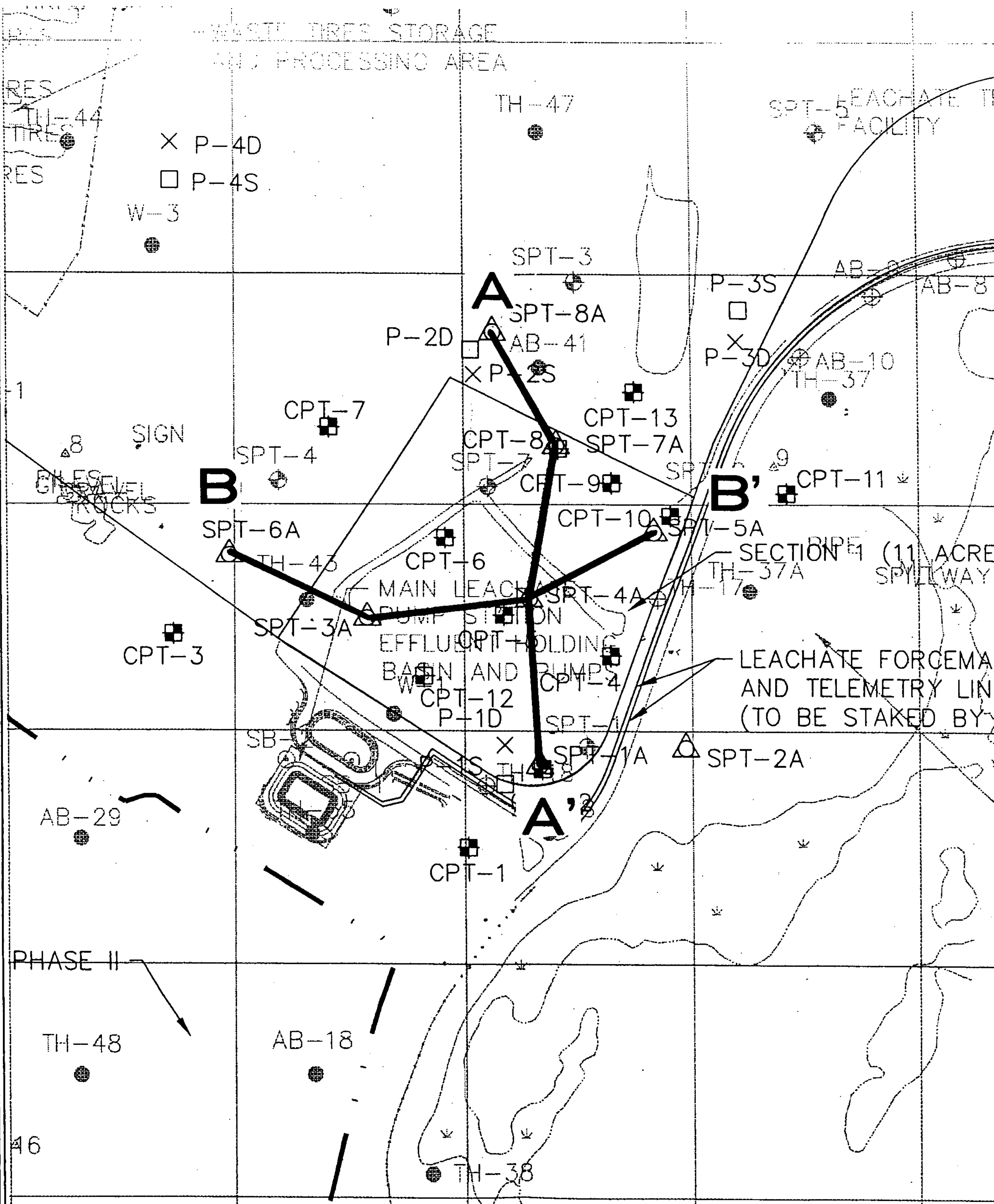


BFA Environmental Consultants
Barnes, Ferland and Associates, Inc.

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, SEPTEMBER 1996

By P.A. Metz, J.A. Mattie, and M.A. Corral

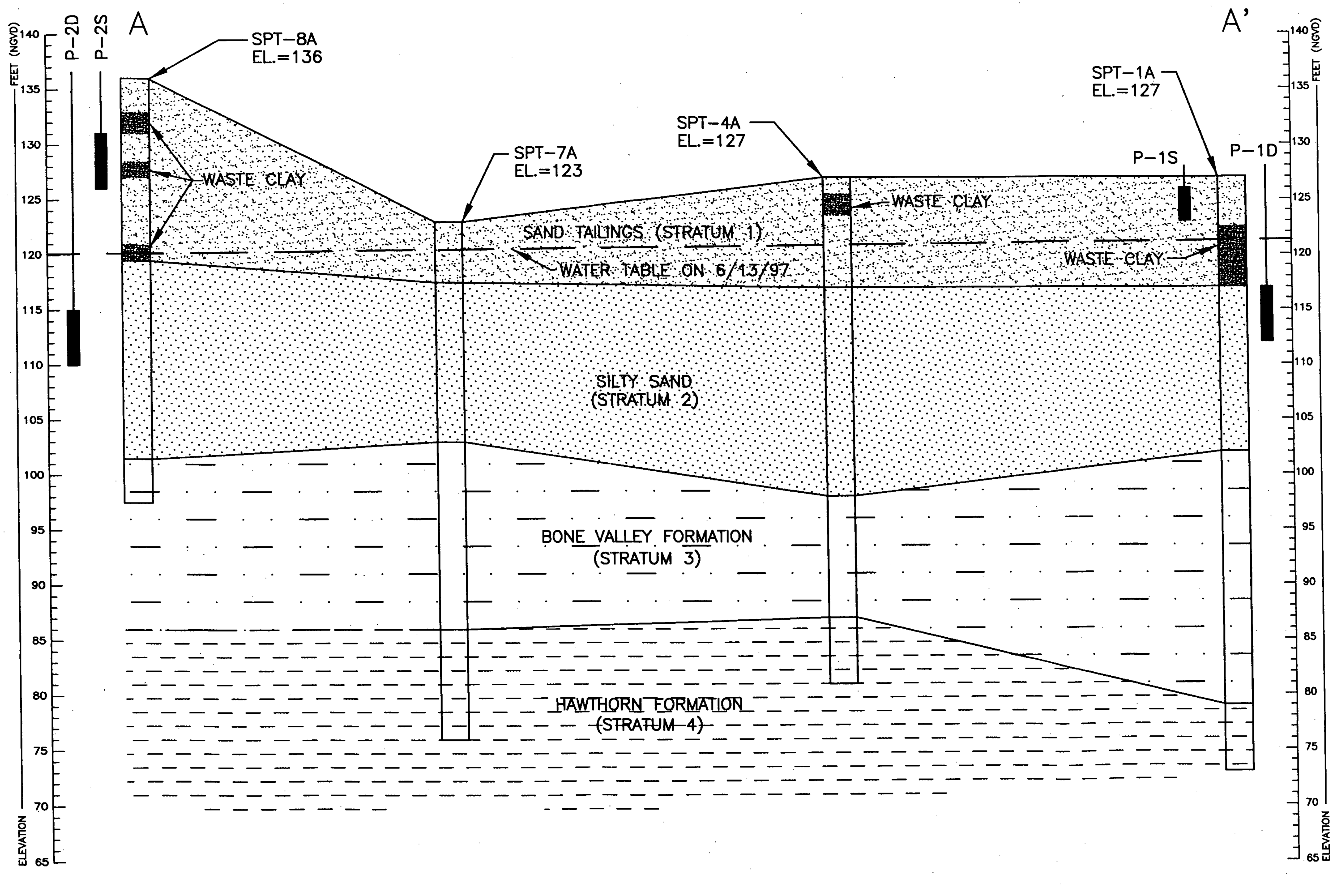
Figure 11



BFA Environmental Consultants
Barnes, Ferland and Associates, Inc.

LOCATION MAP OF
CROSS SECTIONS A-A' AND B-B'

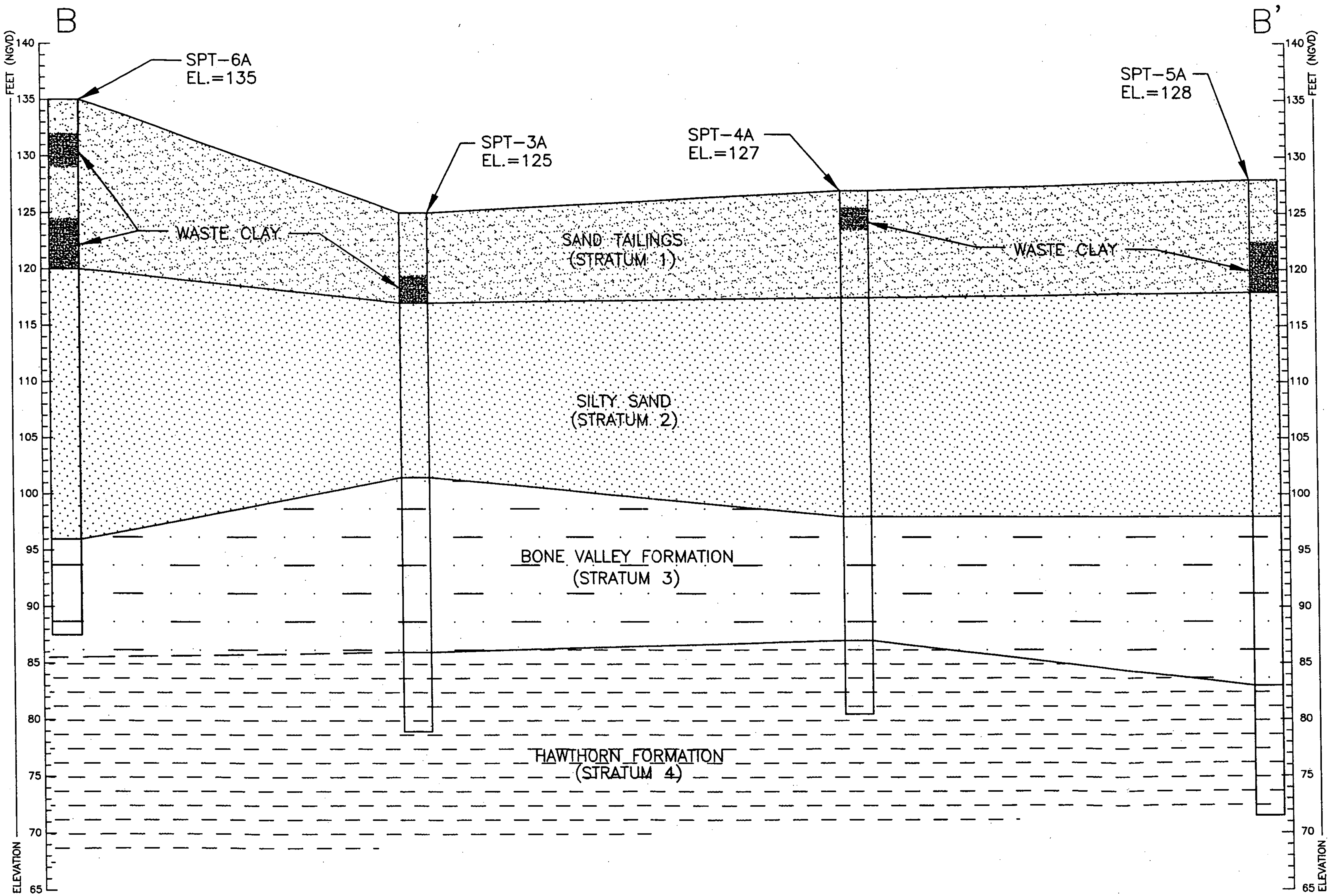
FIGURE
12



HOR. SCALE:1"=100'
VERT. SCALE:1"=10'

CAD FILE: SEC_A-A.DWG 07-01-1997 3:47 PM

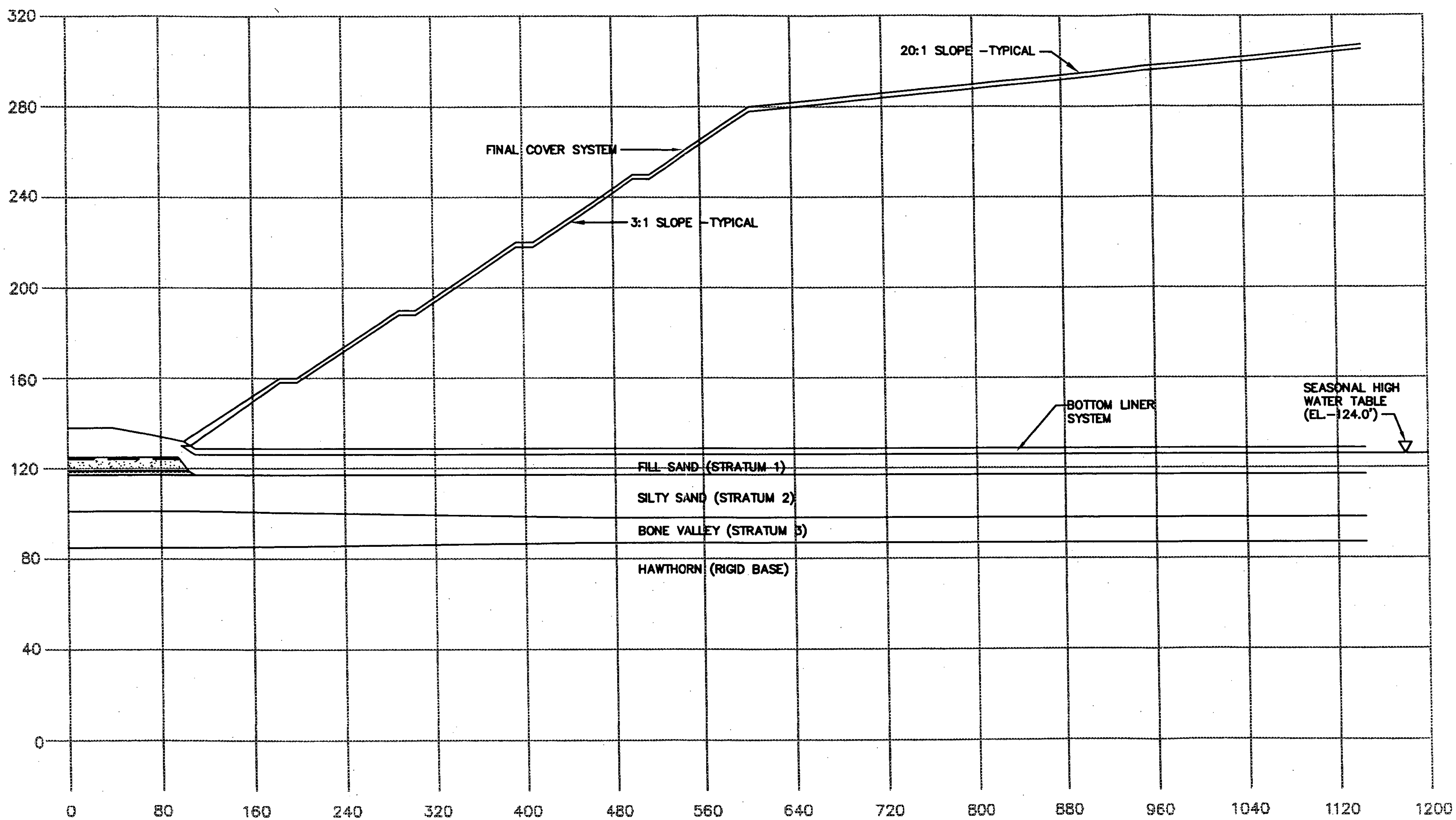
BFA Environmental Consultants Barnes, Ferland and Associates, Inc. 3655 MAGUIRE BOULEVARD SUITE 150, ORLANDO, FL 32803	HILLSBOROUGH CO. SOUTHEAST CO. FACILITY SECTION I DISPOSAL EXPANSION AREA CROSS SECTION A-A'	FIGURE 13



HOR. SCALE:1"=100'
VERT. SCALE:1"=10'

BFA Environmental Consultants Barnes, Ferland and Associates, Inc. 3655 MAGUIRE BOULEVARD SUITE 150, ORLANDO, FL 32803	HILLSBOROUGH CO. SOUTHEAST LANDFILL SECTION I DISPOSAL EXPANSION AREA CROSS SECTION B-B'	FIGURE 14

CAD FILE: SEC_B-B.DWG 07-01-1997 3:47 PM



LEGEND

– SAND TAILINGS

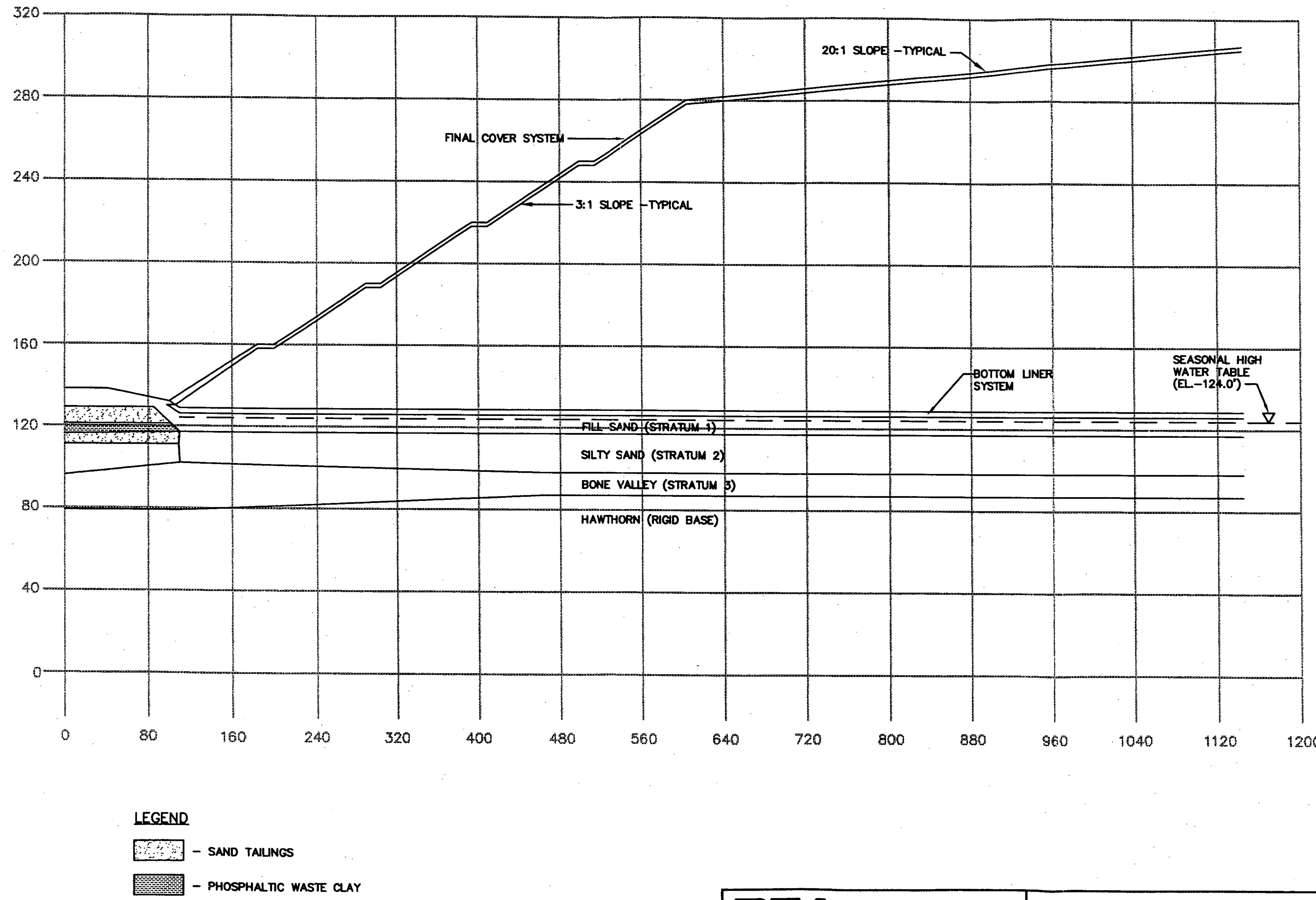
– PHOSPHALTIC WASTE CLAY

BFA Environmental Consultants
Barnes, Ferland and Associates, Inc.
3655 Maguire Blvd. Suite 150, Orlando, FL, 32803
PH: (407) 896-8608 FAX: (407) 896-1822

DESIGN SECTION FOR THE SOUTHWEST LANDFILL FACE

PROJECT NO.:	95–005
DATE:	7/31/97
SCALE:	N.T.S.

FIGURE 15



BFA Environmental Consultants
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DESIGN SECTION FOR THE SOUTHEAST LANDFILL FACE

PROJECT NO.: 95-005
DATE: 7/31/97
SCALE: N.T.S.

FIGURE 16

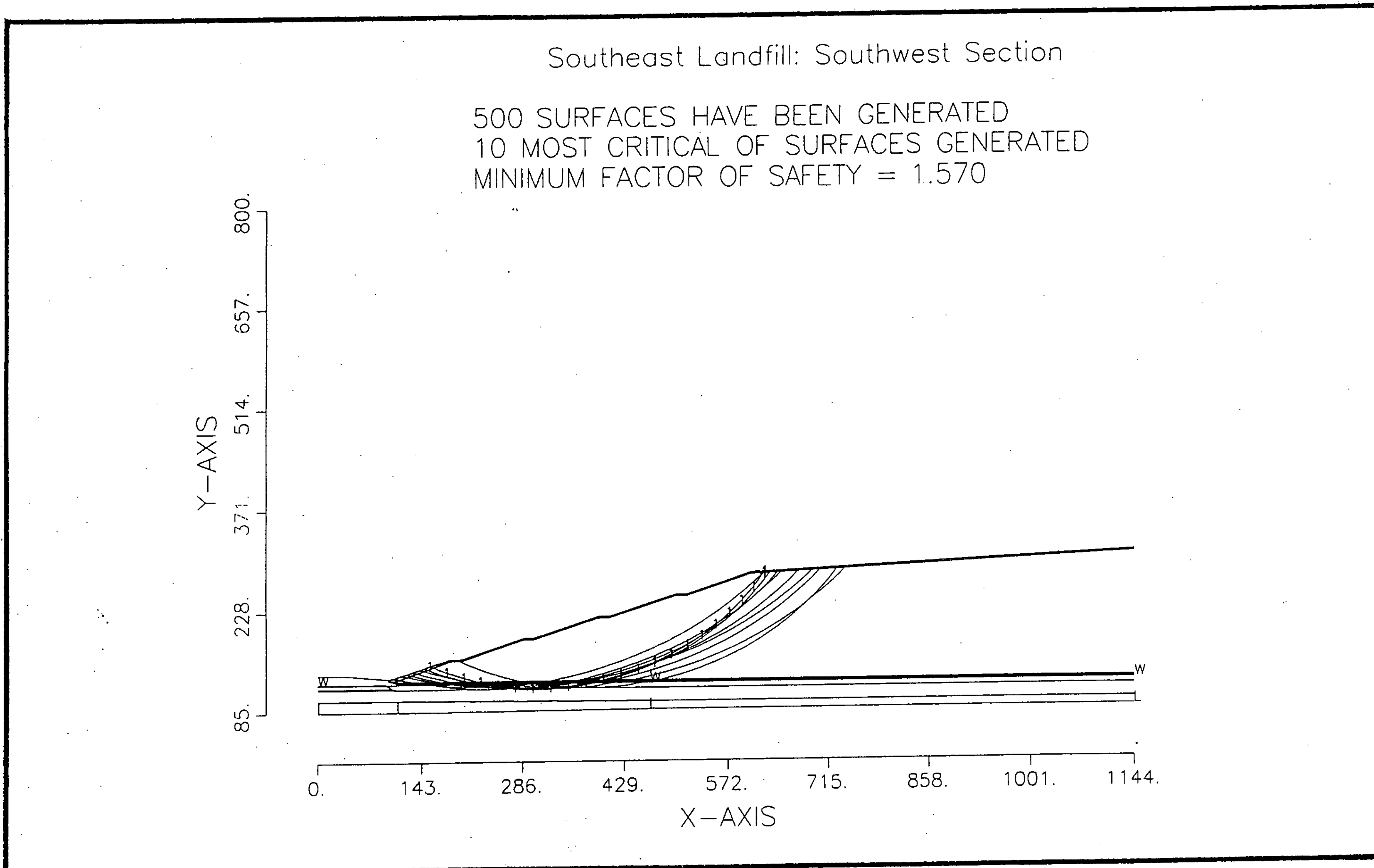


Figure 17A - Circular Arc Analysis with Phosphatic Waste Clay in Stratum I

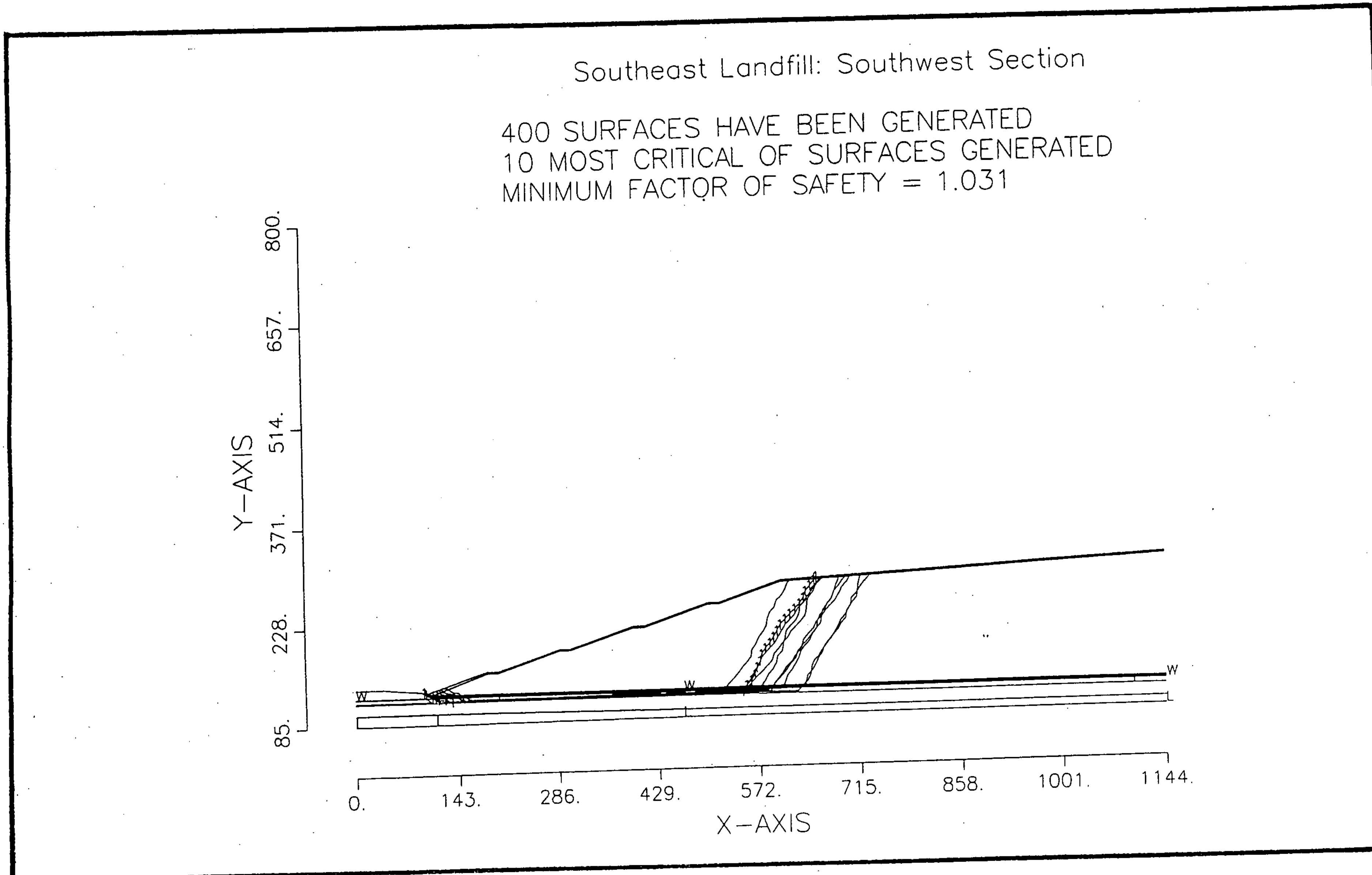


Figure 17B - Sliding Block Analysis with Phosphatic Waste Clay in Stratum I

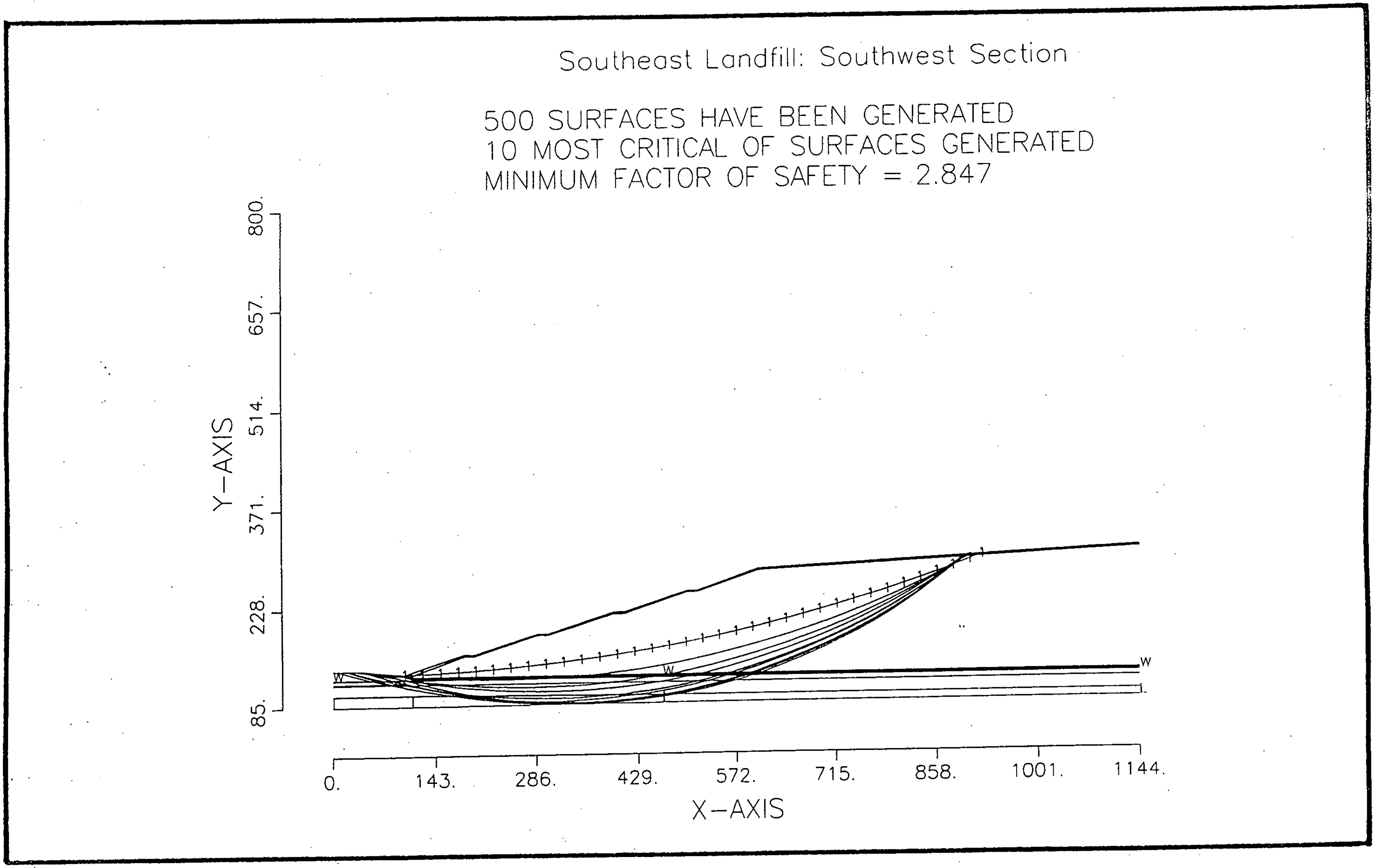


Figure 18A - Circular Arc Analysis with Replaced Fill Sand in Stratum I (Deep Failures)

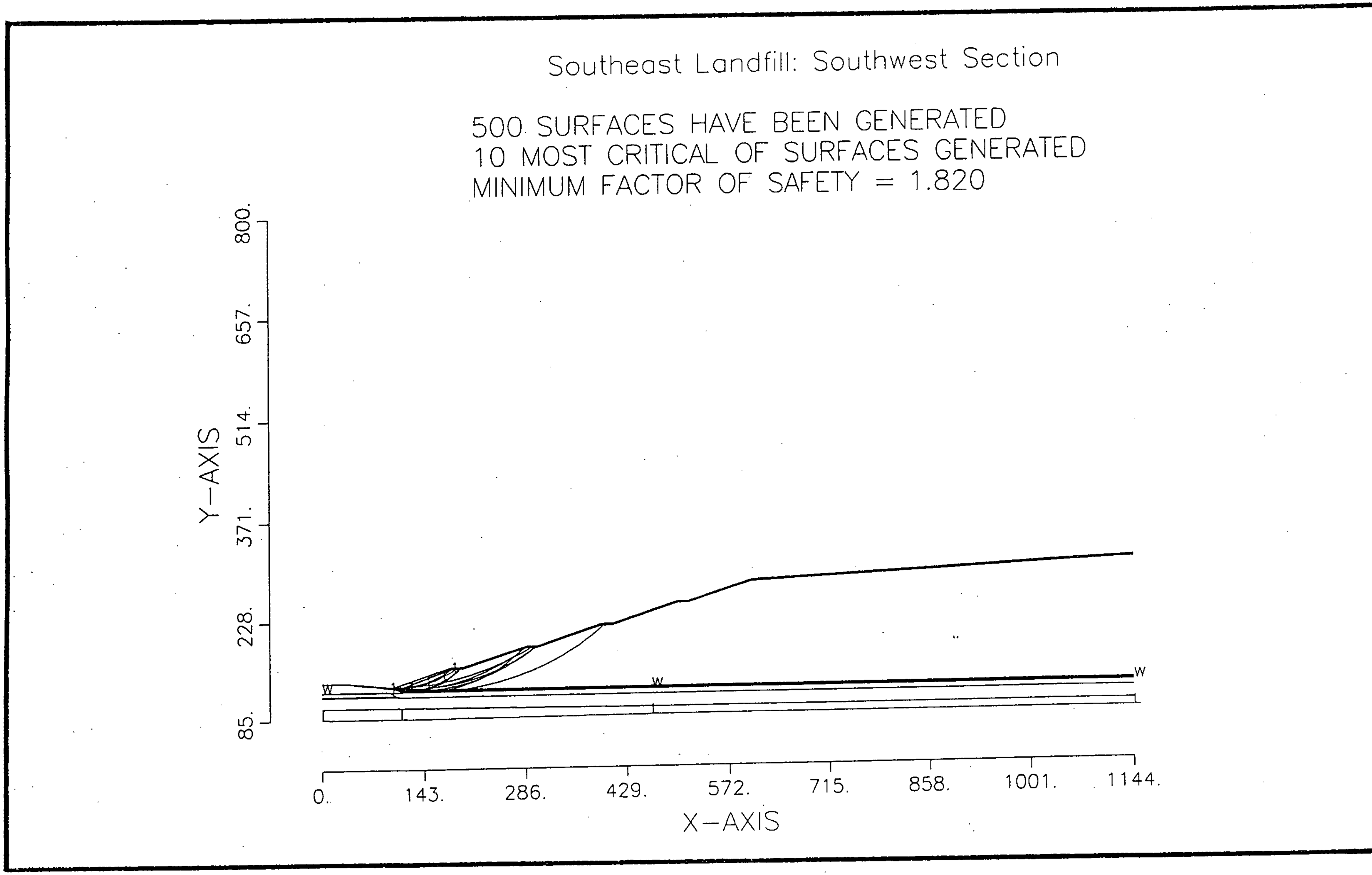


Figure 18B - Circular Arc Analysis with Replaced Fill Sand in Stratum I (Shallow Failures)

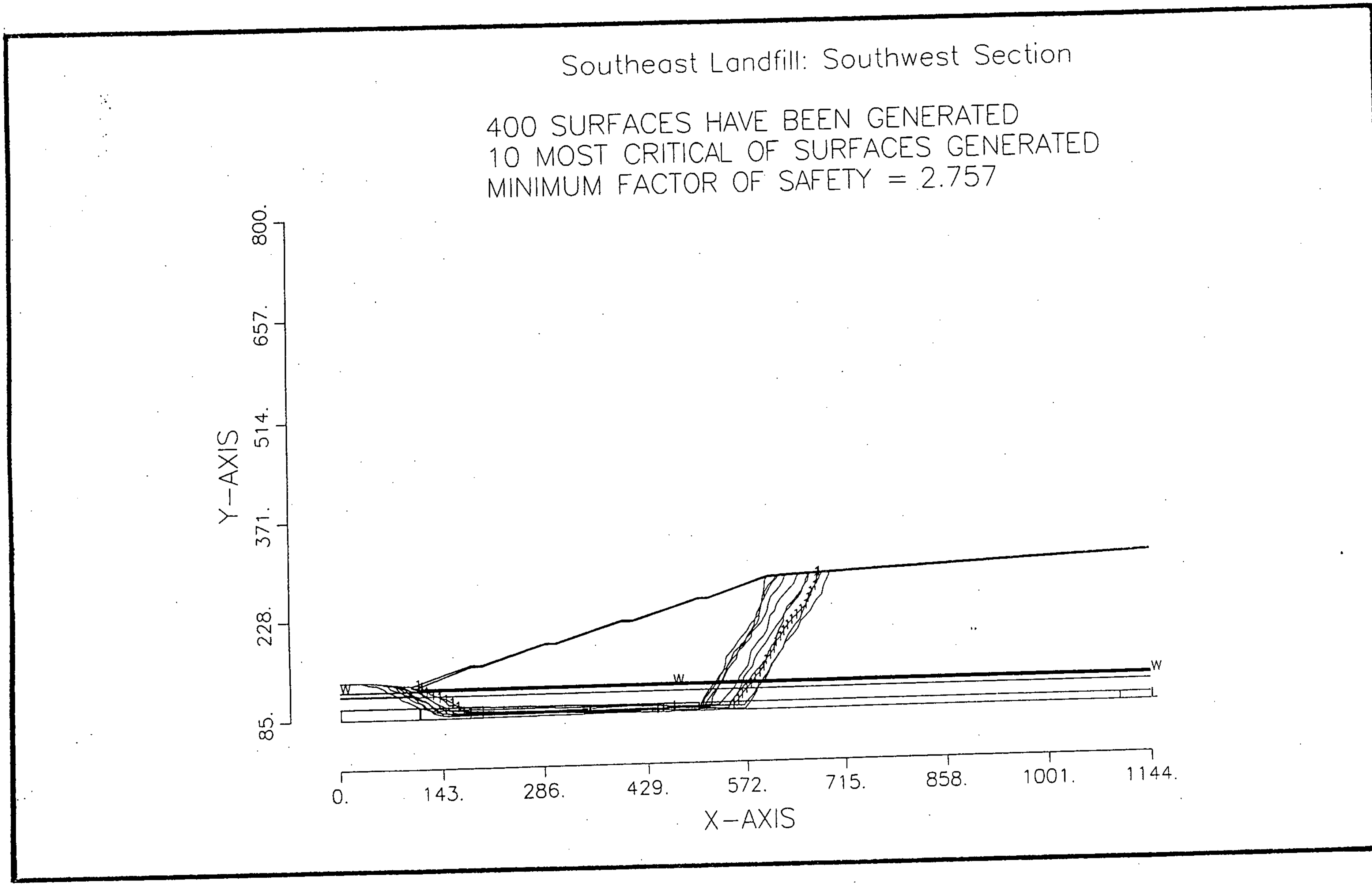


Figure 19A - Sliding Block Analysis with Replaced Fill Sand in Stratum I (Deep Failures)

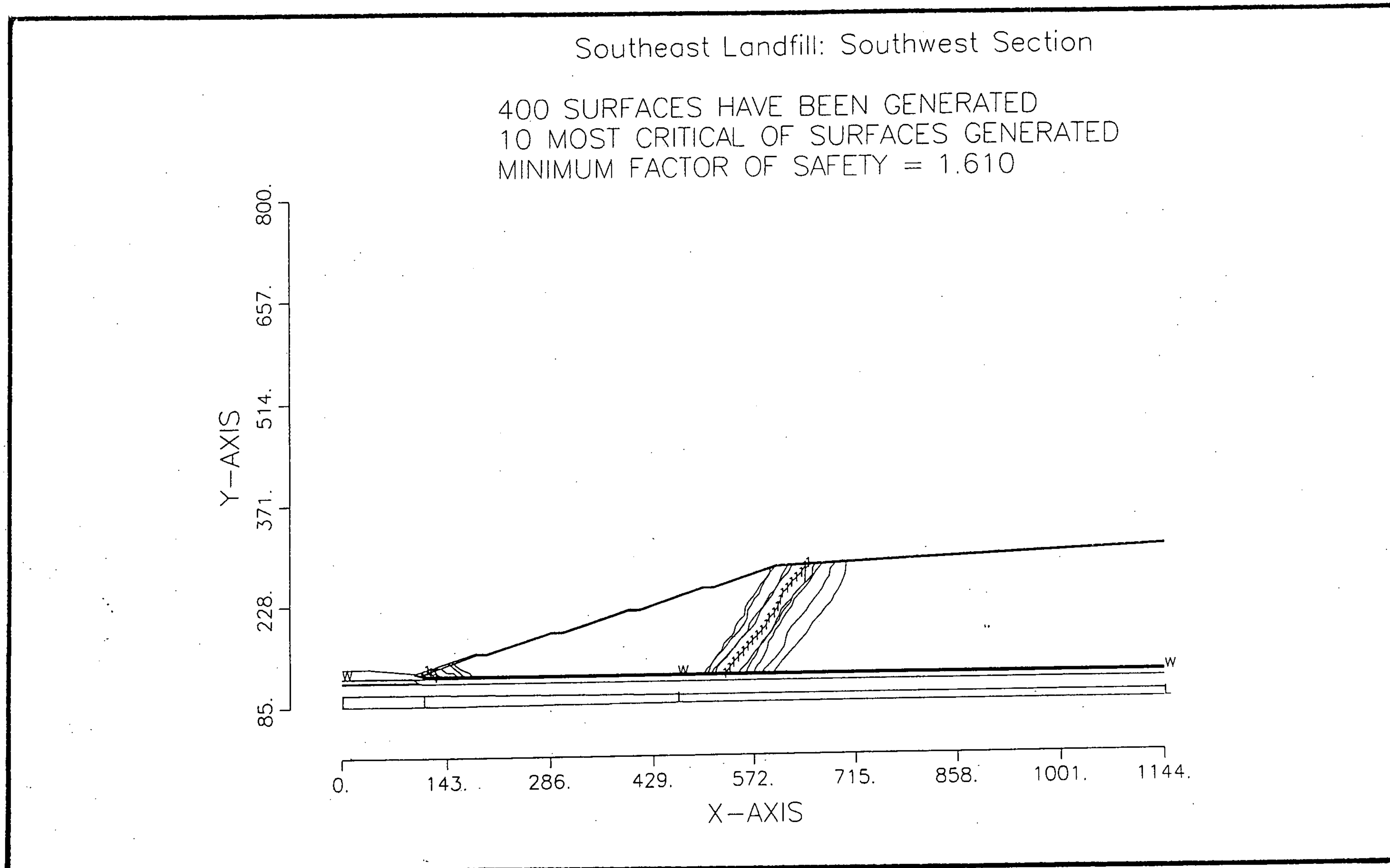


Figure 19B - Sliding Block Analysis with Replaced Fill Sand in Stratum I (Shallow Failures)

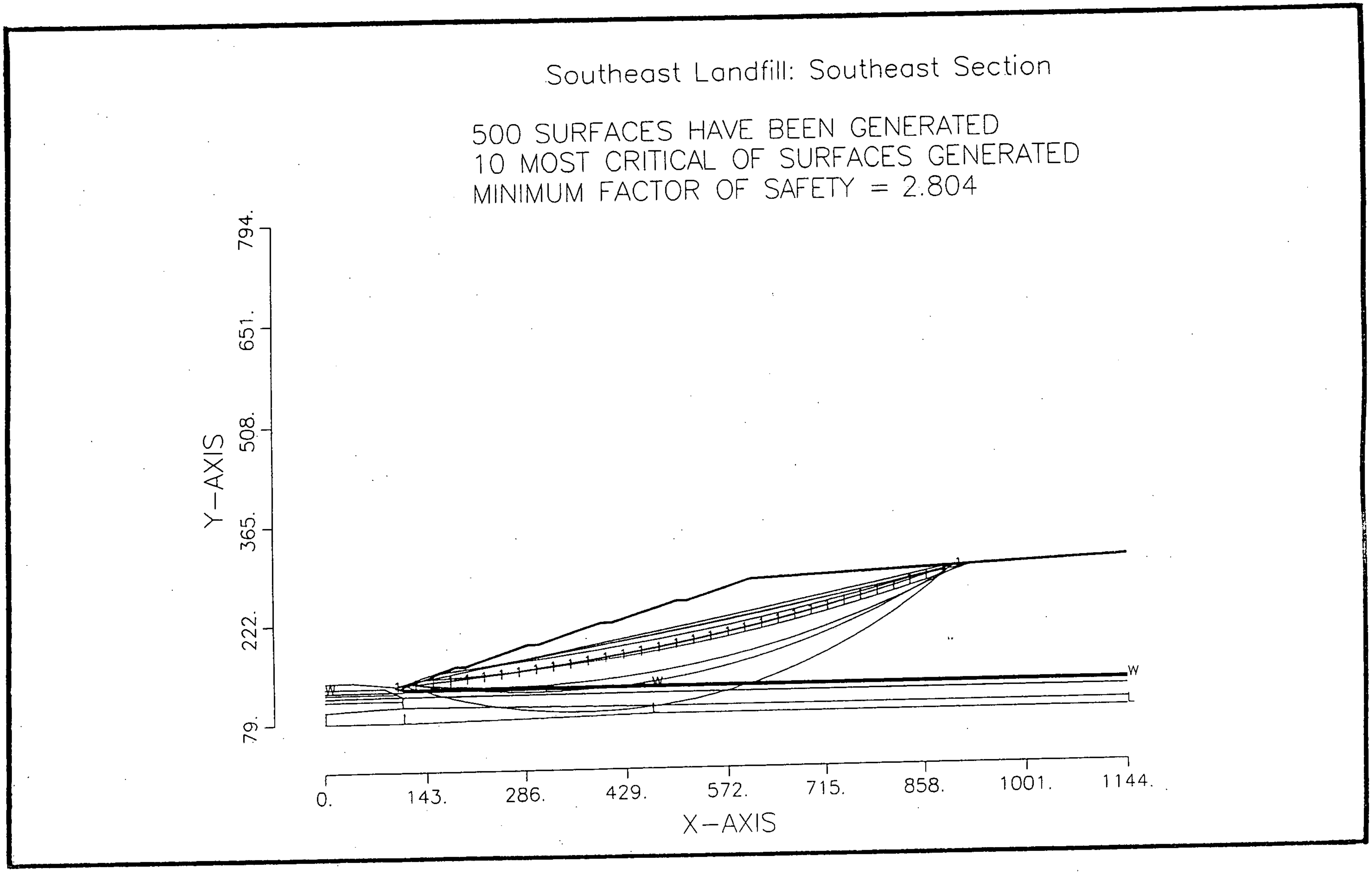


Figure 20A - Circular Arc Analysis with Replaced Fill Sand in Stratum I (Deep Failures)

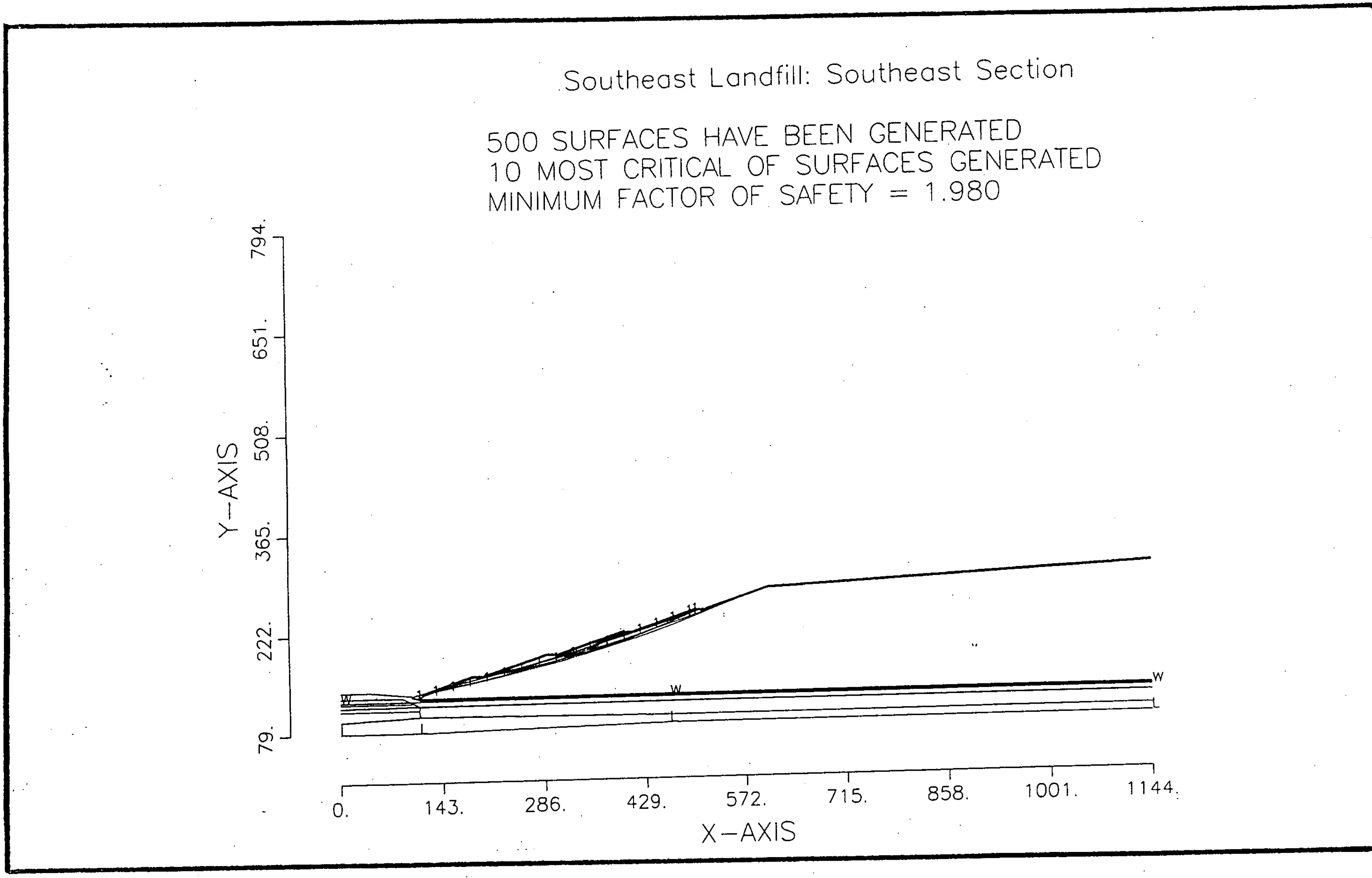


Figure 20B - Circular Arc Analysis with Replaced Fill Sand in Stratum I (Shallow Failures)

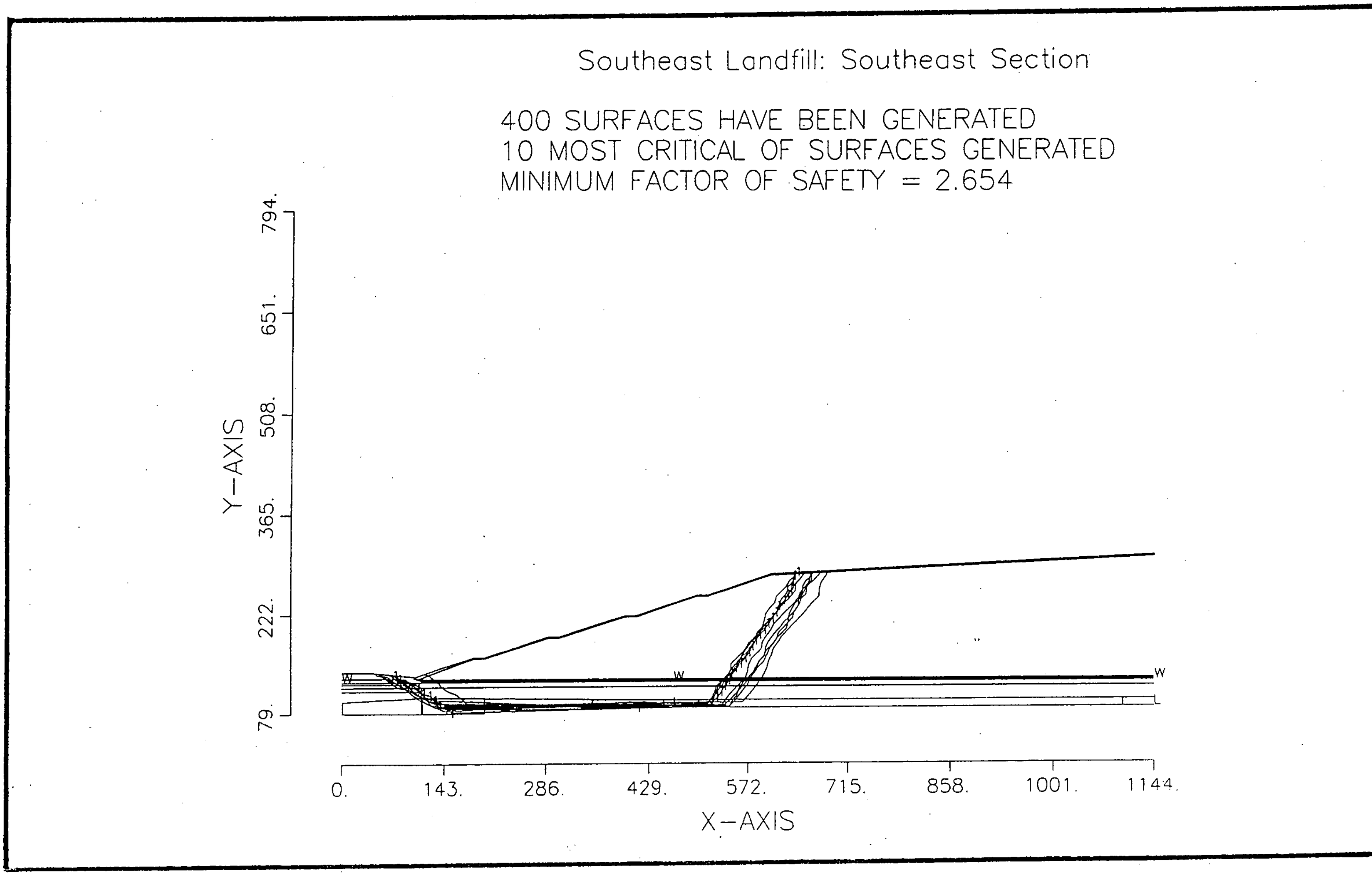


Figure 21A - Sliding Block Analysis with Replaced Fill Sand in Stratum I (Deep Failures)

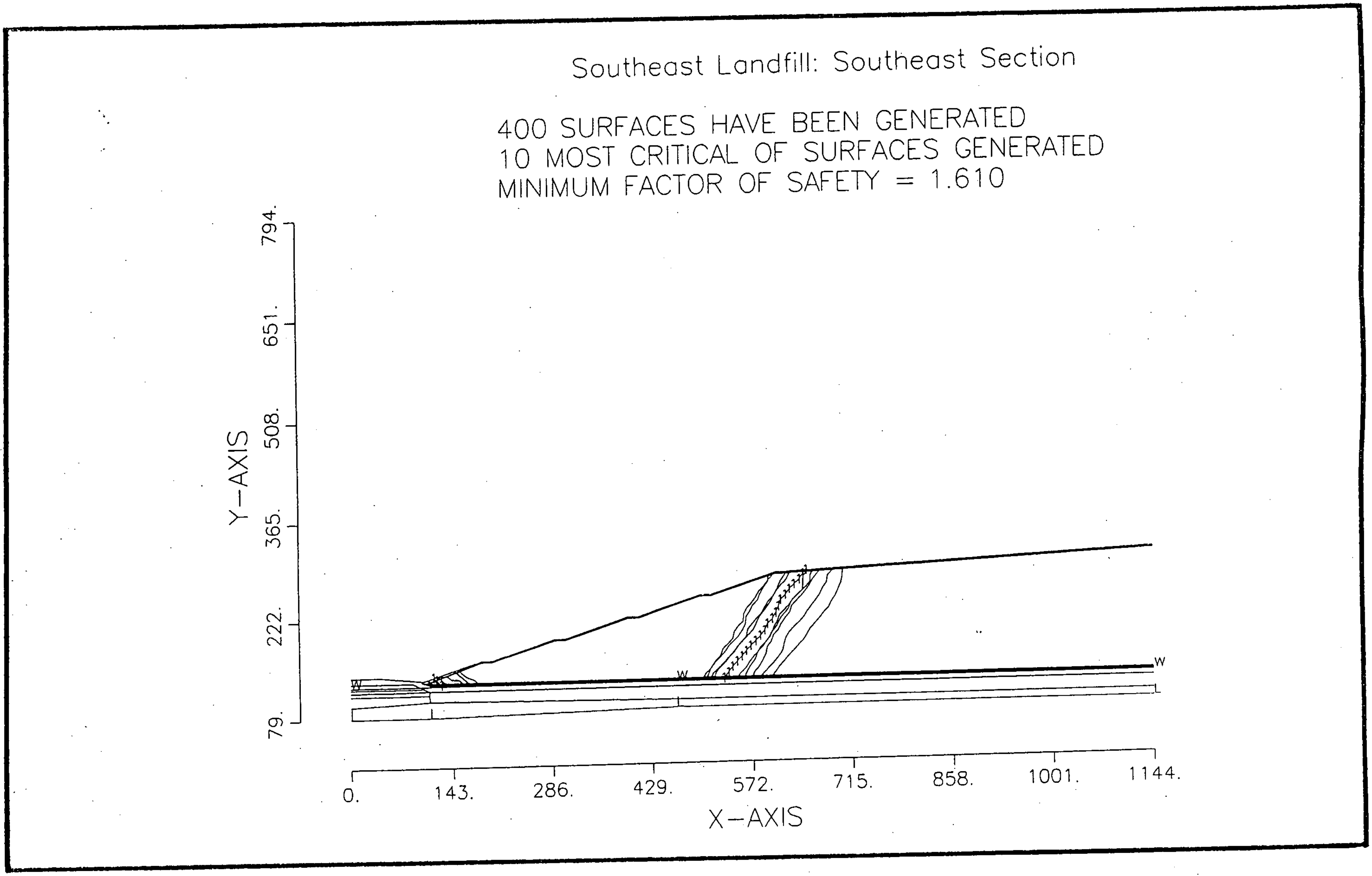


Figure 21B - Sliding Block Analysis with Replaced Fill Sand in Stratum I (Shallow Failures)

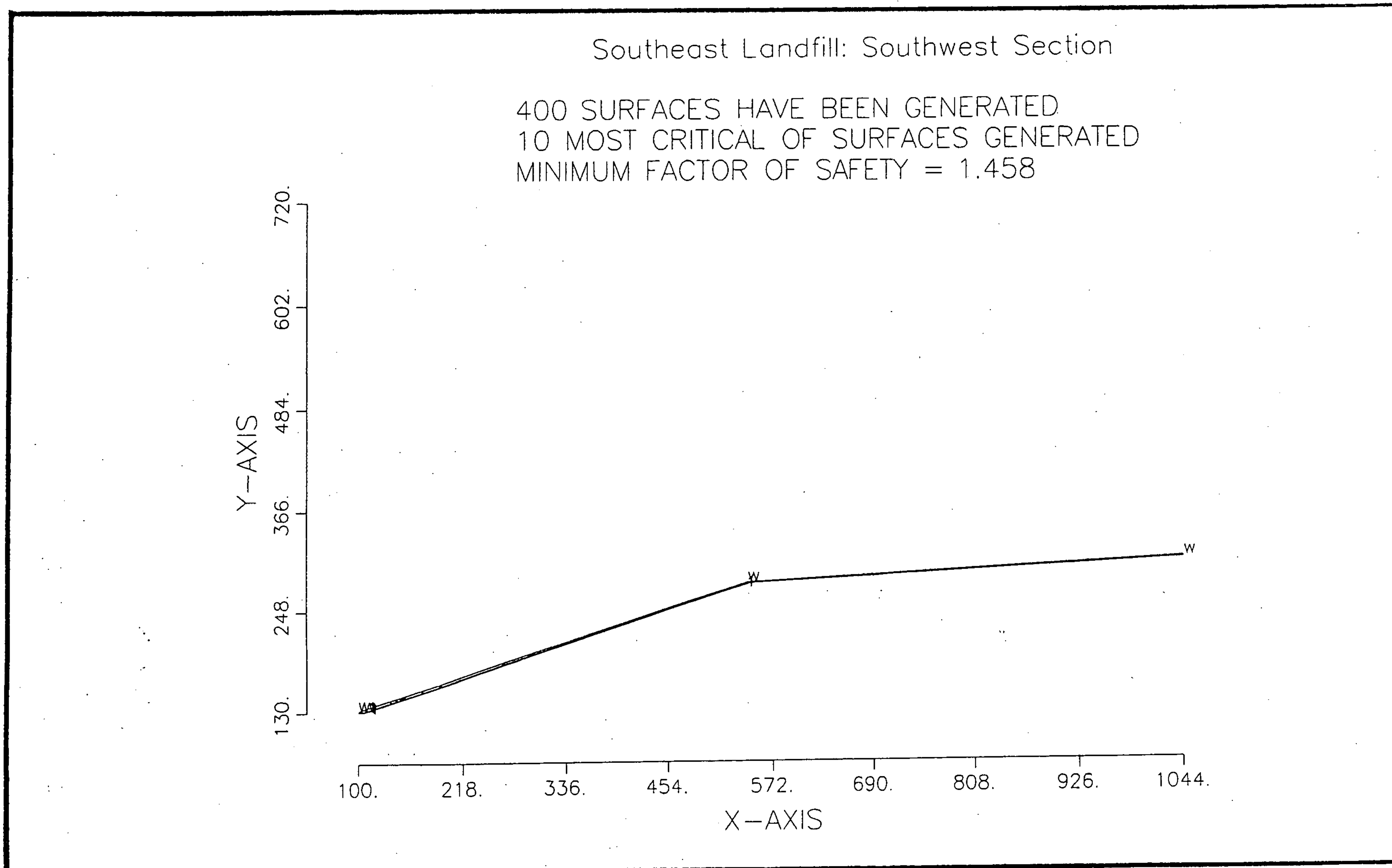


Figure 22 - Sability Analysis for Final Cover System

REPORT OF GEOTECHNICAL EXPLORATION

Section 1 Expansion
Southeast Landfill

For
Hillsborough County
Solid Waste Department

Ardaman & Associates, Inc.

OFFICES

Orlando, 8008 S. Orange Avenue, Orlando, Florida 32809, Phone (407) 855-3860
Bartow, 1525 Centennial Drive, Bartow, Florida 33831, Phone (813) 533-0858
Cocoa, 1300 N. Cocoa Blvd., Cocoa, Florida 32922, Phone (407) 632-2503
Fort Lauderdale, 3665 Park Central Boulevard, North, Pompano Beach, Florida 33064, Phone (305) 969-8788
Fort Myers, 9970 Bavaria Road, Fort Myers, Florida 33913, Phone (813) 768-6600
Miami, 2608 W. 84th Street, Hialeah, Florida 33016, Phone (305) 825-2683
Port Charlotte, 740 Tamiami Trail, Unit 3, Port Charlotte, Florida 33954, Phone (813) 624-3393
Port St. Lucie, 1017 S.E. Holbrook Ct., Port St. Lucie, Florida 34952, Phone (407) 337-1200
Sarasota, 2500 Bee Ridge Road, Sarasota, Florida 34239, Phone (813) 922-3526
Tallahassee, 3175 West Tharpe Street, Tallahassee, Florida 32303, Phone (904) 576-6131
Tampa, 1406 Tech Boulevard, Tampa, Florida 33619, Phone (813) 620-3389
West Palm Beach, 2511 Westgate Avenue, Suite 10, West Palm Beach, Florida 33409, Phone (407) 687-8200

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

June 25, 1997
File Number 97-9628

Hillsborough County
Solid Waste Department
P.O. Box 1110
Tampa, Florida 33601

Attention: Mr. John W. Johnson

Subject: Geotechnical Services, Proposed Section 1 Landfill Expansion, Hillsborough County Southeast Landfill, Picnic, Florida

Dear Mr. Johnson:

As authorized, Ardaman & Associates, Inc. has completed geotechnical services related to the proposed Section 1 Expansion of the Southeast Landfill, Hillsborough County, Florida

The scope of our services consisted of providing geotechnical field and laboratory support services for use by the project design consultants, SCS Engineers and BFA, Inc. More specifically, the services consisted of the following:

- Met with County representatives and consultant representatives to generally scope site access.
- Performed eight (8) Standard Penetration Test (SPT) borings at locations selected by BFA, Inc.
- Collected 19 "undisturbed" Shelby tube samples.
- Performed thirteen (13) Cone Penetration Test Soundings (CPT) with pore pressure dissipation at locations selected by BFA, Inc.
- Installed ten (10) shallow and deep piezometers at locations selected by BFA, Inc. to monitor groundwater fluctuations.
- Performed index and classification testing of soils as directed by BFA, Inc. consisting of natural moisture content, grain size distribution, percent finer than -200 Sieve, Atterberg limits, organic content, and cation exchange.
- Performed strength testing of selected 'undisturbed' samples as directed by BFA, Inc. which

1406 Tech Boulevard, Tampa, Florida 33619 Phone (813) 620-3389 FAX (813) 628-4006

included seven (7) consolidated, undrained triaxial compression tests and three (3) unconfined compression tests.

- Performed four (4) permeability tests on "undisturbed" samples as directed by BFA, Inc.

SITE LOCATION AND DESCRIPTION

The site is located in an unfilled portion of the landfill. A general site location is presented in Figure 1. The site elevations vary from about +125 ft. NGVD to +145 ft. NGVD.

FIELD EXPLORATION AND FINDINGS

Standard Penetration Test Borings (SPT)

A total of eight (8) SPT borings were advanced at the locations noted on Figure 1. The boring locations and depths were selected by BFA, Inc. field personnel. Boring depths varied from 37 feet to 58.8 feet below existing grade. The soils encountered in the borings are depicted on the Boring Profiles, Figures 2 and 3. The borings generally found 5 to 30 feet of fill materials consisting of sands, tailing sands, and waste phosphatic clays above native sands and clayey sands. The fill soils were generally very loose to loose. The underlying native granular soils were very loose to near refusal, however, the density of these materials did not increase linearly with depth but was somewhat random due to intermittent cementation.

We refer the reader to the boring profiles (Figures 2 and 3) for specific descriptions and blow count information as well as groundwater level readings at each boring location. Soil stratigraphy at locations other than these eight (8) borings would be expected to differ from that disclosed by the borings.

Cone Penetration Test Soundings

A total of thirteen (13) Cone Penetration Test Soundings (CPT) were performed at locations directed by BFA, Inc. The depths of the CPT borings varied from 13 feet to 31 feet below present site grades. The CPT results are presented in Figures 4 and 16. During the CPT testing, pore pressure distribution readings were obtained through the use of a piezocone tip in place of the standard cone tip. The piezocone monitors pore pressure dissipation by transducer. In this way, the piezometric water level in the soil stratum can be estimated. The data can be used to gain insight into the state of consolidation of fine-grained deposits, permeability characteristics of a soil stratum and presence of water-bearing zones within the subsurface. The pore pressure dissipation results are presented in Figures 17 through 42.

Piezometer Installation

A total of ten (10) piezometers were installed at locations and to depths selected by BFA, Inc. The depths of piezometers varied from 4 feet to 45 feet below land surface. The piezometers are constructed of 2 inch diameter PVC pipe with protective casings. The piezometer well installation records and completion reports are presented in Appendix D.

LABORATORY TESTING

Laboratory testing requested was related to index and classification tests on SPT jar samples as well as strength and permeability testing of 'undisturbed' Shelby tube samples. The index and classification tests were performed in our Tampa laboratory while the undisturbed samples were tested in our Orlando Corporate laboratory. The index and classification test results are summarized in Table 1, Appendix E. The laboratory testing performed on 'undisturbed' samples was reported directly to the project geotechnical consultant, Remedial Engineering and Science, Inc. It is reproduced herein and presented in Appendix F.

CLOSURE

The information presented herein is for the exclusive use of Hillsborough County Solid Waste Department and their project consultants for the design and permitting of the proposed expansion of Section 1, Hillsborough County Southeast Landfill. The field and laboratory data presented is only applicable to the locations where the data was obtained. Any interpretation of soil stratigraphy or properties between SPT or CPT is at the discretion of the County and their consultants. Ardaman & Associates, Inc. is not responsible for such interpretations.

The recovered soil samples will be retained for a period of 90 days following completion of this report and then discarded unless otherwise directed by Hillsborough County Solid Waste Department.

It has been a pleasure assisting you with this phase of your project. If there are any questions or when we may be of further assistance, please contact the undersigned at (813) 620-3389.

Respectfully,
ARDAMAN & ASSOCIATES, INC.

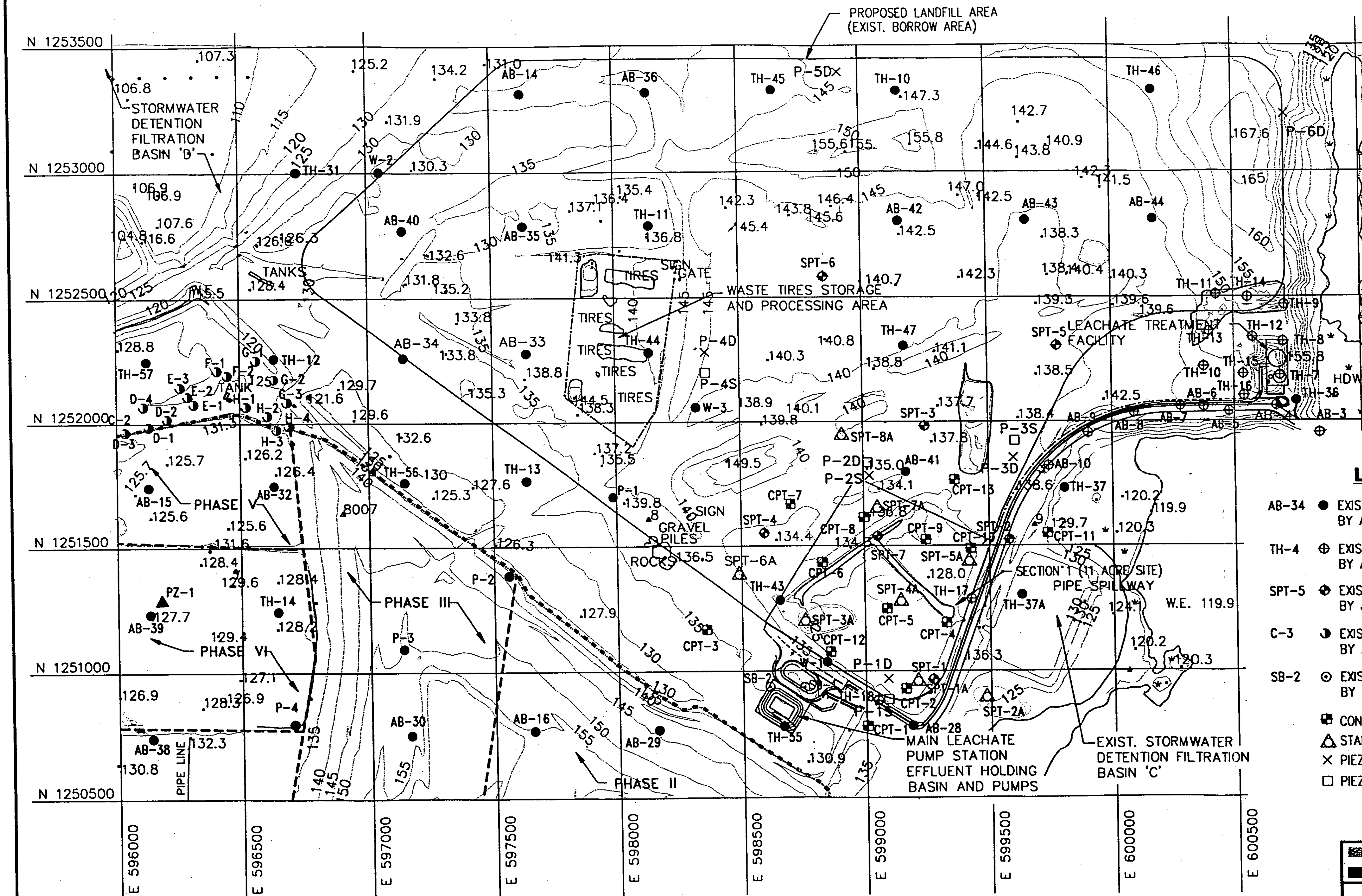
Wayne Pandorf, P.E.
Branch Manager
Florida Registration No. 30254

Thomas J. Leto, P.E.
Principal
Florida Registration No. 12458

TJL/WP:lt
Enclosure
sse#5\97-9628\report.wpd

FIGURES

Appendix A
Geotechnical Explorations
And Laboratory Testing Results



LEGEND

AB-34	●	EXISTING SOIL BORING LOCATION BY ARDAMAN & ASSOC. (1983)
TH-4	⊕	EXISTING SOIL BORING LOCATION BY ARDAMAN & ASSOC. (1990)
SPT-5	⊕	EXISTING SOIL BORING LOCATION BY JAMMAL & ASSOC. (1990)
C-3	◑	EXISTING SOIL BORING LOCATION BY ARDAMAN & ASSOC. (1991)
SB-2	⊙	EXISTING SOIL BORING LOCATION BY ATLANTIC & ASSOC. (1991)
	⊞	CONE PENETRATION TEST (CPT)
	△	STANDARD PENETRATION TEST (SPT)
	×	PIEZOMETER-SURFICIAL AQUIFER
	□	PIEZOMETER-PERCHED WATER TABLE

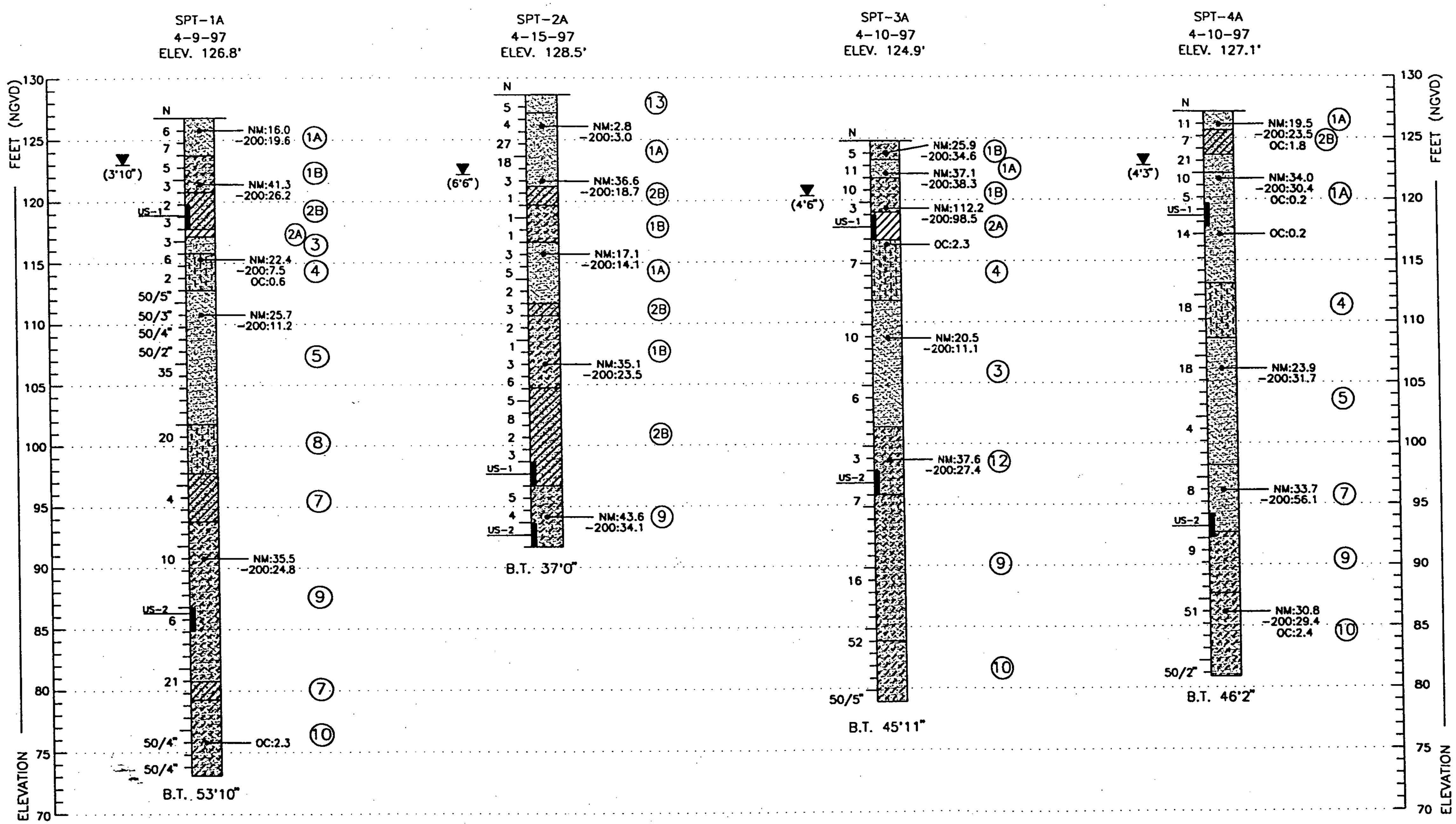
FIGURE 1

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

BORING LOCATION PLAN
SECTION 1 EXPANSION
SOUTHEAST LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: WAC	CHECKED BY:	DATE: 5-97
FILE NO. 97-9628	APPROVED BY:	

97-9628\FC-1



LEGEND

- (1A) GRAYISH BROWN SAND WITH SILT TO SILTY SAND WITH CLAY (SP-SM TO SM-SC) TAILING SAND
- (1B) GRAYISH BROWN CLAYEY SAND (SC) TAILING SAND AND PHOSPHATIC WASTE CLAY MIX
- (2A) GREENISH GRAY PHOSPHATIC WASTE CLAY (CH)
- (2B) GREENISH GRAY SANDY PHOSPHATIC WASTE CLAY (CH-CL) PHOSPHATIC WASTE CLAY AND TAILING SAND MIX
- (3) BROWNISH GRAY SAND WITH SILT (SP-SM)
- (4) DARK BROWN SILTY SAND (SM) HARD PAN
- (5) LIGHT BROWN SAND WITH SILT TO SILTY SAND OCCASIONALLY CEMENTED (SP-SM TO SM)
- (6) GRAY SAND WITH CEMENTED SAND PARTICLES (SP)
- (7) GRAY SANDY CLAY WITH PHOSPHATE (CH)
- (8) LIGHT GRAY SILTY SAND WITH CLAY (SM-SC)
- (9) GRAY CLAYEY SAND WITH PHOSPHATE (SC)
- (10) LIGHT BROWN CLAYEY SAND WITH SILT AND PHOSPHATE, CEMENTED (SC)
- (11) GRAY BROWN AND ORANGISH BROWN MOTTLED CLAYEY SAND WITH PHOSPHATE (SC) FILL
- (12) GRAY CLAYEY SAND (SC)
- (13) LIGHT BROWN SAND WITH SILT (SP-SM) FILL

SPT	STANDARD PENETRATION TEST (SPT) BORING LOCATION
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FT
50/3"	50 BLOWS FOR 3-INCH PENETRATION INTO SOIL
WOR	WEIGHT OF ROD
▼ (DEPTH)	GROUNDWATER LEVEL MEASURED ON DATE DRILLED
N.M.	NATURAL MOISTURE CONTENT
-200	PERCENT PASSING NO.200 SIEVE SIZE (PERCENT FINES)
LL	LIQUID LIMIT
PI	PLASTICITY INDEX
OC	ORGANIC CONTENT
US-1	UNDISTURBED SAMPLE OBTAINED WITH A 3-INCH DIA. SHELBY TUBE
B.T.	BORING TERMINATION DEPTH
SP,SP-SM SM,SC,CH	UNIFIED SOIL CLASSIFICATION SYSTEM

STANDARD PENETRATION TEST DATA:
SPOON I.D.= 1.375" HAMMER DROP= 30"
SPOON O.D.= 2.0" HAMMER WEIGHT= 140 lbs.

DRILL RIG: CME #55 DRILLER: E. PARKER

FIGURE 2

GENERAL NOTES

UPON COMPLETION OF EACH BORING, THE BOREHOLE WAS GROUTED WITH CEMENT-BENTONITE SLURRY

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTICS OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES AT THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER SURFACE DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THESE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS IN THE FUTURE.

ENGINEERING CLASSIFICATION

COHESIONLESS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.	BLOW COUNT "N"
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

BORING PROFILES
SECTION 1 EXPANSION
SOUTHEAST LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

DRAWN BY: WAC	CHECKED BY:	DATE: 5-97
FILE NO. 97-9628	APPROVED BY:	

97-9628\FIG-2

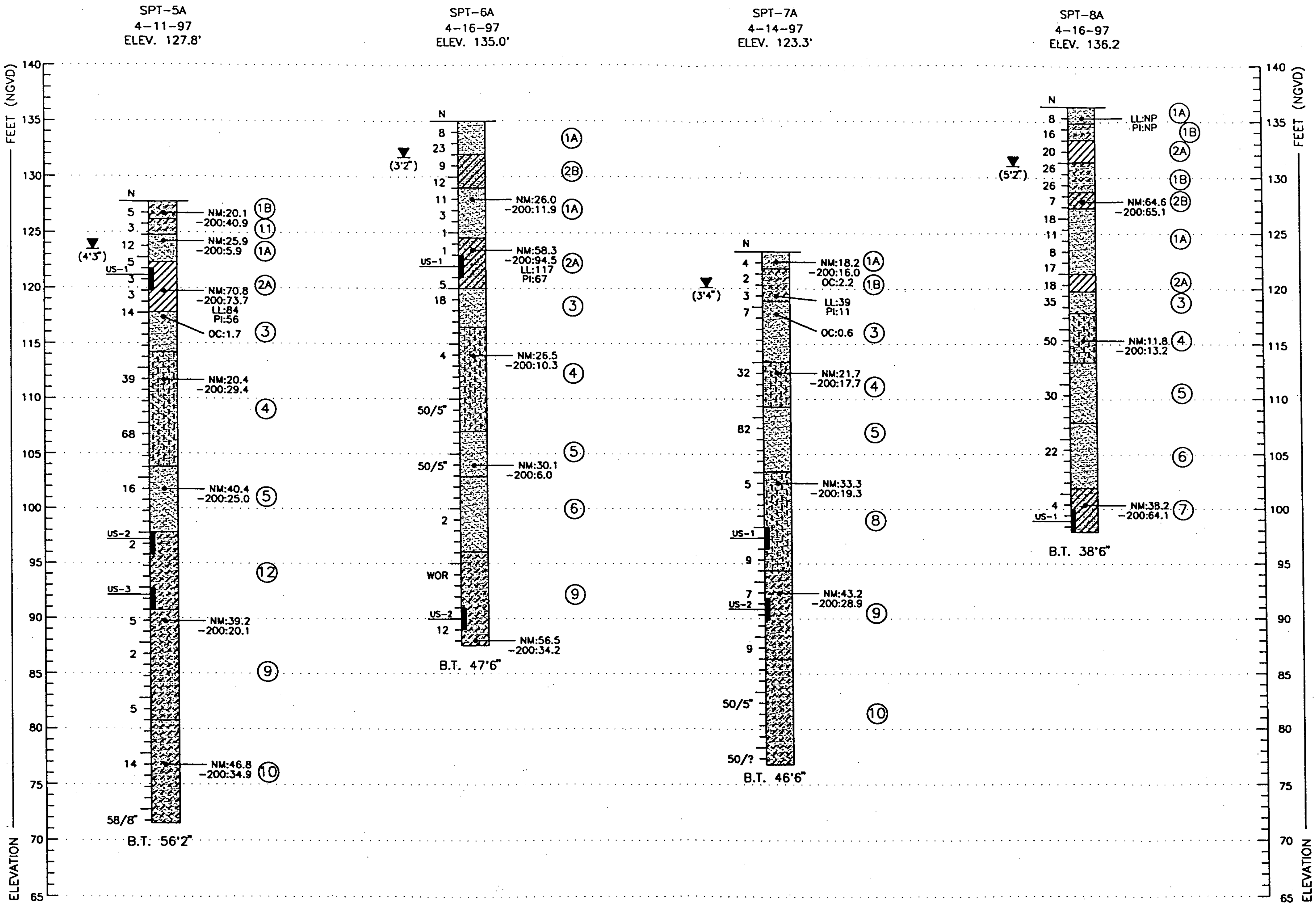


FIGURE 3

GENERAL NOTES

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTICS OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES AT THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER SURFACE DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THESE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS IN THE FUTURE.

ENGINEERING CLASSIFICATION

COHESIONLESS		COHESIVE		
DESCRIPTION	BLOW COUNT "N"	DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.	BLOW COUNT "N"
VERY LOOSE	0 TO 4	VERY SOFT	BELOW .25	0 TO 2
LOOSE	4 TO 10	SOFT	.25 TO .50	2 TO 4
MEDIUM DENSE	10 TO 30	MEDIUM STIFF	.50 TO 1.0	4 TO 8
DENSE	30 TO 50	STIFF	1 TO 2	8 TO 15
VERY DENSE	ABOVE 50	VERY STIFF	2 TO 4	15 TO 30
		HARD	ABOVE 4	ABOVE 30

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

BORING PROFILES
SECTION 1 EXPANSION
SOUTHEAST LANDFILL
HILLSBOROUGH COUNTY, FLORIDA

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FILE NO. 97-9628	APPROVED BY:	

97-9628\FIG-3

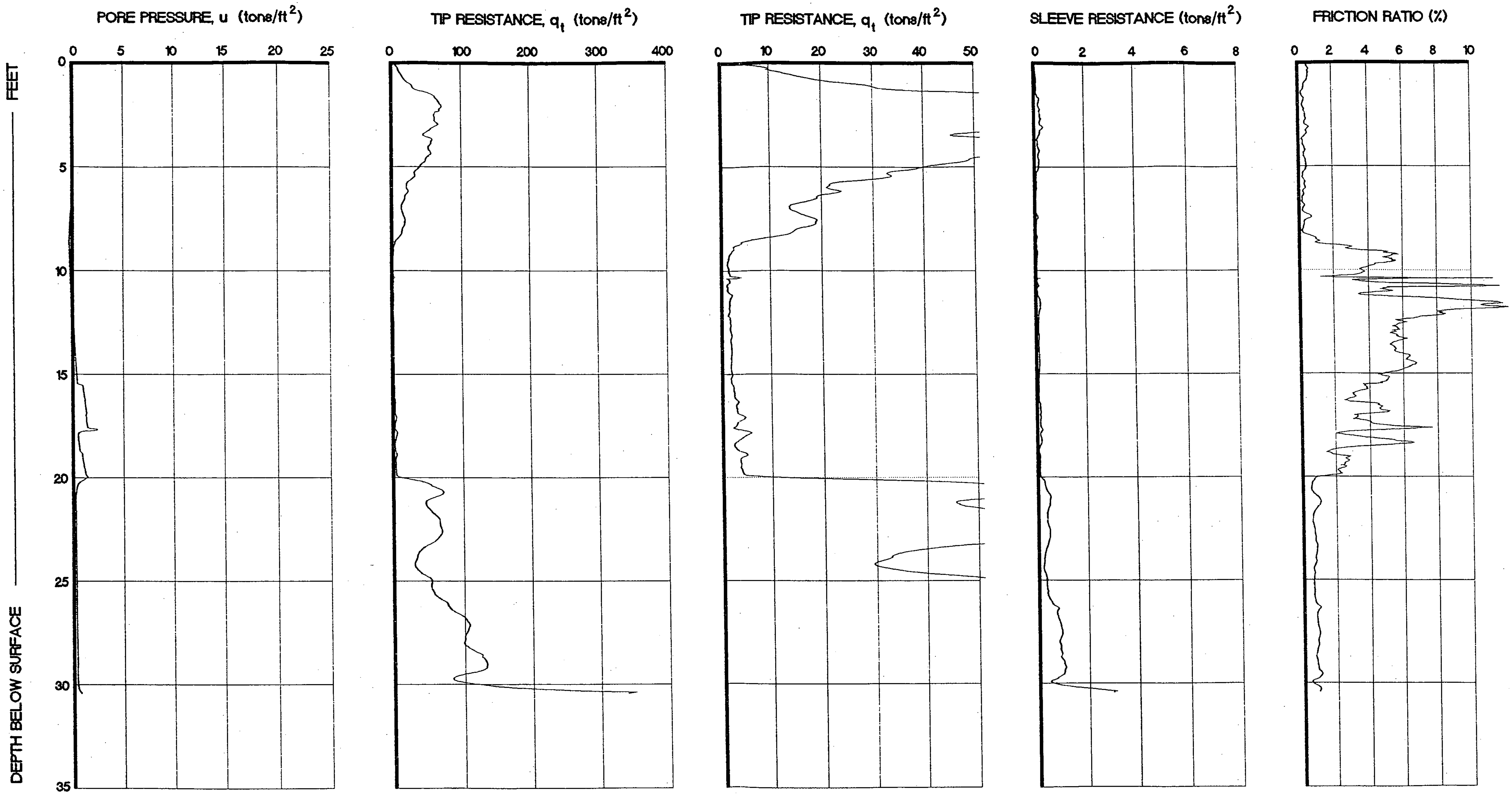


FIGURE 4

PENETRATION DATA FOR SOUNDING NO. CPTU-1

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

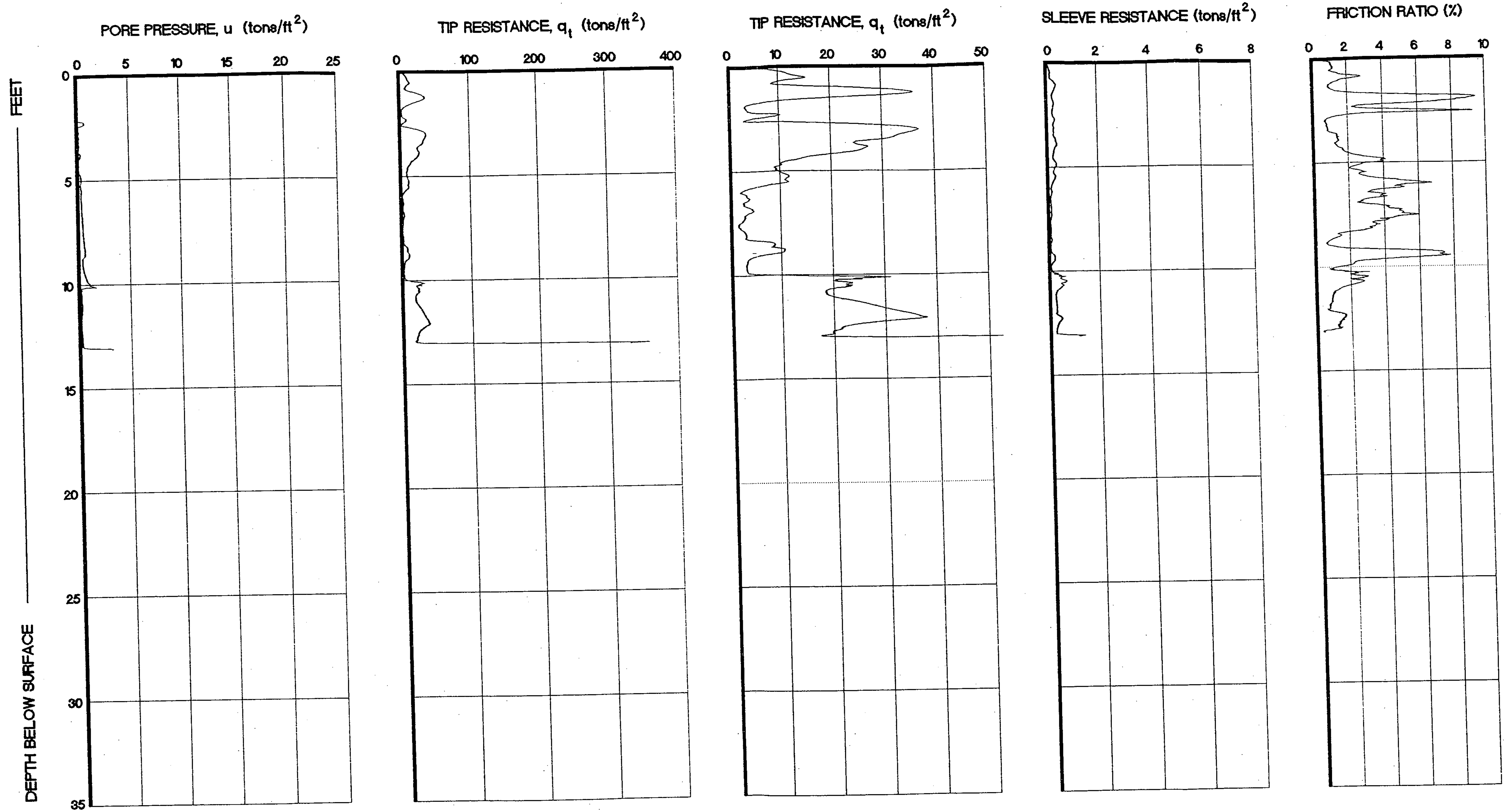


FIGURE 5

PENETRATION DATA FOR SOUNDING NO. CPTU-2

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

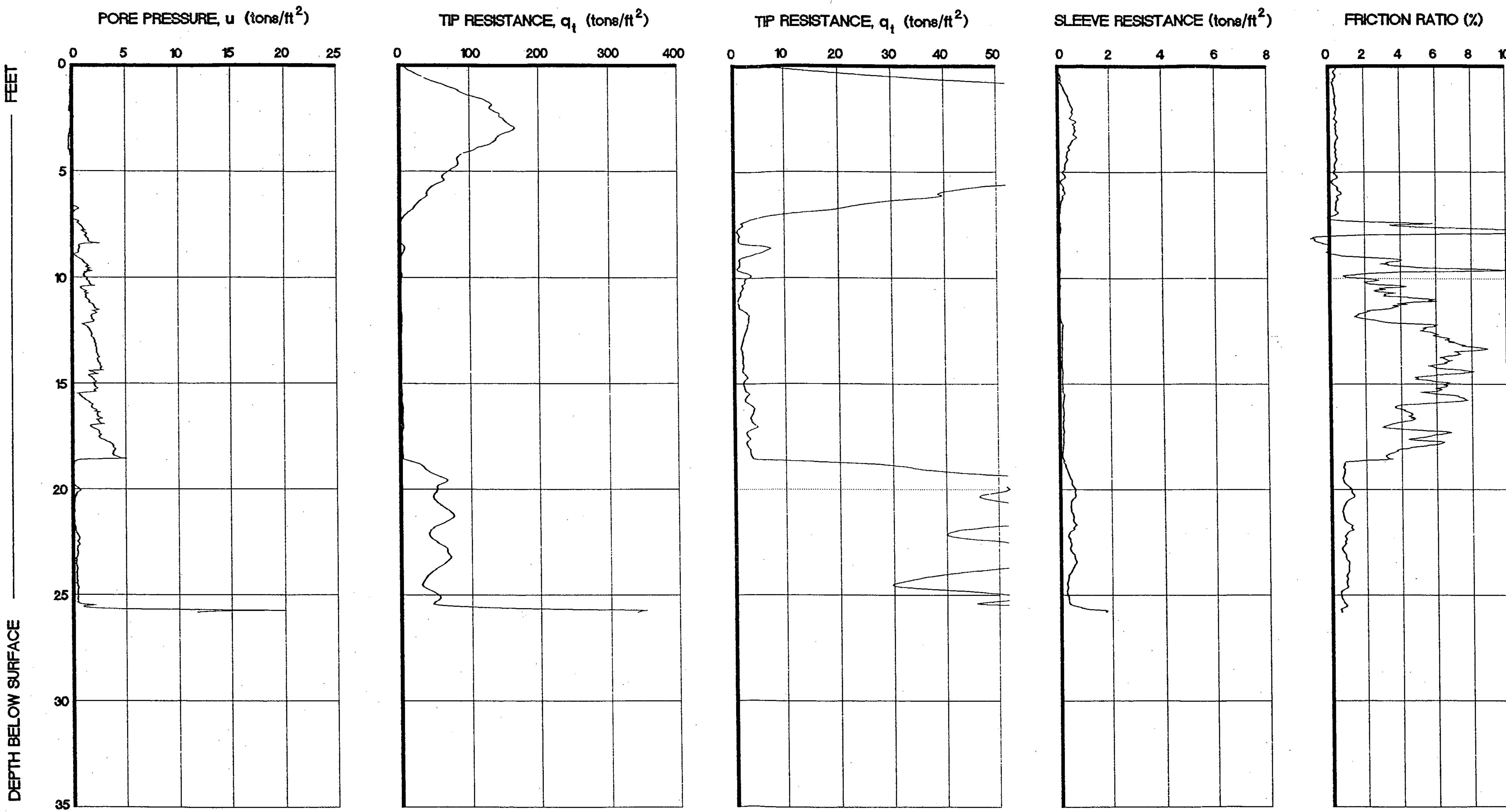


FIGURE 6
PENETRATION DATA FOR SOUNDING NO. CPTU-3

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

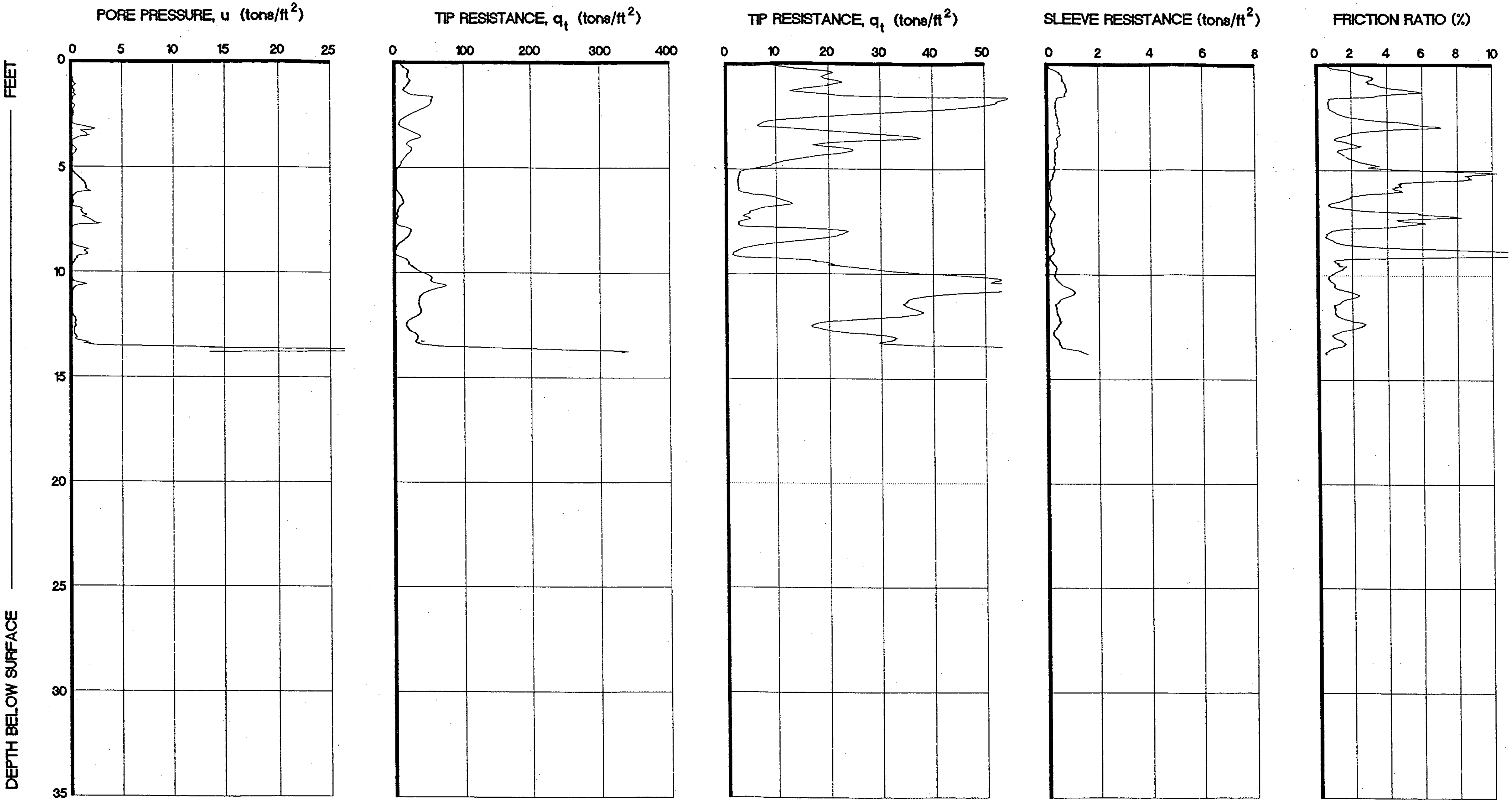


FIGURE 7

PENETRATION DATA FOR SOUNDING NO. CPTU-4

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

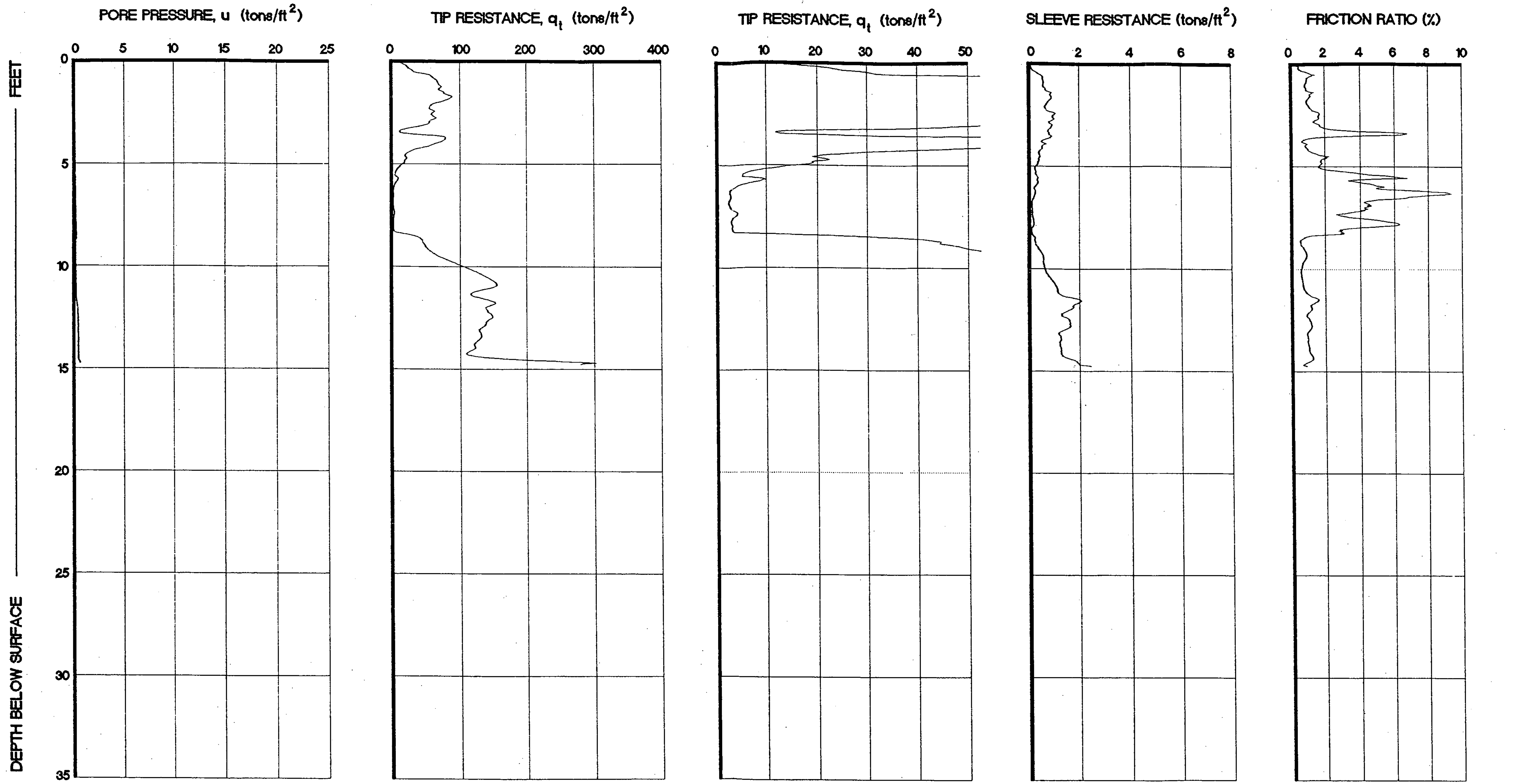


FIGURE 8

PENETRATION DATA FOR SOUNDING NO. CPTU-5

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

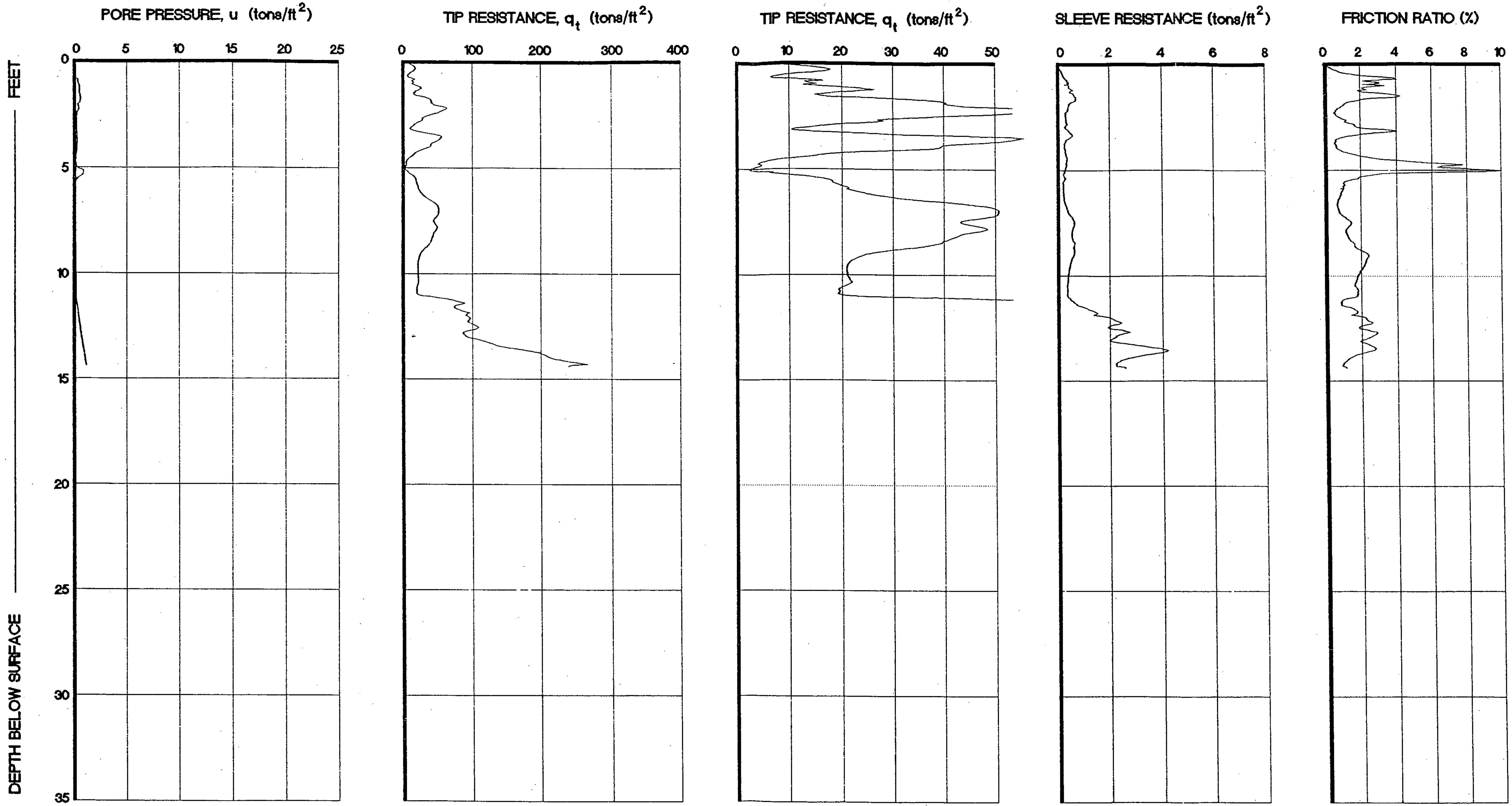


FIGURE 9

PENETRATION DATA FOR SOUNDING NO. CPTU-6

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

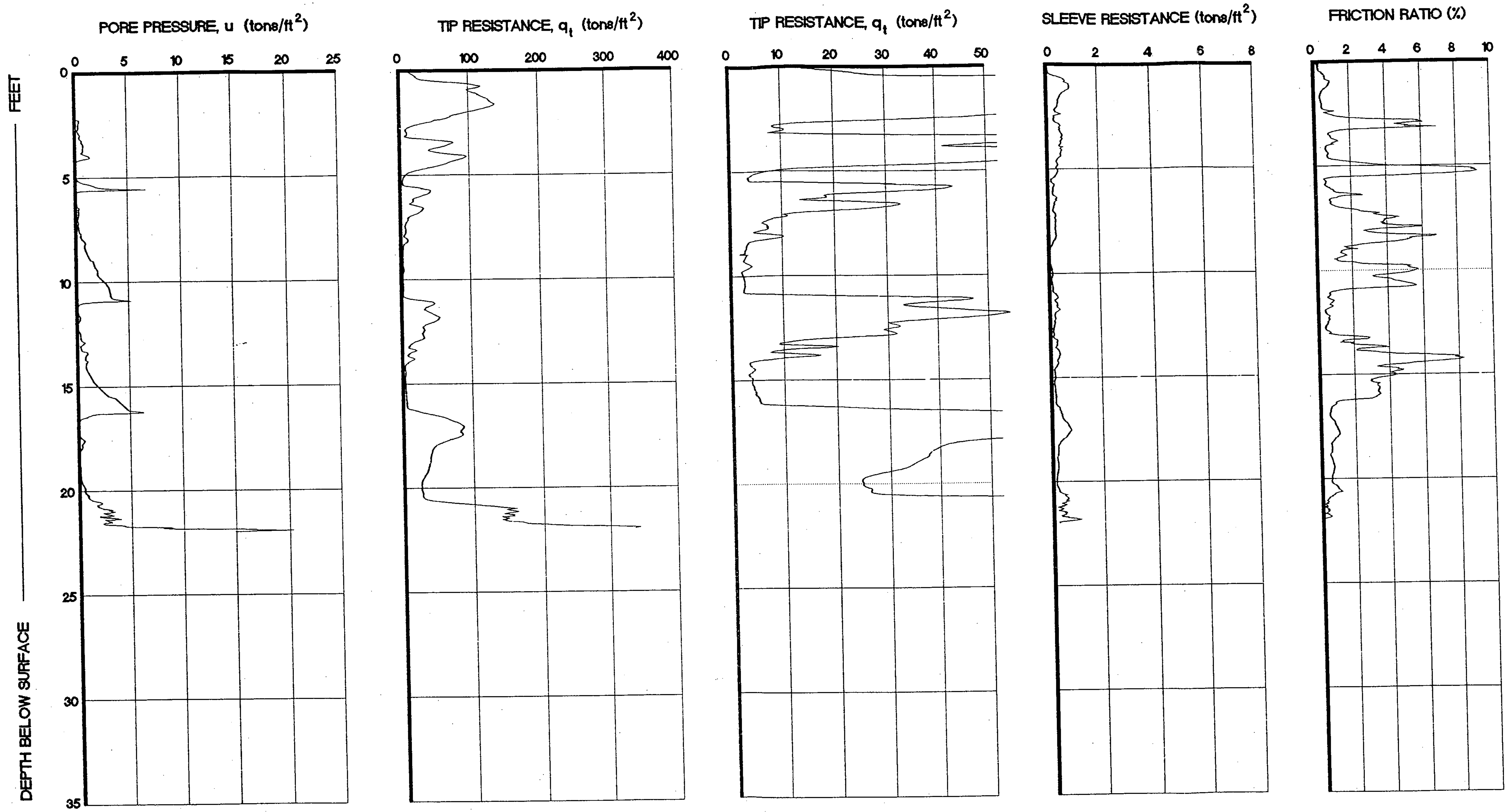


FIGURE 10

PENETRATION DATA FOR SOUNDING NO. CPTU-7

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

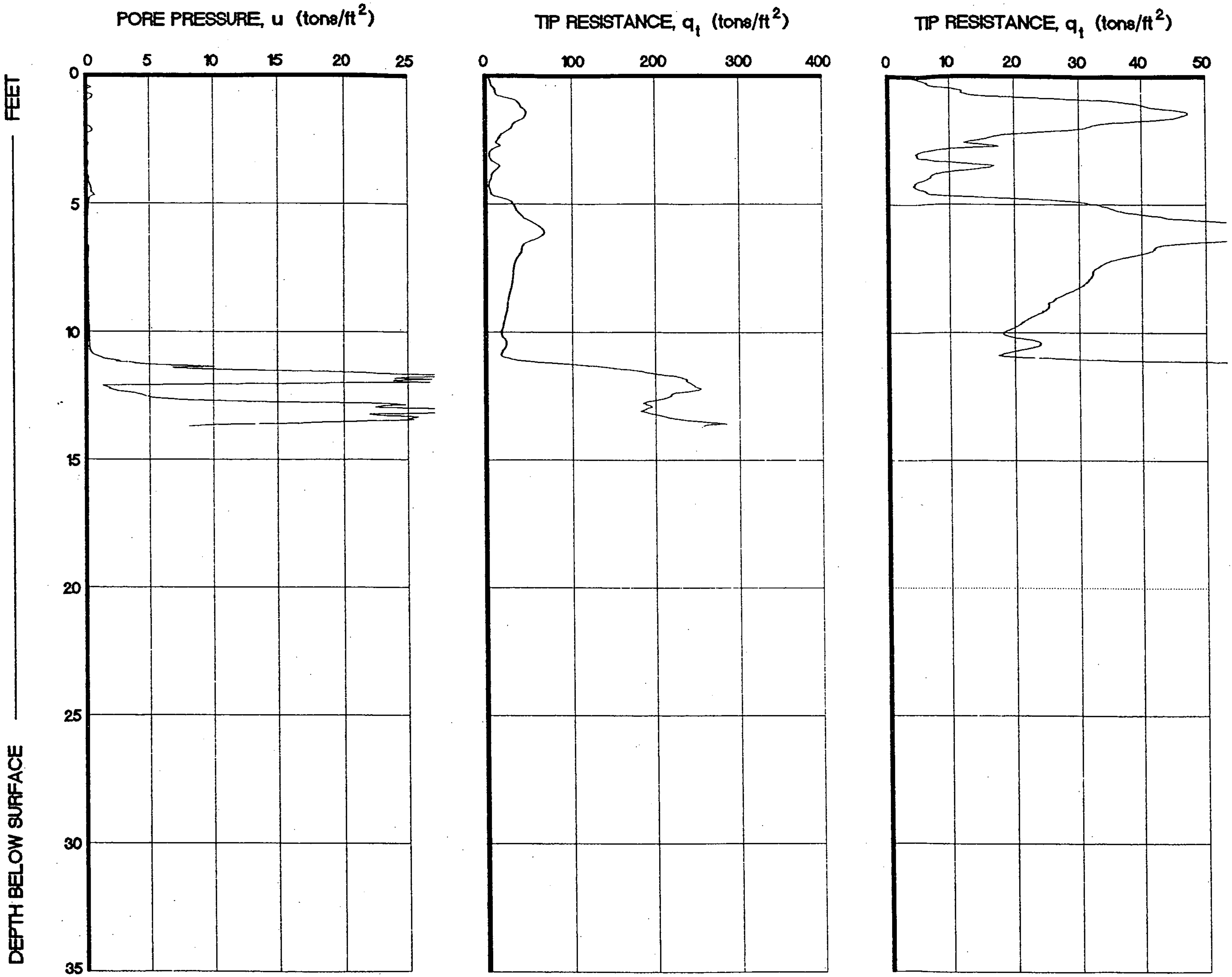


FIGURE 11

PENETRATION DATA FOR SOUNDING NO. CPTU-8

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

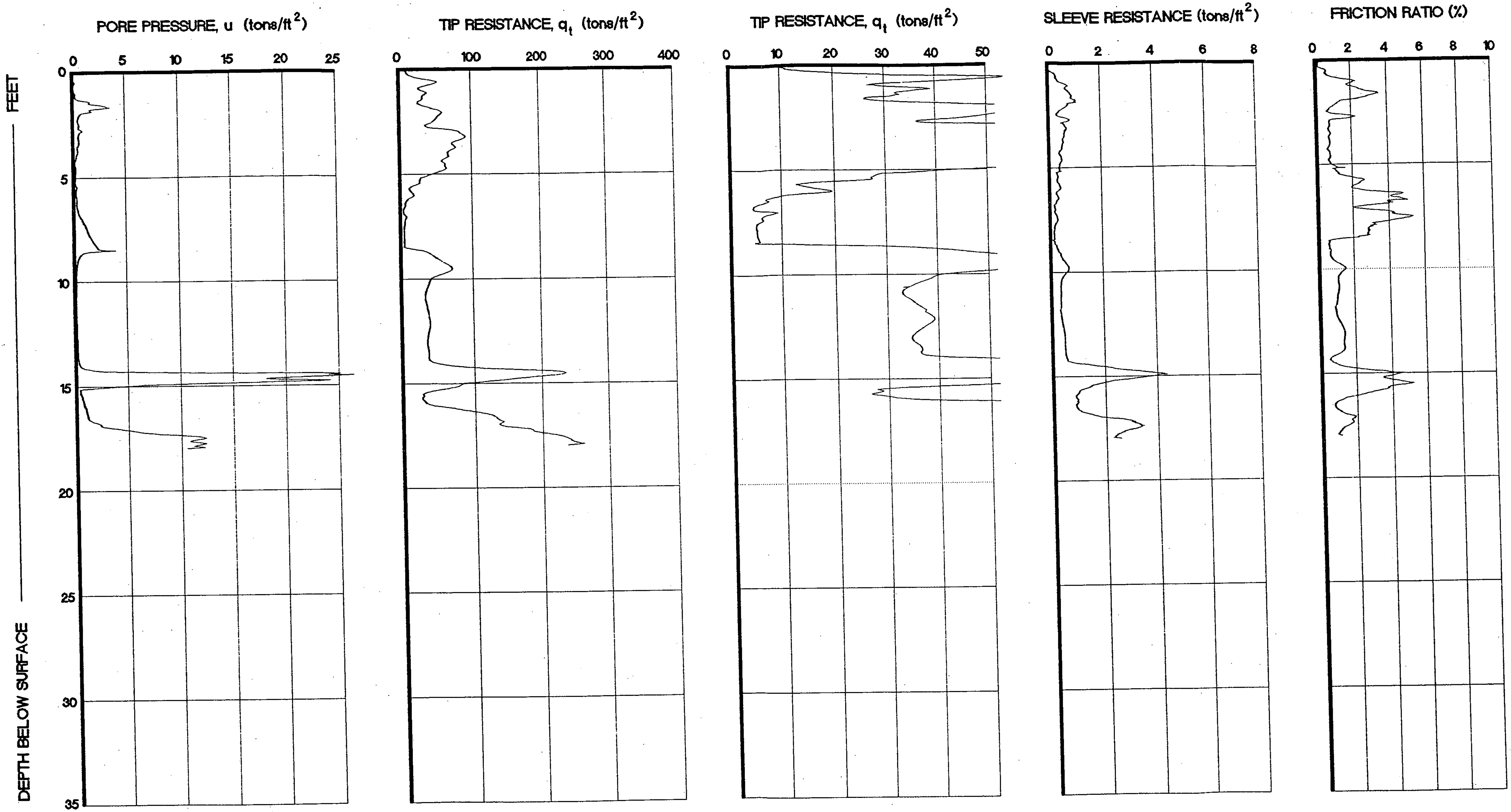


FIGURE 12
PENETRATION DATA FOR
SOUNDING NO. CPTU-9

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

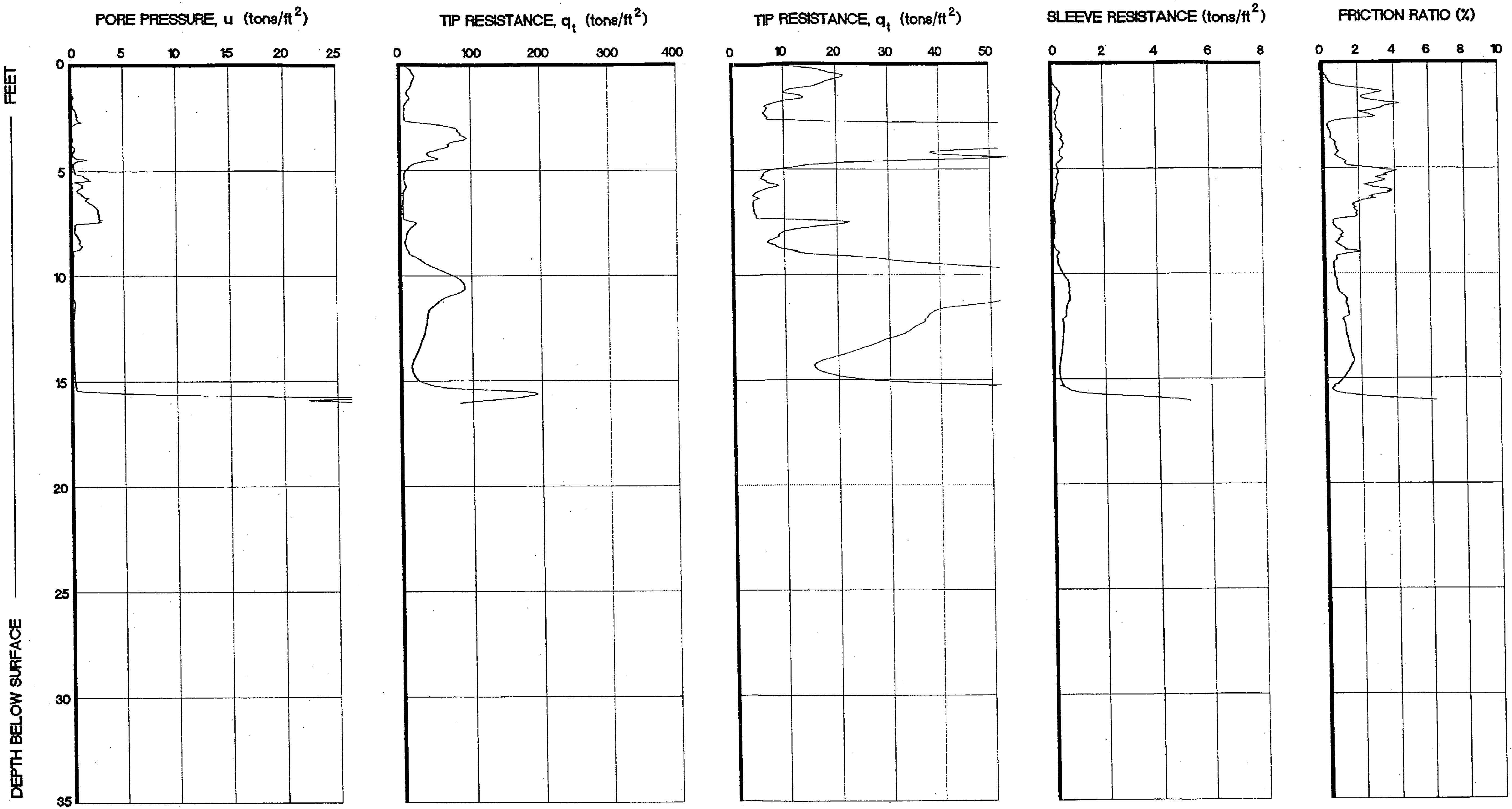


FIGURE 13

PENETRATION DATA FOR SOUNDING NO. CPTU-10

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

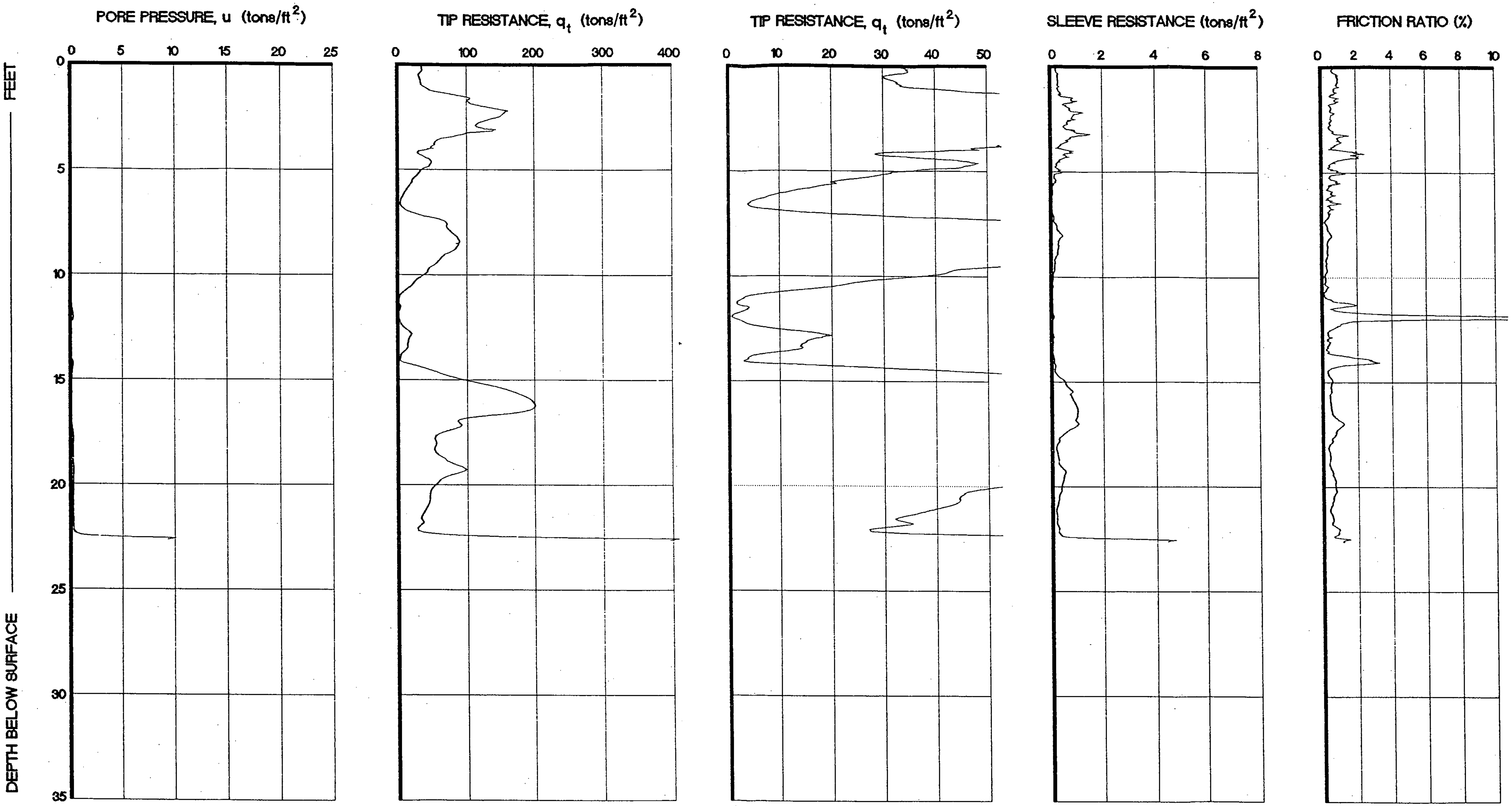


FIGURE 14

PENETRATION DATA FOR SOUNDING NO. CPTU-11

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

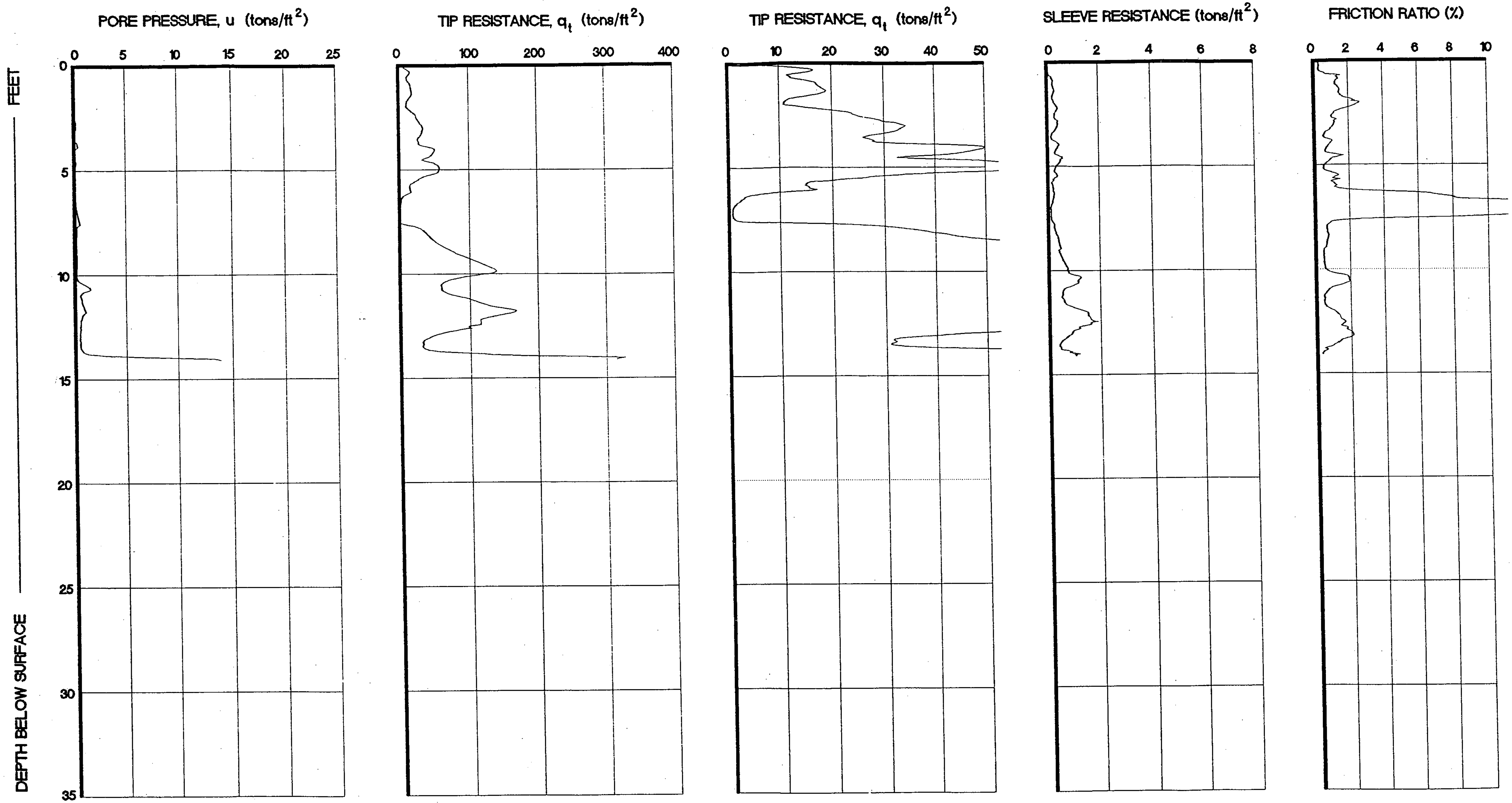


FIGURE 15
PENETRATION DATA FOR SOUNDING NO. CPTU-12

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

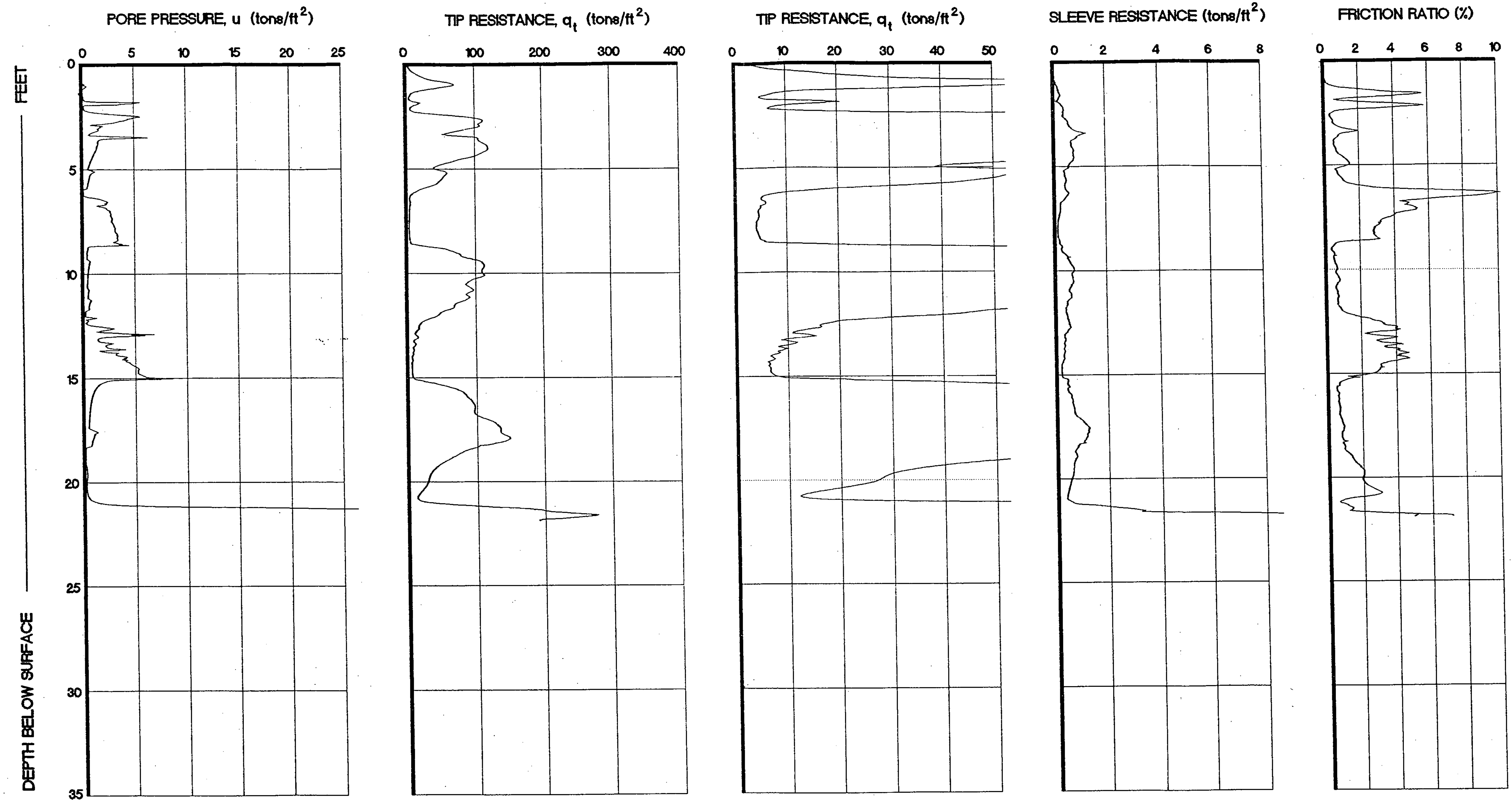


FIGURE 16

PENETRATION DATA FOR SOUNDING NO. CPTU-13

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/30/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

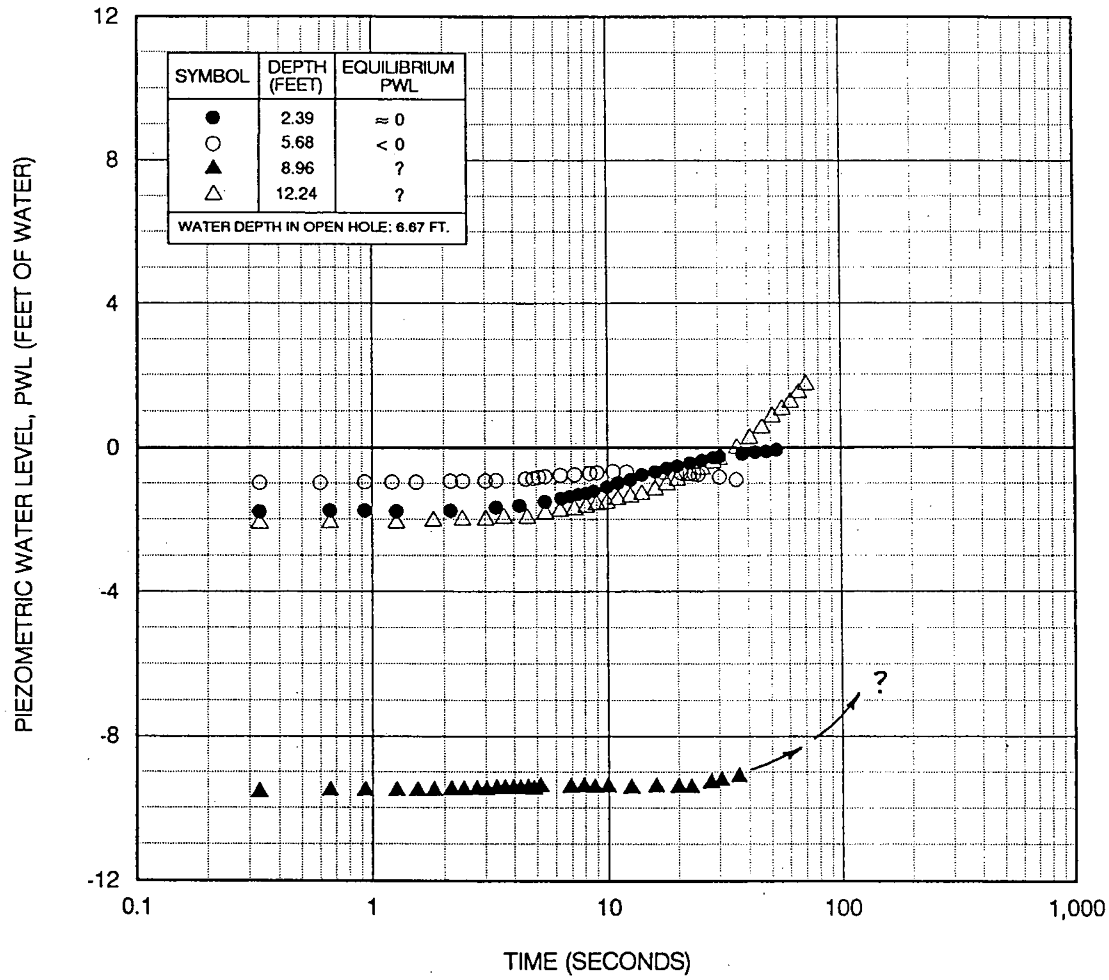


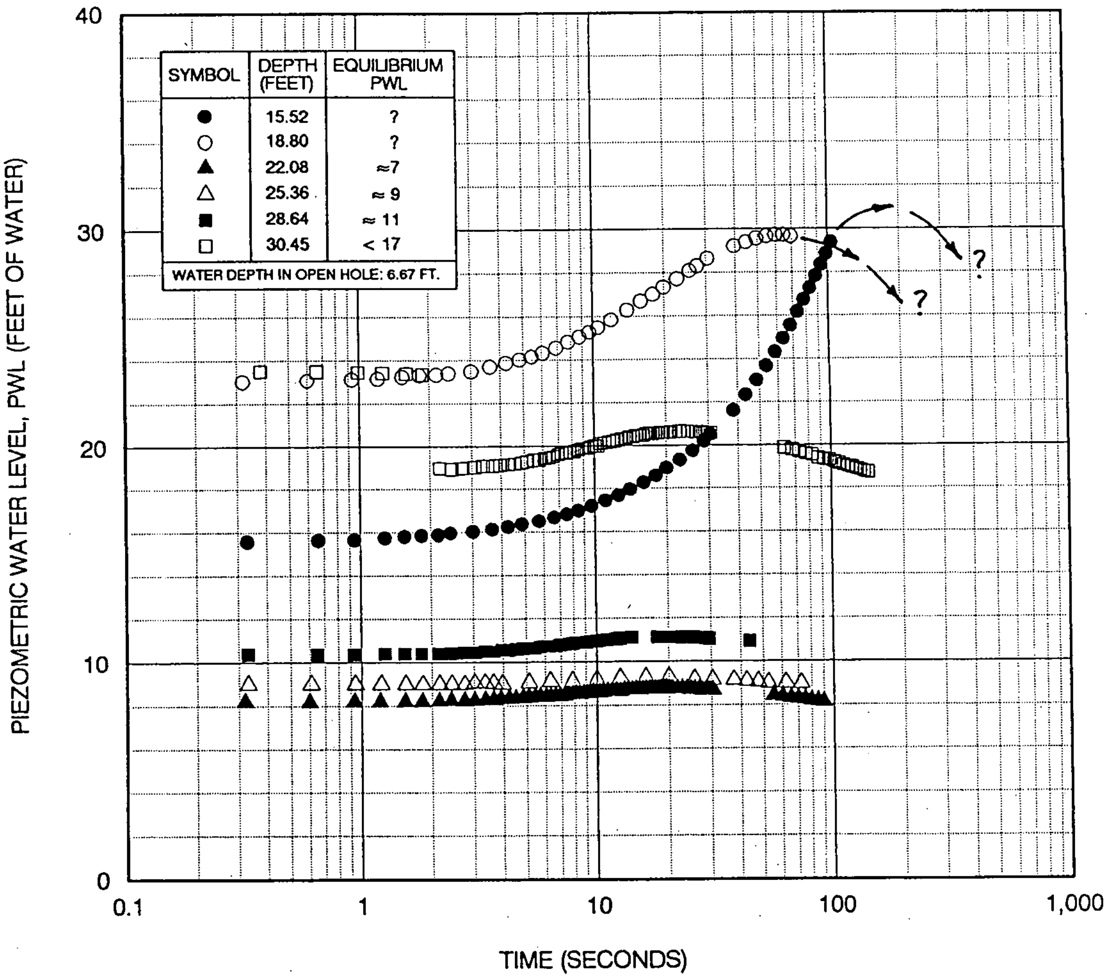
FIGURE 17

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-1

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:



SYMBOL	DEPTH (FEET)	EQUILIBRIUM PWL
●	15.52	?
○	18.80	?
▲	22.08	≈7
△	25.36	≈ 9
■	28.64	≈ 11
□	30.45	< 17

WATER DEPTH IN OPEN HOLE: 6.67 FT.

FIGURE 18

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-1

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

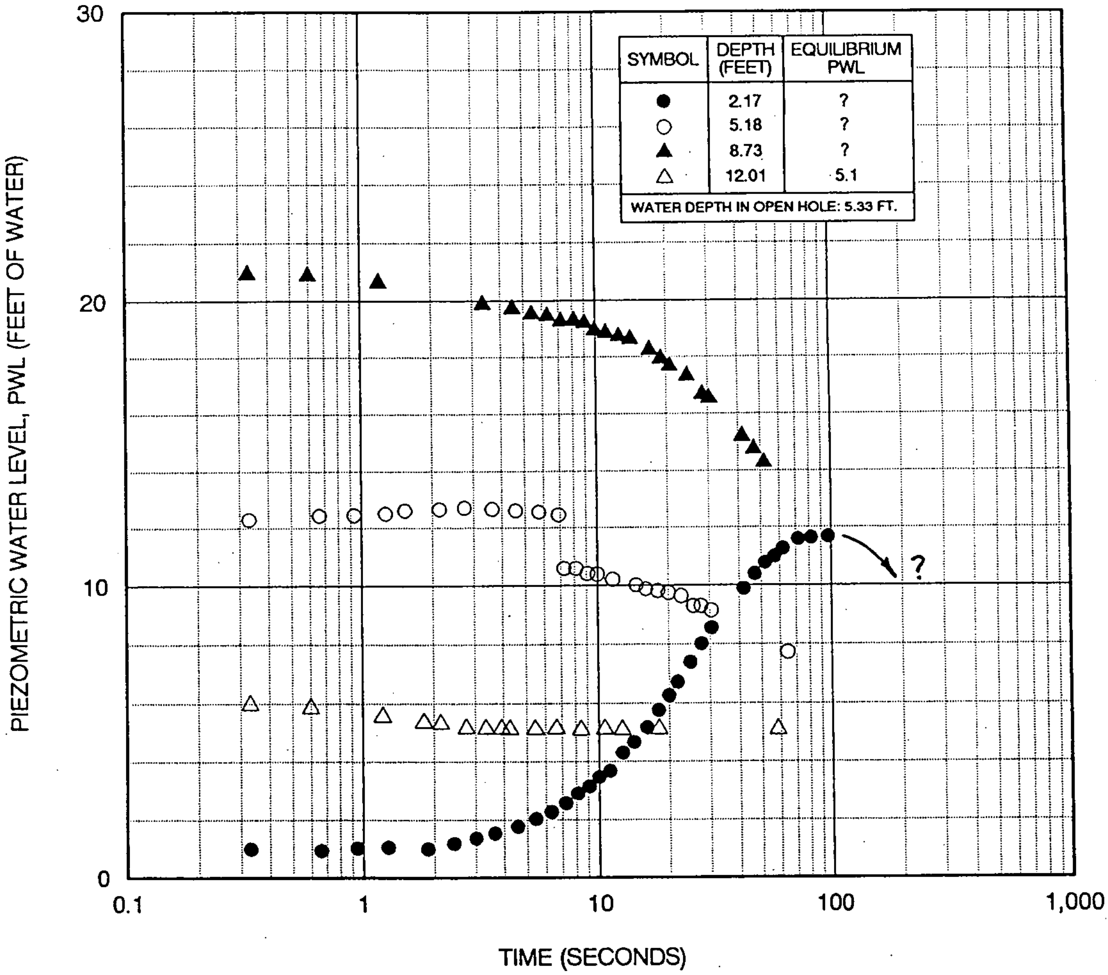


FIGURE 19

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-2

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

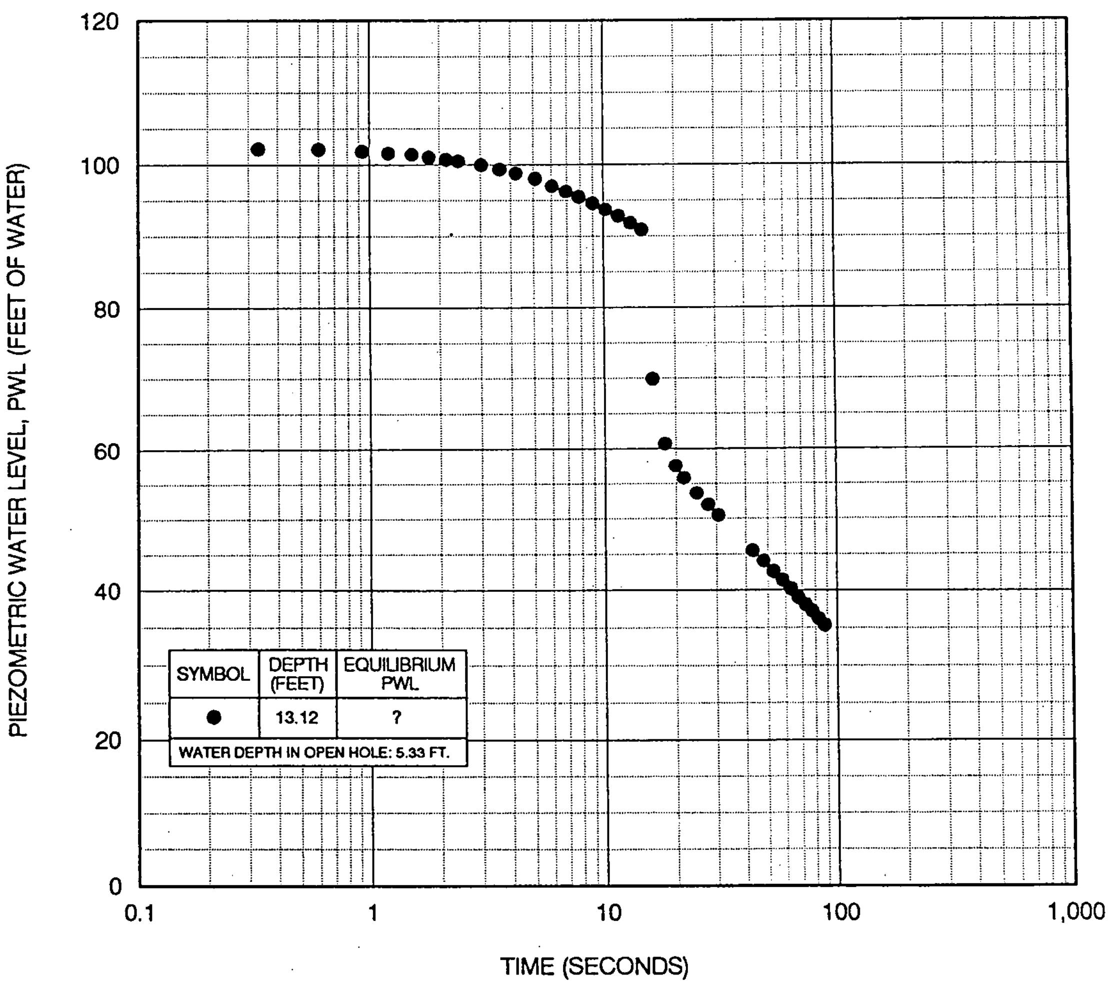


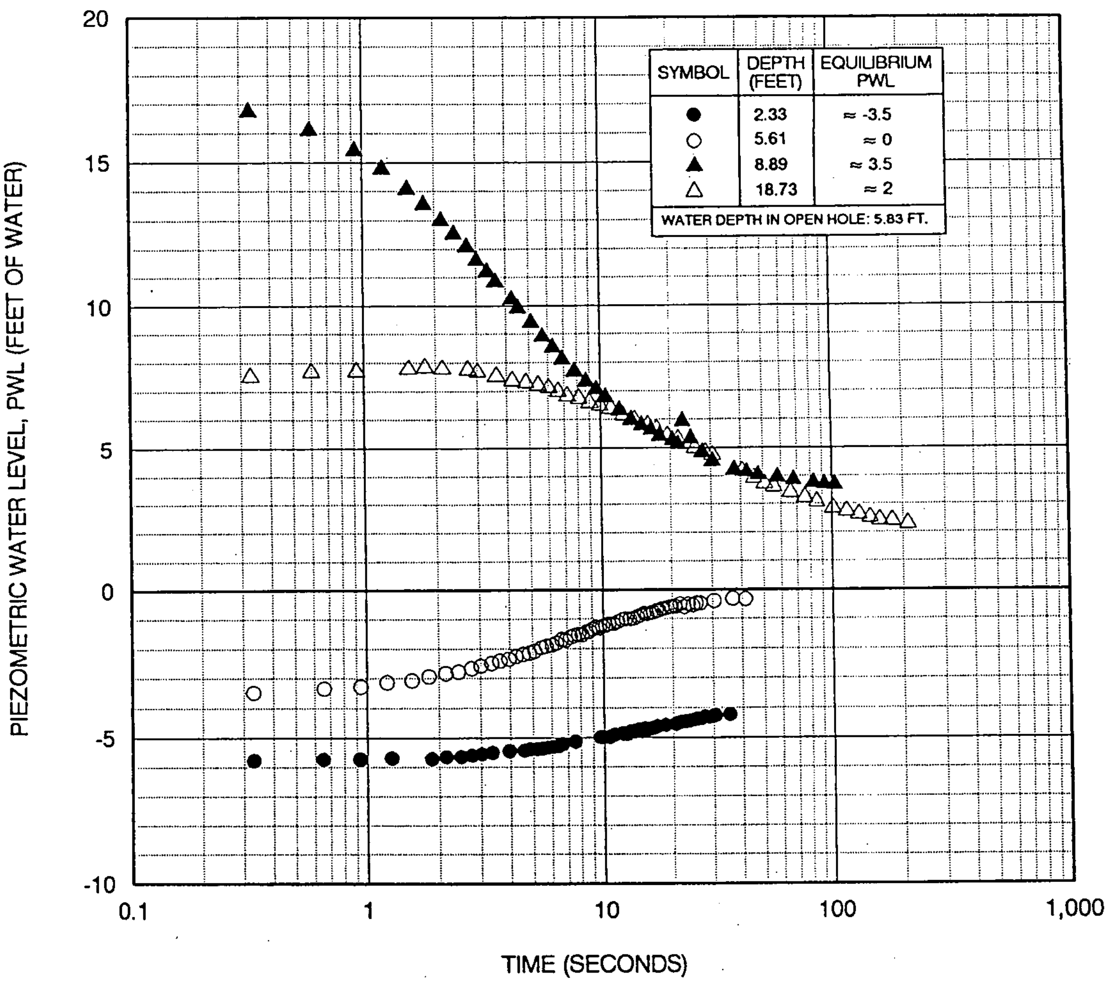
FIGURE 20

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-2

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:



PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-3

FIGURE 21

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

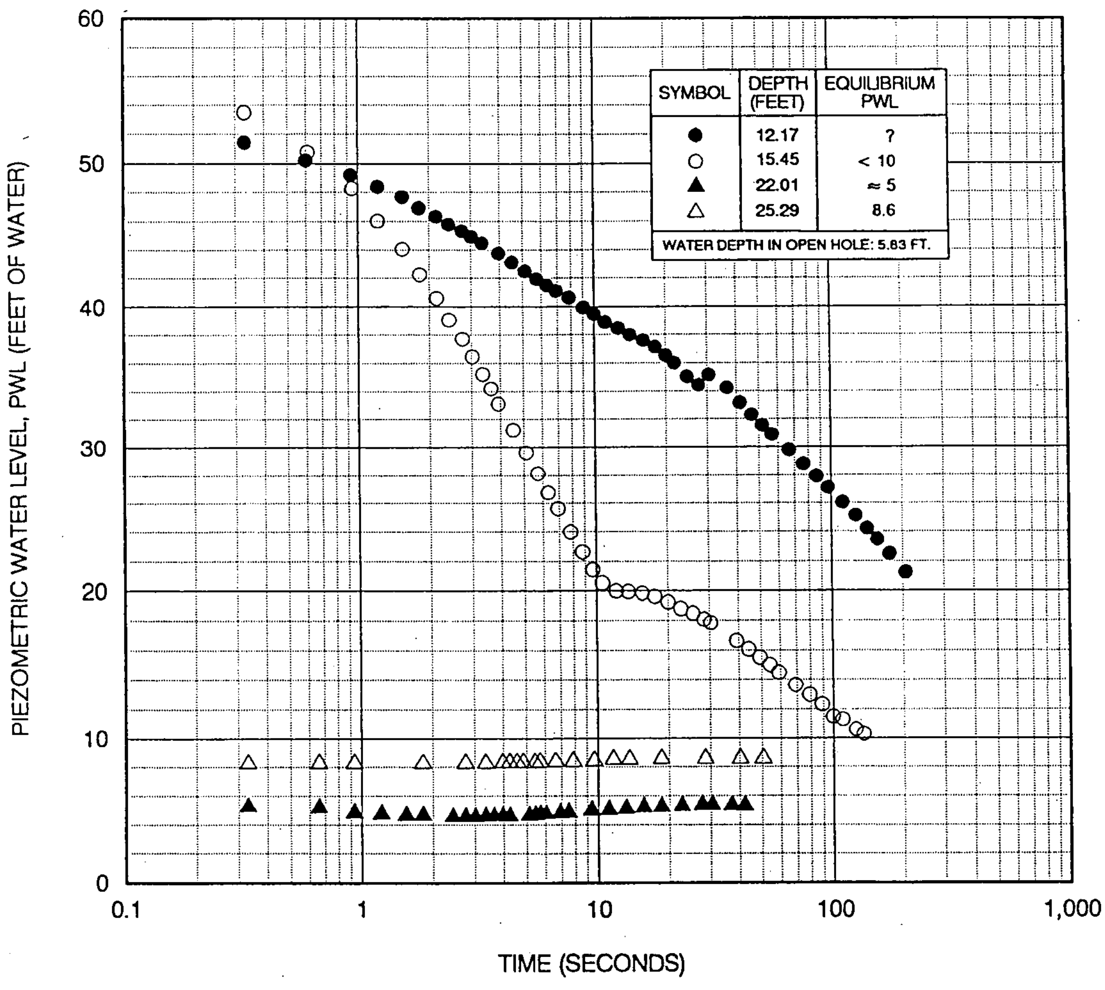


FIGURE 22

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-3

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

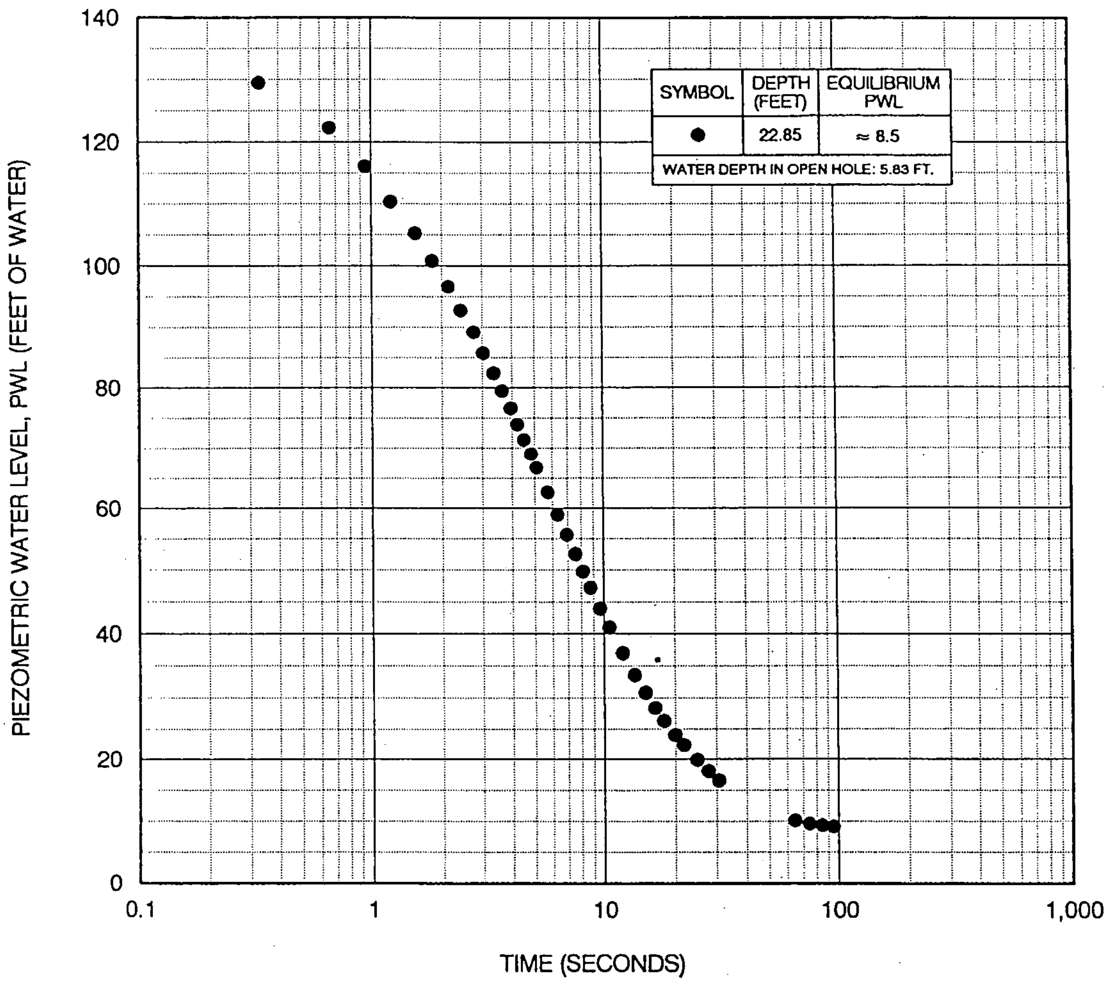


FIGURE 23

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-3

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

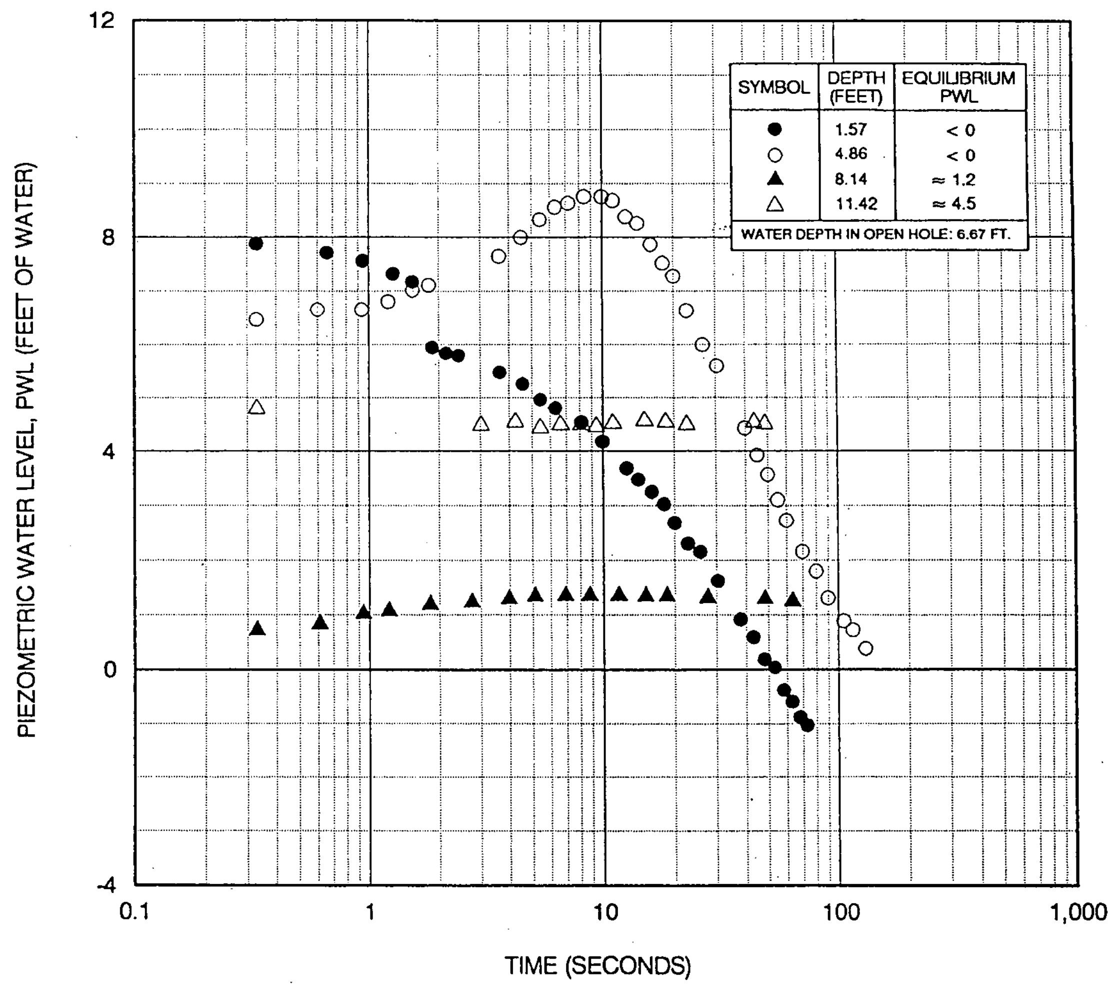


FIGURE 24

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-4

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

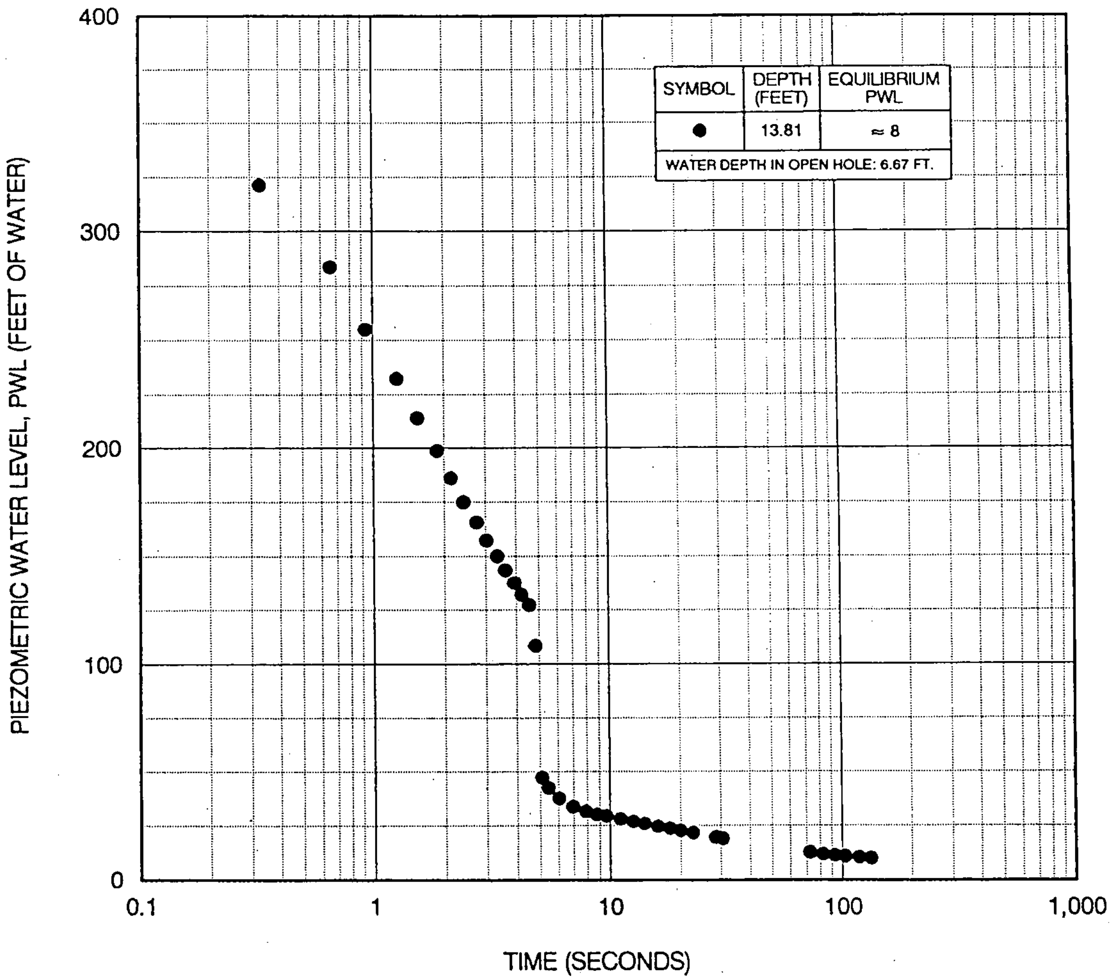


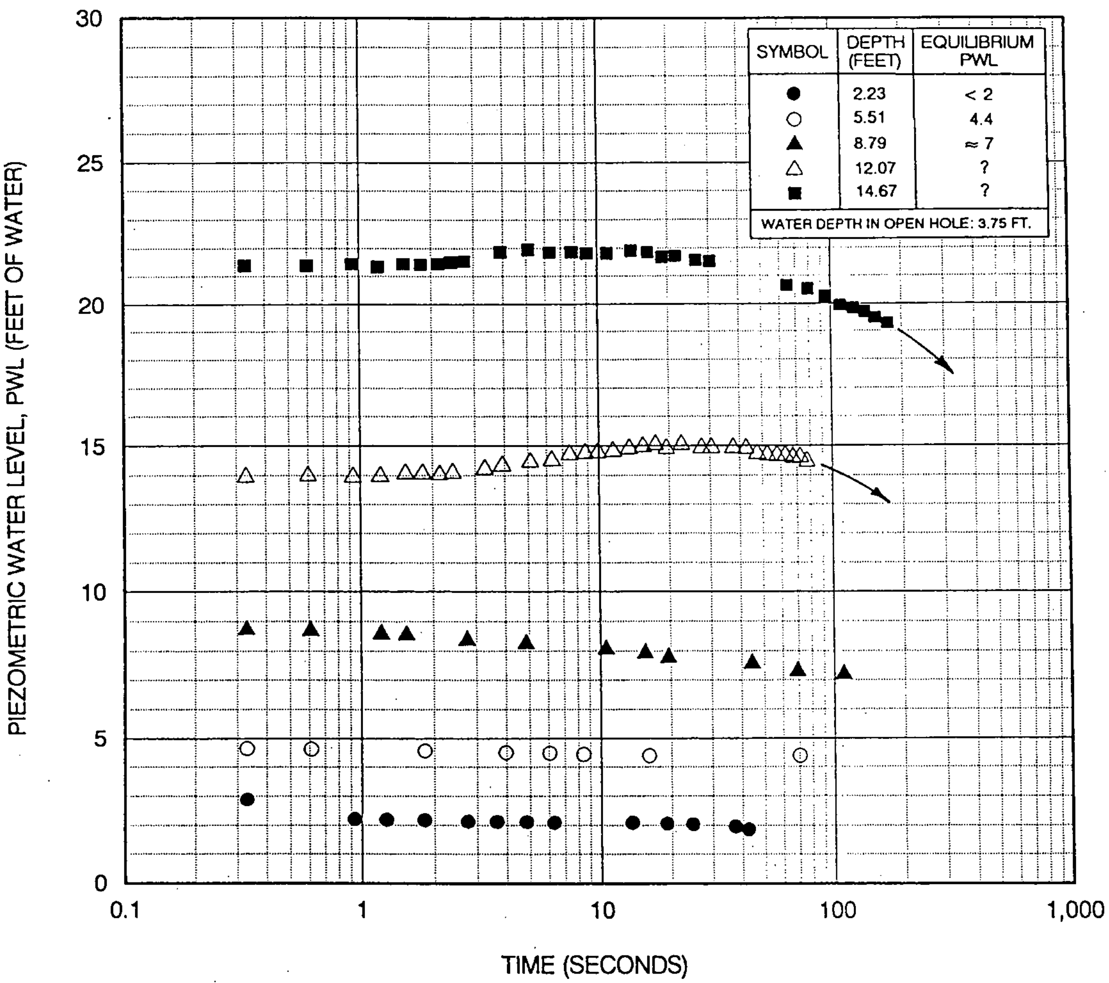
FIGURE 25

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-4

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:



SYMBOL	DEPTH (FEET)	EQUILIBRIUM PWL
●	2.23	< 2
○	5.51	4.4
▲	8.79	≈ 7
△	12.07	?
■	14.67	?

WATER DEPTH IN OPEN HOLE: 3.75 FT.

FIGURE 26

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-5

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

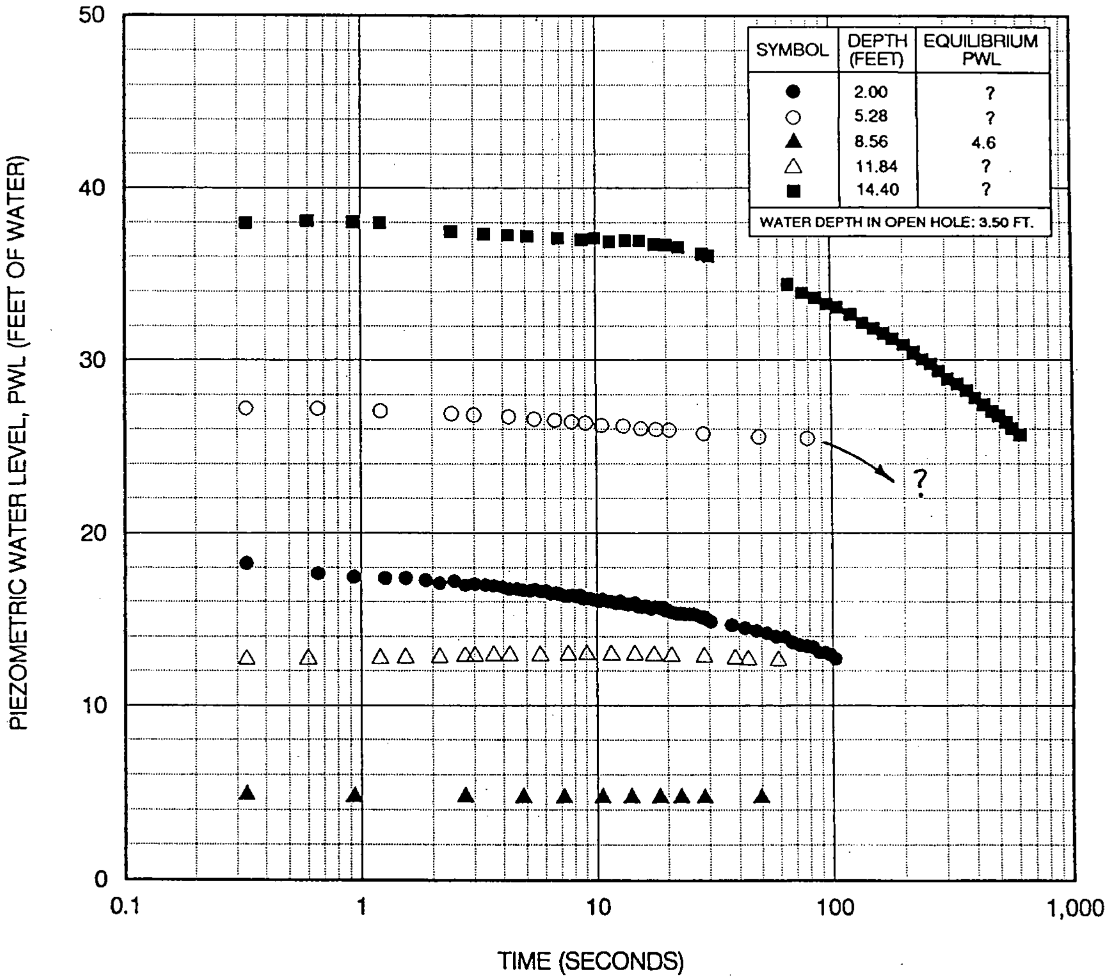
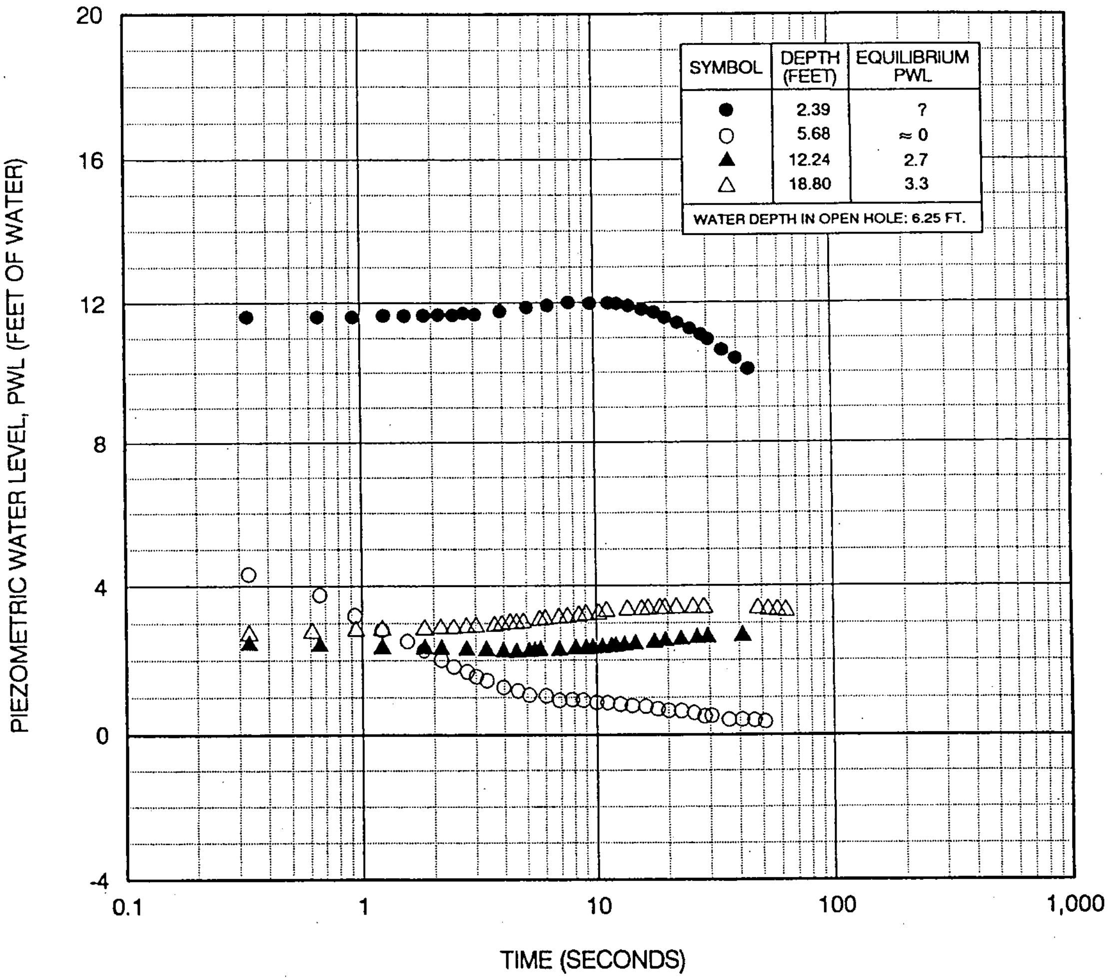


FIGURE 27

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-6

Ardaman & Associates, Inc. Geotechnical, Environmental and Materials Consultants		
SOUTHEAST LANDFILL PIEZOCONE TEST SOUNDINGS APRIL 21-22, 1997		
DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:



PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-7

FIGURE 28

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

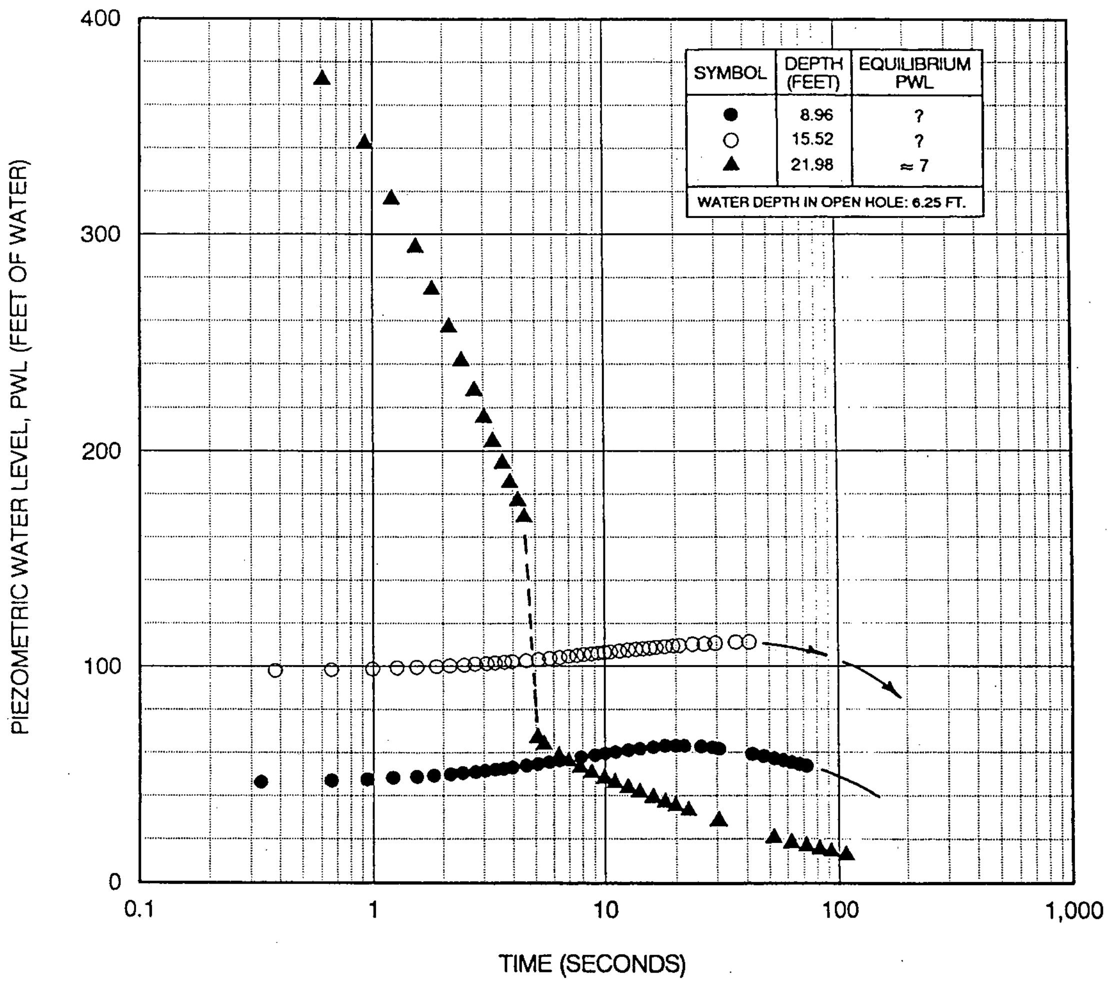


FIGURE 29

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-7

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

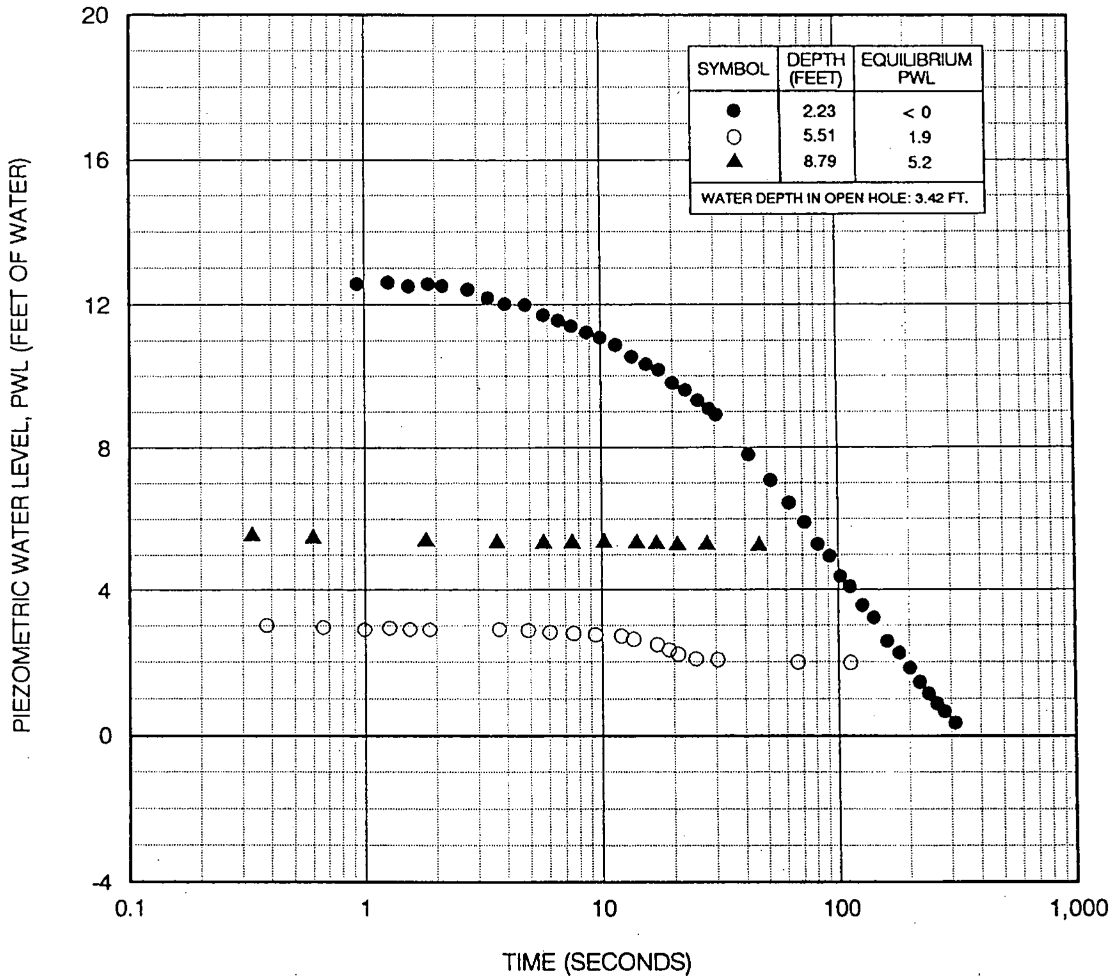


FIGURE 30

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-8

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

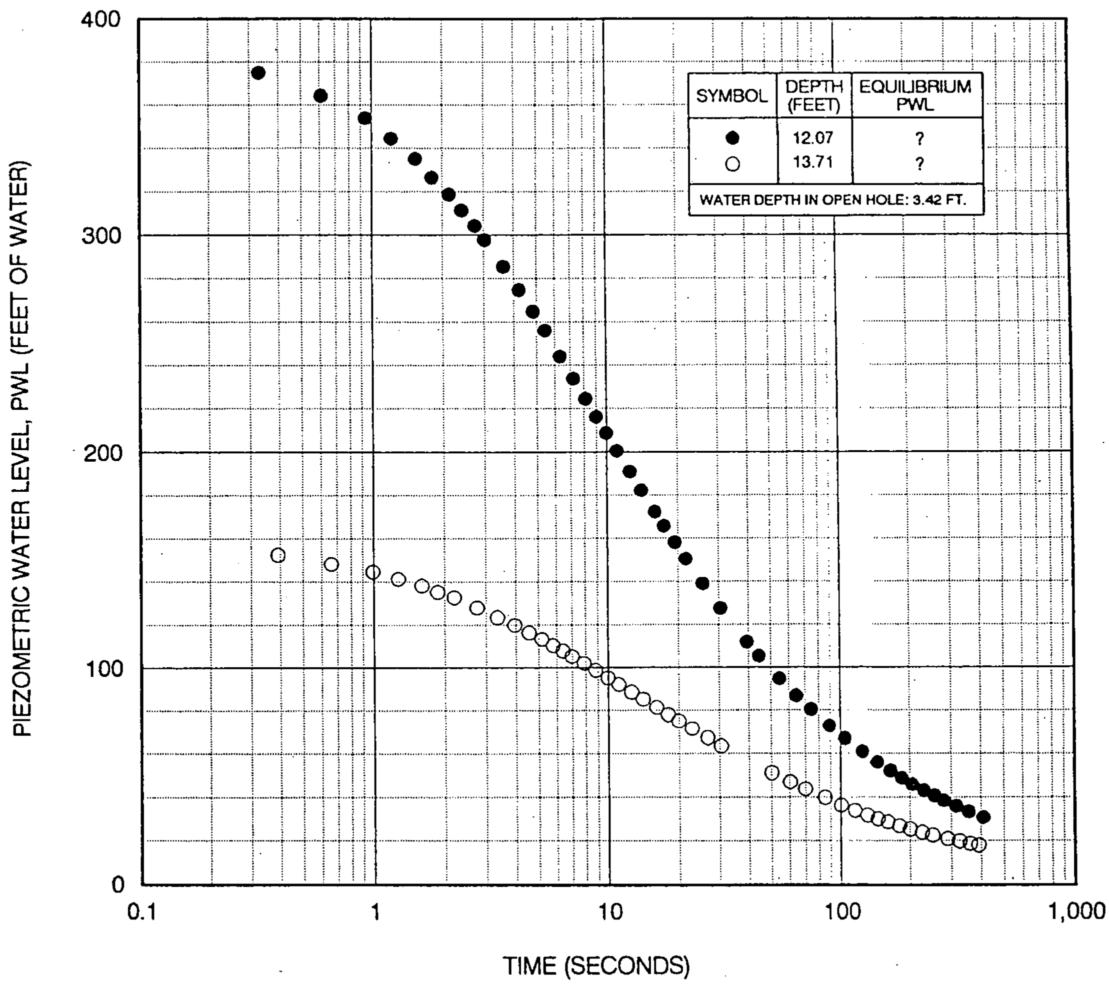


FIGURE 31

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-8

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

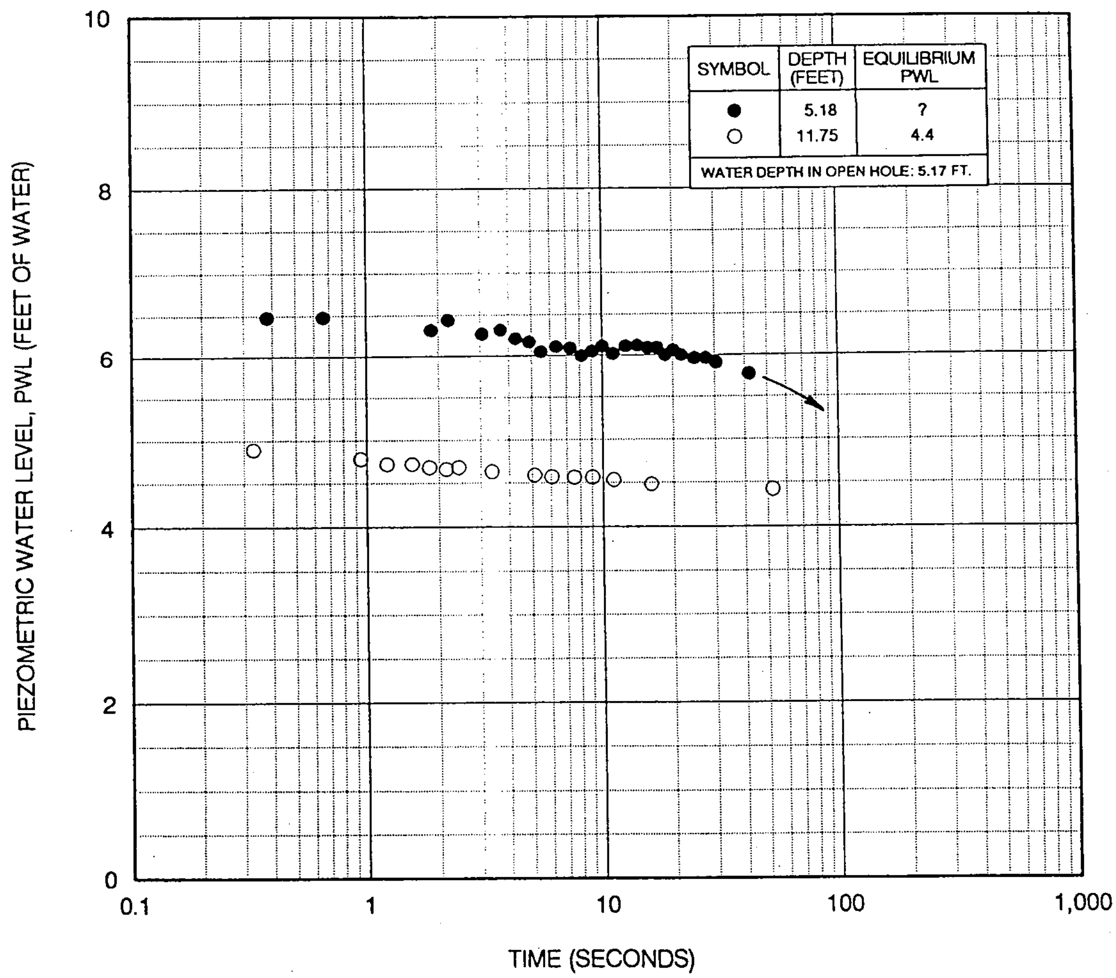


FIGURE 32

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-9

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

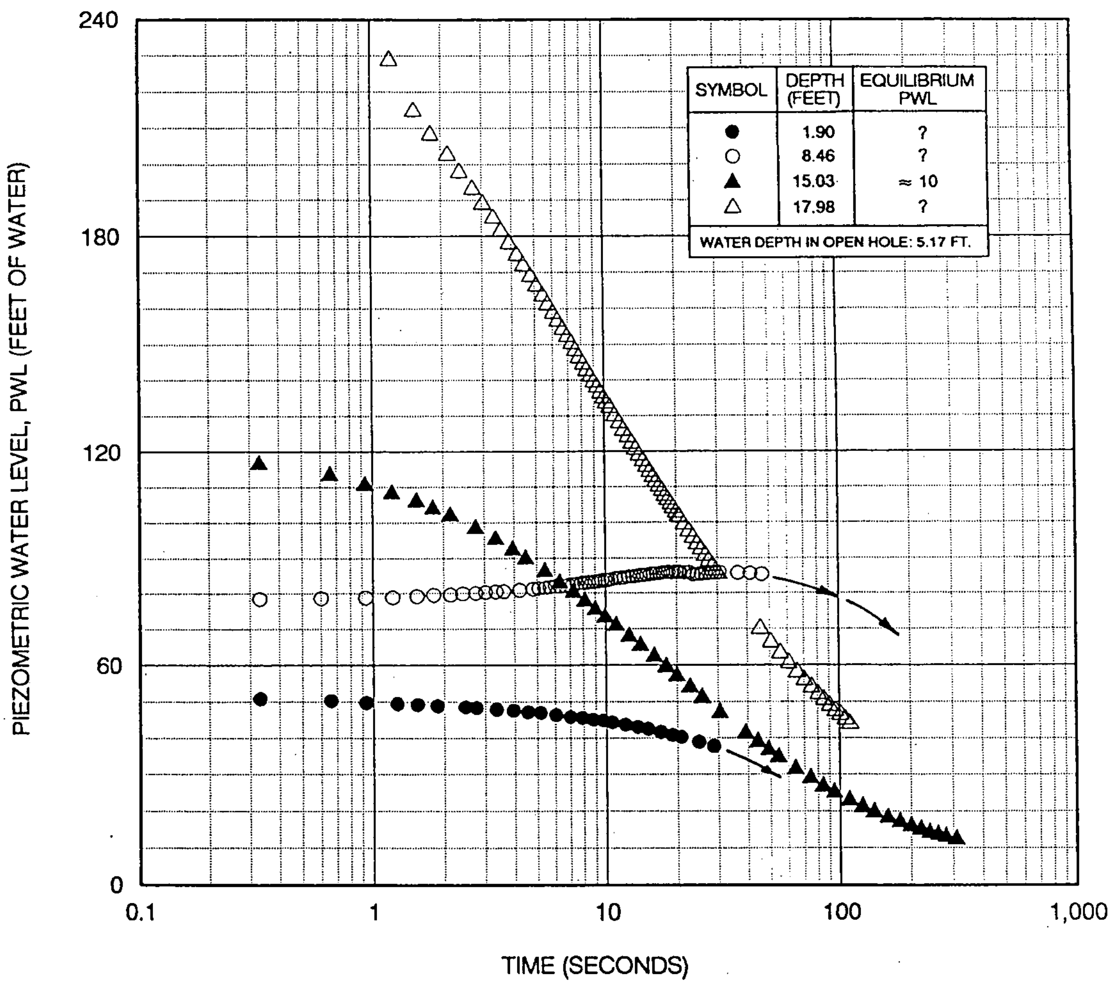


FIGURE 33

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-9

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

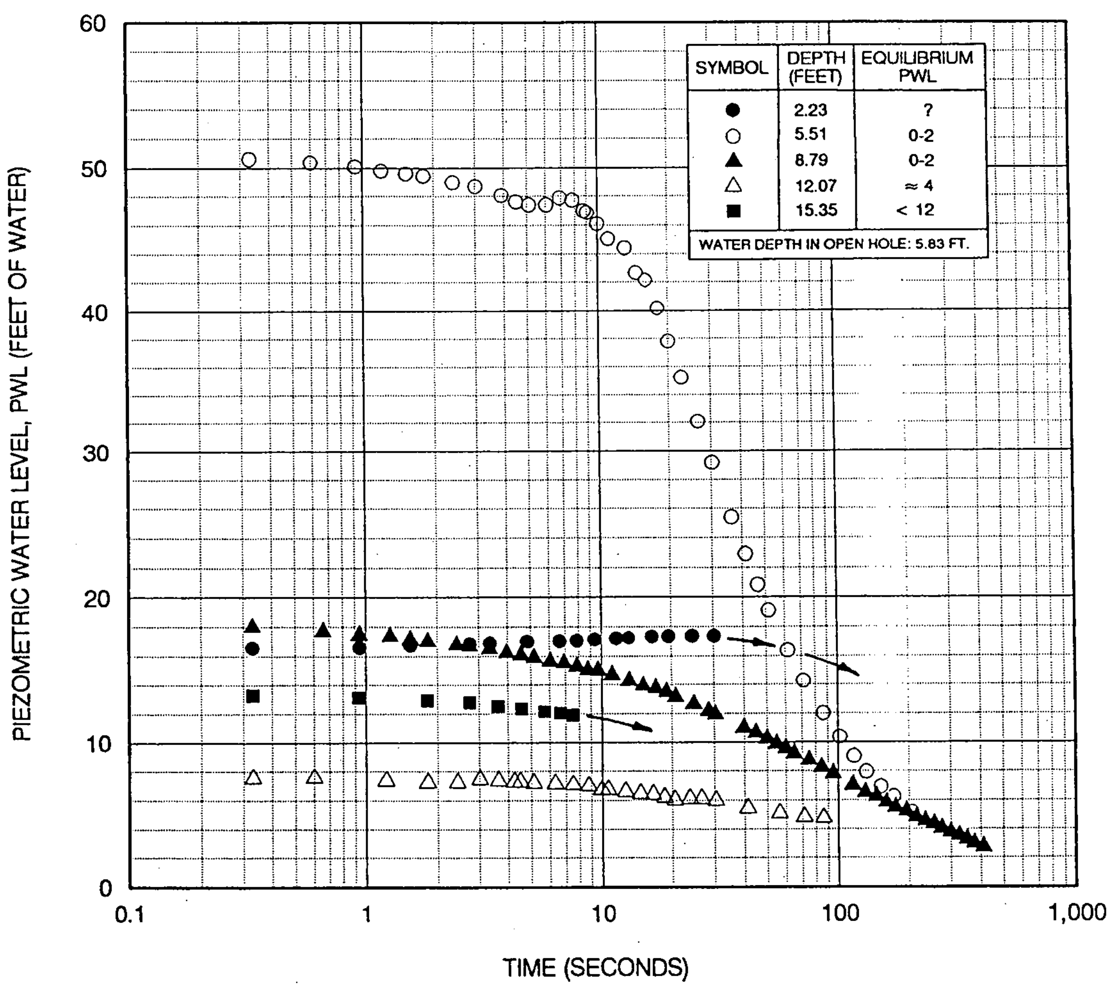


FIGURE 34

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-10

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

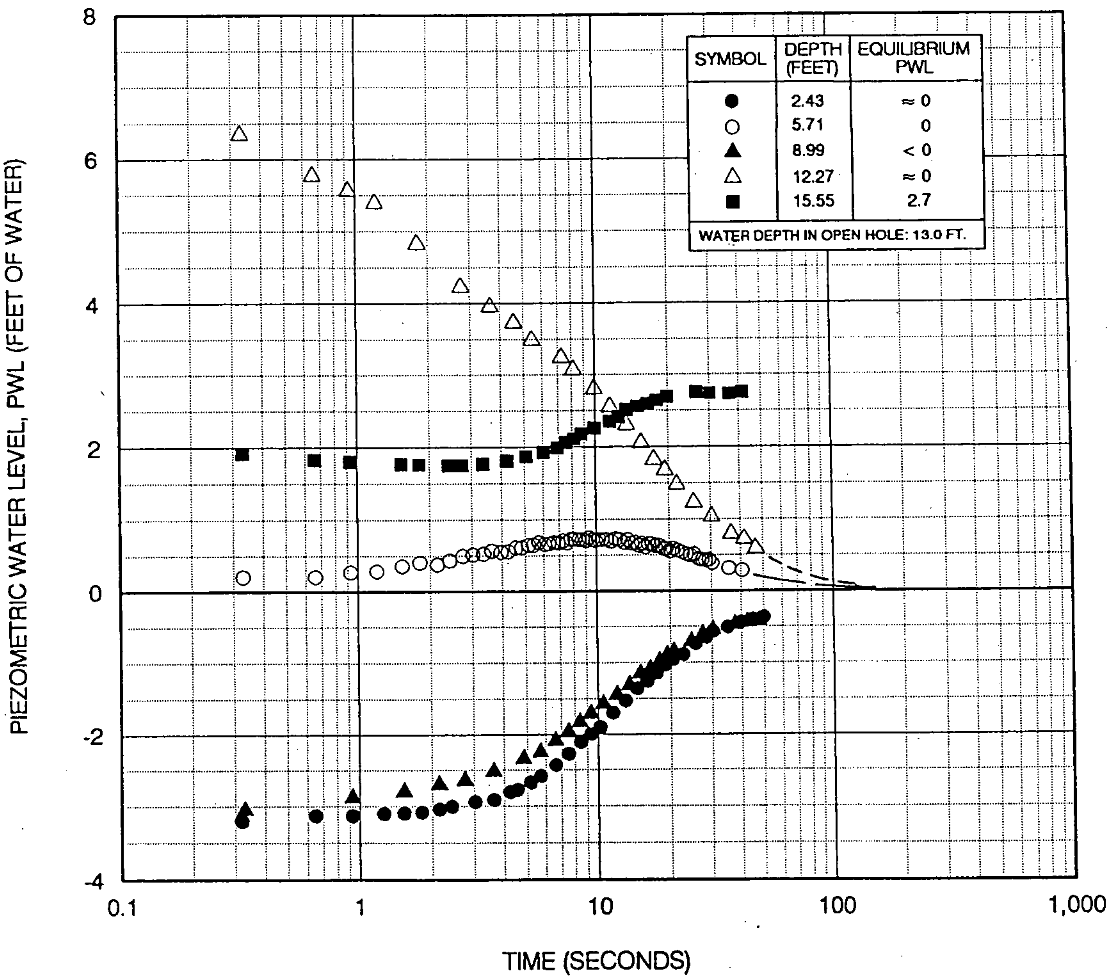


FIGURE 35

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-11

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

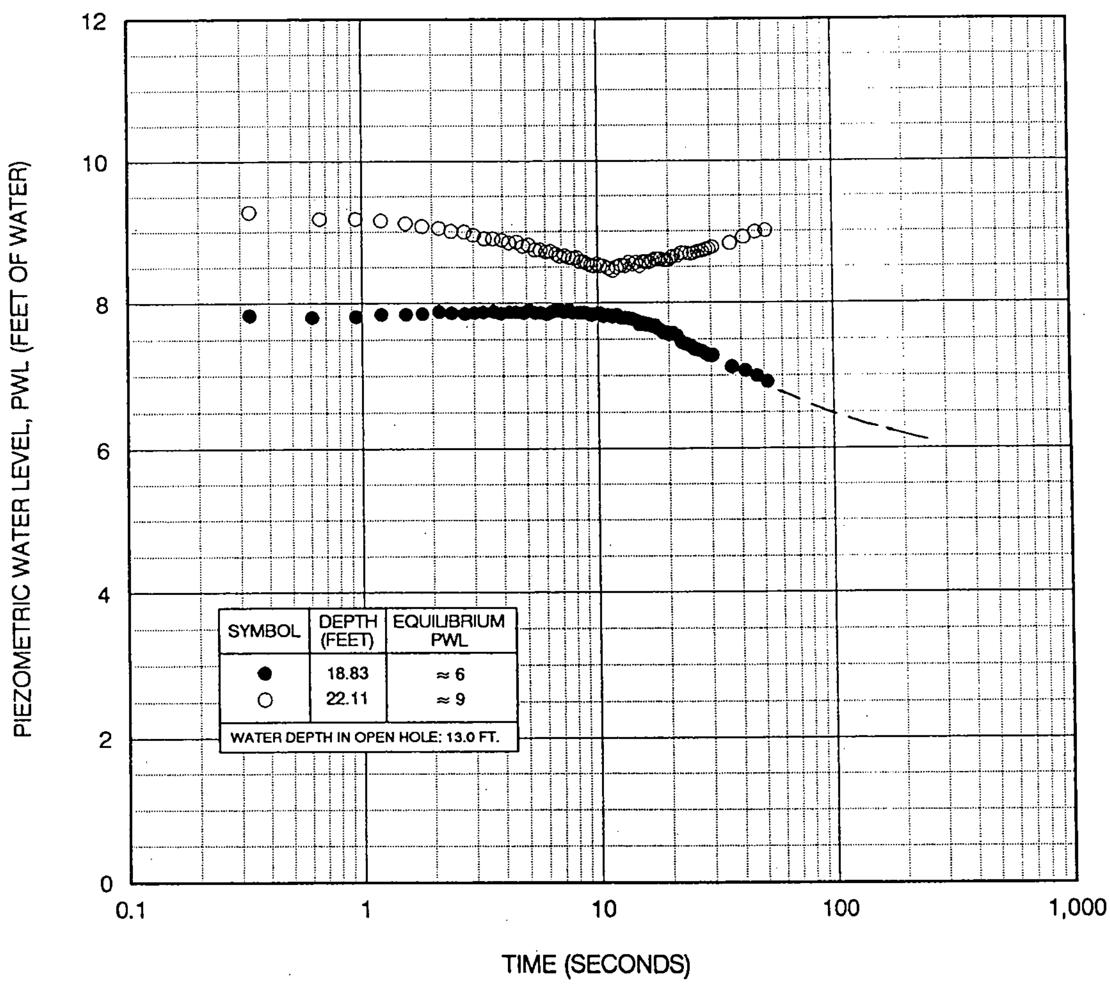


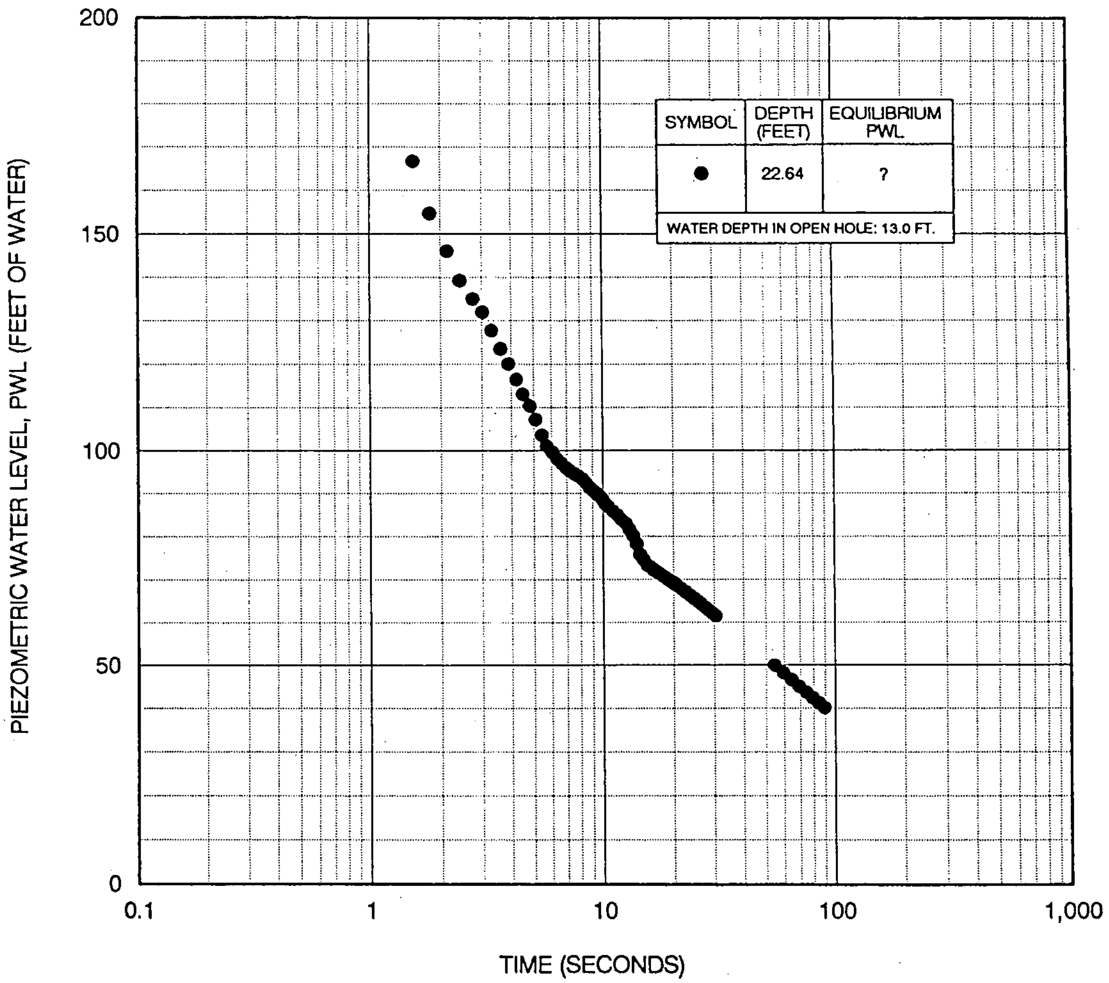
FIGURE 36

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-11

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:



PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-11

FIGURE 37

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

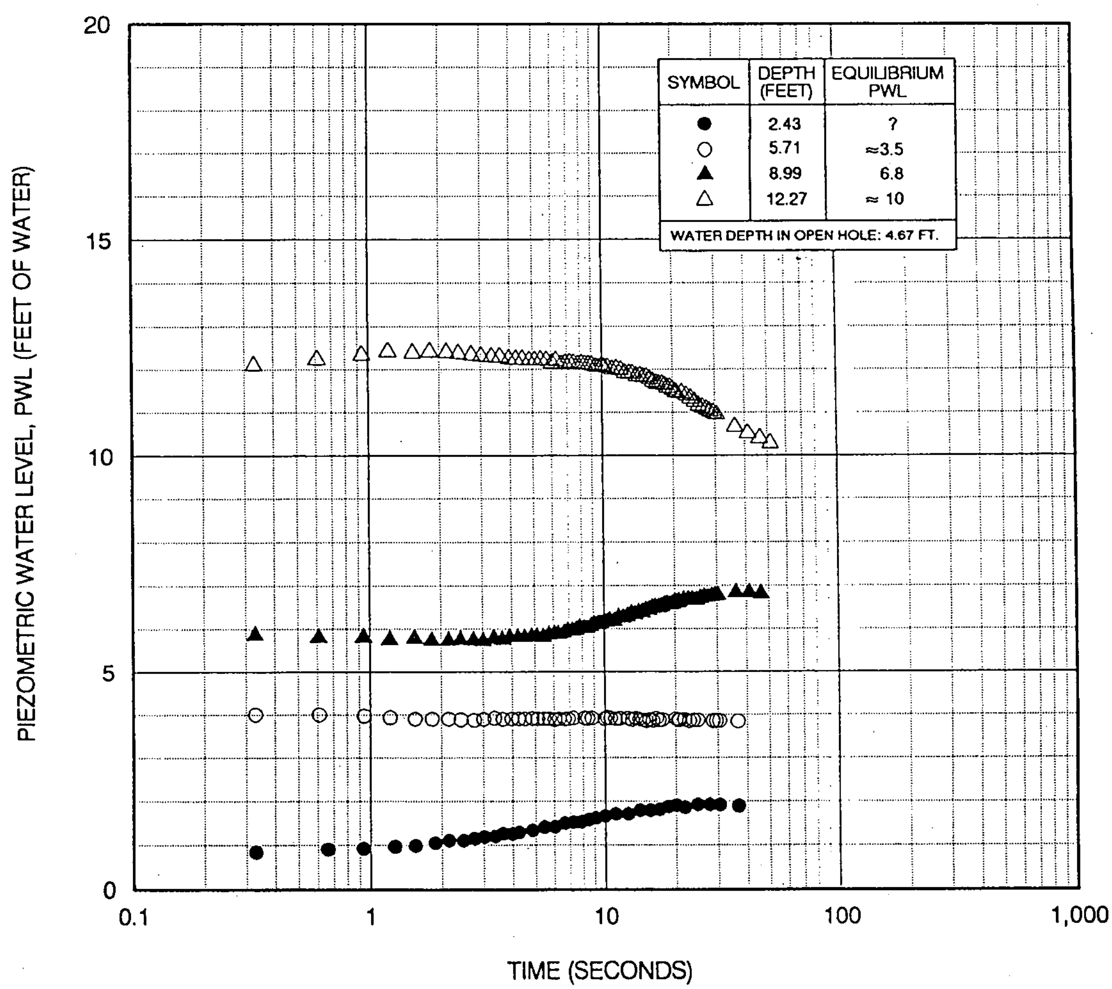


FIGURE 38

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-12

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

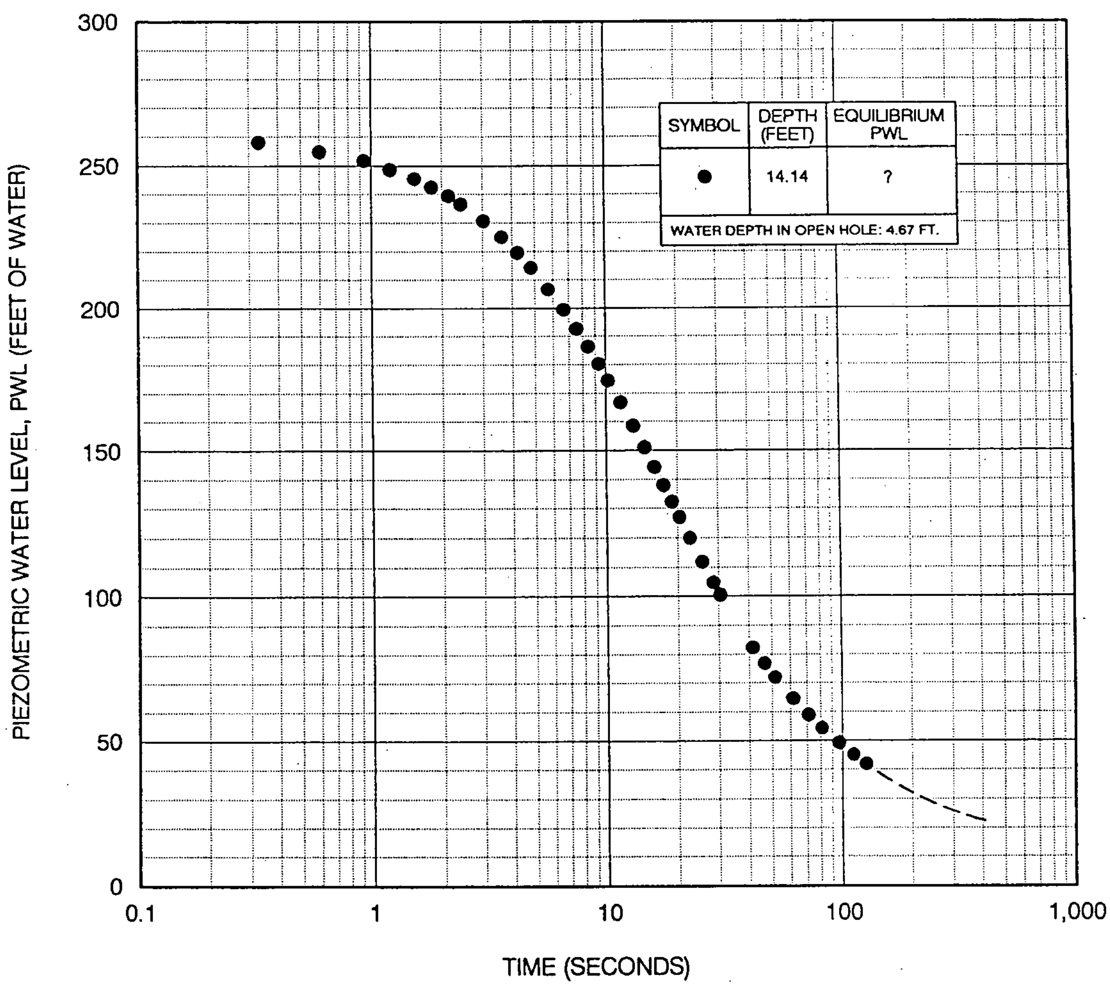


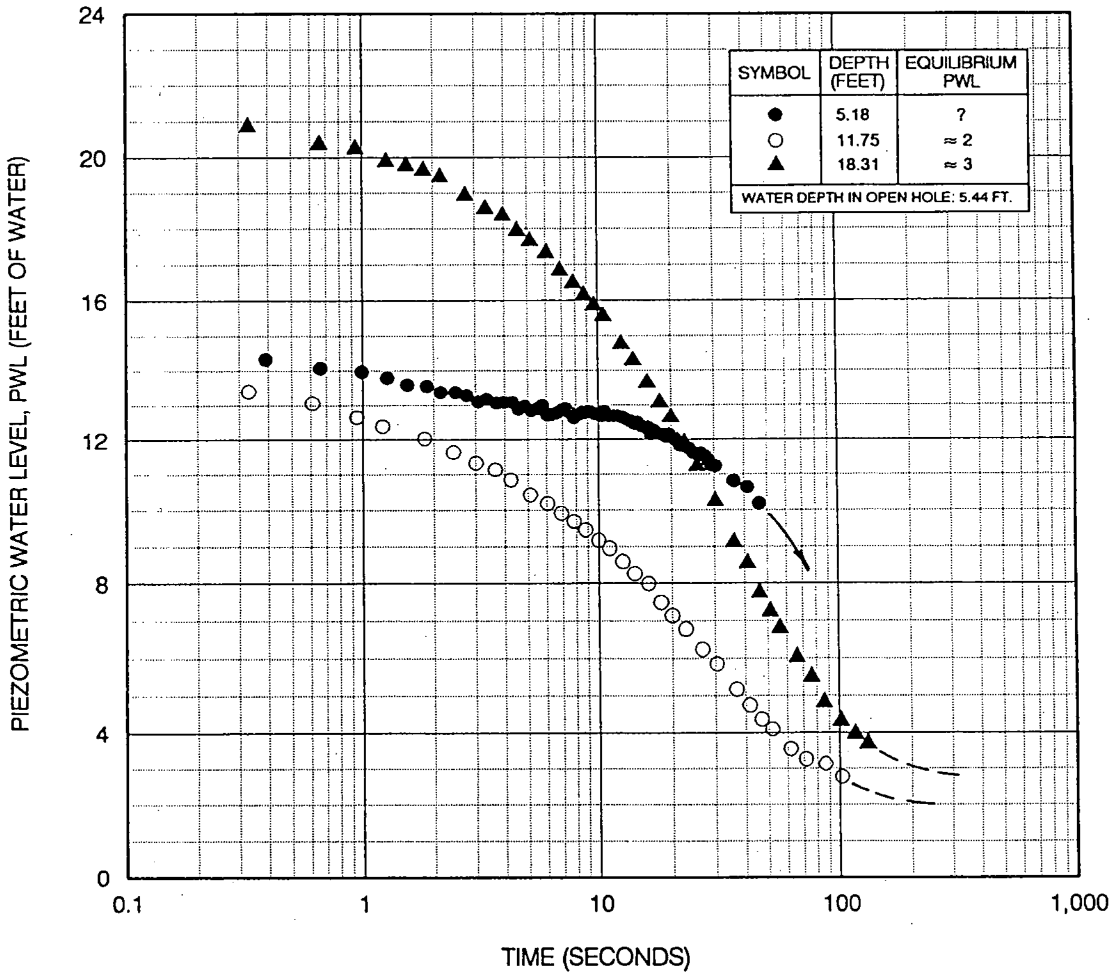
FIGURE 39

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-12

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:



PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-13

FIGURE 40

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

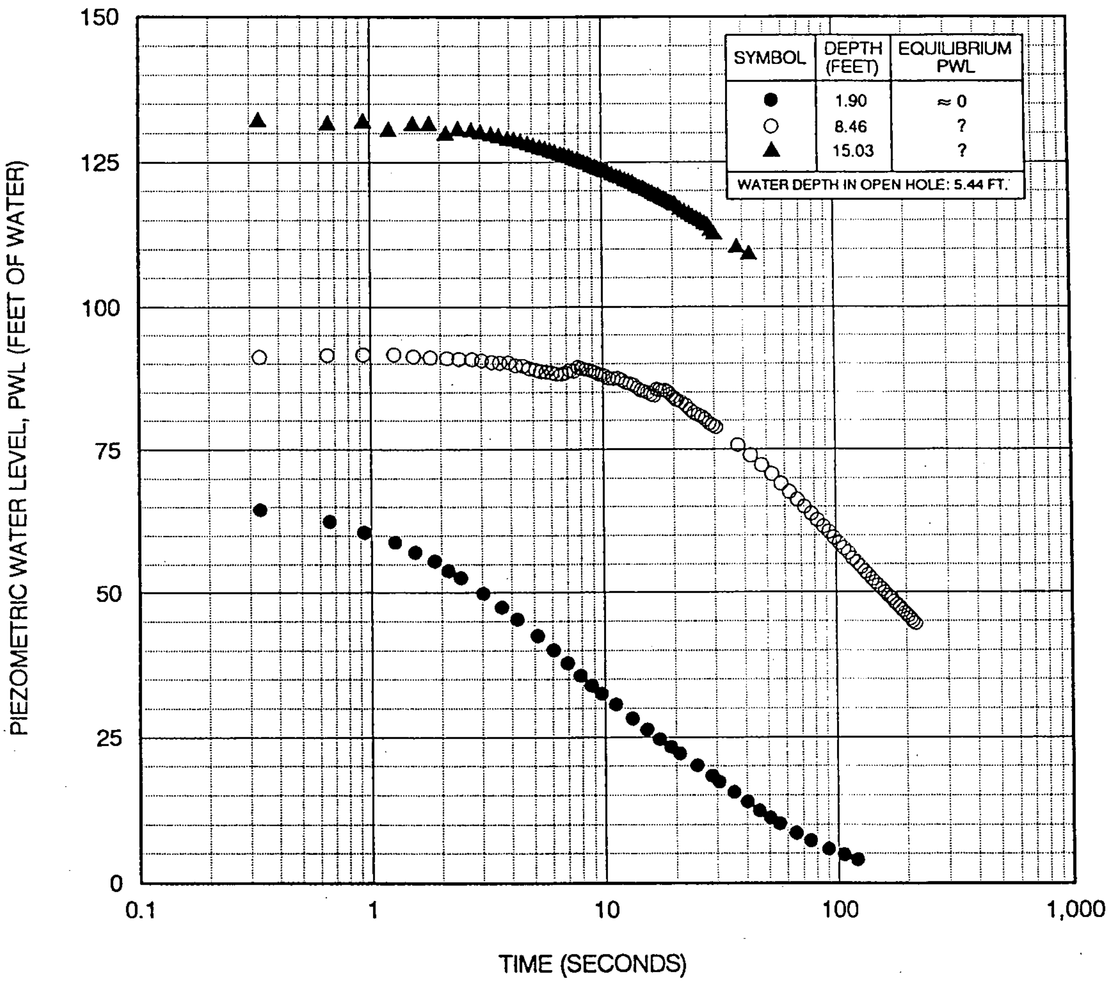


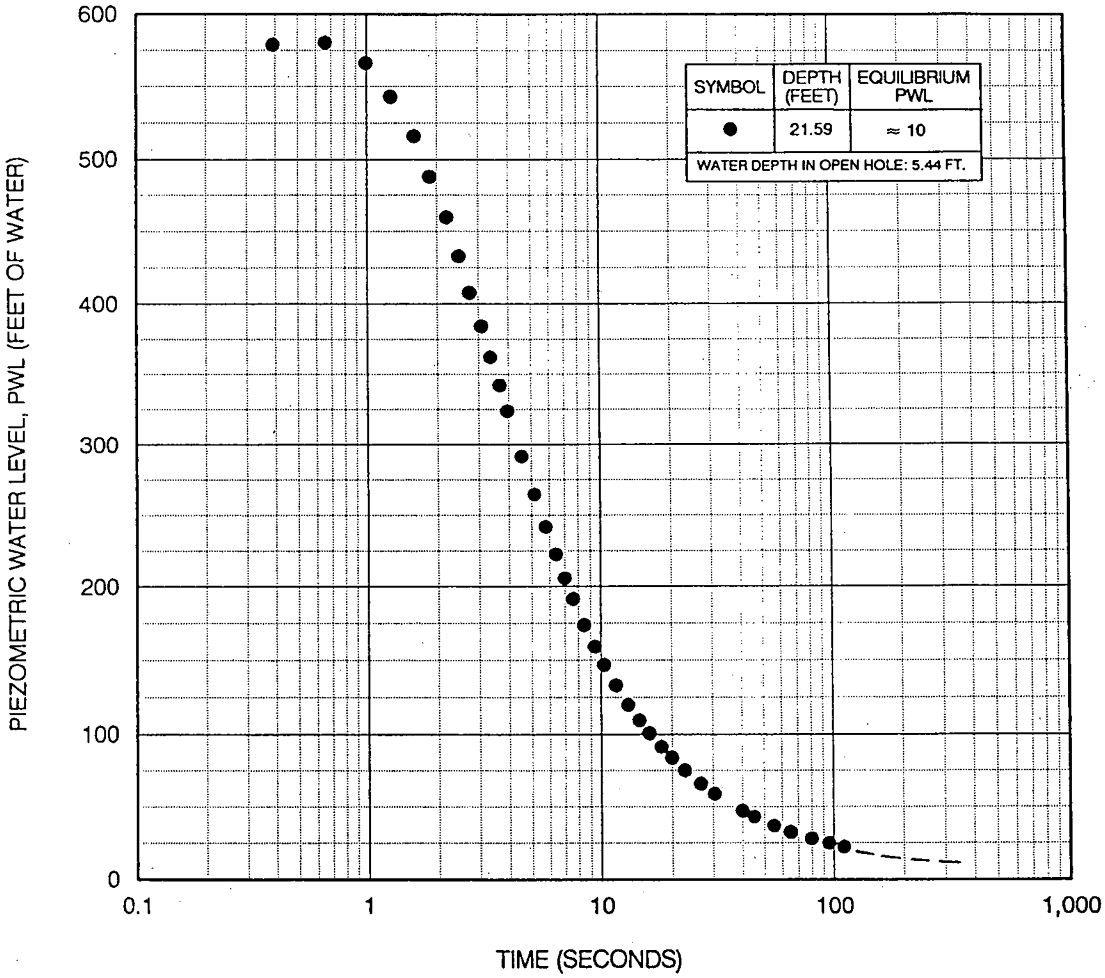
FIGURE 41

PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-13

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

**SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997**

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:



PORE PRESSURE DISSIPATION RESULTS FOR PIEZOCONE SOUNDING NO. CPTU-13

FIGURE 42

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
PIEZOCONE TEST SOUNDINGS
APRIL 21-22, 1997

DRAWN BY: RW	CHECKED BY:	DATE: 4/28/97
FILE NO.: 97-9628	APPROVED BY:	FIGURE:

APPENDIX A
FIELD TEST PROCEDURES FOR STANDARD PENETRATION TESTS (SPT)

STANDARD PENETRATION TEST

The Standard Penetration Test is a widely accepted method of in-situ testing of foundation soils (ASTM D-1586). A 2-foot long, 2-inch outside diameter, split-barrel ("spoon") sampler, attached to the end of drilling rods, is driven 18 inches into the ground by successive blows of a 140-pound hammer freely dropping 30 inches. The number of blows needed for each six inches of penetration is recorded. The sum of the blows required for penetration of the second and third 6-inch increments of penetration constitutes the test result or N-value. After the test, the sampler is extracted from the ground and opened to allow visual examination and classification of the retained soil sample. The N-value has been empirically correlated with various soil properties allowing a conservative estimate of the behavior of soils under load.

The tests are usually performed at 5-foot intervals. However, more frequent or continuous testing is done by our firm through depths where a more accurate definition of the soils is required. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. Usually, the circulating fluid, which is a bentonite drilling mud, also serves to keep the hole open below the water table by maintaining an excess hydrostatic pressure inside the hole. In some soil deposits, particularly highly pervious ones, flush-coupled casing must be driven to just above the testing depth to keep the hole open and/or to prevent the loss of circulating fluid.

Representative split-spoon samples from soils at every 5 feet of drilled depth and from every different stratum are brought to our laboratory in air-tight jars for further evaluation and testing, if necessary. Samples not used in testing are stored for at least sixty (60) days prior to being discarded. After completion of a test boring, the hole is kept open until a steady state groundwater level is recorded. The hole is then sealed if necessary, and backfilled.

APPENDIX B
FIELD TEST PROCEDURES FOR CONE PENETRATION TEST SOUNDINGS (CPT)

CONE PENETROMETER TESTS

The Dutch Cone Penetrometer is an in-situ deep-testing device utilized to obtain information concerning the strength and compressibility of foundation soils. In the test a shaft with a conical point is pushed into the soil. The resistance to penetration of the point and the friction developed on the circumference of the shaft are measured. The measured values constitute the test result. The cone apparatus does not recover soil samples. Originally developed and extensively used in Europe, the Dutch Cone has recently been accepted in the United States as a valuable geotechnical engineering tool (ASTM Special Technical Publication 479). Similar portable hand-operated penetrometers have been used extensively by our firm for many years as an alternate means for compaction control work and shallow subsurface soil exploration.

The Dutch Cone or Begemann penetrometer employs a 60-degree, hardened-steel cone point with a projected area of 10 square centimeters. The point is located at the end of a smooth cylindrical shaft which is free to move ahead of a second slightly larger cylindrical shaft of friction sleeve. The testing assembly is attached to the end of a string of concentric inner and outer rods which connect it to the surface. The outer rods are used to push the testing assembly and the inner rods to the desired testing depth where they are disengaged and remain stationary while the test is being performed.

During the test, the inner rods are engaged and a hydraulic jack is used to push the cone point ahead of the friction sleeve. After a free travel of 1.5 inches, the friction sleeve engages and together with the cone tip they are pushed an additional 1.7 inches. Penetration speed is one to two centimeters per second. The thrust required to push the cone tip alone, and that required to push it and the friction sleeve are measured by the sensitive pressure gauges. After the completion of the test, the outer rods are reengaged and pushed, collapsing the telescoped testing device and carrying it to the next testing depth which is usually 20 centimeters deeper and the test is repeated. The value of the bearing pressure exerted by the cone point (q_{cone}) has been empirically correlated to various soil properties. The ratio of this value, q_{cone}, to the value of the frictional resistance of the disturbed soils surrounding the friction sleeve gives an indication of type of soil penetrated.

The mantle cone, which we occasionally use, is essentially a Dutch Cone without the friction sleeve. The conical tip which bears directly upon the soil is like that of the Dutch Cone and the procedure of testing is similar to that described above, except that only the cone bearing value, q_{cone}, is obtained.

APPENDIX C
FIELD TEST PROCEDURES FOR THIN-WALLED TUBE SAMPLING OF SOILS

THIN-WALLED TUBE SAMPLING OF SOILS

Thin-walled tube sampling of soils is performed, when it is necessary to secure a relatively undisturbed sample of soil, for subsequent use in the soils laboratory. Undisturbed samples are used to provide test specimens for laboratory shear tests, permeability tests, consolidation tests, and other tests where minimum sample disturbance is desired.

The procedure for obtaining thin-walled tube samples is described in ASTM Standard D-1587. Tube samples can be obtained at any desired depth, using appropriate exploration equipment and sampling equipment. Suitable tube sizes and dimensions are shown in Table I of ASTM D-1587. Variations in the sampling technique described in ASTM D-1587 may include using an inner piston to create a suction on the sample (useful in retrieving very soft or loose saturated soils), using a spring loaded mechanism to allow advancement of the tube using a constant pressure, and the use of a water-flushed exterior core barrel to allow penetration of very stiff clay soils or of very sensitive soils.

The above sampling variations are commonly referred to as Shelby Tube, Piston, and Pitcher or Dennison sampling methods. The most common method of sampling is the Shelby Tube method. The Shelby Tube method is used when sampling soft to stiff cohesive soils, above or below the water table or medium dense, fine to medium grained sandy soils above the water table. The sample is obtained by pushing a 3-inch diameter , 30-inch long, thin-walled tube through the soil, at the desired depth, a distance of 24 inches.

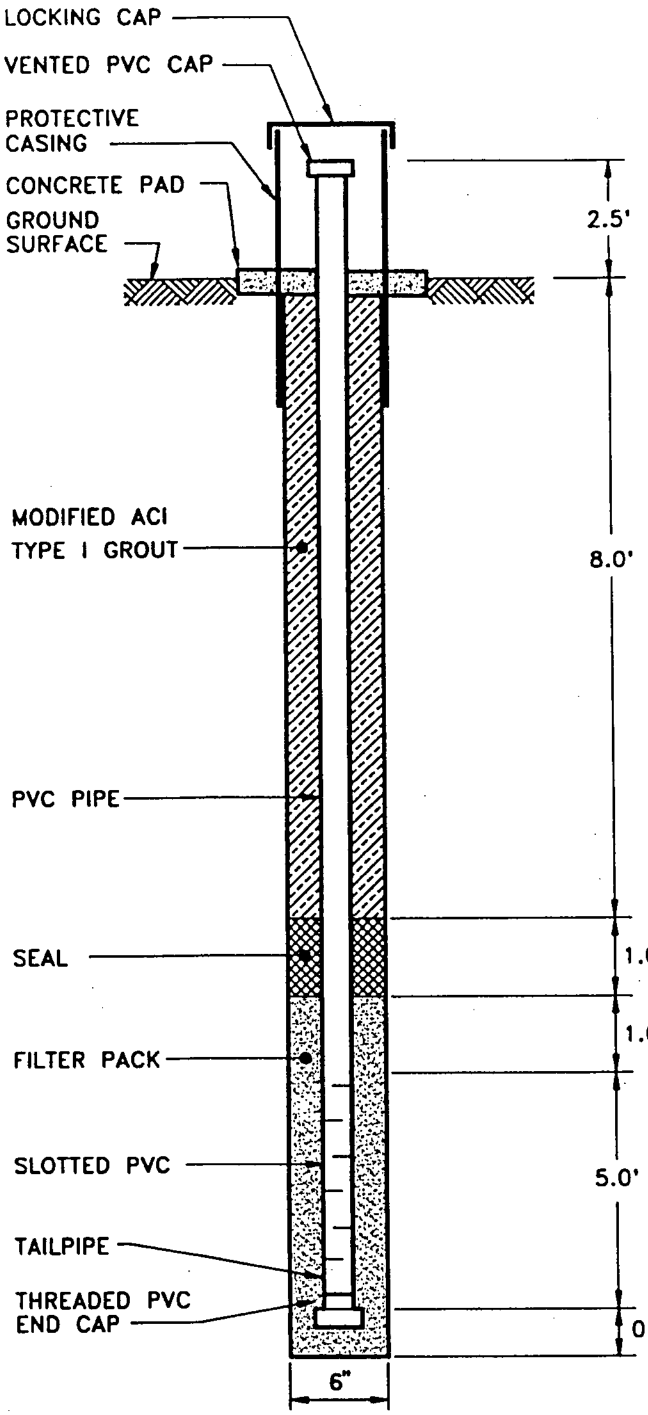
Following a short "resting period", to allow dissipation of excess pore water pressure in the soil, the sampler is rotated, to shear the soil at the base, and withdrawn to the surface. Excess hydrostatic pressure, if the sample is below the water table, is dissipated by means of a check valve at the top of the sampler.

After the sample has been retrieved, the ends of the tube are sealed to prevent the loss of moisture. Preparation for transportation of the sample to the laboratory includes cushioning the tube to prevent impacts which might disturb the sample, and transporting it in the upright orientation, in which it existed in the ground. The sample tube is then transported to the laboratory for visual examination and specified testing.

c:appendix.twt

APPENDIX D
PIEZOMETER INSTALLATION RECORDS/COMPLETION REPORTS

PIEZOMETER WELL INSTALLATION RECORD P1-D



File No.: 97-9628

Project: SOUTH EAST LANDFILL

Client: HILLSBOROUGH COUNTY SOLID WASTE DEPT.

Well No.: P1-D

Date Installed: 4-24-97

Crew Supervisor: E. PARKER

Well Location: N 1250752.913

E 442931.011

TOC (MSL): 129.35

Protective Casing: (size and type)

4" ALUMINUM

Concrete Pad: (size) 2' x 2' x 4"

PVC Pipe: (size and type)

2" SCHEDULE 40, THREADED

Seal: (type) BENTONITE

Filter Pack: (type) 30/65 SILICA SAND

Slotted PVC: (size and type)

2"ø 0.01" SLOTTED WELL SCREEN

Total Length of PVC Pipe:	12.5	ft(BLS)
Total Length of Slotted PVC:	5	ft(BLS)
Total Length of End Point:	0	ft
Total Depth of Well:	15	ft(BLS)

No. Bags of Cement:	2
No. Bags of Filter Pack:	8
Amount of Seal:	25 lbs.

Remarks:

Water Level Readings:

Date: 4-24-97

Depth BTOC: 9'0" Depth BLS: 6'6"

Date:

Depth BTOC: Depth BLS:

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

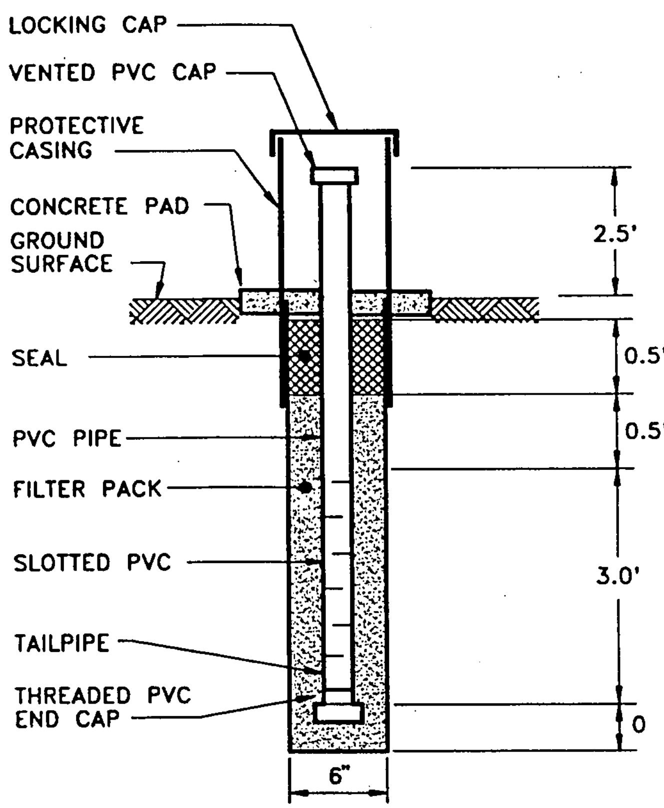
BLS: = Below Land Surface
BTOC: = Below Top of Casing
TOC: = Top of Casing
MSL: = Mean Sea Level

97-9628\P1-D

PIEZOMETER WELL INSTALLATION RECORD P1-S

File No.: 97-9628
Project: SOUTH EAST LANDFILL
Client: HILLSBOROUGH COUNTY SOLID WASTE DEPT.

Well No.: P1-S
Date Installed: 4-24-97
Crew Supervisor: E. PARKER
Well Location: N 1250744.422
E 442937.500
TOC (MSL): 129.76



Protective Casing: (size and type)
4" ALUMINUM
Concrete Pad: (size) 2' x 2' x 4"
PVC Pipe: (size and type)
2" SCHEDULE 40, THREADED
Seal: (type) BENTONITE
Filter Pack: (type) 30/65 SILICA SAND
Slotted PVC: (size and type)
2"ø 0.01" SLOTTED WELL SCREEN

Total Length of PVC Pipe: 3.5 ft(BLS)
Total Length of Slotted PVC: 3 ft(BLS)
Total Length of End Point: 0 ft
Total Depth of Well: 4 ft(BLS)

No. Bags of Cement: NA
No. Bags of Filter Pack: 3
Amount of Seal: 25 lbs.

Water Level Readings:
Date: 4-24-97
Depth BTOC: 5'9" Depth BLS: 3'6"
Date: ________
Depth BTOC: ________ Depth BLS: ________

Remarks: ________

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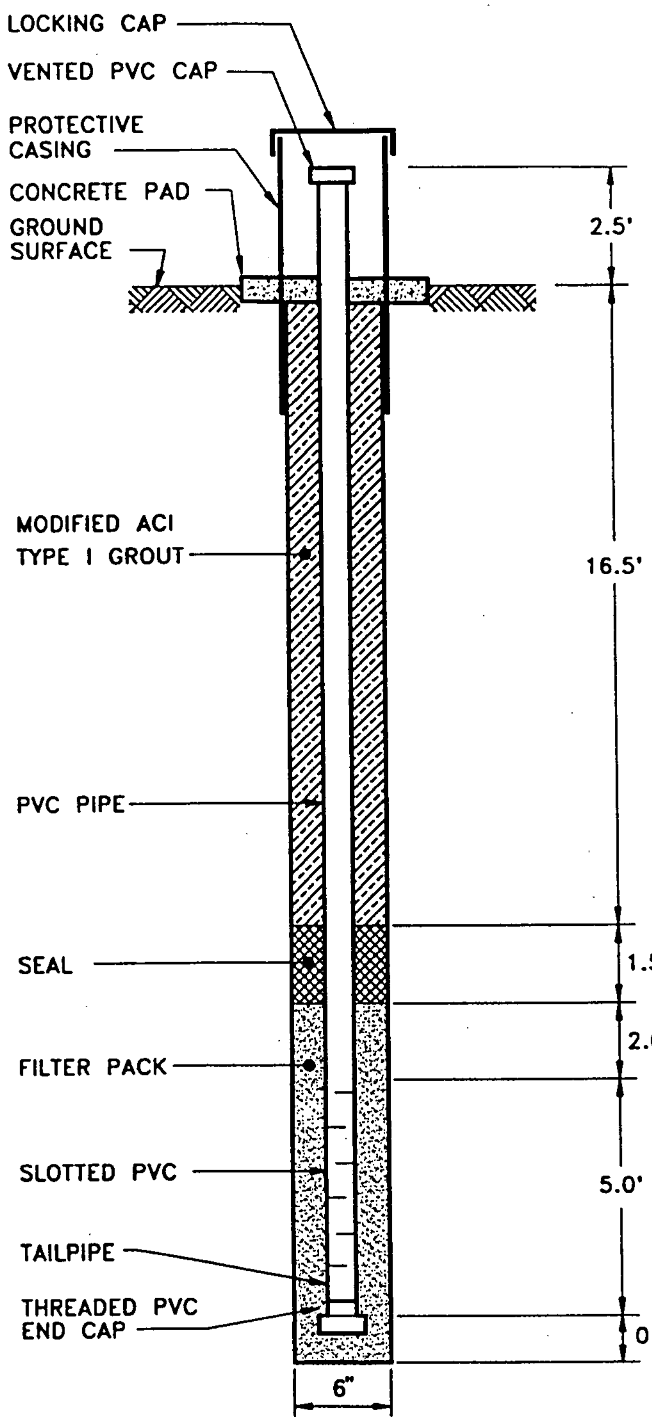
BLS: = Below Land Surface
BTOC: = Below Top of Casing
TOC: = Top of Casing
MSL: = Mean Sea Level

97-9628\P1-S

PIEZOMETER WELL INSTALLATION RECORD P-2D



File No.: 97-9628

Project: SOUTH EAST LANDFILL

Client: HILLSBOROUGH COUNTY SOLID WASTE DEPT.

Well No.: P-2D

Date Installed: 4-24-97

Crew Supervisor: E. PARKER

Well Location: N 1251708.752

E 442844.414

TOC (MSL): 138.59

Protective Casing: (size and type)

4" ALUMINUM

Concrete Pad: (size) 2' x 2' x 4"

PVC Pipe: (size and type)

2" SCHEDULE 40, THREADED

Seal: (type) BENTONITE

Filter Pack: (type) 30/65 SILICA SAND

Slotted PVC: (size and type)

2"ø 0.01" SLOTTED WELL SCREEN

Total Length of PVC Pipe: 22.5 ft(BLS)

Total Length of Slotted PVC: 5 ft(BLS)

Total Length of End Point: 0 ft

Total Depth of Well: 25 ft(BLS)

No. Bags of Cement: 4

No. Bags of Filter Pack: 9

Amount of Seal: 50 lbs.

Remarks:

Water Level Readings:

Date: 4-24-97

Depth BTOC: 21'4" Depth BLS: 18'10"

Date:

Depth BTOC: Depth BLS:

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Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

BLS: = Below Land Surface
BTOC: = Below Top of Casing
TOC: = Top of Casing
MSL: = Mean Sea Level

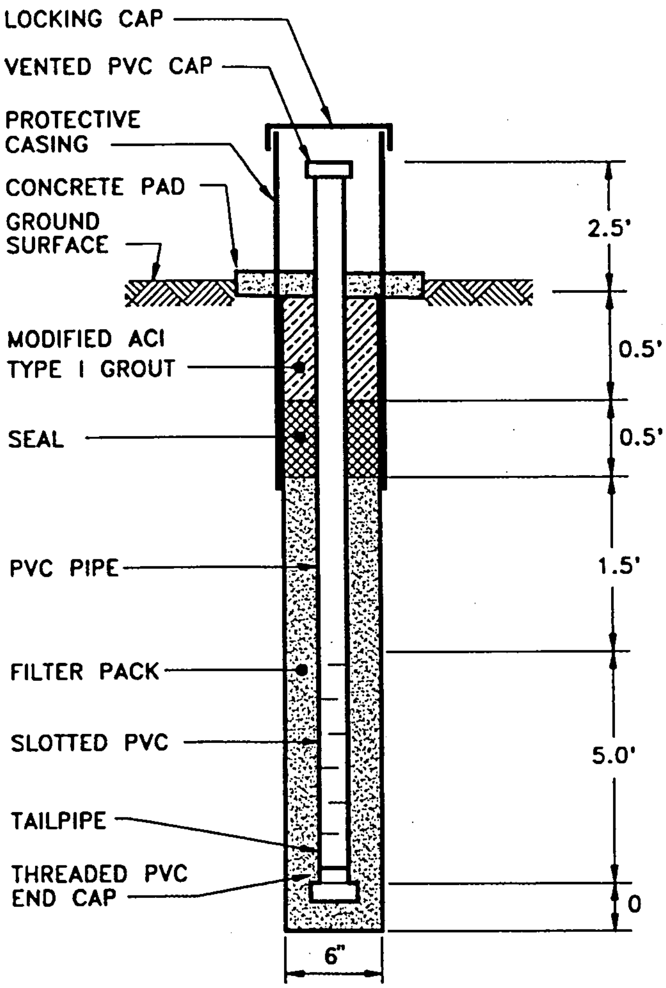
97-9628\P-2D

PIEZOMETER WELL INSTALLATION RECORD P-2S

File No.: 97-9628

Project: SOUTH EAST LANDFILL

Client: HILLSBOROUGH COUNTY SOLID WASTE DEPT.



Well No.: P-2S

Date Installed: 4-24-97

Crew Supervisor: E. PARKER

Well Location: N 1251700.153

E 442849.597

TOC (MSL): 138.76

Protective Casing: (size and type)

4" ALUMINUM

Concrete Pad: (size) 2' x 2' x 4"

PVC Pipe: (size and type)

2" SCHEDULE 40, THREADED

Seal: (type) BENTONITE

Filter Pack: (type) 30/65 SILICA SAND

Slotted PVC: (size and type)

2"ø 0.01" SLOTTED WELL SCREEN

Total Length of PVC Pipe: 5 ft(BLS)

Total Length of Slotted PVC: 5 ft(BLS)

Total Length of End Point: 0 ft

Total Depth of Well: 7.5 ft(BLS)

No. Bags of Cement: <1

No. Bags of Filter Pack: 3

Amount of Seal: 25 lbs.

Remarks:

Water Level Readings:

Date: 4-24-97

Depth BTOC: 8'10" Depth BLS: 6'4"

Date:

Depth BTOC: Depth BLS:

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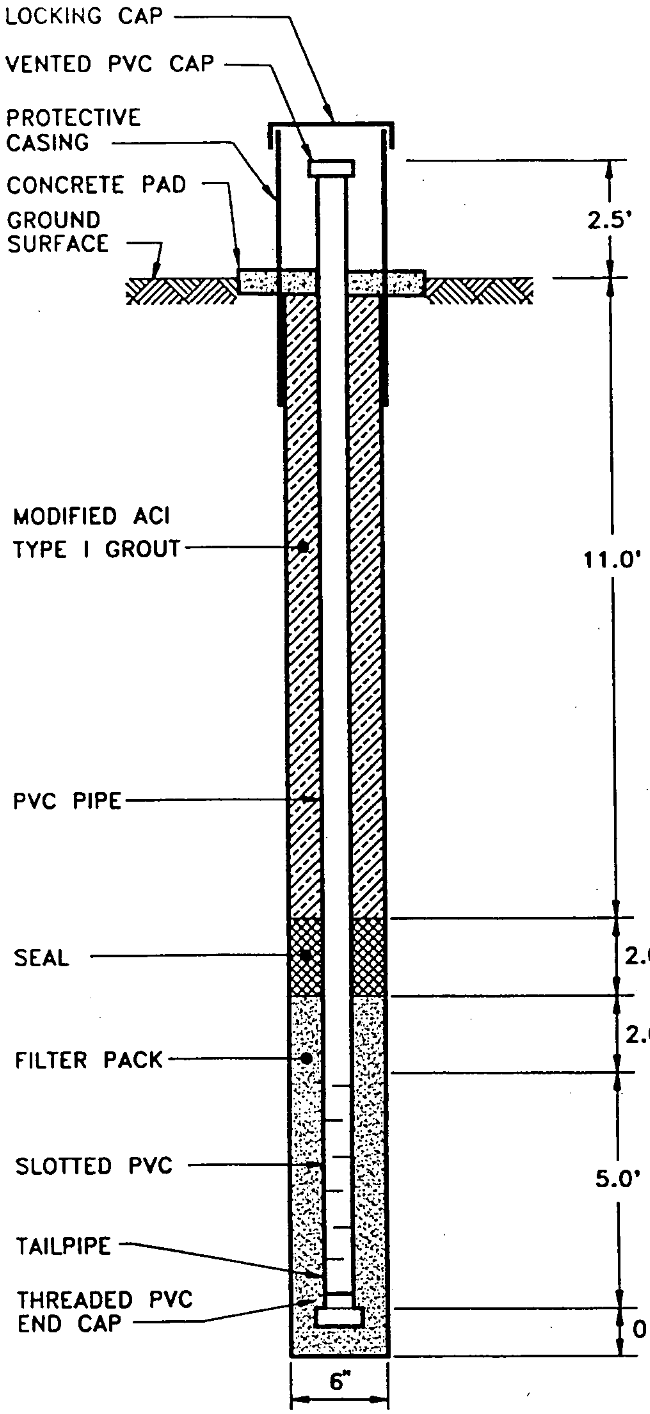
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

BLS: = Below Land Surface
BTOC: = Below Top of Casing
TOC: = Top of Casing
MSL: = Mean Sea Level

97-9628\P-2S

PIEZOMETER WELL INSTALLATION RECORD P-3D



File No.: 97-9628
Project: SOUTH EAST LANDFILL
Client: HILLSBOROUGH COUNTY SOLID WASTE DEPT.

Well No.: P-3D
Date Installed: 4-24-97
Crew Supervisor: E. PARKER
Well Location: N 1251884.384
E 443578.301
TOC (MSL): 143.10

Protective Casing: (size and type)
4" ALUMINUM
Concrete Pad: (size) 2' x 2' x 4"
PVC Pipe: (size and type)
2" SCHEDULE 40, THREADED
Seal: (type) BENTONITE
Filter Pack: (type) 30/65 SILICA SAND
Slotted PVC: (size and type)
2"ø 0.01" SLOTTED WELL SCREEN

Total Length of PVC Pipe: 17.5 ft(BLS)
Total Length of Slotted PVC: 5 ft(BLS)
Total Length of End Point: 0 ft
Total Depth of Well: 20 ft(BLS)

No. Bags of Cement: 3
No. Bags of Filter Pack: 3
Amount of Seal: 50 lbs.

Water Level Readings:
Date: 4-24-97
Depth BTOC: 21'6" Depth BLS: 19'0"
Date: ______
Depth BTOC: ______ Depth BLS: ______

Remarks: ______

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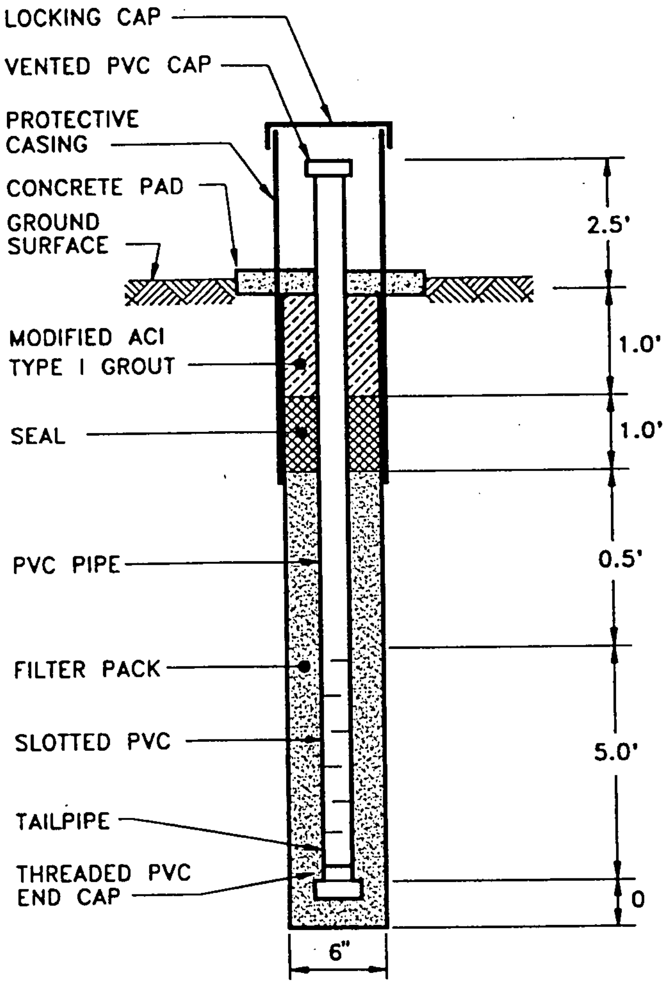
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

BLS: = Below Land Surface
BTOC: = Below Top of Casing
TOC: = Top of Casing
MSL: = Mean Sea Level

97-9628\P-3D

PIEZOMETER WELL INSTALLATION RECORD P-3S

File No.: 97-9628
Project: SOUTH EAST LANDFILL
Client: HILLSBOROUGH COUNTY SOLID WASTE DEPT.



Well No.: P-3S
Date Installed: 4-24-97
Crew Supervisor: E. PARKER
Well Location: N 1251896.462
E 443580.830
TOC (MSL): 143.20

Protective Casing: (size and type)
4" ALUMINUM
Concrete Pad: (size) 2' x 2' x 4"
PVC Pipe: (size and type)
2" SCHEDULE 40, THREADED
Seal: (type) BENTONITE
Filter Pack: (type) 30/65 SILICA SAND
Slotted PVC: (size and type)
2"ø 0.01" SLOTTED WELL SCREEN

Total Length of PVC Pipe: 5 ft(BLS)
Total Length of Slotted PVC: 5 ft(BLS)
Total Length of End Point: 0 ft
Total Depth of Well: 7.5 ft(BLS)

No. Bags of Cement: <1
No. Bags of Filter Pack: 3
Amount of Seal: 25 lbs.

Remarks:

Water Level Readings:
Date: 4-24-97
Depth BTOC: 0'0" (DRY) Depth BLS: DRY
Date:
Depth BTOC: Depth BLS:

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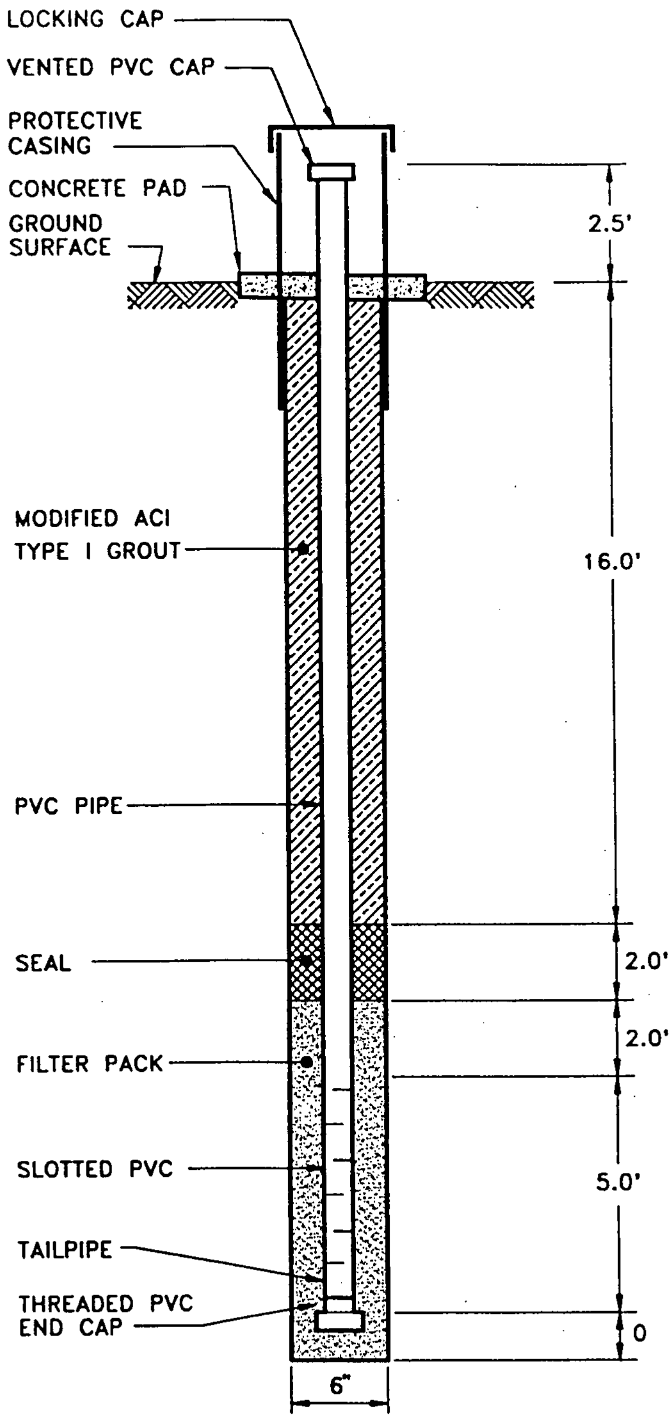
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

BLS: = Below Land Surface
BTOC: = Below Top of Casing
TOC: = Top of Casing
MSL: = Mean Sea Level

97-9628\P-3S

PIEZOMETER WELL INSTALLATION RECORD P-4D



File No.: 97-9628

Project: SOUTH EAST LANDFILL

Client: HILLSBOROUGH COUNTY SOLID WASTE DEPT.

Well No.: P-4D

Date Installed: 4-25-97

Crew Supervisor: E. PARKER

Well Location: N 1252160.687

E 442204.283

TOC (MSL): 141.68

Protective Casing: (size and type)

4" ALUMINUM

Concrete Pad: (size) 2' x 2' x 4"

PVC Pipe: (size and type)

2" SCHEDULE 40, THREADED

Seal: (type) BENTONITE

Filter Pack: (type) 30/65 SILICA SAND

Slotted PVC: (size and type)

2"ø 0.01" SLOTTED WELL SCREEN

Total Length of PVC Pipe: 22.5 ft(BLS)

Total Length of Slotted PVC: 5 ft(BLS)

Total Length of End Point: 0 ft

Total Depth of Well: 25 ft(BLS)

No. Bags of Cement: 3

No. Bags of Filter Pack: 3

Amount of Seal: 50 lbs.

Water Level Readings:

Date: 4-25-97

Depth BTOC: 18'2" Depth BLS: 15'8"

Date: ________

Depth BTOC: ________ Depth BLS: ________

Remarks: ________

Ardaman & Associates, Inc.

Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

BLS: = Below Land Surface
BTOC: = Below Top of Casing
TOC: = Top of Casing
MSL: = Mean Sea Level

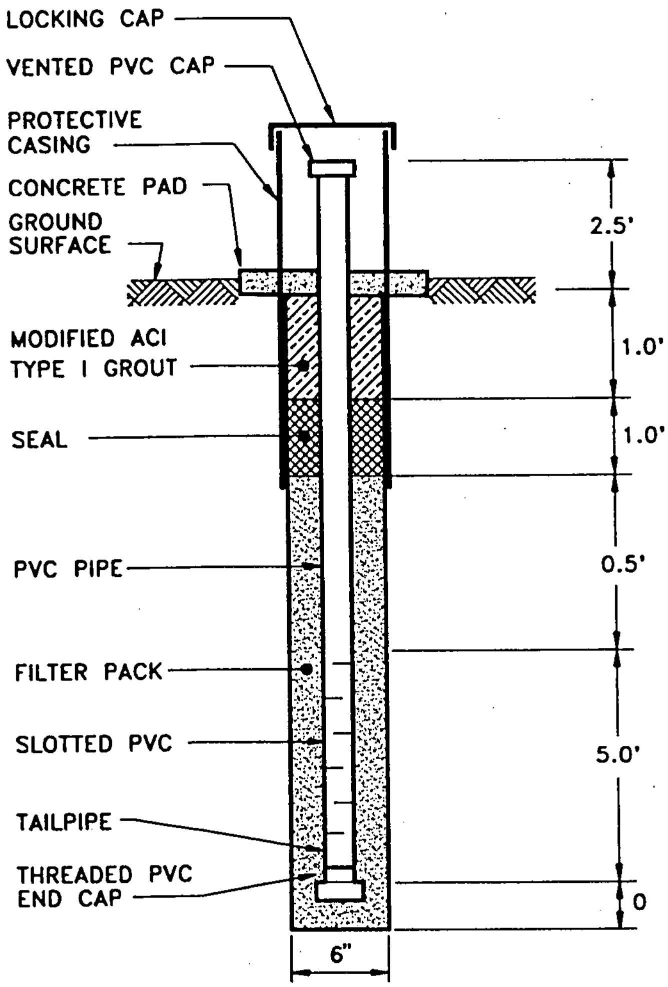
97-9628\P-4D

PIEZOMETER WELL INSTALLATION RECORD P-4S

File No.: 97-9628

Project: SOUTH EAST LANDFILL

Client: HILLSBOROUGH COUNTY SOLID WASTE DEPT.



Well No.: P-4S

Date Installed: 4-25-97

Crew Supervisor: E. PARKER

Well Location: N 1252153.106

E 442200.956

TOC (MSL): 141.86

Protective Casing: (size and type)

4" ALUMINUM

Concrete Pad: (size) 2' x 2' x 4"

PVC Pipe: (size and type)

2" SCHEDULE 40, THREADED

Seal: (type) BENTONITE

Filter Pack: (type) 30/65 SILICA SAND

Slotted PVC: (size and type)

2"ø 0.01" SLOTTED WELL SCREEN

Total Length of PVC Pipe: 5 ft(BLS)

Total Length of Slotted PVC: 5 ft(BLS)

Total Length of End Point: 0 ft

Total Depth of Well: 7.5 ft(BLS)

No. Bags of Cement: 1

No. Bags of Filter Pack: <1

Amount of Seal: 25 lbs.

Remarks: ____________________

Water Level Readings:

Date: 4-25-97

Depth BTOC: 3'8" Depth BLS: 1'2"

Date: ________

Depth BTOC: ________ Depth BLS: ________

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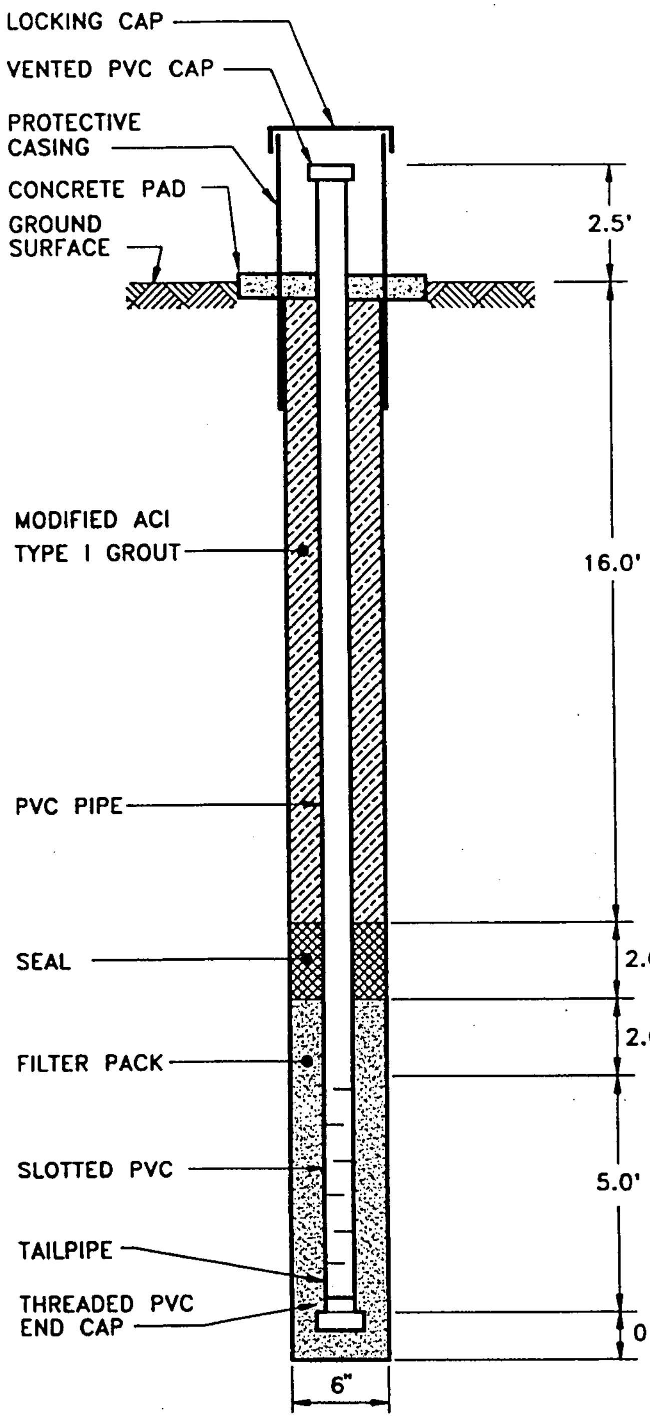
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

BLS: = Below Land Surface
BTOC: = Below Top of Casing
TOC: = Top of Casing
MSL: = Mean Sea Level

97-9628\P-4S

PIEZOMETER WELL INSTALLATION RECORD P-5D



File No.: 97-9628
Project: SOUTH EAST LANDFILL
Client: HILLSBOROUGH COUNTY SOLID WASTE DEPT.

Well No.: P-5D
Date Installed: 4-29-97
Crew Supervisor: E. PARKER
Well Location: N 123584.016
E 443356.615
TOC (MSL): 156.75

Protective Casing: (size and type)
4" ALUMINUM
Concrete Pad: (size) 2' x 2' x 4"
PVC Pipe: (size and type)
2" SCHEDULE 40, THREADED
Seal: (type) BENTONITE
Filter Pack: (type) 30/65 SILICA SAND
Slotted PVC: (size and type)
2"ø 0.01" SLOTTED WELL SCREEN

Total Length of PVC Pipe: 22.5 ft(BLS)
Total Length of Slotted PVC: 5 ft(BLS)
Total Length of End Point: 0 ft
Total Depth of Well: 25 ft(BLS)

No. Bags of Cement: 4
No. Bags of Filter Pack: 5
Amount of Seal: 50 lbs.

Remarks:

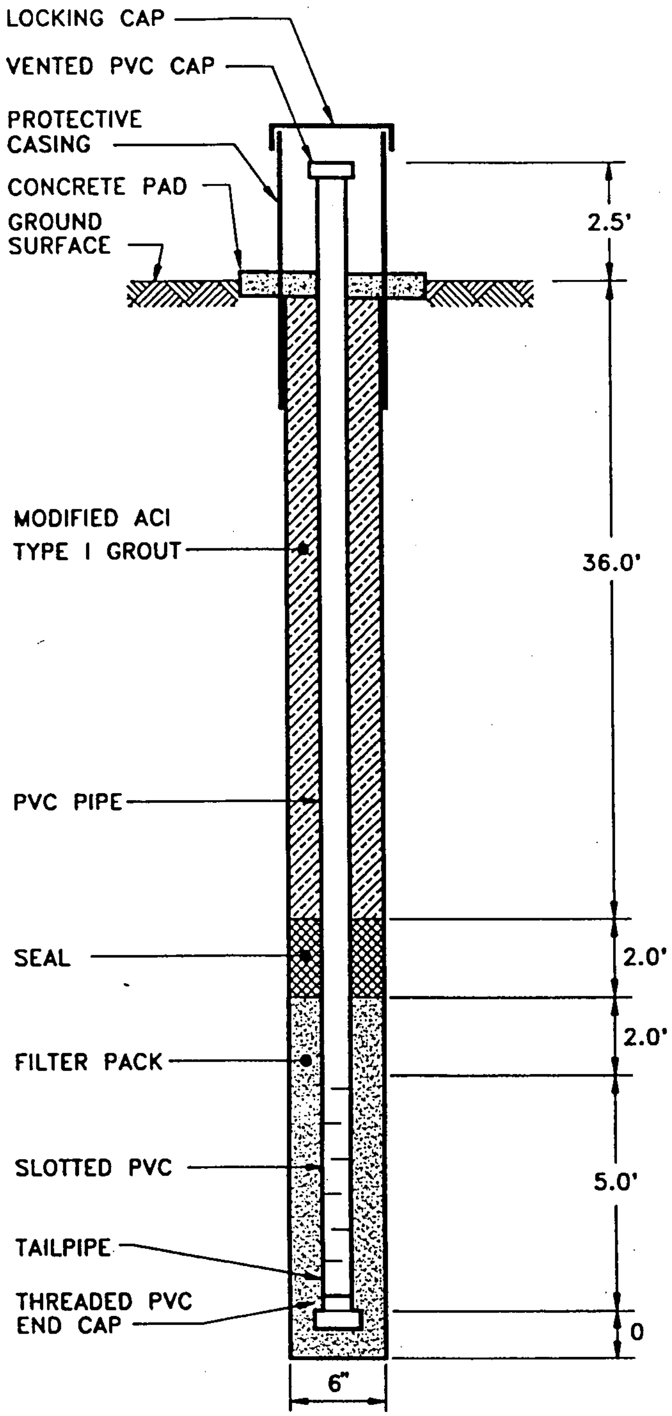
Water Level Readings:
Date: 4-29-97
Depth BTOC: 18'2" Depth BLS: 15'8"
Date:
Depth BTOC: Depth BLS:

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

BLS: = Below Land Surface
BTOC: = Below Top of Casing
TOC: = Top of Casing
MSL: = Mean Sea Level

97-9628\P-5D

PIEZOMETER WELL INSTALLATION RECORD P-6D



File No.: 97-9628
Project: SOUTH EAST LANDFILL
Client: HILLSBOROUGH COUNTY SOLID WASTE DEPT.

Well No.: P-6D
Date Installed: 5-1-97
Crew Supervisor: E. PARKER
Well Location: N 1253248.997
E 444329.166
TOC (MSL): 159.03

Protective Casing: (size and type)
4" ALUMINUM
Concrete Pad: (size) 2' x 2' x 4"
PVC Pipe: (size and type)
2" SCHEDULE 40, THREADED
Seal: (type) BENTONITE
Filter Pack: (type) 30/65 SILICA SAND
Slotted PVC: (size and type)
2"ø 0.01" SLOTTED WELL SCREEN

Total Length of PVC Pipe: 42.5 ft(BLS)
Total Length of Slotted PVC: 5 ft(BLS)
Total Length of End Point: 0 ft
Total Depth of Well: 45 ft(BLS)

No. Bags of Cement: 7
No. Bags of Filter Pack: 3
Amount of Seal: 50 lbs.

Remarks:

Water Level Readings:
Date: 5-1-97
Depth BTOC: 35'7" Depth BLS: 33'1"
Date:
Depth BTOC: Depth BLS:

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

BLS: = Below Land Surface
BTOC: = Below Top of Casing
TOC: = Top of Casing
MSL: = Mean Sea Level

97-9628\P-6D

STATE OF FLORIDA PERMIT APPLICATION TO CONSTRUCT, REPAIR, MODIFY, OR ABANDON A WELL

☐ Southwest
☐ Northwest
☐ St. Johns River
☐ South Florida
☐ Suwannee River

CHECK BOX FOR APPROPRIATE DISTRICT. ADDRESS ON BACK OF PERMIT FORM.

THIS FORM **MUST** BE FILLED OUT COMPLETELY.

The water well contractor is responsible for completing this form and forwarding the permit to the appropriate delegated county where applicable.

Permit No. 591588-02
Florida Unique I.D.
Permit Stipulations Required (See attached) 1-3 31 + 8
62-524 well ☐
CUP/WUP Application No.

ABOVE THIS LINE FOR OFFICIAL USE ONLY

1. Hillsborough County Solid Waste Dept P.O. BOX 1110, Tampa, FL 33601 813-276-2927
Owner, Legal Name of Entity if Corporation — Address — City — Zip — Telephone Number

2. Southeast Landfill, CR672, Picnic, Hillsborough County, FL
Well Location — Address, Road Name or Number, City

3. ARDAMAN & ASSOCIATES, INC. 2368 941 533-0858
Well Drilling Contractor — License No. — Telephone No.

P.O. BOX 812
Address

BARTOW, FL. 33831
City — State — Zip

4. ____ 1/4 of ____ 1/4 of Section 14
(smallest) (biggest)
(Indicate Well on Chart)

5. Township 31 S Range 21 E

NW		NE	
	X		
X			X
X			
SW		SE	

6. Hillsborough | | | |
County — Subdivision Name — Lot — Block — Unit

7. Number of proposed wells 5 Check the use of well: (See back of permit for additional choices) ____ Domestic Monitor (type) Piezometer
____ Irrigation (type) (See Back) Public Water Supply (type) ____ (See Back) List Other ____
Distance from septic system NA ft. Description of facility Landfill Estimated start of construction date 4-28-97

8. Application for: X New Construction ____ Repair/Modify ____ Abandonment ____ (Reason for Abandonment)

Date Stamp
Southwest Florida Water Management District
RECEIVED
APR 21 '97
Bartow Reg. Service Office

9. Estimated: Well Depth 25' Casing Depth 10 Screen Interval from 10 to 25
Casing Material: Blk-Steel / Gal / [✓ PVC] Casing Diameter 2 inch Seal Material ____

10. If applicable: Proposed Grouting Interval
From 0 to 6' Seal Material Cement Grout
From 6' to 8' Seal Material Bentonite
From 8' to 25' Seal Material 30/65 Sand

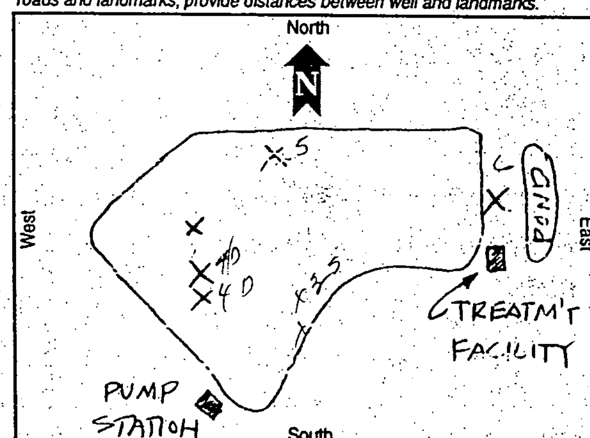
11. Telescope Casing ____ or Liner ____ (check one) Diameter ____
Blk-Steel / Galvanized / PVC Other (specify: ____

12. Method of Construction: ____ Rotary ____ Cable Tool ____ Combination
X Auger ____ Other (specify:) ____)

13. Indicate total No. of wells on site 25. List number of unused wells on site 6.

14. Is this well or any other well or water withdrawal on the owner's contiguous property covered under a Consumptive/Water Use Permit (CUP/WUP) or CUP/WUP Application? X No ____ Yes
(If yes, complete the following) CUP/WUP No. ____
District well I.D. No. ____
Latitude ____ Longitude ____
Data obtained from GPS ____ or map ____ or survey ____ (map datum NAD 27 ____ NAD 83 ____)

Draw a map of well location and indicate well site with an "X". Identify known roads and landmarks; provide distances between well and landmarks.



15. I hereby certify that I will comply with the applicable rules of Title 40, Florida Administrative Code, and that a water use permit or artificial recharge permit, if needed, has been or will be obtained prior to commencement of well construction. I further certify that all information provided on this application is accurate and that I will obtain necessary approval from other federal, state, or local governments, if applicable. I agree to provide a well completion report to the District within 30 days after drilling or the permit expiration, whichever occurs first.

I certify that I am the owner of the property, that the information provided is accurate, and that I am aware of my responsibilities under Chapter 373, Florida Statutes, to maintain or properly abandon this well; or, I certify that I am the agent for the owner, that the information provided is accurate, and that I have informed the owner of his responsibilities as stated above. Owner consents to personnel of the WMD or a representative access to the well site.

[illegible] 2368 [illegible] 4-8-97
Signature of Contractor — License No. — Owner's or Agent's Signature — Date

DO NOT WRITE BELOW THIS LINE — FOR OFFICIAL USE ONLY

Approval Granted By: [illegible] Issue Date: 4-21-97 Hydrologist Approval ____ Initials
Owner Number: 6996 Fee Received: $ 50.- Receipt No.: 7-012874 Check No.: 942

THIS PERMIT NOT VALID UNTIL PROPERLY SIGNED BY AN AUTHORIZED OFFICER OR REPRESENTATIVE OF THE WMD. IT SHALL BE AVAILABLE AT THE WELL SITE DURING ALL DRILLING OPERATIONS. ***This permit is valid for 90 days from date of issue.***

FORM 41.10 – 410 (1) REV. 4/95

WHITE: ORIGINAL FILE
YELLOW: DRILLING CONTRACTOR

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

SERVICE OFFICE

STIPULATION # 8 - TEST/MONITOR WELL

A. This well is to be used as a test/monitor well. If it is to be converted into a production well, an additional permit shall be obtained prior to conversion.

B. There shall be no injection of fluids into the monitor well without prior written approval from the District. This includes, but is not limited to treated ground water, or the introduction of microbes for In-Situ aquifer restoration.

C. While drilling the well, if confining beds (i.e. clay or hardpan intervals) are encountered, then the well shall be constructed in such a manner as to prevent the unauthorized interchange of water between different water bearing zones as per Chapter 17-532.500(2)(C), Florida Administrative Code, (F.A.C.). This includes, but is not limited to the screened or open hole interval and the annular space.

Southwest Florida Water Management District Received APR 21 '97 Bartow Reg. Bartow, Florida

D. Prior written approval from the District shall be required if the monitor well will be pumped for use in hydrodynamic control and/or contaminant plume management.

E. In the event the well needs to be abandoned, an abandonment permit shall be obtained prior to commencing with abandonment procedures.

F. An observer from our Enforcement Department is required on all abandonments to ensure compliance with Chapter 17-532, F.A.C. Please contact the Enforcement Coordinator, Jim Calandra, in our Bartow Office at (813) 534- 1448 for additional information.

1-800-492-7862

Approved by: [signature]

Permit # 591582-02, 591583-05, 591587-01, 591588,05

Date: 4-21-97

Stip #8
(2/93)
COPY TO OWNER

STIPULATION NUMBER 39 - WELL AND DRILLHOLE ABANDONMENT

It will be the **water well contractor's** responsibility to have any incomplete well or drillhole attempted under this permit properly abandoned.

Any incomplete or abandoned well or drillhole as described in 40D-3, F.A.C., shall be abandoned as follows:

A. The well examined from land surface to the original depth of construction for debris or obstructions (any debris or obstruction shall be removed prior to abandonment).

B. The well plugged from bottom to top by an approved method of grouting with either Portland neat cement grout or an approved Bentonite product as specified in 40D-3.517 2. (b), F.A.C.

Southwest Florida Water Management Received APR 21 '97 Bartow Reg. Bartow, Florida

It will be the **owner's** responsibility to have any well completed under this permit, or any existing well on this property, which meets the definition of an abandoned well as defined in Chapter 40D-3, Florida Administrative Code (F.A.C.), properly abandoned.
It will be the **owner's** responsibility to have any inactive well which does not meet the above criteria and is no threat to the water resource properly capped in an air and water tight manner with a threaded, welded or bolted cover or valve. If the pump and well seal are water tight, the pump may be left in place. If practical, a protective cover two (2) feet in height shall be placed around the well casing.

A. Wells with a diameter of six (6) inches or more without pumping equipment shall have the casing extended a minimum of two(2) ft. above land surface.

B. Wells with a diameter of less than six (6) inches without pumping equipment shall be securely set in a concrete slab and have either the well casing extended a minimum height of two (2) feet above land surface or a protective cover centered over the well casing. The concrete slab shall be a minimum of four (4) inches in thickness by two (2) feet by two (2) feet square. The protective cover shall be set in the concrete slab and extend a minimum of two (2) feet above land surface.

In flood prone areas all wells shall extend a minimum of one (1) foot above the 100 year flood elevation, if practical.

Any plugging operations shall be permitted separately from this permit by the Southwest Florida Water Management District and be witnessed by a designated District representative. Arrangement for a District representative shall be made with the local District Field Services office a minimum of twenty four (24) hours in advance of these operations. A District representative will be available for assignment during normal working hours (8:00 AM - 4:30 PM), Monday through Friday. Travel time must be taken into consideration. Exemptions may be made for extenuating circumstances. For scheduling, please contact the Field Service Coordinator, **Jim Calandra**, in our **BARTOW** office at **1-800-492-7862.**

Approved by: [signature]

Permit Number: 591582-02
591583-05
591587-01
591588-05

Date: 4-21-97

Stip#39
(1/31/97)

COPY TO OWNER

P-45

:LL COMPLETION REPORT (Please complete in black ink or type.)

MIT # 591588.01 CUP/WUP #__________ DID #________

ːmit is for multiple wells indicate the number of wells drilled ________.

ate remaining wells to be cancelled________.

ER WELL CONTRACTOR'S

IATURE [signature] License # 2368

I certify that the information provided in this report is accurate and true.

rout	No. of Bags	From (Ft.)	To (Ft.)
eat Cement:	1	0.0	1.0
entonite:	1/2 / 25lbs	1.0	2.0

LL LOCATION: County Hillsborough

Y 1/4 of SW 1/4 of Section 14 Twp: 31S Rge: 21E

itude ________ Longitude ________

DATE STAMP

Official Use Only

Sketch of well location on property N

Give distances from septic tank and house or other reference points

EMICAL ANALYSIS WHEN REQUIRED

n: ____ ppm Sulfate: ____ ppm

loride:_____ ppm

| Lab Test [ ] Field Test Kit

mp Type

| Centrifugal [ ] Jet [ ] Submersible [ ] Turbine

rsepower ________ Capacity ________ G.P.M. ________

mp Depth ________ Ft. Intake Depth ________ Ft.

Form 41.10-410(2) Rev. 6/95

OWNER'S NAME Hillsborough Co. Solid Waste Dep

COMPLETION DATE 5-1-97 Florida Unique I.D. __________

WELL USE: DEP/Public ____ Irrigation ____ Domestic ____ Monitor ✓

HRS Limited ____ 62-524 ____ Other ________

DRILL METHOD [ ] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [✓] Auger Other________

Measured Static Water Level 3.8 Measured Pumping Water Level ____

After____ Hours at ____ G.P.M. Measuring Pt. (Describe): TOP of PVC

Which is 2.5 Ft. [X] Above [ ] Below Land Surface

Casing: [ ] Black Steel [ ] Galv. [X] PVC Other ________

[ ] Open Hole [X] Screen	Depth (Ft.)		DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones.
Casing Diameter & Depth (Ft.)	From	To	*Color / Grain Size / Type of Material*
Diameter 2" From 0.0 To 2.5	0.0	7.5	Lt. Br. SA w/ Lt. Br. Cl. & Phos. (Tailing)
Diameter ____ From ____ To ____			7.5 EOB
Liner [ ] or Casing [ ] Diameter ____ From ____ To ____			

Driller's Name: (print or type) Edward J. Parker

2-4-D

LL COMPLETION REPORT (Please complete in black ink or type.)

MIT # 591588.02 CUP/WUP #______ DID #______

mit is for multiple wells indicate the number of wells drilled ______.

ate remaining wells to be cancelled ______.

ER WELL CONTRACTOR'S
IATURE [signature] License # 2368

I certify that the information provided in this report is accurate and true.

rout	No. of Bags	From (Ft.)	To (Ft.)
eat Cement:	3	0.0	16.0
entonite:	1	16.0	18.0

. LOCATION: County Hills borough

1/4 of SW 1/4 of Section 14 Twp: 30S Rge: 21E

itude ______ Longitude ______

DATE STAMP

Official Use Only

Sketch of well location on property N

Give distances from septic tank and house or other reference points

EMICAL ANALYSIS WHEN REQUIRED

n: ____ ppm Sulfate: ____ ppm

loride: ____ ppm

] Lab Test [ ] Field Test Kit

imp Type

] Centrifugal [ ] Jet [ ] Submersible [ ] Turbine

orsepower ______ Capacity ______ G.P.M. ______

imp Depth ______ Ft. Intake Depth ______ Ft.

Form 41.10-410(2) Rev. 6/95

OWNER'S NAME Hillsborough Co. Solid Waste Dept.

COMPLETION DATE 5-1-97 Florida Unique I.D. ______

WELL USE: DEP/Public ____ Irrigation ____ Domestic ____ Monitor ✓

HRS Limited ____ 62-524 ____ Other ______

DRILL METHOD [ ] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [✓] Auger Other ______

Measured Static Water Level 18.1 Measured Pumping Water Level ____

After ____ Hours at ____ G.P.M. Measuring Pt. (Describe): TOP OF Well

Which is 2.5 Ft. [X] Above [ ] Below Land Surface

Casing: [ ] Black Steel [ ] Galv. [X] PVC Other ______

[ ] Open Hole [X] Screen / Casing Diameter & Depth (Ft.)	Depth (Ft.) From	To	DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones. *Color / Grain Size / Type of Material*
Diameter 2 From 0.0 To 20.0	0.0	11.0	BR. SA w/ LT. BR Cl. & Pnos (Tailing)
	11.0	25.0	DK.BR - BR silty SA
Diameter ___ From ___ To ___			25.0 EOB
Liner [ ] or Casing [ ] Diameter ___ From ___ To ___			

Driller's Name: (print or type) Edward J. Parkel

P.S.-P

LL COMPLETION REPORT (Please complete in black ink or type.)

AIT # 591588.03 CUP/WUP # ______ DID # ______

mit is for multiple wells indicate the number of wells drilled ______.

ate remaining wells to be cancelled ______.

ER WELL CONTRACTOR'S
IATURE [signature] License # 2368

I certify that the information provided in this report is accurate and true.

rout	No. of Bags	From (Ft.)	To (Ft.)
eat Cement:	4	0.0	16.0
entonite:	1	16.0	18.0

L LOCATION: County Hillsborough

S 1/4 of NW 1/4 of Section 14 Twp: 31S Rge: 21E

de. ______ Longitude ______

DATE STAMP

Official Use Only

Sketch of well location on property N

Give distances from septic tank and house or other reference points

EMICAL ANALYSIS WHEN REQUIRED

n: ____ ppm Sulfate: ____ ppm

loride: ____ ppm

[ ] Lab Test [ ] Field Test Kit

imp Type

[ ] Centrifugal [ ] Jet [ ] Submersible [ ] Turbine

orsepower ______ Capacity ______ G.P.M. ______

imp Depth ______ Ft. Intake Depth ______ Ft.

Form 41.10-410(2) Rev. 6/95

OWNER'S NAME Hillsborough Co. Solid Waste Dep

COMPLETION DATE 5-1-97 Florida Unique I.D. ______

WELL USE: DEP/Public ____ Irrigation ____ Domestic ____ Monitor ✓

HRS Limited ____ 62-524 ____ Other ______

DRILL METHOD [ ] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [X] Auger Other ______

Measured Static Water Level 27.1 Measured Pumping Water Level ______

After ____ Hours at ____ G.P.M. Measuring Pt. (Describe): TOP OF WELL

Which is 2.5 Ft. [X] Above [ ] Below Land Surface

Casing: [ ] Black Steel [ ] Galv. [X] PVC Other ______

[ ] Open Hole / [X] Screen / Casing Diameter & Depth (Ft.)	Depth (Ft.) From	To	DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones. Color / Grain Size / Type of Material
Diameter 2"	0.0	13.0	BR SA w/ LT. BR Cl.
From 0.0			& PHOS (To, l, ng)
To 20.0	13.0	25.0	DBR.-BR. Silty SA
Diameter ____			25.0 EOB
From ____			
To ____			
Liner [ ] or Casing [ ]			
Diameter ____			
From ____			
To ____			

Driller's Name: (print or type) Edward J PARKER

26-0

LL COMPLETION REPORT (Please complete in black ink or type.)

IIT # 59 1588.04 CUP/WUP #________ DID #________

nit is for multiple wells indicate the number of wells drilled ________.

ite remaining wells to be cancelled ________.

ER WELL CONTRACTOR'S
ATURE [signature] License # 2368

I certify that the information provided in this report is accurate and true.

'out	No. of Bags	From (Ft.)	To (Ft.)
eat Cement:	7	0.0	36.0
entonite:	1	36	38.0

'. LOCATION: County Hillsborough
1/4 of SE 1/4 of Section 14 Twp: 31S Rge: 21E

tude ________ Longitude ________

DATE STAMP

Official Use Only

Sketch of well location on property N

Give distances from septic tank and house or other reference points

EMICAL ANALYSIS WHEN REQUIRED

n: ____ ppm Sulfate: ____ ppm

loride: ____ ppm

] Lab Test [ ] Field Test Kit

imp Type

] Centrifugal [ ] Jet [ ] Submersible [ ] Turbine

orsepower ______ Capacity ______ G.P.M. ______

imp Depth ______ Ft. Intake Depth ______ Ft.

Form 41.10-410(2) Rev. 6/95

OWNER'S NAME Hills borough Co. Solid Waste Dept.

COMPLETION DATE ________ Florida Unique I.D. ________

WELL USE: DEP/Public ____ Irrigation ____ Domestic ____ Monitor ✓

HRS Limited ____ 62-524 ____ Other ________

DRILL METHOD [ ] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [X] Auger Other ________

Measured Static Water Level 35.6' Measured Pumping Water Level ____

After ____ Hours at ____ G.P.M. Measuring Pt. (Describe): Top of Well

Which is 2.5 Ft. [ ] Above [ ] Below Land Surface

Casing: [ ] Black Steel [ ] Galv. [X] PVC Other ________

[ ] Open Hole [X] Screen	Depth (Ft.)		DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones.
Casing Diameter & Depth (Ft.)	From	To	*Color / Grain Size / Type of Material*
Diameter 2"	0.0	20.0	Br. SA w/ Phos (Tailing)
From 0.0	20.0	35.0	BR. SA w/ Phos (Tailing)
To 40.0	35.0	45.0	DK BR - BR. Silty SA
Diameter ____			45.0 EOB
From ____			
To ____			
Liner [ ] or			
Casing [ ]			
Diameter ____			
From ____			
To ____			

Driller's Name: (print or type) Edward J Parker

P-35

L COMPLETION REPORT (Please complete in black ink or type.)

T # 591588.05 CUP/WUP # ____________ DID # ________

t is for multiple wells indicate the number of wells drilled ________.

remaining wells to be cancelled ________.

WELL CONTRACTOR'S
TURE [signature] License # 2368

I certify that the information provided in this report is accurate and true.

t	No. of Bags	From (Ft.)	To (Ft.)
t Cement:	1	0.0	1.0
tonite:	1/2 / 25lbs	1.0	2.0

LOCATION: County Hillsborough

¼ of SE 1/4 of Section 14 Twp: 31S Rge: 21E

________ Longitude ________

DATE STAMP

Official Use Only

Sketch of well location on property N

Give distances from septic tank and house or other reference points

CAL ANALYSIS WHEN REQUIRED

____ ppm Sulfate: ____ ppm

de: ____ ppm

b Test [ ] Field Test Kit

Type

entrifugal [ ] Jet [ ] Submersible [ ] Turbine

power ________ Capacity ________ G.P.M. ________

Depth ________ Ft. Intake Depth ________ Ft.

Form 41.10-410(2) Rev. 6/95

OWNER'S NAME Hillsborough Co. Solid Waste Dept

COMPLETION DATE 5-1-97 Florida Unique I.D. ________

WELL USE: DEP/Public ____ Irrigation ____ Domestic ____ Monitor ✓

HRS Limited ____ 62-524 ____ Other ________

DRILL METHOD [ ] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [✓] Auger Other ________

Measured Static Water Level Not Enc. Measured Pumping Water Level ____

After ____ Hours at ____ G.P.M. Measuring Pt. (Describe): Top of Well

Which is 2.5 Ft. [X] Above [ ] Below Land Surface

Casing: [ ] Black Steel [ ] Galv. [X] PVC Other ________

[ ] Open Hole / [X] Screen / Casing Diameter & Depth (Ft.)	Depth (Ft.) From	To	DRILL CUTTINGS LOG (Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones.) Color | Grain Size | Type of Material
Diameter 2" From 0.0 To 2.5	0.0	7.5	Lt. Br. SD w/ lt. Br Cl. & Phos (Tailing)
			7.5 EOB
Diameter ____ From ____ To ____			Water level not Encountered At This Depth
Liner [ ] or Casing [ ] Diameter ____ From ____ To ____			

Driller's Name: (print or type) Edward J. Parker

STATE OF FLORIDA PERMIT APPLICATION TO CONSTRUCT, REPAIR, MODIFY, OR ABANDON A WELL

☐ Southwest
☐ Northwest
☐ St. Johns River
☐ South Florida
☐ Suwannee River

CHECK BOX FOR APPROPRIATE DISTRICT. ADDRESS ON BACK OF PERMIT FORM.

THIS FORM *MUST* BE FILLED OUT COMPLETELY.

The water well contractor is responsible for completing this form and forwarding the permit to the appropriate delegated county where applicable.

Permit No. 591583-05
Florida Unique I.D.
Permit Stipulations Required (See attached) #3) (#8)
62-524 well ☐
CUP/WUP Application No.

ABOVE THIS LINE FOR OFFICIAL USE ONLY

1. Hillsborough County Solid Waste Dept. P.O. Box 1110 Tampa FL 33601 813-276-2927
Owner, Legal Name of Entity if Corporation — Address — City — Zip — Telephone Number

2. Southeast Landfill, CR 672, Picnic, FL
Well Location — Address, Road Name or Number, City

3. Ardaman & Associates, Inc. 2368 — 941-533-0858
Well Drilling Contractor — License No. — Telephone No.
P.O. Box 812
Address
Bartow, Fl. 33831
City — State — Zip

4. N 1/2 1/4 of ____ 1/4 of Section 23
(smallest) (biggest)
(Indicate Well on Chart)

5. Township 31S Range 21E

NW NE SW SE

6. Hillsborough
County — Subdivision Name — Lot — Block — Unit

7. Number of proposed wells 5 Check the use of well: (See back of permit for additional choices) ____ Domestic Monitor (type) Peizometer
____ Irrigation (type) (See Back) Public Water Supply (type) ____ List Other ____
Distance from septic system NA ft. Description of facility (See Back) Landfill Estimated start of construction date 4-28-97

8. Application for: X New Construction ____ Repair/Modify ____ Abandonment ____
(Reason for Abandonment)

9. Estimated: Well Depth 25 Casing Depth 10 Screen Interval from 10 to 25
Casing Material: Blk-Steel / Gal / (PVC) Casing Diameter 2 inch Seal Material

Date Stamp: Southwest Florida Water Management District — Received APR 21 '97 Bartow

10. If applicable: Proposed Grouting Interval
From 0 to 6 Seal Material Cement Grout
From 6 to 8 Seal Material Bentonite
From 8 to 25 Seal Material 30/65 Sand

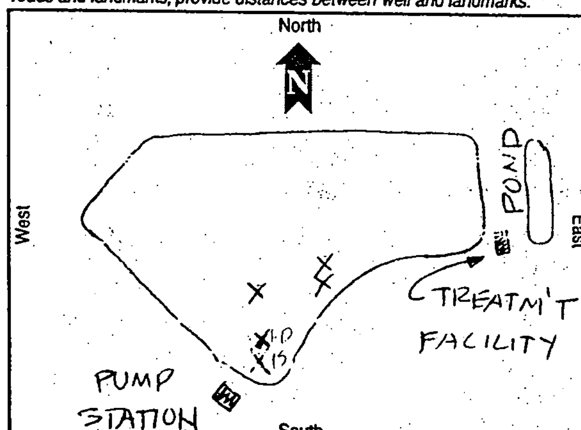
11. Telescope Casing ____ or Liner ____ (check one) Diameter ____
Blk-Steel / Galvanized / PVC Other (specify: ____

12. Method of Construction: ____ Rotary ____ Cable Tool ____ Combination
X Auger ____ Other (specify:) ____)

13. Indicate total No. of wells on site 25. List number of unused wells on site 6.

14. Is this well or any other well or water withdrawal on the owner's contiguous property covered under a Consumptive/Water Use Permit (CUP/WUP) or CUP/WUP Application? X No ____ Yes
(If yes, complete the following) CUP/WUP No. ____
District well I.D. No. ____
Latitude ____ Longitude ____
Data obtained from GPS ____ or map ____ or survey ____ (*map datum NAD 27* ____ *NAD 83* ____)

Draw a map of well location and indicate well site with an "X". Identify known roads and landmarks; provide distances between well and landmarks.



15. I hereby certify that I will comply with the applicable rules of Title 40, Florida Administrative Code, and that a water use permit or artificial recharge permit, if needed, has been or will be obtained prior to commencement of well construction. I further certify that all information provided on this application is accurate and that I will obtain necessary approval from other federal, state, or local governments, if applicable. I agree to provide a well completion report to the District within 30 days after drilling or the permit expiration, whichever occurs first.

[signature] 2368
Signature of Contractor — License No.

I certify that I am the owner of the property, that the information provided is accurate, and that I am aware of my responsibilities under Chapter 373, Florida Statutes, to maintain or properly abandon this well; or, I certify that I am the agent for the owner, that the information provided is accurate, and that I have informed the owner of his responsibilities as stated above. Owner consents to personnel of the WMD or a representative access to the well site.

[signature] 4-8-97
Owner's or Agent's Signature — Date

DO NOT WRITE BELOW THIS LINE — FOR OFFICIAL USE ONLY

Approval Granted By: [signature] Issue Date: 4-21-97 Hydrologist Approval ____ Initials
Owner Number: 6996 Fee Received: $50 Receipt No. 97-01287A Check No.: 942

THIS PERMIT NOT VALID UNTIL PROPERLY SIGNED BY AN AUTHORIZED OFFICER OR REPRESENTATIVE OF THE WMD. IT SHALL BE AVAILABLE AT THE WELL SITE DURING ALL DRILLING OPERATIONS. ***This permit is valid for 90 days from date of issue.***

FORM 41.10 – 410 (1) REV. 4/95

WHITE: ORIGINAL FILE
YELLOW: DRILLING CONTRACTOR
PINK: OWNER

STIPULATION NUMBER 39 - WELL AND DRILLHOLE ABANDONMENT

It will be the **water well contractor's** responsibility to have any incomplete well or drillhole attempted under this permit properly abandoned.

Any incomplete or abandoned well or drillhole as described in 40D-3, F.A.C., shall be abandoned as follows:

A. The well examined from land surface to the original depth of construction for debris or obstructions (any debris or obstruction shall be removed prior to abandonment).

B. The well plugged from bottom to top by an approved method of grouting with either Portland neat cement grout or an approved Bentonite product as specified in 40D-3.517 2. (b), F.A.C.

Southwest Florida Water Management District Received APR 21 '97 Bartow Reg. Bartow, Florida

It will be the **owner's** responsibility to have any well completed under this permit, or any existing well on this property, which meets the definition of an abandoned well as defined in Chapter 40D-3, Florida Administrative Code (F.A.C.), properly abandoned.
It will be the **owner's** responsibility to have any inactive well which does not meet the above criteria and is no threat to the water resource properly capped in an air and water tight manner with a threaded, welded or bolted cover or valve. If the pump and well seal are water tight, the pump may be left in place. If practical, a protective cover two (2) feet in height shall be placed around the well casing.

A. Wells with a diameter of six (6) inches or more without pumping equipment shall have the casing extended a minimum of two(2) ft. above land surface.

B. Wells with a diameter of less than six (6) inches without pumping equipment shall be securely set in a concrete slab and have either the well casing extended a minimum height of two (2) feet above land surface or a protective cover centered over the well casing. The concrete slab shall be a minimum of four (4) inches in thickness by two (2) feet by two (2) feet square. The protective cover shall be set in the concrete slab and extend a minimum of two (2) feet above land surface.

In flood prone areas all wells shall extend a minimum of one (1) foot above the 100 year flood elevation, if practical.

Any plugging operations shall be permitted separately from this permit by the Southwest Florida Water Management District and be witnessed by a designated District representative. Arrangement for a District representative shall be made with the local District Field Services office a minimum of twenty four (24) hours in advance of these operations. A District representative will be available for assignment during normal working hours (8:00 AM - 4:30 PM), Monday through Friday. Travel time must be taken into consideration. Exemptions may be made for extenuating circumstances. For scheduling, please contact the Field Service Coordinator, **Jim Calandra** , in our **BARTOW** office at **1-800-492-7862**.

Approved by: [signature]

Permit Number: 591582-02
591583-05
591587-01
591588-05

Date: 4-21-97

Stip#39
(1/31/97)

COPY TO OWNER

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

SERVICE OFFICE

STIPULATION # 8 - TEST/MONITOR WELL

A. This well is to be used as a test/monitor well. If it is to be converted into a production well, an additional permit shall be obtained prior to conversion.

B. There shall be no injection of fluids into the monitor well without prior written approval from the District. This includes, but is not limited to treated ground water, or the introduction of microbes for In-Situ aquifer restoration.

C. While drilling the well, if confining beds (i.e. clay or hardpan intervals) are encountered, then the well shall be constructed in such a manner as to prevent the unauthorized interchange of water between different water bearing zones as per Chapter 17-532.500(2)(C), Florida Administrative Code, (F.A.C.). This includes, but is not limited to the screened or open hole interval and the annular space.

Southwest Florida Water Management District Received APR 21 '97 Bartow Reg. Bartow, Florida

D. Prior written approval from the District shall be required if the monitor well will be pumped for use in hydrodynamic control and/or contaminant plume management.

E. In the event the well needs to be abandoned, an abandonment permit shall be obtained prior to commencing with abandonment procedures.

F. An observer from our Enforcement Department is required on all abandonments to ensure compliance with Chapter 17-532, F.A.C. Please contact the Enforcement Coordinator, Jim Calandra, in our Bartow Office at (813) 534- 1448 for additional information.

1-800-492-7862

Approved by: [signature]

Permit #: 591582-02, 591583-05, 591587-01, 591588, 05

Date: 4-21-97

Stip #8
(2/93)
COPY TO OWNER

2 3 D
. COMPLETION REPORT (Please complete in black ink or type.)

· # 591583.05 CUP/WUP #________ DID #________

: is for multiple wells indicate the number of wells drilled ________.

remaining wells to be cancelled ________.

: WELL CONTRACTOR'S
'URE [signature] License # 2368

I certify that the information provided in this report is accurate and true.

ıt	No. of Bags	From (Ft.)	To (Ft.)
t Cement:	3	0.0	11.0
'onite:	1	11.0	13.0

.OCATION: County Hillsborough
1/4 of NE 1/4 of Section 23 Twp: 31S Rge: 21E

le ________ Longitude ________

DATE STAMP

Official Use Only

Sketch of well location on property N

Give distances from septic tank and house or other reference points

ICAL ANALYSIS WHEN REQUIRED

____ ppm Sulfate: ____ ppm

ide:____ ppm

ab Test [ ] Field Test Kit

ɔ Type

:entrifugal [ ] Jet [ ] Submersible [ ] Turbine

epower ________ Capacity ________ G.P.M. ________

p Depth ________ Ft. Intake Depth ________ Ft.

Form 41.10-410(2) Rev. 6/95

OWNER'S NAME Hillsborough Co. Solid Waste Dept

COMPLETION DATE ________ Florida Unique I.D. ________

WELL USE: DEP/Public ____ Irrigation ____ Domestic ____ Monitor ✓

HRS Limited ____ 62-524 ____ Other ________

DRILL METHOD [ ] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [X] Auger Other________

Measured Static Water Level 21.5 Measured Pumping Water Level ____
After____ Hours at ____ G.P.M. Measuring Pt. (Describe): Top OF Well
Which is 2.5 Ft. [X] Above [ ] Below Land Surface
Casing: [ ] Black Steel [ ] Galv. [X] PVC Other ________

[ ] Open Hole / [X] Screen / Casing Diameter & Depth (Ft.)	Depth (Ft.) From	To	DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones. Color | Grain Size | Type of Material
Diameter 2"	~~0.0~~	~~25.0~~	
From 0.0	0.0	12.0	Lt. Bl. SA w/ Lt. Bl. Cl.
To 15.0			& Phos Tailing
	12.0	19.5	Bl. Silty SA
Diameter ____	19.5	20.0	Gr Br Sandy Cl.
From ____			
To ____			20.0 EOB
Liner [ ] or Casing [ ] Diameter ____ From ____ To ____			

Driller's Name: (print or type) Edward J Parker

P2-5

L COMPLETION REPORT (Please complete in black ink or type.)

T # 591583.01 CUP/WUP #_____________ DID #________

it is for multiple wells indicate the number of wells drilled _________.

e remaining wells to be cancelled _________.

R WELL CONTRACTOR'S
TURE [signature] License # 2368

I certify that the information provided in this report is accurate and true.

out	No. of Bags	From (Ft.)	To (Ft.)
at Cement:	1/2	0.0	0.5
ntonite:	1/4 / 12.5 lbs	0.5	1.0

LOCATION: County Hillsborough

1/4 of NW 1/4 of Section 23 Twp: 31S Rge: 21E

ude ____________ Longitude ____________

DATE STAMP

Official Use Only

Sketch of well location on property N

Give distances from septic tank and house or other reference points

MICAL ANALYSIS WHEN REQUIRED

: _____ ppm Sulfate: _____ ppm

oride: ______ ppm

Lab Test [ ] Field Test Kit

np Type

Centrifugal [ ] Jet [ ] Submersible [ ] Turbine

sepower ________ Capacity ________ G.P.M. ________

np Depth ________ Ft. Intake Depth ________ Ft.

Form 41.10-410(2) Rev. 6/95

OWNER'S NAME Hillsborough Co. Solid Waste Dept

COMPLETION DATE __________ Florida Unique I.D. __________

WELL USE: DEP/Public ____ Irrigation ____ Domestic ____ Monitor ✓

HRS Limited ____ 62-524 ____ Other __________

DRILL METHOD [ ] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [✓] Auger Other________

Measured Static Water Level 8.8 Measured Pumping Water Level ______

After____ Hours at ____ G.P.M. Measuring Pt. (Describe): TOP OF Well

Which is 2.5 Ft. [X] Above [ ] Below Land Surface

Casing: [ ] Black Steel [ ] Galv. [X] PVC Other __________

[ ] Open Hole [X] Screen / Casing Diameter & Depth (Ft.)	Depth (Ft.) From	Depth (Ft.) To	DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones. Color / Grain Size / Type of Material
Diameter 2" From 0.0 To 2.5	0.0	7.5	BR. SO (Tailing)
Diameter ____ From ____ To ____			
Liner [ ] or Casing [ ] Diameter ____ From ____ To ____			

Driller's Name: (print or type) Edward J Parker

...L COMPLETION REPORT (Please complete in black ink or type.)

...IIT # 59158302 CUP/WUP #______________DID #________

...nit is for multiple wells indicate the number of wells drilled ________.

...te remaining wells to be cancelled ________.

...ER WELL CONTRACTOR'S
...ATURE [signature] License #2368

I certify that the information provided in this report is accurate and true.

...out	No. of Bags	From (Ft.)	To (Ft.)
...at Cement:	4	6.0	16.5
...ntonite:	1	16.5	18.5

...L LOCATION: County Hillsborough

_ 1/4 of NW 1/4 of Section 23 Twp: 31S Rge: 21E

...ude ________________ Longitude ________________

DATE STAMP

Official Use Only

Sketch of well location on property N

Give distances from septic tank and house or other reference points

...MICAL ANALYSIS WHEN REQUIRED

...: _____ ppm Sulfate: _____ ppm

...oride: _____ ppm

... Lab Test [ ] Field Test Kit

...np Type

... Centrifugal [ ] Jet [ ] Submersible [ ] Turbine

...sepower ________ Capacity ________ G.P.M. ________

...np Depth ________ Ft. Intake Depth ________ Ft.

Form 41.10-410(2) Rev. 6/95

OWNER'S NAME Hillsborough Co. Solid Waste Dept

COMPLETION DATE 5-1-97 Florida Unique I.D. ______________

WELL USE: DEP/Public ____ Irrigation ____ Domestic ____ Monitor ✓

HRS Limited ____ 62-524 ____ Other ______________

DRILL METHOD [ ] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [X] Auger Other__________

Measured Static Water Level 21.2' Measured Pumping Water Level ______

After____ Hours at ____ G.P.M. Measuring Pt. (Describe): Top of Well

Which is 2.5 Ft. [X] Above [ ] Below Land Surface

Casing: [ ] Black Steel [ ] Galv. [X] PVC Other ______

[ ] Open Hole [X] Screen	Depth (Ft.)		DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones.
Casing Diameter & Depth (Ft.)	From	To	Color / Grain Size / Type of Material
Diameter 2"	0.0	9.0	U. Br. SA w/U. Br Cl. &
From 0.0			P nos (tailing)
To 20.0	9.0	25.0	DK. Br - Br. Silty SA
Diameter ____			25.0 EOB
From ____			
To ____			
Liner [ ] or Casing [ ] Diameter ____ From ____ To ____			

Driller's Name: (print or type) Edward J. Parker

P.15
.L COMPLETION REPORT (Please complete in black ink or type.)

IIT # 591583.03 CUP/WUP #________ DID #______

nit is for multiple wells indicate the number of wells drilled ______.

te remaining wells to be cancelled ______.

:R WELL CONTRACTOR'S

ATURE [signature] License # 2368

I certify that the information provided in this report is accurate and true.

out	No. of Bags	From (Ft.)	To (Ft.)
at Cement:			
ntonite:	1/2	0.0	0.5

. LOCATION: County Hillsborough

_ 1/4 of NW 1/4 of Section 23 Twp: 31S Rge: 21E

ude ______ Longitude ______

DATE STAMP

Official Use Only

Sketch of well location on property N

Give distances from septic tank and house or other reference points

MICAL ANALYSIS WHEN REQUIRED

___ ppm Sulfate: ___ ppm

ride: ___ ppm

.ab Test [ ] Field Test Kit

ip Type

Centrifugal [ ] Jet [ ] Submersible [ ] Turbine

sepower _____ Capacity _____ G.P.M. _____

ip Depth _____ Ft. Intake Depth _____ Ft.

Form 41.10-410(2) Rev. 6/95

OWNER'S NAME Hillsborough Co. Solid Waste Dept.

COMPLETION DATE 5-1-97 Florida Unique I.D. ______

WELL USE: DEP/Public ___ Irrigation ___ Domestic ___ Monitor ✓

HRS Limited ___ 62-524 ___ Other ______

DRILL METHOD [ ] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [X] Auger Other ______

Measured Static Water Level 5.7 Measured Pumping Water Level

After ___ Hours at ___ G.P.M. Measuring Pt. (Describe): Top of Well

Which is 2.5 Ft. [X] Above [ ] Below Land Surface

Casing: [ ] Black Steel [ ] Galv. [X] PVC Other ______

[ ] Open Hole [X] Screen	Depth (Ft.)		DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones.
Casing Diameter & Depth (Ft.)	From	To	*Color / Grain Size / Type of Material*
Diameter 2" From 0.0 To 1.0	0.0	4.0	Lt. Br. SA w/ Phos (Tailing)
			4.0' EOB
Diameter ___ From ___ To ___			
Liner [ ] or Casing [ ] Diameter ___ From ___ To ___			

Driller's Name: (print or type) Edward J Parker

P1-D

LL COMPLETION REPORT (Please complete in black ink or type.)

AIT # 591583.04 CUP/WUP #______________ DID #________

nit is for multiple wells indicate the number of wells drilled ________.

ite remaining wells to be cancelled ________.

ER WELL CONTRACTOR'S

ATURE [signature] License # 2368

I certify that the information provided in this report is accurate and true.

out	No. of Bags	From (Ft.)	To (Ft.)
eat Cement:	2	0.0	8.0
entonite:	1/2 / 25 lbs	8.0	9.0

L LOCATION: County Hills borough

1/4 of NW 1/4 of Section 23 Twp: 31S Rge: 21E

de ________________ Longitude ________________

DATE STAMP

Official Use Only

Sketch of well location on property N

Give distances from septic tank and house or other reference points

MICAL ANALYSIS WHEN REQUIRED

: _____ ppm Sulfate: _____ ppm

oride:______ ppm

Lab Test [ ] Field Test Kit

np Type

Centrifugal [ ] Jet [ ] Submersible [ ] Turbine

sepower ________ Capacity ________ G.P.M. ________

np Depth ________ Ft. Intake Depth ________ Ft.

Form 41.10-410(2) Rev. 6/95

OWNER'S NAME Hillsborough Co. Solid Waste Dept

COMPLETION DATE 5-1-97 Florida Unique I.D. ______________

WELL USE: DEP/Public ____ Irrigation ____ Domestic ____ Monitor ✓

HRS Limited ____ 62-524 ____ Other ______________

DRILL METHOD [ ] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [X] Auger Other________

Measured Static Water Level 9.0 Measured Pumping Water Level

After____ Hours at ____ G.P.M. Measuring Pt. (Describe): Top of Well

Which is 2.5 Ft. [X] Above [ ] Below Land Surface

Casing: [ ] Black Steel [ ] Galv. [X] PVC Other ____________

[ ] Open Hole [X] Screen / Casing Diameter & Depth (Ft.)	Depth (Ft.) From	To	DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones. Color / Grain Size / Type of Material
Diameter 2" From 0.0 To 10.0	0.0	9.0	Br. SA w/Lt.Br, Cl. & Phos. Tailing
	9.0	15.0	DK.BR-BR Silty SA
Diameter _____ From _____ To _____			15.0 EOB
Liner [ ] or Casing [ ] Diameter _____ From _____ To _____			

Driller's Name: (print or type) Edward J Parker

APPENDIX E
INDEX/CLASSIFICATION LABORATORY TEST SUMMARY

TABLE 1
LABORATORY TEST SUMMARY
STANDARD PENETRATION TEST SAMPLES

Boring Number	Sample Number	Soil Type	Sample Depth (ft.)	Natural Moisture Conent (%)	Passing No. 200 Sieve (%)	Passing No. 100 Sieve (%)	Passing No. 60 Sieve (%)	Passing No. 40 Sieve (%)	Passing No. 10 Sieve (%)	Passing No. 4 Sieve (%)	Liquid Limit (%)	Plasiticity Index (%)	Organic Content (%)
TH - 1A	1	1	1.0	16.0	19.6	38.6	62.9	83.1	100.0	100.0			
TH - 1A	4	2	5.5	41.3	26.2	79.1	98.1	99.6	100.0	100.0			
TH - 1A	8	2	11.5	22.4	7.5	33.1	66.3	97.4	100.0	100.0			0.6
TH - 1A	11	4	16.0	25.7	11.2	35.1	68.9	99.9	99.9	100.0			
TH - 1A	17	7	36.0	35.5	24.8	62.8	77.4	86.5	96.4	99.4			
TH - 1A	20	9	51.0										2.3
TH - 2A	2	10	2.5	2.8	3.0	14.8	45.5	79.6	99.9	100.0			
TH - 2A	5	1	7.0	36.6	18.7	66.8	87.4	96.4	100.0	100.0			
TH - 2A	9	1	13.0	17.1	14.1	39.4	74.5	92.7	100.0	100.0			
TH - 2A	15	2	22.0	35.1	23.5	71.1	86.6	95.2	99.7	100.0			
TH - 2A	22	4	34.5	43.6	34.1	71.5	84.7	91.6	97.9	100.0			
TH - 3A	1	1	1.0	25.9	34.6	61.0	83.6	94.0	99.8	100.0			
TH - 3A	2	1	2.5	37.1	38.3	53.0	73.4	88.2	99.9	100.0			
TH - 3A	4	2	5.5	112.2	98.5	99.1	99.6	99.9	100.0	100.0			
TH - 3A	5	4	8.5										2.3
TH - 3A	6	1	16.0	20.5	11.1	21.2	65.0	91.8	100.0	100.0			
TH - 3A	8	9	26.0	37.6	27.4	87.7	94.9	98.6	100.0	100.0			2.3
TH - 4A	1	1	1.0	19.5	23.5	40.3	60.9	79.3	99.8	100.0			1.8

TABLE 1 Cont'd
LABORATORY TEST SUMMARY
STANDARD PENETRATION TEST SAMPLES

Boring Number	Sample Number	Soil Type	Sample Depth (ft.)	Natural Moisture Conent (%)	Passing No. 200 Sieve (%)	Passing No. 100 Sieve (%)	Passing No. 60 Sieve (%)	Passing No. 40 Sieve (%)	Passing No. 10 Sieve (%)	Passing No. 4 Sieve (%)	Liquid Limit (%)	Plasiticity Index (%)	Organic Content (%)
TH - 4A	4	1	5.5	34.0	30.4	88.2	98.8	99.8	100.0	100.0			0.2
TH - 4A	6	10	10.0										0.2
TH - 4A	8	6	21.0	23.9	31.7	61.5	77.3	86.7	99.3	100.0			
TH - 4A	10	9	31.0	33.7	56.1	78.6	89.5	94.6	99.4	100.0			
TH - 4A	12	9	41.0	30.8	29.4	50.1	61.7	71.4	87.7	97.9			2.4
TH - 5A	1	1	1.0	20.1	40.9	71.8	90.4	95.9	99.5				
TH - 5A	3	10	3.5	25.9	5.9	32.4	92.3	99.3	99.9	100.0			
TH - 5A	6	9	8.0	70.8	73.7	90.6	96.9	99.1	100.0	100.0	84.0	56.0	
TH - 5A	7	3	10.5										1.7
TH - 5A	8	5	16.0	20.4	29.4	50.8	79.1	94.2	100.0	100.0			
TH - 5A	10	4	26.0	40.4	25.0	84.0	92.6	96.0	99.0	100.0			
TH - 5A	12	8	38.0	39.2	20.1	44.8	71.9	82.1	92.2	97.9			
TH - 5A	15	9	51.0	46.8	34.9	37.6	46.8	89.8	95.3	96.9			
TH - 6A	5	10	7.0	26.0	11.9	43.4	89.0	99.2	100.0	100.0			
TH - 6A	8	2	11.5	58.3	94.5	95.7	96.8	97.6	98.8	99.6	117	67	
TH - 6A	11	1	21.0	26.5	10.3	32.6	68.4	93.2	100.0	100.0			
TH - 6A	13	3	31.0	30.1	6.0	10.4	42.5	90.5	99.9	100.0			
TH - 6A	16	9	47.0	56.5	34.2	87.3	95.3	98.6	100.0	100.0			
TH - 7A	1	1	1.0	18.2	16.0	50.2	78.0	91.6	99.6	99.8			2.23

TABLE 1 Cont'd
LABORATORY TEST SUMMARY
STANDARD PENETRATION TEST SAMPLES

Boring Number	Sample Number	Soil Type	Sample Depth (ft.)	Natural Moisture Conent (%)	Passing No. 200 Sieve (%)	Passing No. 100 Sieve (%)	Passing No. 60 Sieve (%)	Passing No. 40 Sieve (%)	Passing No. 10 Sieve (%)	Passing No. 4 Sieve (%)	Liquid Limit (%)	Plasiticity Index (%)	Organic Content (%)
TH - 7A	3	1	4.0								39	11	
TH - 7A	4	3	5.5										0.6
TH - 7A	5	3	11.0	21.7	17.7	40.7	72.1	92.7	99.9	100.0			
TH - 7A	7	11	21.0	33.3	19.3	50.7	75.1	87.1	100.0	100.0			
TH - 7A	9	8	31.0	43.2	28.9	78.1	88.3	93.0	98.4	99.6			
TH - 8A	1	1	1.0								NP	NP	
TH - 8A	6	12	8.5	64.6	65.1	87.8	99.2	99.9	100.0	100.0			
TH - 8A	13	4	21.0	11.8	13.2	39.5	71.1	92.4	100.0	100.0			
TH - 8A	16	11	36.0	38.2	64.1	85.0	94.2	97.5	99.9	100.0			

Boring Number	Sample Number	Cation Exchange (meg EC/100grams)
TH - 1A	5	508
TH - 1A	15	259
TH - 2A	4	99
TH - 5A	15	426
TH - 8A	16	55

APPENDIX F
REPORT OF LABORATORY TESTING ON UNDISTURBED SAMPLINGS AS REPORTED TO REMEDIAL ENGINEERING & SCIENCE, INC. (6/19/97)

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

June 19, 1997
File Number 97-9628

Remedial Engineering & Science, Inc.
206 White Marsh Circle
Orlando, Florida 32859-3322

Attention: Dr. Bijay Panigrahi

Subject: Laboratory Testing of Soil Samples, Southeast Landfill, Hillsborough County

Gentlemen:

As requested, consolidated undrained triaxial compression tests, unconfined compression tests and permeability tests have been completed on the nine Shelby tube soil samples provided for testing by your firm. The samples were labeled: SPT-1A/US-1 (7' - 9'); SPT-2A/US-1 (30'- 32'); SPT-3A/US-1 (6' - 8'); SPT-3A/US-2 (27' - 29'); SPT-4A/US-1 (7.5' - 9.5'); SPT-5A/US-1 (6' - 8'); SPT-6A/US-1 (12' - 14'); SPT-7A/US-1 (25' - 27'); and SPT-7A/US-2 (31.5' - 33.5').

Index Tests and Classification

The soils were extruded from the Shelby tubes, and representative portions of each sample were selected for the requested tests. The visual description of the soil samples, recovered lengths, individual measured moisture contents on 3 to 6 specimens per sample, and average moisture contents, total unit weights and dry densities on the samples are presented in Table 1. The fines contents (i.e., percent soil by dry weight finer than the U.S. Standard No. 200 sieve) measured on each permeability and strength test specimen are also presented in Table 1.

Permeability Tests

The permeability tests were performed in general accordance with ASTM Standard D 5084. The permeability test results are summarized in Table 2. The cylindrical test specimens were maintained at the as-received diameter of the Shelby tube and trimmed to heights of 5.3 to 11.7 cm. Each permeability test specimen was mounted in a triaxial-type permeameter and encased within a latex membrane. The specimens were confined using average isotropic effective confining stresses of 6 to 15 lb/in^2, and permeated with deaired tap water under back-pressures of 174 to 183 lb/in^2. Satisfactory saturation of each specimen was verified by a B-factor greater than 95%. The inflow to and outflow from each specimen were monitored with time, and the hydraulic conductivity was calculated for each recorded flow increment. The tests were continued until steady-state flow rates were achieved, as evidenced by an outflow/inflow ratio between 0.75 and 1.25, and until stable values of hydraulic conductivity were measured. The final degree of saturation of each specimen was calculated upon completion of testing using the final measured dry mass, moisture content and volume, and assuming a specific gravity of 2.70 for clayey sand specimens and 2.75 for clay specimens. Upon completion of permeability testing, the particle-size distributions of the clayey sand specimens were determined in general accordance with ASTM Standard D 422, and the fines contents of the clay specimens were determined in general accordance with ASTM Standard D 1140. The results of the particle-size analyses are plotted in Figure 1, and the fines content of each specimen is presented in Table 2.

Consolidated Undrained Triaxial Compression Tests

Consolidated undrained triaxial compression tests with pore pressure measurements ($\overline{\text{CIUC}}$ tests) were performed in general accordance with ASTM Standard D 4767. Cylindrical test specimens 3.5 cm in diameter and 7.1 cm in height were trimmed from the requested Shelby tube samples. The specimens were mounted in triaxial cells, fitted with filter strips, and encased in thin latex membranes. The cell pressure and back-pressure were increased together in increments until the back-pressure equalled the test values of 8.0 to 12.0 kg/cm^2. The specimens were then isotropically consolidated in one, two or three increments under the requested effective stresses of 0.39 to 5.58 kg/cm^2. The volume change during consolidation was monitored. Consolidation under the applied effective stress was allowed to continue until primary consolidation was complete and then for an additional period of at least 12 hours. The specimens were sheared undrained at a constant rate of axial deformation of 0.0012 cm/minute (a strain rate of about 1%/hour), and the load, axial deformation, shear induced excess pore pressure and cell pressure were monitored with time.

The initial and pre-shear moisture contents and dry densities of the specimens, and a summary of the triaxial test results are presented in Table 3. Photographs of four of the triaxial test specimens after shearing are shown in Figures 2, 3 and 4. The effective stress paths, stress difference versus axial strain, excess pore pressure versus axial strain, and stress ratio versus axial strain for the nine individual tests are presented in Figures 5 through 13. The effective stress paths for the five clay specimens and four clayey sand specimens are presented together in Figures 14 and 15, respectively. Upon completion of testing, the fines content of each specimen was determined in general accordance with ASTM Standard D 1140. The fines contents are presented in Table 3.

Unconfined Compression Tests

The unconfined compression tests were performed in general accordance with ASTM Standard D 2166. Sufficient intact sample was not available from either SPT-1A/US-1 (7' - 9') or SPT-6A/US-1 (12' - 14') to perform the requested unconfined compression tests. Cylindrical test specimens were trimmed to a diameter of 3.5 cm and a height of 7.1 cm. The specimens were loaded at a constant rate of axial deformation of 0.076 cm/minute (strain rate of about 1.0%/minute). The moisture content and dry density of the specimens, unconfined compressive strength, and axial strain at failure are presented in Table 4. The stress-strain curves are presented in Figures 16 through 18. Upon completion of testing, the fines content of each specimen was determined in general accordance with ASTM Standard D 1140. The fines contents are presented in Table 4.

If you have questions about the test results or require additional testing services, please contact us.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

Shawkat Ali, Ph.D.
Geotechnical Engineer

Thomas S. Ingra, P.E.
Senior Project Engineer
Florida Registration No. 31987

SA/TSI/jo

cc: John Watson
Wayne Pandorf

Table 1

SHELBY TUBE SOIL SAMPLE DESCRIPTIONS

Boring	Sample	Depth (feet)	Description	Tests	Recovery (inches)		-200 (%)	w_c (%)	Tube Average w_c (%)	Tube Average γ_t (pcf)	Tube Average γ_d (pcf)
SPT-1A	US-1	7-9	Brown clayey sand with lenses of brown clay	None	15.75	24.25	-	47.6 56.9 41.7	62.6	103.0	63.3
			Brown and gray (laminated) clay	$\overline{CU}$ KC	8.50		100 100	67.0 109.5			
SPT-2A	US-1	30-32	Lt. brown clayey sand with lenses of brown sand and brown cemented sand fragments	KC	12.75	23.75	24	25.0 25.4 29.2	29.1	117.7	91.2
			Brown sand with lenses of clayey sand	None	5.0		-	-			
			Lt. greenish-gray clayey sand with some cemented sand fragments	$\overline{CU}$	6.0		35	28.8 37.2			
SPT-3A	US-1	6-8	Gray clay	$\overline{CU}$	10.0	24.0	100	99.3 116.7 111.3	62.2	96.5	59.5
			Dark gray sand with trace organics	None	7.0		-	27.3 22.4			
			Grayish-brown sand	None	7.0		-	20.5			
SPT-3A	US-2	27-29	Light gray to gray clayey sand	$\overline{CU}$ $\overline{CU}$ QU	22.5		25 26 21	34.2 38.1 36.6 36.4 30.2	35.1	113.6	84.0
SPT-4A	US-1	7.5-9.5	Gray and light gray (laminated) clay	$\overline{CU}$ QU KC	11.25	18.5	100 100 99	94.2 107.0 102.0	70.9	101.6	59.4
			Gray to dark gray sand	None	7.25		-	24.1			

Where: -200 = Fines content (i.e., amount of material finer than the U.S. Standard No. 200 sieve); w_c = Moisture content; γ_t = Total unit weight; γ_d = Dry density; $\overline{CU}$ = $\overline{CIUC}$ triaxial test (ASTM D 4767); QU = Unconfined compression test (ASTM D 2166); and KC = Permeability test (ASTM D 5084).

Southeast Landfill
Hillsborough County
File Number 97-9628
June 19, 1997

Table 1 (Continued)

SHELBY TUBE SOIL SAMPLE DESCRIPTIONS

Boring	Sample	Depth (feet)	Description	Tests	Recovery (inches)		-200 (%)	w_c (%)	Tube Average w_c (%)	Tube Average γ_t (pcf)	Tube Average γ_d (pcf)
SPT-5A	US-1	6-8	Gray slightly clayey sand	None	3.25	24.25	-	-	-	100.0	-
			Laminated gray sandy clay, grayish-brown clayey sand and light brown silty sand	None	5.50		-	76.7 69.5			
			Gray and light gray (laminated) clay	$\overline{CU}$ QU	8.00		99 100	101.4 102.5			
			Gray sand with trace clay	None	2.00		-	22.6			
			Gray clay	None	1.50		-	-			
			Brown slightly clayey sand	None	4.00		-	21.0			
SPT-6A	US-1	12-14	Drilling disturbed soil	None	4.00	23.75	-	-	68.2	97.1	57.7
			Brown silty sand laminated with gray clay	None	10.50			74.1 54.1			
			Gray clay with trace sand lenses	$\overline{CU}$	9.25		96	72.4 72.1			
SPT-7A	US-1	25-27	Greenish-gray clayey sand	$\overline{CU}$	23.25		31	38.7 45.4 42.7 40.0	41.7	111.3	78.5
SPT-7A	US-2	31.5-33.5	Greenish-gray clayey sand with phosphate	KC	25.50		17	34.0 34.6 29.5 34.5	33.2	117.8	88.5

Where: -200 = Fines content (i.e., amount of material finer than the U.S. Standard No. 200 sieve); w_c = Moisture content; γ_t = Total unit weight; γ_d = Dry density; $\overline{CU}$ = $\overline{CIUC}$ triaxial test (ASTM D 4767); QU = Unconfined compression test (ASTM D 2166); and KC = Permeability test (ASTM D 5084).

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Hillsborough County
File Number 97-9628
June 19, 1997

Table 2

PERMEABILITY TEST RESULTS

Boring	Sample	Depth (feet)	Initial Conditions					Test Conditions				Final Conditions				k_{20} (cm/sec)	-200 (%)
			w_c (%)	γ_d (pcf)	S (%)	L (cm)	D (cm)	$\bar{\sigma}_c$ (psi)	u_b (psi)	i_{avg}	B (%)	w_c (%)	γ_d (pcf)	S (%)	$\Delta V/V_o$ (%)		
SPT-1A	US-1	7-9	105.4	44.6	102	5.30	7.12	6	183	24	99	104.0	45.0	102	-0.9	$2.6x10^{-8}$	100
SPT-2A	US-1	30-32	25.3	100.1	100	11.74	6.94	15	174	11	97	22.0	105.7	100	-5.3	$1.1x10^{-7}$	24
SPT-4A	US-1	7.5-9.5	95.2	47.0	99	5.79	7.29	6	183	24	100	92.2	48.8	101	-3.7	$3.5x10^{-8}$	99
SPT-7A	US-2	31.5-33.5	30.7	89.4	94	11.62	7.37	15	174	14	100	31.2	92.4	102	-3.3	$2.1x10^{-7}$	17

Where: w_c = Moisture content; γ_d = Dry density; S = Calculated degree of saturation using an assumed specific gravity of 2.70 or 2.75; L = Specimen length; D = Specimen diameter; $\bar{\sigma}_c$ = Average isotropic effective consolidation stress; u_b = Back-pressure; i_{avg} = Average hydraulic gradient; B = B factor; $\Delta V/V_o$ = Volume change (+ denotes swell; - denotes consolidation); k_{20} = Saturated hydraulic conductivity at 20°C; and -200 = Fines content.

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Southeast Landfill
Hillsborough County
File Number 97-9628
June 19, 1997

Table 3

ISOTROPICALLY CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION ($\overline{CIUC}$) TEST RESULTS

Boring	Sample	Depth (feet)	Initial Conditions: H (cm)	D (cm)	w_c (%)	γ_d (lb/ft³)	G_s	S (%)	σ_c' (kg/cm²)	u_b (kg/cm²)	B Factor (%)	Pre-Shear Conditions: ϵ_{vol} (%)	γ_d (lb/ft³)	w_c (%)	-200 (%)	Stresses and Strains at $(\sigma_1-\sigma_3)_{max}$ and $(\sigma_1'/\sigma_3')_{max}$: Criteria	ϵ_a (%)	Δu (kg/cm²)	σ_1' (kg/cm²)	σ_3' (kg/cm²)
SPT-1A	US-1	7-9	7.13	3.55	109.5	42.8	2.75	100	4.29	9.0	99	-26.3	58.0	71.2	100	$(\sigma_1-\sigma_3)_{max}$	12.2	2.83	3.64	1.50
																$(\sigma_1'/\sigma_3')_{max}$	12.5	2.84	3.63	1.49
SPT-2A	US-1	30-32	7.11	3.53	37.2	83.7	2.70	99	5.58	8.0	93*	-9.5	92.5	30.4	35	$(\sigma_1-\sigma_3)_{max}$	10.0	3.88	5.93	1.71
																$(\sigma_1'/\sigma_3')_{max}$	8.9	3.88	5.92	1.70
SPT-3A	US-1	6-8	7.10	3.54	104.2	44.5	2.75	100	0.39	12.0	100	-0.5	44.8	103.1	100	$(\sigma_1-\sigma_3)_{max}$	2.7	0.27	0.68	0.12
																$(\sigma_1'/\sigma_3')_{max}$	2.3	0.27	0.67	0.12
SPT-3A	US-2	27-29	7.06	3.52	40.7	80.3	2.70	100	1.46	12.0	98	-9.5	88.7	33.3	26	$(\sigma_1-\sigma_3)_{max}$	4.9	1.14	1.80	0.44
																$(\sigma_1'/\sigma_3')_{max}$	10.7	1.10	1.75	0.42
SPT-3A	US-2	27-29	7.07	3.53	37.8	83.6	2.70	100	5.32	7.5	93	-10.0	92.9	30.2	25	$(\sigma_1-\sigma_3)_{max}$	17.3	3.93	5.27	1.44
																$(\sigma_1'/\sigma_3')_{max}$	9.8	3.96	5.13	1.39
SPT-4A	US-1	7.5-9.5	7.11	3.55	102.3	45.1	2.75	100	2.34	10.5	100	-17.5	54.7	77.8	100	$(\sigma_1-\sigma_3)_{max}$	6.8	1.36	2.36	1.00
																$(\sigma_1'/\sigma_3')_{max}$	14.0	1.57	2.12	0.81
SPT-5A	US-1	6-8	7.12	3.55	101.4	45.3	2.75	100	1.85	12.0	100	-15.4	53.6	80.1	99	$(\sigma_1-\sigma_3)_{max}$	7.8	1.22	2.16	0.65
																$(\sigma_1'/\sigma_3')_{max}$	14.5	1.34	2.03	0.54
SPT-6A	US-1	12-14	7.10	3.54	68.3	59.8	2.75	100	3.32	10.0	95	-13.2	68.9	54.3	96	$(\sigma_1-\sigma_3)_{max}$	3.4	2.26	3.31	1.05
																$(\sigma_1'/\sigma_3')_{max}$	5.8	2.40	3.11	0.94
SPT-7A	US-1	25-27	7.11	3.52	45.2	75.2	2.70	98	1.46	12.0	98	-3.3	77.7	43.2	31	$(\sigma_1-\sigma_3)_{max}$	5.1	0.83	2.66	0.66
																$(\sigma_1'/\sigma_3')_{max}$	10.1	0.85	2.64	0.65

Where: H = Specimen height; D = Specimen diameter; w_c = Moisture content; γ_d = Dry density; G_s = Specific gravity (assumed); S = Calculated degree of saturation using the assumed specific gravity; σ_c' = Isotropic effective consolidation stress; u_b = Back-pressure; ϵ_{vol} = Volumetric strain (negative denotes consolidation and positive denotes swelling) during isotropic consolidation; -200 = Amount of material finer than the U.S. Standard No. 200 sieve; ϵ_a = Axial strain; Δu = Excess pore pressure; σ_1' = Effective major principal stress; σ_3' = Effective minor principal stress.

* B factor remained relatively constant for two consecutive increments of applied cell pressure.

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Soutneast Landfill
Hillsborough County
File Number 97-9628
June 19, 1997

Table 4

UNCONFINED COMPRESSION TEST RESULTS

Boring	Sample	Depth (feet)	Specimen Dimensions			w_c (%)	γ_d (lb/ft³)	-200 (%)	$\dot{\varepsilon}$ (cm/min)	ε_f (%)	Maximum Load (kg)	Unconfined Compressive Strength (kg/cm²)
			Height H (cm)	Diameter D (cm)	H/D							
SPT-3A	US-2	27 - 29	7.10	3.53	2.01	34.6	87.2	21	0.076	2.9	5.88	0.58
SPT-4A	US-1	7.5 - 9.5	7.11	3.52	2.02	107.0	44.3	100	0.076	4.8	3.52	0.34
SPT-5A	US-1	6 - 8	7.12	3.53	2.02	102.5	45.6	100	0.076	4.8	4.00	0.39

Where: w_c = Moisture content measured at end of test; γ_d = Dry density; -200 = Fines content (Amount of material finer than the U.S. Standard No. 200 sieve); $\dot{\varepsilon}$ = Vertical displacement rate; and ε_f = Axial strain at maximum load.

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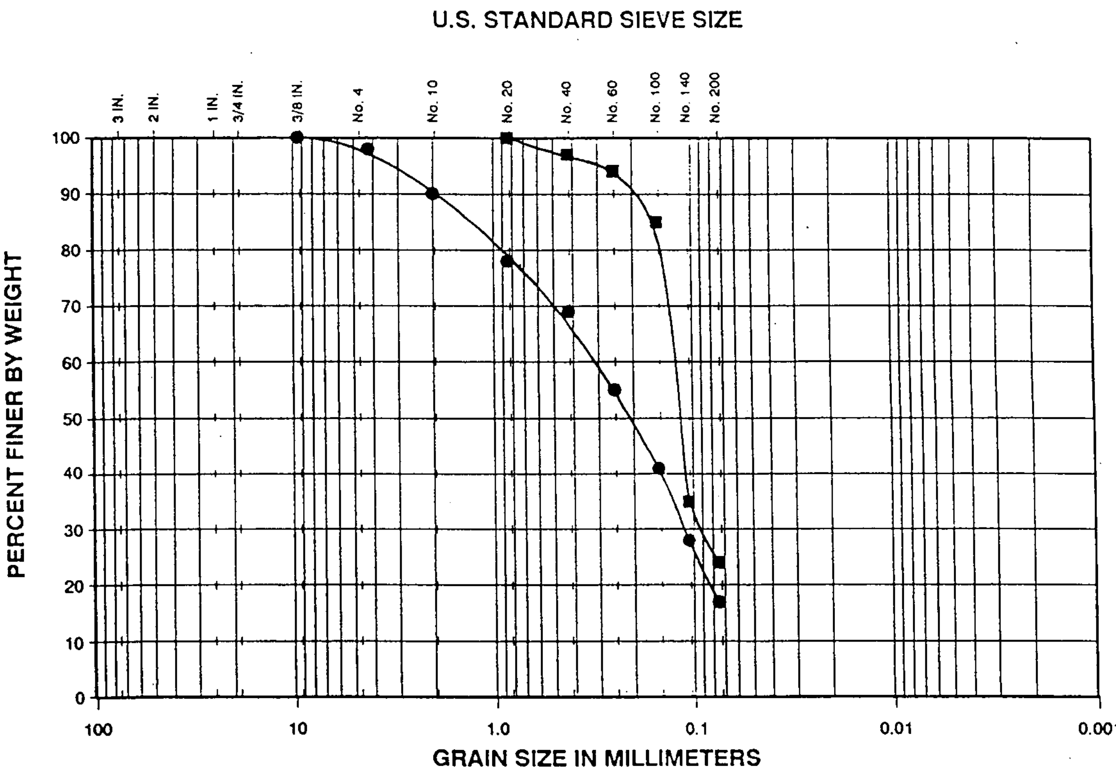

GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

BORING	SAMPLE	DEPTH (FEET)	SYMBOL	DESCRIPTION
SPT-2A	US-1	30 - 32	■	Light brown clayey sand
SPT-7A	US-2	31.5 - 33.5	●	Greenish-gray clayey sand with phosphate

PARTICLE-SIZE ANALYSES ON PERMEABILITY TEST SPECIMENS

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
HILLSBOROUGH COUNTY

REMEDIAL ENGINEERING & SCIENCE, INC.
ORLANDO, FLORIDA

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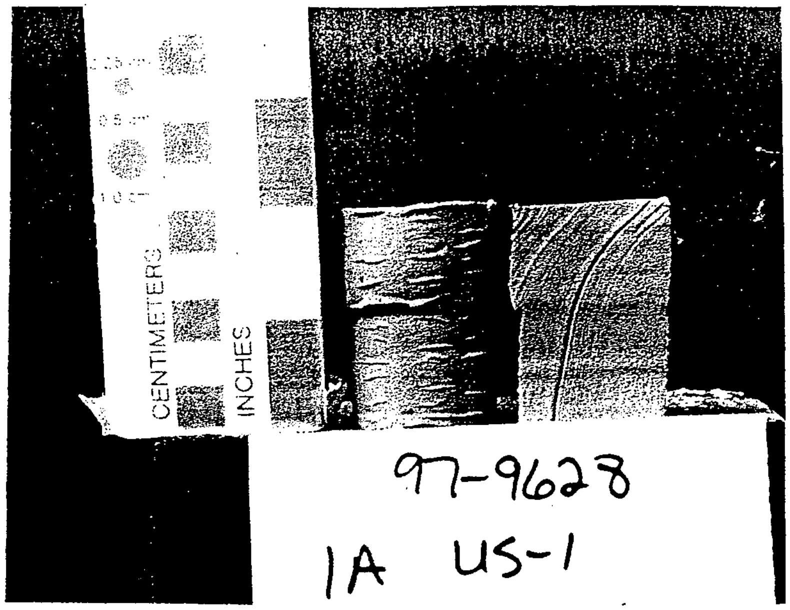
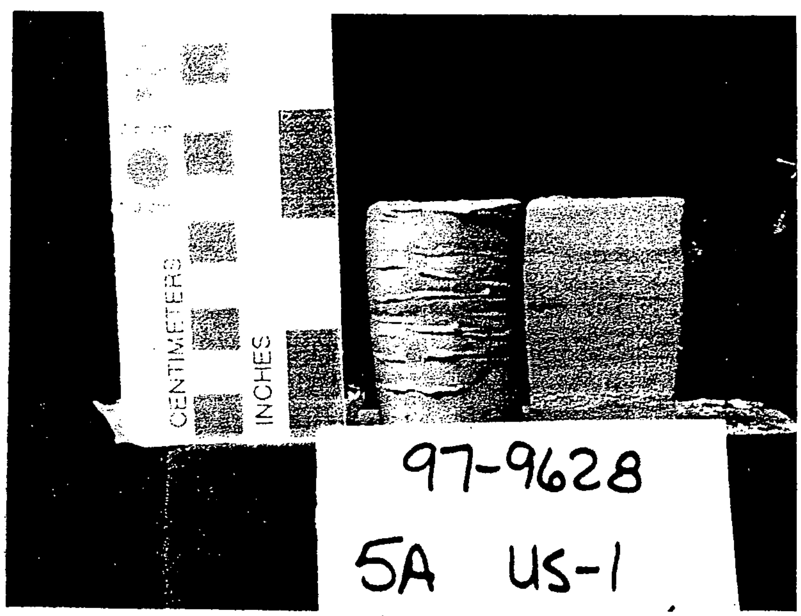
BEST AVAILABLE COPY



A) SPECIMEN FROM BORING SPT-1A, SAMPLE US-1



B) SPECIMEN FROM BORING SPT-5A, SAMPLE US-1

PHOTOGRAPHS OF TRIAXIAL TEST SPECIMENS FROM BORINGS SPT-1A AND SPT-5A

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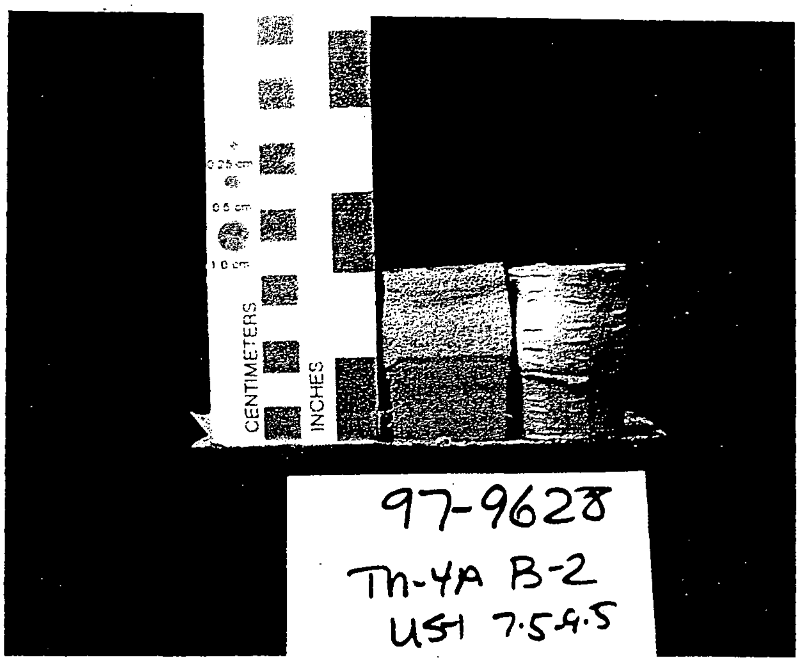

SPECIMEN FROM BORING SPT-4A, SAMPLE US-1

PHOTOGRAPH OF TRIAXIAL TEST SPECIMEN FROM BORING SPT-4A

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Geotechnical, Environmental and Materials Consultants

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HILLSBOROUGH COUNTY

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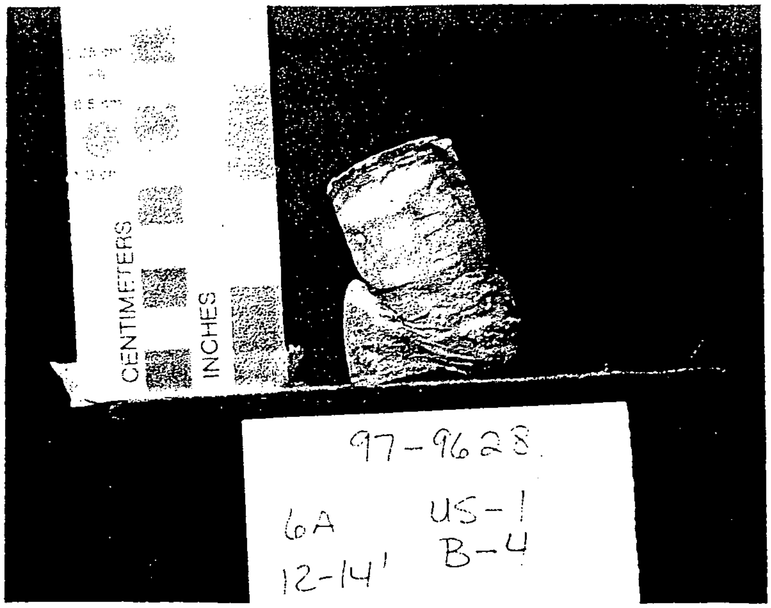
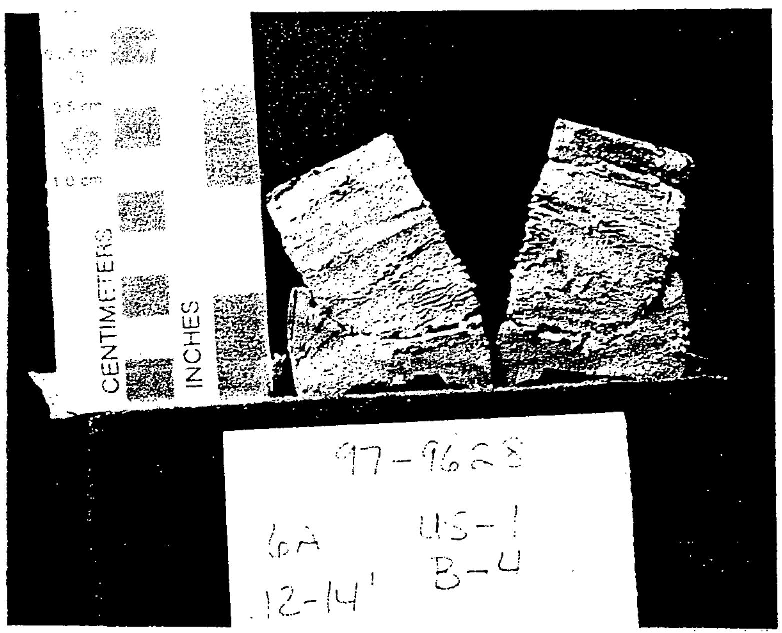


A) VIEW OF SPECIMEN AT END OF TEST



B) VIEW OF LAMINATED STRUCTURE OF SPECIMEN

PHOTOGRAPHS OF TRIAXIAL TEST SPECIMEN FROM BORING SPT-6A, SAMPLE US-1

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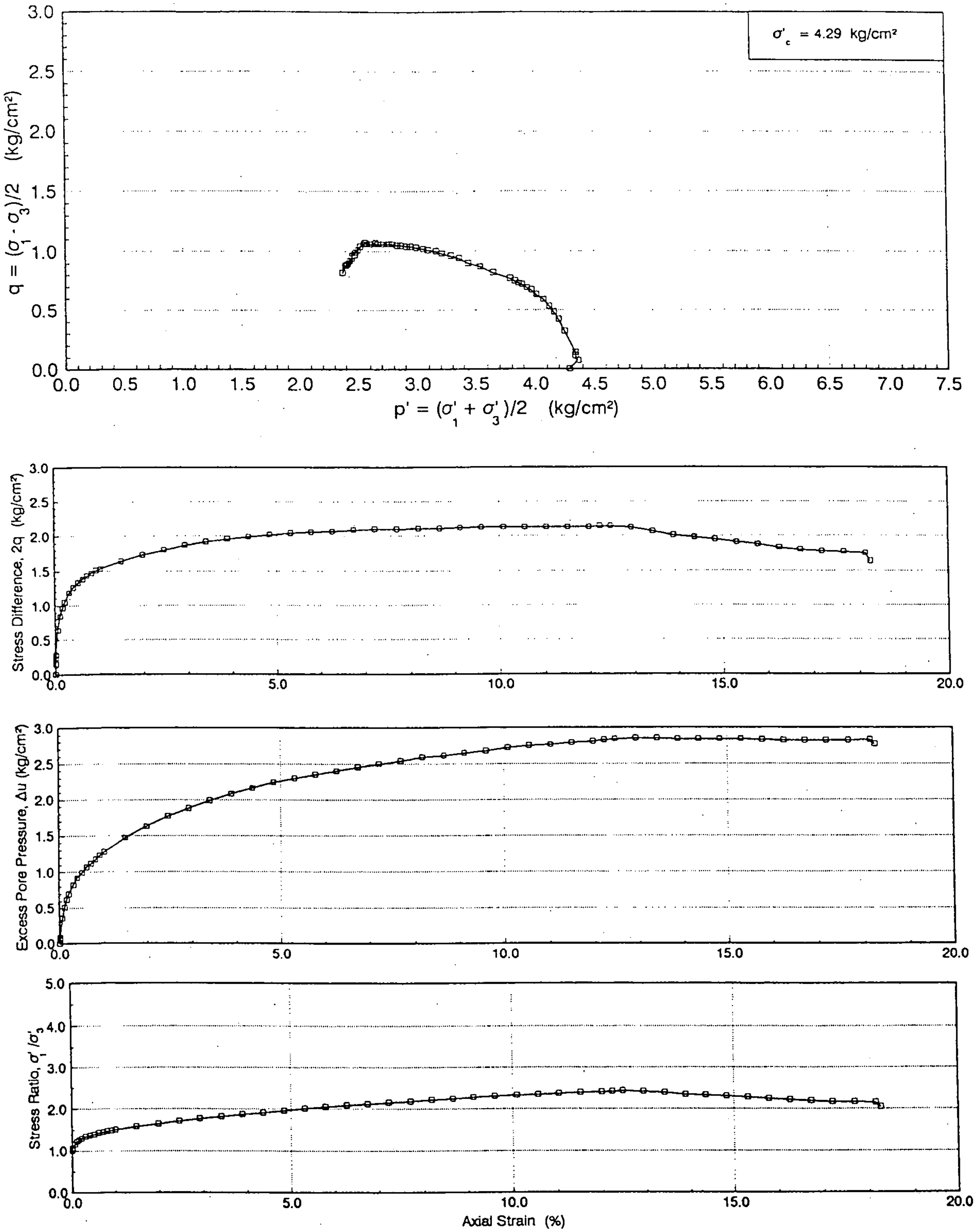

CONSOLIDATED UNDRAINED ($\overline{\text{CIU}}$C) TRIAXIAL TEST ON

BORING SPT-1A, SAMPLE US-1

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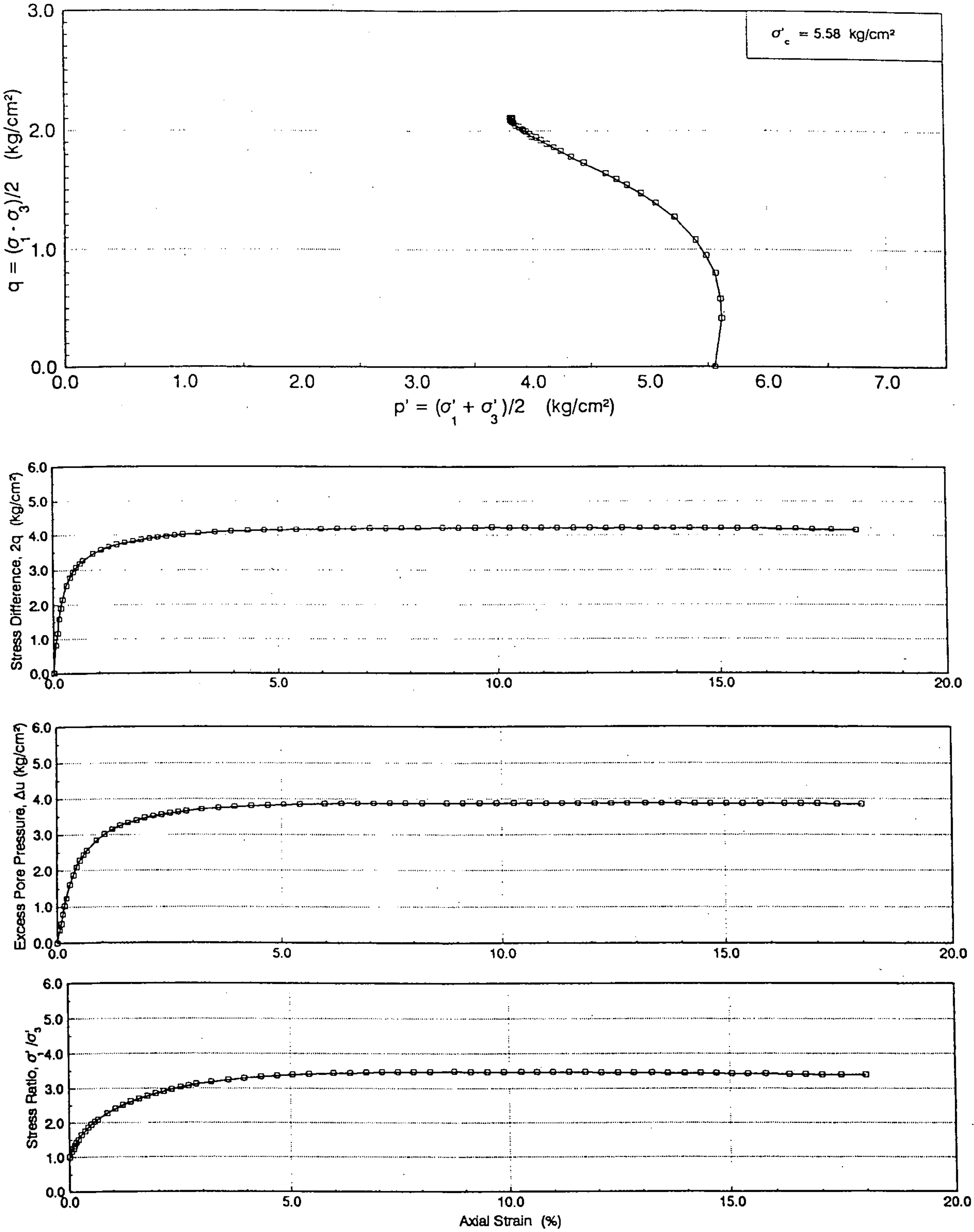

CONSOLIDATED UNDRAINED ($\overline{\text{CIUC}}$) TRIAXIAL TEST ON BORING SPT-2A, SAMPLE US-1

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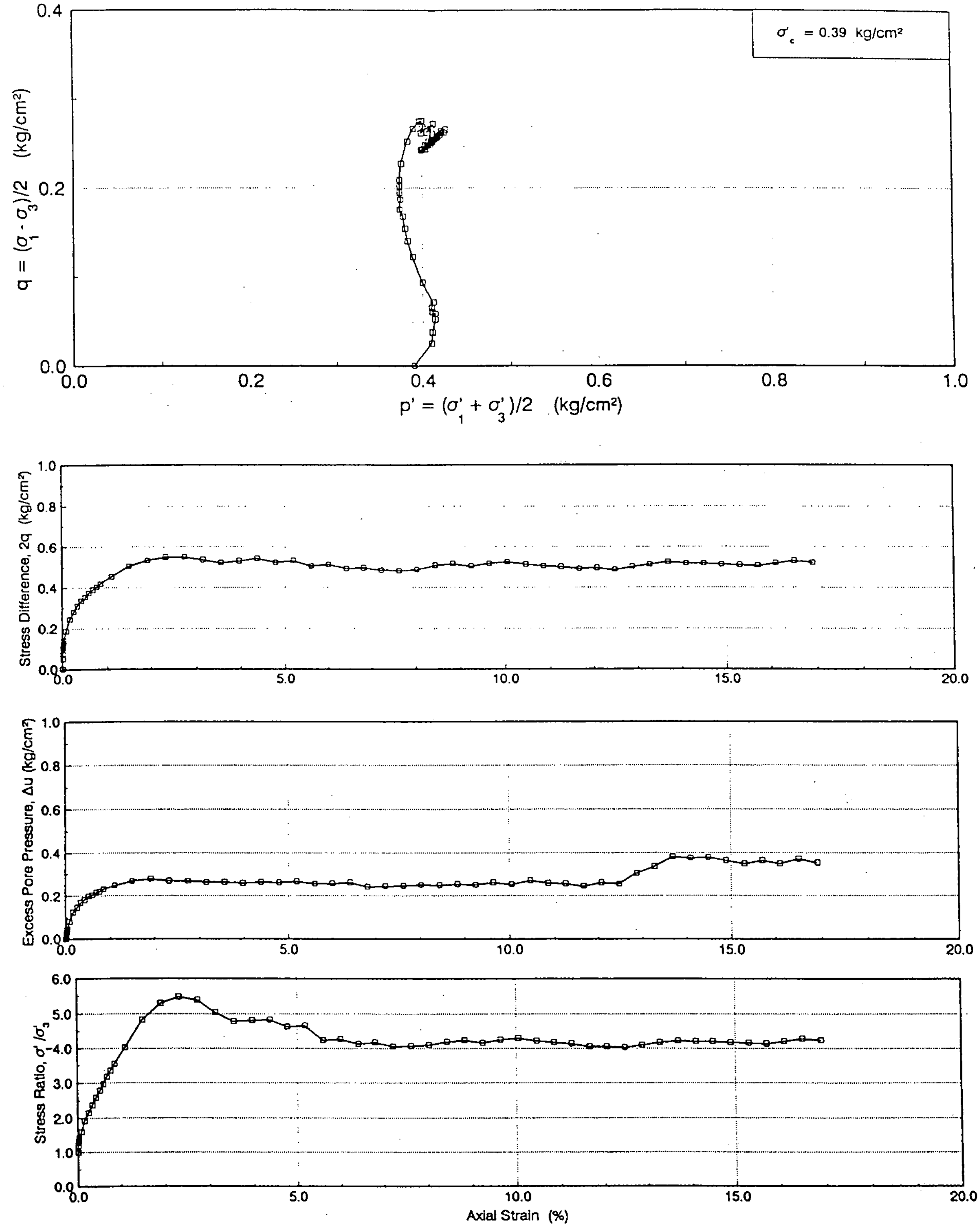

CONSOLIDATED UNDRAINED ($\overline{CIUC}$) TRIAXIAL TEST ON BORING SPT-3A, SAMPLE US-1

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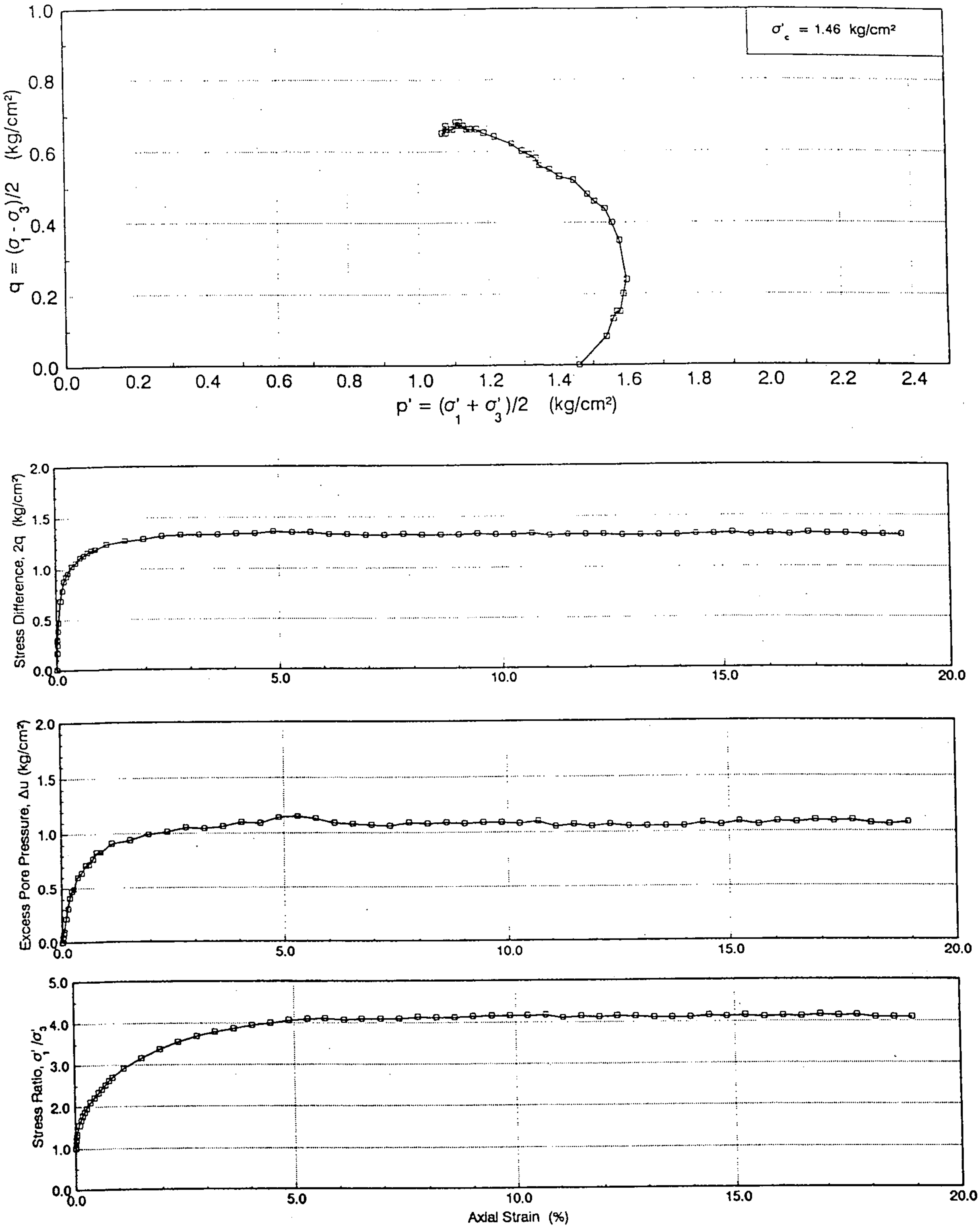

CONSOLIDATED UNDRAINED ($\overline{CIU}C$) TRIAXIAL TEST ON

BORING SPT-3A, SAMPLE US-2

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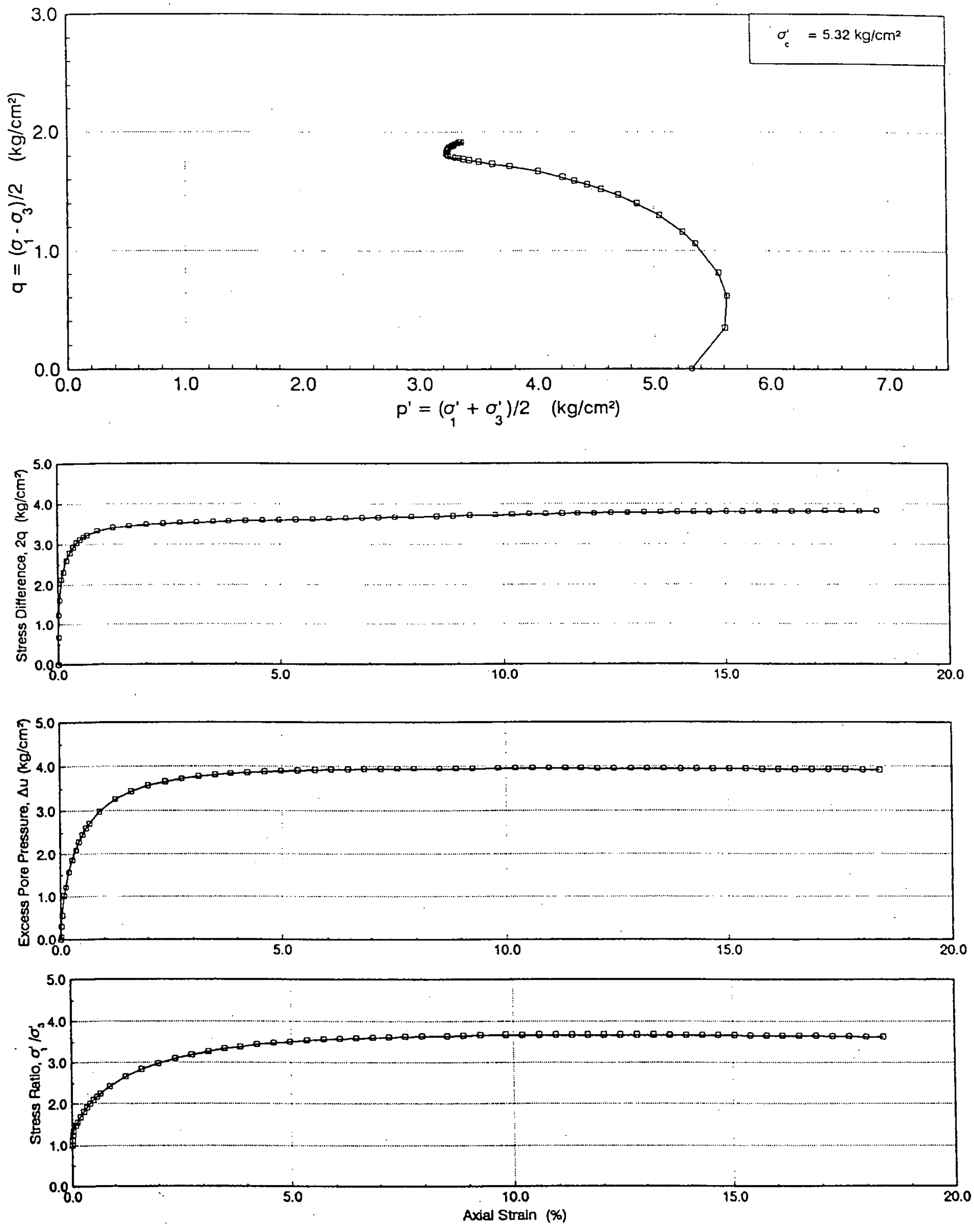

CONSOLIDATED UNDRAINED ($\overline{\text{CIUC}}$) TRIAXIAL TEST ON

BORING SPT-3A, SAMPLE US-2

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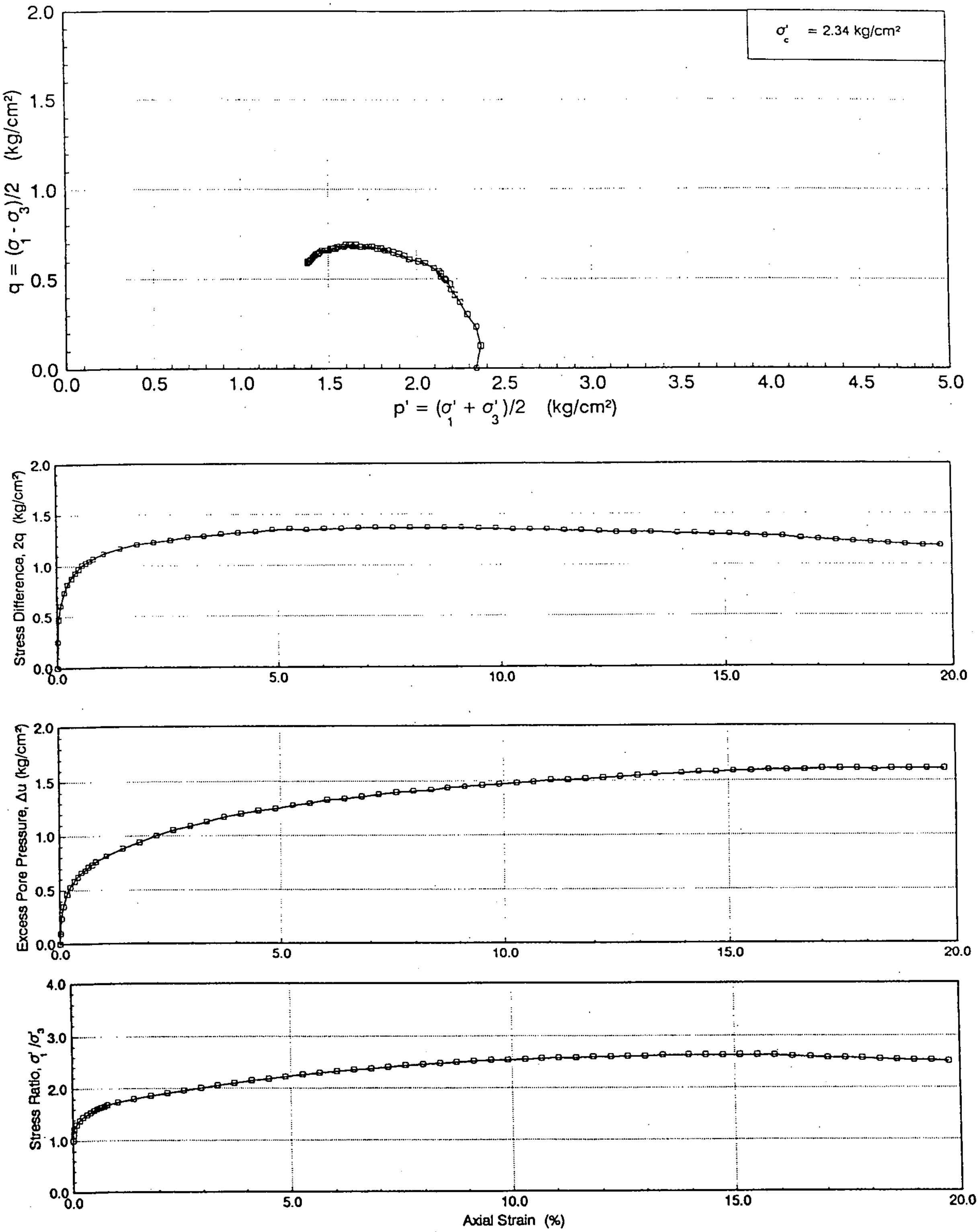

CONSOLIDATED UNDRAINED ($\overline{\text{CIUC}}$) TRIAXIAL TEST ON

BORING SPT-4A, SAMPLE US-1

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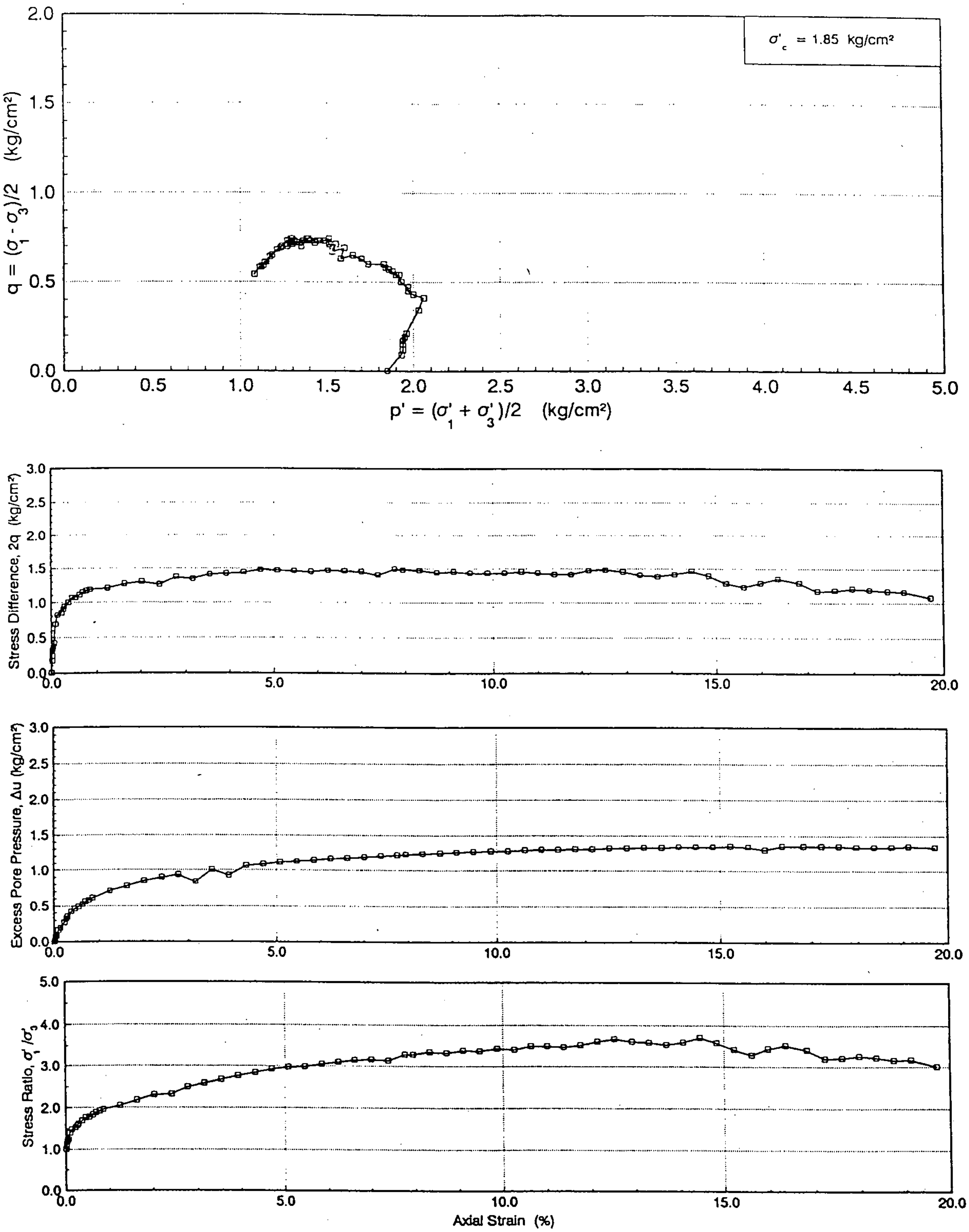

CONSOLIDATED UNDRAINED ($\overline{\text{CIUC}}$) TRIAXIAL TEST ON BORING SPT-5A, SAMPLE US-1

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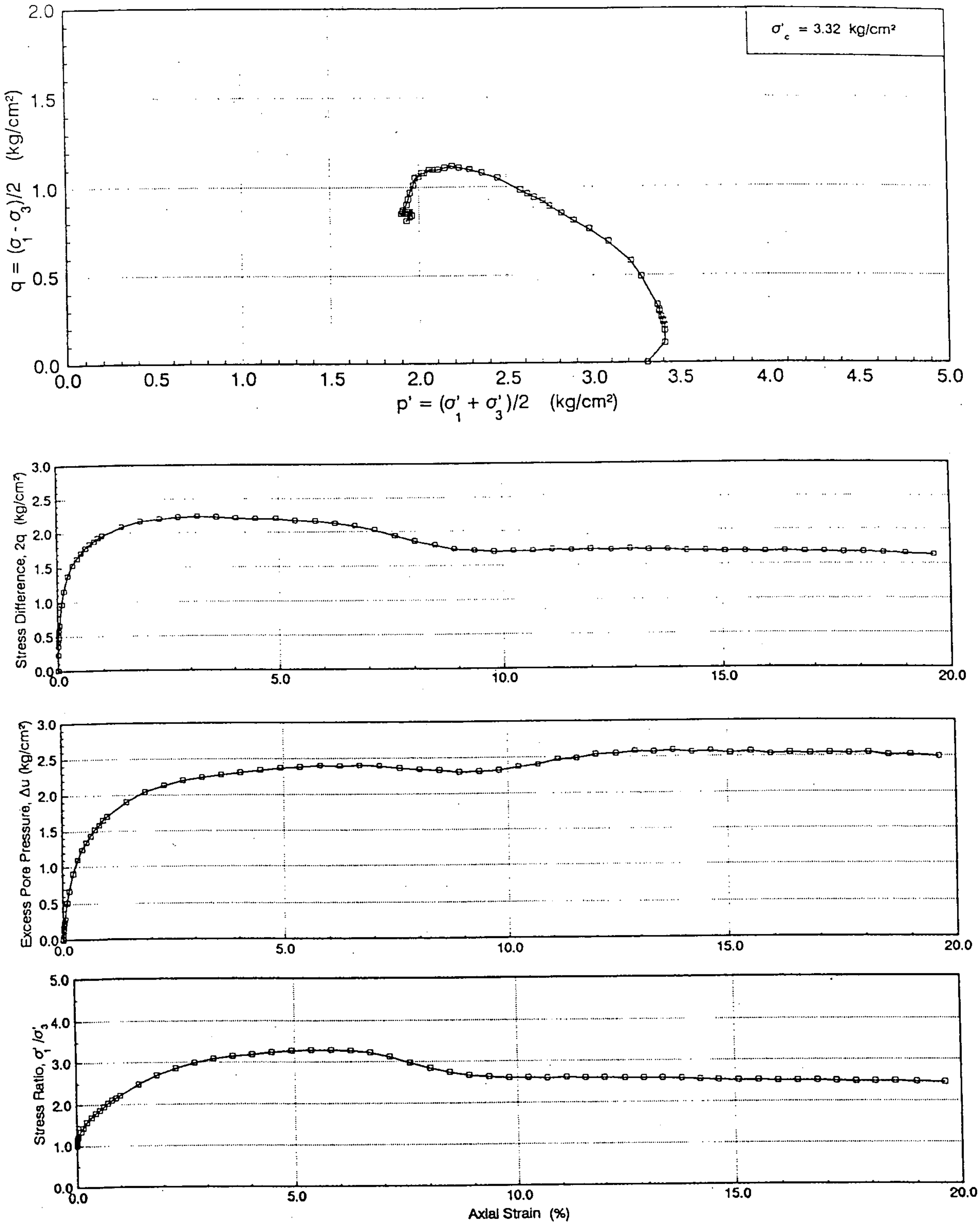

CONSOLIDATED UNDRAINED ($\overline{CIUC}$) TRIAXIAL TEST ON

BORING SPT-6A, SAMPLE US-1

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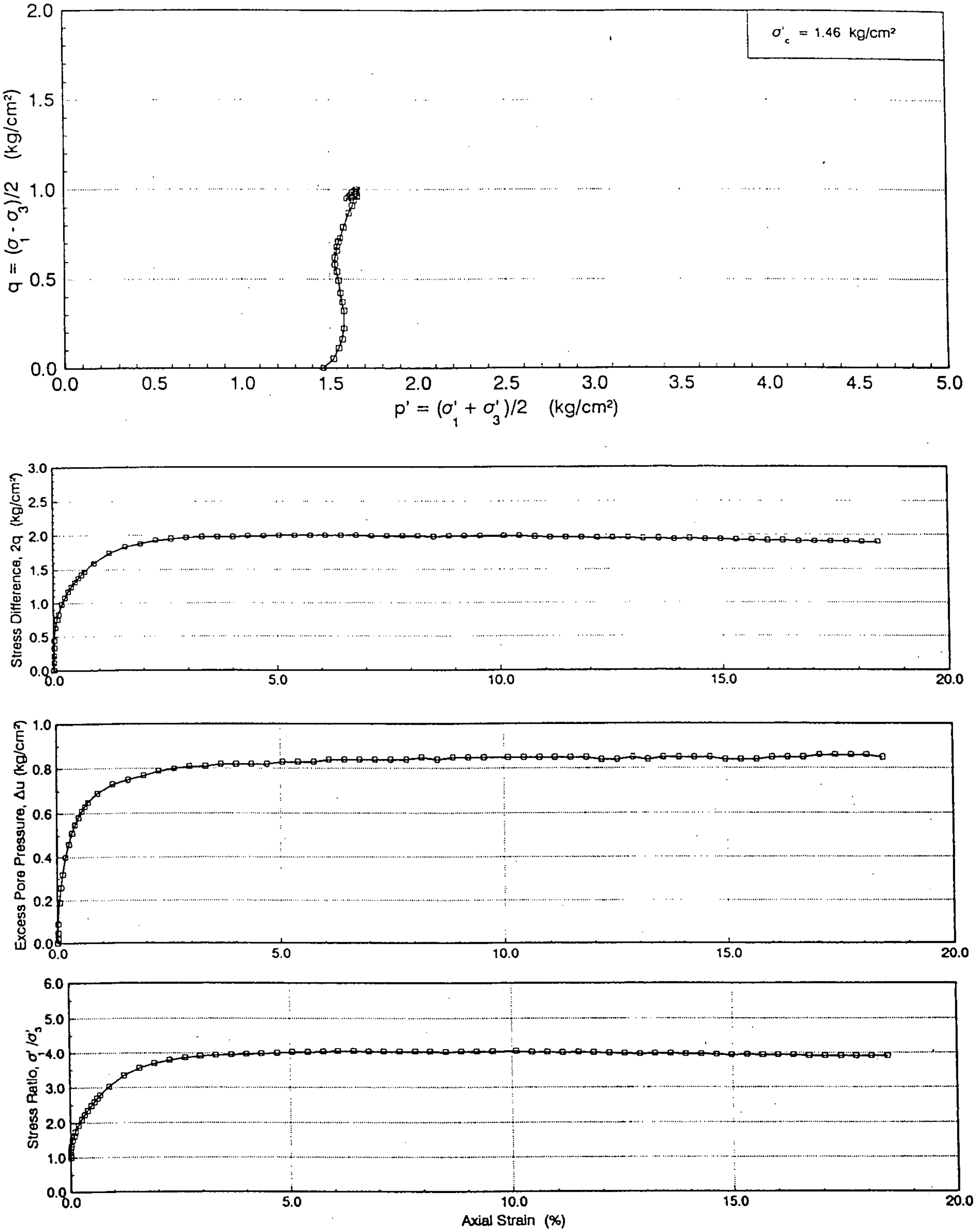

CONSOLIDATED UNDRAINED ($\overline{CIUC}$) TRIAXIAL TEST ON BORING SPT-7A, SAMPLE US-1

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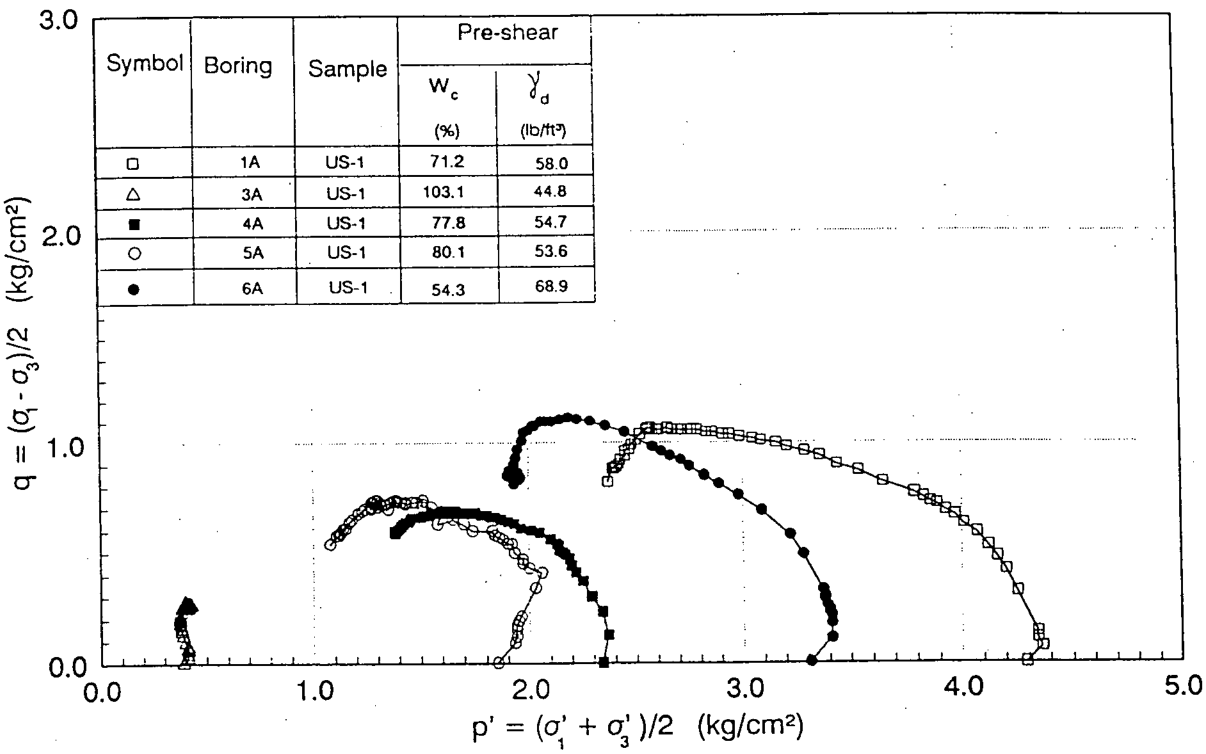

Symbol	Boring	Sample	Pre-shear W_c (%)	Pre-shear γ_d (lb/ft³)
□	1A	US-1	71.2	58.0
△	3A	US-1	103.1	44.8
■	4A	US-1	77.8	54.7
○	5A	US-1	80.1	53.6
●	6A	US-1	54.3	68.9

EFFECTIVE STRESS PATHS FROM
CONSOLIDATED UNDRAINED ($\overline{CIUC}$) TRIAXIAL TESTS ON CLAY SPECIMENS

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
HILLSBOROUGH COUNTY

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ORLANDO, FLORIDA

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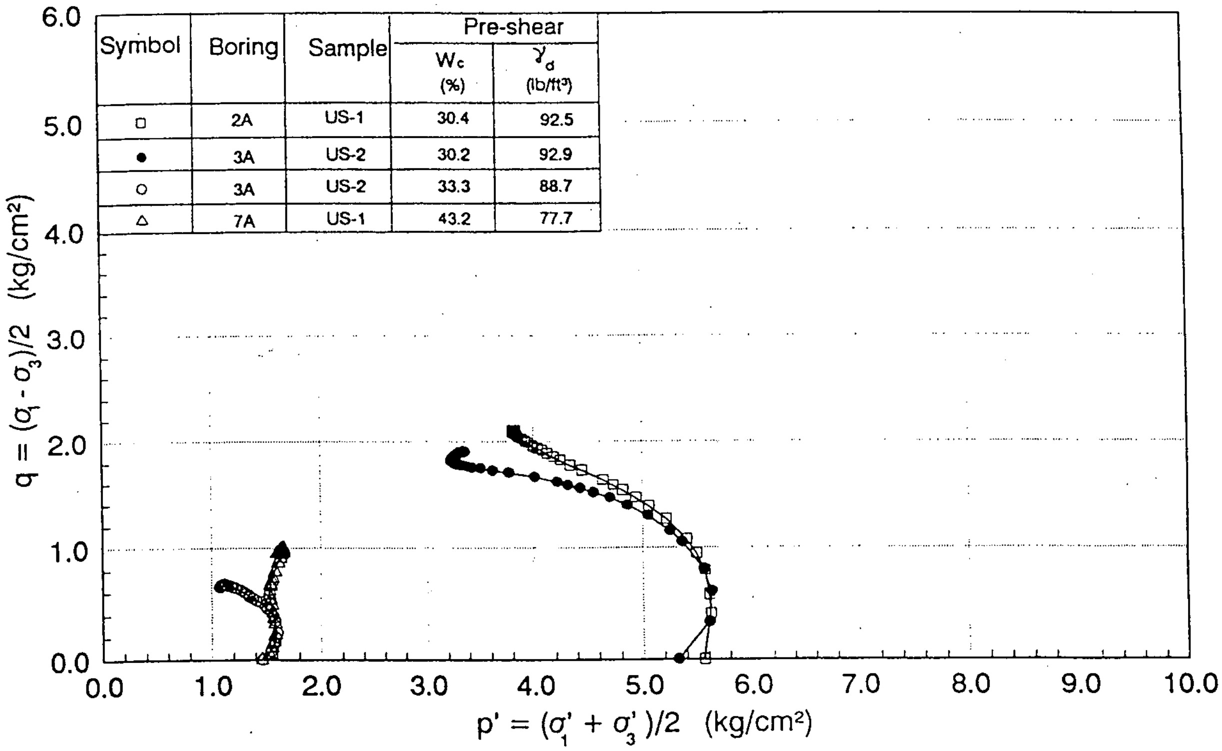

EFFECTIVE STRESS PATHS FROM
CONSOLIDATED UNDRAINED (CIUC) TRIAXIAL TESTS ON
CLAYEY SAND SPECIMENS

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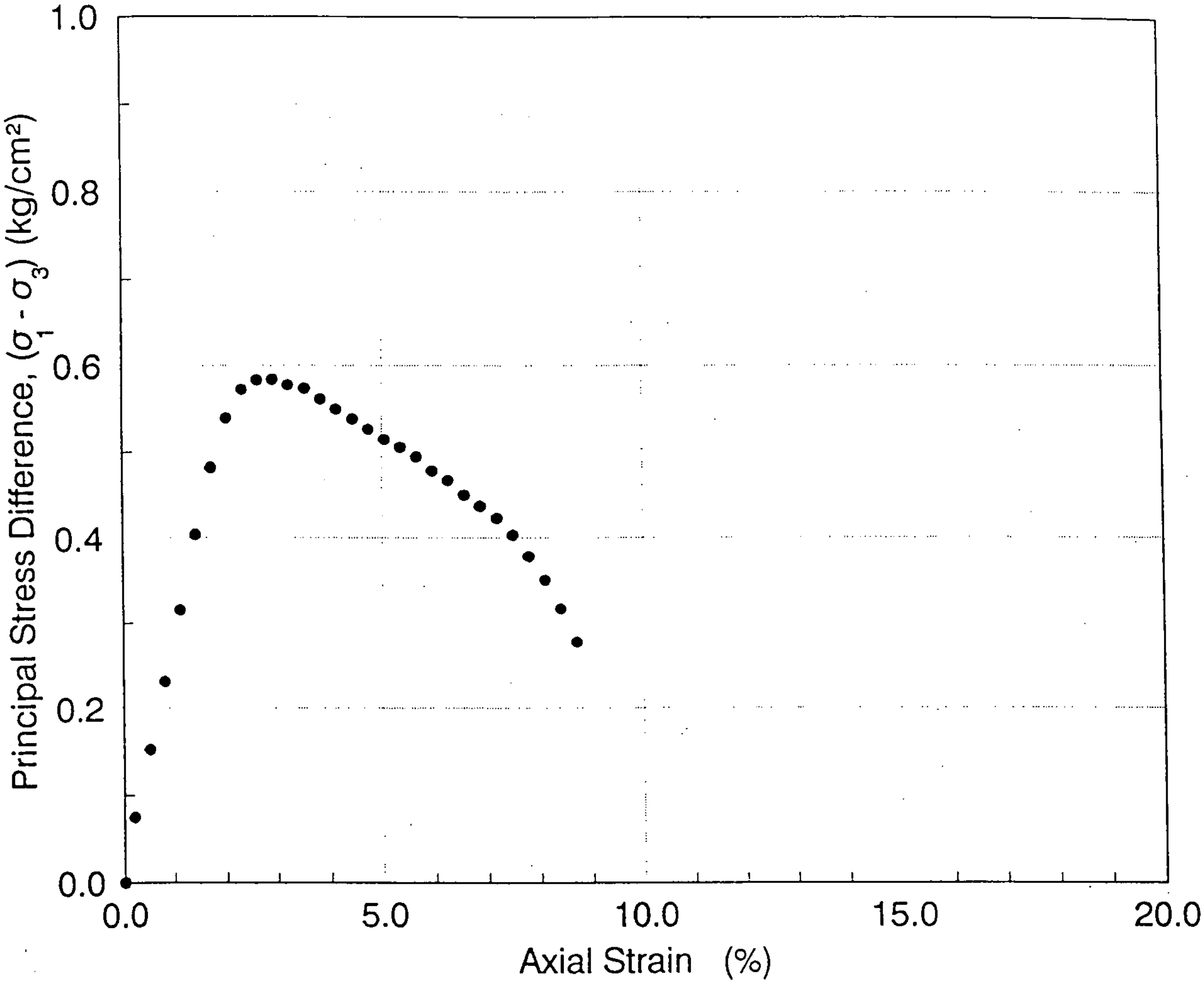

UNCONFINED COMPRESSION TEST ON SPECIMEN FROM BORING SPT-3A, SAMPLE US-2

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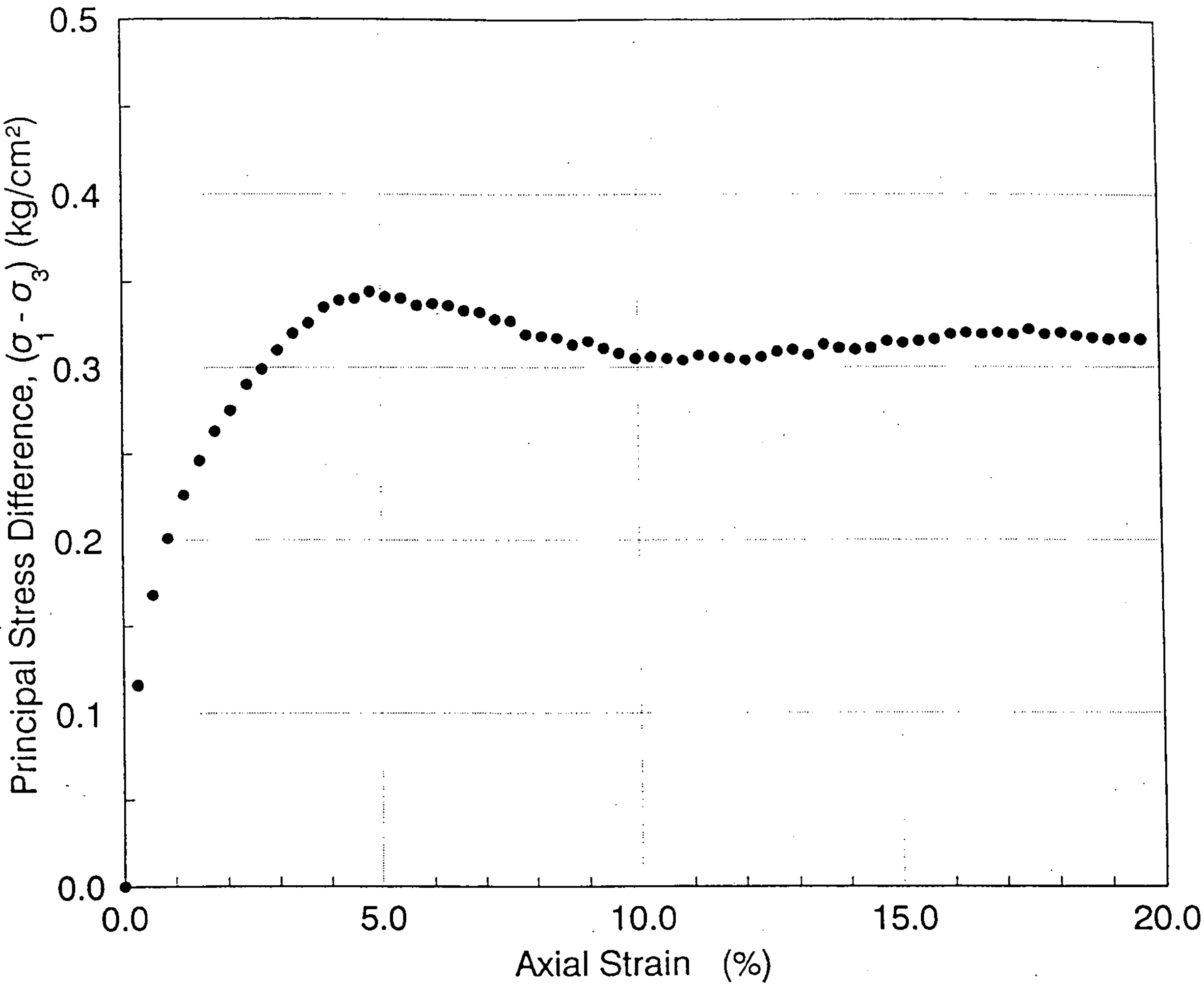
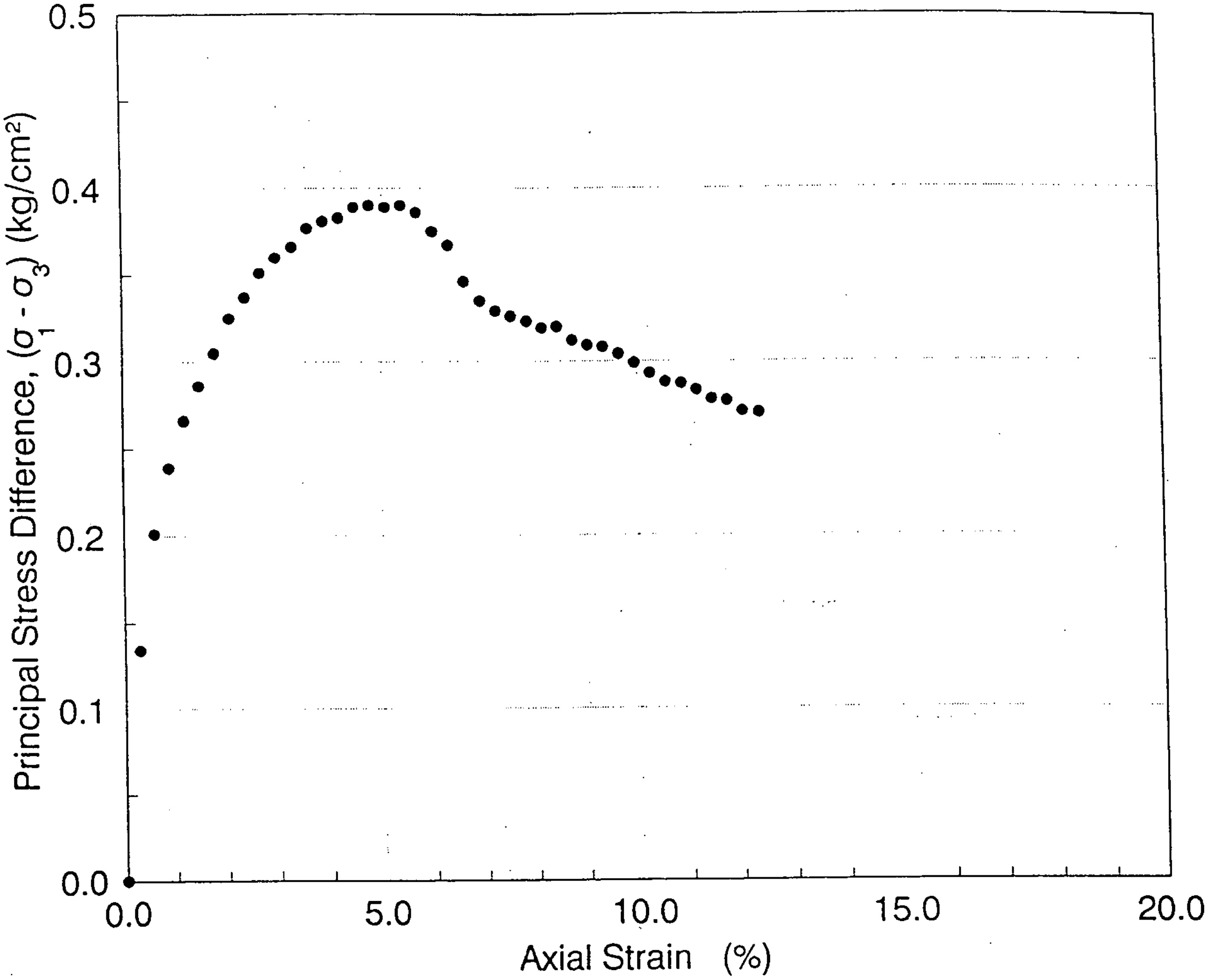
REMEDIAL ENGINEERING & SCIENCE, INC. ORLANDO, FLORIDA		
DRAWN BY: SA	CHECKED BY: SA	DATE: 06-18-97
FILE NO.: 97-9628	APPROVED BY:	FIGURE: 16

uchills3.drw



UNCONFINED COMPRESSION TEST ON SPECIMEN FROM BORING SPT-4A, SAMPLE US-1

Ardaman & Associates, Inc. Geotechnical, Environmental and Materials Consultants		
SOUTHEAST LANDFILL HILLSBOROUGH COUNTY REMEDIAL ENGINEERING & SCIENCE, INC. ORLANDO, FLORIDA		
DRAWN BY: SA	CHECKED BY: SA	DATE: 06-18-97
FILE NO.: 97-9628	APPROVED BY:	FIGURE: 17



UNCONFINED COMPRESSION TEST ON SPECIMEN FROM BORING SPT-5A, SAMPLE US-1

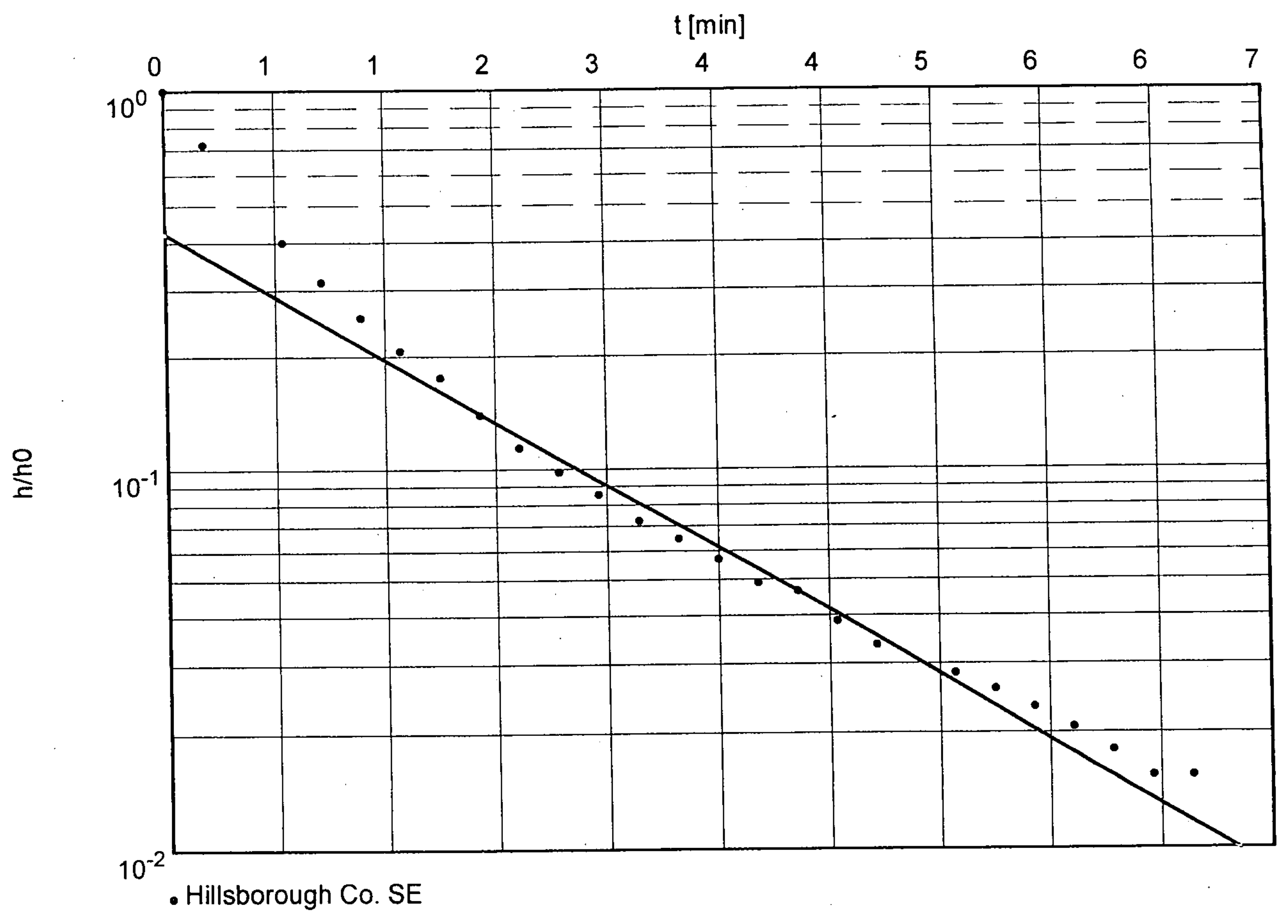
Ardaman & Associates, Inc. Geotechnical, Environmental and Materials Consultants		
SOUTHEAST LANDFILL HILLSBOROUGH COUNTY REMEDIAL ENGINEERING & SCIENCE, INC. ORLANDO, FLORIDA		
DRAWN BY: SA	CHECKED BY: SA	DATE: 06-18-97
FILE NO.: 97-9628	APPROVED BY:	FIGURE: 18

uchifs2.drw

Appendix B
Horizontal Hydraulic Conductivity Testing Results

Barnes, Ferland & Associates 3655 Maguire Boulevard, Suite 150 Orlando, Florida 32803 ph.(407) 896-8608	slug/bail test analysis BOUWER-RICE's method	Page 1 Project: Hillsborough Co. SE Landfill Evaluated by: MM — Date: 6/4/97

Slug Test No. 2	Test conducted on: May 1, 1997
Well P-1D	



Hydraulic conductivity [ft/min]: 1.68×10^{-3}

Hydraulic conductivity = 2.25 ft/day

Barnes, Ferland & Associates
3655 Maguire Boulevard, Suite 150
Orlando, Florida 32803
ph.(407) 896-8608

slug/bail test analysis
BOUWER-RICE's method

Project: Hillsborough Co. SE Landfill

Evaluated by: MM | Date: 6/4/97

Slug Test No. 2 | Test conducted on: May 1, 1997

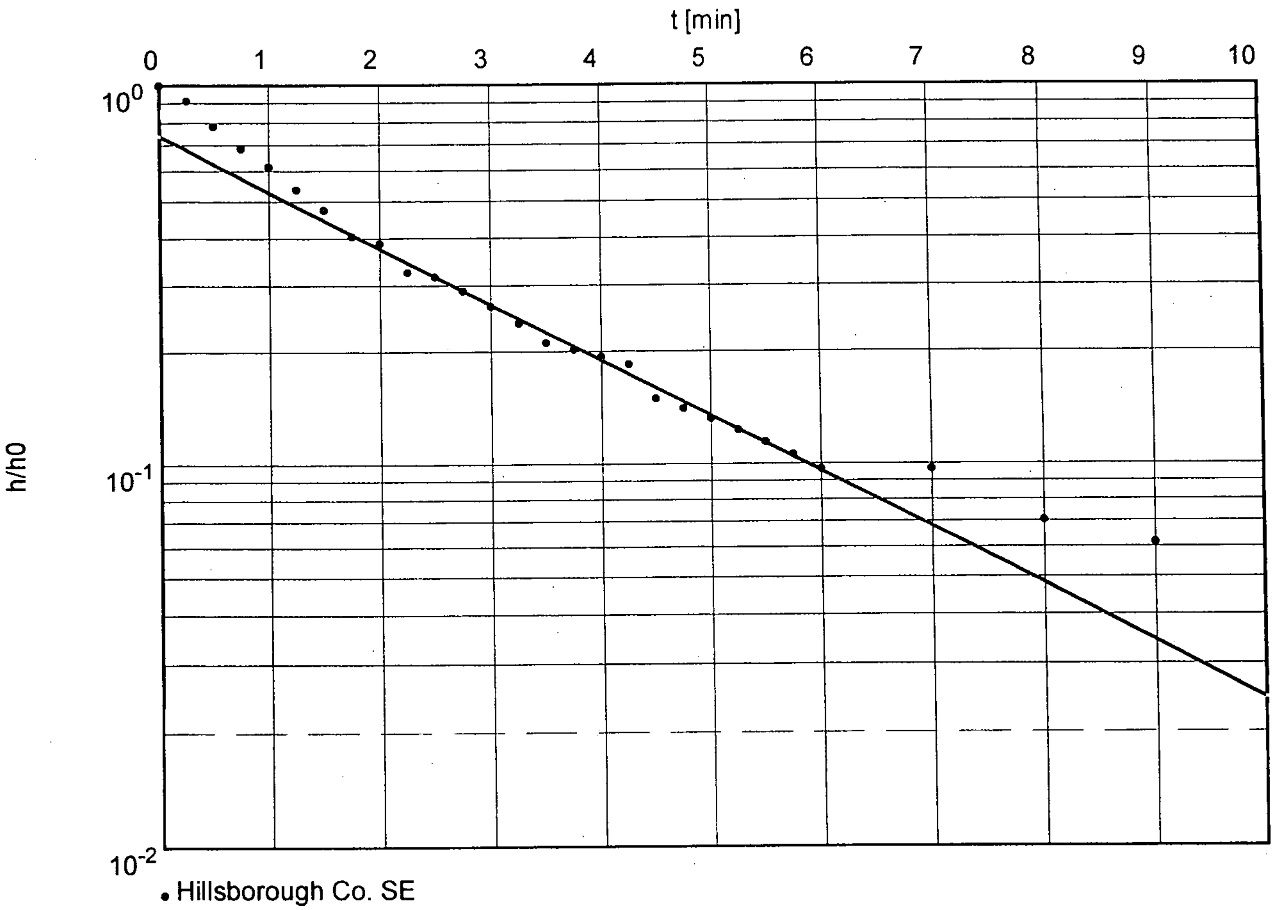
Well P-1D | Hillsborough Co. SE Landfill

Static water level: 7.76 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	0.00	-7.76
2	0.25	2.16	-5.60
3	0.75	4.66	-3.10
4	1.00	5.32	-2.44
5	1.25	5.80	-1.96
6	1.50	6.16	-1.60
7	1.75	6.40	-1.36
8	2.00	6.68	-1.08
9	2.25	6.88	-0.88
10	2.50	7.00	-0.76
11	2.75	7.10	-0.66
12	3.00	7.20	-0.56
13	3.25	7.26	-0.50
14	3.50	7.32	-0.44
15	3.75	7.38	-0.38
16	4.00	7.40	-0.36
17	4.25	7.46	-0.30
18	4.50	7.50	-0.26
19	5.00	7.54	-0.22
20	5.25	7.56	-0.20
21	5.50	7.58	-0.18
22	5.75	7.60	-0.16
23	6.00	7.62	-0.14
24	6.25	7.64	-0.12
25	6.50	7.64	-0.12

Barnes, Ferland & Associates 3655 Maguire Boulevard, Suite 150 Orlando, Florida 32803 ph.(407) 896-8608	slug/bail test analysis BOUWER-RICE's method	Page 1 Project: Hillsborough Co. SE Landfill Evaluated by: MM — Date: 6/12/97

Slug Test No. 2	Test conducted on: May 2, 1997
Well P-2S	



Hydraulic conductivity [ft/min]: 7.85×10^{-4}

Hydraulic conductivity = 1.13 ft/day

Barnes, Ferland & Associates 3655 Maguire Boulevard, Suite 150 Orlando, Florida 32803 ph.(407) 896-8608	slug/bail test analysis BOUWER-RICE's method	Page 2 Project: Hillsborough Co. SE Landfill Evaluated by: MM — Date: 6/12/97

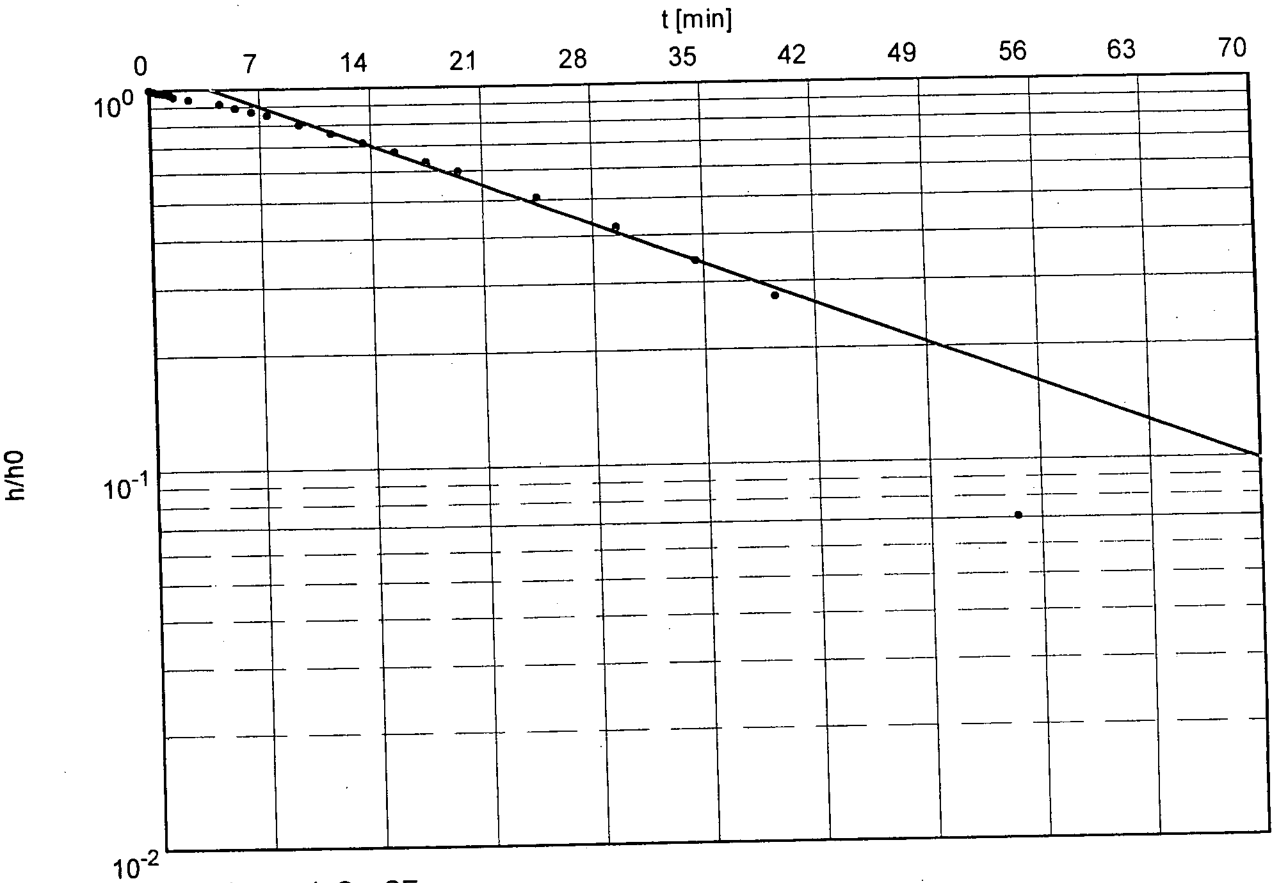
Slug Test No. 2	Test conducted on: May 2, 1997
Well P-2S	Hillsborough Co. SE Landfill

Static water level: 7.82 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	10.10	2.28
2	0.25	9.90	2.08
3	0.50	9.60	1.78
4	0.75	9.38	1.56
5	1.00	9.22	1.40
6	1.25	9.04	1.22
7	1.50	8.90	1.08
8	1.75	8.74	0.92
9	2.00	8.70	0.88
10	2.25	8.56	0.74
11	2.50	8.54	0.72
12	2.75	8.48	0.66
13	3.00	8.42	0.60
14	3.25	8.36	0.54
15	3.50	8.30	0.48
16	3.75	8.28	0.46
17	4.00	8.26	0.44
18	4.25	8.24	0.42
19	4.50	8.16	0.34
20	4.75	8.14	0.32
21	5.00	8.12	0.30
22	5.25	8.10	0.28
23	5.50	8.08	0.26
24	5.75	8.06	0.24
25	6.00	8.04	0.22
26	7.00	8.04	0.22
27	8.00	7.98	0.16
28	9.00	7.96	0.14

Barnes, Ferland & Associates 3655 Maguire Boulevard, Suite 150 Orlando, Florida 32803 ph.(407) 896-8608	slug/bail test analysis BOUWER-RICE's method	Page 1 Project: Hillsborough Co. SE Landfill Evaluated by: MM · Date: 6/12/97

Slug Test No. 2	Test conducted on: May 1, 1997
Well P-2D	



Hydraulic conductivity [ft/min]: 8.05×10^{-5}

Hydraulic conductivity = 0.12 ft/day

Barnes, Ferland & Associates
3655 Maguire Boulevard, Suite 150
Orlando, Florida 32803
ph.(407) 896-8608

slug/bail test analysis
BOUWER-RICE's method

Project: Hillsborough Co. SE Landfill

Evaluated by: MM | Date: 6/12/97

Slug Test No. 2 | Test conducted on: May 1, 1997

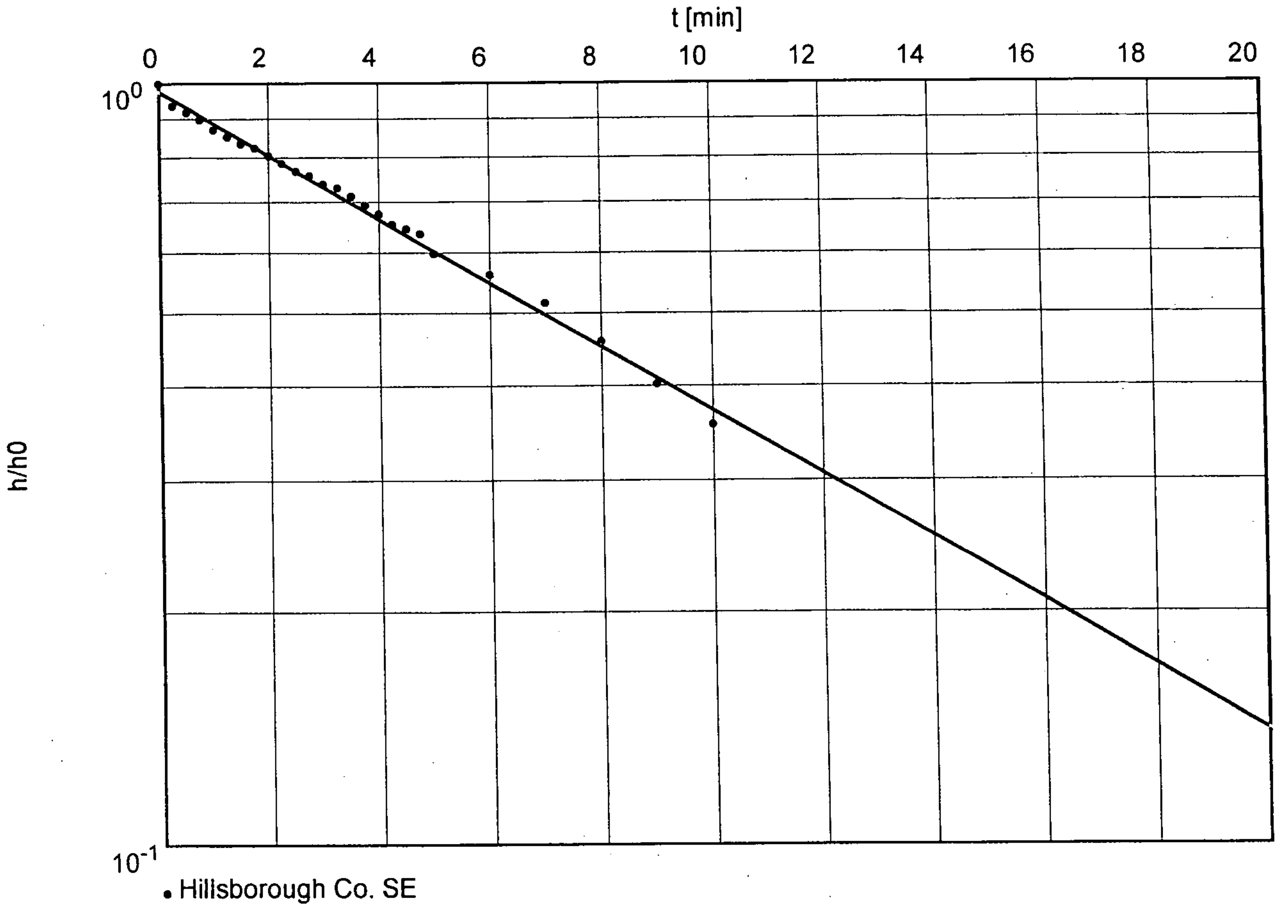
Well P-2D | Hillsborough Co. SE Landfill

Static water level: 9.60 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	0.80	-8.80
2	0.25	0.86	-8.74
3	0.50	0.92	-8.68
4	0.75	0.96	-8.64
5	1.00	1.02	-8.58
6	1.25	1.06	-8.54
7	1.50	1.20	-8.40
8	2.50	1.34	-8.26
9	4.50	1.56	-8.04
10	5.50	1.76	-7.84
11	6.50	1.96	-7.64
12	7.50	2.14	-7.46
13	9.50	2.56	-7.04
14	11.50	2.94	-6.66
15	13.50	3.30	-6.30
16	15.50	3.66	-5.94
17	17.50	4.02	-5.58
18	19.50	4.34	-5.26
19	24.50	5.14	-4.46
20	29.50	5.90	-3.70
21	34.50	6.60	-3.00
22	39.50	7.20	-2.40
23	54.50	8.98	-0.62

Barnes, Ferland & Associates 3655 Maguire Boulevard, Suite 150 Orlando, Florida 32803 ph.(407) 896-8608	slug/bail test analysis BOUWER-RICE's method	Page 1 Project: Hillsborough Co. SE Landfill Evaluated by: MM · Date: 6/12/97

Slug Test No. 1	Test conducted on: May 2, 1997
Well P-4S	



Hydraulic conductivity [ft/min]: 1.33×10^{-4}

Hydraulic conductivity = 0.19 ft/day

Barnes, Ferland & Associates
3655 Maguire Boulevard, Suite 150
Orlando, Florida 32803
ph.(407) 896-8608

slug/bail test analysis
BOUWER-RICE's method

Project: Hillsborough Co. SE Landfill

Evaluated by: MM | Date: 6/12/97

Slug Test No. 1 | Test conducted on: May 2, 1997

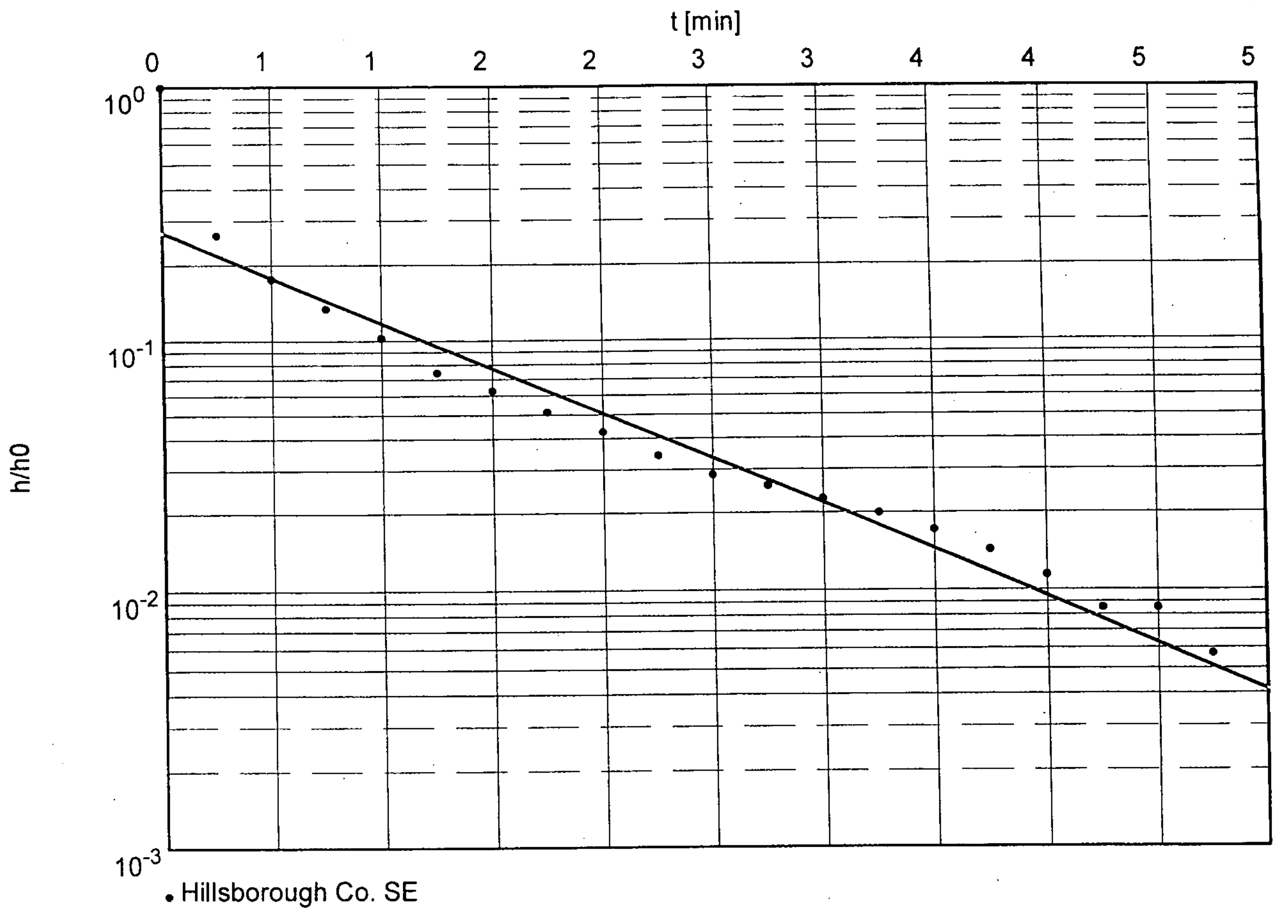
Well P-4S | Hillsborough Co. SE Landfill

Static water level: 8.22 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	10.36	2.14
2	0.25	10.22	2.00
3	0.50	10.18	1.96
4	0.75	10.14	1.92
5	1.00	10.08	1.86
6	1.25	10.04	1.82
7	1.50	10.00	1.78
8	1.75	9.98	1.76
9	2.00	9.94	1.72
10	2.25	9.90	1.68
11	2.50	9.86	1.64
12	2.75	9.84	1.62
13	3.00	9.80	1.58
14	3.25	9.78	1.56
15	3.50	9.74	1.52
16	3.75	9.70	1.48
17	4.00	9.66	1.44
18	4.25	9.62	1.40
19	4.50	9.60	1.38
20	4.75	9.58	1.36
21	5.00	9.50	1.28
22	6.00	9.42	1.20
23	7.00	9.32	1.10
24	8.00	9.20	0.98
25	9.00	9.08	0.86
26	10.00	8.98	0.76

Barnes, Ferland & Associates 3655 Maguire Boulevard, Suite 150 Orlando, Florida 32803 ph.(407) 896-8608	slug/bail test analysis BOUWER-RICE's method	Page 1 Project: Hillsborough Co. SE Landfill Evaluated by: MM — Date: 6/10/97

Slug Test No. 2	Test conducted on: May 2, 1997
Well #P-4D	



Hydraulic conductivity [ft/min]: 1.34×10^{-3}

Hydraulic conductivity = 1.93 ft/day

Barnes, Ferland & Associates 3655 Maguire Boulevard, Suite 150 Orlando, Florida 32803 ph.(407) 896-8608	slug/bail test analysis BOUWER-RICE's method	Page 2 Project: Hillsborough Co. SE Landfill Evaluated by: MM — Date: 6/10/97

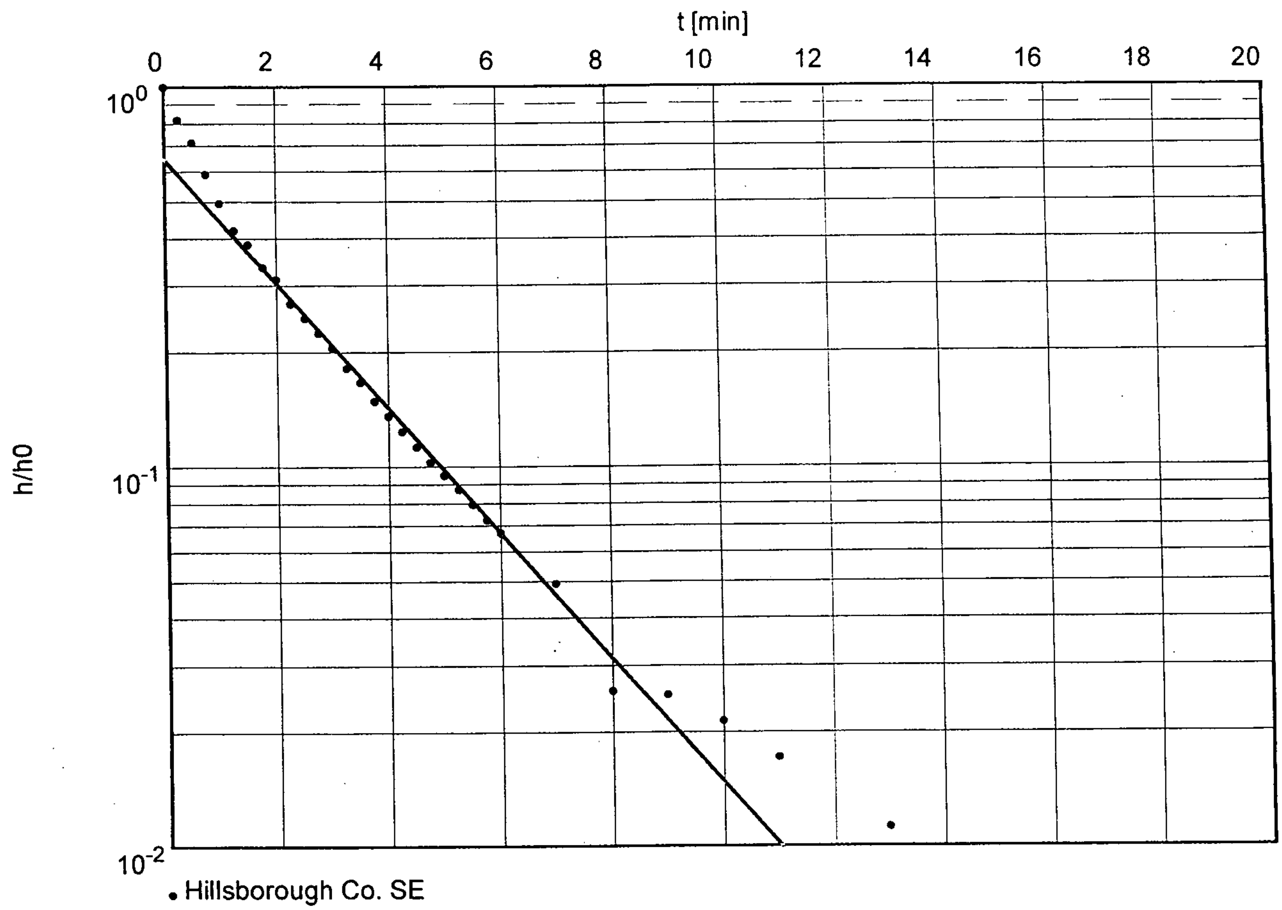
Slug Test No. 2	Test conducted on: May 2, 1997
Well #P-4D	Hillsborough Co. SE Landfill

Static water level: 22.54 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	15.50	-7.04
2	0.25	20.70	-1.84
3	0.50	21.30	-1.24
4	0.75	21.60	-0.94
5	1.00	21.82	-0.72
6	1.25	22.02	-0.52
7	1.50	22.10	-0.44
8	1.75	22.18	-0.36
9	2.00	22.24	-0.30
10	2.25	22.30	-0.24
11	2.50	22.34	-0.20
12	2.75	22.36	-0.18
13	3.00	22.38	-0.16
14	3.25	22.40	-0.14
15	3.50	22.42	-0.12
16	3.75	22.44	-0.10
17	4.00	22.46	-0.08
18	4.25	22.48	-0.06
19	4.50	22.48	-0.06
20	4.75	22.50	-0.04

Barnes, Ferland & Associates 3655 Maguire Boulevard, Suite 150 Orlando, Florida 32803 ph.(407) 896-8608	slug/bail test analysis BOUWER-RICE's method	Page 1 Project: Hillsborough Co. SE Landfill Evaluated by: MM — Date: 6/10/97

Slug Test No. 1	Test conducted on: May 2, 1997
Well P-6D	



Hydraulic conductivity [ft/min]: 7.42×10^{-4}

Hydraulic conductivity = 1.07 ft/day

Barnes, Ferland & Associates
3655 Maguire Boulevard, Suite 150
Orlando, Florida 32803
ph.(407) 896-8608

slug/bail test analysis
BOUWER-RICE's method

Project: Hillsborough Co. SE Landfill

Evaluated by: MM | Date: 6/10/97

Slug Test No. 1 | Test conducted on: May 2, 1997

Well P-6D | Hillsborough Co. SE Landfill

Static water level: 37.40 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	0.00	-37.40
2	0.25	6.90	-30.50
3	0.50	10.78	-26.62
4	0.75	15.36	-22.04
5	1.00	18.96	-18.44
6	1.25	21.72	-15.68
7	1.50	23.00	-14.40
8	1.75	24.92	-12.48
9	2.00	25.80	-11.60
10	2.25	27.40	-10.00
11	2.50	28.26	-9.14
12	2.75	29.02	-8.38
13	3.00	29.76	-7.64
14	3.25	30.66	-6.74
15	3.50	31.20	-6.20
16	3.75	31.86	-5.54
17	4.00	32.34	-5.06
18	4.25	32.80	-4.60
19	4.50	33.20	-4.20
20	4.75	33.58	-3.82
21	5.00	33.86	-3.54
22	5.25	34.16	-3.24
23	5.50	34.44	-2.96
24	5.75	34.70	-2.70
25	6.00	34.90	-2.50
26	7.00	35.56	-1.84
27	8.00	36.44	-0.96
28	9.00	36.46	-0.94
29	10.00	36.60	-0.80
30	11.00	36.76	-0.64
31	13.00	36.98	-0.42

Appendix C
SWFWMD Permitted Wells
Within the Project Vicinity

WELL PERMITS ISSUED REPORT

COUNTY: HILLSBOROUGH ISSUE DATE RANGE: 01/01/70 THRU 08/20/97

WCP NUMBER	OWNER ID	OWNER INFORMATION	WELL DIAMETER	LOCATION S-T-R	USE CD DESCRIPTION	CONTRACTOR ID	PRIM DEPTH	TELESCOPE FROM	TO	LINER FROM	TO	WELL DEPTH
385897.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	23-31-21	TEST WELL/PIEZOMETER	002365	10.0					29.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD		CITY/STATE: TAMPA, FL			ZIP: 33601-1110	PHONE: (813) 272-5912				
385898.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	23-31-21	TEST WELL/PIEZOMETER	002365	5.0					25.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD		CITY/STATE: TAMPA, FL			ZIP: 33601-1110	PHONE: (813) 272-5912				
385908.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	23-31-21	TEST WELL/PIEZOMETER	002365	20.0					35.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD		CITY/STATE: TAMPA, FL			ZIP: 33601-1110	PHONE: (813) 272-5912				
385909.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	23-31-21	TEST WELL/PIEZOMETER	002365	21.0					27.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD		CITY/STATE: TAMPA, FL			ZIP: 33601-1110	PHONE: (813) 272-5912				
385911.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	23-31-21	TEST WELL/PIEZOMETER	002365	12.0					18.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD		CITY/STATE: TAMPA, FL			ZIP: 33601-1110	PHONE: (813) 272-5912				
385912.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	23-31-21	TEST WELL/PIEZOMETER	002365	14.0					19.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD		CITY/STATE: TAMPA, FL			ZIP: 33601-1110	PHONE: (813) 272-5912				
397387.01	019220	HILLSBOROUGH CO. WASTE MGT., INC	4.00	23-31-21	PUBLIC SUPPLY	001232	209.0					423.0
		ADDRESS: 6015 HIGHWAY 301 NORTH		CITY/STATE: TAMPA, FL			ZIP: 33610-	PHONE: (000) 000-0000				
401639.01	015890	MORGAN CONSTRUCTION CO	4.00	23-31-21	PUBLIC SUPPLY	001232	220.0					470.0
		ADDRESS: 4110 GUNN HIGHWAY		CITY/STATE: TAMPA, FL			ZIP: 33688-	PHONE: (000) 000-0000				
427483.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	23-31-21	OBSERVATION OR MONIT	002372	3.0					34.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD		CITY/STATE: TAMPA, FL			ZIP: 33601-1110	PHONE: (813) 272-5912				
427484.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	23-31-21	OBSERVATION OR MONIT	002372	3.0					19.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD		CITY/STATE: TAMPA, FL			ZIP: 33601-1110	PHONE: (813) 272-5912				
427485.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	23-31-21	OBSERVATION OR MONIT	002372	3.0					24.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD		CITY/STATE: TAMPA, FL			ZIP: 33601-1110	PHONE: (813) 272-5912				
430856.01	001321	HILLSBOROUGH CO. BOCC-PARKS & RECREATION DEPT	2.00	23-31-21	OBSERVATION OR MONIT	002372	9.0					19.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD		CITY/STATE: TAMPA, FL			ZIP: 33602-	PHONE: (813) 272-5912				
582259.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	23-31-21	OBSERVATION OR MONIT	009126	14.0					24.0
		WELL LOC: HWY 672						PHONE: (813) 272-5912				

WELL PERMITS ISSUED REPORT

WELL PERMITS ISSUED REPORT

COUNTY: HILLSBOROUGH ISSUE DATE RANGE: 01/01/70 THRU 08/20/97

WCP NUMBER	OWNER ID	OWNER INFORMATION	WELL DIAMETER	LOCATION S-T-R	USE CD DESCRIPTION	CONTRACTOR ID	PRIM DEPTH	TELESCOPE FROM	TELESCOPE TO	LINER FROM	LINER TO	WELL DEPTH
582259.02	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	23-31-21	OBSERVATION OR MONIT	009126	20.0					30.0
		WELL LOC: HWY 672						PHONE: (813) 272-5912				
591583.01	006996	HILLSBOROUGH CO. UTILITIES & W.C.R.W.S.A.	2.00	23-31-21	OBSERVATION OR MONIT	002368	1.0					4.0
		WELL LOC: SOUTHEAST LANDFILL						PHONE: (813) 272-5000				
591583.02	006996	HILLSBOROUGH CO. UTILITIES & W.C.R.W.S.A.	2.00	23-31-21	OBSERVATION OR MONIT	002368	2.5					7.5
		WELL LOC: SOUTHEAST LANDFILL						PHONE: (813) 272-5000				
591583.03	006996	HILLSBOROUGH CO. UTILITIES & W.C.R.W.S.A.	2.00	23-31-21	OBSERVATION OR MONIT	002368	10.0					15.0
		WELL LOC: SOUTHEAST LANDFILL						PHONE: (813) 272-5000				
591583.04	006996	HILLSBOROUGH CO. UTILITIES & W.C.R.W.S.A.	2.00	23-31-21	OBSERVATION OR MONIT	002368	15.0					20.0
		WELL LOC: SOUTHEAST LANDFILL						PHONE: (813) 272-5000				
591583.05	006996	HILLSBOROUGH CO. UTILITIES & W.C.R.W.S.A.	2.00	23-31-21	OBSERVATION OR MONIT	002368	20.0					25.0
		WELL LOC: SOUTHEAST LANDFILL						PHONE: (813) 272-5000				
591587.01	006996	HILLSBOROUGH CO. UTILITIES & W.C.R.W.S.A.	2.00	23-31-21	OBSERVATION OR MONIT	002368	7.0					10.5
		WELL LOC: SOUTHEAST LANDFILL						PHONE: (813) 272-5000				

COUNTY: HILLSBOROUGH   ISSUE DATE RANGE: 01/01/70 THRU 08/20/97

WCP NUMBER	OWNER ID	OWNER INFORMATION	WELL DIAMETER	LOCATION S-T-R	USE CD DESCRIPTION	CONTRACTOR ID	PRIM DEPTH	TELESCOPE FROM	TELESCOPE TO	LINER FROM	LINER TO	WELL DEPTH
385903.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	14-31-21	TEST WELL/PIEZOMETER	002365	14.0					21.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD CITY/STATE: TAMPA, FL ZIP: 33601-1110 PHONE: (813) 272-5912										
385904.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	14-31-21	TEST WELL/PIEZOMETER	002365	29.0					49.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD CITY/STATE: TAMPA, FL ZIP: 33601-1110 PHONE: (813) 272-5912										
385905.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	14-31-21	TEST WELL/PIEZOMETER	002365	41.0					61.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD CITY/STATE: TAMPA, FL ZIP: 33601-1110 PHONE: (813) 272-5912										
385906.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	14-31-21	TEST WELL/PIEZOMETER	002365	27.0					42.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD CITY/STATE: TAMPA, FL ZIP: 33601-1110 PHONE: (813) 272-5912										
385907.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	14-31-21	TEST WELL/PIEZOMETER	002365	33.0					48.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD CITY/STATE: TAMPA, FL ZIP: 33601-1110 PHONE: (813) 272-5912										
385910.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	14-31-21	TEST WELL/PIEZOMETER	002365	158.0					163.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD CITY/STATE: TAMPA, FL ZIP: 33601-1110 PHONE: (813) 272-5912										
385914.01	000118	HILLSBOROUGH CO. BOARD OF COUNTY COMMISSIONERS	2.00	14-31-21	TEST WELL/PIEZOMETER	002365	5.0					15.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD CITY/STATE: TAMPA, FL ZIP: 33601-1110 PHONE: (813) 272-5912										
433639.01	000622	HILLSBOROUGH CO. DEPT. OF PUBLIC UTILITIES & WASTEWATER	2.00	14-31-21	PLUGGED OR ABONDONED	002372	19.0					19.0
		ADDRESS: PO BOX 1110-601 E KENNEDY BLVD CITY/STATE: TAMPA, FL ZIP: 33618- PHONE: (813) 272-5912										
573402.01	178778	HILLSBOROUGH CO. PLANNING & DEV. MANAGEMENT DEPT	2.00	14-31-21	OBSERVATION OR MONIT	002633	3.0					14.0
		WELL LOC: HWY 39 AND I4 PHONE: (813) 272-5920										
573402.02	178778	HILLSBOROUGH CO. PLANNING & DEV. MANAGEMENT DEPT	2.00	14-31-21	OBSERVATION OR MONIT	002633	3.0					14.0
		WELL LOC: HWY 39 AND I4 PHONE: (813) 272-5920										
591588.01	006996	HILLSBOROUGH CO. UTILITIES & W.C.R.W.S.A.	2.00	14-31-21	OBSERVATION OR MONIT	002368	2.5					7.5
		WELL LOC: SOUTHEAST LANDFILL PHONE: (813) 272-5000										
591588.02	006996	HILLSBOROUGH CO. UTILITIES & W.C.R.W.S.A.	2.00	14-31-21	OBSERVATION OR MONIT	002368	2.5					7.5
		WELL LOC: SOUTHEAST LANDFILL PHONE: (813) 272-5000										
591588.03	006996	HILLSBOROUGH CO. UTILITIES & W.C.R.W.S.A.	2.00	14-31-21	OBSERVATION OR MONIT	002368	20.0					25.0
		WELL LOC: SOUTHEAST LANDFILL PHONE: (813) 272-5000										

WELL PERMITS ISSUED REPORT

COUNTY: HILLSBOROUGH   ISSUE DATE RANGE: 01/01/70 THRU 08/20/97

WCP NUMBER	OWNER ID	OWNER INFORMATION	WELL DIAMETER	LOCATION S-T-R	USE CD DESCRIPTION	CONTRACTOR ID	PRIM DEPTH	TELESCOPE FROM	TO	LINER FROM	TO	WELL DEPTH
591588.04	006996	HILLSBOROUGH CO. UTILITIES & W.C.R.W.S.A.	2.00	14-31-21	OBSERVATION OR MONIT	002368	20.0					25.0
	WELL LOC:	SOUTHEAST LANDFILL						PHONE: (813) 272-5000				
591588.05	006996	HILLSBOROUGH CO. UTILITIES & W.C.R.W.S.A.	2.00	14-31-21	OBSERVATION OR MONIT	002368	40.0					45.0
	WELL LOC:	SOUTHEAST LANDFILL						PHONE: (813) 272-5000				
594600.01	006000	HILLSBOROUGH CO. BOCC-STORMWATER MAINTENANCE DEPT	2.00	14-31-21	OBSERVATION OR MONIT	002368	26.0					36.0
	WELL LOC:	SE LANDFILL CR 672 2.5 MI E /39						PHONE: (813) 272-6760				
594601.01	006000	HILLSBOROUGH CO. BOCC-STORMWATER MAINTENANCE DEPT	2.00	14-31-21	PLUGGED OR ABONDONED	002368	46.0					46.0
	WELL LOC:	SE LANDFILL CR672 2.5MI W OF 39						PHONE: (813) 272-6760				

Appendix D
Stability Analyses Results

Appendix D-1
Laboratory Testing Results

TABLE 1
LABORATORY TEST SUMMARY
STANDARD PENETRATION TEST SAMPLES

Boring Number	Sample Number	Soil Type	Sample Depth (ft.)	Natural Moisture Conent (%)	Passing No. 200 Sieve (%)	Passing No. 100 Sieve (%)	Passing No. 60 Sieve (%)	Passing No. 40 Sieve (%)	Passing No. 10 Sieve (%)	Passing No. 4 Sieve (%)	Liquid Limit (%)	Plasiticity Index (%)	Organic Content (%)
TH - 1A	1	1	1.0	16.0	19.6	38.6	62.9	83.1	100.0	100.0			
TH - 1A	4	2	5.5	41.3	26.2	79.1	98.1	99.6	100.0	100.0			
TH - 1A	8	2	11.5	22.4	7.5	33.1	66.3	97.4	100.0	100.0			0.6
TH - 1A	11	4	16.0	25.7	11.2	35.1	68.9	99.9	99.9	100.0			
TH - 1A	17	7	36.0	35.5	24.8	62.8	77.4	86.5	96.4	99.4			
TH - 1A	20	9	51.0										2.3
TH - 2A	2	10	2.5	2.8	3.0	14.8	45.5	79.6	99.9	100.0			
TH - 2A	5	1	7.0	36.6	18.7	66.8	87.4	96.4	100.0	100.0			
TH - 2A	9	1	13.0	17.1	14.1	39.4	74.5	92.7	100.0	100.0			
TH - 2A	15	2	22.0	35.1	23.5	71.1	86.6	95.2	99.7	100.0			
TH - 2A	22	4	34.5	43.6	34.1	71.5	84.7	91.6	97.9	100.0			
TH - 3A	1	1	1.0	25.9	34.6	61.0	83.6	94.0	99.8	100.0			
TH - 3A	2	1	2.5	37.1	38.3	53.0	73.4	88.2	99.9	100.0			
TH - 3A	4	2	5.5	112.2	98.5	99.1	99.6	99.9	100.0	100.0			
TH - 3A	5	4	8.5										2.3
TH - 3A	6	1	16.0	20.5	11.1	21.2	65.0	91.8	100.0	100.0			
TH - 3A	8	9	26.0	37.6	27.4	87.7	94.9	98.6	100.0	100.0			2.3
TH - 4A	1	1	1.0	19.5	23.5	40.3	60.9	79.3	99.8	100.0			1.8

TABLE 1 Cont'd
LABORATORY TEST SUMMARY
STANDARD PENETRATION TEST SAMPLES

Boring Number	Sample Number	Soil Type	Sample Depth (ft.)	Natural Moisture Conent (%)	Passing No. 200 Sieve (%)	Passing No. 100 Sieve (%)	Passing No. 60 Sieve (%)	Passing No. 40 Sieve (%)	Passing No. 10 Sieve (%)	Passing No. 4 Sieve (%)	Liquid Limit (%)	Plasiticity Index (%)	Organic Content (%)
TH - 4A	4	1	5.5	34.0	30.4	88.2	98.8	99.8	100.0	100.0			0.2
TH - 4A	6	10	10.0										0.2
TH - 4A	8	6	21.0	23.9	31.7	61.5	77.3	86.7	99.3	100.0			
TH - 4A	10	9	31.0	33.7	56.1	78.6	89.5	94.6	99.4	100.0			
TH - 4A	12	9	41.0	30.8	29.4	50.1	61.7	71.4	87.7	97.9			2.4
TH - 5A	1	1	1.0	20.1	40.9	71.8	90.4	95.9	99.5				
TH - 5A	3	10	3.5	25.9	5.9	32.4	92.3	99.3	99.9	100.0			
TH - 5A	6	9	8.0	70.8	73.7	90.6	96.9	99.1	100.0	100.0	84.0	56.0	
TH - 5A	7	3	10.5										1.7
TH - 5A	8	5	16.0	20.4	29.4	50.8	79.1	94.2	100.0	100.0			
TH - 5A	10	4	26.0	40.4	25.0	84.0	92.6	96.0	99.0	100.0			
TH - 5A	12	8	38.0	39.2	20.1	44.8	71.9	82.1	92.2	97.9			
TH - 5A	15	9	51.0	46.8	34.9	37.6	46.8	89.8	95.3	96.9			
TH - 6A	5	10	7.0	26.0	11.9	43.4	89.0	99.2	100.0	100.0			
TH - 6A	8	2	11.5	58.3	94.5	95.7	96.8	97.6	98.8	99.6	117	67	
TH - 6A	11	1	21.0	26.5	10.3	32.6	68.4	93.2	100.0	100.0			
TH - 6A	13	3	31.0	30.1	6.0	10.4	42.5	90.5	99.9	100.0			
TH - 6A	16	9	47.0	56.5	34.2	87.3	95.3	98.6	100.0	100.0			
TH - 7A	1	1	1.0	18.2	16.0	50.2	78.0	91.6	99.6	99.8			2.23

TABLE 1 Cont'd
LABORATORY TEST SUMMARY
STANDARD PENETRATION TEST SAMPLES

Boring Number	Sample Number	Soil Type	Sample Depth (ft.)	Natural Moisture Conent (%)	Passing No. 200 Sieve (%)	Passing No. 100 Sieve (%)	Passing No. 60 Sieve (%)	Passing No. 40 Sieve (%)	Passing No. 10 Sieve (%)	Passing No. 4 Sieve (%)	Liquid Limit (%)	Plasiticity Index (%)	Organic Content (%)
TH - 7A	3	1	4.0								39	11	
TH - 7A	4	3	5.5										0.6
TH - 7A	5	3	11.0	21.7	17.7	40.7	72.1	92.7	99.9	100.0			
TH - 7A	7	11	21.0	33.3	19.3	50.7	75.1	87.1	100.0	100.0			
TH - 7A	9	8	31.0	43.2	28.9	78.1	88.3	93.0	98.4	99.6			
TH - 8A	1	1	1.0								NP	NP	
TH - 8A	6	12	8.5	64.6	65.1	87.8	99.2	99.9	100.0	100.0			
TH - 8A	13	4	21.0	11.8	13.2	39.5	71.1	92.4	100.0	100.0			
TH - 8A	16	11	36.0	38.2	64.1	85.0	94.2	97.5	99.9	100.0			

Boring Number	Sample Number	Cation Exchange (meg EC/100grams)
TH - 1A	5	508
TH - 1A	15	259
TH - 2A	4	99
TH - 5A	15	426
TH - 8A	16	55

Ardaman & Associates, Inc.

Geotechnical, Environmental and Materials Consultants

June 19, 1997
File Number 97-9628

Remedial Engineering & Science, Inc.
206 White Marsh Circle
Orlando, Florida 32859-3322

Attention: Dr. Bijay Panigrahi

Subject: Laboratory Testing of Soil Samples, Southeast Landfill, Hillsborough County

Gentlemen:

As requested, consolidated undrained triaxial compression tests, unconfined compression tests and permeability tests have been completed on the nine Shelby tube soil samples provided for testing by your firm. The samples were labeled: SPT-1A/US-1 (7' - 9'); SPT-2A/US-1 (30'- 32'); SPT-3A/US-1 (6' - 8'); SPT-3A/US-2 (27' - 29'); SPT-4A/US-1 (7.5' - 9.5'); SPT-5A/US-1 (6' - 8'); SPT-6A/US-1 (12' - 14'); SPT-7A/US-1 (25' - 27'); and SPT-7A/US-2 (31.5' - 33.5').

Index Tests and Classification

The soils were extruded from the Shelby tubes, and representative portions of each sample were selected for the requested tests. The visual description of the soil samples, recovered lengths, individual measured moisture contents on 3 to 6 specimens per sample, and average moisture contents, total unit weights and dry densities on the samples are presented in Table 1. The fines contents (i.e., percent soil by dry weight finer than the U.S. Standard No. 200 sieve) measured on each permeability and strength test specimen are also presented in Table 1.

Permeability Tests

The permeability tests were performed in general accordance with ASTM Standard D 5084. The permeability test results are summarized in Table 2. The cylindrical test specimens were maintained at the as-received diameter of the Shelby tube and trimmed to heights of 5.3 to 11.7 cm. Each permeability test specimen was mounted in a triaxial-type permeameter and encased within a latex membrane. The specimens were confined using average isotropic effective confining stresses of 6 to 15 lb/in^2, and permeated with deaired tap water under back-pressures of 174 to 183 lb/in^2. Satisfactory saturation of each specimen was verified by a B-factor greater than 95%. The inflow to and outflow from each specimen were monitored with time, and the hydraulic conductivity was calculated for each recorded flow increment. The tests were continued until steady-state flow rates were achieved, as evidenced by an outflow/inflow ratio between 0.75 and 1.25, and until stable values of hydraulic conductivity were measured. The final degree of saturation of each specimen was calculated upon completion of testing using the final measured dry mass, moisture content and volume, and assuming a specific gravity of 2.70 for clayey sand specimens and 2.75 for clay specimens. Upon completion of permeability testing, the particle-size distributions of the clayey sand specimens were determined in general accordance with ASTM Standard D 422, and the fines contents of the clay specimens were determined in general accordance with ASTM Standard D 1140. The results of the particle-size analyses are plotted in Figure 1, and the fines content of each specimen is presented in Table 2.

Consolidated Undrained Triaxial Compression Tests

Consolidated undrained triaxial compression tests with pore pressure measurements ($\overline{CIU}C$ tests) were performed in general accordance with ASTM Standard D 4767. Cylindrical test specimens 3.5 cm in diameter and 7.1 cm in height were trimmed from the requested Shelby tube samples. The specimens were mounted in triaxial cells, fitted with filter strips, and encased in thin latex membranes. The cell pressure and back-pressure were increased together in increments until the back-pressure equalled the test values of 8.0 to 12.0 kg/cm^2. The specimens were then isotropically consolidated in one, two or three increments under the requested effective stresses of 0.39 to 5.58 kg/cm^2. The volume change during consolidation was monitored. Consolidation under the applied effective stress was allowed to continue until primary consolidation was complete and then for an additional period of at least 12 hours. The specimens were sheared undrained at a constant rate of axial deformation of 0.0012 cm/minute (a strain rate of about 1%/hour), and the load, axial deformation, shear induced excess pore pressure and cell pressure were monitored with time.

The initial and pre-shear moisture contents and dry densities of the specimens, and a summary of the triaxial test results are presented in Table 3. Photographs of four of the triaxial test specimens after shearing are shown in Figures 2, 3 and 4. The effective stress paths, stress difference versus axial strain, excess pore pressure versus axial strain, and stress ratio versus axial strain for the nine individual tests are presented in Figures 5 through 13. The effective stress paths for the five clay specimens and four clayey sand specimens are presented together in Figures 14 and 15, respectively. Upon completion of testing, the fines content of each specimen was determined in general accordance with ASTM Standard D 1140. The fines contents are presented in Table 3.

Unconfined Compression Tests

The unconfined compression tests were performed in general accordance with ASTM Standard D 2166. Sufficient intact sample was not available from either SPT-1A/US-1 (7' - 9') or SPT-6A/US-1 (12' - 14') to perform the requested unconfined compression tests. Cylindrical test specimens were trimmed to a diameter of 3.5 cm and a height of 7.1 cm. The specimens were loaded at a constant rate of axial deformation of 0.076 cm/minute (strain rate of about 1.0%/minute). The moisture content and dry density of the specimens, unconfined compressive strength, and axial strain at failure are presented in Table 4. The stress-strain curves are presented in Figures 16 through 18. Upon completion of testing, the fines content of each specimen was determined in general accordance with ASTM Standard D 1140. The fines contents are presented in Table 4.

If you have questions about the test results or require additional testing services, please contact us.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

Shawkat Ali, Ph.D.
Geotechnical Engineer

Thomas S. Ingra, P.E.
Senior Project Engineer
Florida Registration No. 31987

SA/TSI/jo

cc: John Watson
Wayne Pandorf

Southeast Landfill
Hillsborough County
File Number 97-9628
June 19, 1997

Table 1

SHELBY TUBE SOIL SAMPLE DESCRIPTIONS

Boring	Sample	Depth (feet)	Description	Tests	Recovery (inches)		-200 (%)	w_c (%)	Tube Average w_c (%)	Tube Average γ_t (pcf)	Tube Average γ_d (pcf)
SPT-1A	US-1	7-9	Brown clayey sand with lenses of brown clay	None	15.75	24.25	-	47.6 56.9 41.7	62.6	103.0	63.3
			Brown and gray (laminated) clay	$\overline{CU}$ KC	8.50		100 100	67.0 109.5			
SPT-2A	US-1	30-32	Lt. brown clayey sand with lenses of brown sand and brown cemented sand fragments	KC	12.75	23.75	24	25.0 25.4 29.2	29.1	117.7	91.2
			Brown sand with lenses of clayey sand	None	5.0		-	-			
			Lt. greenish-gray clayey sand with some cemented sand fragments	$\overline{CU}$	6.0		35	28.8 37.2			
SPT-3A	US-1	6-8	Gray clay	$\overline{CU}$	10.0	24.0	100	99.3 116.7 111.3	62.2	96.5	59.5
			Dark gray sand with trace organics	None	7.0		-	27.3 22.4			
			Grayish-brown sand	None	7.0		-	20.5			
SPT-3A	US-2	27-29	Light gray to gray clayey sand	$\overline{CU}$ $\overline{CU}$ QU	22.5		25 26 21	34.2 38.1 36.6 36.4 30.2	35.1	113.6	84.0
SPT-4A	US-1	7.5-9.5	Gray and light gray (laminated) clay	$\overline{CU}$ QU KC	11.25	18.5	100 100 99	94.2 107.0 102.0	70.9	101.6	59.4
			Gray to dark gray sand	None	7.25		-	24.1			

Where: -200 = Fines content (i.e., amount of material finer than the U.S. Standard No. 200 sieve); w_c = Moisture content; γ_t = Total unit weight; γ_d = Dry density; $\overline{CU}$ = $\overline{CIUC}$ triaxial test (ASTM D 4767); QU = Unconfined compression test (ASTM D 2166); and KC = Permeability test (ASTM D 5084).

Table 1 (Continued)

SHELBY TUBE SOIL SAMPLE DESCRIPTIONS

Boring	Sample	Depth (feet)	Description	Tests	Recovery (inches)		-200 (%)	w_c (%)	Tube Average w_c (%)	Tube Average γ_t (pcf)	Tube Average γ_d (pcf)
SPT-5A	US-1	6-8	Gray slightly clayey sand	None	3.25	24.25	-	-	-	100.0	-
			Laminated gray sandy clay, grayish-brown clayey sand and light brown silty sand	None	5.50		-	76.7 69.5			
			Gray and light gray (laminated) clay	$\overline{CU}$ QU	8.00		99 100	101.4 102.5			
			Gray sand with trace clay	None	2.00		-	22.6			
			Gray clay	None	1.50		-	-			
			Brown slightly clayey sand	None	4.00		-	21.0			
SPT-6A	US-1	12-14	Drilling disturbed soil	None	4.00	23.75	-	-	68.2	97.1	57.7
			Brown silty sand laminated with gray clay	None	10.50			74.1 54.1			
			Gray clay with trace sand lenses	$\overline{CU}$	9.25		96	72.4 72.1			
SPT-7A	US-1	25-27	Greenish-gray clayey sand	$\overline{CU}$	23.25		31	38.7 45.4 42.7 40.0	41.7	111.3	78.5
SPT-7A	US-2	31.5-33.5	Greenish-gray clayey sand with phosphate	KC	25.50		17	34.0 34.6 29.5 34.5	33.2	117.8	88.5

Where: -200 = Fines content (i.e., amount of material finer than the U.S. Standard No. 200 sieve); w_c = Moisture content; γ_t = Total unit weight; γ_d = Dry density; $\overline{CU}$ = $\overline{CIUC}$ triaxial test (ASTM D 4767); QU = Unconfined compression test (ASTM D 2166); and KC = Permeability test (ASTM D 5084).

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S[illegible]east Landfill
Hillsborough County
File Number 97-9628
June 19, 1997

Table 2

PERMEABILITY TEST RESULTS

Boring	Sample	Depth (feet)	Initial Conditions					Test Conditions				Final Conditions				k_{20} (cm/sec)	-200 (%)
			w_c (%)	γ_d (pcf)	S (%)	L (cm)	D (cm)	$\bar{\sigma}_c$ (psi)	u_b (psi)	i_{avg}	B (%)	w_c (%)	γ_d (pcf)	S (%)	$\Delta V/V_o$ (%)		
SPT-1A	US-1	7-9	105.4	44.6	102	5.30	7.12	6	183	24	99	104.0	45.0	102	-0.9	2.6×10^{-8}	100
SPT-2A	US-1	30-32	25.3	100.1	100	11.74	6.94	15	174	11	97	22.0	105.7	100	-5.3	1.1×10^{-7}	24
SPT-4A	US-1	7.5-9.5	95.2	47.0	99	5.79	7.29	6	183	24	100	92.2	48.8	101	-3.7	3.5×10^{-8}	99
SPT-7A	US-2	31.5-33.5	30.7	89.4	94	11.62	7.37	15	174	14	100	31.2	92.4	102	-3.3	2.1×10^{-7}	17

Where: w_c = Moisture content; γ_d = Dry density; S = Calculated degree of saturation using an assumed specific gravity of 2.70 or 2.75; L = Specimen length; D = Specimen diameter; $\bar{\sigma}_c$ = Average isotropic effective consolidation stress; u_b = Back-pressure; i_{avg} = Average hydraulic gradient; B = B factor; $\Delta V/V_o$ = Volume change (+ denotes swell; - denotes consolidation); k_{20} = Saturated hydraulic conductivity at 20°C; and -200 = Fines content.

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Southeast Landfill
Hillsborough County
File Number 97-9628
June 19, 1997

Table 3

ISOTROPICALLY CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION ($\overline{CIU}C$) TEST RESULTS

Boring	Sample	Depth (feet)	Initial Conditions						σ_c' (kg/cm²)	u_b (kg/cm²)	B Factor (%)	Pre-Shear Conditions			-200 (%)	Stresses and Strains at $(\sigma_1-\sigma_3)_{max}$ and $(\sigma_1'/\sigma_3')_{max}$				
			H (cm)	D (cm)	w_c (%)	γ_d (lb/ft³)	G_s	S (%)				ϵ_{vol} (%)	γ_d (lb/ft³)	w_c (%)		Criteria	ϵ_a (%)	Δu (kg/cm²)	σ_1' (kg/cm²)	σ_3' (kg/cm²)
SPT-1A	US-1	7-9	7.13	3.55	109.5	42.8	2.75	100	4.29	9.0	99	-26.3	58.0	71.2	100	$(\sigma_1-\sigma_3)_{max}$ $(\sigma_1'/\sigma_3')_{max}$	12.2 12.5	2.83 2.84	3.64 3.63	1.50 1.49
SPT-2A	US-1	30-32	7.11	3.53	37.2	83.7	2.70	99	5.58	8.0	93*	-9.5	92.5	30.4	35	$(\sigma_1-\sigma_3)_{max}$ $(\sigma_1'/\sigma_3')_{max}$	10.0 8.9	3.88 3.88	5.93 5.92	1.71 1.70
SPT-3A	US-1	6-8	7.10	3.54	104.2	44.5	2.75	100	0.39	12.0	100	-0.5	44.8	103.1	100	$(\sigma_1-\sigma_3)_{max}$ $(\sigma_1'/\sigma_3')_{max}$	2.7 2.3	0.27 0.27	0.68 0.67	0.12 0.12
	US-2	27-29	7.06	3.52	40.7	80.3	2.70	100	1.46	12.0	98	-9.5	88.7	33.3	26	$(\sigma_1-\sigma_3)_{max}$ $(\sigma_1'/\sigma_3')_{max}$	4.9 10.7	1.14 1.10	1.80 1.75	0.44 0.42
	US-2	27-29	7.07	3.53	37.8	83.6	2.70	100	5.32	7.5	93	-10.0	92.9	30.2	25	$(\sigma_1-\sigma_3)_{max}$ $(\sigma_1'/\sigma_3')_{max}$	17.3 9.8	3.93 3.96	5.27 5.13	1.44 1.39
SPT-4A	US-1	7.5-9.5	7.11	3.55	102.3	45.1	2.75	100	2.34	10.5	100	-17.5	54.7	77.8	100	$(\sigma_1-\sigma_3)_{max}$ $(\sigma_1'/\sigma_3')_{max}$	6.8 14.0	1.36 1.57	2.36 2.12	1.00 0.81
SPT-5A	US-1	6-8	7.12	3.55	101.4	45.3	2.75	100	1.85	12.0	100	-15.4	53.6	80.1	99	$(\sigma_1-\sigma_3)_{max}$ $(\sigma_1'/\sigma_3')_{max}$	7.8 14.5	1.22 1.34	2.16 2.03	0.65 0.54
SPT-6A	US-1	12-14	7.10	3.54	68.3	59.8	2.75	100	3.32	10.0	95	-13.2	68.9	54.3	96	$(\sigma_1-\sigma_3)_{max}$ $(\sigma_1'/\sigma_3')_{max}$	3.4 5.8	2.26 2.40	3.31 3.11	1.05 0.94
SPT-7A	US-1	25-27	7.11	3.52	45.2	75.2	2.70	98	1.46	12.0	98	-3.3	77.7	43.2	31	$(\sigma_1-\sigma_3)_{max}$ $(\sigma_1'/\sigma_3')_{max}$	5.1 10.1	0.83 0.85	2.66 2.64	0.66 0.65

Where: H = Specimen height; D = Specimen diameter; w_c = Moisture content; γ_d = Dry density; G_s = Specific gravity (assumed); S = Calculated degree of saturation using the assumed specific gravity; σ_c' = Isotropic effective consolidation stress; u_b = Back-pressure; ϵ_{vol} = Volumetric strain (negative denotes consolidation and positive denotes swelling) during isotropic consolidation; -200 = Amount of material finer than the U.S. Standard No. 200 sieve; ϵ_a = Axial strain; Δu = Excess pore pressure; σ_1' = Effective major principal stress; σ_3' = Effective minor principal stress.

* B factor remained relatively constant for two consecutive increments of applied cell pressure.

D:\AL\97-9628.001

Table 4

UNCONFINED COMPRESSION TEST RESULTS

Boring	Sample	Depth (feet)	Specimen Dimensions			w_c (%)	γ_d (lb/ft^3)	-200 (%)	$\dot{\varepsilon}$ (cm/min)	ε_f (%)	Maximum Load (kg)	Unconfined Compressive Strength (kg/cm^2)
			Height H (cm)	Diameter D (cm)	H/D							
SPT-3A	US-2	27 - 29	7.10	3.53	2.01	34.6	87.2	21	0.076	2.9	5.88	0.58
SPT-4A	US-1	7.5 - 9.5	7.11	3.52	2.02	107.0	44.3	100	0.076	4.8	3.52	0.34
SPT-5A	US-1	6 - 8	7.12	3.53	2.02	102.5	45.6	100	0.076	4.8	4.00	0.39

Where: w_c = Moisture content measured at end of test; γ_d = Dry density; -200 = Fines content (Amount of material finer than the U.S. Standard No. 200 sieve); $\dot{\varepsilon}$ = Vertical displacement rate; and ε_f = Axial strain at maximum load.

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1. Waste phosphatic clay: $\gamma_t = 85$ pcf, $\phi' = 0°$, $c' = 700$ psf.

* From Geotechnical Laboratory Testings of UNCONFINED COMPRESSION TEST RESULTS as presented on TABLE 4 of APPENDIX D-1,

$c' = 0.34$ kg/cm² $\simeq 700$ psf (SPT-4A, US-1, 7.5'–9.5')
$= 0.39$ kg/cm² $\simeq 800$ psf (SPT-5A, US-1, 6.0'–8.0')

Taking conservative assumptions, the lower value was selected.

$\Rightarrow c' = 700$ psf and $\phi' = 0°$.

* $\gamma_t = (1 + w_c)\gamma_d$; γ_d = dry unit wt.; and w_c = moisture content.

= 91.7 pcf (SPT-4A, US-1, 7.5'–9.5') Table 4, Appendix D-1
= 92.3 pcf (SPT-5A, US-1, 6.0'–8.0') Table 4, Appendix D-1
= 100.4 pcf (SPT-6A, US-1, 12.0'–14.0') Table 3, Appendix D-1
= 91.5 pcf (SPT-5A, US-1, 6.0'–8.0') Table 3, Appendix D-1
= 91.1 pcf (SPT-4A, US-1, 7.5'–9.5') Table 3, Appendix D-1
= 89.4 pcf (SPT-1A, US-1, 7.0'–9.0') Table 3, Appendix D-1

Taking conservative assumption of w_c limited to 100%, the

$\Rightarrow \gamma_t = 85.6$ pcf for SPT-1A, US-1, 7.0'–9.0'
$\simeq 85$ pcf.

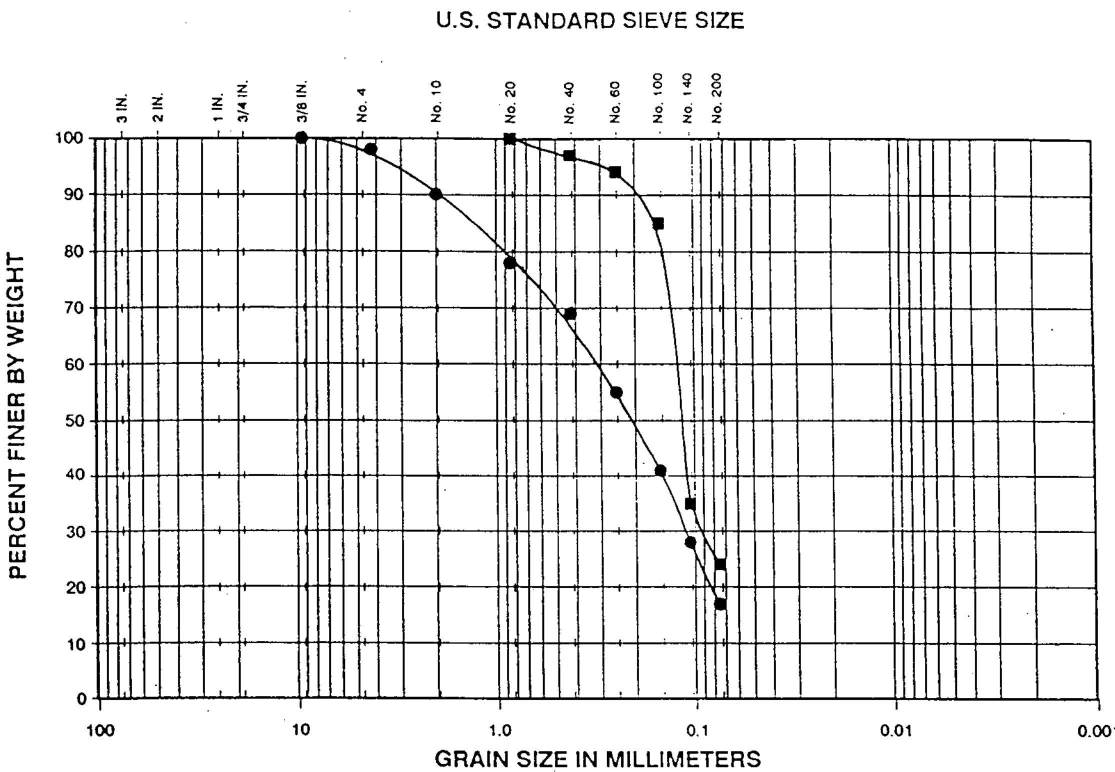
2. Bone Valley formation: $\gamma_t = 118$ pcf, $\phi' = 30°$, $c' = 0$ psf.

* From Geotechnical Laboratory Testings of CONSOLIDATED UNDRAINED TRIAXIAL TESTS as presented on FIGURE 15 OF APPENDIX D-1,

The envelope of all four Tests results in the range of
$\phi' = 30°$ to $34°$ and $c' = 0$ (Passing through 0 intercept)
Taking conservative assumptions, the lower values was selected.

$\Rightarrow \phi' = 30°$. and $c' = 0$ psf.

* Following Similar Principle for calculating γ_t as presented above, the four samples representing Bone Valley on figure 15 in Appendix D-1,
$\gamma_t = 120.7$ pcf, 121 pcf, 118.2 pcf, and 111.3 pcf
Taking a mean of all four γ_t values, $\gamma_{t\,mean} = \gamma_t = 117.8$ pcf.
$\simeq 118$ pcf.
$\Rightarrow \gamma_t = 118$ pcf.



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

BORING	SAMPLE	DEPTH (FEET)	SYMBOL	DESCRIPTION
SPT-2A	US-1	30 - 32	■	Light brown clayey sand
SPT-7A	US-2	31.5 - 33.5	●	Greenish-gray clayey sand with phosphate

PARTICLE-SIZE ANALYSES ON PERMEABILITY TEST SPECIMENS

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTHEAST LANDFILL
HILLSBOROUGH COUNTY

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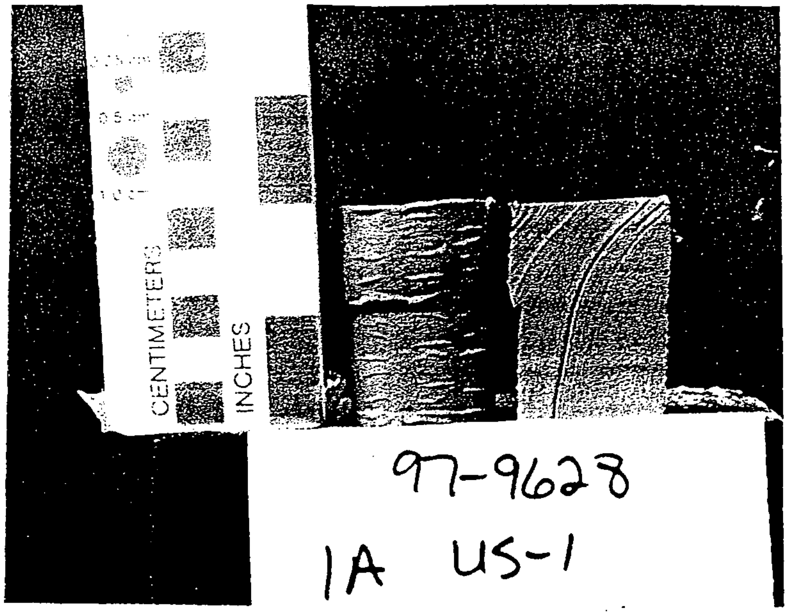
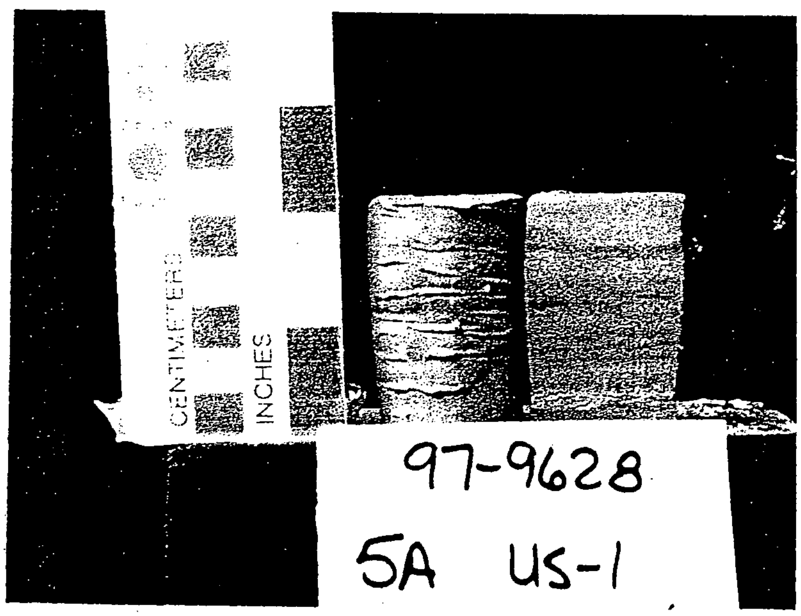


A) SPECIMEN FROM BORING SPT-1A, SAMPLE US-1



B) SPECIMEN FROM BORING SPT-5A, SAMPLE US-1

PHOTOGRAPHS OF TRIAXIAL TEST SPECIMENS FROM BORINGS SPT-1A AND SPT-5A

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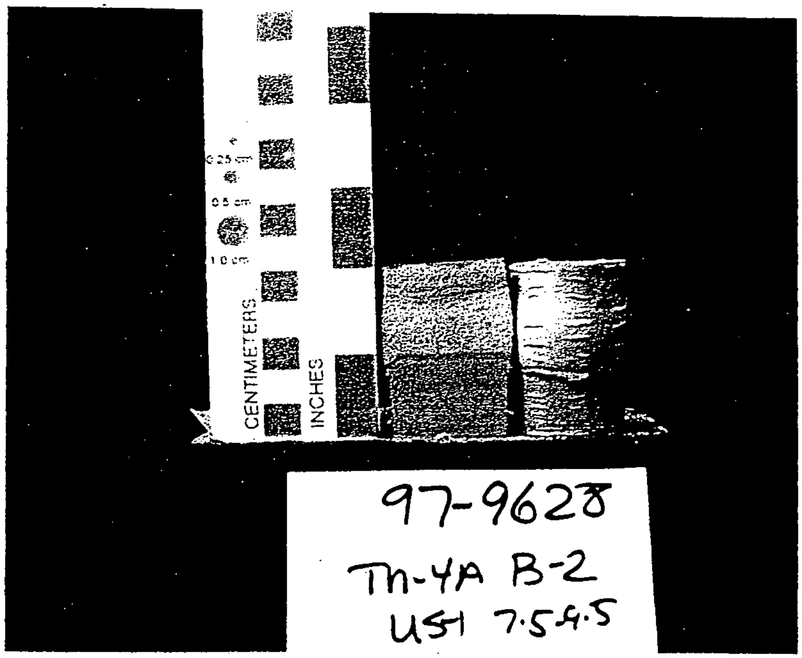

SPECIMEN FROM BORING SPT-4A, SAMPLE US-1

PHOTOGRAPH OF TRIAXIAL TEST SPECIMEN FROM BORING SPT-4A

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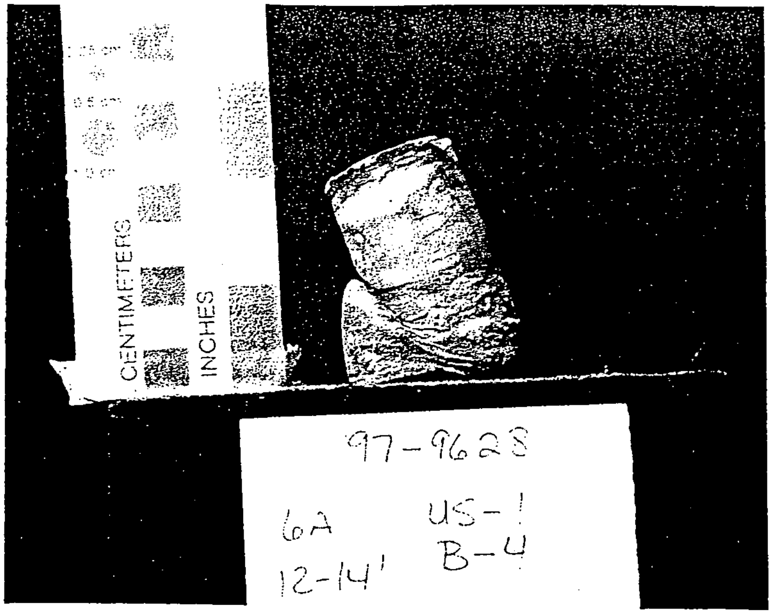
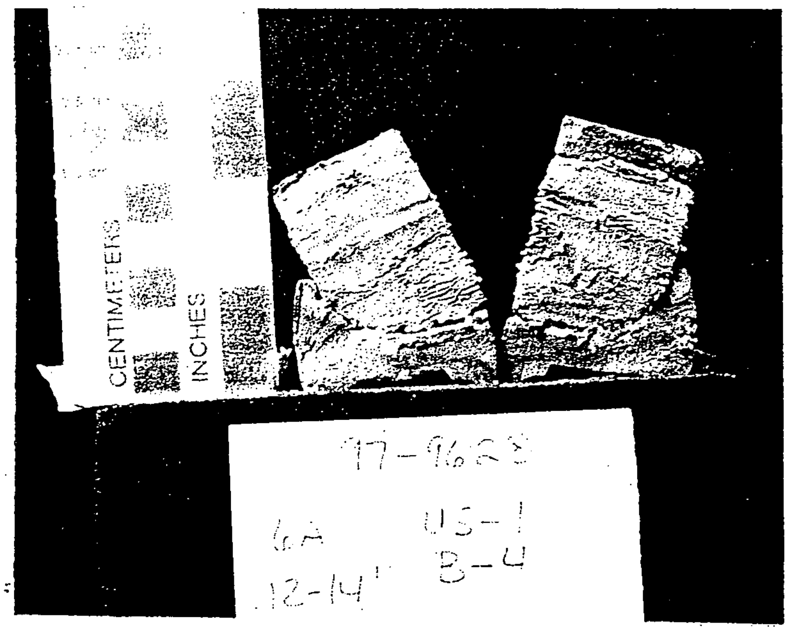


A) VIEW OF SPECIMEN AT END OF TEST



B) VIEW OF LAMINATED STRUCTURE OF SPECIMEN

PHOTOGRAPHS OF TRIAXIAL TEST SPECIMEN FROM BORING SPT-6A, SAMPLE US-1

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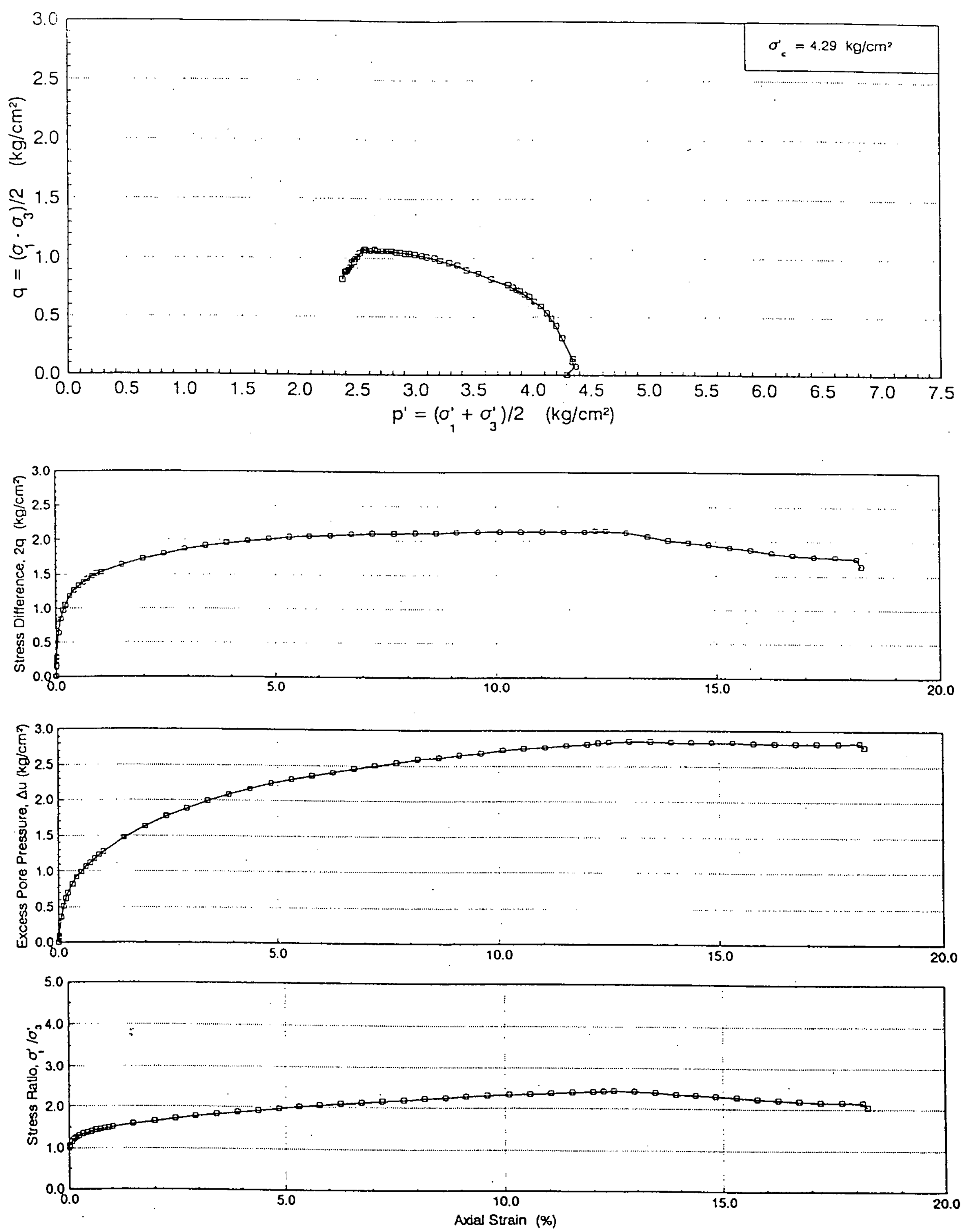

CONSOLIDATED UNDRAINED ($\overline{\text{CIU}}$C) TRIAXIAL TEST ON BORING SPT-1A, SAMPLE US-1

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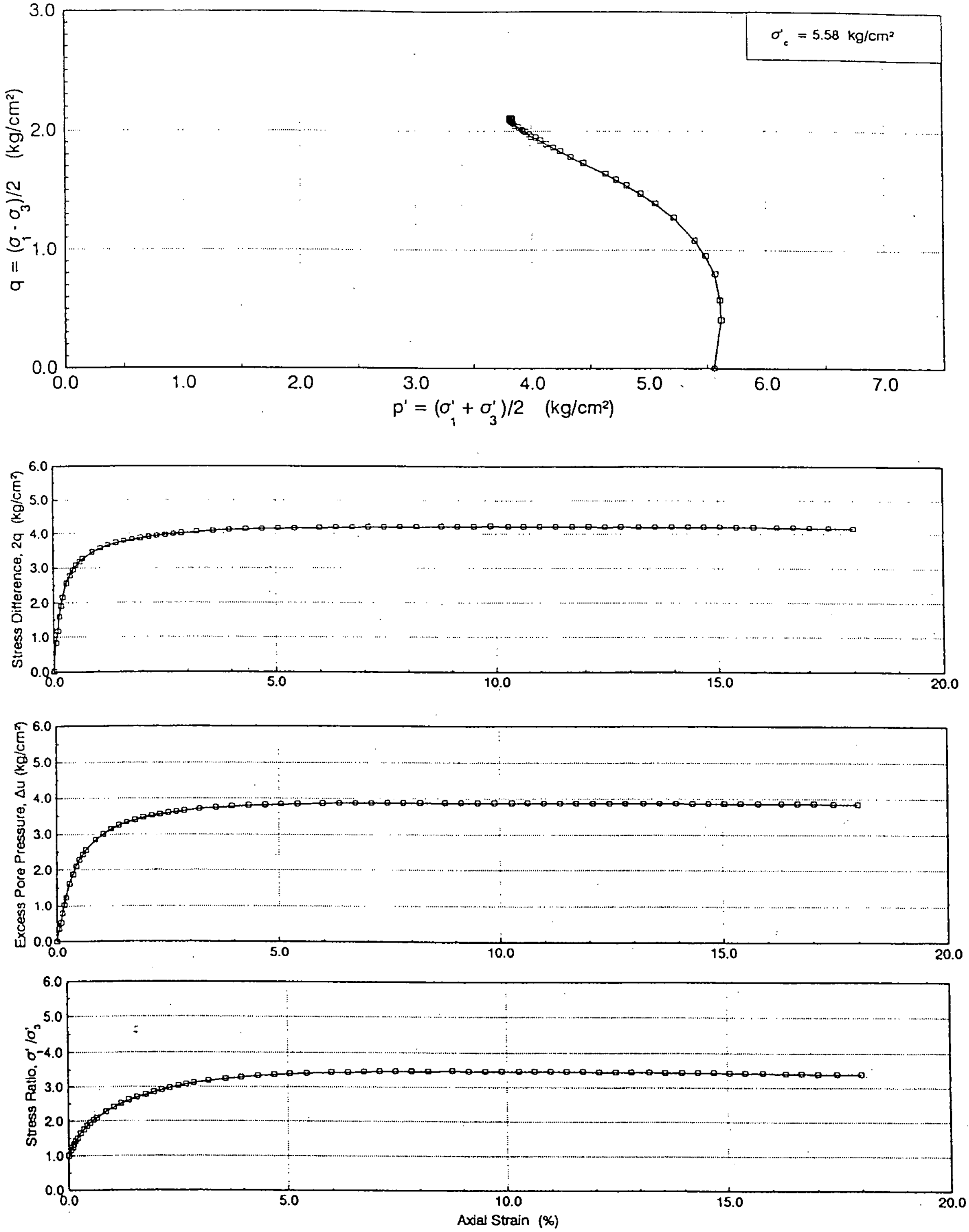

CONSOLIDATED UNDRAINED (CIUC) TRIAXIAL TEST ON BORING SPT-2A, SAMPLE US-1

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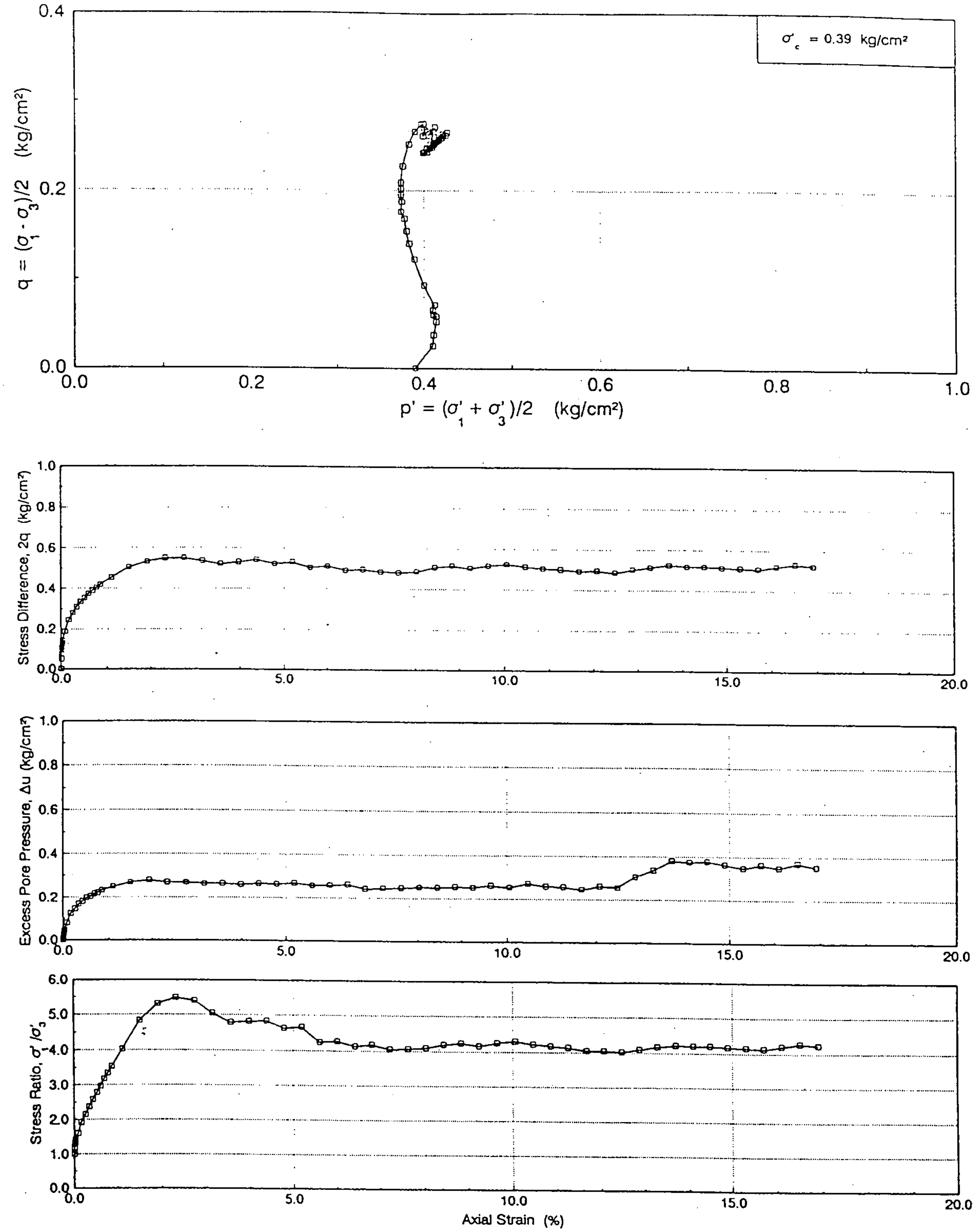
FILE NO.: 97-9626	APPROVED BY: [signature]	FIGURE: 6



CONSOLIDATED UNDRAINED ($\overline{CIU}C$) TRIAXIAL TEST ON

BORING SPT-3A, SAMPLE US-1

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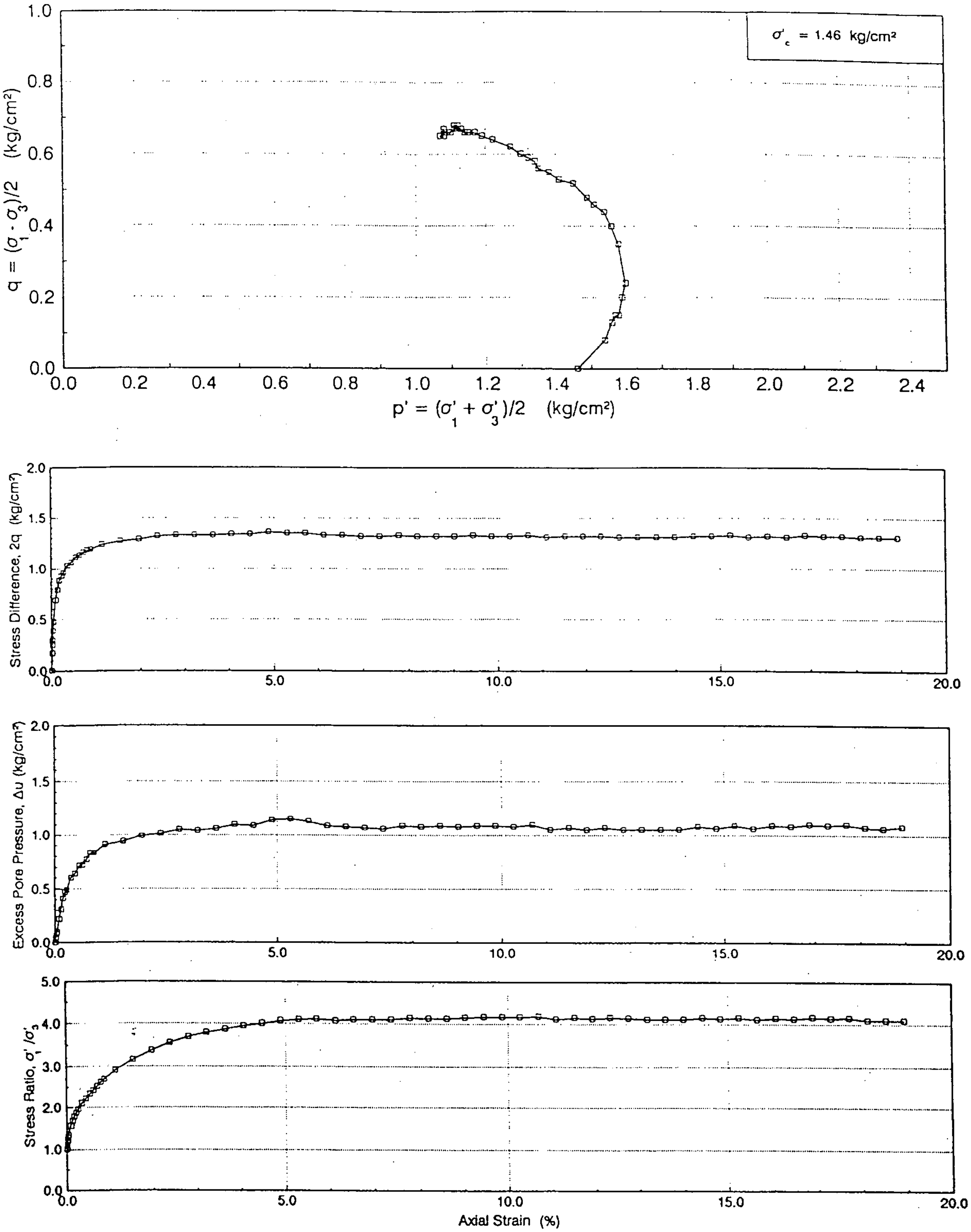
FILE NO.: 97-9628	APPROVED BY: [signature]	FIGURE: 7



CONSOLIDATED UNDRAINED ($\overline{CIUC}$) TRIAXIAL TEST ON BORING SPT-3A, SAMPLE US-2

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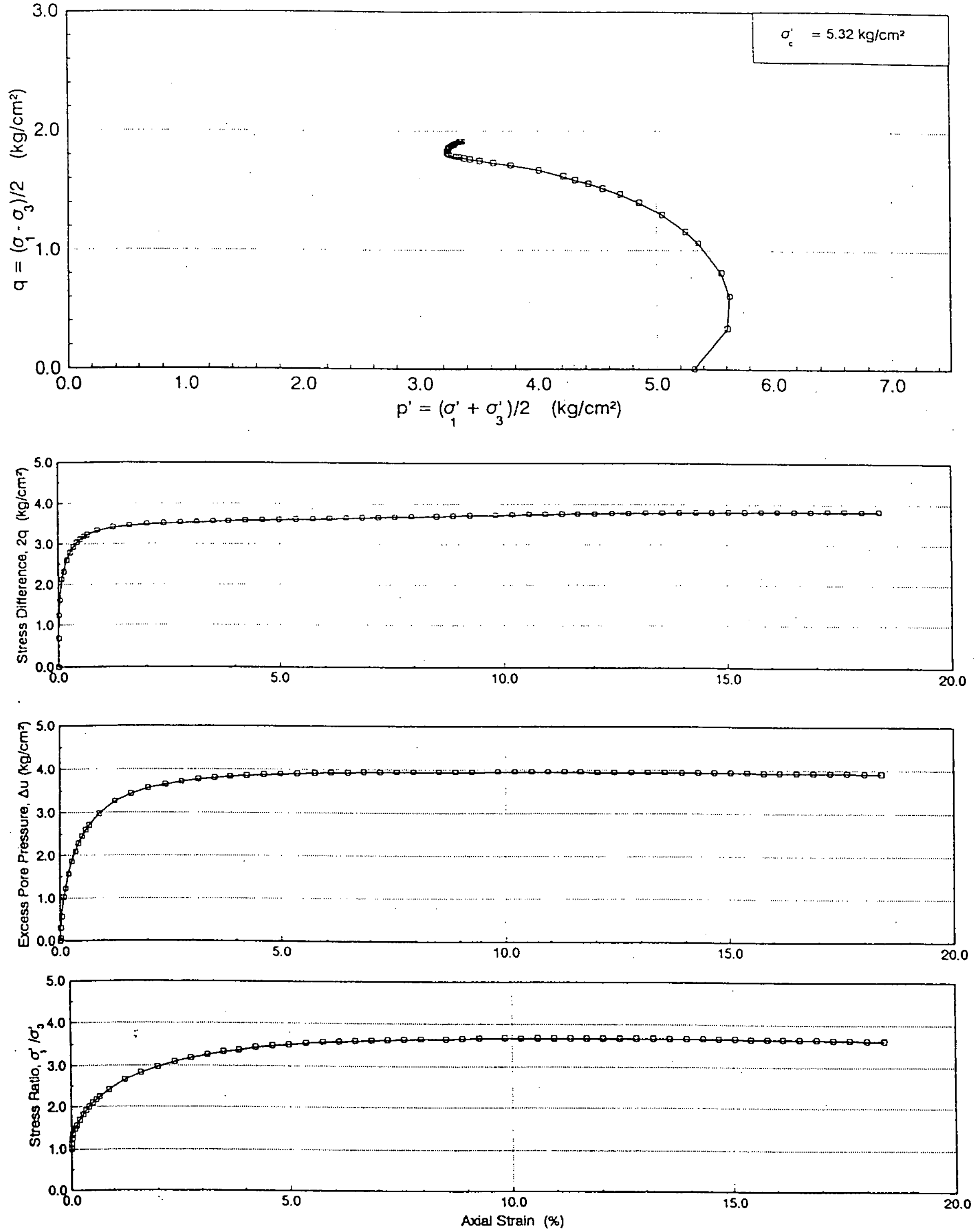
FILE NO.: 97-9628	APPROVED BY: [signature]	FIGURE: 8



CONSOLIDATED UNDRAINED ($\overline{\text{CIUC}}$) TRIAXIAL TEST ON

BORING SPT-3A, SAMPLE US-2

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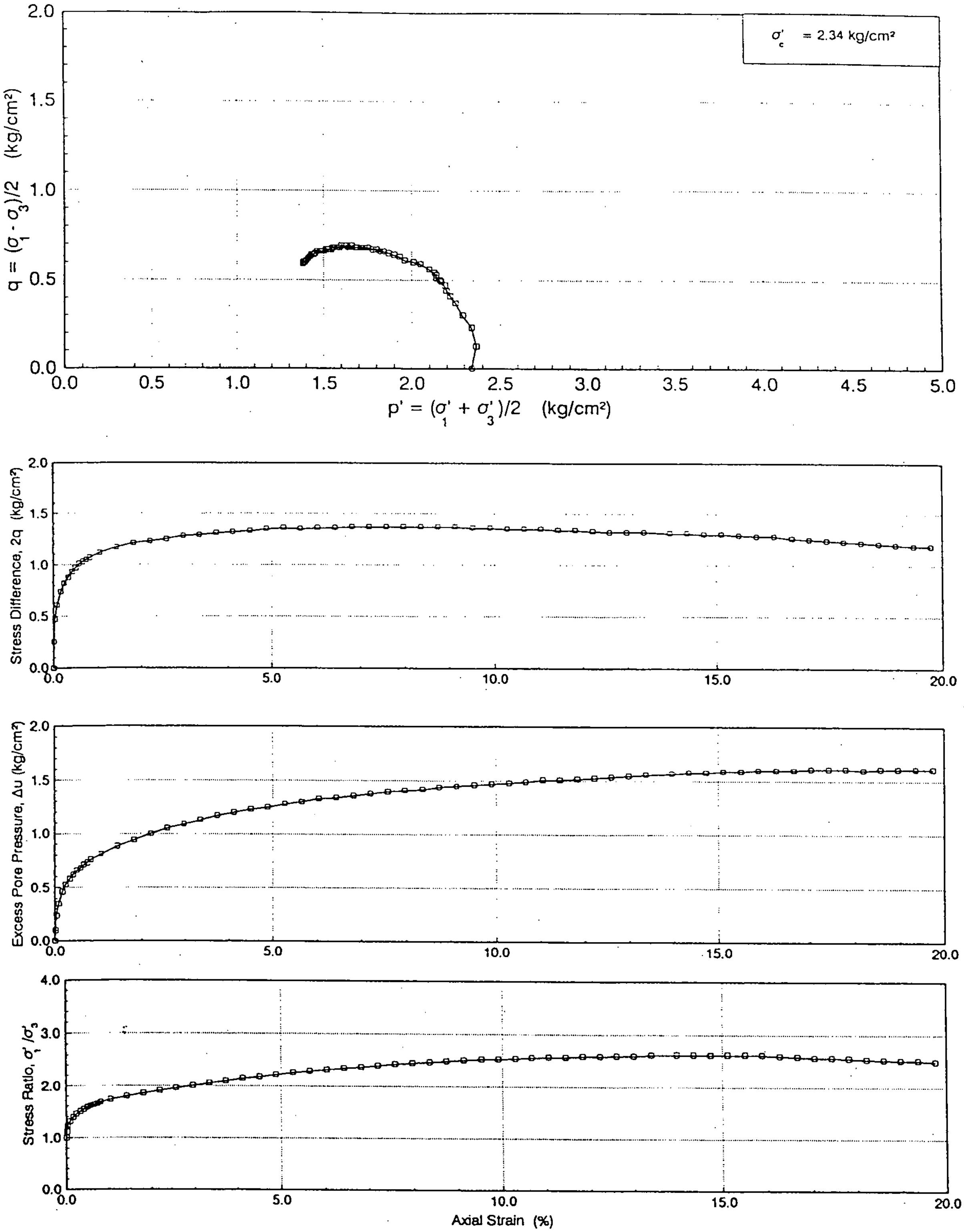
FILE NO.: 97-9628	APPROVED BY: [signature]	FIGURE: 9



CONSOLIDATED UNDRAINED ($\overline{\text{CIUC}}$) TRIAXIAL TEST ON BORING SPT-4A, SAMPLE US-1

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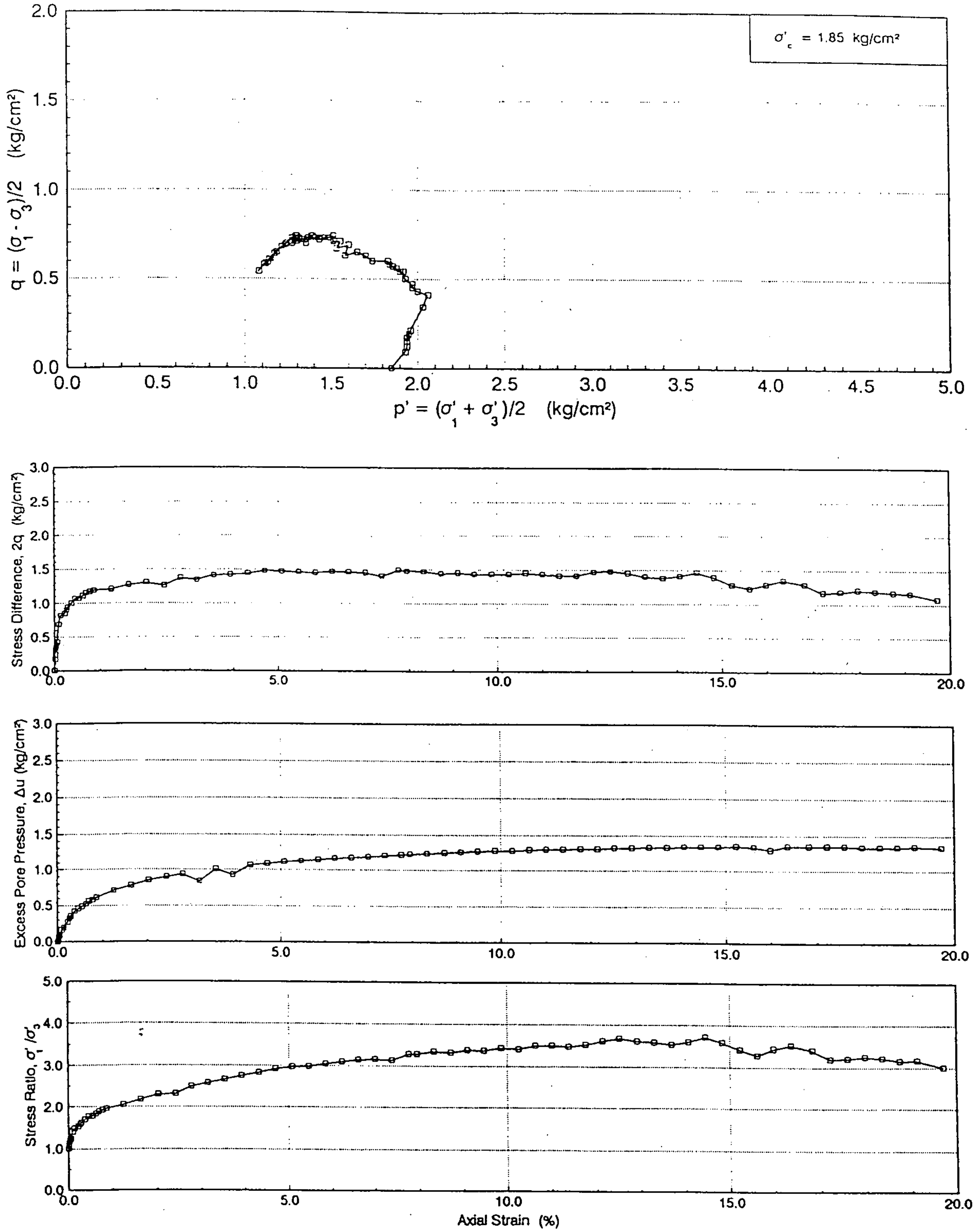
FILE NO.: 97-9628		APPROVED BY: [signature]		FIGURE: 10	



CONSOLIDATED UNDRAINED ($\overline{\text{CIUC}}$) TRIAXIAL TEST ON BORING SPT-5A, SAMPLE US-1

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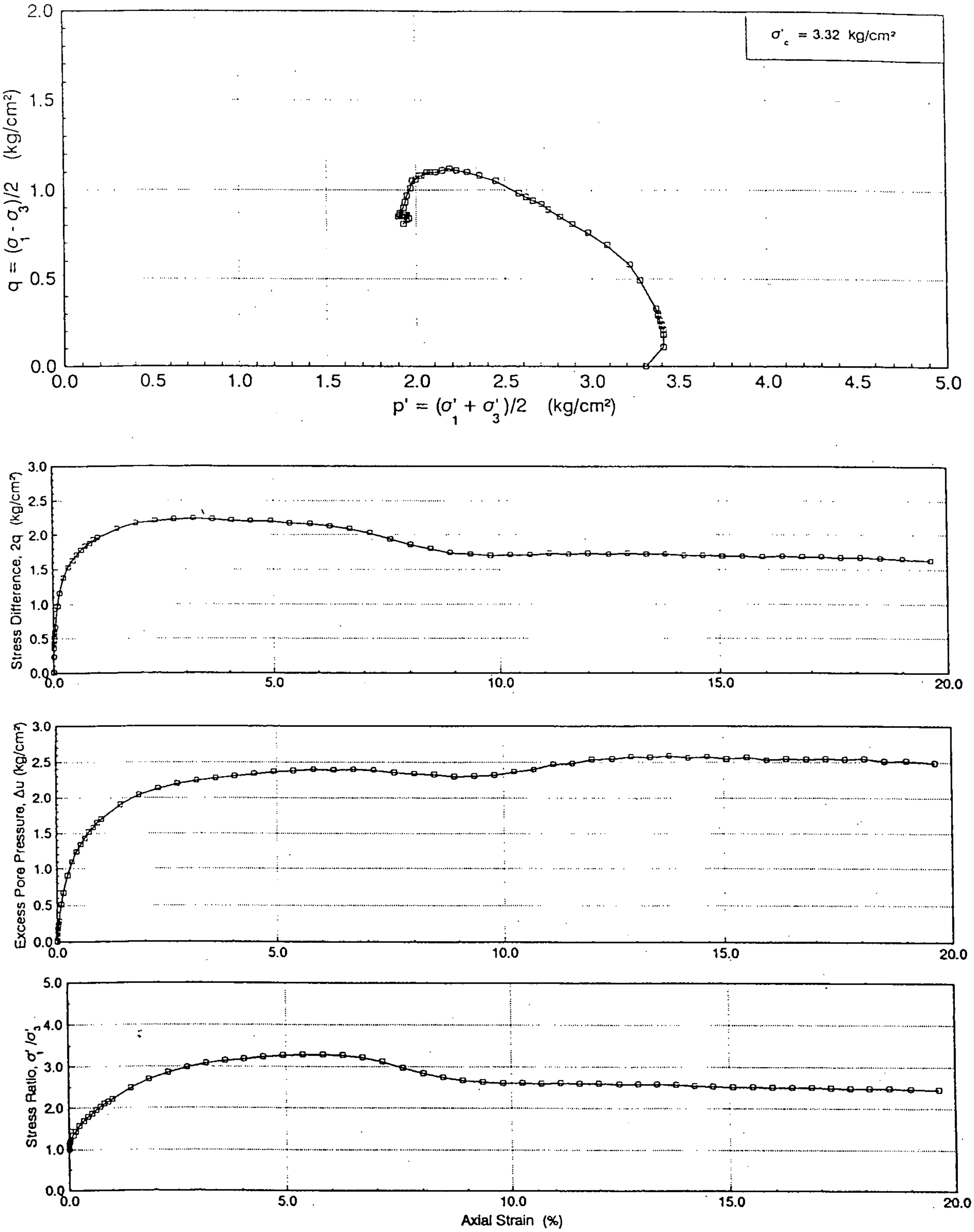
FILE NO.: 97-9628	APPROVED BY: [signature]	FIGURE: 11



CONSOLIDATED UNDRAINED ($\overline{CIU}C$) TRIAXIAL TEST ON BORING SPT-6A, SAMPLE US-1

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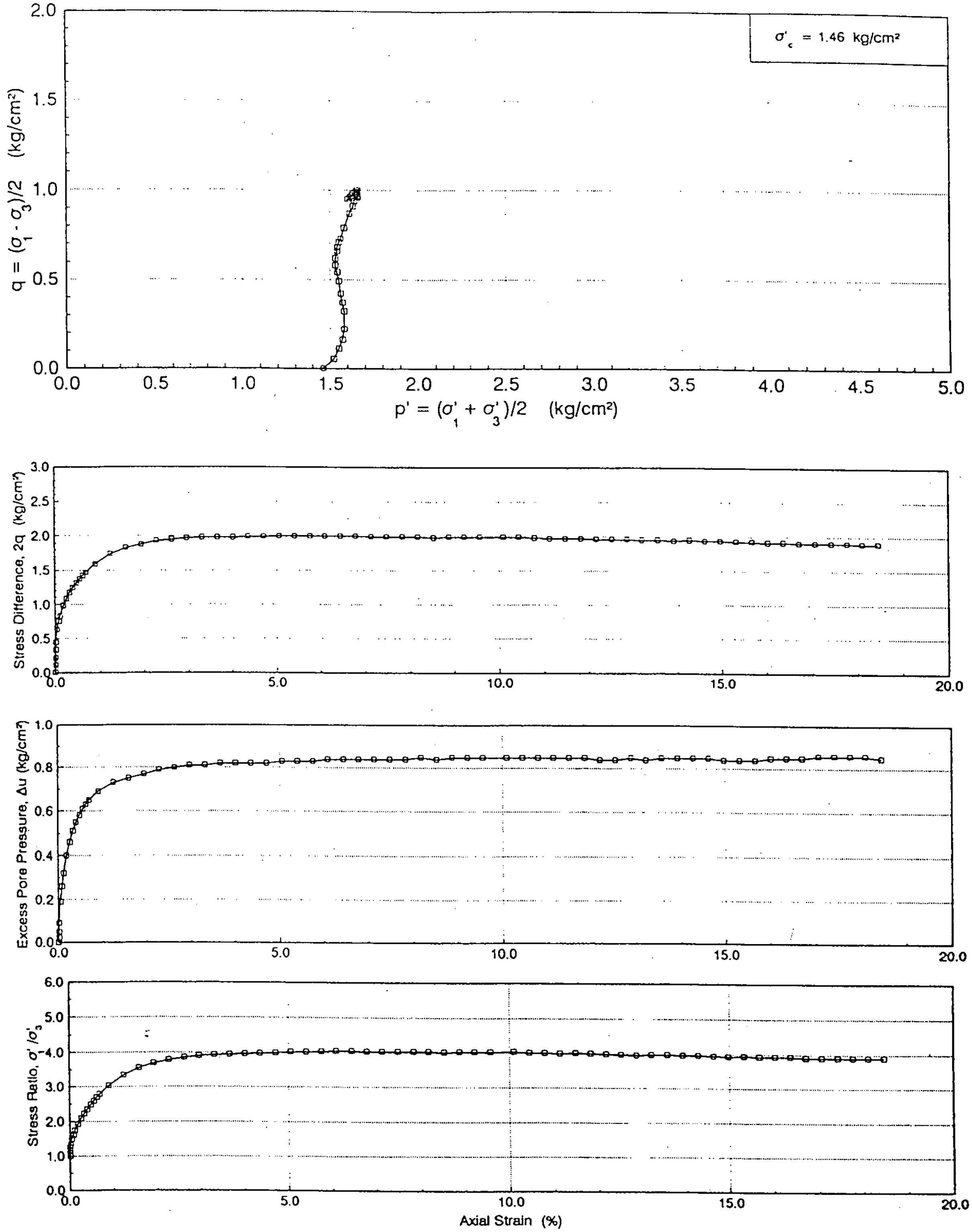
FILE NO.: 97-9628	APPROVED BY:	FIGURE: 12



CONSOLIDATED UNDRAINED ($\overline{CIUC}$) TRIAXIAL TEST ON BORING SPT-7A, SAMPLE US-1

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REMEDIAL ENGINEERING & SCIENCE, INC. ORLANDO, FLORIDA		
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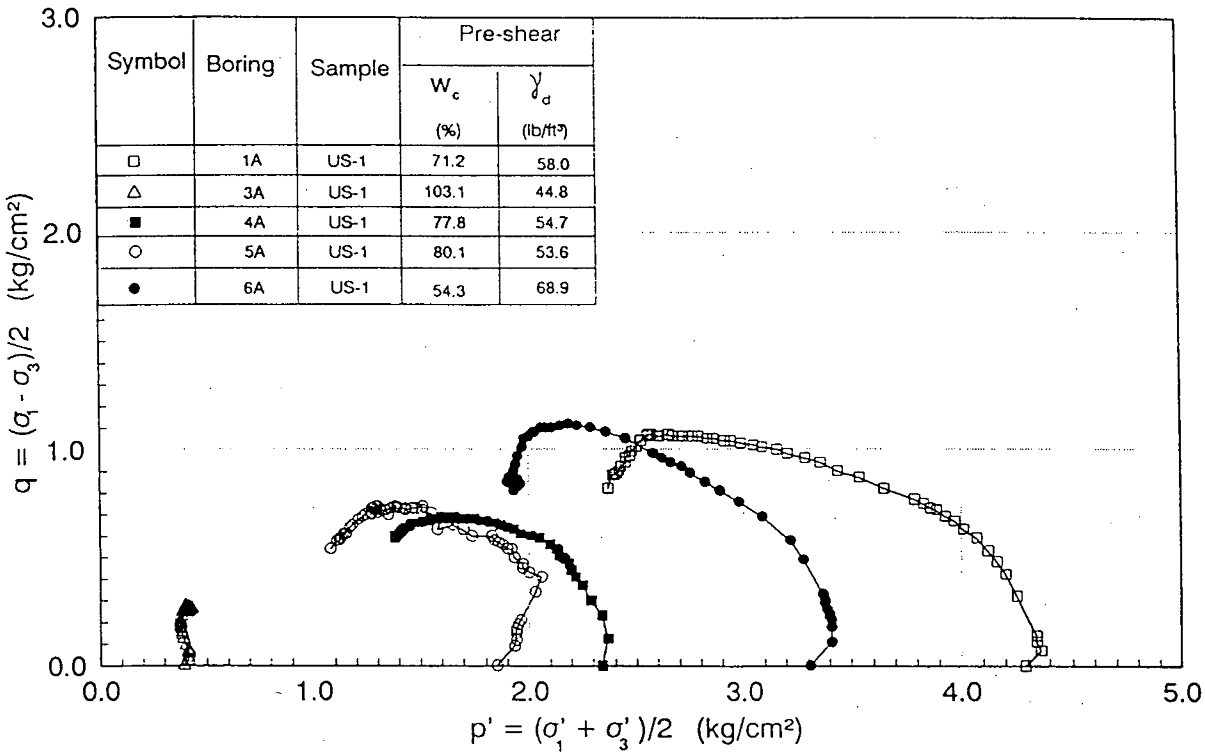
FILE NO.: 97-9628	APPROVED BY:	FIGURE: 13



EFFECTIVE STRESS PATHS FROM

CONSOLIDATED UNDRAINED ($\overline{CIUC}$) TRIAXIAL TESTS ON CLAY SPECIMENS

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SOUTHEAST LANDFILL HILLSBOROUGH COUNTY		
REMEDIAL ENGINEERING & SCIENCE, INC. ORLANDO, FLORIDA		
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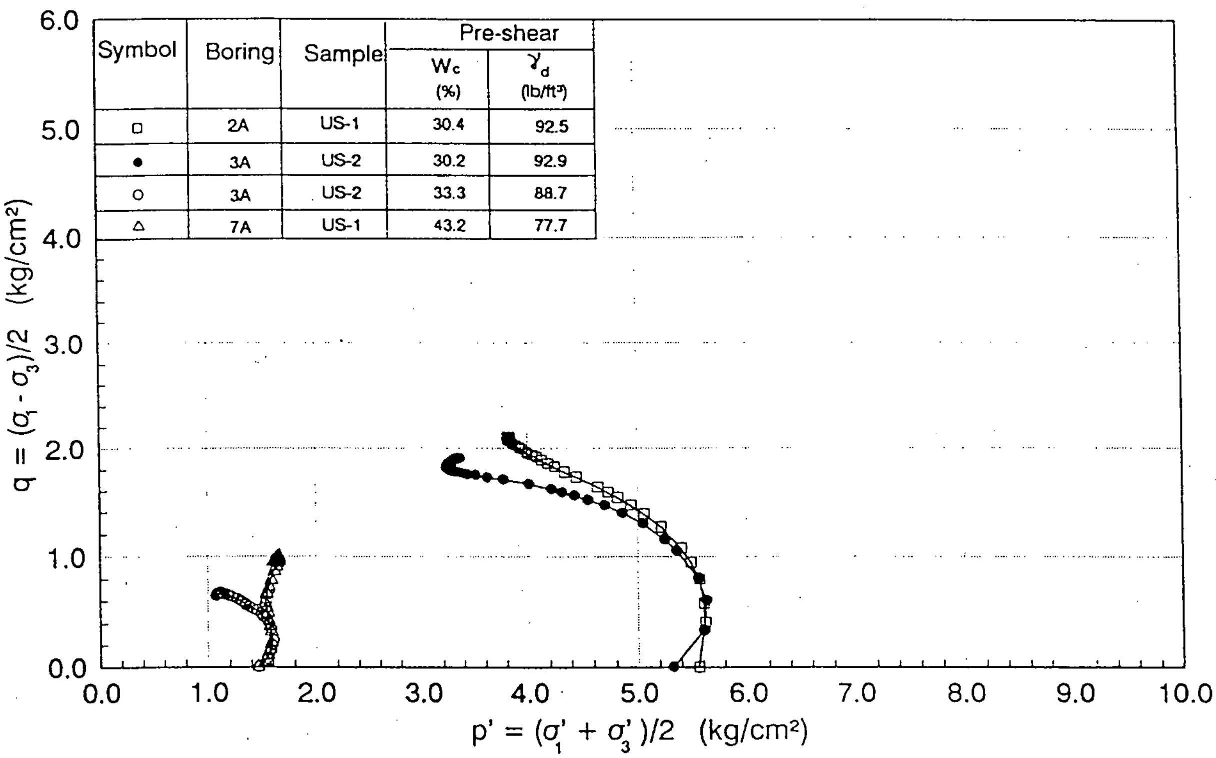
FILE NO.: 97-9628	APPROVED BY: [signature]	FIGURE: 14



Symbol	Boring	Sample	Pre-shear W_c (%)	Pre-shear γ_d (lb/ft³)
□	2A	US-1	30.4	92.5
●	3A	US-2	30.2	92.9
○	3A	US-2	33.3	88.7
△	7A	US-1	43.2	77.7

EFFECTIVE STRESS PATHS FROM CONSOLIDATED UNDRAINED ($\overline{CIUC}$) TRIAXIAL TESTS ON CLAYEY SAND SPECIMENS

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HILLSBOROUGH COUNTY

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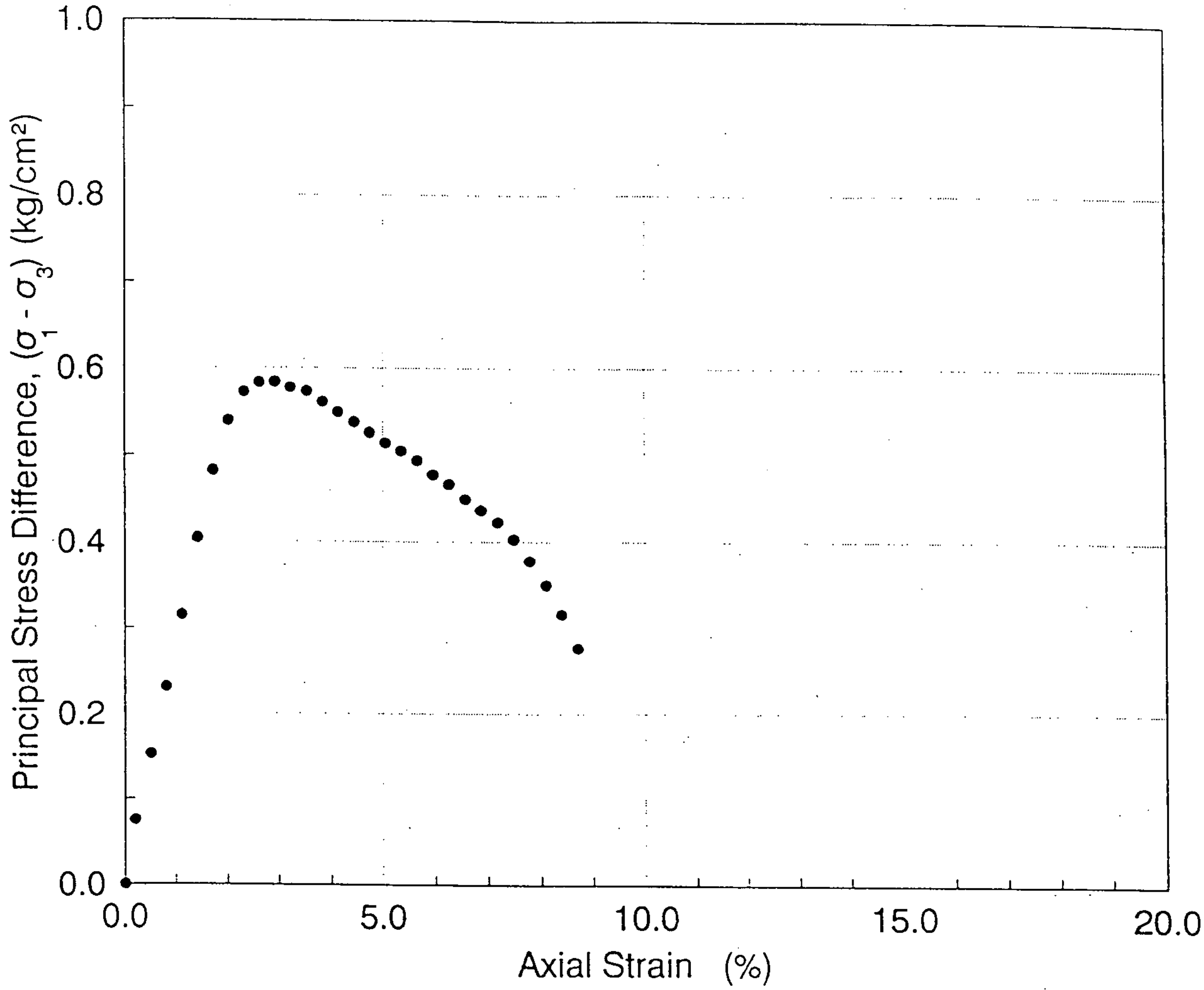
FILE NO.: 97-9628	APPROVED BY:	FIGURE: 15



UNCONFINED COMPRESSION TEST ON SPECIMEN FROM BORING SPT-3A, SAMPLE US-2

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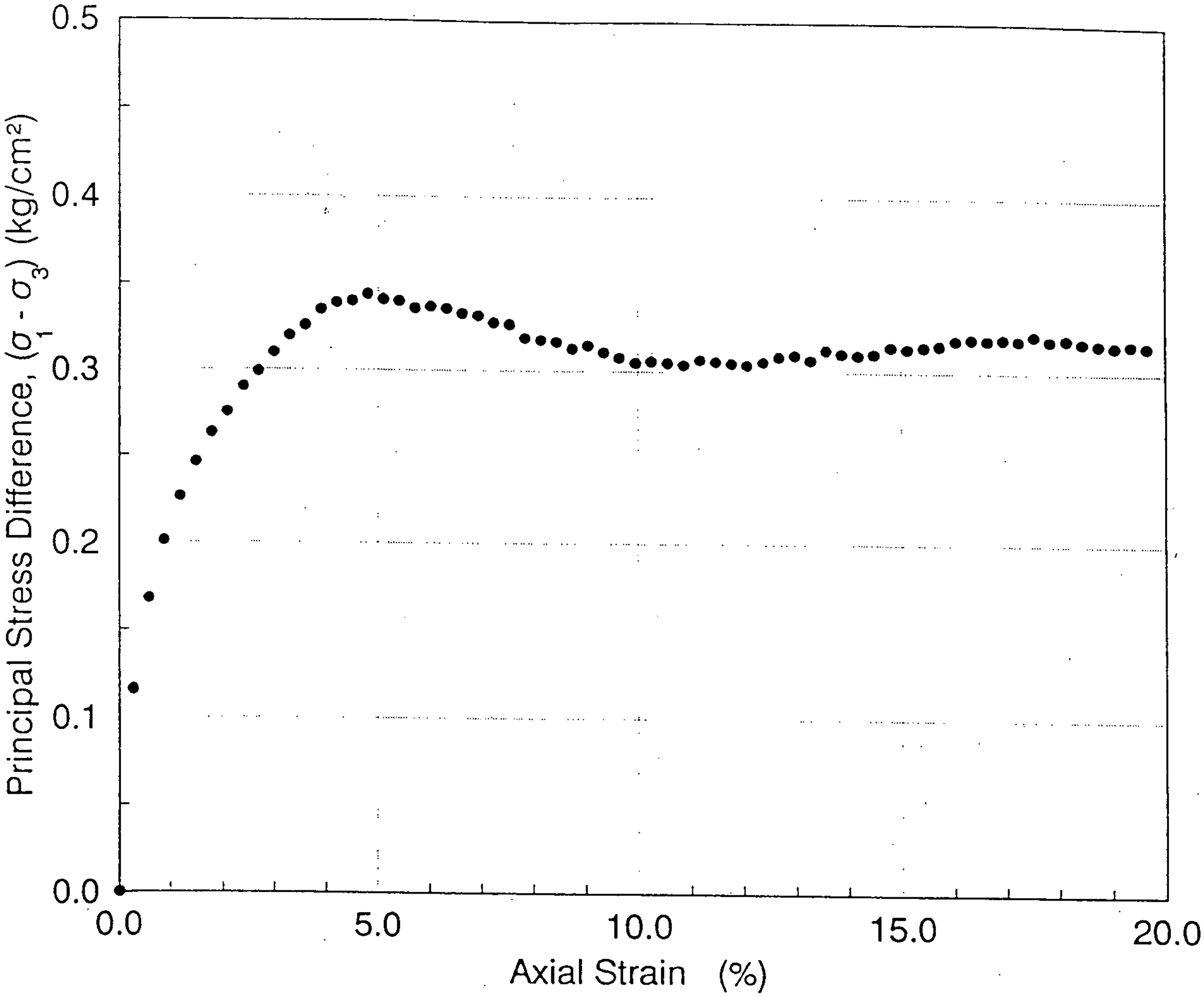
FILE NO.: 97-9628	APPROVED BY: [signature]	FIGURE: 16



UNCONFINED COMPRESSION TEST ON SPECIMEN FROM BORING SPT-4A, SAMPLE US-1

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SOUTHEAST LANDFILL HILLSBOROUGH COUNTY REMEDIAL ENGINEERING & SCIENCE, INC. ORLANDO, FLORIDA			
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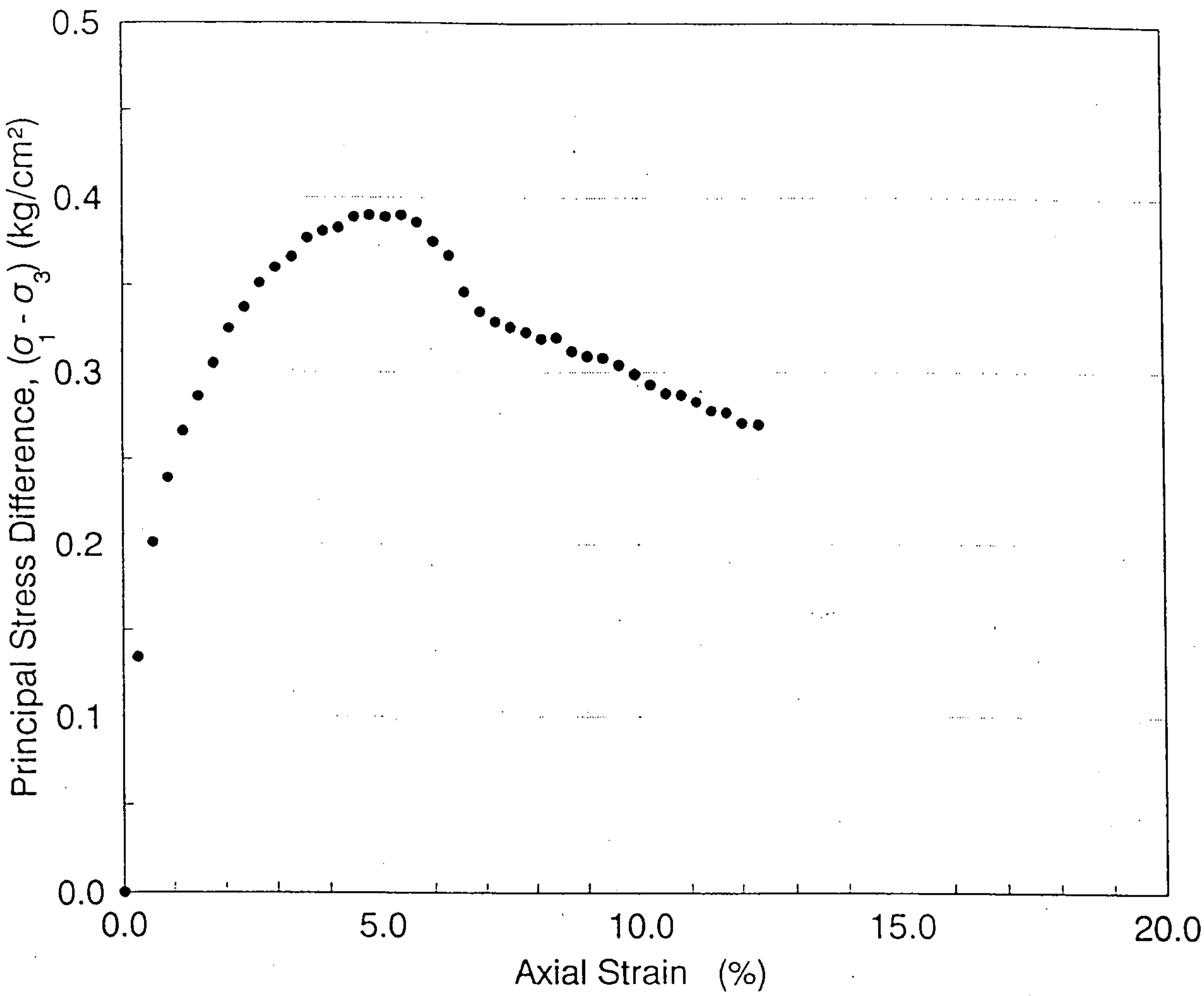
FILE NO.: 97-9628	APPROVED BY:		FIGURE: 17



UNCONFINED COMPRESSION TEST ON SPECIMEN FROM BORING SPT-5A, SAMPLE US-1

Ardaman & Associates, Inc. Geotechnical, Environmental and Materials Consultants		
SOUTHEAST LANDFILL HILLSBOROUGH COUNTY REMEDIAL ENGINEERING & SCIENCE, INC. ORLANDO, FLORIDA		
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FILE NO.: 97-9628	APPROVED BY: Thomas [signature]	FIGURE: 18

Appendix D-2 through D-5
Computer Output for Stability Analyses

NOTE: COMPUTER OUTPUT IS INCLUDED IN THE ENCLOSED DISKETTE

Appendix D-2: Case A. Computer Output for Stability Analyses with in-place Phosphatic Waste Clay

File Names: SW307CP.OUT and SW307.SP.OUT

Appendix D-3: Case B. Computer Output for Stability Analysis with Fill Sand in Stratum 1 for the Southwest Face

File Names: SW307CF.OUT and SW307SF.OUT

Appendix D-4: Case C. Computer Output for Stability Analyses with Fill Sand in Stratum for the Southeast Face

File Names: SE307CF.OUT and SE307.SF.OUT

Appendix D-5: Case D. Computer Output for Stability Analyses of the Final Cover

File Name: SW307FC.OUT

Appendix D-6
Settlement Analyses

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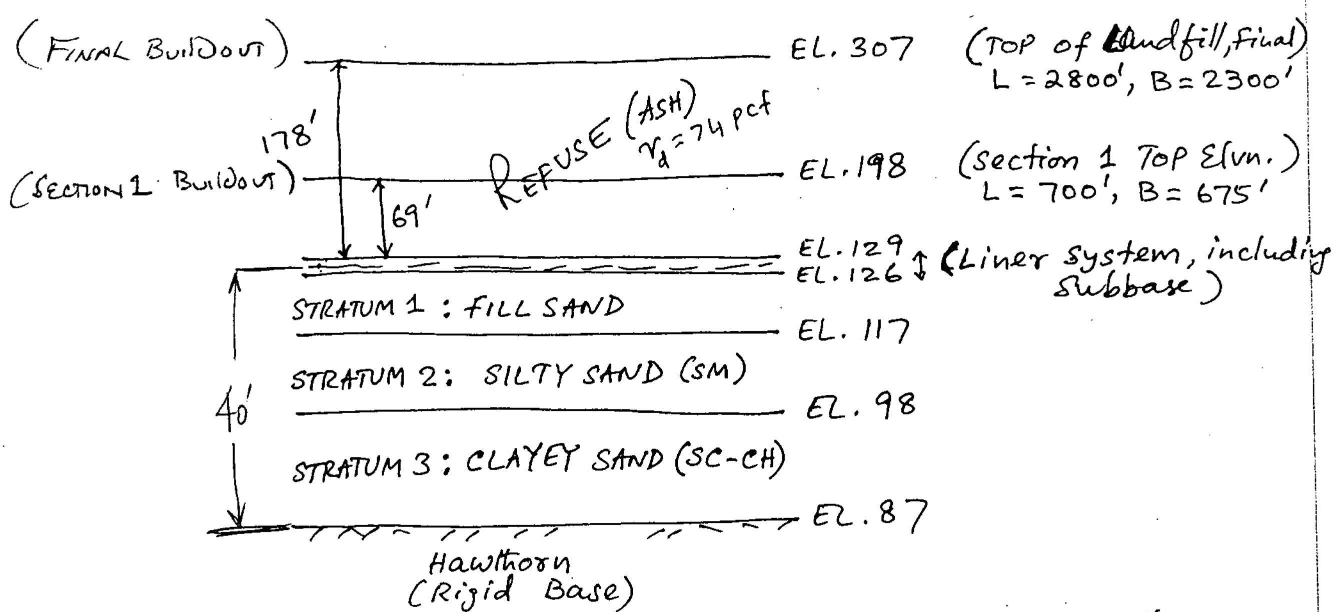

SKEMATIC SKETCH
(NOT TO SCALE)

A. INSTANTANEOUS / IMMEDIATE SETTLEMENT

- Elastic compression/settlement of granular Soils
- stratum 1 clay is Replaced with Fill Sand.

From NAVFAC, DM 7.1 (Soil Mechanics Design Manual 7.1), May 1982:

$$\delta_v = q B I \left(\frac{1-\nu^2}{E_u} \right)$$

δ_v = Instantaneous Settlement
q = Applied Uniform Pressure
B = Width of Loading Area
I = Influence Factor
ν = Poisson's Ratio
E_u = Modulus of Elasticity.

*** SECTION 1.**

- q = (69' x 74 pcf) + (2' x 120 pcf) = 5,346 psf   weight of Refuse
- B = 675' ; ν = 0.33
- E_u = 5,000 psi (for Dense Sand, Lower Limit) = 720,000 psf
- I for Rigid Base (Hawthorn):

H = 127' − 87' = 40'

(700/675) $L/B = 1.05$; (40/675) $H/B = 0.06$

from NAVFAC, DM 7.1, Page 213 ⇒ $H/B = 0 \rightarrow I = 0.0$; $H/B = 0.5 \rightarrow I = 0.09$ } for $\nu = 0.33$

By interpolation, I (for $H/B = 0.06$) = **0.011**

$$- \delta_v = (5,346) \times (675) \times (0.011) \times \left(\frac{1-(0.33)^2}{720,000}\right)$$

$= 0.049$ ft $= 0.59$ inches

- Factor of Safety in Bearing failure < 3.0

$\therefore \delta_c = \delta_v / SR$

δ_c = Corrected Instantaneous Settlement

SR = Settlement Ratio

from Fig. 4b, NAVFAC, DM 7.1, Page 217,

Initial Shear Stress Ratio (f) for Low P.I. and Normally consolidated Materials (OCR = 1.0) = 0.75

From Fig. 4a, NAVFAC, DM 7.1, page 216,

SR > 0.3 (for $q/q_{ultimate} = 1.0$, $f = 0.75$, and $H/B = 0.5$)

⇒ Assume, SR = 0.5 for $H/B = 0.06$

$\therefore \delta_c = 0.59/0.5$ = **1.2 inches** (FINAL BUILDOUT SECTION 1)

*** FINAL.** (FINAL BUILDOUT ENTIRE SITE)

- $q = (178' \times 74 \text{ pcf}) + (2' \times 120 \text{ pcf}) = 13,412$ psf
- $B = 2300'$; $\nu = 0.33$; $E_u = 720,000$ psf
- I for Rigid Base (Hawthorn):

(2800/2300) $L/B = 1.2$ $H/B = 0.02$ (40/2300 =)

$I = 0.004$ (for $H/B = 0.02$ by interpolation)

$$- \delta_v = (13,412) \times (2300) \times (0.004) \times \left(\frac{1-(0.33)^2}{720,000}\right)$$

$= 0.153$ ft $= 1.83$ inches

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- $\delta_c = \delta_V / SR = 1.83/0.5 = 3.7$ inches

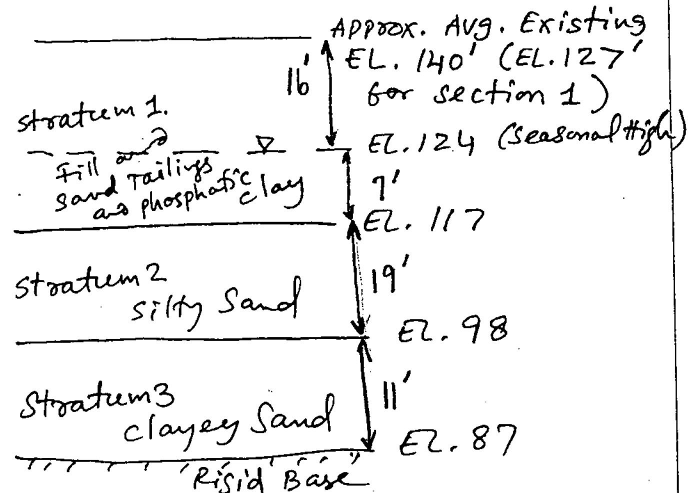
B. CONSOLIDATION SETTLEMENT

- Initial Condition

$P_o = (16' \times 120\,pcf) + (7' \times (120 - 62.4)\,pcf)$
$+ (19')(118 - 62.4)$
$+ (\frac{11'}{2}) \times (118 - 62.4)\,pcf$

$= 1,920 + 403 + 1,056 + 306$

$= 3,685$ psf.

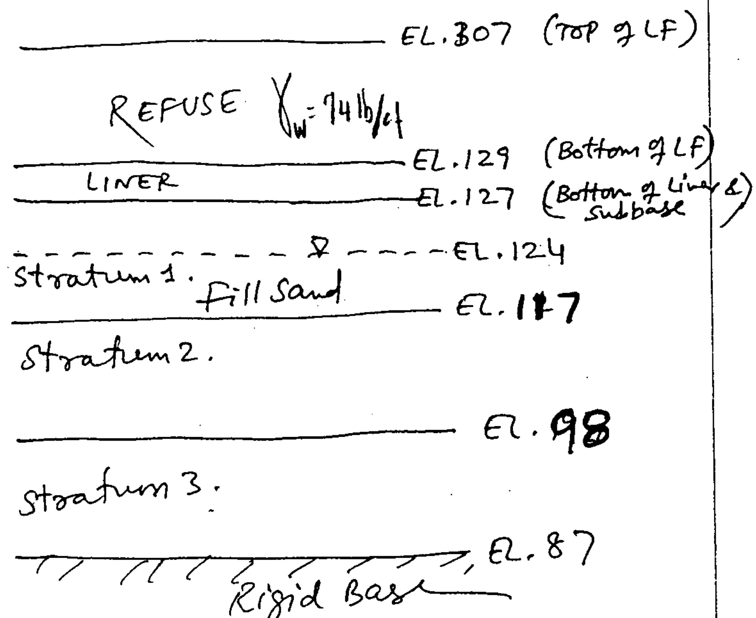


- Final Condition

$P_f = (178' \times 74\,pcf)$
$+ (2' \times 120\,pcf)$
$+ (3' \times 120\,pcf + 7' \times (120 - 62.4))$
$+ (19' \times (118 - 62.4)\,pcf)$
$+ (\frac{11'}{2} \times (118 - 62.4)\,pcf)$

$= 13,172 + 240 + 360$
$+ 403 + 1,056 + 306$

$= 15,537$ psf.



- $\Delta P = P_f - P_o = 15,537 - 3,685 = 11,852$ psf.

- Based on experience, consolidation Settlement in Sands and fill Sand (stratum 1) = 0.0.

⇒ Calculate Settlement in Stratum 2 and 3 only.

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Orlando, Florida
file NO. FL97003

- $\Delta P_{stratum 3} = 11{,}852$ psf. ✓

- $\Delta P_{stratum 2} = -P_{o\,@stratum 2} + P_{F\,@stratum 2}$

$= -[16' \times 120 + 7' \times (120-62.4) + \frac{19'}{2} \times (118-62.4)]$
$+ [178' \times 74 + 2' \times 120 + 3' \times 120 + 7'(120-62.4) + \frac{19'}{2} \times (118-62.4)]$

$= (13{,}172 + 240 + 360 + 403 + 528) - (1{,}920 + 403 + 528)$

$= 14{,}703 - 2{,}851 = 11{,}852$ psf. ✓

- Media Properties:

$G_s = 2.70$ for silty sand & clayey sand samples (Table 3, Appendix D-1)

STRATUM 3: LL = 39 % for mixed sand tailings and phosphatic clay with fines content of 38% (Table 1, Appendix D-1)

Assume: this value is valid for SC type soils present in stratum 3. (in the absence of actual sample tests)

STRATUM 2: LL = 35 % (Assume for SM materials of stratum 2).

⇒ Compression Index, $C_c = 0.009\,(LL - 10\%) = 0.261$ for stratum 3 (LL=39%)

$C_c = 0.009\,(LL - 10\%) = 0.225$ for stratum 2 (LL=35%)

Initial Void Ratio, e_o for stratum 2 = 1.01 (Based on Laboratory Data in Appendix D-1)

e_o for stratum 3 = 1.09 (—do—)

calculations are based on $e = \frac{G_s \gamma_w}{\gamma_t} - 1$ $\left(\frac{2.7(62.4)}{118} - 1\right)$

for stratum 2 (SPT2A, US-1, 30'-32')

for stratum 3 (SPT3A, US-2, 27'-29' and SPT7A, US-1, 25'-27')

- Settlement, $S = \frac{C_c H}{1+e_o} \log\left(\frac{P_o + \Delta P}{P_o}\right)$

$H_{for\ stratum 2} = 19'$

$H_{for\ stratum 3} = 11'$

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File No. FL97003

$$S_{\text{for stratum 2}} = \frac{(0.225)(19')}{(1+1.01)} \log\left(\frac{2,851 + 11,852}{2,851}\right)$$

$$= 1.52 \text{ ft} = 18.2 \text{ inches}$$

$$S_{\text{for stratum 3}} = \frac{(0.261)(11')}{(1+1.09)} \log\left(\frac{3,685 + 11,852}{3,685}\right)$$

$$= 0.86 \text{ ft} = 10.3 \text{ inches}$$

$$S = S_{\text{stratum 2}} + S_{\text{stratum 3}} = 18.2 + 10.3 = 28.5 \text{ inches}$$

C. • Total Settlement AND DIFFERENTIAL

– Total Settlement

$$\delta_{total} = S_{instantaneous} + \delta_{consolidation} = 3.7 + 28.5 = \underline{\underline{32 \text{ inches}}}.$$

– Differential Settlement

Differential settlement = Total settlement over a distance
= δ_{total} over the Length of the final slope
(i.e., Length from Top Edge of slope to Toe of slope) = 500 ft.
= δ_{total} over 500 ft (=L)

⇒ Angular Distortion, $\alpha = \frac{\delta_{total}}{L} = \frac{32''}{500'} = 0.0053 = 0.5\%$

From Murphy and Gilbert, 1985 (Settlement and Cover Subsidence of Hazardous Waste Landfills, USEPA. EPA/600/2-85/035),

Tensile Strain ≤ 0.1% (corresponding to $\alpha = 0.5\%$)

∴ No distortional threat to Liner is estimated since 1% tensile is current minimum estimated threshold for any liner distress.