INTERNATIONAL PAPER

Carmen Johnson
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RIEGELWOOD MILL
JOHN L. RIEGEL ROAD
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December 29, 1999

Mr. James Coffey
Permitting Branch, Solid Waste Section
Division of Solid Waste Management
P.O. Box 27687
Raleigh, North Carolina 27611-7687

Subject: Site Application
Sanitary Waste Landfill
International Paper
Riegelwood, North Carolina

Dear Mr. Coffey:

Enclosed is a "Site Application Sanitary Waste Landfill, International Paper, Riegelwood, North Carolina" prepared by our consultant, Earth Tech.

If you have any questions, require additional information, or wish to discuss our application, please contact me at (910) 655-6229.

Yours truly,

for EJK 12/30/99

Edward J. Kreul
Environmental Services Superintendent

DAVID STEWART
910-655-6582

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SITE APPLICATION
SANITARY LANDFILL

International Paper Company
Riegelwood Mill
John L. Riegel Road
Riegelwood, North Carolina 28456

Prepared by:

Earth Tech of North Carolina, Inc.
701 Corporate Center Drive, Suite 475
Raleigh, North Carolina 27607

December 1999

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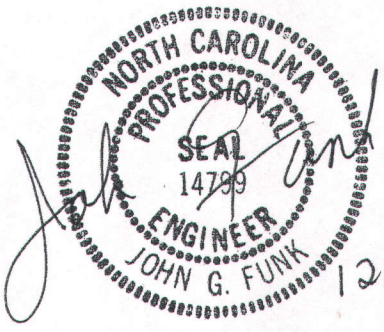

12/30/9

December 1999

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SECTION 1

Introduction

International Paper intends to construct and operate a sanitary landfill for disposal of industrial solid waste generated at its pulp and paper mill in Riegelwood, North Carolina. This Site Application is submitted in accordance with the provisions contained in 15A NCAC 13B.0504, "Application Requirements for Sanitary Landfills." This application is organized such that each section of the application corresponds to a specific paragraph in the Rule as listed in the Table of Contents. It is anticipated that no additional information beyond that contained in this application is pertinent to the suitability of the proposed site for a sanitary landfill.

The proposed landfill site is located in Columbus County, approximately 20 miles northwest of Wilmington, North Carolina. The site occupies approximately 450 acres, and is located east of the mill wastewater treatment basin. The site is bounded on the west by Livingston Creek, and on the north by the Cape Fear River. There are no airport runways located within 10,000 feet of the site, and there are no state parks, recreation areas, or scenic areas located in the immediate vicinity of the landfill site. All residences and water supply wells in the site vicinity are located south of the landfill site. The nearest residence is located 500 feet from the future landfill development area on the western portion of the site, and the nearest residence on the eastern portion of the site is located 675 feet from the proposed initial landfill development area. The groundwater flow direction is generally from south to north toward the Cape Fear River, such that all water supply wells are on the upgradient side of the landfill.

Due to topographic relief at the site, no flood-prone areas are anticipated on the upland portions of the site where the proposed landfill is to be located. There are no recorded sightings of any federally-listed endangered or threatened species as listed by the United States Fish and Wildlife Service at the proposed site, and the site will not impact any critical habitat. For any archaeological sites impacted by the landfill, International Paper will devise a program of data recovery in consultation with the North Carolina State Historic Preservation Office, the United States Army Corps of Engineers, and the Advisory Council on Historic Preservation. The purpose of the recovery program is to recover information important to the understanding of the historic properties to avoid an adverse effect under Section 6 of the National Historic Preservation Act. In summary, the information provided in this application demonstrates that the proposed site is suitable for construction and operation of a sanitary waste landfill, and this the application contains all the information required by Rules 0.504 and .0503(1) of 15A NCAC 13B for siting a sanitary landfill.

SECTION 2

Rule .0504(1)(a) Aerial Photograph

An aerial photograph (Figure 2-1) of the landfill site is provided in this section. The August 1999 photograph is on a scale of 1-inch equals 400 feet and includes the area within one-fourth mile of the proposed site's boundaries. The following information is provided on the photograph:

(i) Entire property owned by International Paper;
(ii) Land use and zoning (note: the land is agriculture and does not have a zoning classification);
(iii) Location of homes, industrial buildings, public or private utilities, and roads;
(iv) Location of wells, watercourses, dry runs, and other applicable details regarding the general topography;
(v) Flood plains.

Aerial photographs were taken of the site in August 1998 and August 1999. Earth Tech personnel obtained the information concerning 100-year flood plain, zoning, and land use in February 1999. Earth Tech personnel also toured the area encompassed by the August 1998 photograph in May 1999 to verify the location of residences and determine the location of residential wells. The site area was re-photographed in August 1999, and no additional structures or wells have occurred within a 1/4 mile of the landfill boundary. A new home was constructed off State Route (SR) 1818 to the southeast of the landfill site, but the home is just beyond a 1/4 mile from the site boundary.

The western boundary of the proposed landfill site is contiguous to the International Paper Mill property. The southern, northern and eastern property lines are shown on the photograph. The photograph shows the locations of homes and wells, and demonstrates that the landfill site meets the minimum buffer requirements for a sanitary landfill. The distance from the nearest residence and well is 500 feet from the future landfill development area on the western portion of the site. The distance from the nearest residence and well to the proposed initial development area on the eastern portion of the site is 675 feet. The required minimum distance is 500 feet. Also as determined in the Geological and Hydrologic Study in Section 4, the residential wells are upgradient of the landfill with the predominant groundwater flow direction is toward the Cape Fear River. The toe of the landfill berms will be a minimum of 50 feet from the International Paper property line, and there is a 50-foot separation distance between the landfill berms and the nearest river or stream. The landfill area is not within the 100-year flood plain

as shown on the photograph. The information provided in the aerial photograph meets the applicable criteria for siting of a sanitary landfill at the proposed location.

3

SECTION 3

Rule .0504(1)(b) Area Map

This section provides an area map (Figure 3-1) of the proposed landfill site in a scale of 1-inch equals 1000 feet, and includes an area within two miles of the proposed landfill site's boundaries. In accordance with the Rule cited above, the following information is included on the map:

(i) Significant ground-water users;
(ii) Potential or existing sources of ground-water and surface water pollution;
(iii) Water intakes;
(iv) No airports and runways are located within the two mile radius of the proposed landfill site;
(v) Subdivisions.

In February 1999, Earth Tech personnel contacted Environmental Data Resources, Inc. (EDR), a private data research firm, to access various federal and state environmental agency data bases in order to identify facilities with known or potential environmental concerns at and in the vicinity of the proposed landfill site. The listing of potential and confirmed groundwater contamination sources as indicated on the Topograph Map were developed from EDR data base search. The location of subdivisions identified on the Map were determined by Earth Tech personnel in February 1999.

The topographic map shows that all groundwater users are located south of the proposed landfill site. The Geologic and Hydrologic Study of Section 4 determined that the predominant groundwater flow direction is toward the Cape Fear River to the north. Therefore, the proposed landfill is situated down gradient of the groundwater users. The Town of Riegelwood and the Mill have a surface water intake on the Cape Fear River upstream of the proposed landfill site. Potential sources of groundwater pollution would not impact groundwater monitoring at the proposed landfill site. The information provided in the Topographic Map meets the applicable criteria for siting of a sanitary landfill at the proposed location.

SECTION 4

Rule .0504(1)(c) Geological and Hydrological Study

This section provides a Geological and Hydrological Study of the proposed landfill site. The study included the installation of shallow and deep piezometers to obtain standard penetration resistance and collect undisturbed soil samples for particle size analysis, soil classification, saturated hydraulic conductivity, volume percent water, and porosity. In addition, bulk soil samples were collected for saturated hydraulic conductivity testing, total porosity, and atterberg limits. The study includes stratagraphic cross-sections that identify hydrogeological units, and the piezometers were used to obtain water table elevations. A survey map is included that shows the locations of the piezometers, soil boring, and monitoring wells installed on the proposed site, and a potentiometric map of the surficial aquifer is also included.

The proposed landfill site is located in Columbus County approximately 20 miles northwest of Wilmington, North Carolina and is located in the Coastal plain physiographic province. The Cape Fear River borders the site to the north and Livingston Creek forms the western boundary of the site. The site is contained within the Cape Fear River watershed. Three unnamed streams drain the site. The stream on the west drains to Livingston Creek, and the streams in the central and eastern portions of the site drain directly into the Cape Fear River. Surface drainage generally flows east and west to the slopes of the unnamed streams. Due to topographic relief at the site, no flood-prone areas are anticipated on the upland portions of the site where the proposed landfill is to be located.

The site lithology consists mainly of clayey sand and sandy clay. Fine– to coarse-grained, unconsolidated sands are found at the surface and are underlain by plastic clays. The surficial soil encountered at the site consists of sand ranging in size from fine-grained to coarse-grained and is generally poorly sorted. Below the surficial sand at a depth of 10 to 25 feet below ground surface, borings encountered greenish gray, plastic, compressible clay, consistent with the Pee Dee Formation.

The subsurface investigations and hydrologic data suggest that the zone of saturation is consistent throughout the site and generally follows topography. Based on hydrologic cross sections and the elevation contour map, the overall groundwater flow direction is from south to north and local variations influenced by the incised streams that divide the site. Using the average gradient on the site uplands and the average hydraulic conductivities for the upper aquifer sands, the groundwater flow velocity is estimated to be 0.14 ft per day (51 ft per year).

The seasonal high potentimetric surface is best estimated from water level measurements over time at a given site. Seven rounds of groundwater elevation data have been

collected for the facility since the beginning of this year. The December 1999 data shows the water table at its highest level for the measurement dates with the December data indicating water table elevations approximately 0.5 feet high than the May 1999 data. Earth Tech attempted to collect water level water measurements on October 4, 1999, two weeks after Hurricane Floyd impacted the area, but only the eastern portion of the site was accessible. The eastern portion of the site also had standing water over much of the site area. Only PZ-1, PZ-2, PZ-4D, PZ-4S, MW-1, MW-2, and PZ-100 were accessible and the data is included in Table 2 of the report. The October 1999 data reflects historic groundwater elevation and not seasonal elevation. The water level data collected to data indicates that a 4-foot separation distance between the seasonal high water table and the waste can be provided at the site.

Based upon the results of the Geological and Hydrological Study, it is concluded that the proposed site is suitable for a sanitary landfill. It is recommended in the Study that additional characterization be undertaken in the eastern portion of the site to support detailed design after the Division of Solid Waste issues their approval of the site. The additional characterization would consist of placement of a deep and shallow piezometer in the vicinity of MW-1, a shallow piezometer between MW-1 and MW-2, a shallow piezometer at the southeastern property line of the site.

GEOLOGICAL AND HYDROLOGICAL STUDY

Revision 2

PROPOSAL SANITARY LANDFILL
INTERNATIONAL PAPER
RIEGELWOOD, NORTH CAROLINA

Prepared By

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NORTH CAROLINA LICENSED SEAL 467 GEOLOGIST MICHAEL W. BRANSON

December 1999

John G. Funk

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12/22/99

TABLES

FIGURES

APPENDICES

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this study is to describe and present the findings of the geological and hydrological investigation for a proposed sanitary landfill at International Paper's Mill in Riegelwood, Columbus County, North Carolina. The proposed landfill is located east of the existing International Paper Mill as shown on Figure 1. This study provides a characterization and evaluation of the geology and hydrology of the proposed landfill to fulfill the requirements of 15A NCAC 13B.0504(c) of the North Carolina Department of Environment and Natural Resources (NCDENR) Solid Waste Management regulations. This information is presented to assess the site's suitability for a sanitary landfill. This report incorporates the work of Earth Tech and work conducted previously by McKim & Creed.

The site location and surrounding land use are discussed in the remaining portions of this section. Section 2 of this report summarizes the regional physical setting of the landfill. Sections 3 and 4 discuss the regional geology and hydrology. Section 5 describes the geologic and hydrologic investigation conducted by Earth Tech. Section 6 and 7 provide detailed discussions of the site geology and hydrogeology based on the findings of the investigation. Section 8 contains conclusions and recommendations.

1.2 LOCATION AND DESCRIPTION

The proposed landfill site study area is located approximately two miles northeast of Riegelwood, North Carolina, in the northeast corner of Columbus County. Access to the site is by State Road (SR) 1818 and SR 1819, which lie to the south of the proposed site. The proposed landfill site is bounded on the west by Livingston Creek and on the north by the Cape Fear River. A regional map showing the location of the site study area is provided in Figure 1. A topographic map of the site study area is provided in Figure 2.

The site is comprised of undeveloped land that has been cleared by logging operations except for wooded areas in several ravines which divide the site.

1.3 SURROUNDING LAND USE

The surrounding land to the south and east of the site is a mix of residential and agricultural, and is not zoned. The International Paper Mill is located west of the site. The Cape Fear River and Cape Fear Lowlands are north of the site.

The Cape Fear River, which borders the site on the north, has a frontage of about 5000 feet along the site. No state parks, scenic areas, recreational facilities, state nature, or state historical preserves are known to exist within a two-mile radius of the site.

2.0 REGIONAL PHYSICAL SETTING

2.1 CLIMATE

The site is located approximately 20 miles northwest of Wilmington, North Carolina and the climate at the site is typically warm and humid with a mean annual temperature of 63.4^{0}F and an average annual rainfall of approximately 54.2 inches. Figure 3 illustrates the 30-year monthly average precipitation amounts from 1961 through 1990 for the Wilmington, North Carolina, area. As shown by the figure, rainfall is somewhat higher in the summer months of June through August with a July average of 8.13 inches. The lowest overall rainfall average occurs in the fall months with an October average of 2.69 inches.

Mean monthly temperatures from the 30-year average range from 45.0^{0}F in January to 80.5^{0}F in July. Snow cover, which averages 2.3 inches annually, may occur in December through March with the highest accumulation generally in December and February.

2.2 TOPOGRAPHIC SETTING

The proposed landfill site is located in the Coastal Plain physiographic province of North Carolina. The southeastern part of the North Carolina Coastal Plain, where the site lies, is characterized by a flat, sandy plain, much of which is occupied by swamps, marshes, and lakes. Some areas between streams are more gently rolling, but along rivers and major streams, the topography can be steep and rugged (Stuckey and Steel, 1953).

Columbus County lies entirely within the Coastal Plain province. The county is best described as low and flat, with the highest elevations reaching only 125 to 130 feet above sea level. According to published sources, swampy areas constitute about 1/5 of the land surface and generally are less than 75 feet above sea level (Blankenship, 1965).

The site is located in an area of diverse topography and land features as illustrated on the USGS Acme 7.5-minute quadrangle provided on Figure 1. North of the site, the Cape Fear River has

created the Cape Fear Lowlands, a swampy area that generally is less than 15 feet above sea level. This swamp area extends to the south side of the Cape Fear River, which encompasses the northern portion of the study area. The swamp south of the river is situated on a strip of land approximately 1000 feet wide and, in the site study area, extends from Neils Eddy Landing to Livingston Creek. This swamp then follows Livingston Creek, on the west boundary of the site, but at a lesser width. The swampy area on the north and west sides of the site is abruptly terminated by a steep embankment rising from an elevation of about 6 feet above sea level to an elevation at the top of about 45 feet above sea level. The topographic relief on the east side of the site is similar, but is the result of a ravine formed by an unnamed perennial stream flowing to the Cape Fear River. The central and southern portion of the site is flat with a slight rise in elevation southward to a maximum elevation of about 50 feet above sea level.

2.3 SITE FEATURES

2.3.1 Streams, Creeks, and Drainage Features

The site study area is within one watershed, which consists of Livingston Creek and the Cape Fear River. Livingston Creek is a tributary of the Cape Fear River and flows south to north before entering the Cape Fear River at the northwest corner of the study area. The Cape Fear River borders the site on the north and flows west to east to the Atlantic Ocean. Three unnamed streams divide the site into roughly equal sections. The westernmost stream flows to Livingston Creek and the other streams feed directly into the Cape Fear River. The streams are located within the deeply incised ravines on the site. These ravines create distinctive surface drainage routes from various locations at the site; however, the ultimate discharge point for surface drainage is the Cape Fear River.

2.3.2 Existing Water Supply Wells

Several residences are located south of the site, and these residences utilize local groundwater as a water supply. The location of private, potable supply wells are provided in Figure 4 which is an aerial photograph of the landfill study area within a ¼ mile of the proposed landfill.

3.0 REGIONAL GEOLOGY

3.1 STRATIGRAPHY AND LITHOLOGY

The North Carolina Coastal Plain consist of interlayered sedimentary units of sand, silt, clay, limestone, and marls overlying a basement rock of volcanic and plutonic origins. In Columbus County, the sedimentary units are approximately 1000 feet thick and range in age from late Cretaceous to Tertiary. The oldest sedimentary unit in Columbus County is the Cape Fear Formation followed by the Black Creek Formation, the Peedee Formation, and the Waccamaw Formation.

The Cape Fear Formation lies unconformably on the basement bedrock. This formation consists of interbedded clays and sands. The clay beds are usually pale to medium gray, although thin red zones within the clays are common, and they range in thickness from a few inches to about 8 feet. Some of the clay strata have lateral continuity. Generally, the clay beds have scattered fine mica flakes and disseminated woody debris. The sands of the Cape Fear Formation also range from thin- to thick-bedded and are either massive or poorly cross-bedded with clay clasts common. Overall, the sands are quite clayey and, as a result, are poorly sorted.

The Black Creek Formation overlies the Cape Fear Formation and consists of dark gray, fine-grained sandy clay and very fine to very coarse sand. The predominant lithology is clay and sandy clay. Cross-bedded sand lenses ranging from a few inches to more than 30 feet may occur between clay layers. Lignite, in small pieces and layers, occurs throughout the formation and logs of wood not yet altered to lignite have been observed. While the thickness of the Black Creek Formation varies, it thickens from the northwest to southeast and may be between 300 feet and 400 feet thick in Columbus County.

Overlying the Black Creek Formation is the Peedee Formation. The lithology of this unit is complex, but is predominantly a dark-greenish to gray clayey sand with occasional mica and glauconite. The sand is generally massive with calcareous concretions appearing randomly or in a distinctive layer. Dark marine clays are present throughout the formation, but are a minor contribution to the lithology. However, locally these clays may be as much as 6 feet thick. In addition, marl layers appear inconsistently throughout the formation and are associated with sand beds containing high

concentrations of glauconite. The Peedee Formation increases in thickness from north to south; it is a few feet thick in north and western Columbus County and reaches several hundred feet in southern Columbus County.

Several areas of Columbus County, including the site study area in the northeast corner of the county, are covered with a surficial sand deposit over the Peedee Formation. This sand deposit is the Waccamaw Formation of Tertiary age. These deposits are bluish-gray to tan fossiliferous sand with silt and clay. The sand is unconsolidated and, in Columbus County, appears to reach a maximum thickness of about 35 feet, although it is absent in much of the county.

3.2 STRUCTURE

Regionally, the basement surface on which Coastal Plain sediments were deposited is not a simple, seaward dipping platform, but is characterized by broad upwarps and downwarps. The axis of one such upwarp is located in central Columbus County and is known as the Cape Fear Arch. This axis is oriented northwest to southeast and the structure plunges to the southeast. This structural feature is thought to be the result of tectonic uplift during the Cretaceous. In general, deposits on the arches are thinner and provide a less complete depositional record.

No other structural features, such as faults or lineaments, have been identified in the study area.

3.3 SOILS

The major soil types present near the proposed landfill site are classified as the Norfolk-Lynchburg-Goldsboro association. These soils are generally found on uplands and are nearly level to gently sloping. The subgroups within this association are the Blanton sand, Chastain soils, Goldsboro fine sandy loams, Udults soils, and Wagram loamy fine sand.

The Chastain soils are found in the poorly drained areas on flood plains along the Cape Fear River, which are present on the north side of the site. The Udults soils are the excessively drained or moderately drained soils found on the steep embankments along the Cape Fear River, such as those bordering the swamps on the north and west sides of the site. This soil is mostly loamy, but is clayey

in some areas. Surface water runoff is rapid and erosion is a hazard. The Blanton, Goldsboro, and Wagram soils are found on the broad uplands in the area with the major differences being in the soil constituents. The Blanton soil is a dark gray sand typically in wooded areas, but can also be found in pastures and cropland. The Goldsboro soil is a dark grayish brown fine sandy loam found in flat to slightly convex areas and associated mainly with cropland with some forest and pasture cover. The Wagram soil is a brown loamy fine sand found on broad smooth flats and side slopes on uplands. Most of the acreage of Wagram soil is cropland with some forest and pasture (USDA, 1990)

4.0 REGIONAL HYDROGEOLOGY

4.1 SURFACE WATER HYDROLOGY

The proposed landfill site lies within the Cape Fear River watershed. Surface water discharges from the site will drain into one of three unnamed streams or directly into the Cape Fear River. One of the unnamed streams on the west side of the site is a tributary of Livingston Creek, which drains into the Cape Fear River. The unnamed streams in the central and eastern portions of the site drain into the Cape Fear River.

4.2 REGIONAL GROUNDWATER HYDROLOGY

Groundwater in the Coastal Plain province is found in the unconsolidated and consolidated sediments deposited in the region. Both artesian and nonartesian conditions are present; the artesian conditions are encountered in the sands of the Cretaceous sediments and the nonartesian conditions are encountered in the surficial strata (Blankenship, 1965). The groundwater yield of the sands is dependent upon the thickness of the saturated zone, topographic setting, vegetative covering, and the permeability of the soil. Recharge of the surficial aquifers is through infiltration of precipitation. Water infiltrates through the residual soil into the saturated soil zone. Groundwater may flow into the deeper confined aquifers through lateral movement or vertically through leaky confining layers. Upon reaching the surficial saturated zone, groundwater flows downgradient to discharge areas in topographic lows.

The principal regional aquifers in the study area are the Black Creek Formation and the Peedee Formation. The Black Creek Formation is the most important aquifer in the western part of Columbus County. Groundwater from this aquifer is found in multiple layers of sand. According to Blankenship (1965), wells tapping the Black Creek Formation are 350 to 450 feet deep and can yield up to 700 gallons per minute. Water levels measured in this formation are 15 to 20 feet below ground surface. In eastern Columbus County, the Black Creek Formation contains brackish water. The Peedee Formation is the most important aquifer in central and western Columbus County where it is composed mainly of beds of sandy silt. The well yields in this area from the Peedee Formation are similar to those from the Black Creek Formation. In the northeast portion of Columbus County

in the vicinity of the site, the Peedee Formation yields lesser quantities of water, mainly because its thickness is significantly less. Records for wells drilled in the Delco, Acme, and Riegelwood vicinity report well depths of 50 feet to 250 feet with yields of 15 to 90 gallons per minute.

The surficial deposits in the site area will produce sufficient quantities of water for domestic use. Water levels in the surficial deposits are generally only a few feet below the ground surface, but will fluctuate as a function of precipitation, evapotranspiration, and infiltration. Water levels will rise quickly during periods of wet weather and decline slowly during dry periods.

4.3 SITE GROUNDWATER HYDROGEOLOGY

Groundwater flow rates and direction at any site is dependent on the topography and lithology. As a general rule, groundwater will flow in the downhill direction of the topography and will travel more freely through sand than clay. Groundwater discharge will be at topographically low areas where streams, rivers, or lakes are located. The proposed landfill site is flat with sharp downward topographic relief to streams or the Cape Fear River. As a result, the groundwater at the site is anticipated to flow toward these discharge points.

A visual well inventory was conducted to identify supply wells within approximately 2000 feet of the proposed landfill facility. A review was conducted of state and county records and surrounding residents were interviewed to identify private and public supply wells located within ¼ mile radius of the boundaries of the proposed landfill. Figure 4 shows that each of the identified offsite wells is located upgradient from groundwater flow directions estimated at the site or are situated across a hydrogeologic divide. Activities at the proposed landfill are not anticipated to impact water quality at these identified locations.

5.0 SITE HYDROGEOLOGIC INVESTIGATION

5.1 SUBSURFACE EXPLORATIONS

At total of twenty-six piezometers were installed at the proposed landfill site between March 1994 and January 1999. In March and April 1994, McKim & Creed contracted with S&ME to drill and install six piezometers (MW-1 – MW-6) and over 50 soil borings for evaluation of the site as a wastewater holding pond. In January 1999, Earth Tech drilled and installed 20 piezometers at the site to characterize the site's suitability for a sanitary landfill. Copies of the McKim & Creed logs are provided in Appendix E. This section describes the investigation techniques performed by Earth Tech only, but the information from the McKim & Creed work is relevant to characterizing of the site and has been included to supplement the Earth Tech investigation.

Of the twenty piezometers installed by Earth Tech, four sets (PZ4, PZ-7, PZ11, and PZ-12) were installed as nested pairs. The balance, (piezometers PZ-1 through PZ-16) were installed as single piezometers with four piezometers (PZ-13 through PZ-16) installed as temporary piezometers in the Cape Fear flood plain on the north side of the site. All piezometer locations, including the McKim & Creed piezometers, are shown in Figure 5. Piezometer locations were selected to provide information regarding the various topographic areas of the study area. Technical oversight for all piezometers was provided by experienced geologists. Drilling and piezometer installations were provided by Graham & Currie Diversified Drilling.

5.1.1 Soil Borings

At each location, borings were drilled using hollow stem augers, and the borings logs are provided in Appendix A. Undisturbed subsurface soil samples were collected using 24-inch long, 2.0-inch O.D. Shelby Tube samplers driven by a 140-pound hammer free falling 30-inches. Disturbed or bulk soil samples were collected by taking cuttings from specific intervals and placing them in plastic containers.

Geologists prepared field logs describing subsurface conditions encountered in each boring. Soils and sediments were classified in the field in accordance with the Unified Soils Classification System (USCS) and procedures described in ASTM D-2488 (Standard Practice for Description and Identification of Soils, Visual – Manual Procedure).

Boring Logs were prepared for each boring/piezometer location. Boring Logs prepared as part of this investigation are presented in Appendix A.

5.1.2 Piezometer Installation

Twenty-six piezometers were constructed by both McKim & Creed and Earth Tech to evaluate water-bearing strata underlying the site. At locations PZ-4, PZ-7, PZ-11, and PZ-12, piezometer pairs were installed with vertically separated screens to determine vertical gradients within the aquifer. A summary of piezometer construction data is presented in Table 1. Detailed Piezometer Construction Summaries are included in Appendix B.

Each Earth Tech piezometer was constructed of 2.0-inch I.D. threaded flush joint schedule 40 PVC and features a 5- or 10-foot long threaded flush joint machined slot screen. Slot size for each screen was 0.010-inches. All piezometer screen and riser lengths are recorded on the Piezometer Construction Summaries presented in Appendix B.

Piezometers were constructed by lowering the PVC through the hollow stem of the auger. The filter pack consisting of medium sand was placed while the augers were incrementally removed from the borehole. The filter pack was placed to extend approximately two feet above the top of the screened interval. A bentonite seal approximately three feet thick consisting of bentonite chips was then emplaced on top of the sand. Where the bentonite seal was constructed above the water table, the bentonite chips were hydrated using potable water. The annular space above the bentonite was sealed using grout.

All piezometers, except those constructed in the Cape Fear flood plain on the north side of the site (PZ-13, PZ-14, PZ-15, and PZ-16), were completed with the installation of a locking 4-inch by 4-inch by 5-foot long locking steel protective cover and secured by a 2-foot by 2-foot by 6-inch thick

concrete pad. The protective covers were secured with identically keyed locks. Each permanent piezometer is identified with a riveted tag as per North Carolina Well Regulations.

Each permanent piezometer was developed either by alternately surging and bailing or pumping. Sediment, which settled in the bottom of the piezometer, was removed. The recovery was monitored to insure good hydraulic connection with the aquifer. Stabilized water levels were measured in January, February, May, July, and December 1999, and these data are provided in Table 2.

5.2 IN-SITU HYDRAULIC CONDUCTIVITY TESTING

Slug tests were performed to evaluate the hydraulic characteristics of the saprolite aquifers at the site. All slug test were performed and analyzed using the techniques outlined by Bouwer and Rice (1976) and Bouwer (1989). Results of the testing are discussed in Section 7.3 and data is included in Appendix C.

5.3 SURVEYING

Locations, ground surface, and top of casing elevations for each of the piezometers installed were determined by McKim and Creed, N.C.R.L.S. under contract to International Paper in 1999. Surveying data is based upon the N.C. State Plane Coordinate System and msl elevations.

5.4 GEOTECHNICAL TESTING

Laboratory soil testing was performed by Froehling and Robertson, Inc., in Raleigh, North Carolina. Three undisturbed Shelby Tube samples (PZ-7, PZ-11, and PZ-12D) were submitted to the laboratory and tested for Sieve Analysis (ASTM D422-63), Hydrometer Analysis (ASTM D422-63), Atterberg Limits (ASTM D4318-95), unit weight, and hydraulic conductivity (ASTM D5084-90). Three disturbed bulk Soil samples (PZ-11D, PZ-12, and PZ-12D) were submitted to the laboratory and tested for Sieve Analysis (ASTM D422-63), Hydrometer Analysis (ASTM D422-63), Atterberg Limits (ASTM D4318-95), unit weight, and Proctor Test. Two of the bulk samples PZ-12 and PZ-12D were tested for consolidated undrained (CU) triaxial shear, and for hydraulic conductivity. The

samples tested for hydraulic conductivity were compacted to 95% of the maximum dry density and 1% above the optimum moisture content based upon the results of the Standard Proctor Tests. All tests were performed in general accordance with ASTM standards. Testing results are summarized in Table 3, and laboratory test reports are provided in Appendix D.

In July 1999, five test pits were excavated on the south side of the landfill site in a potential liner borrow area. Clay soils were encountered at depths ranging from 1 to 6 feet below ground surface. Logs of the test pits are provided in Appendix A. Two bulk samples, TP-1 and TP-2, were collected for determination of Atterberg limits, and one sample, TP-1, was tested to determine its moisture-density relationship, Modified Proctor, and hydraulic conductivity. At a density of 90% Modified Proctor and 3% above optimum moisture, the hydraulic conductivity was determined as 1.9×10^{-7}. At a density of 95% Modified Proctor and 3% above optimum moisture, the hydraulic conductivity was determined as 9.4×10^{-8}. Test reports are provided in Appendix D.

6.0 SITE GEOLOGY

The site has been described as being underlain by consolidated sediments associated with the Coastal Plain physiographic province. These sediments include sands, clays, silts, limestones, marls, and peats (Blankenship, 1965). These sediments are the result of deposition and erosion over a granitic to volcanic basement rock. The Coastal Plain sediments were deposited in a wedge-shaped cross-section that thickens from west to east. The basement rock in the site study area is generally at a depth of about 1000 feet below ground surface.

6.1 LITHOLOGY

This exploration program for the proposed landfill site area confirmed that the site lithology consists mainly of clayey sand and sandy clay. Fine- to coarse-grained, unconsolidated sands are found at the surface and are underlain by plastic sandy clays. Auger refusal was not encountered in any of the borings, with the deepest boring penetrating to a depth of 50 feet below ground surface. A detailed discussion of soil conditions encountered during this investigation is presented in the following sections. Figure 6 shows the aerial coverage of the cross sections, which depict sectional view of the site geology.

6.2 SOIL

The surficial soil encountered at the site is consistent throughout the property. This soil consists of sand ranging in size from fine-grained to coarse-grained and is generally poorly sorted. Some of the borings encountered clay lenses within this sand, but the clay is a minor constituent. When saturated, these sands tend to be flowing. Depending on the location of the boring, the thickness of the surficial sand unit ranges from a few feet in the ravines to over 20 feet in the upland areas between the ravines. The characteristics observed for this sand are consistent with the Waccamaw Formation.

Below the surficial sand, the borings encountered a greenish gray, plastic, compressible clay with minor amounts of sand. This unit was present at a depth of 10 feet in piezometer PZ-4 and 12 feet in piezometer PZ-6, but was generally at a depth of 15 to 25 feet throughout the site. In several of the

piezometers, the top of this layer was described as containing shell fragments. Standard penetration tests (SPTs) in this unit indicated blow counts of about 10 to 20 blows per foot. Four deep piezometer borings were advanced to a depth of 50 feet. All these borings encountered the clay and all the borings were terminated within the clay, so the actual thickness of the unit was not determined. Based on a thickness of at least 30 feet and the other characteristics observed, this unit is consistent with the Pee Dee Formation.

6.3 GEOLOGICAL CROSS SECTIONS

The cross-sections (Figures 7 through 14) conceptually depict the surficial sands and the Pee Dee Formation, which were encountered in the borings at the site. There are seven cross-sections drawn to depict the conditions across the site study area. The elevation and contour of the Pee Dee Formation is depicted in Figure 16.

7.0 SITE HYDROGEOLOGY

7.1 SURFACE WATER HYDROLOGY

The site lies within the Coastal Plain physiographic province which is characterized by flat upland surfaces with steep slopes bordering major drainage pathways and swamps in the lowlands (Stuckey and Steel, 1953; Blankenship, 1965). General site topography ranges from a relatively flat river valley on the north to a flat upland on the south that is incised by streams.

The site is contained within the Cape Fear River watershed. Three unnamed streams drain the site. The stream on the west drains into Livingston Creek, which flows into the Cape Fear River. The streams in the central and eastern portions of the study area drain directly into the Cape Fear River. Surface drainage generally flows east and west to the slopes of the unnamed streams.

One spring was identified during the field reconnaissance. This spring is located on a road cut of the west-facing slope of the central incised stream. The spring location (SH-1) is depicted in Figure 15. While no other springs or seeps were specifically identified, the streams in each of the ravines appear to be perennial. Because the headwaters of each stream are located in the study area with intermittent surface drainage, the baseflow of each stream must be from groundwater seepage into the stream.

7.2 FLOOD PRONE AREAS

Flood-prone areas are found in the flood plain of the Cape Fear River and Livingston Creek. These areas also coincide with the flood plains identified on Figure 4. Because of the topographic relief, no flood-prone areas are anticipated on the upland portions of the site where the proposed landfill is to be located.

7.4 GROUNDWATER HYDROLOGY

Site specific groundwater hydrogeology is interpreted from data collected from the most recent investigation performed at the site in January 1999.

7.4.1 Uppermost Aquifer

The subsurface investigations and hydrologic data suggest that the zone of saturation is consistent throughout the site and generally follows topography. Upon review of the soil logs and the hydrogeologic information, the uppermost aquifer on the site is considered to be unconfined. Materials that comprise the uppermost aquifer at the site predominantly consist of sand in the upper 15 to 20 feet and sandy clay in the Pee Dee Formation.

The vertical hydraulic conductivities of the upper clayey sand as determined from laboratory testing of two undisturbed samples ranged from 8.6E-05 cm/sec at PZ-11S to 3.5E-05 cm/sec at PZ-12D. The sample from P-14S is an alluvial soil. The vertical hydraulic conductivity of the Pee Dee Formation, as determined from laboratory testing of one undisturbed sample from PZ-7, indicated a result of 6.1E-06 cm/sec

Stabilized water levels have been measured at periodic intervals in the recently installed piezometers and the previously installed monitoring wells. A map showing the water level measurements and the groundwater elevation contours based on the February 3 1999, water level measurements and spring head (SH-1) elevations is presented in Figure 15. This date was used because it represented the most comprehensive set of data for the site. Table 2 lists the water level measurements obtained throughout the site study.

Based on the water level measurements, observations can be made regarding the vertical gradient at the site. The vertical gradient in unconfined aquifers is an indicator of the magnitude and direction of flow between upper portion and lower portion of the aquifer. The vertical gradient is calculated from the water levels in the four nested pairs of piezometers at the site and is a function of the difference between the water level elevations in the shallow and deep well in each pair and the difference between the screen depths. A positive value indicates a downward gradient and a negative value indicates an upward gradient. Table 5 presents the seasonal vertical gradient values in nested pairs PZ-4, PZ-7, PZ-11, and PZ-12. The gradients range from –0.00037ft/ft to 0.050698ft/ft. These

R_e = effective radial distance over which the head difference, y, is dissipated (feet)

K = hydraulic conductivity (feet per second)

$In(R_e/r_w$ = dimensionless ratio used to evaluate R_e for various system geometries (see Bouwer and Rice, 1976)

A summary of in-situ permeability test results is presented in Table 4. Calculation sheets and semi-logarithmic plots of time versus recovery are presented in Appendix C.

7.4.2 Groundwater Flow

The groundwater flow pattern is depicted in Figure 15. Horizontal gradients on the uplands of the site range from 0.007 ft/ft to 0.009 ft/ft with a general flow direction to the north and northeast. Local gradients and flow directions near the ravines may be higher. The horizontal gradient between the upland and lowland swampy areas on the north side of the property steepens significantly, as expected, and averages approximately 0.06 ft/ft.

In-situ permeability tests were performed on four piezometers (PZ-3, PZ-7S, PZ-11S, and PZ-11D). A summary of the test results are shown in Table 4. The results indicate hydraulic conductivities in the shallow sands at the site range from 4.53E-03 cm/sec (PZ-11S) to 5.41E-04 cm/sec (PZ-3). These hydraulic conductivities are consistent with published values for silts and sands as encountered in the upper part of the aquifer. Hydraulic conductivity testing for the lower portion of the aquifer, represented by PZ-11D, resulted in 1.92E-06 cm/sec. This conductivity is in the expected range for clay as was encountered in the Pee Dee Formation. Using the observed average hydraulic conductivity and average hydraulic gradients for the upper aquifer, groundwater flow velocity can be estimated using the Darcy equation:

$$\bar{v} = Ki/N$$

where:

$\bar{v}$ = average groundwater flow velocity

gradients suggest a slight downward gradient in nested pairs PZ-4 and PZ-7, and a slight upward gradient in nested pairs PZ-11 and PZ-12, but for practical purposes they indicate relative equilibrium.

Hydrogeologic cross sections are presented in Figures 7 through 14. The cross sections show the water table within the soil unit. Based on the cross-sections and the elevation contour map, the overall groundwater flow direction is from south to north with local variations influenced by the incised streams.

In-situ hydraulic testing was conducted on four of the piezometers installed. Three shallow piezometers (PZ-3, PZ-7S, and PZ-11S) and one deep piezometer (PZ-11D) were tested using rising head tests. Rising head tests were conducted by pumping the piezometer to lower the water level and then measuring the rate of recharge.

The data was recorded and used to generate semi-logarithmic plots of recovery versus time. Hydraulic conductivity valued were calculated using the following equation (Bouwer and Rice, 1976; Bouwer 1989):

$$K = \frac{(r'_c)^2 \ln (R_e/r_w)}{2L_e} x \frac{1}{t} x \ln (y_o/y_t)$$

r'_c = radius of inside piezometer casing (corrected for unsaturated gravel pack response as shown in Bouwer, 1989) (feet)

r_w = radial distance between piezometer center and undisturbed aquifer (r_c plus thickness of gravel envelope or developed zone outside casing, plus casing thickness (feet)

L_e = effective length of perforated, screened, uncased, or otherwise open section of piezometer through which groundwater actually enters (feet)

y_o = hydraulic head at time zero (feet)

y_t = hydraulic head at time t

t = time difference associated with y_o and y_t

K = average hydraulic conductivity (1.85E-03 cm/sec)

I = average hydraulic gradient (0.008)

N = effective porosity (~ 0.3 sand)

Using an average gradient on the site uplands and the average hydraulic conductivity for the upper aquifer sands, the groundwater flow velocity is estimated to be 0.14 ft per day (51 ft per year.

7.4.3 Seasonal High Potentiometric Surface

The seasonal high potentiometer surface is best estimated from water level measurements over time at a given site. Groundwater elevations in many of the piezometers and monitoring wells have been measured in January, February, May, July, and December 1999. As noted previously in this report, the wettest months are June through August, which generally represents the time period when the seasonal high potentiometric surface will occur. A review of the groundwater elevations shown in Table 2 indicates that the elevations in February and July are essentially the same. However, the elevations observed in May 1999 are higher than either February or July. The December data had the highest elevations, after the limited October data, but the December elevations may be due to the effects of Hurricane Floyd. The groundwater elevation contours for February 1999 are shown on Figure 15. The May elevations are approximately 1.5 to 2 feet higher then the groundwater elevation contours shown on Figure 15, and the December 1999 elevations are 0.5 feet higher than the May elevations, but the May data likely best represents the seasonal high water table for the site.

8.0 CONCLUSIONS

The following conclusions have been derived from this investigation.

1. The site lies within the Coastal Plain physiographic province of North Carolina.

2. The site soils are predominantly sand in the upper 15 to 20 feet below ground surface and clay to sandy clay underlying the sand.

3. No bedrock or significant structures are located within a 500-foot depth below ground surface.

4. The groundwater flow pattern indicates that the groundwater flow direction on the study area is from the south to north or northeast. The average flow velocity in the upland areas of the site where the proposed landfill will likely be located is about 51 feet per year.

5. The results of the study indicate that the site is suitable for use as a sanitary landfill.

6. The seasonal high water table is estimated to be no more than 1.5 to 2 feet higher than the groundwater elevation contours shown on Figure 15.

9.0 RECOMMENDATIONS

It is proposed to develop the first phases of the landfill on the southeastern portion of the site area. To support development of that section of the site, the following additional characterization is recommended:

1. Install a deep and shallow piezometer in the vicinity of existing monitoring well MW-1 to determine the top of the PeeDee Formation for the design of future landfill monitoring well, and to determine vertical gradients.

2. Install a shallow piezometer between existing monitoring wells MW-1 and MW-2 where the first landfill phase is planned to provide data on depth to ground water, and to determine final base grades for detailed landfill design.

3. Install a shallow piezometer at the southeast property line to characterize groundwater movement to the east of the site.

4. Continue to collect groundwater elevations from site piezometers and monitoring wells.

REFERENCES

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Tables

TABLE 1
PIEZOMETER CONSTRUCTION SUMMARY
PROPOSED INTERNATIONAL PAPER LANDFILL
RIEGELWOOD, NORTH CAROLINA
EARTH TECH PROJECT NO. 33004

PIEZOMETER	TOTAL DEPTH (feet bgs)	SCREEN DEPTH (feet bgs)	CONSTRUCTION MATERIAL AND SIZE	TOP OF CASING ELEVATION
PZ-1	15	10 – 15	2" ID PVC	51.06
PZ-2	18	13 – 18	2" ID PVC	50.19
PZ-3	10	5 – 10	2" ID PVC	40.51
PZ-4S	14	9 – 14	2" ID PVC	42.37
PZ-4D	50	45 – 50	2" ID PVC	42.72
PZ-5	18	13 – 18	2" ID PVC	43.42
PZ-6	15	10 – 15	2" ID PVC	44.67
PZ-7S	13.5	8.5 – 13.5	2" ID PVC	41.34
PZ-7D	50	45 – 50	2" ID PVC	42.41
PZ-8	13	8 – 13	2" ID PVC	47.03
PZ-9	13	8 – 13	2" ID PVC	50.13
PZ-10	18	13 – 18	2" ID PVC	54.56
PZ-11S	13.5	8.5 – 13.5	2" ID PVC	50.92
PZ-11D	49	44 – 49	2" ID PVC	51.27
PZ-12S	18	13 – 18	2" ID PVC	54.17
PZ-12D	50	45 – 50	2" ID PVC	55.4
PZ-13	5	3 – 5	2" ID PVC	13.34
PZ-14	5	3 – 5	2" ID PVC	7.47
PZ-15	5	3 – 5	2" ID PVC	7.06
PZ-16	5	3 – 5	2" ID PVC	7.78

bgs = below ground surface
All elevations are surveyed above mean sea level.
PZ-13 – PZ-16 installed in flood plain with hand auger.

TABLE 2
GROUNDWATER MEASUREMENTS AND ELEVATIONS
PROPOSED INTERNATIONAL PAPER LANDFILL
RIEGELWOOD, NORTH CAROLINA

WELL ID	ELEV. (TOC)	ELEV. (GS)	DEPTH TO BOTTOM (TOC)	1/5-12/99 DEPTH TO WATER	1/5-12/99 GW ELEV. (msl)	1/13/99 DEPTH TO WATER	1/13/99 GW ELEV. (msl)	1/20/99 DEPTH TO WATER	1/20/99 GW ELEV. (msl)	2/3/99 DEPTH TO WATER	2/3/99 GW ELEV. (msl)	5/21/99 DEPTH TO WATER	5/21/99 GW ELEV. (msl)	7/1/99 DEPTH TO WATER	7/1/99 GW ELEV. (msl)	10/4/99 DEPTH TO WATER	10/4/99 GW ELEV. (msl)	12/3/99 GW ELEV. WATER	12/3/99 GW ELEV. (msl)
PZ-1	51.06	48.25	18.52	13.00	38.06	>18.52	NA	>18.52	NA	17.37	33.69	16.84	34.22	17.61	33.45	14.28	36.78	16.36	34.70
PZ-2	50.19	47.92	21.10	16.00	34.19	>21.10	NA	>21.10	NA	19.91	30.28	19.42	30.77	20.64	29.55	17.60	32.59	18.88	31.31
PZ-3	40.51	38.49	12.58	4.00	36.51	5.42	35.09	5.02	35.49	3.96	36.55	3.74	36.77	3.93	36.58	NA		3.45	37.06
PZ-4S	42.37	40.50	16.09	9.50	32.87	9.12	33.25	8.46	33.91	7.84	34.53	7.63	34.74	8.54	33.83	6.54	35.83	7.34	35.03
PZ-4D	42.72	40.47	52.02	6.00	36.72	9.72	33.00	9.75	32.97	8.52	34.20	8.22	34.50	8.96	33.76	7.04	35.68	7.96	34.76
PZ-5	43.42	40.73	21.46	9.00	34.42	9.41	34.01	10.50	32.92	9.73	33.69	9.26	34.16	10.39	33.03	NA	NA	8.89	34.53
PZ-6	44.67	41.90	18.25	9.00	35.67	13.52	31.15	13.42	31.25	12.84	31.83	12.55	32.12	13.42	31.25	NA	NA	12.05	32.62
PZ-7S	41.34	40.12	15.18	9.00	32.34	7.77	33.57	7.68	33.66	7.19	34.15	6.70	34.64	7.14	34.20	NA	NA	6.32	35.02
PZ-7D	42.41	40.20	52.00	11.00	31.41	9.17	33.24	12.12	30.29	13.77	28.64	8.86	33.55	8.88	33.53	NA	NA	8.46	33.95
PZ-8	47.03	45.62	15.20	9.00	38.03	11.62	35.41	11.49	35.54	10.76	36.27	10.14	36.89	11.06	35.97	NA	NA	9.78	37.25
PZ-9	50.13	47.41	17.07	9.00	41.13	11.22	38.91	10.89	39.24	9.80	40.33	8.53	41.60	NA	NA	NA	NA	8.23	41.90
PZ-10	54.56	52.45	21.10	16.00	38.56	18.44	36.12	17.07	37.49	16.09	38.47	15.23	39.33	16.34	38.22	NA	NA	15.74	38.82
PZ-11S	50.92	49.18	16.24	11.00	39.92	12.92	38.00	11.13	39.79	9.93	40.99	8.40	42.52	9.83	41.09	NA	NA	7.96	42.96
PZ-11D	51.27	49.30	51.14	11.00	40.27	30.02	21.25	11.90	39.37	10.33	40.94	8.78	42.49	10.09	41.18	NA	NA	8.32	42.95
PZ-12S	54.17	52.70	20.06	13.00	41.17	13.18	40.99	13.46	40.71	12.34	41.83	11.26	42.91	12.52	41.65	NA	NA	10.88	43.29
PZ-12D	55.40	52.74	52.54	13.00	42.40	18.20	37.20	15.70	39.70	13.77	41.63	12.43	42.97	13.68	41.72	NA	NA	12.10	43.30
PZ-13	13.34	11.91	NA	0.50	12.84	0.31	13.03	0.27	13.07	1.52	11.82	NA	NA	NA	NA	NA	NA	NA	NA
PZ-14	7.47	5.88	NA	0.50	6.97	1.44	6.03	1.94	5.53	0.75	6.72	NA	NA	NA	NA	NA	NA	NA	NA
PZ-15	7.06	5.84	NA	0.50	6.56	1.21	5.85	1.16	5.90	0.00	7.06	NA	NA	NA	NA	NA	NA	NA	NA
PZ-16	7.78	6.19	NA	0.50	7.28	1.63	6.15	1.61	6.17	0.50	7.28	NA	NA	NA	NA	NA	NA	NA	NA
MW-1	56.51	54.57	NA	NA	NA	NA	NA	NA	NA	14.03	42.48	12.55	43.96	NA	NA	6.90	49.61	12.07	44.44
MW-2	48.75	46.00	NA	NA	NA	NA	NA	NA	NA	9.38	39.37	8.49	40.26	NA	NA	6.02	42.73	8.10	40.65
MW-3	48.02	46.15	18.75	NA	NA	NA	NA	NA	NA	7.50	40.52	NA	NA	NA	NA	NA	NA	7.12	40.90
MW-5	58.45	57.05	26.00	NA	NA	NA	NA	NA	NA	16.92	41.53	19.63	38.82	NA	NA	NA	NA	19.22	39.23
MW-6	55.14	53.23	27.45	NA	NA	NA	NA	NA	NA	20.39	34.75	NA	NA	NA	NA	NA	NA	19.89	35.25
PZ-100	55.37	53.06	25.50	NA	NA	NA	NA	NA	NA	12.50	42.87	10.84	44.53	NA	NA	4.80	20.70	10.31	45.06

NOTES: Groundwater meaurements for PZ-14, PZ-15, and PZ-16 are estimated.
NA Not Measured
1/5-12/99 data are the initial installation water levels.
1/13/99 data are 24-hour measurements.
1/20/99 data are the 7-day measuurements.
10/4/99 data obtained 2 weeks after Hurricane Floyd - Historic high data.

TABLE 3

GEOTECHNICAL TESTING RESULTS
PROPOSED INTERNATIONAL PAPER LANDFILL
RIEGELWOOD, NORTH CAROLINA
EARTH TECH PROJECT NO. 3300

TEST	Test Pit (TP-1)	PZ-11D (BULK)	PZ-12S (BULK)	PZ-12D (BULK)	PZ-11S (ST)	PZ-12D (ST)	PZ-7S(ST)
USCS Classification	CH	SM-SC	SC	SC	SC	SC	SC
Liquid Limit	57	28	30	24	43	46	28
Plasticity Index	33	4	15	9	17	18	8
Moisture Content (%)	25.1	24.7	14.4	15.6	16.6	17.2	26.2
Specific Gravity	2.72	NA	2.674	2.681	2.767	2.708	2.693
Hydraulic Conductivity (cm/sec)	1.9E-07-90.5% 9.4E-08-95.4%	NA	1.1E-04	1.2E-04	8.6E-05	3.5E-05	6.1E-06
Porosity (%)	NA	NA	38.8	29.7	36	36.6	39.6
Depth (ft)	3-5	23 – 41	3 - 5	2.5 – 4.5	3 - 5	2.5 – 4.5	14 – 16

ST - Shelby Tube (undisturbed) Samples

Bulk - Disturbed Samples

Note: PZ-11D (Bulk) Sample from PeeDee formation

TABLE 4

IN-SITU HYDRAULIC CONDUCTIVITY
PROPOSED INTERNATIONAL PAPER LANDFILL
RIEGELWOOD, NORTH CAROLINA
EARTH TECH PROJECT NO. 3300

PIEZOMETER	K (CM/SEC)	K (FT/SEC)
PZ-3	5.41E-04	1.78E-05
PZ-11S	4.53E-03	1.49E-04
PZ-11D	1.92E-06	6.30E-08
PZ-7S	4.72E-04	1.55E-05

Calculations and data are presented in Appendix C.

Figures

LEGEND

Potential Groundwater Contamination Sources

1. Abandoned Gas Station
2. Filters and Hydraulics, Inc (ASTs)
3. Texaco Station
4. Acme Agricultural Services (Kaiser Acme Farmmarket)
5. Brunswick Co. (Solid Waste - Closed)

Confirmed Groundwater Contamination Sources

1. BP Station, also known as Handy Hugo, was Exxon Station (LUST)
2. Wright Chemical Corp.
3. IP/Federal Paper

Significant Groundwater User

1. Cape Fear Christian School

Significant Surface Water User

2. International Paper

Subdivisions

1. Riegelwood Subdivision
2. Livingston Hill Subdivision
3. Pineland Acres Subdivision
4. North Woods Subdivision
5. Ravenscroft Subdivision
6. Foxwood Acres Subdivision

N

0 1/2 1 Mile

SCALE

	DRN	CHK	DATE
REVISIONS			
NO			

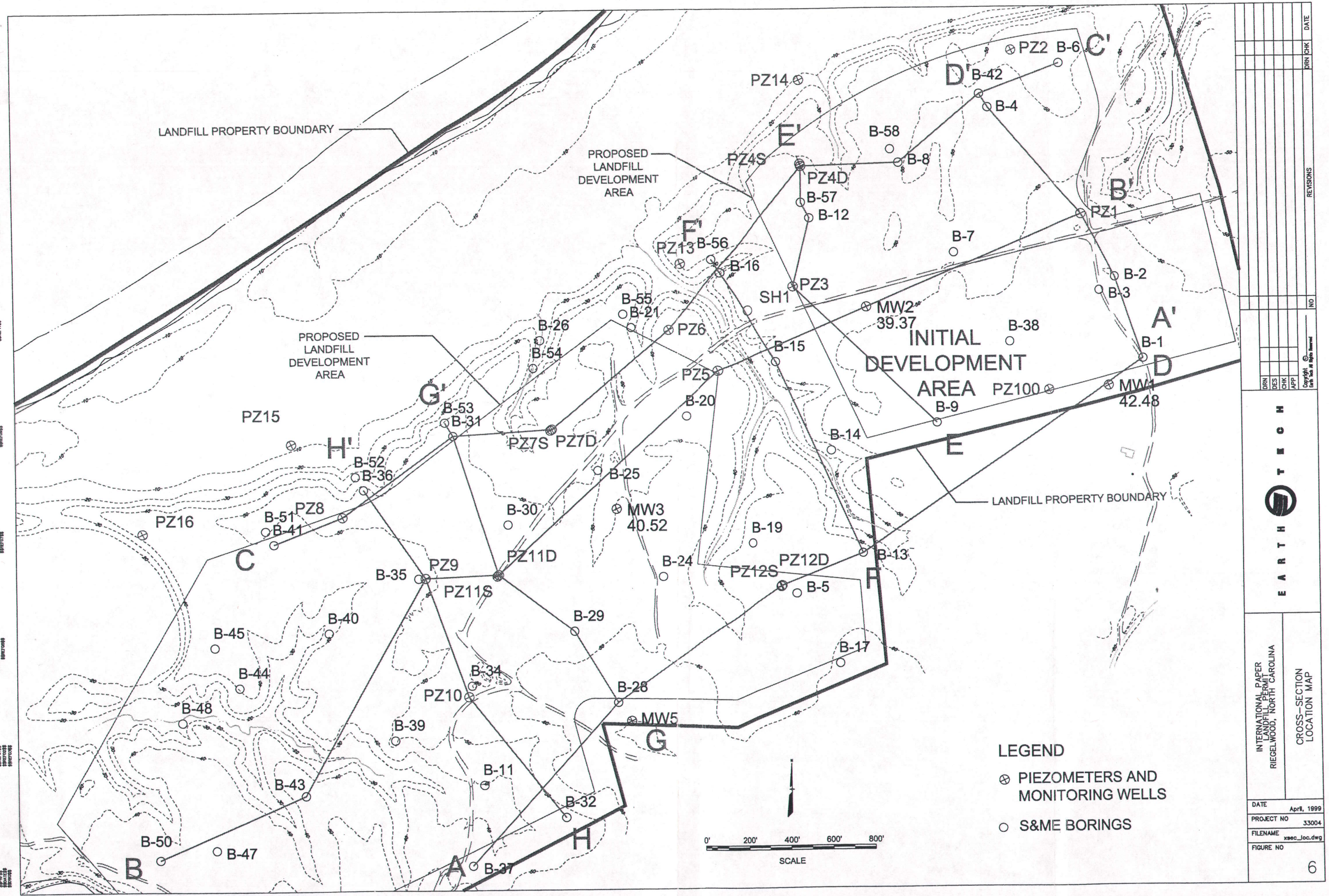
DRN KJS 1/'99
DES
CHK
APP

EARTH TECH

INTERNATIONAL PAPER
LANDFILL PERMIT
RIEGELWOOD, NORTH CAROLINA

VICINITY MAP

DATE	April, 1999
PROJECT NO	33004
FILENAME	usgs01.dwg
FIGURE NO	1


LANDFILL PROPERTY BOUNDARY
PROPOSED LANDFILL DEVELOPMENT AREA
PROPOSED LANDFILL DEVELOPMENT AREA
INITIAL DEVELOPMENT AREA
LANDFILL PROPERTY BOUNDARY
A
A'
B
B'
C
C'
D
D'
E
E'
F
F'
G
G'
H
H'
PZ1
PZ2
PZ3
PZ4S
PZ4D
PZ5
PZ6
PZ7S
PZ7D
PZ8
PZ9
PZ10
PZ11S
PZ11D
PZ12S
PZ12D
PZ13
PZ14
PZ15
PZ16
PZ100
MW1 42.48
MW2 39.37
MW3 40.52
MW5
SH1
B-1
B-2
B-3
B-4
B-5
B-6
B-7
B-8
B-9
B-11
B-12
B-13
B-14
B-15
B-16
B-17
B-19
B-20
B-21
B-24
B-25
B-26
B-28
B-29
B-30
B-31
B-32
B-34
B-35
B-36
B-37
B-38
B-39
B-40
B-41
B-42
B-43
B-44
B-45
B-47
B-48
B-50
B-51
B-52
B-53
B-54
B-55
B-56
B-57
B-58
0' 200' 400' 600' 800'
SCALE
LEGEND
PIEZOMETERS AND MONITORING WELLS
S&ME BORINGS
DRN DES CHK APP
DRN CHK DATE
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INTERNATIONAL PAPER
LANDFILL PERMIT
RIEGELWOOD, NORTH CAROLINA
CROSS-SECTION LOCATION MAP
DATE April, 1999
PROJECT NO 33004
FILENAME xsec_loc.dwg
FIGURE NO 6

LANDFILL PROPERTY BOUNDARY

PROPOSED LANDFILL DEVELOPMENT AREA

PROPOSED LANDFILL DEVELOPMENT AREA

INITIAL DEVELOPMENT AREA

PZ14 PZ2 B-6 B-42 B-4 B-58 B-8 PZ4S PZ4D B-57 B-12 PZ1 B-7 PZ13 B-56 B-16 SH1 PZ3 B-2 B-3 B-55 B-21 MW2 39.37 B-26 B-54 PZ6 B-15 B-38 B-1 PZ5 B-20 PZ100 MW1 42.48 B-9 B-53 B-31 PZ15 PZ7S PZ7D B-14 B-52 B-36 B-25 PZ8 B-51 B-41 PZ16 B-30 MW3 40.52 B-19 B-13 B-35 PZ9 PZ11D B-24 PZ12S PZ12D B-5 PZ11S B-40 B-29 B-45 B-17 B-44 B-34 B-28 PZ10 B-48 MW5 B-39 B-11 B-43 B-32 B-50 B-47 B-37

LANDFILL PROPERTY BOUNDARY

0' 200' 400' 600' 800'
SCALE

LEGEND

⊛ PIEZOMETERS AND MONITORING WELLS

○ S&ME BORINGS

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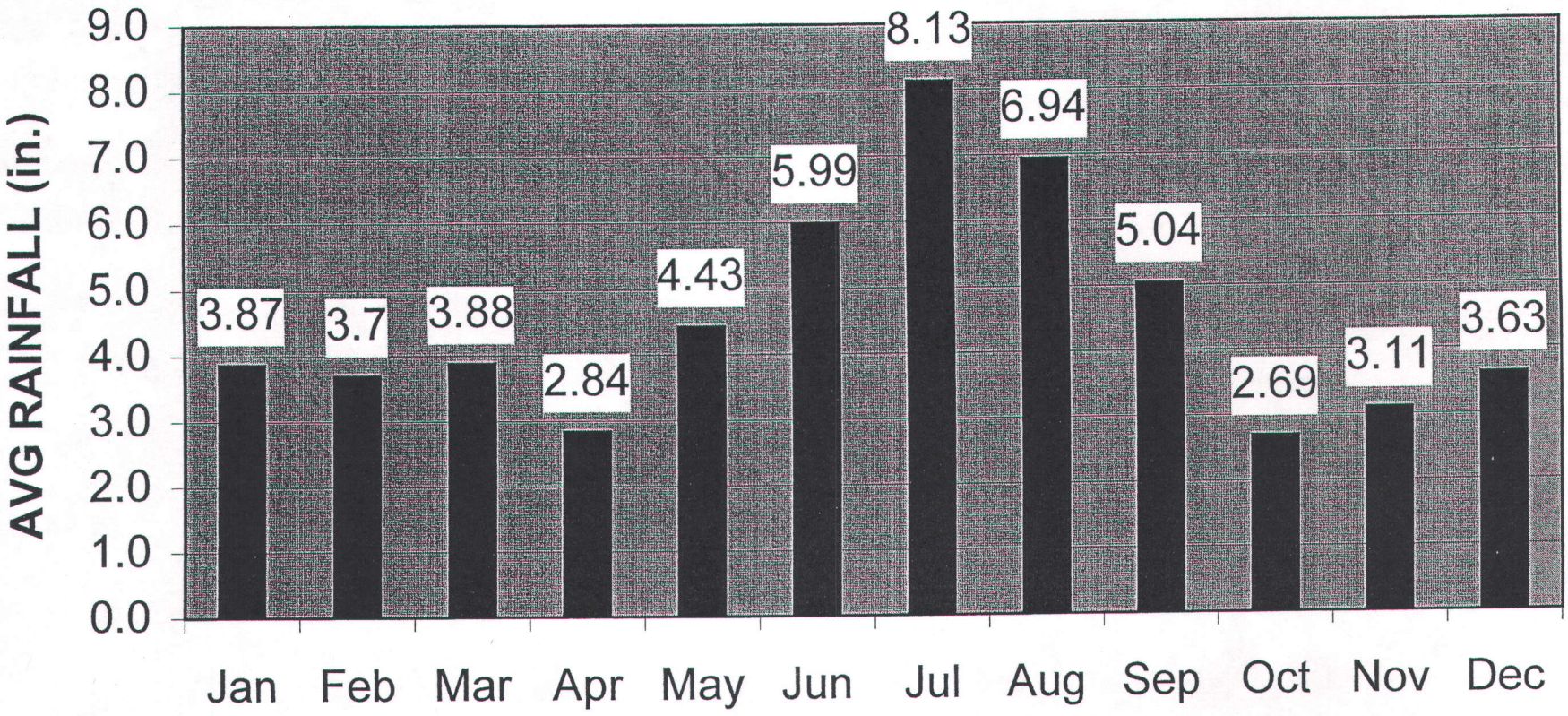
RIEGELWOOD, NORTH CAROLINA

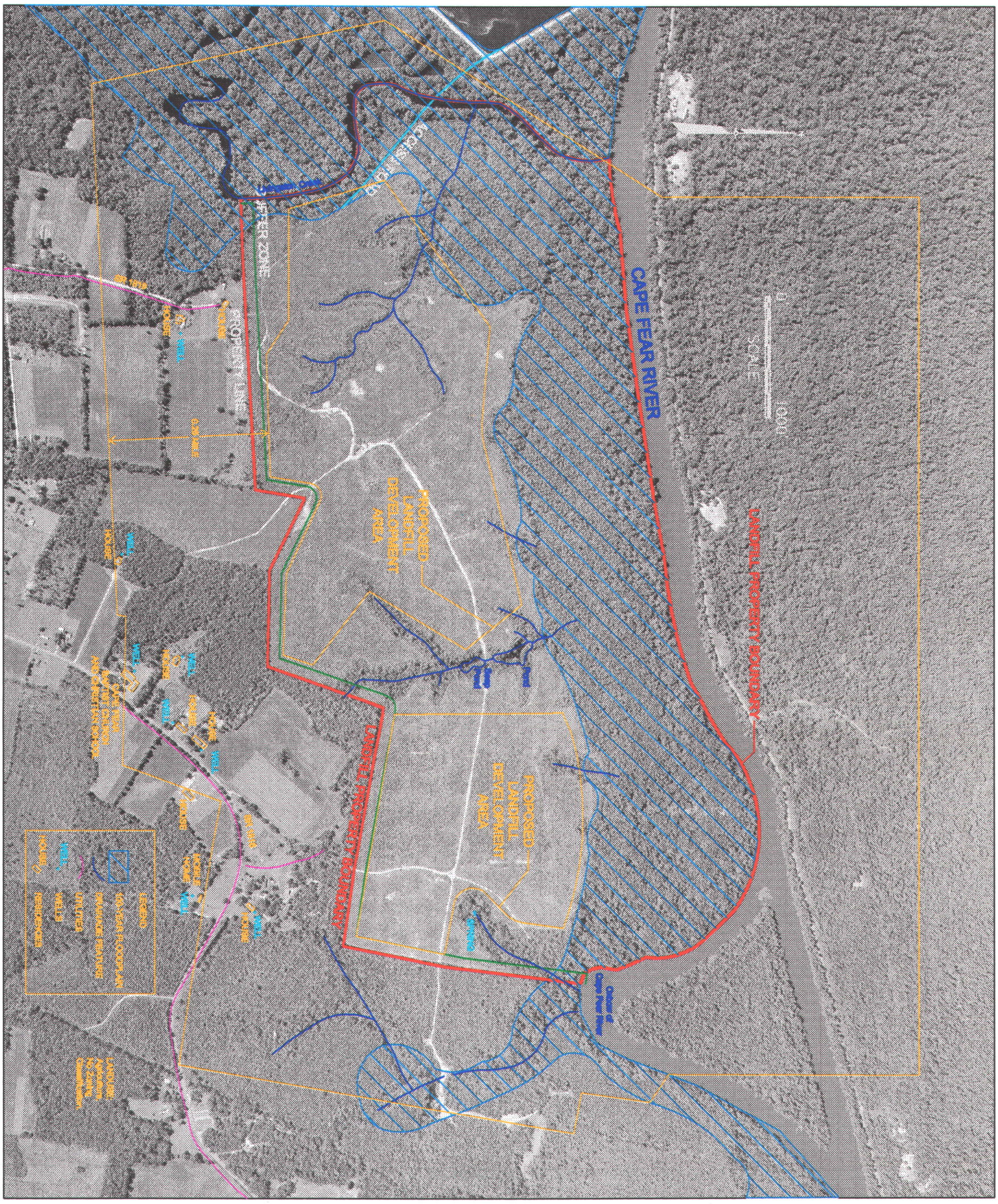
PIEZOMETER, BORING AND MONITOR WELL LOCATIONS

DATE April, 1999
PROJECT NO 33004
FILENAME pz_b_loc.dwg
FIGURE NO 5

30 YEAR (1961 - 1990) AVERAGE MONTHLY RAINFALL



30-YEAR AVERAGE MONTHLY RAINFALL
WILMINGTON, NORTH CAROLINA
FIGURE 3



INTERNATIONAL PAPER
LANDFILL PERMIT
RIEGELWOOD, NORTH CAROLINA

OFF-SITE WELL LOCATIONS

EARTH TECH

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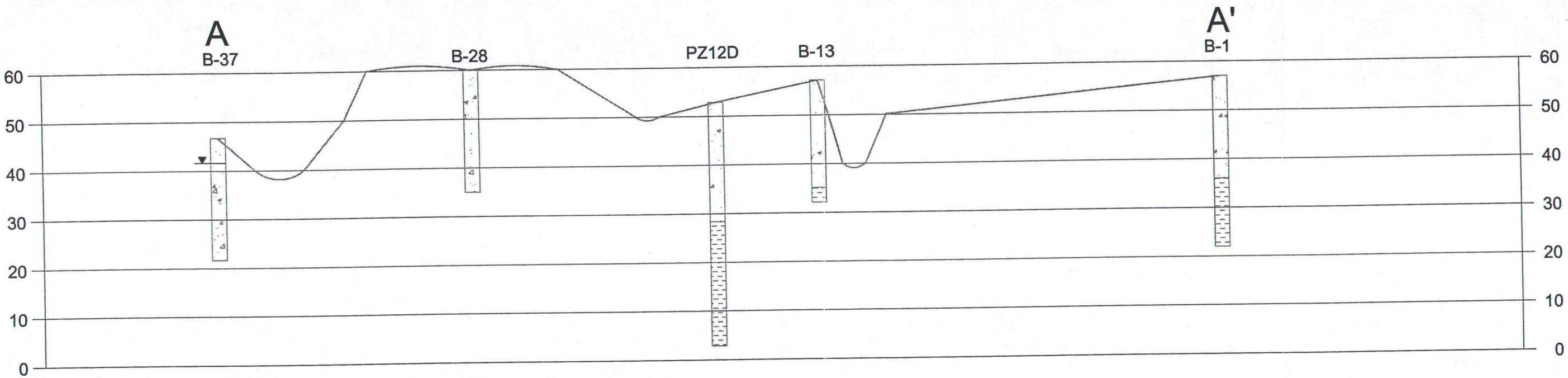
DES			
CHK			
APP			

NO	REVISIONS	DRN	CHK	DATE

DATE April, 1999
PROJECT NO 33004
FILENAME well_oer.dwg
FIGURE NO 4



LEGEND

SAND AND SILT

CLAY TO SANDY CLAY

REVISIONS			
NO		DRN	CHK	DATE

OFFNAME
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DES
CHK
APP

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LANDFILL PERMIT
RIEGELWOOD, NORTH CAROLINA

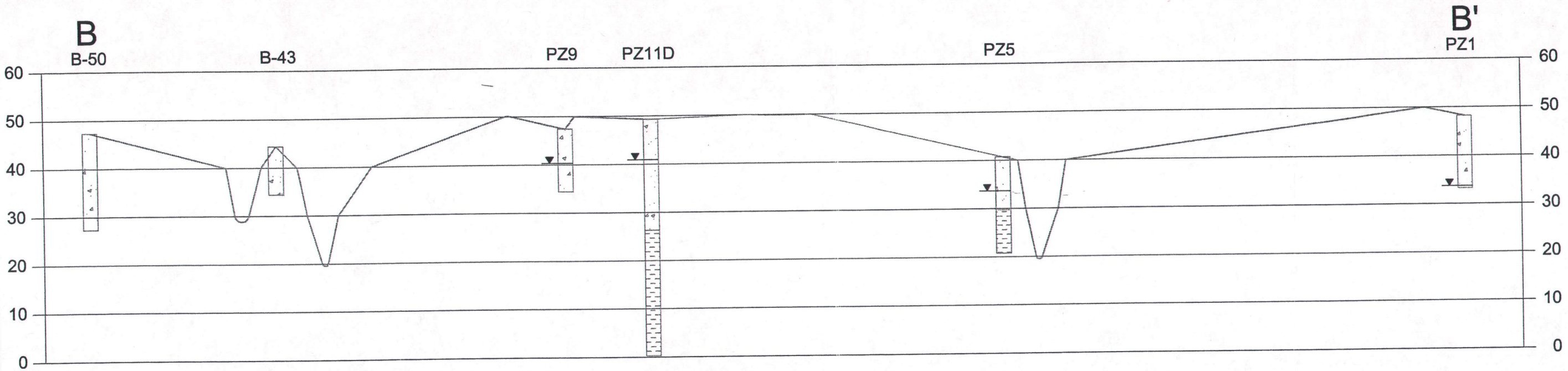
CROSS-SECTION A-A'

DATE April, 1999

PROJECT NO 33004

FILENAME xsec_a.dwg

FIGURE NO 7



LEGEND

SAND AND SILT

CLAY TO SANDY CLAY

NO	REVISIONS	DRN	CHK	DATE

OFFNAME
OFFPHONE

DRN
DES
CHK
APP

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RIEGELWOOD, NORTH CAROLINA

CROSS-SECTION B-B'

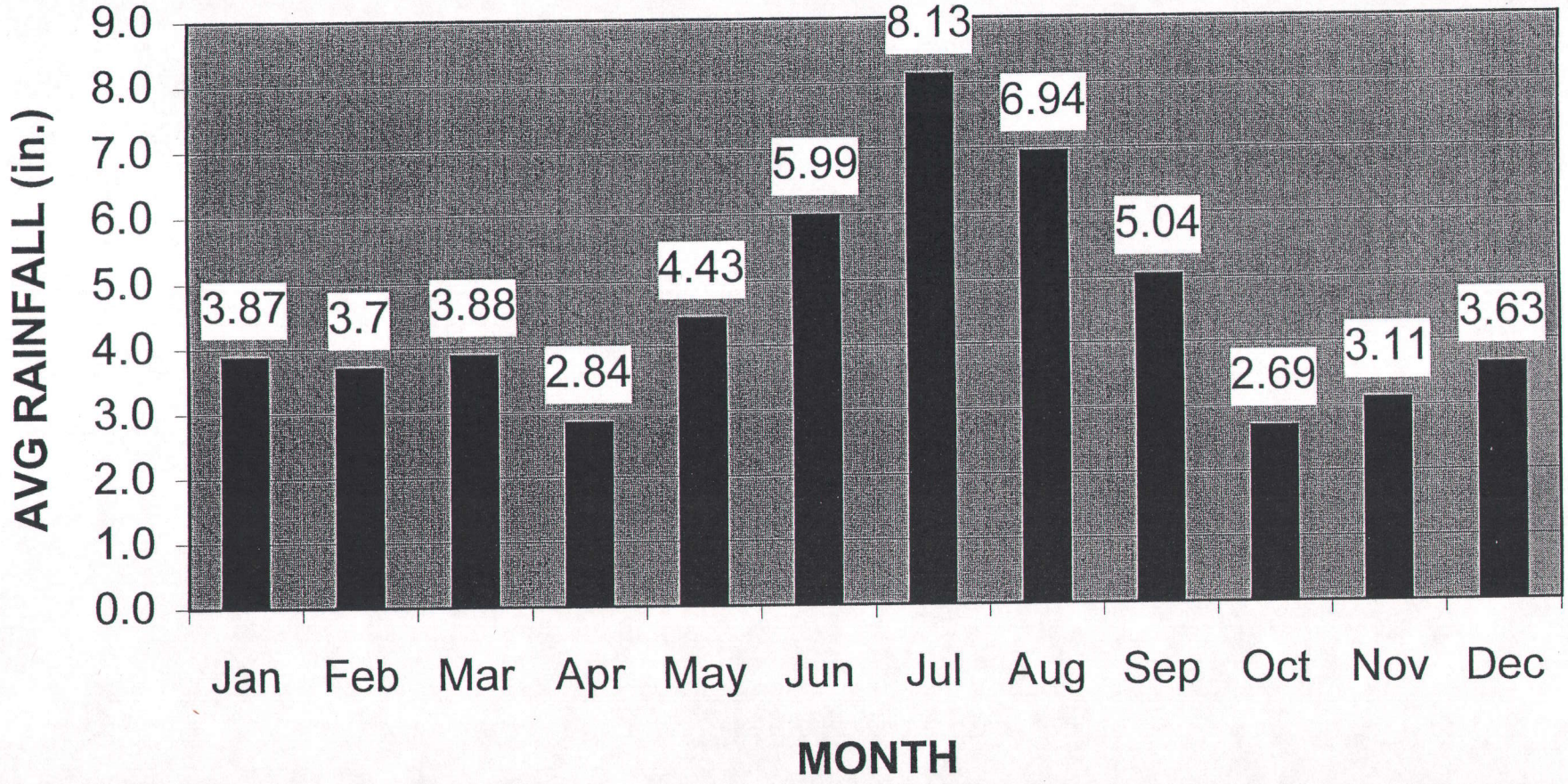
DATE April, 1999

PROJECT NO 33004

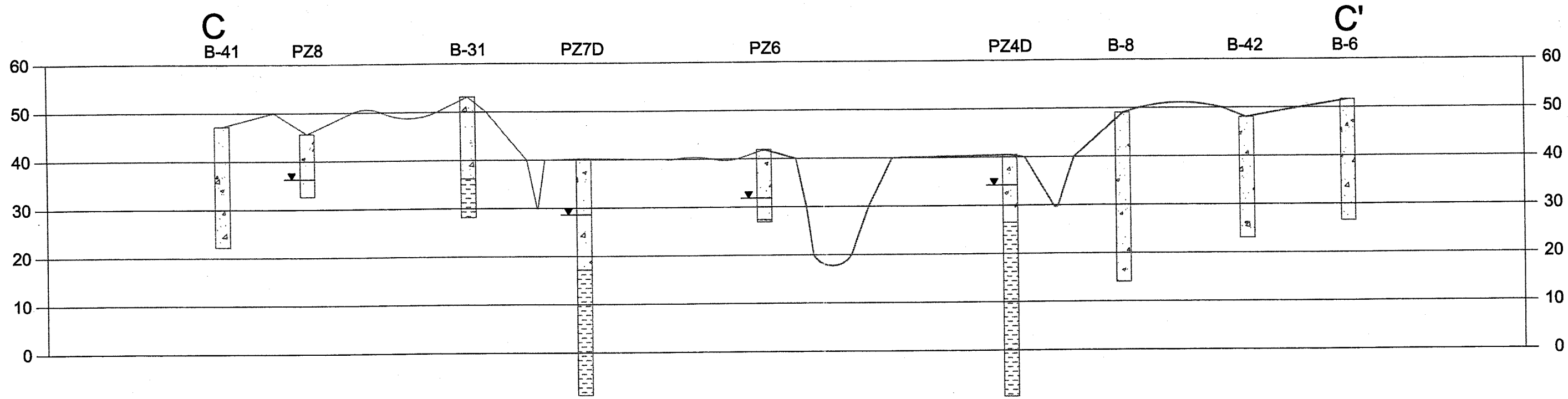
FILENAME xsec_b.dwg

FIGURE NO 8

30 YEAR (1961 - 1990) AVERAGE MONTHLY RAINFALL



30-YEAR AVERAGE MONTHLY RAINFALL
WILMINGTON, NORTH CAROLINA
FIGURE 3



LEGEND

SAND AND SILT

CLAY TO SANDY CLAY

NO	REVISIONS	DRN	CHK	DATE

OFFNAME
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DES
CHK
APP

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RIEGELWOOD, NORTH CAROLINA

CROSS-SECTION C-C'

DATE April, 1999

PROJECT NO 33004

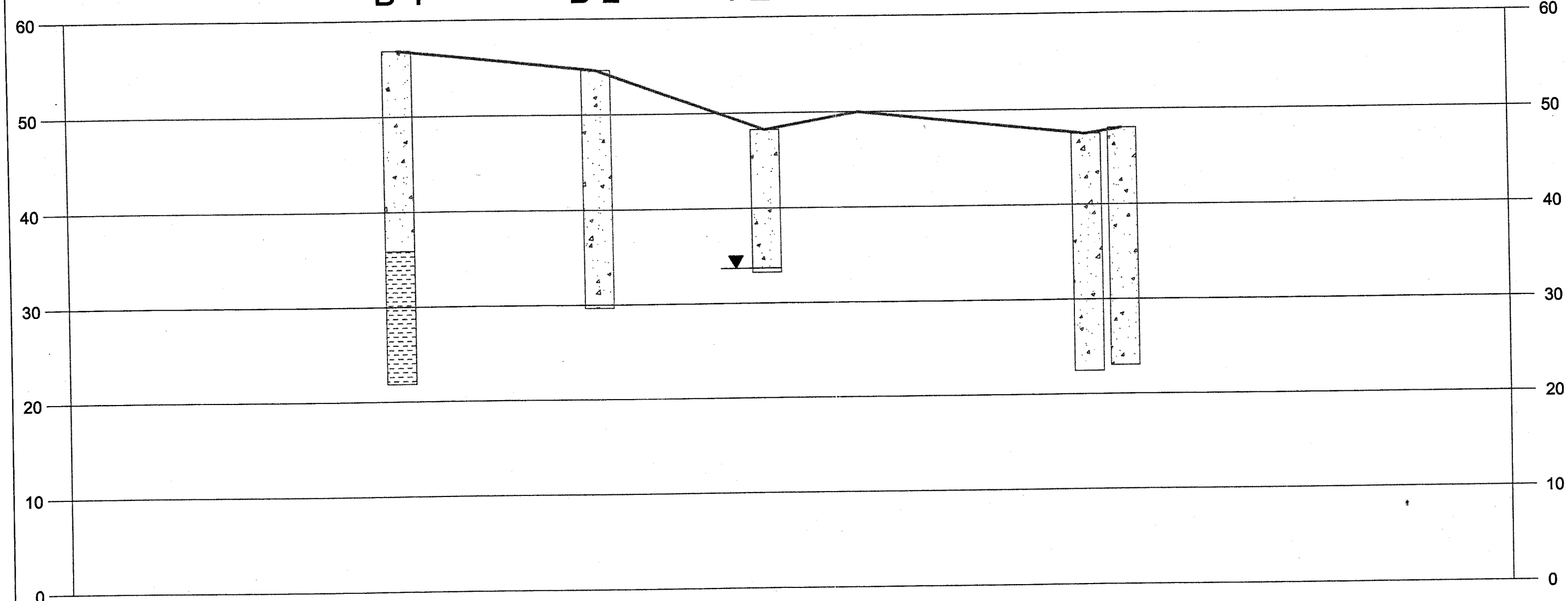
FILENAME xsec_c.dwg

FIGURE NO 9

D

D'

B-1 B-2 PZ1 B-4 B-42



LEGEND

SAND AND SILT

CLAY TO SANDY CLAY

NO	REVISIONS	DRN	CHK	DATE

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CROSS-SECTION D-D'

DATE April, 1999

PROJECT NO 33004

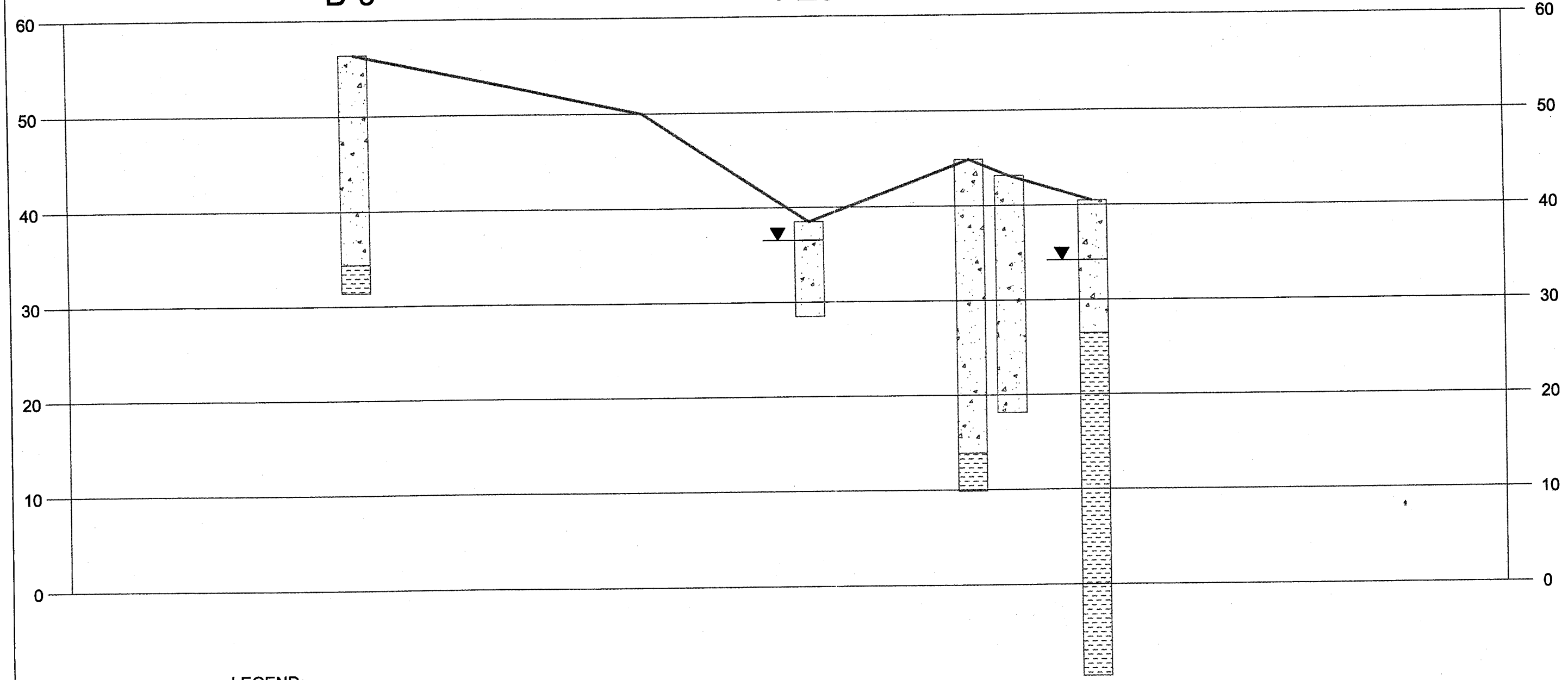
FILENAME xsec_d.dwg

FIGURE NO 10

E

E'

B-9 PZ3 B-12 B-57 PZ4D



LEGEND

SAND AND SILT

CLAY TO SANDY CLAY

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RIEGELWOOD, NORTH CAROLINA

CROSS-SECTION E-E'

DATE April, 1999

PROJECT NO 33004

FILENAME xsec_e.dwg

FIGURE NO 11

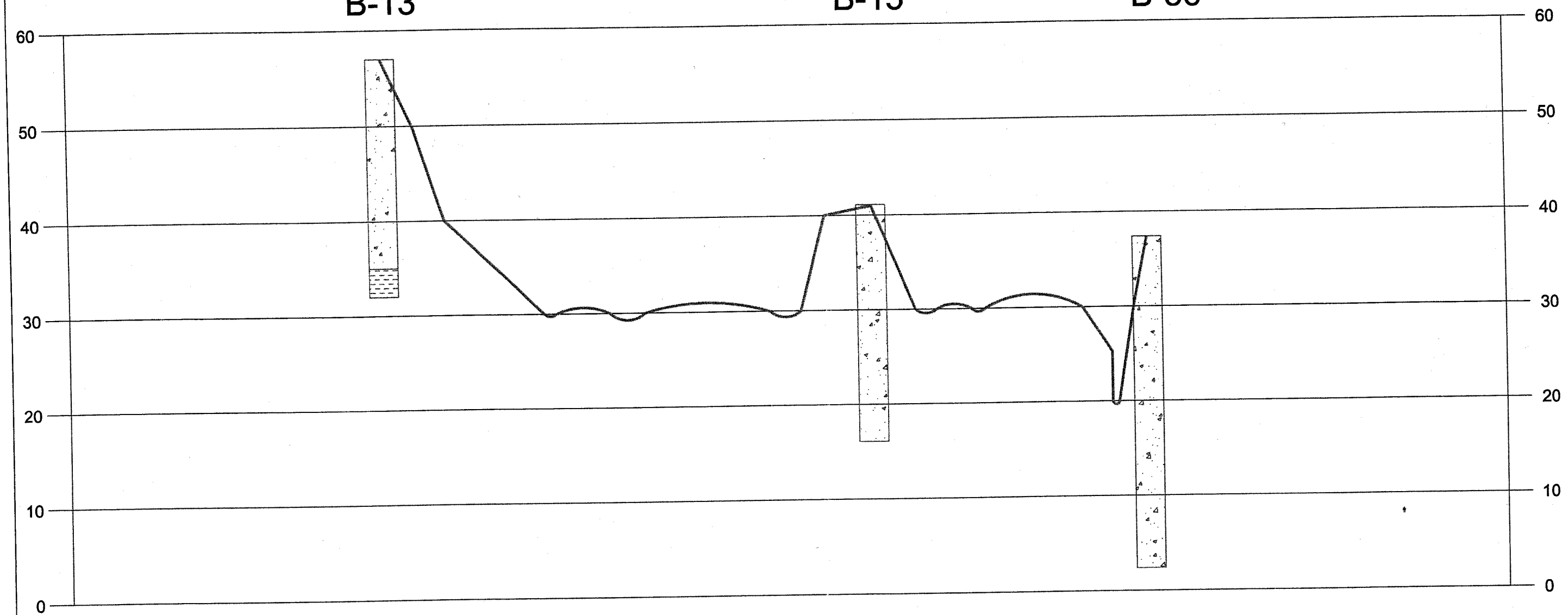
F

F'

B-13

B-15

B-56



LEGEND

SAND AND SILT

CLAY TO SANDY CLAY

								NO	REVISIONS	DRN	CHK	DATE
OFFNAME OFFBASE	DRN											
	DES											
	CHK											
	APP											

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RIEGELWOOD, NORTH CAROLINA

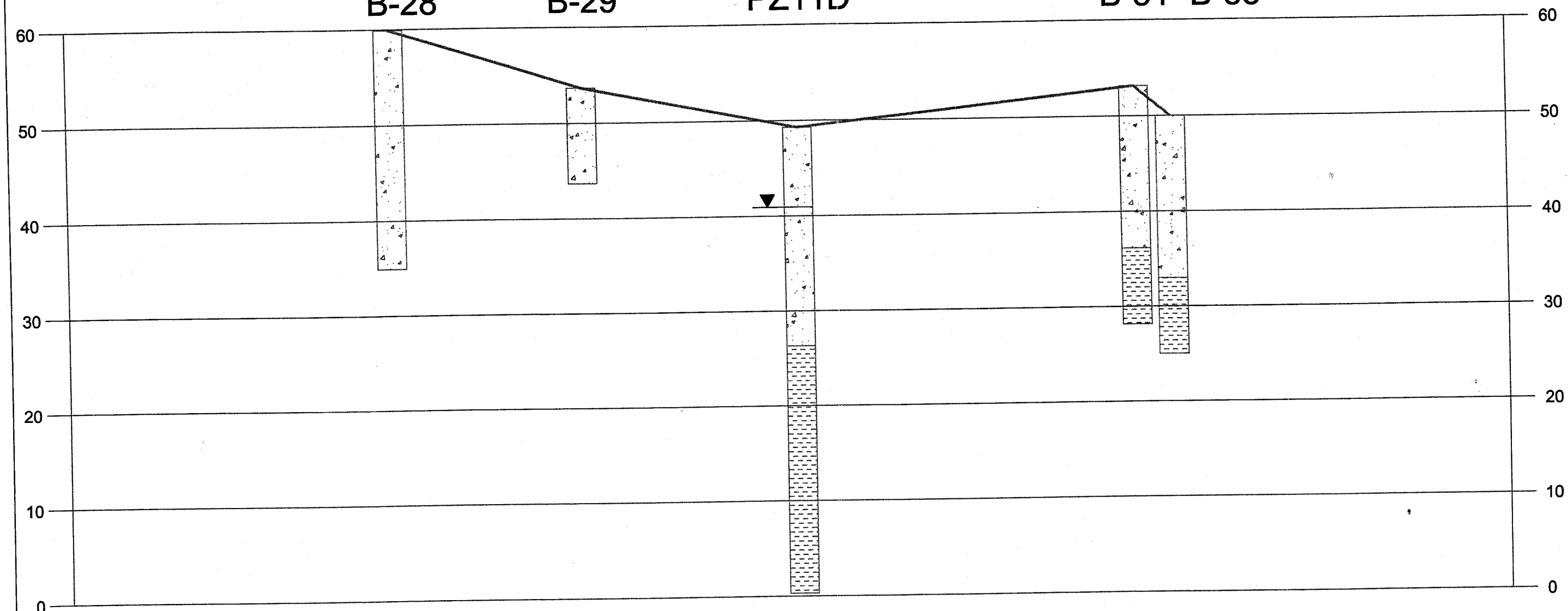
CROSS-SECTION F-F'

DATE April, 199

PROJECT NO 3300

FILENAME xsec_f.dw

FIGURE NO 12



LEGEND

SAND AND SILT

CLAY TO SANDY CLAY

				NO	REVISIONS
				DRN	CHK
					DATE

OFFNAME
OFFADDR
OFFPHONE

DRN
DES
CHK
APP

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INTERNATIONAL PAPER
LANDFILL PERMIT
RIEGELWOOD, NORTH CAROLINA

CROSS-SECTION G-G'

DATE April, 1999

PROJECT NO 33004

FILENAME xsec_g.dwg

FIGURE NO 13

H

H'

B-32

PZ10

PZ9

B-36

60

50

40

30

20

10

0

LEGEND

SAND AND SILT

CLAY TO SANDY CLAY

REVISIONS

NO	DRN	CHK	DATE

OFFNAME
OFFADD
OFFPHONE

DRN
DES
CHK
APP

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RIEGELWOOD, NORTH CAROLINA

CROSS-SECTION H-H'

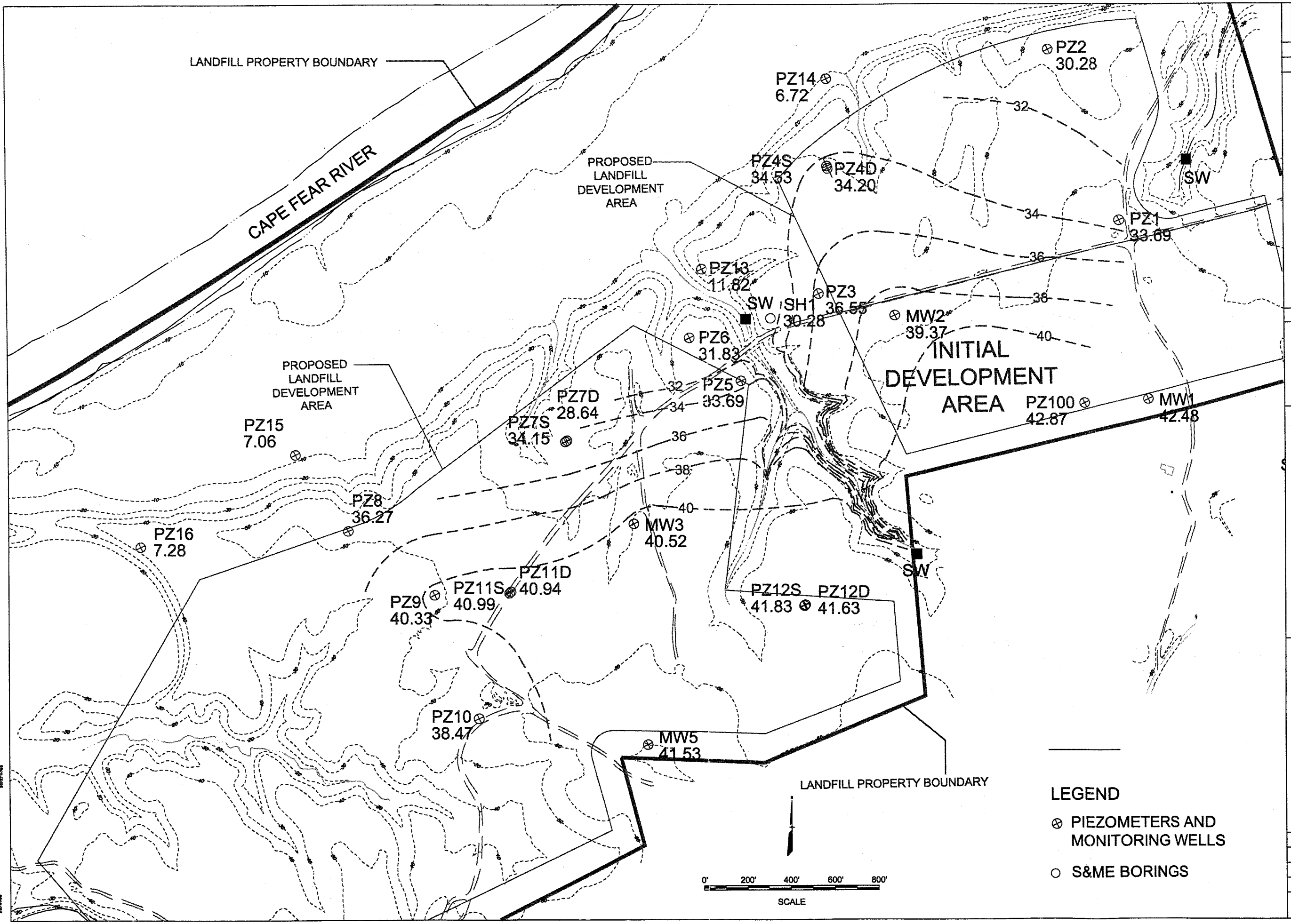
DATE April, 1999

PROJECT NO 33004

FILENAME xsec_h.dwg

FIGURE NO

14



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RIEGELWOOD, NORTH CAROLINA

GROUNDWATER ELEVATION CONTOUR MAP

DATE	September, 1999
PROJECT NO	33004
FILENAME	grdwtr.dwg
SHEET NO	15
DRAWING NO	15

LANDFILL PROPERTY BOUNDARY

CAPE FEAR RIVER

PROPOSED LANDFILL DEVELOPMENT AREA

PROPOSED LANDFILL DEVELOPMENT AREA

INITIAL DEVELOPMENT AREA

PZ1 PZ2 PZ3 PZ4S PZ4D PZ5 PZ6 PZ7S PZ7D PZ8 PZ9 PZ10 PZ11S PZ11D PZ12S PZ12D PZ13 PZ14 PZ15 PZ16 PZ100

SW SH1 SW SW SW

30.97

20.20

25.30

29.24

22' 24' 26' 28' 30'

LANDFILL PROPERTY BOUNDARY

0' 200' 400' 600' 800'

SCALE

LEGEND

⊗ PIEZOMETERS AND MONITORING WELLS

/ PEEDEE ELEVATION CONTOUR

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RIEGELWOOD, NORTH CAROLINA

PEEDEE FORMATION ELEVATION CONTOUR MAP

DATE	September, 1999
PROJECT NO	33004
FILENAME	grdwtr.dwg
SHEET NO	15
DRAWING NO	16

A

APPENDIX A

BORING LOGS

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-1
PAGE 1
ELEVATION
DATE 1/5/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
		3			(SW) Tan and gray medium organic sand. Moist.
		4			
		3			
		2			(SW) Tan to light gray medium-fine sand. Moist.
		3			
		4			
		2			
		3			(SW) Tan to gray medium-fine sand. Moist.
		5			
5.0		8			
		8			
		5			(SW) Tan to light gray medium-fine sand. Moist.
		6			
		8			
		5			
		6			(SW) Tan to light gray medium-fine sand. Moist.
		2			
		10			
		10			
10.0		12			
		7			(SW) Tan to light gray medium-fine sand. Very moist.
		5			
		5			
		7			
		6			(SW) Tan to gray medium sand. Wet at 13'.
		5			
		3			
		3			
		5			(SW) Tan to gray medium sand. Saturated. Terminated boring at 15'.
15.0		7			
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-2
PAGE 1
ELEVATION
DATE 1/5/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					(SP-SM) Dark brown organic sandy topsoil.
					(SW) Gray mottled with orange medium-fine sand. Moist.
		2			
		3			
		3			
5.0		3			
					(SW) Light gray medium-fine sand. Moist.
		5			
		7			
		8			
10.0		8			
					(SW) 13'-14.5' light gray medium-fine sand. Moist. From 14.5'-15' orange medium sand. Moist
		4			
		4			
		3			
15.0		4			
					(SP-SM) Orange poorly sorted silty sand. Wet. Terminated boring at 18'.
		1			
		1			
		1			
20.0		1			

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-3
PAGE 1
ELEVATION
DATE 1/6/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					(SP) Gray poorly sorted medium and coarse sand. Wet at 4'.
		3			
		3			
		3			
5.0		3			
		1			(SP-SC) Gray poorly sorted medium and coarse sand. Little orange clay. Non-cohesive. Wet. Terminated boring at 10'.
		1			
		1			
10.0		1			
15.0					
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-4s
PAGE 1
ELEVATION
DATE 1/6/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					(SP) Dark gray poorly sorted sandy topsoil. Moist.
					(SW) Tan to orange well sorted medium-fine sand. Trace of orange clay. Non-cohesive. Moist.
		2			
		3			
		4			
5.0		3			
		2			(SP) From 8'-9.5 tan, poorly sorted medium-coarse sand. Wet. From 9.5'-10' (CH) greenish gray fat clay with sand. Pee Dee formation. Terminated boring at 14'.
		3			
		2			
10.0		1			
15.0					
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-4d
PAGE 1
ELEVATION
DATE 1/6/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					(SP) Dark gray poorly sorted sandy topsoil. Moist.
					(SW) Tan to orange well sorted medium-fine sand. Trace of orange clay. Non-cohesive. Moist.
		2			
		3			
		4			
5.0		3			
		2			(SP) From 8'-9.5 tan, poorly sorted medium-coarse sand. Wet. From 9.5'-10' (CH) greenish gray fat clay with sand. Pee Dee formation.
		3			
		2			
10.0		1			
15.0					
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ - 4d
PAGE 2
ELEVATION
DATE 1/6/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
		3			(CH) Pee Dee formation to 40'.
		5			
		6			
		11			
		4			
		4			
		7			
		12			
		2			
25.		2			
		4			
		9			
		11			
		7			
		6			
		7			
		2			
		3			
		5			
30.0		8			
		4			
		6			
		9			
		15			
		4			
		5			
		6			
		10			
		2			
35.0		2			
		6			
		8			
		2			
		3			
		6			
		10			
		7			
		11			
		15			
40.0		17			

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ - 4d
PAGE 3
ELEVATION
DATE 1/6/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					(CH) Pee Dee formation.
		3			
		4			
		7			
45		11			
		5			
		7			
		9			
50		15			
55					
60					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-5
PAGE 1
ELEVATION
DATE 1/6/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					(SP) Light gray to white poorly sorted sandy topsoil. Moist.
					(CH) Tan fat clay with sand. Stiff, cohesive. Moist.
		3			
		4			
		6			
5.0		11			
					(SW) Light gray well sorted medium-fine sand. Thin layers (<.5") of coarser sand. Moist.
		2			
		3			
		3			
10.0		4			
					(CH) Greenish gray fat clay with sand. Pee Dee formation. Moist, somewhat cohesive. Few shells.
		2			
		3			
		5			
15.0		7			
					(CH) Greenish gray fat clay with sand. Peedee formation. Moist, somewhat cohesive.
		3			
		4			
		8			
20.0		40			

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-6
PAGE 1
ELEVATION
DATE 1/6/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					(SP) Gray poorly sorted sandy topsoil. Moist.
					(SC-CH) Tan and orange clayey sand. Moist. Non-cohesive. Clayey sand approximately 2' thick.
		2			
		3			
		3			
5.0		5			
					(SW) Tan mottled with orange well sorted medium-fine sand. Trace of clay. Wet.
		2			
		3			
		3			
10.0		2			
					(SP) Tan and gray medium and coarse sand. Wet. From 14.5' to 15" (CH-SC) greenish gray fat clay with sand. Pee Dee formation. Terminated boring at 15'.
		1			
		2			
		3			
15.0		6			
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-7s
PAGE 1
ELEVATION
DATE 1/6/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					(SP) Tan organic sandy topsoil. Moist.
					(SP-SC) Gray very sandy clay. Non-cohesive. Moist.
		3			
		4			
		7			
5.0		7			
		2			(SP-SC) Light gray clayey sand. Approximately 10-20% clay. Non-cohesive. Wet. Terminated boring at 13.5'.
		2			
		2			
10.0		2			
15.0					
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
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EQUIPMENT CME 55

BORING NUMBER PZ-7d
PAGE 1
ELEVATION
DATE 1/6/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					(SP) Tan organic sandy topsoil. Moist.
					(SP-SC) Gray very sandy clay. Non-cohesive. Moist.
		3			
		4			
		7			
5.0		7			
					(SP-SC) Light gray clayey sand. Approximately 10-20% clay. Non-cohesive. Wet.
		2			
		2			
		2			
10.0		2			
15.0					
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ - 7d
PAGE 2
ELEVATION
DATE 1/6/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
		10			(CH) Green marine clay, sandy, same to 40'.
		38			
		3			
25.		3			
		4			
		7			
		3			
30.0		5			
		5			
		9			
		3			
35.0		4			
		6			
		8			
		7			
40.0		8			

TEST BORING REPORT

PROJECT Landfill Site
CLIENT International Paper
PROJECT NUMBER 33004.10200
CONTRACTOR Graham & Currie
EQUIPMENT CME55

BORING NUMBER PZ-7d
PAGE 3
ELEVATION
DATE 1/6/99
DRILLER Snow
PREPARED BY Holland

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
		7			(CH) Green marine clay, sandy. Same to 51'.
		11			
		4			
45.0		6			
		9			
		14			
		4			
50.0		6			Set well at 50'. Last ss sample collected from 49'-51'.
		7			
		8			
55.0					
60.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-8
PAGE 1
ELEVATION
DATE 1/6/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					(SP) Light gray sandy topsoil.
					(SW) Light gray medium-fine well sorted sand. Moist.
		2			
		3			
		3			
5.0		4			
		2			(SW) From 8' to 9' light gray medium-fine well sorted sand. Wet. From 9' to 10' (CH) gray sandy clay. Cohesive, wet.
		10			
		13			
10.0		13			(SW) Gray and tan medium fine sand. Wet. Terminated boring at 13'.
		2			
		2			
		3			
		3			
15.0					
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-9
PAGE 1
ELEVATION
DATE 1/7/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					(SP) Dark gray poorly sorted sandy topsoil.
					(SW) Tan and gray well sorted fine sand. Moist.
		2			
		2			
		3			
5.0		5			
					(SW) Tan and orange medium sand. Trace of clay. Wet.
		6			
		8			
		9			
10.0		9			
					(SP) Orange silty poorly sorted sand. Flowing sand. Wet. Terminated boring at 13'.
		1			
		1			
		1			
		1			
15.0					
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-10
PAGE 1
ELEVATION
DATE 1/7/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					(SP) Dark brown and orange topsoil. Little clay. Moist.
					(CH) Orange very sandy clay. Somewhat cohesive.
		3			
		3			
		8			
5.0		11			
					(SW) Tan and white well sorted medium-fine sand. Moist.
		5			
		10			
		11			
10.0		14			
					(SP) Tan and white poorly sorted medium and fine sand. Very moist. Wet bottom of spoon. Terminated boring at 18'.
		2			
		7			
		11			
15.0		14			
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-11s
PAGE 1
ELEVATION
DATE 1/7/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
		2			(SW) Tan and gray medium sand. Moist.
		2			
		3			
		3			(SW) From 2' to 3' tan and gray medium sand. Moist. From 3' to 4' (SC) orange sandy clay. Somewhat cohesive. Moist.
		2			
		1			
		2			
		4			(SC) Orange sandy clay. Somewhat cohesive. Moist.
		3			
5.0		5			
		5			(SW) Tan and gray well sorted fine sand. Moist.
		6			
		3			
		3			(SP) Tan and gray poorly sorted medium and coarse sand. Very moist.
		4			
		4			
		2			
		4			
		4			
10.0		5			(SP) Tan poorly sorted medium and coarse sand. Trace of silt.
		3			
		6			
		7			
		8			Tan to orange poorly sorted fine to medium sand. Trace of silt. Wet. Terminated boring at 13.5'.
		3			
		4			
		5			
		8			
15.0					
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-11d
PAGE 1
ELEVATION
DATE 1/7/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
		2			(SW) Tan and gray medium sand. Moist.
		2			
		3			
		3			
		2			(SW) From 2' to 3' tan and gray medium sand. Moist. From 3' to 4' (SC) orange sandy clay. Somewhat cohesive. Moist.
		1			
		2			
		4			
		3			(SC) Orange sandy clay. Somewhat cohesive. Moist.
5.0		5			
		5			
		6			
		3			(SW) Tan and gray well sorted fine sand. Moist.
		3			
		4			
		4			
		2			(SP) Tan and gray poorly sorted medium and coarse sand. Very moist.
		4			
		4			
10.0		5			
		3			(SP) Tan poorly sorted medium and coarse sand. Trace of silt.
		6			
		7			
		8			
		3			Tan to orange poorly sorted fine to medium sand. Trace of silt. Wet.
		4			
		5			
		8			
15.0					
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ - 11d
PAGE 2
ELEVATION
DATE 1/7/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					Heaving sand. No SS sample collected. Drilled to 23'.
		6			(CH) Green,plastic,sandy marine clay. Pee Dee formation. Same to 40'.
		8			
		4			
25.		7			
		4			
		3			
		6			
		6			
		3			
		5			
		7			
		11			
		3			
30.0		5			
		7			
		8			
		4			
		5			
		9			
		23			
		4			
		12			
		29			
35.0		52			
		3			
		4			
		7			
		10			
		3			
		4			
		6			
		8			
		4			
40.0		7			

TEST BORING REPORT

PROJECT Landfill Site
CLIENT International Paper
PROJECT NUMBER 33004.10200
CONTRACTOR Graham & Currie
EQUIPMENT CME55

BORING NUMBER PZ-11d
PAGE 3
ELEVATION
DATE 1/7/99
DRILLER Snow
PREPARED BY Holland

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
		8			(Ch) Green,plastic,sandy marine clay. Pee Dee formation. Same to 49'.
		11			
		1			
		6			
		8			
		10			
		4			
		4			
		6			
45.0		9			
		4			
		7			
		8			
		14			
		4			
		4			
		6			
		11			Set well at 49'.
50.0					
55.0					
60.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-12s
PAGE 1
ELEVATION
DATE 1/11/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
		3			(SP) Poorly sorted organic sandy topsoil. From 1.5' to 2' (SC-CH) gray sandy clay.
		2			
		1			
		1			
					Collected shelby tube of sandy clay.
					(SC) Tan and orange clayey sand. Non-cohesive. Moist.
5.0					
		3			
		6			
		9			
		11			
		4			(SP) Tan medium-fine sand.
		4			
		5			
10.0		7			
		4			(SW) Light gray well sorted silty sand. Trace limestone. Very moist.
		7			
		7			
		7			
					(SW) Gray and orange medium-coarse sand. Saturated, flowing sand.
15.0					
		5			
		9			
		10			
		10			
		4			(SW) From 18' to 19.5' gray and orange medium-coarse sand. Saturated, flowing sand. From 19.5' to 20' (SP) poorly sorted orange medium sand. Some clay. Wet. Set well at 18'.
		11			
		8			
		6			
20.0					

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ-12d
PAGE 1
ELEVATION
DATE 1/11/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
		3			(SP) Poorly sorted organic sandy topsoil. From 1.5' to 2' (SC-CH) gray sandy clay.
		2			
		1			
		1			Collected shelby tube of sandy clay.
					(SC) Tan and orange clayey sand. Non-cohesive. Moist.
5.0					
		3			
		6			
		9			
		11			
		4			(SP) Tan medium-fine sand.
		4			
		5			
10.0		7			
		4			(SW) Light gray well sorted silty sand. Trace limestone. Very moist.
		7			
		7			
		7			
					(SW) Gray and orange medium-coarse sand. Saturated, flowing sand.
15.0					
		5			
		9			
		10			
		10			
		4			(SW) From 18' to 19.5' gray and orange medium-coarse sand. Saturated, flowing sand. From 19.5' to 20' (SP) poorly sorted orange medium sand. Some clay. Wet.
		11			
		8			
20.0		6			

TEST BORING REPORT

PROJECT LANDFILL SITE
CLIENT INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ - 12d
PAGE 2
ELEVATION
DATE 1/11/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					Heaving sand. Drilled to clay layer at 23.5'
		5			
		7			(CL) Lean green marine clay, many shells. Pee Dee formation wet
25.		7			
		5			
		2			
		5			(CL) Lean green sandy marine clay. Moist
		7			
30.0		5			
35.0					
		3			(CL) Lean green sandy marine clay. Moist.
		5			
		7			
40.0		11			

TEST BORING REPORT

PROJECT LANDFILL SITE
[redacted] INTERNATIONAL PAPER
PROJECT NUMBER 33004.10200
CONTRACTOR GRAHAM & CURRIE
EQUIPMENT CME 55

BORING NUMBER PZ - 12d
PAGE 3
ELEVATION
DATE 1/11/99
DRILLER SNOW
PREPARED BY HOLLAND

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	SAMPLE NUMBER	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
45					
		9			(CL) Dark green,lean sandy marine clay. Moist. Terminated boring
		6			
		8			
50		10			
55					
60					

TEST BORING REPORT

PROJECT New Landfill
CLIENT International Paper
PROJECT NUMBER 33004
CONTRACTOR
EQUIPMENT Backhoe

BORING NUMBER Test Pit #1
PAGE 1
ELEVATION N/A
DATE
DRILLER N/A
PREPARED BY John Funk

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	OVA (PPM)	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					0' - 1' Black loam topsoil
					1' - 3' Tan clay
					3' - 8' Tan clay with red mottles
5.0					
					8' - 9' Tan and red sand
10.0					
15.0					
20.0					

TEST BORING REPORT

PROJECT New Landfill
CLIENT International Paper
PROJECT NUMBER 33004
CONTRACTOR
EQUIPMENT Backhoe

BORING NUMBER Test Pit #2
PAGE 1
ELEVATION N/A
DATE
DRILLER N/A
PREPARED BY John Funk

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	OVA (PPM)	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					0' - 1' Black loam topsoil
					1' - 4' Tan clay with red mottles
					4' - 5' Stiff red/tan clay
5.0					
					5' - 6' Clay transitiong to red sand
					6' Tan and red sand
10.0					
15.0					
20.0					

TEST BORING REPORT

PROJECT New Landfill
CLIENT International Paper
PROJECT NUMBER 33004
CONTRACTOR
EQUIPMENT Backhoe

BORING NUMBER Test Pit #3
PAGE 1
ELEVATION N/A
DATE
DRILLER N/A
PREPARED BY John Funk

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	OVA (PPM)	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					0' - 1' Black loam topsoil
					1' - 4' Tan sandy clay
					4' - 6' Tan-white mottled red clay
5.0					
					6' - 7' Clay transitioning to sand
					7' - 8' Tan-red sand
10.0					
15.0					
20.0					

TEST BORING REPORT

PROJECT New Landfill
CLIENT International Paper
PROJECT NUMBER 33004
CONTRACTOR
EQUIPMENT Backhoe

BORING NUMBER Test Pit #4
PAGE 1
ELEVATION N/A
DATE
DRILLER N/A
PREPARED BY John Funk

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	OVA (PPM)	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					0' - 1' Black loam topsoil
					1' - 5' Tan sandy clay
					5' - 6' Sand
5.0					
10.0					
15.0					
20.0					

TEST BORING REPORT

PROJECT New Landfill
CLIENT International Paper
PROJECT NUMBER 33004
CONTRACTOR
EQUIPMENT Backhoe

BORING NUMBER Test Pit #5
PAGE 1
ELEVATION N/A
DATE
DRILLER N/A
PREPARED BY John Funk

DEPTH IN FEET	CASING BLOWS FOOT	BLOWS PER 6 INCHES	OVA (PPM)	SAMPLE DEPTH RANGE	FIELD CLASSIFICATION AND REMARKS
					0' - 1' Black loam topsoil
					1' - 2' Tan sandy clay
					2' - 6' Tan-red clay
5.0					
					6' - 7' Transitioning to reddish sand
10.0					
15.0					
20.0					

B

APPENDIX B

PIEZOMETER CONSTRUCTION DETAILS

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: RIEGELWOOD County: COLUMBUS
   JOHN L. RIEGEL ROAD
   (Road, Community, or Subdivision and Lot No.)
2. OWNER INTERNATIONAL PAPER
   ADDRESS JOHN L. RIEGEL ROAD
   (Street or Route No.)
   RIEGELWOOD NC 28456
   City or Town State Zip Code
3. DATE DRILLED 1/5/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 15'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 17.37 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
10. WATER ZONES (depth): 17.37'
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth From	To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	+2.5	10		2"	SCH 40	PVC

13. GROUT:

	Depth From	To	Ft.	Material	Method
	GS	6		PORTLAND	POUR
	6	8		BENTONITE	POUR

14. SCREEN:

	Depth From	To	Ft.	Diameter	Slot Size	Material
	10	15		2" in.	0.01 in.	PVC
				in.	in.	
				in.	in.	

15. SAND/GRAVEL PACK:

	Depth From	To	Ft.	Size	Material
	8	15		MED	SAND

16. REMARKS: _____

DEPTH From	To	DRILLING LOG Formation Description
0	2	SW
2	4	SW
4	6	SW
6	8	SW
8	10	SW
10	12	SW
12	15	SW

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner.

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: RIEGELWOOD County: COLUMBUS
   JOHN L. RIEGEL ROAD
   (Road, Community, or Subdivision and Lot No.)
2. OWNER INTERNATIONAL PAPER
   ADDRESS JOHN L. RIEGEL ROAD
   (Street or Route No.)
   RIEGELWOOD NC 28456
   City or Town State Zip Code
3. DATE DRILLED 1/5/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 18'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 19.91 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
   WATER ZONES (depth): 19.91
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth From	Depth To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
From	+2.5	13	Ft.	2"	SCH 40	PVC
From			Ft.			
From			Ft.			

13. GROUT:

	Depth From	Depth To	Ft.	Material	Method
From	GS	9	Ft.	PORTLAND	POUR
From	9	11	Ft.	BENTONITE	POUR

14. SCREEN:

	Depth From	Depth To	Ft.	Diameter		Slot Size		Material
From	13	18	Ft	2"	in.	0.01	in.	PVC
From			Ft.		in.		in.	
From			Ft.		in.		in.	

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Ft.	Size	Material
From	11	18	Ft.	MED	SAND
From			Ft.		

16. REMARKS: _____

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner

GW-1 REV. 9/91

DEPTH / DRILLING LOG

From	To	Formation Description
0	2	SP - SM
3	5	SW
8	10	SW
13	15	SW
18	20	SP - SM

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: RIEGELWOOD County: COLUMBUS
   JOHN L. RIEGEL ROAD
   (Road, Community, or Subdivision and Lot No.)
2. OWNER INTERNATIONAL PAPER
   ADDRESS JOHN L. RIEGEL ROAD
   (Street or Route No.)
   RIEGELWOOD (City or Town) NC (State) 28456 (Zip Code)
3. DATE DRILLED 1/6/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 10'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 3.96 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
10. WATER ZONES (depth): 3.96
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth From	Depth To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	+2.5	5		2"	SCH 40	PVC

13. GROUT:

	Depth From	Depth To	Ft.	Material	Method
	GS	2		PORTLAND	POUR
	2	3		BENTONITE	POUR

14. SCREEN:

	Depth From	Depth To	Ft.	Diameter	Slot Size	Material
	5	10	Ft	2" in.	0.01 in.	PVC
			Ft.	in.	in.	
			Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Ft.	Size	Material
	3	10		MED	SAND

16. REMARKS: _____

DEPTH From	DEPTH To	DRILLING LOG Formation Description
3	5	SP
8	10	SP-SC

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner

PZ - 4s

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: RIEGELWOOD County: COLUMBUS
   JOHN L. RIEGEL ROAD
   (Road, Community, or Subdivision and Lot No.)
2. OWNER INTERNATIONAL PAPER
   ADDRESS JOHN L. RIEGEL ROAD
   (Street or Route No.)
   RIEGELWOOD NC 28456
   City or Town State Zip Code
3. DATE DRILLED 1/16/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 14'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 7.84 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
   WATER ZONES (depth): 7.84
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth From	Depth To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	+2.5	9		2"	SCH 40	PVC

13. GROUT:

	Depth From	Depth To	Ft.	Material	Method
	GS	5		PORTLAND	POUR
	5	7		BENTONITE	POUR

14. SCREEN:

	Depth From	Depth To	Ft.	Diameter	Slot Size	Material
	9	14		2" in.	0.01 in.	PVC
				in.	in.	
				in.	in.	

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Ft.	Size	Material
	7	14		MED	SAND

16. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REV. 9/91

Submit original to Division of Environmental Management and copy to well owner

DRILLING LOG

DEPTH From	DEPTH To	Formation Description
0	2	SP
3	5	SW
8	10	SP-CH

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

PZ - 4d

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: RIEGELWOOD County: COLUMBUS
   JOHN L. RIEGEL ROAD
   (Road, Community, or Subdivision and Lot No.)
2. OWNER INTERNATIONAL PAPER
   ADDRESS JOHN L. RIEGEL ROAD
   (Street or Route No.)
   RIEGELWOOD (City or Town) NC (State) 28456 (Zip Code)
3. DATE DRILLED 1/6/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 50'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 8.52 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
10. WATER ZONES (depth): 8.52
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	+2.5	To	45 Ft.	2"	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. GROUT:

	Depth			Material	Method
From	GS	To	41 Ft.	PORTLAND	POUR
From	41	To	43 Ft.	BENTONITE	POUR

14. SCREEN:

	Depth			Diameter	Slot Size	Material
From	45	To	50 Ft	2" in.	0.01 in.	PVC
From		To	Ft.	in.	in.	
From		To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	43	To	50 Ft.	MED	SAND
From		To	Ft.		

16. REMARKS:

DEPTH From	DEPTH To	DRILLING LOG Formation Description
See boring log		

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REV. 9/91

Submit original to Division of Environmental Management and copy to well owner

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Division of Environmental Management - Groundwater Section
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Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: RIEGELWOOD County: COLUMBUS
   JOHN L. RIEGEL ROAD
   (Road, Community, or Subdivision and Lot No.)
2. OWNER INTERNATIONAL PAPER
   ADDRESS JOHN L. RIEGEL ROAD
   (Street or Route No.)
   RIEGELWOOD (City or Town) NC (State) 28456 (Zip Code)
3. DATE DRILLED 1/6/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 18'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 9.73 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
10. WATER ZONES (depth): 9.73
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth From	Depth To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	+2.5	13		2"	SCH 40	PVC

13. GROUT:

	Depth From	Depth To	Ft.	Material	Method
	GS	9		PORTLAND	POUR
	9	11		BENTONITE	POUR

14. SCREEN:

	Depth From	Depth To	Ft	Diameter	in.	Slot Size	in.	Material
	13	18		2"		0.01		PVC

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Ft.	Size	Material
	11	18		MED	SAND

16. REMARKS: _____

DRILLING LOG

From	To	Formation Description
0	2	SP
3	5	CH
8	10	SW
13	15	CH
18	20	CH

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

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Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: RIEGELWOOD County: COLUMBUS
   JOHN L. RIEGEL ROAD
   (Road, Community, or Subdivision and Lot No.)
2. OWNER INTERNATIONAL PAPER
   ADDRESS JOHN L. RIEGEL ROAD
   (Street or Route No.)
   RIEGELWOOD NC 28456
   City or Town State Zip Code
3. DATE DRILLED 1/6/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 15'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 12.84 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
10. WATER ZONES (depth): 12.84
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth From	Depth To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	+2.5	10		2"	SCH 40	PVC

13. GROUT:

	Depth From	Depth To	Ft.	Material	Method
	GS	6		PORTLAND	POUR
	6	8		BENTONITE	POUR

14. SCREEN:

	Depth From	Depth To	Ft.	Diameter		Slot Size		Material
	10	15		2"	in.	0.01	in.	PVC
					in.		in.	
					in.		in.	

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Ft.	Size	Material
	8	15		MED	SAND

16. REMARKS: _____

DEPTH From	DEPTH To	DRILLING LOG Formation Description
0	2	SP
3	5	SC - CH
8	10	SW
13	15	SP

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner

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Division of Environmental Management - Groundwater Section
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FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: RIEGELWOOD County: COLUMBUS
   JOHN L. RIEGEL ROAD
   (Road, Community, or Subdivision and Lot No.)
2. OWNER INTERNATIONAL PAPER
   ADDRESS JOHN L. RIEGEL ROAD
   (Street or Route No.)
   RIEGELWOOD NC 28456
   City or Town State Zip Code
3. DATE DRILLED 1/6/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 13.5'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 7.19 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
10. WATER ZONES (depth): 7.19
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth From	Depth To		Diameter	Wall Thickness or Weight/Ft.	Material
From	+2.5	8.5	Ft.	2"	SCH 40	PVC
From			Ft.			
From			Ft.			

13. GROUT:

	Depth From	Depth To		Material	Method
From	GS	4.5	Ft.	PORTLAND	POUR
From	4.5	6.5	Ft.	BENTONITE	POUR

14. SCREEN:

	Depth From	Depth To		Diameter		Slot Size		Material
From	8.5	13.5	Ft	2"	in.	0.01	in.	PVC
From			Ft.		in.		in.	
From			Ft.		in.		in.	

15. SAND/GRAVEL PACK:

	Depth From	Depth To		Size	Material
From	6.5	13.5	Ft.	MED	SAND
From			Ft.		

16. REMARKS: _____

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SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REV. 9/91

Submit original to Division of Environmental Management and copy to well owner

DRILLING LOG

DEPTH From	DEPTH To	Formation Description
0	2	SP
3	5	SP - SC
8	10	SP - SC

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

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Division of Environmental Management - Groundwater Section
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Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
Nearest Town: RIEGELWOOD County: COLUMBUS

JOHN L. RIEGEL ROAD
(Road, Community, or Subdivision and Lot No.)

2. OWNER INTERNATIONAL PAPER
ADDRESS JOHN L. RIEGEL ROAD
(Street or Route No.)
RIEGELWOOD NC 28456
City or Town State Zip Code

3. DATE DRILLED 1/6/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 50'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 9.16 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*
* Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118
9. YIELD (gpm): NA METHOD OF TEST NA
10. WATER ZONES (depth): 9.16
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth From	Depth To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	+2.5	45		2"	SCH 40	PVC

13. GROUT:

	Depth From	Depth To	Ft.	Material	Method
	GS	43		PORTLAND	POUR
	41	43		BENTONITE	POUR

14. SCREEN:

	Depth From	Depth To	Ft	Diameter	in.	Slot Size	in.	Material
	45	50		2"		0.01		PVC

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Ft.	Size	Material
	43	50		MED	SAND

16. REMARKS: _____

DEPTH From	DEPTH To	DRILLING LOG Formation Description
See boring log		

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REV. 9/91

Submit original to Division of Environmental Management and copy to well owner

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FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent: _____ GW-1 Ent: _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: RIEGELWOOD County: COLUMBUS
   JOHN L. RIEGEL ROAD
   (Road, Community, or Subdivision and Lot No.)
2. OWNER INTERNATIONAL PAPER
   ADDRESS JOHN L. RIEGEL ROAD
   (Street or Route No.)
   RIEGELWOOD (City or Town) NC (State) 28456 (Zip Code)
3. DATE DRILLED 1/6/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 13'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 10.76 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
   WATER ZONES (depth): 10.76
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	+2.5	To	8 Ft.	2"	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. GROUT:

	Depth			Material	Method
From	GS	To	4 Ft.	PORTLAND	POUR
From	4	To	6 Ft.	BENTONITE	POUR

14. SCREEN:

	Depth			Diameter		Slot Size		Material
From	8	To	13 Ft	2"	in.	0.01	in.	PVC
From		To	Ft.		in.		in.	
From		To	Ft.		in.		in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	6	To	13 Ft.	MED	SAND
From		To	Ft.		

16. REMARKS: _____

DRILLING LOG

From	To	Formation Description
0	2	SP
3	5	SW
8	10	SW - CH
11	13	SW

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: RIEGELWOOD County: COLUMBUS
   JOHN L. RIEGEL ROAD
   (Road, Community, or Subdivision and Lot No.)
2. OWNER INTERNATIONAL PAPER
   ADDRESS JOHN L. RIEGEL ROAD
   (Street or Route No.)
   RIEGELWOOD NC 28456
   City or Town State Zip Code
3. DATE DRILLED 1/7/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 13
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 9.80 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
   WATER ZONES (depth): 9.80
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	+2.5	To	8 Ft.	2"	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. GROUT:

	Depth			Material	Method
From	GS	To	4 Ft.	PORTLAND	POUR
From	4	To	6 Ft.	BENTONITE	POUR

14. SCREEN:

	Depth			Diameter		Slot Size		Material
From	8	To	13 Ft	2"	in.	0.01	in.	PVC
From		To	Ft.		in.		in.	
From		To	Ft.		in.		in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	6	To	13 Ft.	MED	SAND
From		To	Ft.		

16. REMARKS: _____

DEPTH From	DEPTH To	DRILLING LOG Formation Description
0	2	SP
3	5	SW
8	10	SW
11	13	SP

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

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Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: RIEGELWOOD County: COLUMBUS
   JOHN L. RIEGEL ROAD
   (Road, Community, or Subdivision and Lot No.)
2. OWNER INTERNATIONAL PAPER
   ADDRESS JOHN L. RIEGEL ROAD
   (Street or Route No.)
   RIEGELWOOD NC 28456
   City or Town State Zip Code
3. DATE DRILLED 1/7/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 49'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 10.33 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
10. WATER ZONES (depth): 10.33
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From +2.5	To 44	Ft.	2"	SCH 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From GS	To 40	Ft.	PORTLAND	POUR
From 40	To 42	Ft.	BENTONITE	POUR

14. SCREEN:

	Depth		Diameter		Slot Size		Material
From 44	To 49	Ft	2"	in.	0.01	in.	PVC
From	To	Ft.		in.		in.	
From	To	Ft.		in.		in.	

15. SAND/GRAVEL PACK:

	Depth		Size	Material
From 42	To 49	Ft.	MED	SAND
From	To	Ft.		

16. REMARKS: _____

DEPTH From	DEPTH To	DRILLING LOG Formation Description
see boring log		

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REV. 9/91

Submit original to Division of Environmental Management and copy to well owner

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
Nearest Town: RIEGELWOOD County: COLUMBUS

JOHN L. RIEGEL ROAD
(Road, Community, or Subdivision and Lot No.)

2. OWNER INTERNATIONAL PAPER
ADDRESS JOHN L. RIEGEL ROAD
(Street or Route No.)
RIEGELWOOD NC 28456
City or Town State Zip Code

3. DATE DRILLED 1/7/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 18
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 16.09 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
10. WATER ZONES (depth): 16.09

11. CHLORINATION: Type NA Amount NA

12. CASING:

	Depth From	Depth To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	+2.5	13		2"	SCH 40	PVC

13. GROUT:

	Depth From	Depth To	Ft.	Material	Method
	GS	9		PORTLAND	POUR
	9	11		BENTONITE	POUR

14. SCREEN:

	Depth From	Depth To	Ft	Diameter		Slot Size		Material
	13	18		2"	in.	0.01	in.	PVC
					in.		in.	
					in.		in.	

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Ft.	Size	Material
	11	18		MED	SAND

16. REMARKS: _____

DRILLING LOG

From	To	Formation Description
0	2	SP
3	5	CH
8	10	SW
13	15	SP

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

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Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
Nearest Town: RIEGELWOOD County: COLUMBUS

JOHN L. RIEGEL ROAD
(Road, Community, or Subdivision and Lot No.)

2. OWNER INTERNATIONAL PAPER
ADDRESS JOHN L. RIEGEL ROAD
(Street or Route No.)
RIEGELWOOD NC 28456
City or Town State Zip Code

3. DATE DRILLED 1/7/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 13.5'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 9.93 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
WATER ZONES (depth): 9.93

11. CHLORINATION: Type NA Amount NA

12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	+2.5	To	8.5 Ft.	2"	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. GROUT:

	Depth			Material	Method
From	GS	To	4.5 Ft.	PORTLAND	POUR
From	4.5	To	6.5 Ft.	BENTONITE	POUR

14. SCREEN:

	Depth			Diameter		Slot Size		Material
From	8.5	To	13.5 Ft.	2"	in.	0.01	in.	PVC
From		To	Ft.		in.		in.	
From		To	Ft.		in.		in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	6.5	To	8.5 Ft.	MED	SAND
From		To	Ft.		

16. REMARKS: _____

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SIGNATURE OF CONTRACTOR OR AGENT DATE

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GW-1 REV. 9/91

DEPTH From	DEPTH To	DRILLING LOG Formation Description
0	2	SW
2	4	SW
4	6	SC
6	8	SW
8	10	SP
10	12	SP
12	14	SP

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

PZ - 12s

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: RIEGELWOOD County: COLUMBUS
   JOHN L. RIEGEL ROAD
   (Road, Community, or Subdivision and Lot No.)
2. OWNER INTERNATIONAL PAPER
   ADDRESS JOHN L. RIEGEL ROAD
   (Street or Route No.)
   RIEGELWOOD NC 28456
   City or Town State Zip Code
3. DATE DRILLED 1/11/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 18'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 12.34 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*

*** Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118**

9. YIELD (gpm): NA METHOD OF TEST NA
   WATER ZONES (depth): 12.34
11. CHLORINATION: Type NA Amount NA
12. CASING:

	Depth From	Depth To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
From	+2.5	13	Ft.	2"	SCH 40	PVC
From			Ft.			
From			Ft.			

13. GROUT:

	Depth From	Depth To	Ft.	Material	Method
From	GS	9	Ft.	PORTLAND	POUR
From	9	11	Ft.	BENTONITE	POUR

14. SCREEN:

	Depth From	Depth To	Ft.	Diameter	in.	Slot Size	in.	Material
From	13	18	Ft	2"	in.	0.01	in.	PVC
From			Ft.		in.		in.	
From			Ft.		in.		in.	

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Ft.	Size	Material
From	11	18	Ft.	MED	SAND
From			Ft.		

16. REMARKS: _____

DEPTH / DRILLING LOG

From	To	Formation Description
0	2	SP
5	7	SC
8	10	SP
10	12	SW
15	17	SW
18	20	SW-SP

If additional space is needed use back of form

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REV. 9/91

Submit original to Division of Environmental Management and copy to well owner

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GRAHAM & CURRIE

DRILLER REGISTRATION NUMBER: # 537

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
Nearest Town: RIEGELWOOD County: COLUMBUS

JOHN L. RIEGEL ROAD
(Road, Community, or Subdivision and Lot No.)

2. OWNER INTERNATIONAL PAPER

ADDRESS JOHN L. RIEGEL ROAD
(Street or Route No.)

RIEGELWOOD (City or Town) NC (State) 28456 (Zip Code)

3. DATE DRILLED 1/11/99 USE OF WELL PIEZOMETER
4. TOTAL DEPTH 50'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 13.77 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS +-2.5 FT. Above Land Surface*
Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118
9. YIELD (gpm): NA METHOD OF TEST NA
10. WATER ZONES (depth): 13.77

11. CHLORINATION: Type NA Amount NA

12. CASING:

	Depth From	Depth To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	+2.5	45		2"	SCH 40	PVC

13. GROUT:

	Depth From	Depth To	Ft.	Material	Method
	GS	41		PORTLAND	POUR
	41	43		BENTONITE	POUR

14. SCREEN:

	Depth From	Depth To	Ft	Diameter	in.	Slot Size	in.	Material
	45	50		2"		0.01		PVC

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Ft.	Size	Material
	43	50		MED	SAND

16. REMARKS:

DEPTH From	DEPTH To	DRILLING LOG Formation Description
0	2	SP
5	7	SC
10	12	SW
15	17	SW
18	20	SW
23	25	CL
28	30	CL
38	40	CL
48	50	CL

If additional space is needed use back of form

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)

SEE MAP

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REV. 9/91

Submit original to Division of Environmental Management and copy to well owner

C

APPENDIX C

HYDRAULIC CONDUCTIVITY CALCULATIONS

EARTH TECH
SLUG TEST DATA ANALYSIS - BOUWER AND RICE METHOD
For an Unconfined Aquifer with a Partially or Fully Penetrating Well

RJH & AMP 11/01/94
Rev. 2 CWH 07/05/96

PROJECT DATA INPUT

Site Name: INTERNATIONAL PAPER
Location: RIEGELWOOD, NC
Project No: 33004
Data Collected By: R. HOLLAND Date: 01/20/99
Data Analyzed By: M. BRANSON Date: 03/31/99

TEST WELL DATA INPUT

Well No: PZ-3
Method: WATER REMOVAL WITH MANUAL WATER LEVEL TAPE

Depth of Well from Measuring Point:	10.02	ft
Depth to Static Water Level from Measuring Point:	5.02	ft
Depth to Top of Screen from Measuring Point:	7.02	ft
Length of Screen:	5.00	ft
Radius of Hole:	0.667	ft
Radius of Casing:	0.167	ft
Aquifer Thickness:	50.00	ft
Porosity of Sandpack:	0.35	as a decimal

Test Type: 1 Rising Head

1 = Rising Head
2 = Falling Head

CALCULATED TEST WELL PARAMETERS

Le=	5.00	ft (effective screen length of well)	ln((H-Lw)/rw)= (raw)	4.21	dimensionless
Lw=	5.00	ft (saturated thickness penetrated by well)			
rw=	0.667	ft (radius of borehole)			
rc=	0.167	ft (radius of casing)	ln(Re/rw)= (if Lw<H)	1.07	dimensionless
rc'=	0.167	ft (effective casing radius for partially saturated screens)			
H=	50.00	ft (aquifer thickness)	ln(Re/rw)= (if Lw=H)	1.45	dimensionless
Le/rw=	7.50	dimensionless			

A=	1.79	dimensionless
B=	0.27	dimensionless
C=	1.07	dimensionless

(Values for A, B, and C valid for Le/rw in range of 4-200)

ln((H-Lw)/rw)=	4.21	dimensionless
ln(Re/rw)=	1.07	dimensionless

REGRESSION ANALYSIS

Regression Output:

Constant	-0.005783	(Y-intercept)
Std Err of Y Est	0.0330611	
R Squared	0.9879966	
No. of Observations	16	
Degrees of Freedom	14	
X Coefficient(s)	-0.15629877978468	(Slope)
Std Err of Coef.	0.004604333782194	

OUTPUT FROM BEST FIT LINE

Yo =	0.9868	ft (= head y @ t=0, derived from y intercept of best fit line on y/t plot)
Yt =	0.1000	ft (= head y @ time t, derived from best fit line of y/t plot)
t =	6.3610	min (= time t @ head Yt, derived from best fit line)

CALCULATED HYDRAULIC CONDUCTIVITY AND TRANSMISSIVITY

K =	1.78E-05	ft/sec			
K =	1.07E-03	ft/min	K =	5.41E-04	cm/sec
K =	1.53E+00	ft/day	K =	5.41E-06	m/sec
T =	7.67E+01	ft^2/day	K =	4.68E-01	m/day
K =	1.15E+01	gpd/ft^2	T =	7.13E+00	m^2/day
T =	5.74E+02	gpd/ft			

REFERENCES

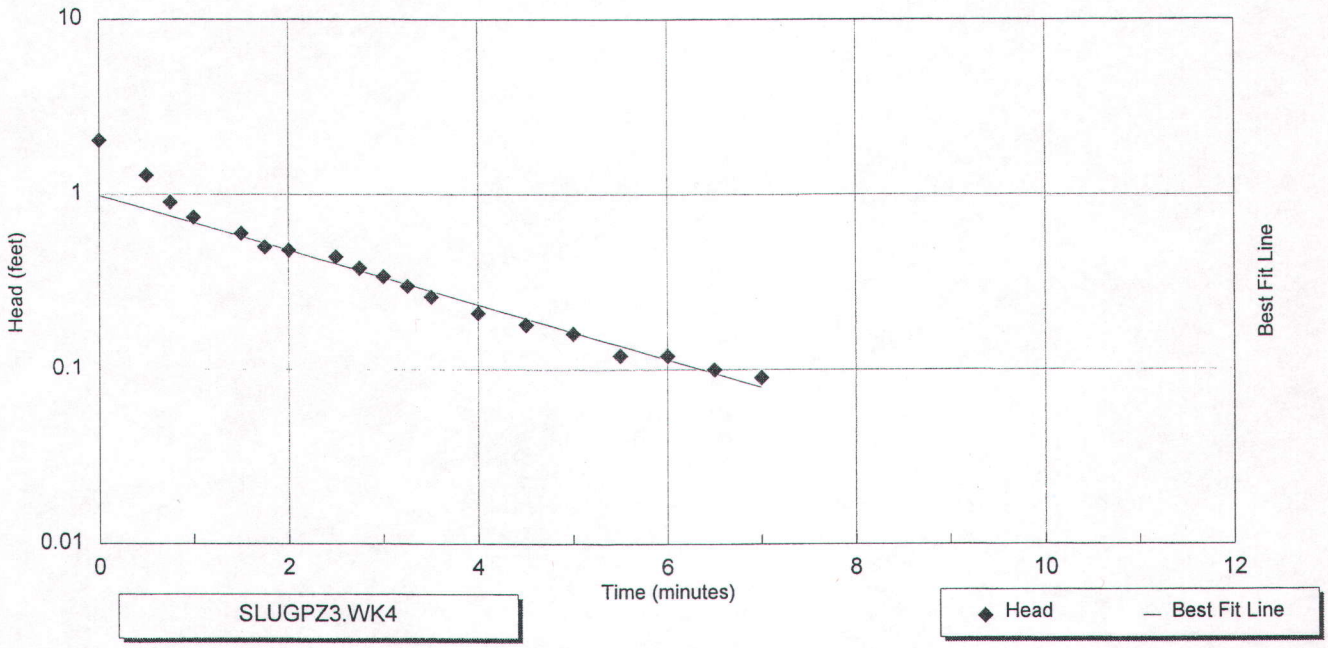
Bouwer, H. and Rice, R.C., 1976, A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells: Water Resources Research, v.12, pp. 423-428.

Bouwer, H., 1989, The Bouwer and Rice slug test - an update: Ground Water, v.27, no.3, pp. 304-309.

Bouwer, H., 1989, DISCUSSION OF:The Bouwer and Rice slug test-an update: Ground Water, v.27, no.5, p.715

PEIZOMETER PZ-3

International Paper



SLUG TEST DATA INPUT, HEAD, AND BEST FIT LINE FROM REGRESSION ANALYSIS

Time (min.)	Depth below MP(ft)	Head (ft)	Log(y)	Head (Best Fit Line)
0.0000	7.06	2.04	0.30963	0.99
0.5000	6.31	1.29	0.11059	0.82
0.7500	5.92	0.90	-0.04576	0.75
1.0000	5.76	0.74	-0.13077	0.69
1.5000	5.62	0.60	-0.22185	0.58
1.7500	5.52	0.50	-0.30103	0.53
2.0000	5.50	0.48	-0.31876	0.48
2.5000	5.46	0.44	-0.35655	0.40
2.7500	5.40	0.38	-0.42022	0.37
3.0000	5.36	0.34	-0.46852	0.34
3.2500	5.32	0.30	-0.52288	0.31
3.5000	5.28	0.26	-0.58503	0.28
4.0000	5.23	0.21	-0.67778	0.23
4.5000	5.20	0.18	-0.74473	0.20
5.0000	5.18	0.16	-0.79588	0.16
5.5000	5.14	0.12	-0.92082	0.14
6.0000	5.14	0.12	-0.92082	0.11
6.5000	5.12	0.10	-1.00000	0.10
7.0000	5.11	0.09	-1.04576	0.08

Rising Head PZ-3
INTERNATIONAL PAPER

Rising Head
INTERNATIONAL PAPER

EARTH TECH
SLUG TEST DATA ANALYSIS - BOUWER AND RICE METHOD
For an Unconfined Aquifer with a Partially or Fully Penetrating Well

PROJECT DATA INPUT

RJH & AMP 11/01/94
Rev. 2 CWH 07/05/96

Site Name: INTERNATIONAL PAPER
Location: RIEGELWOOD, NC
Project No: 33004
Data Collected By: R. HOLLAN Date: 01/20/99
Data Analyzed By: M. BRANSO Date: 03/31/99

TEST WELL DATA INPUT

Well No: PZ-11S
Method: WATER REMOVAL WITH MANUAL WATER LEVEL TAPE

Depth of Well from Measuring Point:	15.24	ft
Depth to Static Water Level from Measuring Poin	11.13	ft
Depth to Top of Screen from Measuring Point:	10.24	ft
Length of Screen:	5.00	ft
Radius of Hole:	0.667	ft
Radius of Casing:	0.167	ft
Aquifer Thickness:	50.00	ft
Porosity of Sandpack:	0.35	as a decimal

Test Type: 1 Rising Head

1 = Rising Head
2 = Falling Head

CALCULATED TEST WELL PARAMETERS

Le=	4.11	ft (effective screen length of well)	ln((H-Lw)/rw)= (raw)	4.23	dimensionless
Lw=	4.11	ft (saturated thickness penetrated by well)			
rw=	0.667	ft (radius of borehole)			
rc=	0.167	ft (radius of casing)	ln(Re/rw)= (if Lw<H)	0.93	dimensionless
rc'=	0.417	ft (effective casing radius for partially saturated screens)			
H=	50.00	ft (aquifer thickness)	ln(Re/rw)= (if Lw=H)	1.30	dimensionless
Le/rw=	6.17	dimensionless			
A=	1.74	dimensionless			
B=	0.27	dimensionless *(Values for A, B, and C valid for Le/rw in range of 4-200)*			
C=	1.00	dimensionless			
(H-Lw)/rw)=	4.23	dimensionless			
ln(Re/rw)=	0.93	dimensionless			

REGRESSION ANALYSIS

Regression Output:

Constant	-1.008864	(Y-intercept)
Std Err of Y Est	0.0141055	
R Squared	0.9918191	
No. of Observations	4	
Degrees of Freedom	2	
X Coefficient(s)	-0.19645	(Slope)
Std Err of Coef.	0.012616	

OUTPUT FROM BEST FIT LINE

Yo =	0.0980	ft (= head y @ t=0, derived from y intercept of best fit line on y/t plot)
Yt =	0.0100	ft (= head y @ time t, derived from best fit line of y/t plot)
t =	5.0451	min (= time t @ head Yt, derived from best fit line)

CALCULATED HYDRAULIC CONDUCTIVITY AND TRANSMISSIVITY

K =	1.49E-04	ft/sec			
K =	8.92E-03	ft/min	K =	4.53E-03	cm/sec
K =	1.28E+01	ft/day	K =	4.53E-05	m/sec
T =	6.42E+02	ft^2/day	K =	3.92E+00	m/day
K =	9.61E+01	gpd/ft^2	T =	5.97E+01	m^2/day
T =	4.81E+03	gpd/ft			

REFERENCES

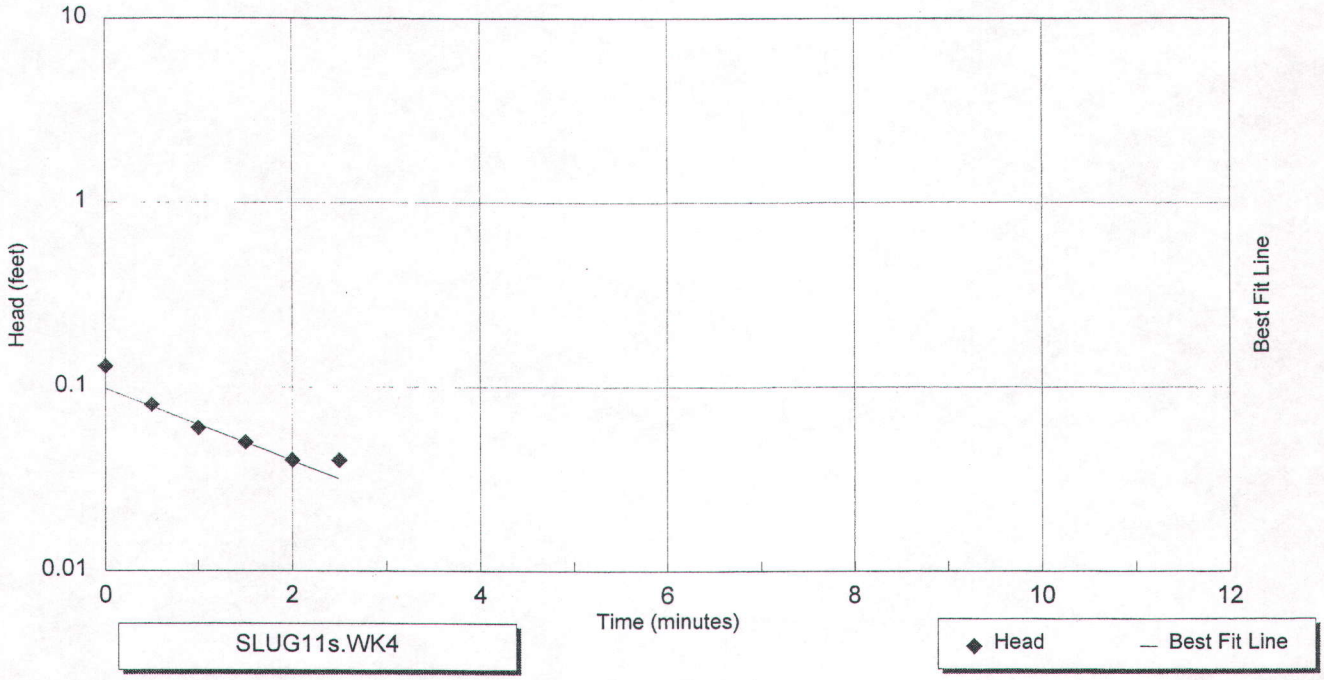
Bouwer, H. and Rice, R.C., 1976, A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells: Water Resources Research, v.12, pp. 423-428.

Bouwer, H., 1989, The Bouwer and Rice slug test - an update: Ground Water, v.27, no.3, pp. 304-309.

Bouwer, H., 1989, DISCUSSION OF:The Bouwer and Rice slug test-an update: Ground Water, v.27, no.5, p.715

PEIZOMETER PZ-11S

International Paper



SLUG TEST DATA INPUT, HEAD, AND BEST FIT LINE FROM REGRESSION ANALYSIS

Time (min.)	Depth below MP(ft)	Head (ft)	Log(y)	Head (Best Fit Line)
0.0000	11.26	0.13	-0.88606	0.10
0.5000	11.21	0.08	-1.09691	0.08
1.0000	11.19	0.06	-1.22185	0.06
1.5000	11.18	0.05	-1.30103	0.05
2.0000	11.17	0.04	-1.39794	0.04
2.5000	11.17	0.04	-1.39794	0.03

Rising Head PZ-11S
INTERNATIONAL PAPER

Rising Head
INTERNATIONAL PAPER

EARTH TECH
SLUG TEST DATA ANALYSIS - BOUWER AND RICE METHOD
For an Unconfined Aquifer with a Partially or Fully Penetrating Well

PROJECT DATA INPUT — RJH & AMP 11/01/94; Rev. 2 CWH 07/05/96

Site Name:	INTERNATIONAL PAPER		
Location:	RIEGELWOOD, NC		
Project No:	33004		
Data Collected By:	R. HOLLAN	Date:	03/26/99
Data Analyzed By:	M. BRANSO	Date:	03/31/99

TEST WELL DATA INPUT

Well No: PZ-11D
Method: WATER REMOVAL WITH MANUAL WATER LEVEL TAPE

Depth of Well from Measuring Point:	51.97	ft
Depth to Static Water Level from Measuring Poin	10.33	ft
Depth to Top of Screen from Measuring Point:	46.97	ft
Length of Screen:	5.00	ft
Radius of Hole:	0.667	ft
Radius of Casing:	0.167	ft
Aquifer Thickness:	50.00	ft
Porosity of Sandpack:	0.35	as a decimal

Test Type: 1 Rising Head

1 = Rising Head
2 = Falling Head

CALCULATED TEST WELL PARAMETERS

Le=	5.00	ft (effective screen length of well)	ln((H-Lw)/rw)= (raw)	2.53	dimensionless
Lw=	41.64	ft (saturated thickness penetrated by well)			
rw=	0.667	ft (radius of borehole)			
rc=	0.167	ft (radius of casing)	ln(Re/rw)= (if Lw<H)	1.68	dimensionless
rc'=	0.167	ft (effective casing radius for partially saturated screens)			
H=	50.00	ft (aquifer thickness)	ln(Re/rw)= (if Lw=H)	2.45	dimensionless
Le/rw=	7.50	dimensionless			
A=	1.79	dimensionless			
B=	0.27	dimensionless			
C=	1.07	dimensionless			
(H-Lw)/rw)=	2.53	dimensionless			
ln(Re/rw)=	1.68	dimensionless			

(Values for A, B, and C valid for Le/rw in range of 4-200)

REGRESSION ANALYSIS

Regression Output:

Constant	0.9676627	(Y-intercept)
Std Err of Y Est	0.00053	
R Squared	0.9876913	
No. of Observations	14	
Degrees of Freedom	12	
X Coefficient(s)	-0.00035	(Slope)
Std Err of Coef.	0.000011	

OUTPUT FROM BEST FIT LINE

Yo =	9.2825	ft (= head y @ t=0, derived from y intercept of best fit line on y/t plot)
Yt =	1.0000	ft (= head y @ time t, derived from best fit line of y/t plot)
t =	2741.5758	min (= time t @ head Yt, derived from best fit line)

CALCULATED HYDRAULIC CONDUCTIVITY AND TRANSMISSIVITY

K =	6.30E-08	ft/sec			
K =	3.78E-06	ft/min	K =	1.92E-06	cm/sec
K =	5.45E-03	ft/day	K =	1.92E-08	m/sec
T =	2.72E-01	ft^2/day	K =	1.66E-03	m/day
K =	4.07E-02	gpd/ft^2	T =	2.53E-02	m^2/day
T =	2.04E+00	gpd/ft			

REFERENCES

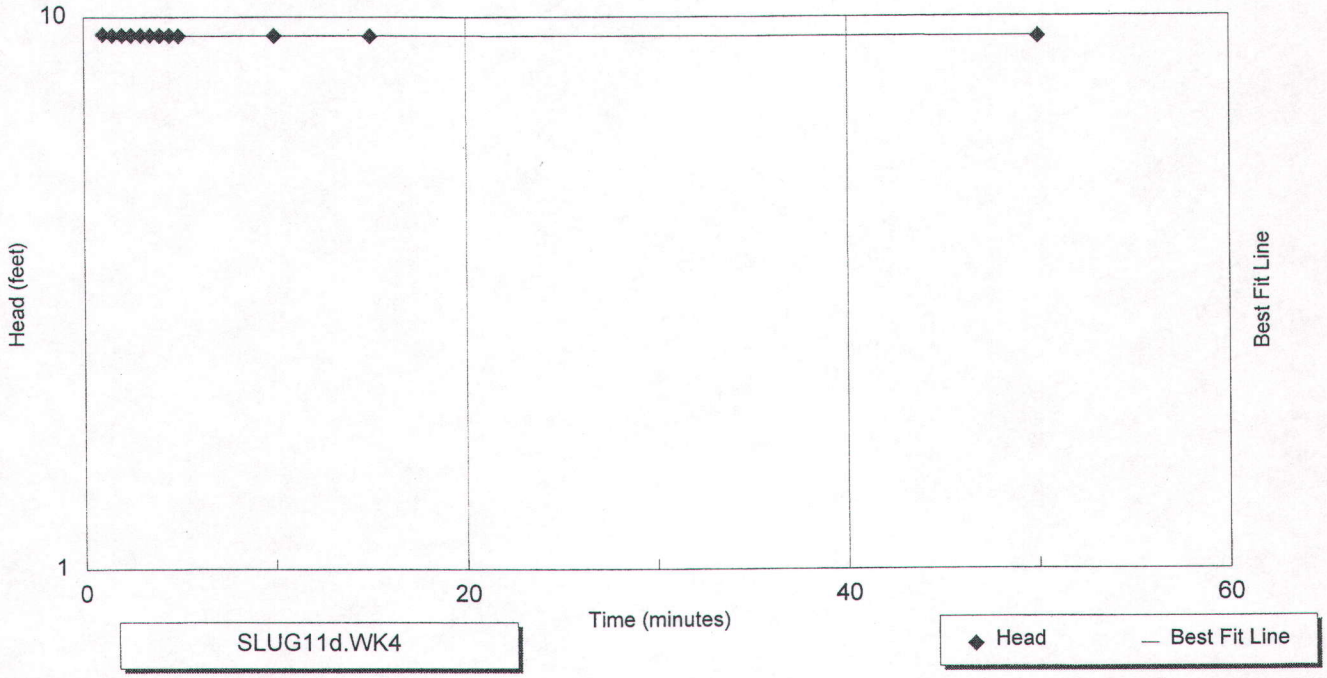
Bouwer, H. and Rice, R.C., 1976, A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells: Water Resources Research, v.12, pp. 423-428.

Bouwer, H., 1989, The Bouwer and Rice slug test - an update: Ground Water, v.27, no.3, pp. 304-309.

Bouwer, H., 1989, DISCUSSION OF:The Bouwer and Rice slug test-an update: Ground Water, v.27, no.5, p.715

PEIZOMETER PZ-11D

International Paper



SLUG TEST DATA INPUT, HEAD, AND BEST FIT LINE FROM REGRESSION ANALYSIS

Time (min.)	Depth below MP(ft)	Head (ft)	Log(y)	Head (Best Fit Line)
0.0000	19.64	9.31	0.96895	9.28
0.5000	19.61	9.28	0.96755	9.28
1.0000	19.60	9.27	0.96708	9.27
1.5000	19.60	9.27	0.96708	9.27
2.0000	19.60	9.27	0.96708	9.27
2.5000	19.60	9.27	0.96708	9.26
3.0000	19.59	9.26	0.96661	9.26
3.5000	19.59	9.26	0.96661	9.26
4.0000	19.58	9.25	0.96614	9.25
4.5000	19.58	9.25	0.96614	9.25
5.0000	19.56	9.23	0.96520	9.24
10.0000	19.52	9.19	0.96332	9.21
15.0000	19.49	9.16	0.96190	9.17
50.0000	19.25	8.92	0.95036	8.91

Rising Head PZ-11D
INTERNATIONAL PAPER

Rising Head
INTERNATIONAL PAPER

EARTH TECH
SLUG TEST DATA ANALYSIS - BOUWER AND RICE METHOD
For an Unconfined Aquifer with a Partially or Fully Penetrating Well

RJH & AMP 11/01/94
Rev. 2 CWH 07/05/96

PROJECT DATA INPUT

Site Name: INTERNATIONAL PAPER
Location: RIEGELWOOD, NC
Project No: 33004
Data Collected By: R. HOLLAN Date: 03/26/99
Data Analyzed By: M. BRANSO Date: 03/31/99

TEST WELL DATA INPUT

Well No: PZ-7S
Method: WATER REMOVAL WITH MANUAL WATER LEVEL TAPE

Depth of Well from Measuring Point:	14.72	ft
Depth to Static Water Level from Measuring Poin	7.19	ft
Depth to Top of Screen from Measuring Point:	9.72	ft
Length of Screen:	5.00	ft
Radius of Hole:	0.667	ft
Radius of Casing:	0.167	ft
Aquifer Thickness:	50.00	ft
Porosity of Sandpack:	0.35	as a decimal

Test Type: 1 Rising Head

1 = Rising Head
2 = Falling Head

CALCULATED TEST WELL PARAMETERS

Le=	5.00	ft (effective screen length of well)	ln((H-Lw)/rw)= (raw)	4.15	dimensionless
Lw=	7.53	ft (saturated thickness penetrated by well)			
rw=	0.667	ft (radius of borehole)			
rc=	0.167	ft (radius of casing)	ln(Re/rw)= (if Lw<H)	1.18	dimensionless
rc'=	0.167	ft (effective casing radius for partially saturated screens)			
H=	50.00	ft (aquifer thickness)	ln(Re/rw)= (if Lw=H)	1.68	dimensionless
Le/rw=	7.50	dimensionless			
A=	1.79	dimensionless			
B=	0.27	dimensionle *(Values for A, B, and C valid for Le/rw in range of 4-200)*			
C=	1.07	dimensionless			
(H-Lw)/rw)=	4.15	dimensionless			
ln(Re/rw)=	1.18	dimensionless			

REGRESSION ANALYSIS

Regression Output:

Constant	0.1893998	(Y-intercept)
Std Err of Y Est	0.049387	
R Squared	0.8370367	
No. of Observations	5	
Degrees of Freedom	3	
X Coefficient(s)	-0.12261	(Slope)
Std Err of Coef.	0.031235	

OUTPUT FROM BEST FIT LINE

Yo =	1.5467	ft (= head y @ t=0, derived from y intercept of best fit line on y/t plot)
Yt =	1.0000	ft (= head y @ time t, derived from best fit line of y/t plot)
t =	1.5447	min (= time t @ head Yt, derived from best fit line)

CALCULATED HYDRAULIC CONDUCTIVITY AND TRANSMISSIVITY

K =	1.55E-05	ft/sec			
K =	9.29E-04	ft/min	K =	4.72E-04	cm/sec
K =	1.34E+00	ft/day	K =	4.72E-06	m/sec
T =	6.69E+01	ft^2/day	K =	4.08E-01	m/day
K =	1.00E+01	gpd/ft^2	T =	6.22E+00	m^2/day
T =	5.00E+02	gpd/ft			

REFERENCES

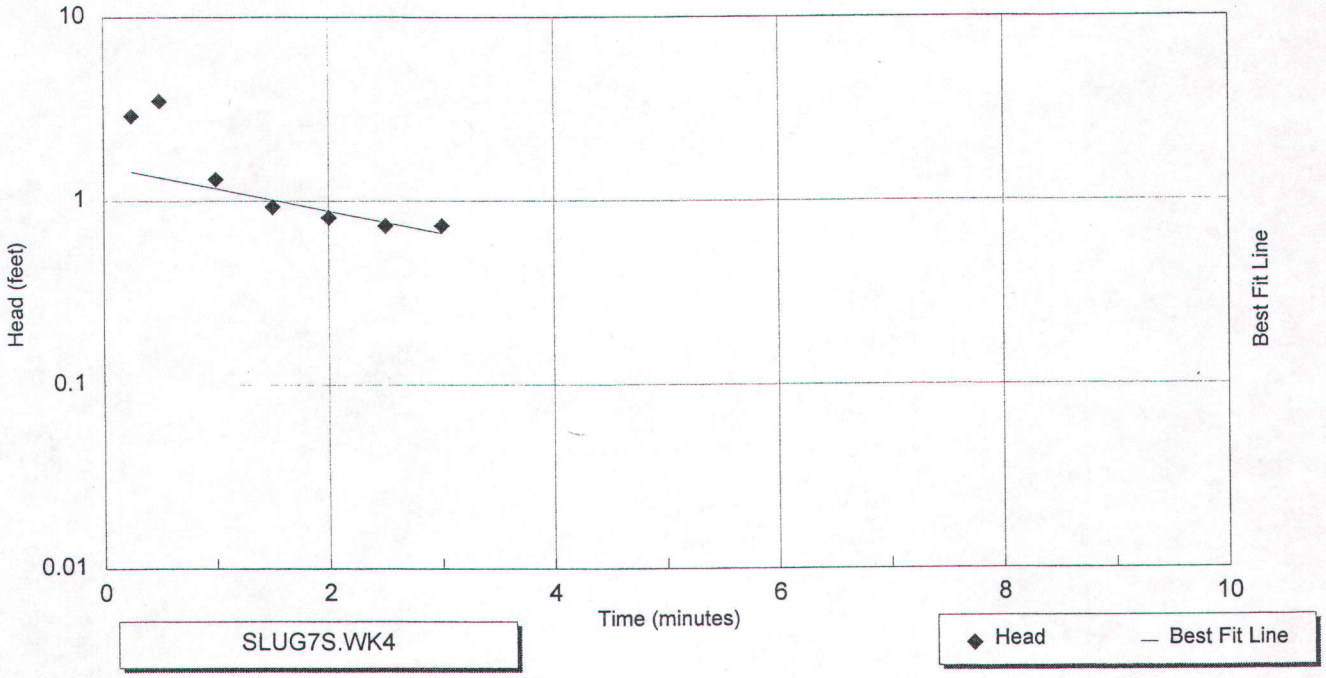
Bouwer, H. and Rice, R.C., 1976, A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells: Water Resources Research, v.12, pp. 423-428.

Bouwer, H., 1989, The Bouwer and Rice slug test - an update: Ground Water, v.27, no.3, pp. 304-309.

Bouwer, H., 1989, DISCUSSION OF:The Bouwer and Rice slug test-an update: Ground Water, v.27, no.5, p.715

PEIZOMETER PZ-7S

International Paper



SLUG TEST DATA INPUT, HEAD, AND BEST FIT LINE FROM REGRESSION ANALYSIS

Time (min.)	Depth below MP(ft)	Head (ft)	Log(y)	Head (Best Fit Line)
0.2500	10.10	2.91	0.46389	1.44
0.5000	10.70	3.51	0.54531	1.34
1.0000	8.50	1.31	0.11727	1.17
1.5000	8.12	0.93	-0.03152	1.01
2.0000	8.00	0.81	-0.09151	0.88
2.5000	7.92	0.73	-0.13668	0.76
3.0000	7.92	0.73	-0.13668	0.66

Rising Head PZ-7S
INTERNATIONAL PAPER

Rising Head
INTERNATIONAL PAPER

D

APPENDIX D

GEOTECHNICAL LABORATORY REPORTS

SINCE
1881

FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"
310 Hubert Street, Raleigh, NC 27603
Telephone: (919) 828-3441
Facsimile: (919) 828-5751

February 3, 1999

Mr. John Funk, P.E.
Earth Tech
701 Corporate Center Drive, Suite 475
Raleigh, North Carolina 27607-5074

Re: **Progress Report No.1**
Laboratory Test Results – COC # 18490
I.P. Landfill Characterization Project
F&R Project No. Z66-371T

Dear John,

Attached are the results of our laboratory tests completed to-date for the referenced project and our corresponding invoice. The balance of the requested tests should be completed this month.

We appreciate the opportunity to be of service to you on this project. Should questions arise, kindly contact us at your convenience.

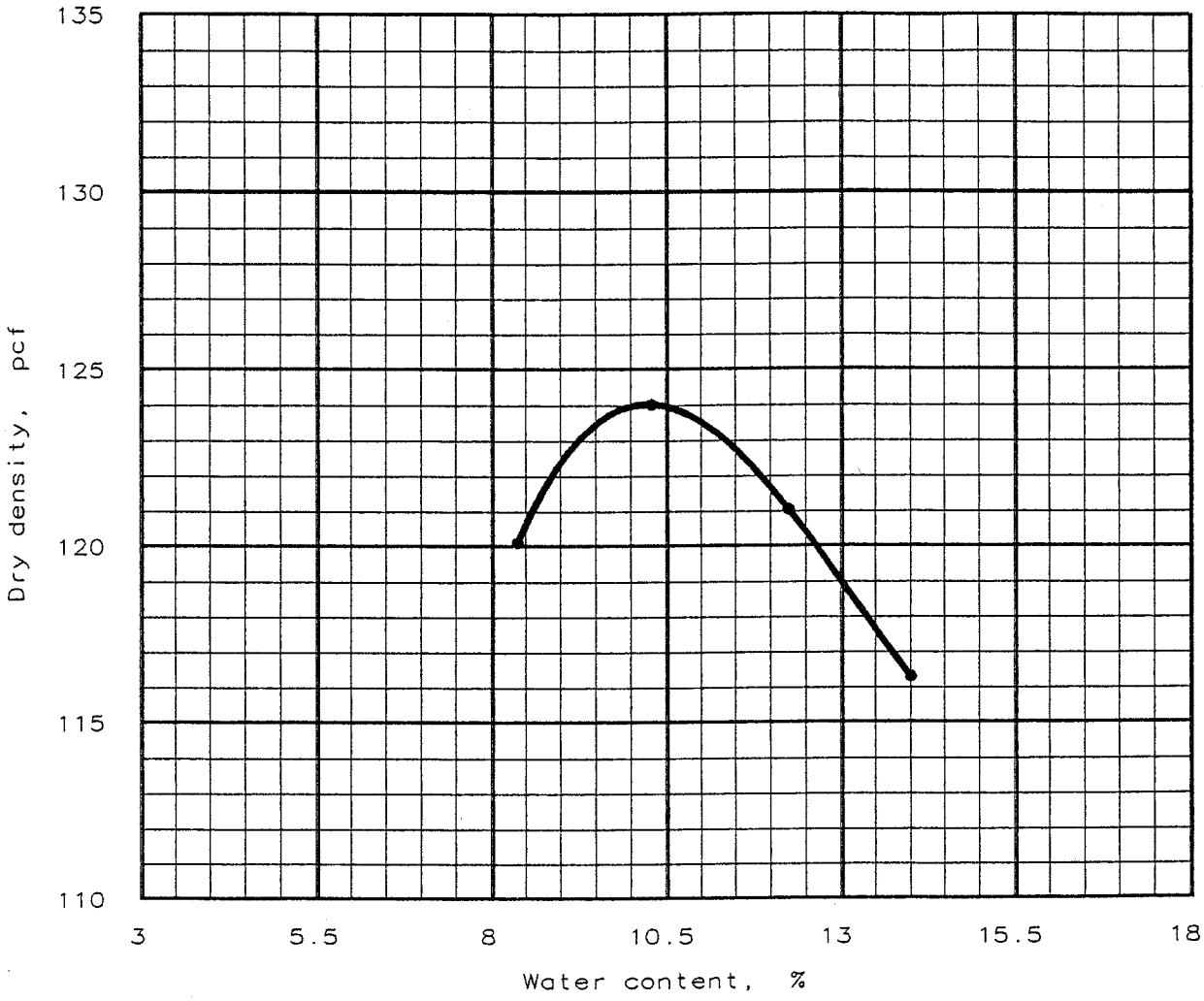
Sincerely,

FROEHLING & ROBERTSON, INC.

David T. Cunningham, P.E.
Geotechnical & Materials Engineer

W/att.

PROCTOR TEST RESULTS



Test specification: ASTM D 698-91 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	SC		15.6 %		24	9	0.0 %	36.3 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 124.0 pcf Optimum moisture = 10.2 %	Light brown clayey SAND/ sandy CLAY

Project No.: Z66-371T
Project: I. P. Landfill
Location: Raleigh, North Carolina

Date: 1-26-1999

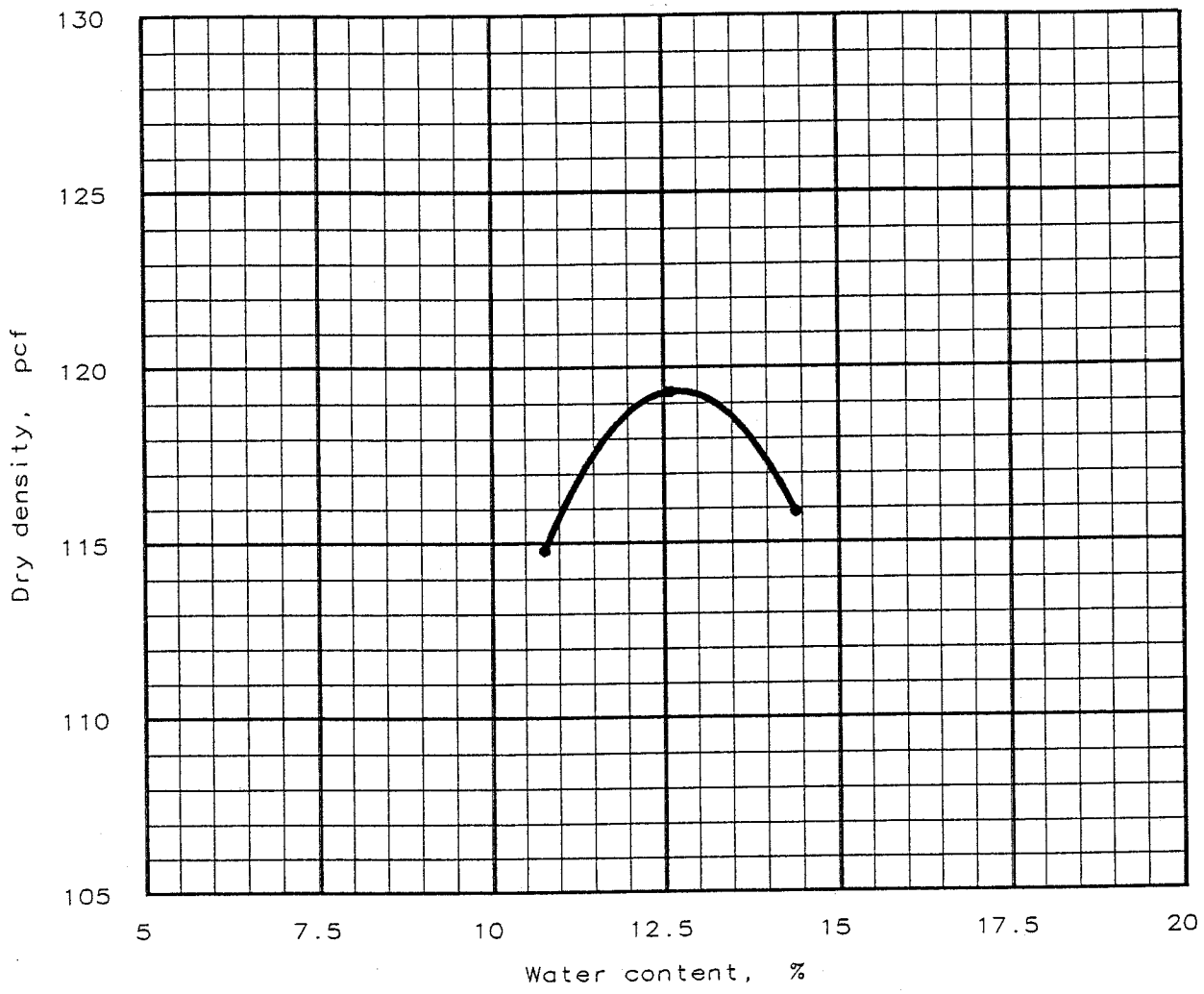
Remarks:
PROCTOR No. 1
PZ-12D
2.5-4.5'

PROCTOR TEST RESULTS

FROEHLING & ROBERTSON, INC.

Fig. No. 1

PROCTOR TEST RESULTS



Test specification: ASTM D 698-91 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
3-5'	SC		14.4 %		30	15	0.0 %	36.0 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 119.4 pcf Optimum moisture = 12.7 %	Tan clayey SAND/sandy CLAY

Project No.: Z66-371T
Project: I. P. Landfill
Location: Raleigh, North Carolina

Date: 1-26-1999

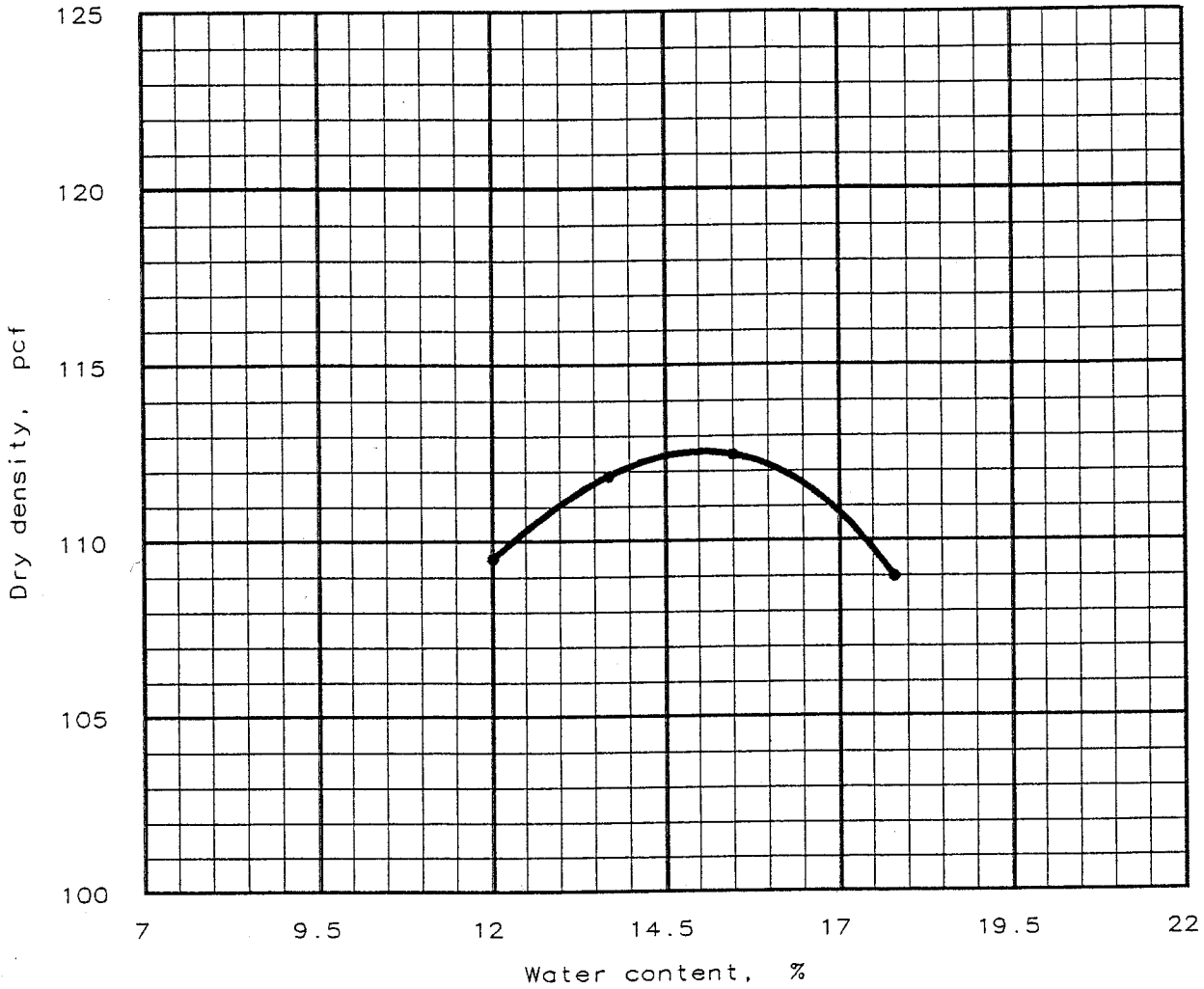
Remarks:
PROCTOR No. 2
PZ-12

PROCTOR TEST RESULTS

FROEHLING & ROBERTSON, INC.

Fig. No. 2

PROCTOR TEST RESULTS



Test specification: ASTM D 698-91 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	SM-SC		24.7 %		28	4	0.0 %	39.6 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 112.6 pcf Optimum moisture = 15.1 %	Dark gray silty clayey SAND/sandy CLAY

Project No.: Z66-371T
Project: I. P. Landfill
Location: Raleigh, North Carolina

Date: 1-26-1999

Remarks:
PROCTOR No. 3
PZ-11D
23-41'

PROCTOR TEST RESULTS

FROEHLING & ROBERTSON, INC.

Fig. No. 3

SINCE F&R 1881

REPORT OF LABORATORY TEST

Client: Earth Tech | Project: I. P. Landfill | Project No.: Z66-371T

Sample No.:	PZ-11D	PZ-12	PZ-12D
Sample Depth, ft.:	23-41	3-5	2.5-4.5
Type of Sample:	Bulk	Bulk	Bulk
Sieve Analysis (ASTM D422-63)			
% Passing No. 4 Sieve	100.0	100.0	100.0
% Passing No. 10 Sieve	99.8	100.0	100.0
% Passing No. 30 Sieve	99.6	94.2	93.9
% Passing No. 40 Sieve	99.2	82.9	83.5
% Passing No. 60 Sieve	98.9	57.9	58.7
% Passing No. 200 Sieve	39.6	36.0	36.3
Hydrometer Analysis (ASTM D422-63)			
% Silt (0.074 to 0.005 mm)	-	-	-
% Clay (0.005 to 0.001 mm)	-	-	-
% Colloids (<0.001 mm)	-	-	-
Atterberg Limits (ASTM D4318-95)			
Liquid Limit	28	30	24
Plasticity Index	4	15	9
Natural Moisture Content (%)	24.7	14.4	15.6
Specific Gravity	-	-	-
Unified Soil Classification	SM-SC	SC	SC
Maximum Density of Soils (In Accordance with ASTM D-698-91, Method A)			
Optimum Moisture (%)	15.1	12.7	10.2
Maximum Density, pcf	112.6	119.4	124.0
Hydraulic Conductivity of Soils (ASTM D-5084-90)			
k cm/sec	-	-	-
Remolded % Density	-	-	-
Moisture Content (%)	-	-	-
Cell pressure (psi)	-	-	-
Back pressure (psi)	-	-	-
Hydraulic gradient (psi)	-	-	-
Porosity	-	-	-

SINCE F&R 1881

REPORT OF LABORATORY TEST

Client: Earth Tech | Project: I. P. Landfill | Project No.: Z66-371T

Sample No.:	PZ-11	PZ-12D
Sample Depth, ft.:	3-5	2.5-4.5
Type of Sample:	ST	ST

Sieve Analysis
(ASTM D422-63)

% Passing No. 4 Sieve	100.0	100.0
% Passing No. 10 Sieve	100.0	100.0
% Passing No. 30 Sieve	91.3	95.0
% Passing No. 40 Sieve	74.8	83.7
% Passing No. 60 Sieve	47.2	59.0
% Passing No. 200 Sieve	29.0	34.4

Hydrometer Analysis
(ASTM D422-63)

% Silt (0.074 to 0.005 mm)	6.0	0.4
% Clay (0.005 to 0.001 mm)	4.0	4.0
% Colloids (<0.001 mm)	19.0	30.0

Atterberg Limits
(ASTM D4318-95)

Liquid Limit	43	46
Plasticity Index	17	18
Natural Moisture Content (%)	16.6	17.2
Specific Gravity	2.767	2.708

Unified Soil Classification

SC	SC

Maximum Density of Soils
(In Accordance with ASTM D-698-91, Method A)

Optimum Moisture (%)	-	-
Maximum Density, pcf	-	-

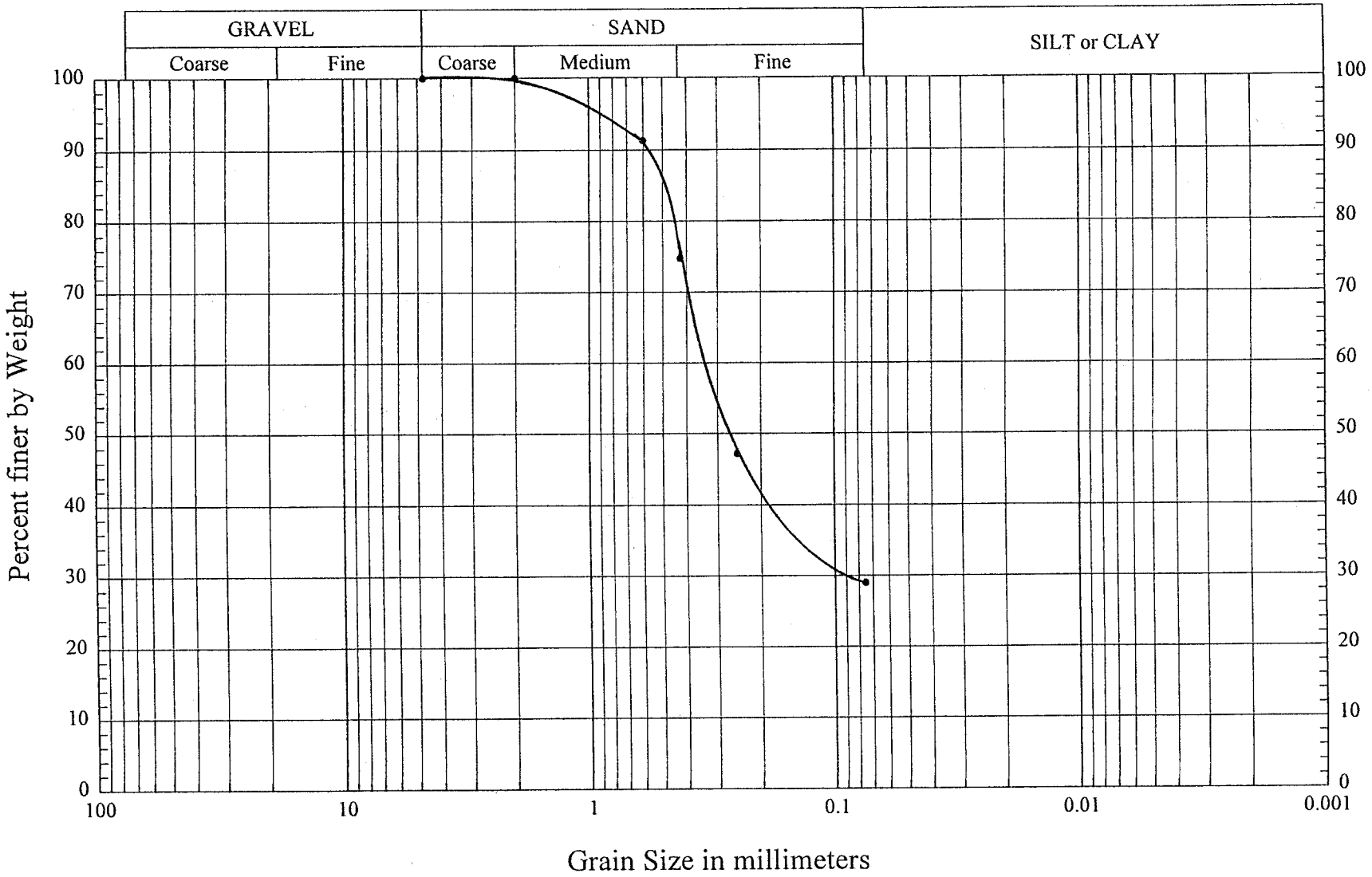
Hydraulic Conductivity of Soils
(ASTM D-5084-90)

k cm/sec	8.6×10^{-5}	3.5×10^{-5}
Remolded % Density	-	-
Moisture Content (%)	16.4	17.2
Cell pressure (psi)	83.0	88.0
Back pressure (psi)	80.0	85.0
Hydraulic gradient (psi)	10.0	10.0

Porosity

36.0	36.6

Particle Size Distribution



Froehling & Robertson, Inc.
Geotechnical - Environmental - Materials
Engineers - Laboratories
Raleigh, NC

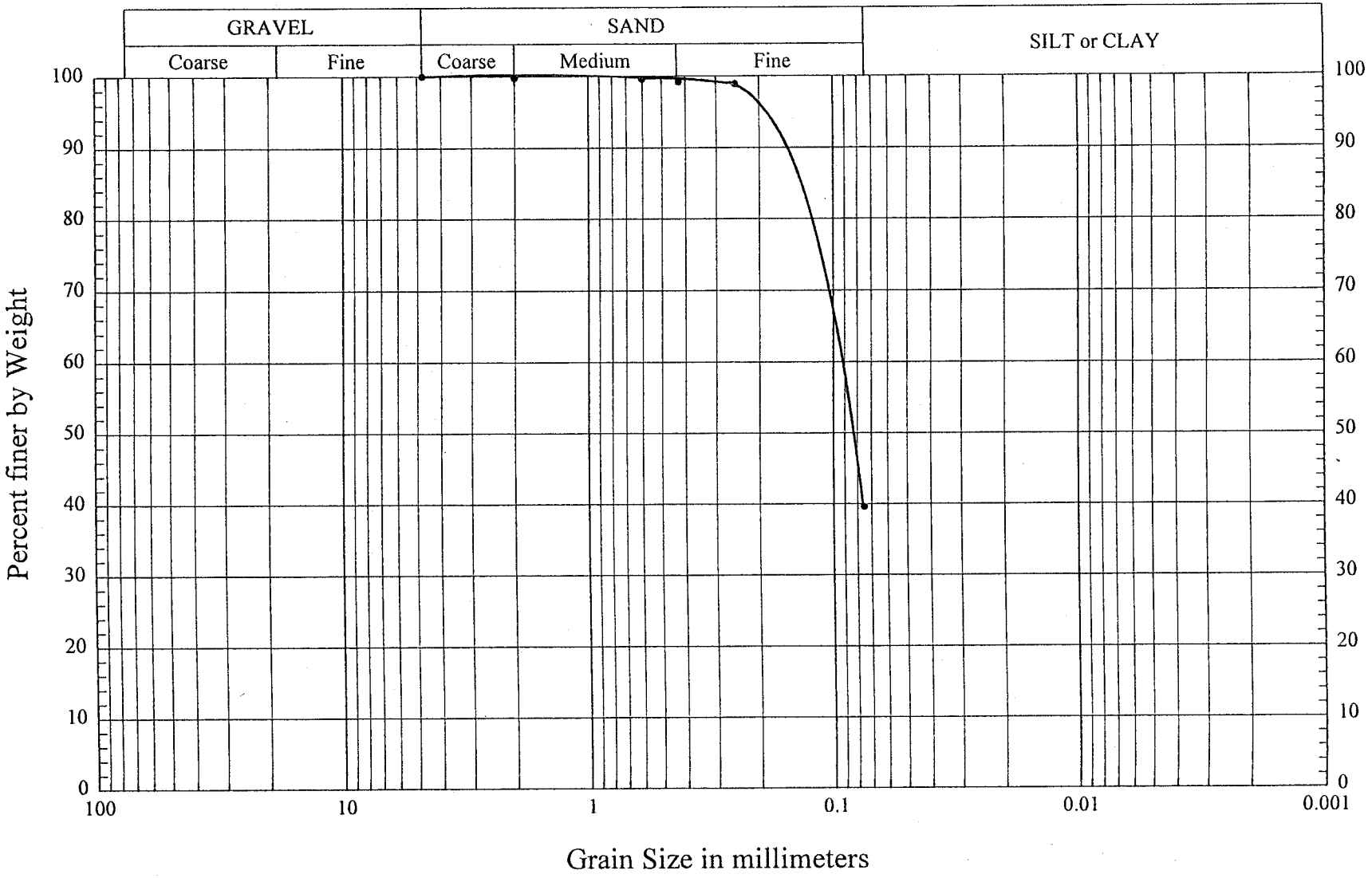
I.P. Landfill Characterization Project
Client: EarthTech
F&R Project No.: Z66-371T

SAMPLE INFORMATION

Sample No.: PZ-11 Sample Depth: 3'-5'
USCS Classification: SC
Atterberg Limits:
LL: 43 PL: 26 PI: 17
Natural Moisture: 16.6%
Porosity: 36.0%

Date: 2/2/99

Particle Size Distribution



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Raleigh, NC

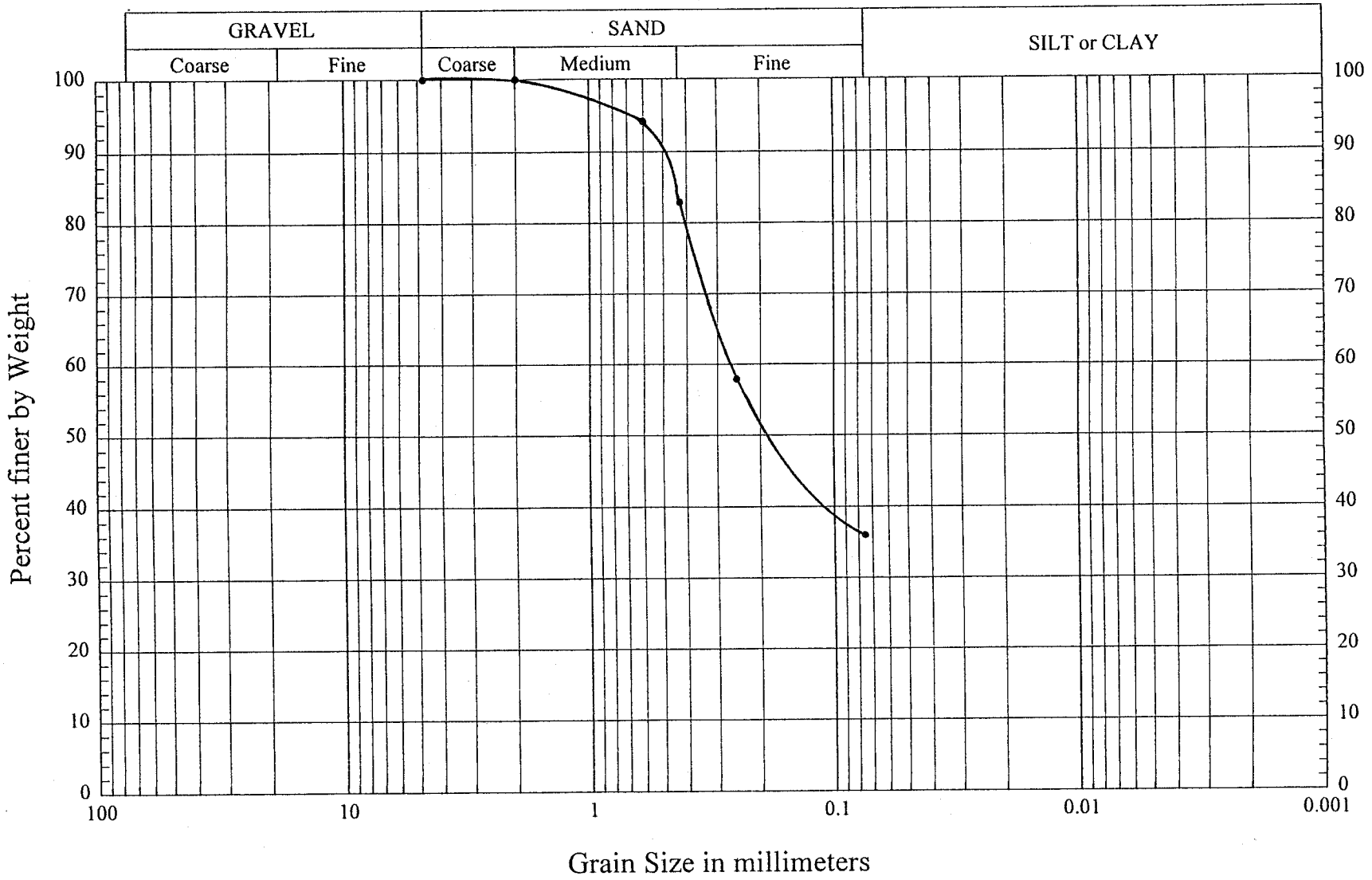
I.P. Landfill Characterization Project
Client: EarthTech
F&R Project No.: Z66-371T

SAMPLE INFORMATION

Sample No.: PZ-11D Sample Depth: 23'-41'
USCS Classification: SM-SC
Atterberg Limits:
LL: 28 PL: 24 PI: 4
Natural Moisture: 24.7%
Porosity:

Date: 2/2/99

Particle Size Distribution



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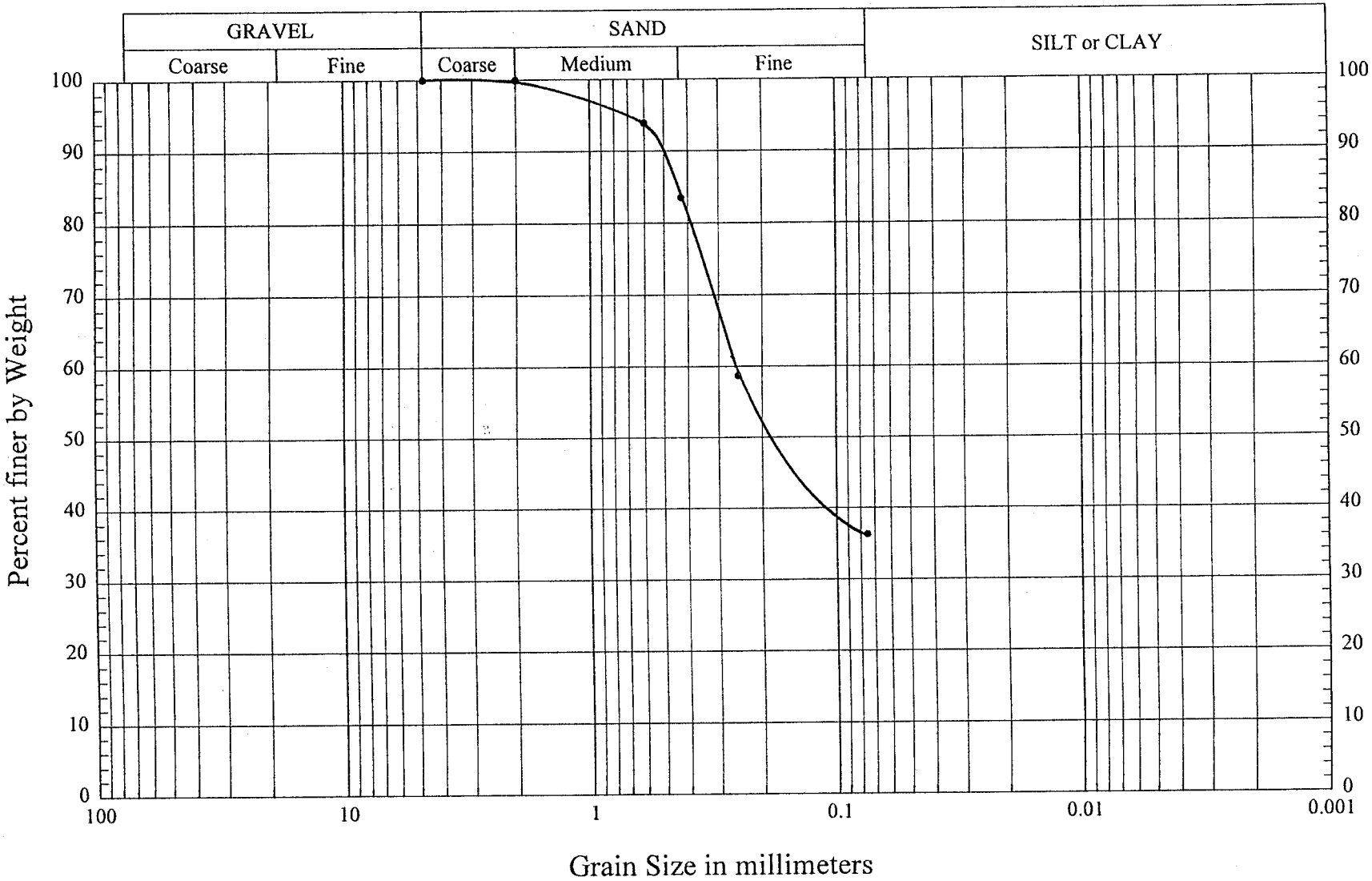
Raleigh, NC

I.P. Landfill Characterization Project
Client: EarthTech
F&R Project No.: Z66-371T

SAMPLE INFORMATION

Sample No.: PZ-12 Sample Depth: 3'-5'
USCS Classification: SC
Atterberg Limits:
LL: 30 PL: 15 PI: 15
Natural Moisture: 14.4%
Porosity:
Date: 2/2/99

Particle Size Distribution



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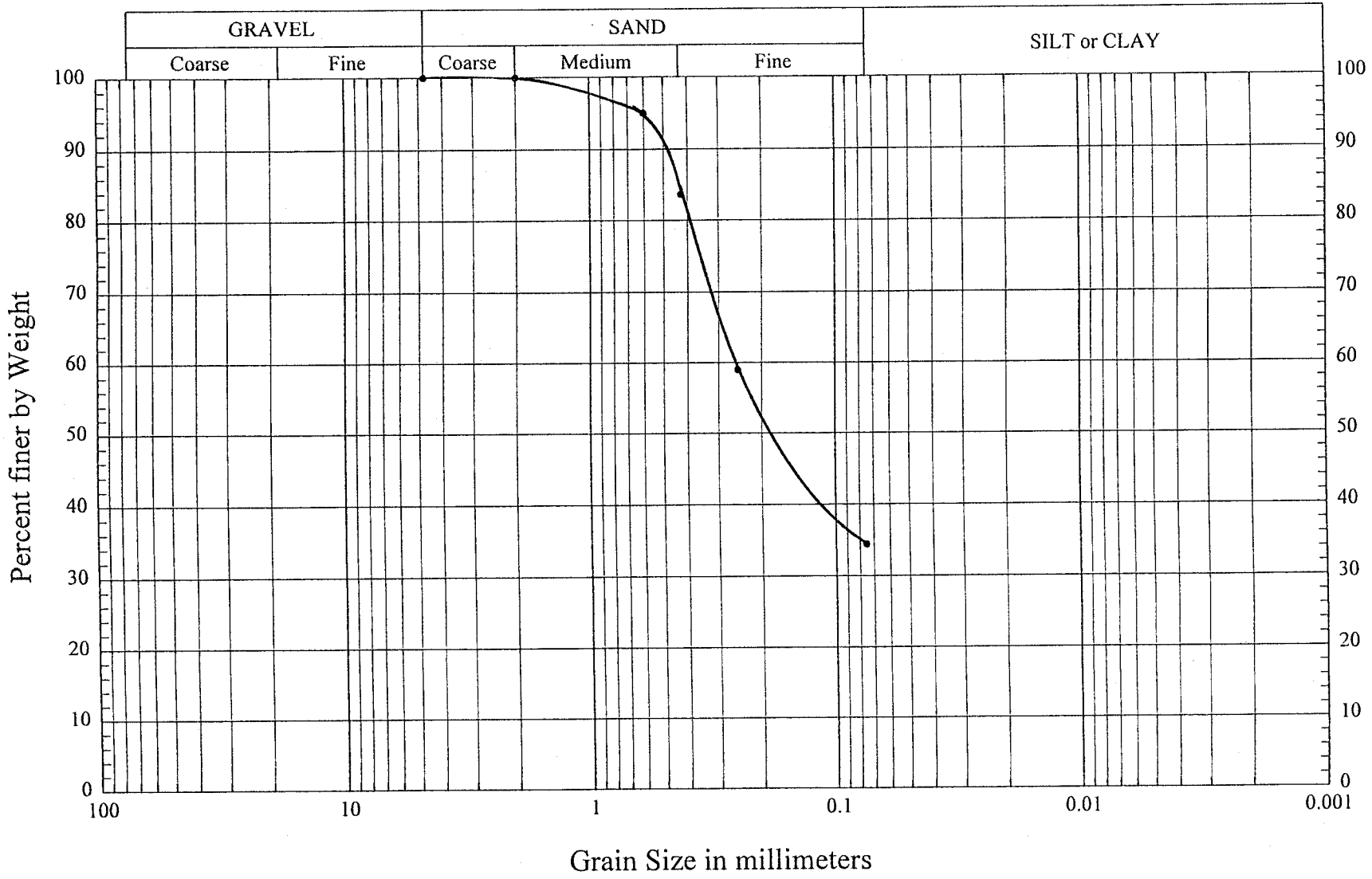
Raleigh, NC

I.P. Landfill Characterization Project
Client: EarthTech
F&R Project No.: Z66-371T

SAMPLE INFORMATION

Sample No.: PZ-12D Sample Depth: 2.5'-4.5'
USCS Classification: SC
Atterberg Limits:
LL: 24 PL: 15 PI: 9
Natural Moisture: 15.6%
Porosity:
Date: 2/2/99

Particle Size Distribution



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Raleigh, NC

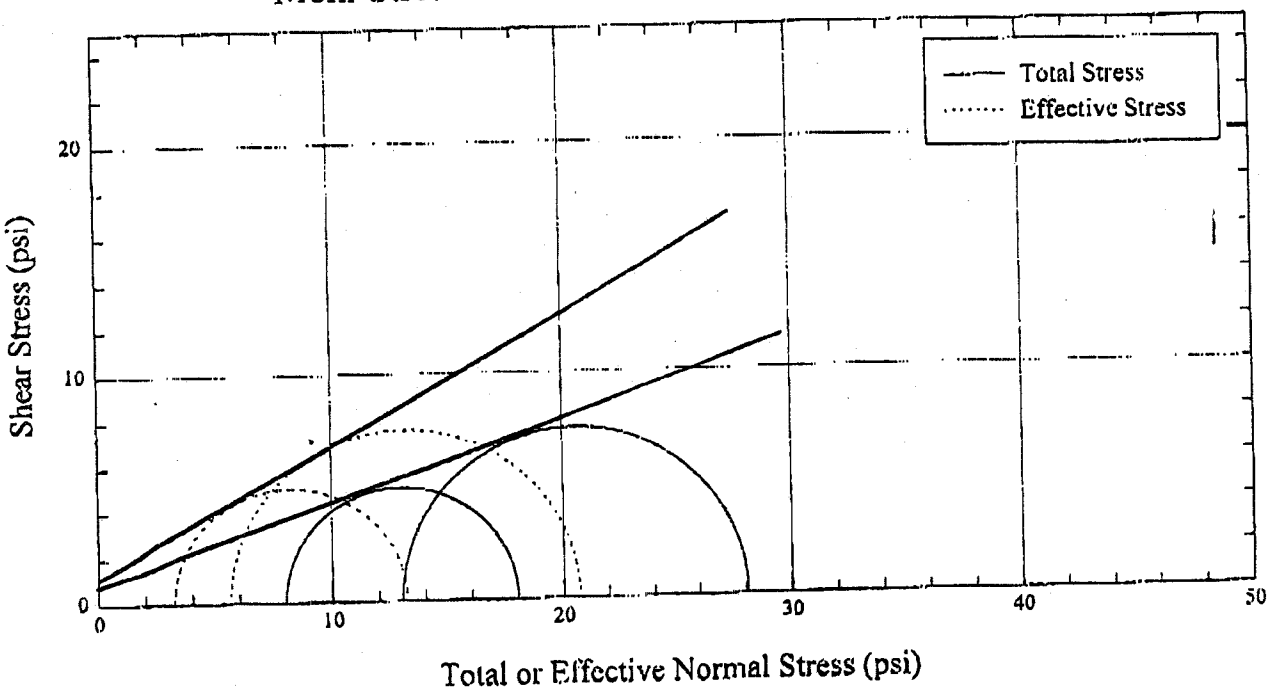
I.P. Landfill Characterization Project
Client: EarthTech
F&R Project No.: Z66-371T

SAMPLE INFORMATION

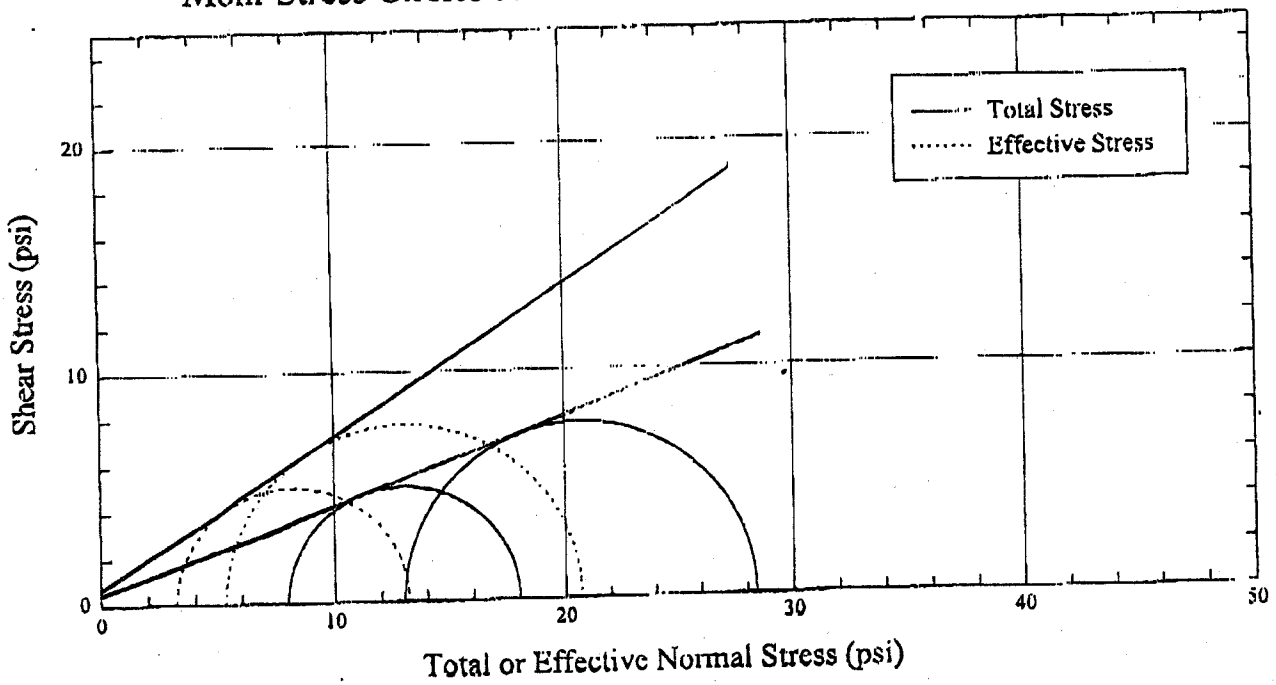
Sample No.: PZ-12D Sample Depth: 2.5'-4.5'
USCS Classification: SC
Atterberg Limits:
LL: 46 PL: 28 PI: 18
Natural Moisture: 17.2%
Porosity: 36.6%

Date: 2/2/99

Mohr Stress Circles at Maximum Deviator Stress



Mohr Stress Circles at Maximum Principal Stress Ratio Criterion



Boring No.: PZ-12 Depth: 3.0-5.0 ft.
Sample Description: Tan clayey SAND/sandy CLAY (SC)
Specimen Type: Remolded Specific Gravity: 2.674 (Calculated) LL: 30 PI: 15 %<200: 36

Froehling & Robertson, Inc.
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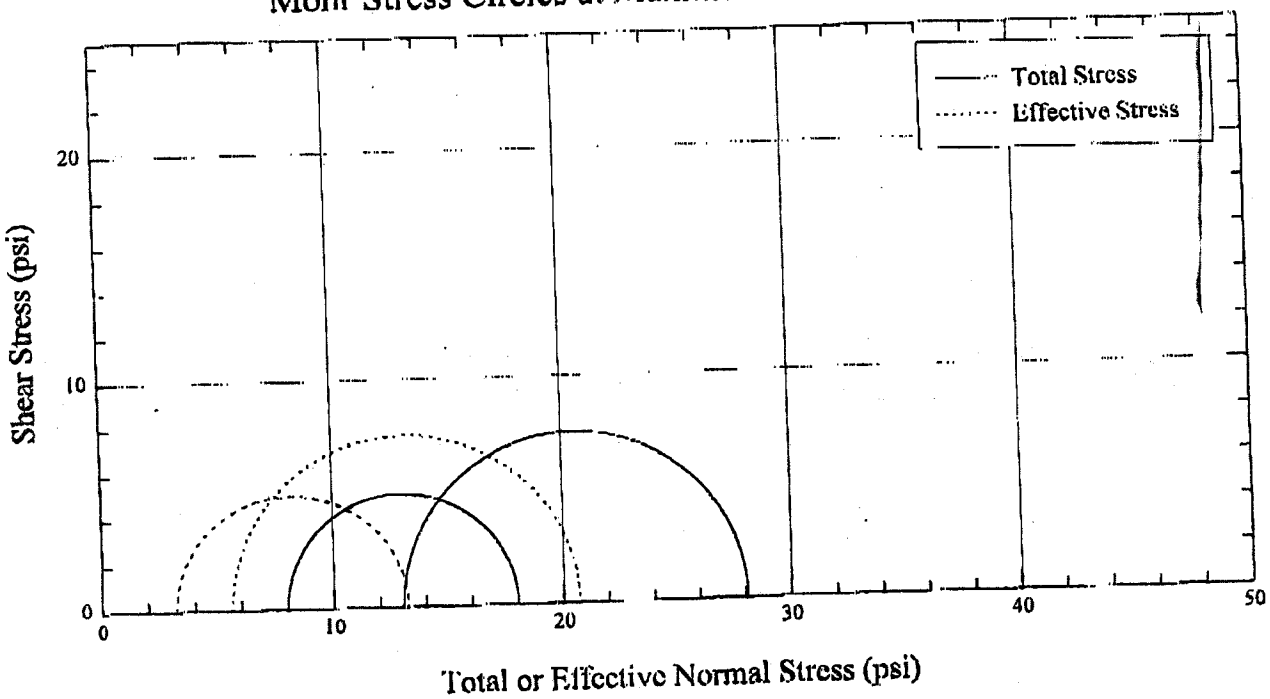
Engineers - Laboratories
Raleigh, NC

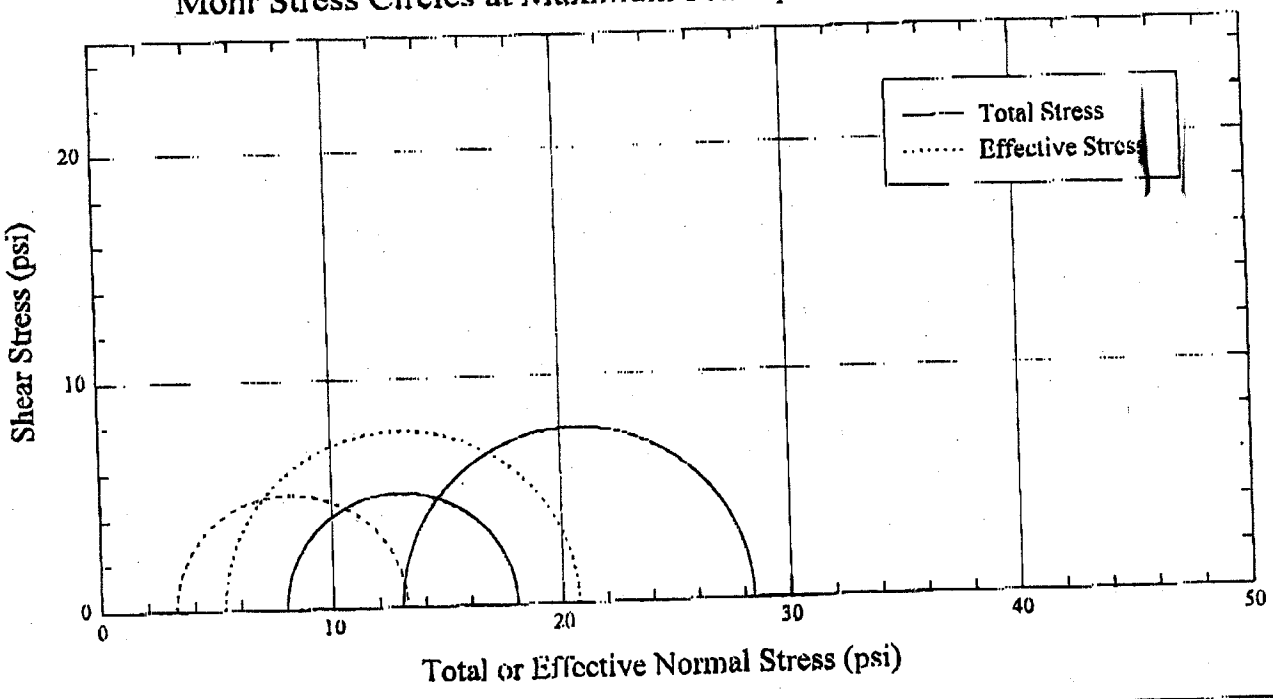
Consolidated Undrained (CU) Triaxial Shear

IP-Landfill

Mohr Stress Circles at Maximum Deviator Stress



Mohr Stress Circles at Maximum Principal Stress Ratio Criterion



Boring No.: PZ-12 Depth: 3.0-5.0 ft.

Sample Description: Tan clayey SAND/sandy CLAY (SC)
Specimen Type: Remolded Specific Gravity: 2.674 (Calculated) LL: 30 PI: 15 %<200: 36

Froehling & Robertson, Inc.
Geotechnical - Environmental - Materials
Engineers - Laboratories
Raleigh, NC

Consolidated Undrained (CU) Triaxial Shear

IP-Landfill

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310 Hubert Street, Raleigh, NC 27603
Telephone: (919) 828-3441
Facsimile: (919) 828-5751

March 25, 1999

Mr. John Funk, P.E.
Earth Tech
701 Corporate Center Drive, Suite 475
Raleigh, North Carolina 27607-5074

Re: **Progress Report No. 2**
Laboratory Test Results – COC # 18490
I.P. Landfill Characterization Project
F&R Project No. Z66-371T

Dear John,

Attached are the balance of our laboratory test results pertaining to the referenced project and our corresponding invoice.

We have appreciated the opportunity to be of service to you on this project. Should questions arise, kindly contact us at your convenience.

Sincerely,
FROEHLING & ROBERTSON, INC.

David T. Cunningham

David T. Cunningham, P.E.
Geotechnical & Materials Engineer

W/att.

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REPORT OF LABORATORY TEST

Client: Earth Tech | Project: I. P. Landfill | Project No.: Z66-371T

Sample No.:	PZ-11D	PZ-12	PZ-12D
Sample Depth, ft.:	23-41	3-5	2.5-4.5
Type of Sample:	Bulk	Bulk	Bulk
Sieve Analysis (ASTM D422-63)			
% Passing No. 4 Sieve	100.0	100.0	100.0
% Passing No. 10 Sieve	99.8	100.0	100.0
% Passing No. 30 Sieve	99.6	94.2	93.9
% Passing No. 40 Sieve	99.2	82.9	83.5
% Passing No. 60 Sieve	98.9	57.9	58.7
% Passing No. 200 Sieve	39.6	36.0	36.3
Hydrometer Analysis (ASTM D422-63)			
% Silt (0.074 to 0.005 mm)	-	-	-
% Clay (0.005 to 0.001 mm)	-	-	-
% Colloids (<0.001 mm)	-	-	-
Atterberg Limits (ASTM D4318-95)			
Liquid Limit	28	30	24
Plasticity Index	4	15	9
Natural Moisture Content (%)	24.7	14.4	15.6
Specific Gravity	-	2.674	2.681
Unified Soil Classification	SM-SC	SC	SC
Maximum Density of Soils (In Accordance with ASTM D-698-91, Method A)			
Optimum Moisture (%)	15.1	12.7	10.2
Maximum Density, pcf	112.6	119.4	124.0
Hydraulic Conductivity of Soils (ASTM D-5084-90)			
k cm/sec	-	1.1×10^{-4}	1.2×10^{-4}
Remolded % Density	-	95.6	94.9
Moisture Content (%)	-	13.7	11.0
Cell pressure (psi)	-	98.0	108.0
Back pressure (psi)	-	95.0	105.0
Hydraulic gradient (psi)	-	10.0	10.0
Porosity (%)			
N	-	38.8	29.7

SINCE F&R 1881

REPORT OF LABORATORY TEST

Client: Earth Tech | Project: I. P. Landfill | Project No.: Z66-371T

Sample No.:	PZ-11	PZ-12D	PZ-7
Sample Depth, ft.:	3-5	2.5-4.5	14.0-16.0
Type of Sample:	ST	ST	ST
Sieve Analysis (ASTM D422-63)			
% Passing No. 4 Sieve	100.0	100.0	100.0
% Passing No. 10 Sieve	100.0	100.0	96.9
% Passing No. 30 Sieve	91.3	95.0	96.3
% Passing No. 40 Sieve	74.8	83.7	96.1
% Passing No. 60 Sieve	47.2	59.0	95.5
% Passing No. 200 Sieve	29.0	34.4	39.9
Hydrometer Analysis (ASTM D422-63)			
% Silt (0.074 to 0.005 mm)	6.0	0.4	26.8
% Clay (0.005 to 0.001 mm)	4.0	4.0	4.1
% Colloids (<0.001 mm)	19.0	30.0	9.0
Atterberg Limits (ASTM D4318-95)			
Liquid Limit	43	46	28
Plasticity Index	17	18	8
Natural Moisture Content (%)	16.6	17.2	26.2
Specific Gravity	2.767	2.708	2.693
Unified Soil Classification	SC	SC	SC
Unit Weight of Soils			
Wet Weight, pcf	124.4	124.3	130.0
Dry Weight, pcf	106.7	106.1	103.0
Moisture Content (%)	16.6	17.2	26.2
Hydraulic Conductivity of Soils (ASTM D-5084-90)			
k cm/sec	8.6×10^{-5}	3.5×10^{-5}	6.1×10^{-6}
Remolded % Density	-	-	-
Moisture Content (%)	16.4	17.2	26.2
Cell pressure (psi)	83.0	88.0	48.0
Back pressure (psi)	80.0	85.0	45.0
Hydraulic gradient (psi)	10.0	10.0	10.0
Porosity (%)			
N, %	36.0	36.6	39.6

SINCE
1881

FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"
310 Hubert Street, Raleigh, NC 27603
Telephone: (919) 828-3441
Facsimile: (919) 828-5751

July 30, 1999

REPORT OF LABORATORY TESTING

Earth Tech
701 Corporate Drive, Suite 475
Raleigh, North Carolina 27607-5074

Attn.: Mr. John Funk, P.E.

Re: I. P. Landfill Characterization Project
Raleigh, North Carolina
F&R Project No. Z66-371T

Dear Mr. Funk:

Attached are the results of our laboratory tests performed on your two bulk soil samples (marked TP-1 and TP-2) from the referenced project. The samples were submitted to our laboratory on July 16, 1999. Each sample was tested to determine the Atterberg limits. Sample No. TP-1 was tested to determine its moisture-density relationship and hydraulic conductivity.

Should questions arise, please contact us at your convenience.

Respectfully,

FROEHLING & ROBERTSON, INC.

Ronald H. Calder
Laboratory Supervisor

RHC/pg

SINCE F&R 1881

LABORATORY TEST RESULTS

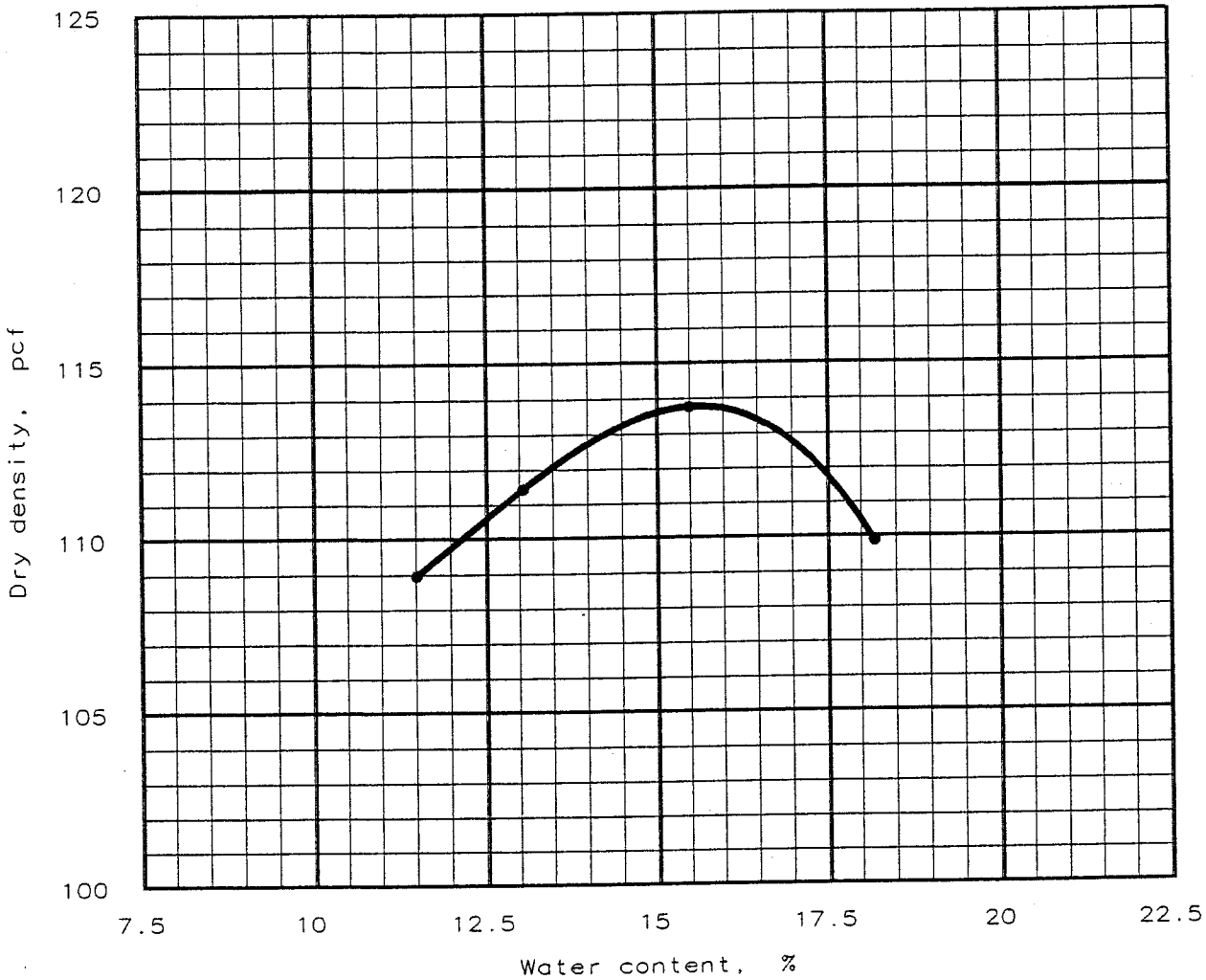
Date: June 21, 1999

Project: I. P. Landfill

Location: Raleigh, North Carolina

Boring	TP-1	TP-1	TP-2
SIEVE ANALYSIS (ASTM D422-63)			
% Passing No. 4 Sieve	100.0	-	100.0
% Passing No. 10 Sieve	100.0	-	99.8
% Passing No. 30 Sieve	98.2	-	98.0
% Passing No. 40 Sieve	95.2	-	95.9
% Passing No. 60 Sieve	84.1	-	88.0
% Passing No. 200 Sieve	62.7	-	63.3
ATTERBERG LIMITS (ASTM D4318-95)			
Liquid Limit	57	-	61
Plasticity Index	33	-	36
Specific Gravity	2.72	-	-
UNIFIED SOIL CLASSIFICATION			
	CH	-	CH
MAXIMUM DENSITY OF SOILS In accordance with ASTM D1557, Method A			
Optimum moisture, %	15.6	-	-
Maximum density, pcf	113.8	-	-
PERMEABILITY OF SOILS			
k cm/sec	1.9×10^{-7}	9.4×10^{-8}	-
Remolded % density	90.5	95.4	-
Moisture content, %	18.5	18.5	-
Cell pressure, psi	93.0	113.0	-
Back pressure, psi	90.0	110.0	-
Hydraulic gradient, psi	10.0	10.0	-

PROCTOR TEST RESULTS



Test specification: ASTM D 1557-91 Method A, Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CH		25.1 %		57	33	0.0 %	62.7 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 113.8 pcf Optimum moisture = 15.6 %	Yellow-tan silty CLAY

Project No.: Z66-371T
Project: I. P. Landfill
Location: Raleigh, North Carolina

Date: 8-04-1999

Remarks:
PROCTOR No. 7
TP-1

PROCTOR TEST RESULTS

FROEHLING & ROBERTSON, INC.

Fig. No. 7

E

APPENDIX E

MCKIM AND CREED GEOTECHNICAL REPORT
BORING LOGS

Geotechnical Report
Proposed Pond
Federal Paper Board Company
Riegelwood, North Carolina
Job No. 1063-93-447

S&ME

June 17, 1994

McKim & Creed Engineers
243 North Front Street
Wilmington, North Carolina 28401

Attention: Mr. Street Lee, P.E.

Reference: Geotechnical Report
Proposed Pond
Federal Paper Board Company
Riegelwood, North Carolina
Job No. 1063-93-447

Gentlemen:

S&ME, Inc. has completed the authorized geotechnical study for the proposed pond project located near the Federal Paper Board Company plant in Riegelwood, North Carolina, as shown in Figures 1 and 2. This investigation was authorized by and conducted in general accordance with S&ME Proposal No. 181-93 dated July 16, 1993. Subsurface conditions were investigated at the proposed approximately 250-acre pond site, the proposed Livingston Creek bridge site, and the proposed pump station site at the existing polishing pond.

The subsurface exploration program at the proposed pond site consisted of drilling a total of 42 soil test borings, excavation of ten test pits, and installation of six temporary piezometers at the approximate locations shown in Figure 3. Three soil borings (B-18, B-23, and B-27) were drilled adjacent to Livingston Creek along the proposed bridge alignment, and one soil test boring (B-10) was drilled at the proposed pump station site at the existing polishing lagoon. Soil test borings were advanced to depths ranging from 10 to 50 feet below existing ground surface by hollow stem augering and wash boring techniques. The boreholes were sampled and tested by the standard penetration test method (ASTM D-1586) to determine the consistency of the subsurface soils. Two undisturbed soil samples were obtained in accordance with the procedures presented in ASTM D-1587. In addition to visually classifying soils encountered at the test pit locations, representative bulk bag samples of the in-place soils were obtained for laboratory testing.

This report presents the findings of the investigation with recommendations for design and construction of the pond and the appurtenant structures based upon evaluations of the subsurface conditions and results of geotechnical engineering analysis.

PROJECT AND SITE DESCRIPTION

The proposed pond will encompass approximately 250 acres of undeveloped land located east of Livingston Creek, south of the Cape Fear River, and north of North Carolina Secondary Road (NCSR) 1818, as shown in Figure 2. The proposed pond site was timbered prior to initiation of the subsurface exploration program; however, the site had not been cleared of stumps and timbering debris. Therefore, a dozer was required to access the proposed boring locations.

The available site topographic map indicates that existing ground surface elevations along the eastern and southern pond perimeter range from approximately +50 feet to +62 feet (plant vertical datum). Ground surface elevations along the northern and western perimeter of the proposed pond typically range from about +40 feet to +50 feet; however, ground surface elevations on the order of +14 feet to +18 feet occur at the western and northern pond perimeter where two natural drainage features traverse the site.

The proposed pond will consist of three interconnected cells with each cell lined with a synthetic geomembrane to prevent the impounded water from seeping into the underlying soils. The area each cell will encompass ranges from approximately 40 to 65 acres. Total storage capacity within the three cells of the pond will be approximately 1.6 billion gallons. Construction of the 14,000-foot long earth embankments will require the placement of about 2.1 million cubic yards of structural fill. Structural fill will be obtained on site by excavating the in-place soils within the limits of the proposed embankment to attain the required pond bottom elevation.

Design features of the proposed embankment construction include the following:

- Upstream (inside) and downstream (outside) slopes: 2.5:1 (horizontal to vertical)
- Crest elevation: +76 feet
- Pool elevation: +73 feet

- Pond bottom elevation: +34.5 feet to +45 feet
- Crest width of dike embankment: 15 feet

In addition to the embankment construction, the proposed project will include the following appurtenant structures:

- A pump station at the northeastern corner of the existing polishing lagoon. The elevation at the bottom of the slab will be approximately +13 feet.
- A pump station at the western edge of the proposed pond. The elevation at the bottom of the slab will be approximately +24.1 feet.
- Two, 48-inch diameter ductile iron pipelines will be constructed beneath the embankment separating Cell 1 from Cell 2 (Divider Station Nos. 1 and 2) and beneath the embankment separating Cell 2 from Cell 3 (Divider Station Nos. 3 and 4). The subgrade elevation beneath Divider Station Nos. 1 and 2 will be approximately +30.9 feet, whereas the subgrade elevation beneath Divider Station Nos. 3 and 4 will be approximately +34.6 feet.
- Another 42-inch diameter ductile iron pipeline will be constructed from Cell 2 (#2 By-Pass Station) to the proposed pond pump station. The subgrade elevation along this pipeline will vary from approximately +30.9 feet at Cell 2 to approximately +26.9 feet at the pump station.
- Flow regulating gates will be constructed within the proposed embankments to control the flow of water through the Divider Station and the #2 By-Pass Station pipelines. The elevation at the top of slab supporting these gates at Divider Station Nos. 1 and 2 and the #2 By-Pass Station will be approximately +29.1 feet, whereas the top of slab elevation at the gates at Divider Station Nos. 3 and 4 will be approximately +32.8 feet.
- The pipeline connecting the existing polishing pond with the proposed pond will be buried in a structural fill embankment, except for the bridge-supported section crossing Livingston Creek. The proposed valve boxes to be constructed adjacent to both pump stations will also be supported by structural fill embankments.

- Surface drainage will be collected along the southern perimeter of the proposed pond, routed through buried pipes, and discharged into existing drainage features near the west and east ends of the site.

SUBSURFACE CONDITIONS

Soil test borings indicate that subsurface conditions at the proposed pond site generally consist of loose to medium dense clean to clayey sands underlain by loose to dense clayey sands/sandy clays (known locally as the Pee Dee Formation soils). Clay seams were noted at 29 of the 58 sampling locations; however, these clay strata appear to occur intermittently across the proposed pond site, both horizontally and vertically. Although the consistency of these clays is typically firm to stiff, very soft to soft clays were encountered at the following boring locations and elevations:

Boring	Elevation, feet
B-11	+31 to Unknown
B-22	+59 to +56
B-26	+31.5 to +29
B-32	+33 to +28
B-37	+36 to +33.5
B-43	+44 to +41
B-47	+31 to +26
B-49	+33 to +29
MW-4	+34 to Unknown

The depth of the clay stratum at boring B-11 and MW-4 is not known since the borings were terminated within these clays at Elevation +30 and +28, respectively.

None of the soil test borings penetrated the Pee Dee Formation soils. Borings previously drilled to depths exceeding 100 feet at the Federal Paper Board Riegelwood Plant site have not penetrated the Pee Dee Formation. As such, the Pee Dee Formation is considered to be the base soil stratum in the geologic profile in this area.

Groundwater elevations observed during and following the subsurface exploration program were determined to vary from about elevations +27 feet to +54 feet. The higher groundwater elevations most likely represent a perched water condition whereby the infiltrated surface waters cannot readily flow through the underlying clays. The groundwater elevations near the natural draws at the western and central portions of the proposed pond site will generally be lower since groundwater can flow laterally and discharge into these draws. The most recent measurements of groundwater elevations at the temporary piezometers were made on May 23, 1994. These measurements, presented in Table No. 1 indicate that groundwater levels vary from elevations +42.8 feet to +45.8 feet. However, the prevailing direction of groundwater flow appears to be toward the north-northwest in the direction of the Cape Fear River and Livingston Creek.

Generalized subsurface profiles, which have been prepared from the soil test boring data to graphically illustrate subsurface conditions encountered along the northern and southern perimeter of the pond, are attached to this report as Figures 4 and 5. Variations from the generalized subsurface profiles described above and more detailed descriptions of the subsurface conditions encountered at individual test boring locations are presented in the Test Boring Records attached as Appendix A.

LABORATORY TESTING

Representative samples of the recovered soils were subjected to laboratory testing to determine moisture content, Atterberg limits, unit weights, gradation characteristics, compaction parameters, and triaxial shear strengths. Results of these tests are discussed below and presented in Appendix B.

Results of the moisture content determinations indicate that the relatively clean sands exhibit moisture contents ranging from four to 30 percent, whereas the clayey sands and sandy clays (excluding the Pee Dee soils) had moisture contents ranging from about twelve to 47 percent. The Pee Dee soils exhibit moisture contents in the 27 to 30 percent range. The gradation test results indicate that the percentage of fines in the clean and clayey sands ranges from three to 42 percent, whereas the percentage of fines in the sandy clays ranges from 51 to 61 percent.

Results of the Atterberg limits testing indicate that the clayey sands are non-plastic. A sample of the very soft clay encountered from a depth of 23.5 to 25 feet at boring B-10 had a liquid limit of 30, a plastic limit of 15, and a plasticity index of 15. Undisturbed soil samples of the clayey sands obtained at borings B-12 and B-42 had wet densities and dry densities ranging from approximately 124 to 129 pounds per cubic foot (pcf) and 106 to 110 pcf, respectively.

Four bulk samples of in-place soils, which will be used as structural fill to construct the pond embankments, were compacted to approximately 95 percent of the standard Proctor maximum dry density and subjected to consolidated-undrained triaxial testing with pore pressure measurements. In addition, one undisturbed soil sample was obtained at boring B-12 and subjected to triaxial testing. Results of the triaxial shear strength testing indicate the following shear strength parameters for the tested soils.

	Effective Stress		Total Stress	
Soil Type	Cohesion, c'	Friction Angle, o'	Cohesion, c	Friction Angle, o
Gray Clean SAND (remolded)	0 psf	30 degrees	40 psf	15 degrees
Gray SAND - Some Clay (remolded)	70 psf	29 degrees	275 psf	14 degrees
Clayey SAND (remolded)	430 psf	29 degrees	790 psf	26 degrees
Sandy CLAY (remolded)	450 psf	16 degrees	560 psf	7 degrees
Clayey SAND (undisturbed)	0 psf	34 degrees	130 psf	29 degrees

STABILITY ANALYSES

As previously indicated in this report, the proposed pond embankments will be constructed by placing 14 to 62 feet of structural fill to attain a crest elevation of +76 feet. The upstream (inside) and downstream (outside) slopes of the embankment will be constructed at 2.5:1 (horizontal to vertical) to provide both a stable slope configuration and to decrease the potential for surface erosion. The lower portion of the downstream (outside) embankment will be sloped at 3:1 (horizontal to vertical) from the level of the service road to the toe of the embankment; however, no service road will be constructed along the northern perimeter of the pond. The pond will be lined with a geomembrane liner system to prevent seepage of the impounded water into the underlying soils.

Slope stability analyses have been conducted for the proposed pond embankment configuration utilizing the computerized version of the Simplified Janbu Method of Slices or Modified Bishop Method developed at Purdue University as the STABL5 Program. Since the pond will be lined with a geomembrane liner system, the phreatic surface through the proposed embankment will not be affected by the impounded water but will reflect the site groundwater level, as shown in Figure 6. Computer print-outs from slope stability analyses are presented in Appendix C of this report. Based upon laboratory shear strength test data and empirical correlations between standard penetration resistance values and shear characteristics of soils, the following effective stress shear strength parameters were utilized for stability analyses of the generalized embankment sections.

Material	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Embankment Fill	120	0	30
In-Place Sands	115	0	30
Pee Dee Soils	125	500	32

As indicated in Figure 6 of this report, the factor of safety for the previously described generalized embankment section is 1.8 for the long-term stability condition. If it is assumed that the embankment fill and in-place soils consist of clays which exhibit a cohesion of 450 psf and a friction angle of 16 degrees, the factor of safety of this section increases to 2.0. The embankment section selected for slope stability analyses is considered to be the most critical section since this section represents the maximum structural height of any embankment section.

RECOMMENDATIONS

Recommendations presented herein are based upon an evaluation of the subsurface conditions as represented by soil test boring and laboratory test data in this report, evaluations of geotechnical engineering analyses, and experience with similar embankment projects. Because of the size of the project site and the large distance between soil borings, it is likely that subsurface conditions adverse to those represented by soil test borings will be encountered between some of the boring locations. In the event that subsurface conditions adverse to those represented by this report are encountered during construction, those differences should be reported to the geotechnical engineer for evaluation prior to continuation of construction. Because of the critical nature of embankment construction, S&ME suggests that all construction activities be monitored by a full-time senior soils technician working under the direct supervision of the geotechnical engineer. Field density tests should be performed to verify that construction has been completed in accordance with the project specifications.

Foundation Support - Appurtenant Structures. Based upon evaluations of subsurface data and the results of geotechnical structural analyses, the following recommendations are presented for foundation support of the proposed pump stations, pipelines, and valve boxes.

- Pump Station at Existing Polishing Lagoon - Subsurface conditions encountered at boring B-10 indicate that the slab which will support this pump station will be underlain by a three-foot thick layer of medium dense clayey sand underlain by a five-foot thick stratum of very soft clay. The in-place very soft clays must be undercut and replaced with No. 57 washed stone or the pump station must be supported by steel "H" piles. Foundation bearing capacity analyses indicate that HP 10x42 steel piles driven to about Elevation -22 feet (35 feet below the proposed slab) will provide an allowable compression load of 40 tons using a factor of safety of two.

- Pump Station at Proposed Pond - Borings B-47 and B-50 located at this structure indicate that firm Pee Dee Formation soils will be encountered at approximate elevation +25 feet. Since the slab will bear at about elevation +24.1 feet, the slab will bear on these firm soils. Provided any soft soils encountered at the slab subgrade elevation are undercut and replaced with either compacted sand backfill or No. 57 washed stone, the firm Pee Dee Formation soils will support a foundation bearing pressure of 3000 pounds per square foot (psf).

- No. 2 By-Pass Station and Pipeline - Hard Pee Dee Formation soils were encountered at approximate elevation +31 feet at boring B-31 located near this structure. The subgrade elevations of the No. 2 By-Pass Station and the gate slab will bear in the hard Pee Dee Formation soils at about elevations +30.9 feet and +28.1 feet, respectively. These hard Pee Dee Formation soils will support a foundation bearing pressure of 3000 psf. Total settlements beneath the pipeline resulting from the embankment surcharge are estimated to be less than one inch. The by-pass pipeline should also bear in the Pee Dee Formation soils along most of the proposed route. The in-place soils should provide suitable subgrade support for this pipeline; however, any soft subgrade soils should be undercut and replaced with No. 57 washed stone.

- Divider Stations No. 1 and No. 2 - The 48-inch diameter pipelines connecting Cell 1 and Cell 2 will bear at about elevation +32.6 feet. The subsurface conditions encountered at borings B-31 and B-53 indicate that loose to medium dense sands with shells occur at this elevation. The loose shells and sands should be undercut and replaced with No. 57 washed stone. Because the Pee Dee Formation soils were encountered at elevations ranging from about +28 feet to +31 feet, it is unlikely that the maximum depth of undercut will exceed approximately five feet. Results of settlement analyses indicate that total settlements beneath these pipelines due to the embankment surcharge will be less than one inch, provided the loose sand and shell stratum is undercut and replaced with backfilled stone material.

  The proposed gates to be constructed at Divider Stations No. 1 and No. 2 will bear at about elevation +28.1 feet, which is within the hard Pee Dee Formation soils. These foundation soils will support an allowable bearing pressure of 3000 psf.

- Divider Stations No. 3 and No. 4 - Subsurface conditions encountered at boring B-15 suggest that the proposed pipelines connecting Cell 3 and Cell 4 will bear on approximately 5.5 feet of loose clayey sands. These clayey sands are underlain by the Pee Dee Formation soils which were encountered at about elevation +29 feet. The loose clayey sands should be undercut and replaced with No. 57 washed stone in order to limit ground settlements beneath the pipelines (due to the embankment surcharge) to less than one inch.

  The proposed gates to be constructed at Divider Stations No. 3 and No. 4 will bear at about elevation +31.8 feet, or approximately three feet above the Pee Dee Formation soils. The loose clayey sands should be undercut at the proposed slab area and replaced with No. 57 washed stone. Upon completion of this foundation subgrade work, the slab subgrade soils will support a foundation bearing pressure of 3000 psf.

- Surface Water Drainage Lines - Surface water runoff will be collected along the southern perimeter of the proposed pond, routed through buried drainage pipes, and discharged into natural drainage features at the west and east end of the site. Since the weight of the drainage pipes and collected waters will not exceed the weight of the excavated soils, no additional load will be transferred to the underlying subgrade soils. Accordingly, settlements along the proposed drainage pipeline route will not be a concern provided any soft or very loose subgrade soils are undercut and replaced with either compacted sand backfill or No. 57 washed stone.

Site Preparation. Site preparation should be initiated by grubbing and stripping the proposed pond site to remove all remaining trees, stumps, rootmat, underbrush, and organic topsoil. If soft surficial soils are encountered at the toe of the downstream slope, these unsuitable foundation supporting soils should be undercut prior to initiation of the fill placement process. Any soft surficial soils which are encountered at the bottom of the proposed pond should also be undercut and replaced with compacted structural backfill prior to installing the pond liner. To prevent the build-up of excess pore pressures at the toe, or on the downstream slope of the completed embankment, french drains should be constructed along the natural draws and extend beyond the downstream toe of the embankment.

Erosion and Sedimentation Control. Subsequent to clearing of the pond site, embedded silt fence structures should be constructed to retain potential sediments that might be eroded from the exposed embankment or newly placed fill sections. The silt fence structures should be constructed along the downstream slope beyond the limits of newly placed fill. Silt fence structures should be in place prior to grubbing and stripping of the embankment.

Groundwater Control. As shown in Figures 4 and 5, the groundwater levels recorded during the subsurface exploration program are typically higher than the proposed elevations at the bottom of the pond. As such, control of groundwater during and following construction will be a major consideration.

Review and exploration of the enclosed subsurface data and site topographical features indicate that a surficial groundwater table occurs above the Pee Dee Formation soils and generally flows to the north-northwest towards the Cape Fear River and Livingston Creek. It is possible that an interceptor drain constructed along the southern perimeter of the pond with lateral drains traversing the pond site will lower the groundwater level by gravity flow. However, if groundwater recharge exceeds the drainage capacity of a gravity flow system, it will be necessary to install a well pumping system to control groundwater.

Embankment Fill Construction. Embankment fill soils to be used in construction of the pond embankment configuration should consist of materials classified by the Unified Soil Classification System (USCS) as SP, SP-SM, SP-SC, SM, SC, ML, or CL soils. These materials range from a clean sand to a low plasticity clay. Findings of the subsurface exploration program indicate that the majority of the in-place soils, which will be excavated for use as structural fill, will consist of relatively clean or clayey sands. These sands, and the in-place low plasticity clays, will be suitable for use as fill material for the proposed embankment construction. However, since the clays will be more sensitive to changes in moisture content, the contractor should be prepared to adjust compaction moisture contents of these soils as needed in order to attain the required density.

The embankment fill soils should be keyed into the existing draws by making relatively narrow and shallow (two to three feet vertically) benches into the existing ground surface prior to placement of new embankment fill soils. Newly placed fill should be spread in thin loose lifts of eight to ten inches and compacted to at least 95 percent of the standard Proctor maximum dry density (ASTM D-698) of the embankment fill material. Field density tests should be conducted in each lift of compacted fill at random horizontal stations to confirm that newly placed fill soils have been compacted to the specified degree of compaction. Field density tests should be conducted in each fill lift at a frequency of one test per 20,000 square feet of embankment fill material placed.

Construction of the pipeline between the proposed pump stations should be delayed until the earth embankments have been in place for two or three months to allow some time for embankment load induced settlement to occur. Since the majority of the fill-induced ground settlements should occur during this time, the amount of long-term ground settlement which occurs beneath the pipelines will be significantly reduced.

CLOSING REMARKS

S&ME appreciates having the opportunity to be of professional geotechnical engineering service to you during this phase of the project. If you have any questions or comments after reviewing this report, or if we can be of additional service to you, please do not hesitate to contact us at your convenience.

Very truly yours,

S&ME, INC.

Michael W. Behen

Michael W. Behen, P.E.
N.C. Registration No. 8384

B. Dan Marks/MWB

B. Dan Marks, Ph.D., P.E.
Chief Geotechnical Consultant
N.C. Registration No. 9631

MWB/jns
Attachments

TABLE 1

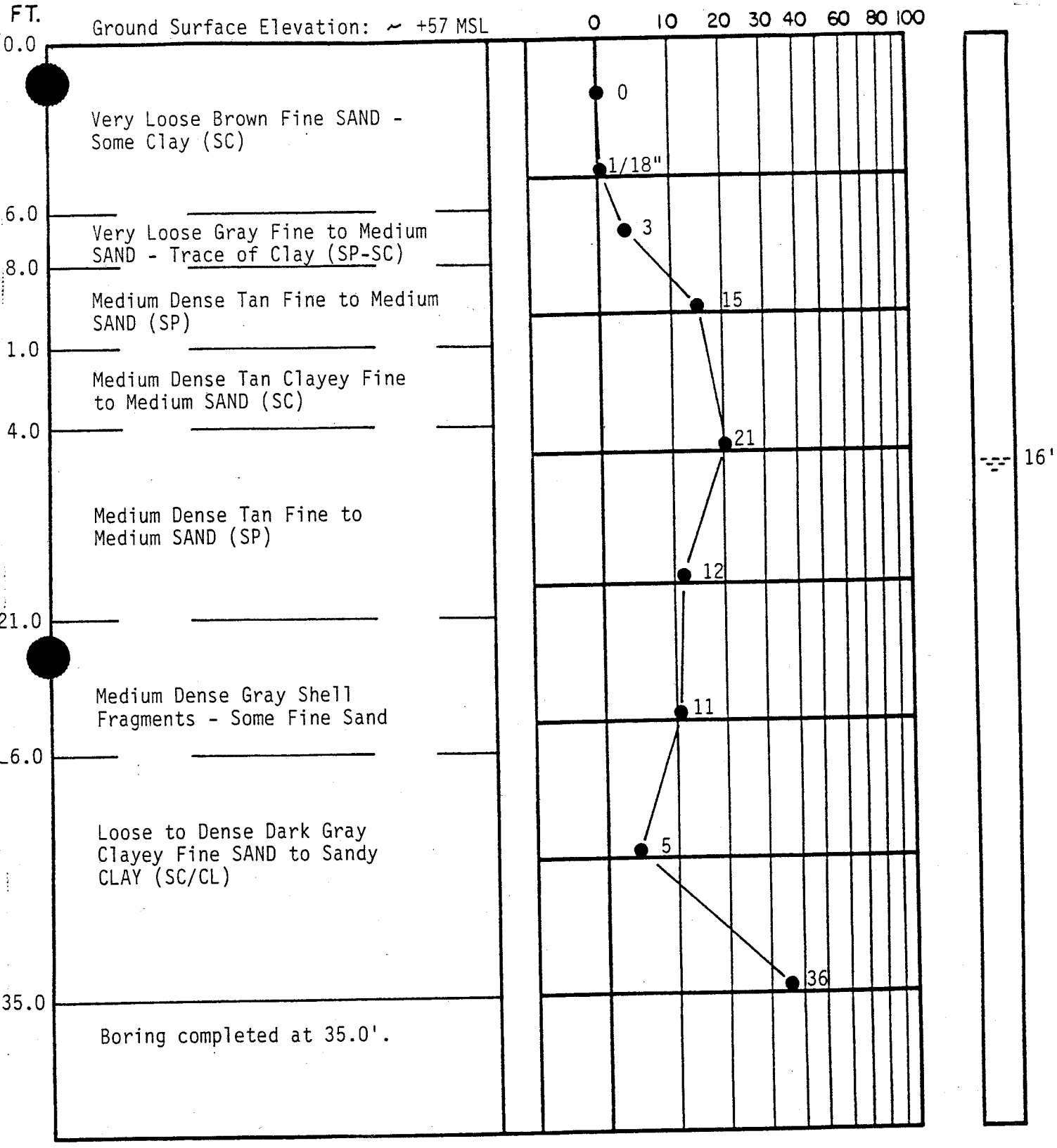
Piezometer Readings
Proposed Pond
Federal Paper Board Company
Riegelwood, North Carolina
Job No. 1063-93-447

Piezometer Number	Approximate Ground Surface Elevation[1]	Groundwater Elevation[1] 2-16-94 or 2-17-94[2]	2-21-94	2-28-94	5-23-94
MW-1	+57	+44	+46.0	+46.3	+45.8
MW-2	+50	+42	+42.5	+44.0	+44.0
MW-3	+50	+43	+43.3	+43.6	+43.2
MW-4	+51	+39	+43.5	+43.5	+42.8
MW-5	+61	+48	+45.0	+41.0	+45.6
MW-6	+56	+43	+38.9	--[3]	--[3]

[1]Ground surface elevations estimated from site topographic map.

[2]Date piezometer installed.

[3]Piezometer apparently destroyed.



TEST BORING RECORD

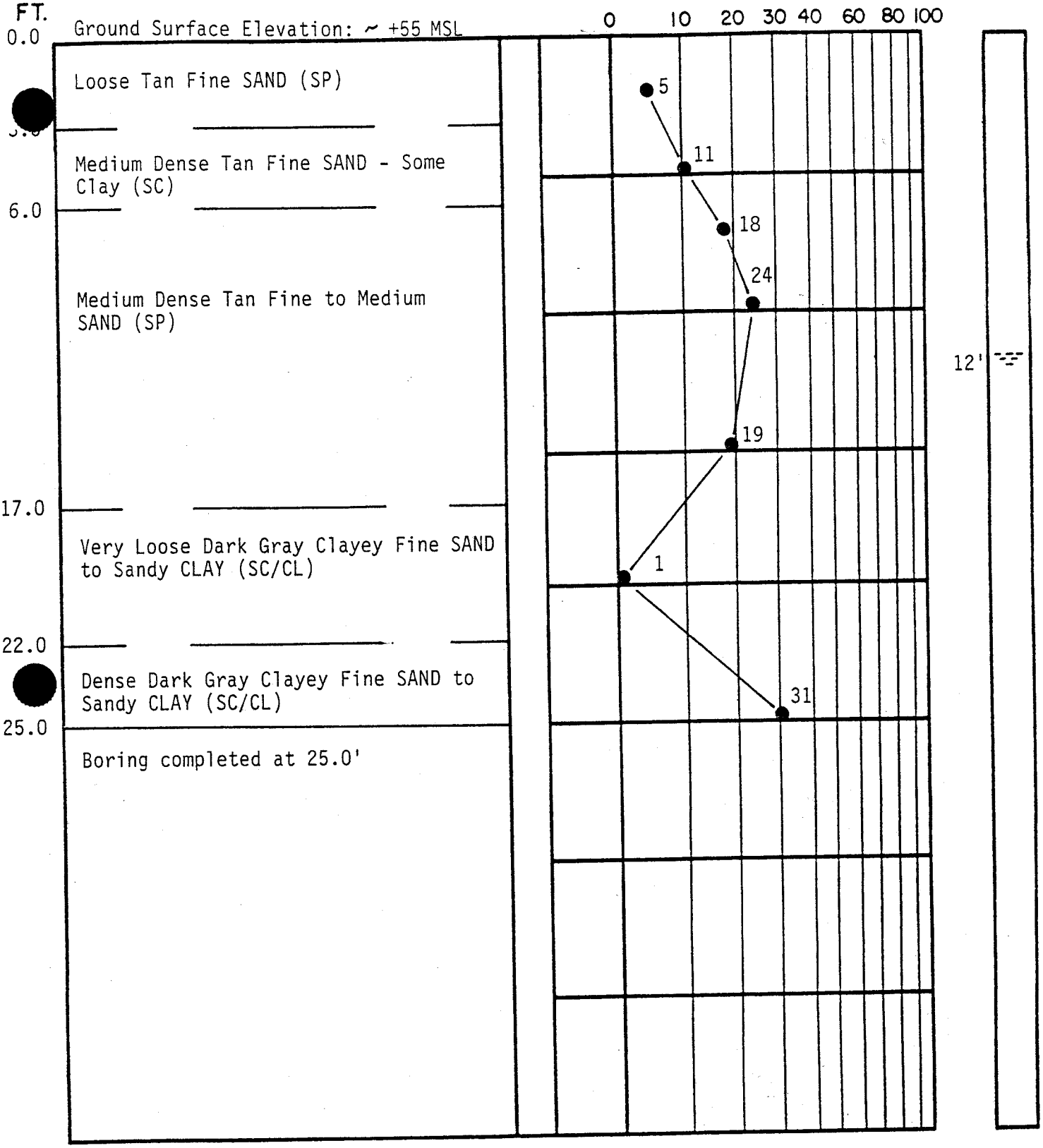
BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

BORING NO. B-1
DATE DRILLED 3-8-94
JOB NO. 1063-93-447

S&ME



TEST BORING RECORD

BORING NO. B-2
DATE DRILLED 4-8-94
JOB NO. 1063-93-447

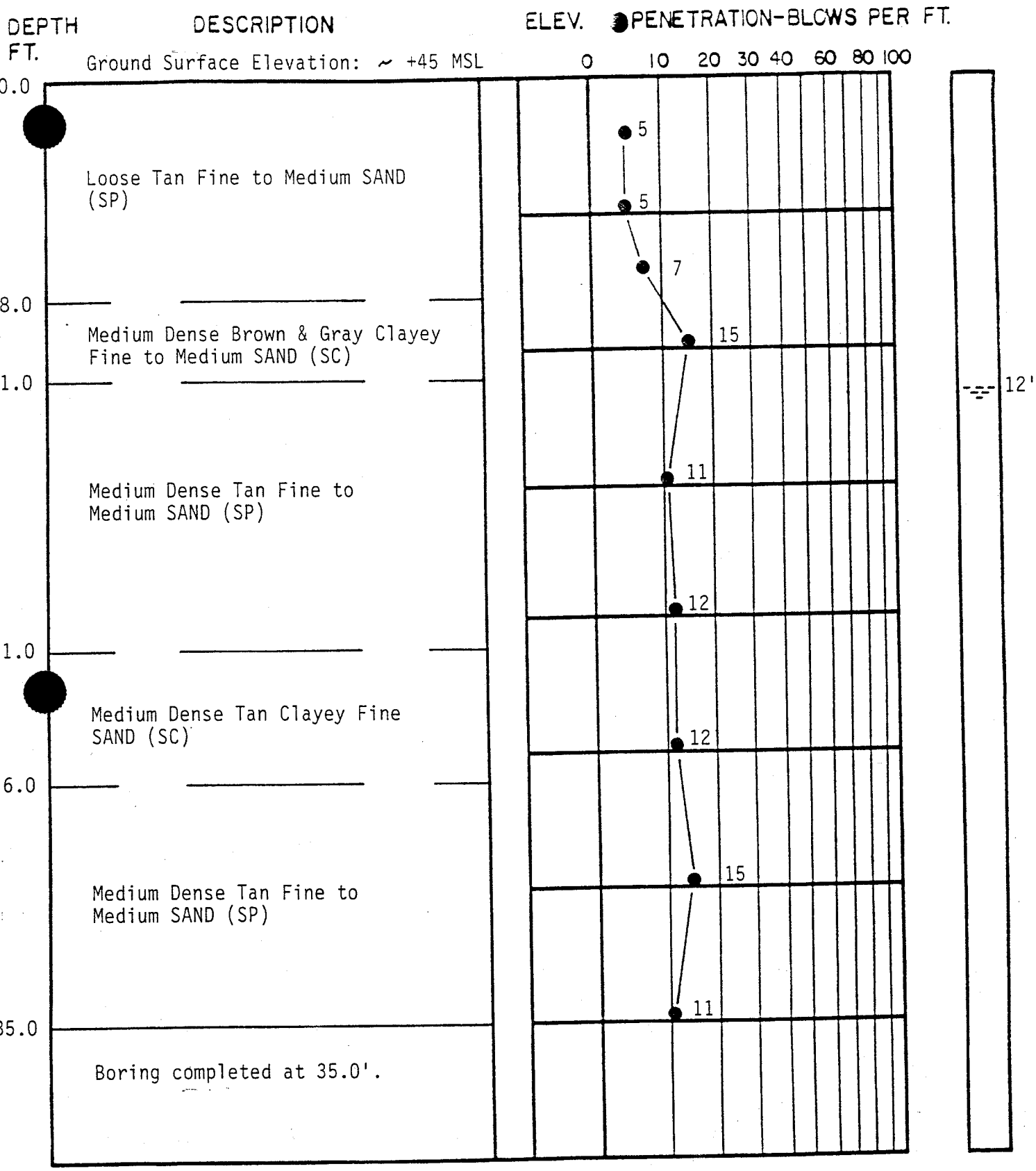
BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME

SM-14



TEST BORING RECORD

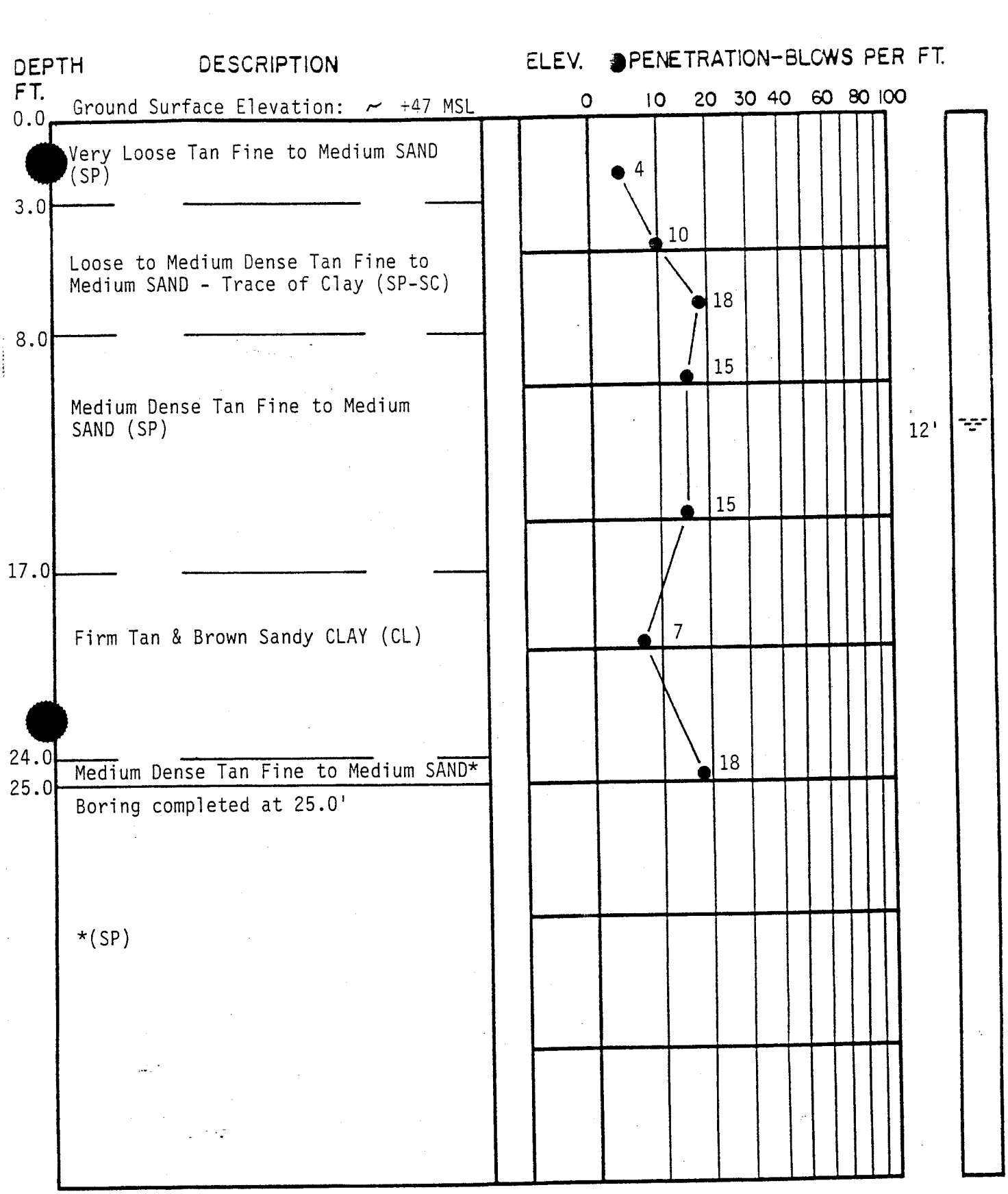
BORING NO. B-3
DATE DRILLED 3-8-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



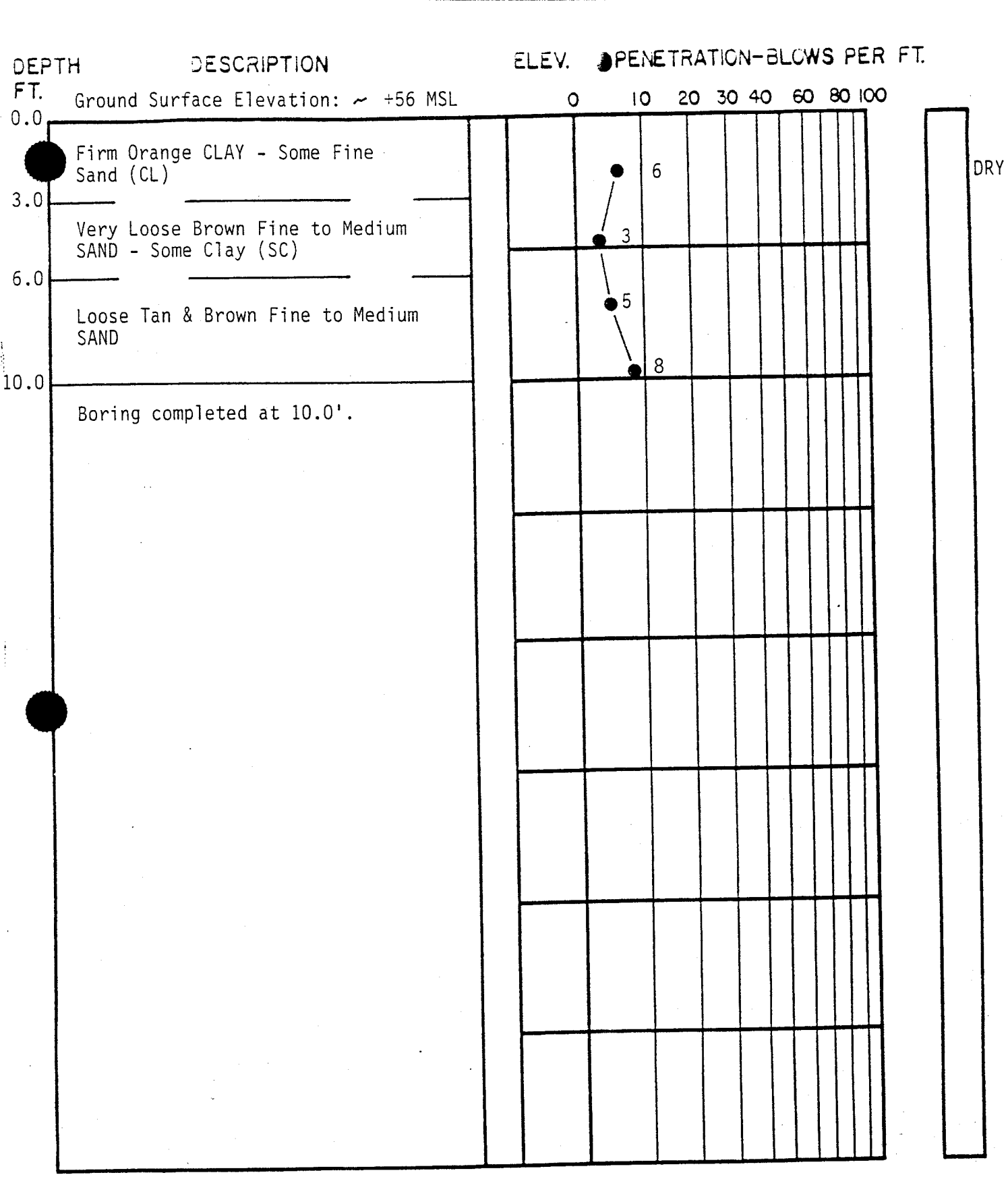
BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

TEST BORING RECORD

BORING NO. B-4
DATE DRILLED 3-12-94
JOB NO. 1063-93-447

S&ME



TEST BORING RECORD

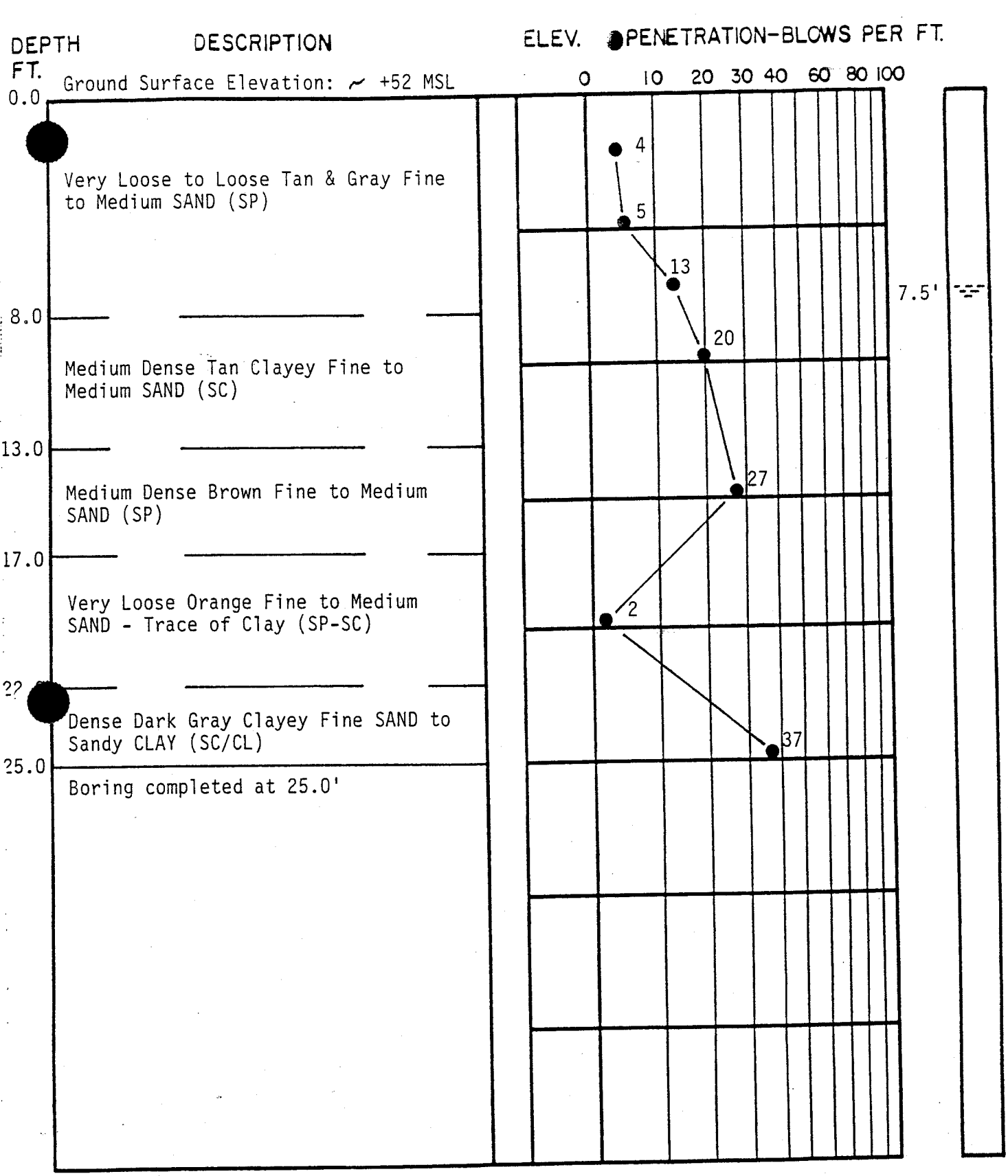
BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

BORING NO. B-5
DATE DRILLED 3-16-94
JOB NO. 1063-93-447

S&ME



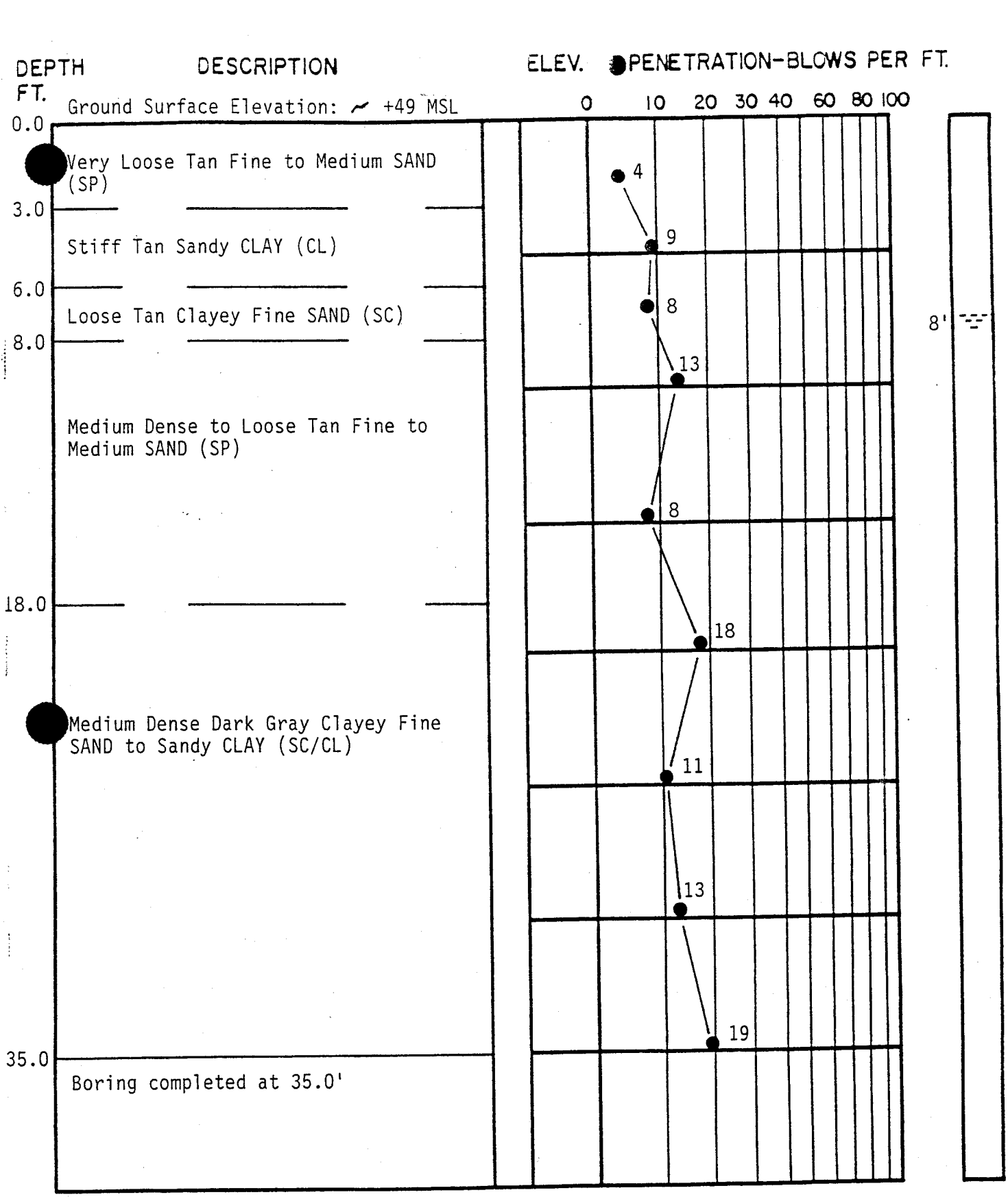
TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

BORING NO. B-6
DATE DRILLED 3-12-94
JOB NO. 1063-93-447

S&ME



BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

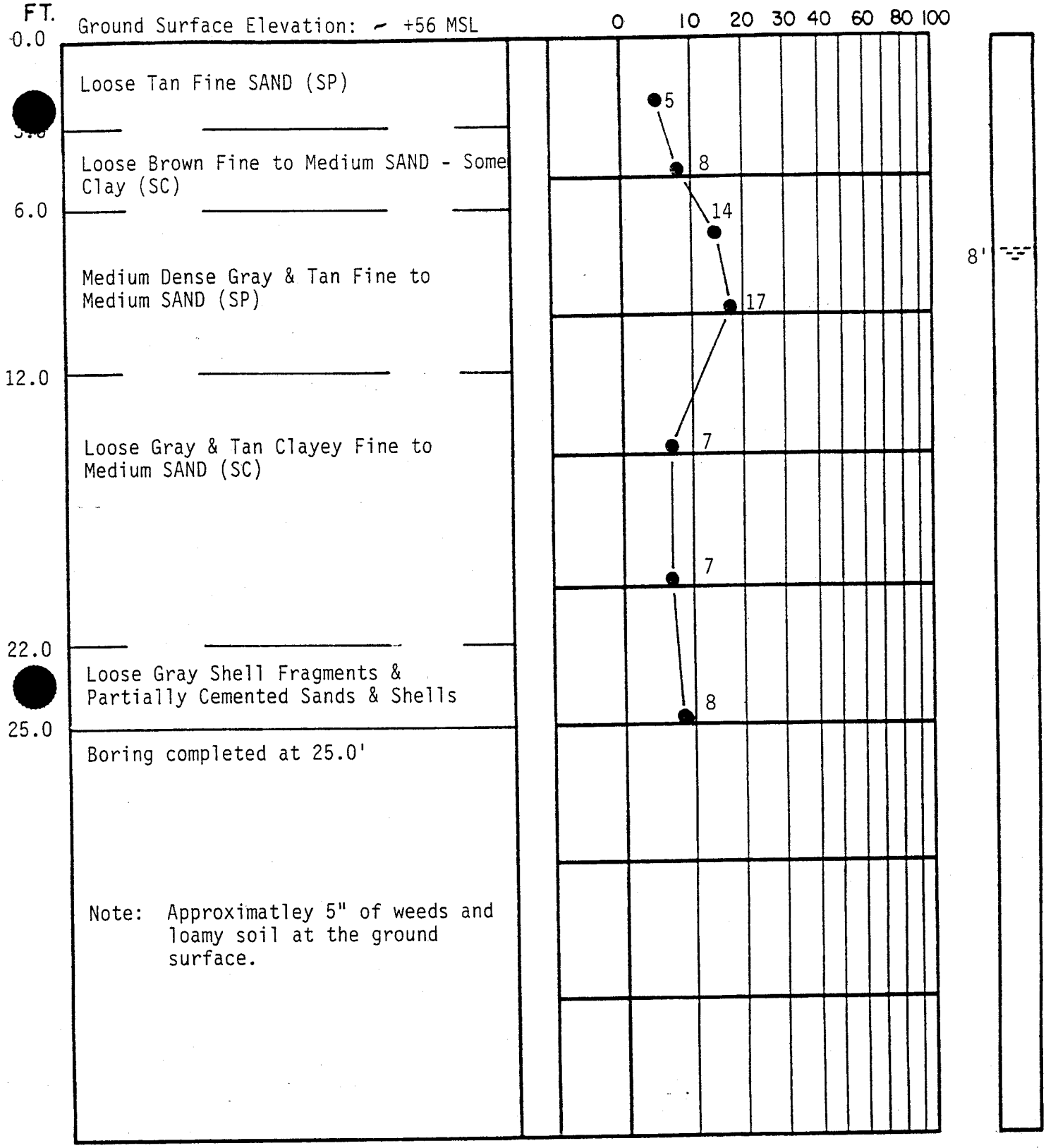
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

TEST BORING RECORD

BORING NO. B-8
DATE DRILLED 3-12-94
JOB NO. 1063-93-447

S&ME



TEST BORING RECORD

BORING NO. B-9
DATE DRILLED 4-8-94
JOB NO. 1063-93-447

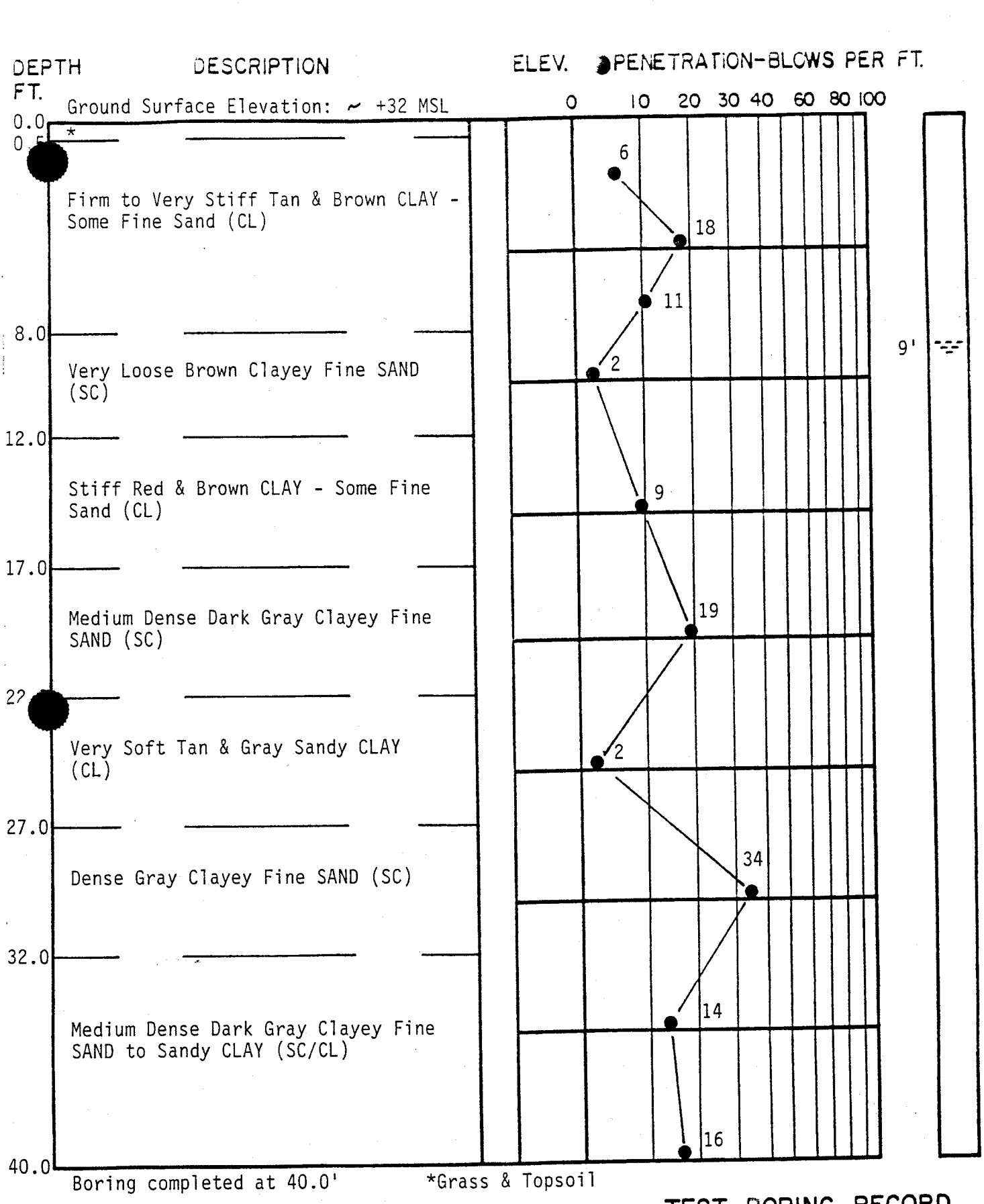
BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR.
WATER TABLE-1 HR.

S&ME

SM-14



TEST BORING RECORD

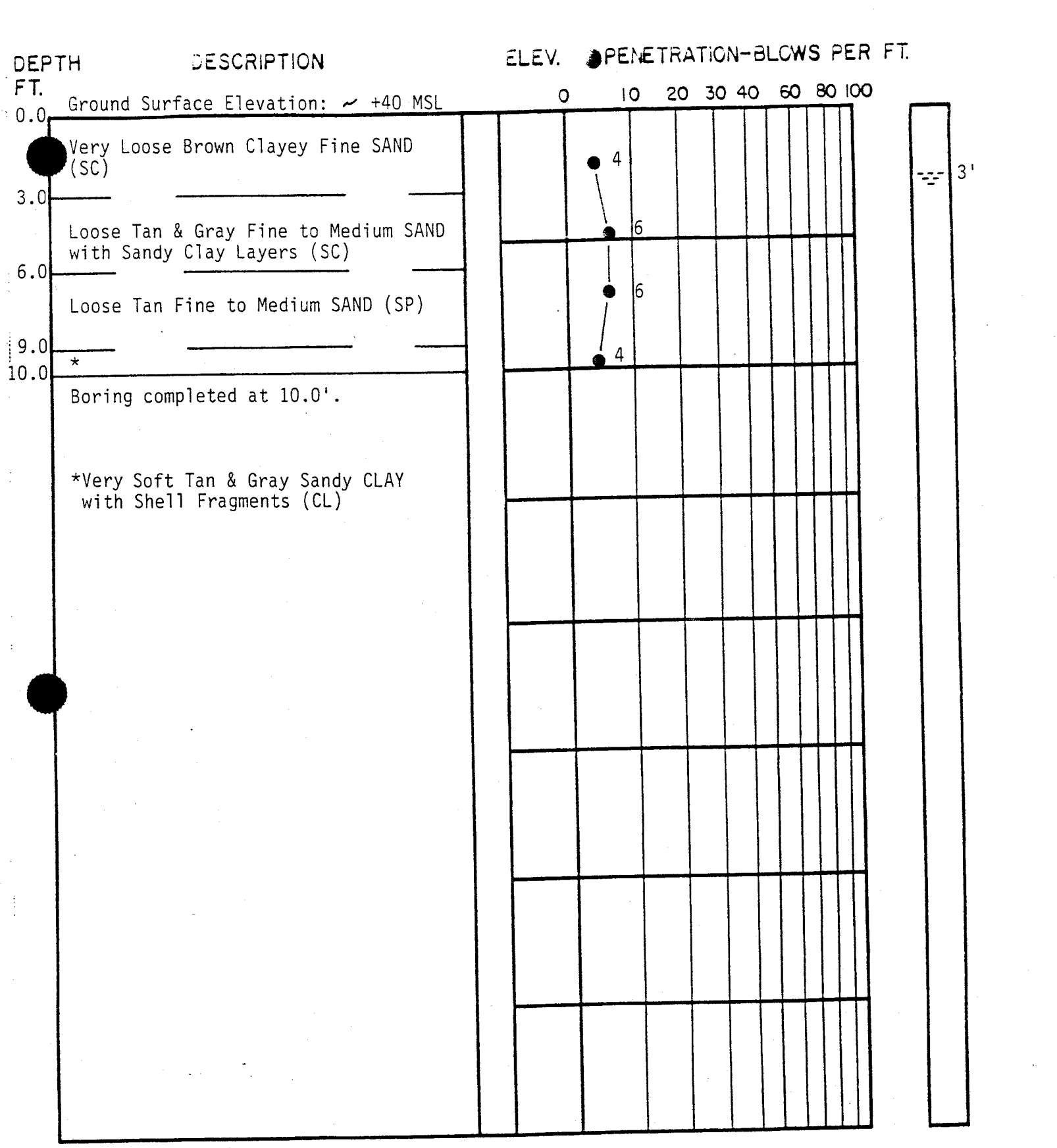
BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

BORING NO. B-10
DATE DRILLED 3-15-94
JOB NO. 1063-93-447

S&ME



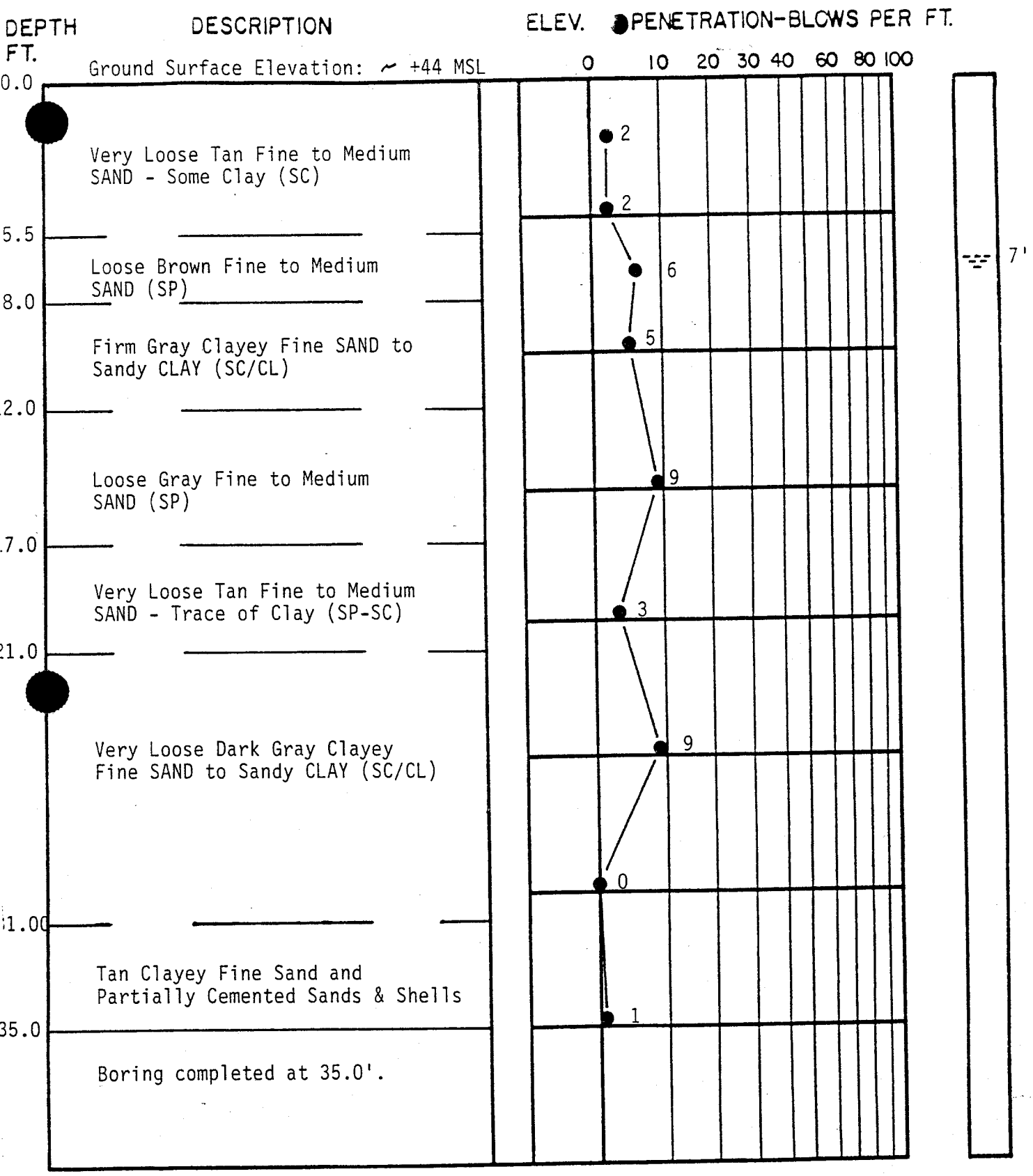
TEST BORING RECORD

BORING NO. B-11
DATE DRILLED 3-16-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

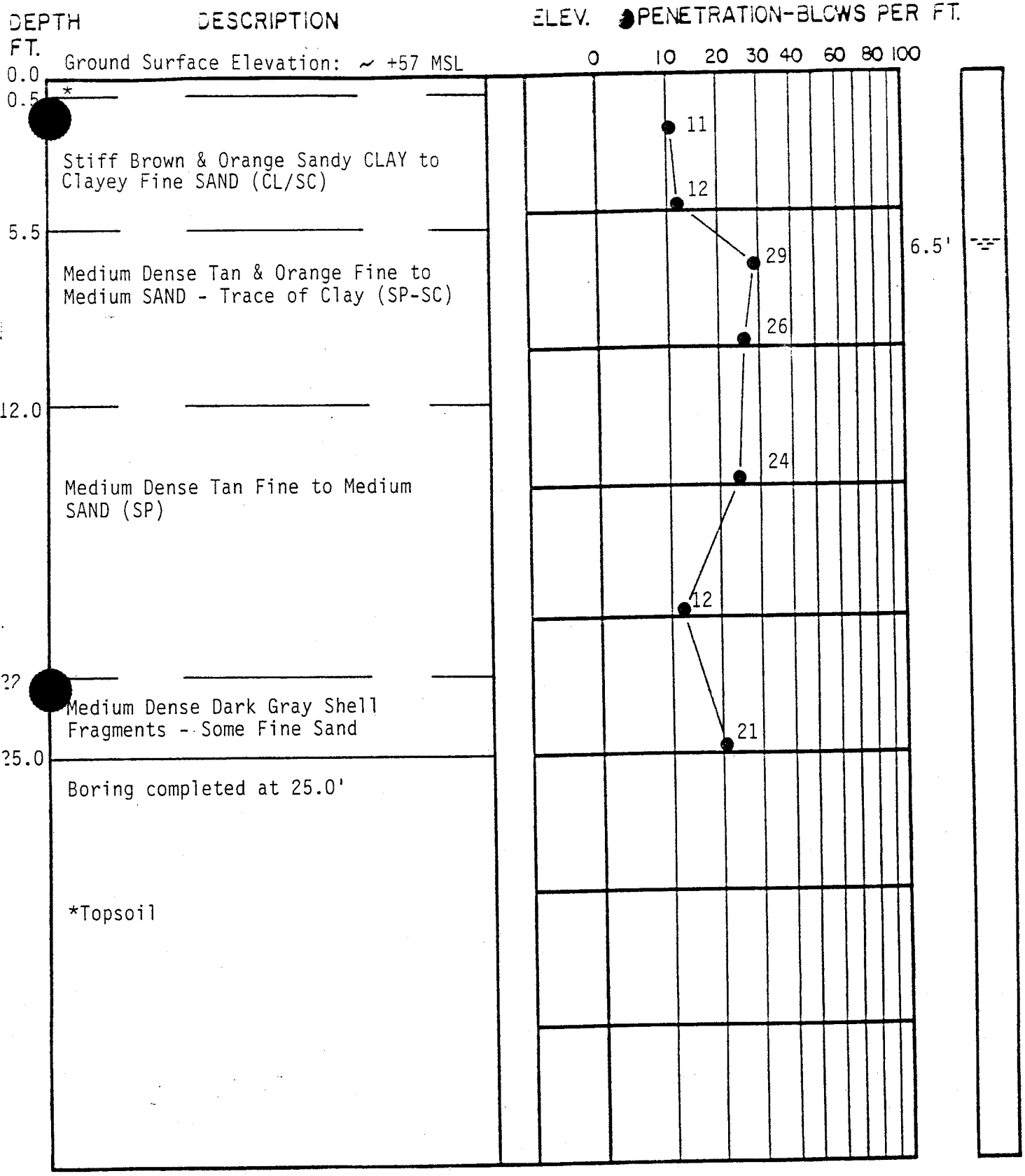
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

TEST BORING RECORD

BORING NO. B-12
DATE DRILLED 3-8-94
JOB NO. 1063-93-447

S&ME



TEST BORING RECORD

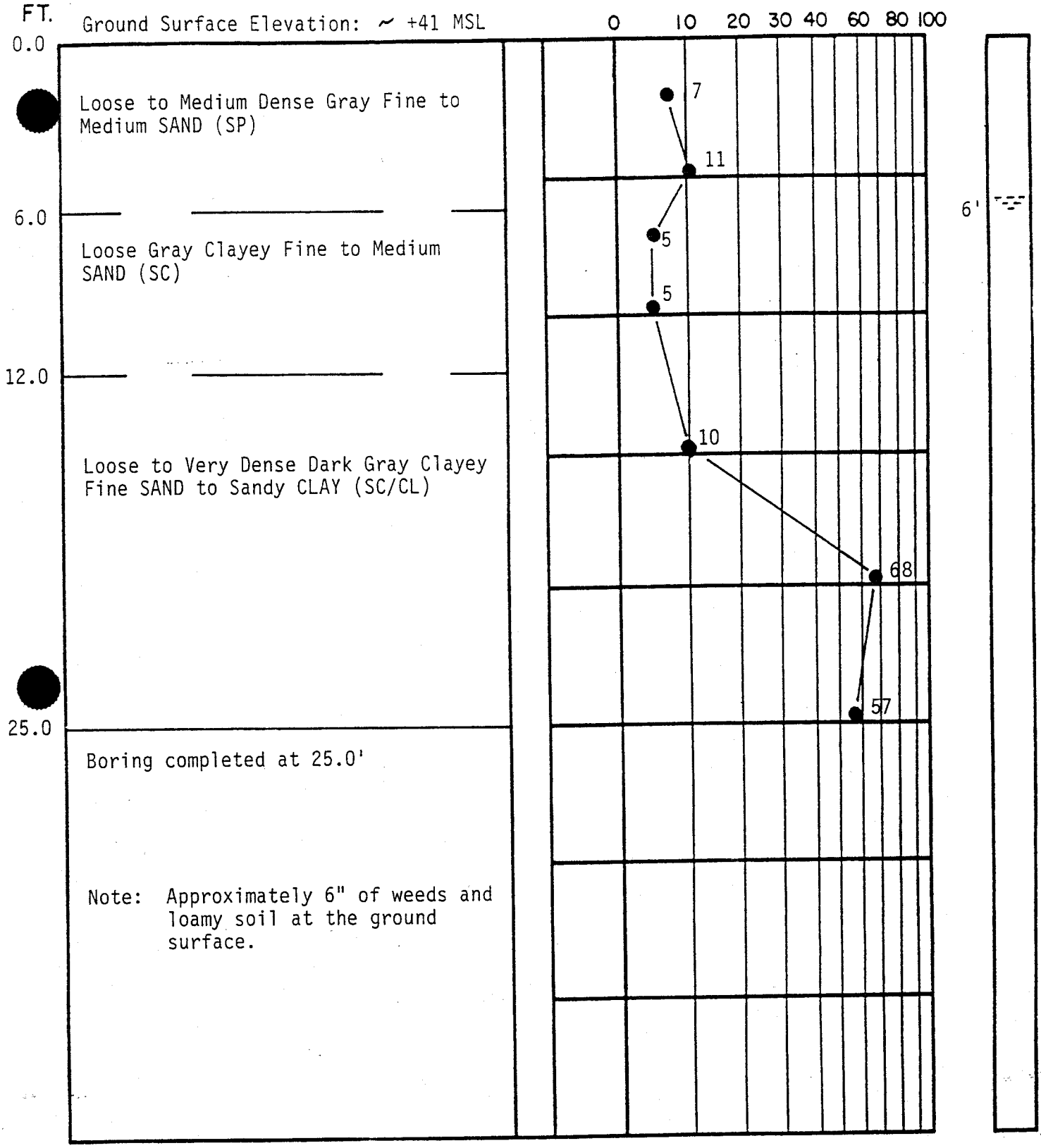
BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

BORING NO. B-13
DATE DRILLED 3-15-94
JOB NO. 1063-93-447

S&ME



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

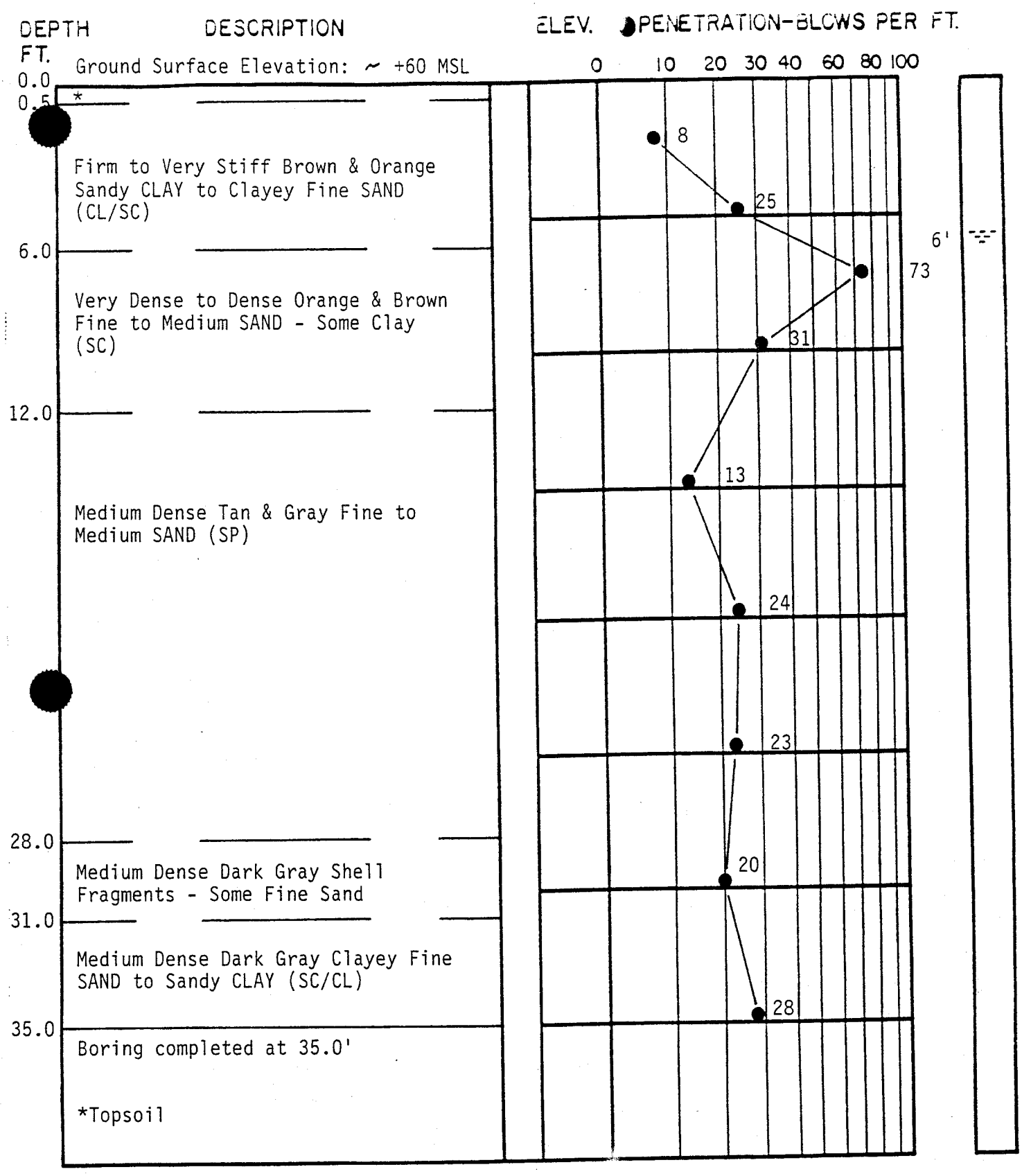
UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR.
WATER TABLE-1 HR.

TEST BORING RECORD

BORING NO. B-15
DATE DRILLED 4-8-94
JOB NO. 1063-93-447

S&ME

SM-



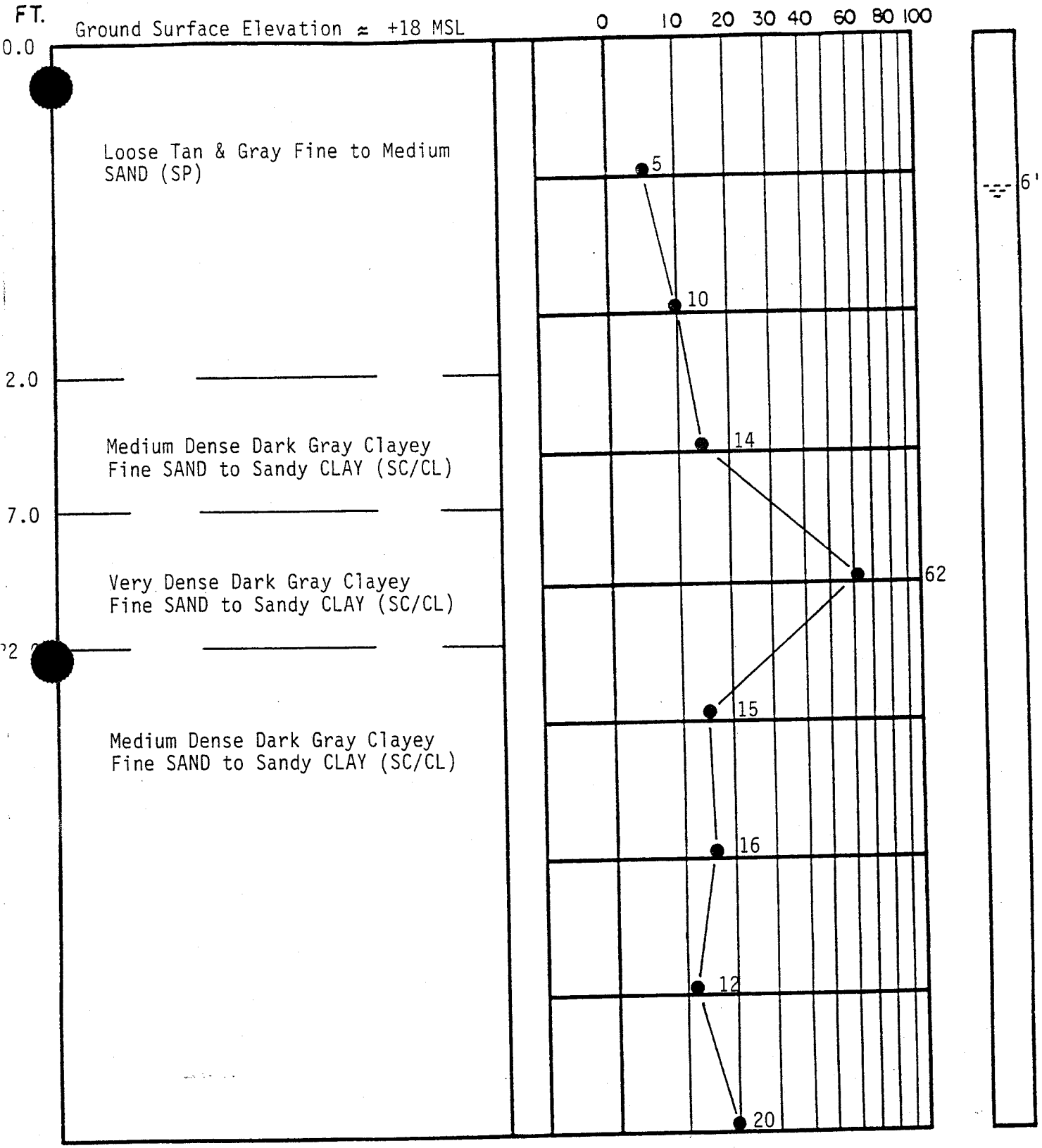
TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

BORING NO. B-17
DATE DRILLED 3-15-94
JOB NO. 1063-93-447

S&ME



TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

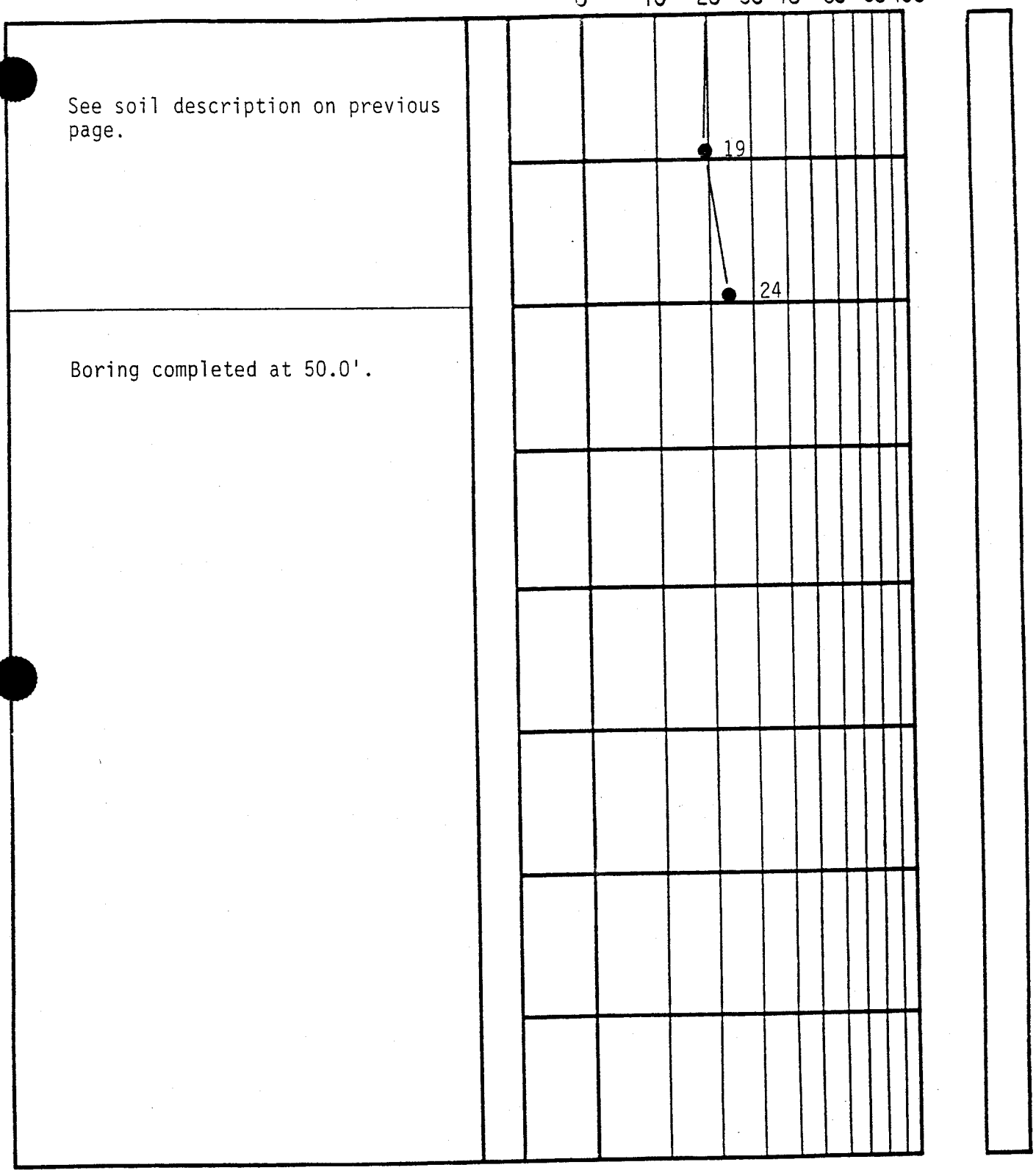
BORING NO. B-18
DATE DRILLED 2-17-94
JOB NO. 1063-93-447

S&ME

DEPTH FT.	DESCRIPTION	ELEV.

PENETRATION-BLOWS PER FT.

0 10 20 30 40 60 80 100



See soil description on previous page.

50.0

Boring completed at 50.0'.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

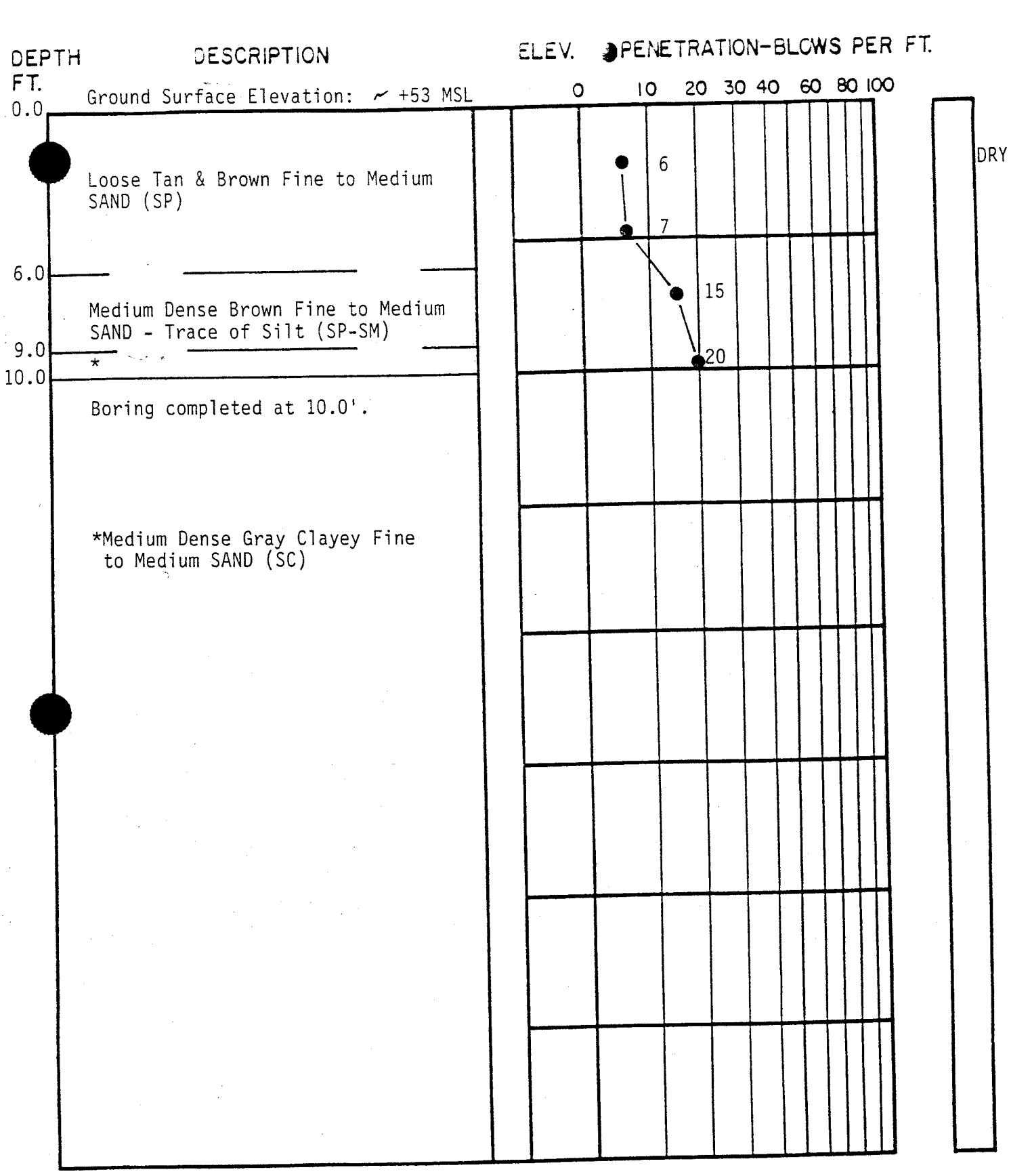
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

TEST BORING RECORD

BORING NO. B-18
DATE DRILLED 2-17-94
JOB NO. 1063-93-447

S&ME



TEST BORING RECORD

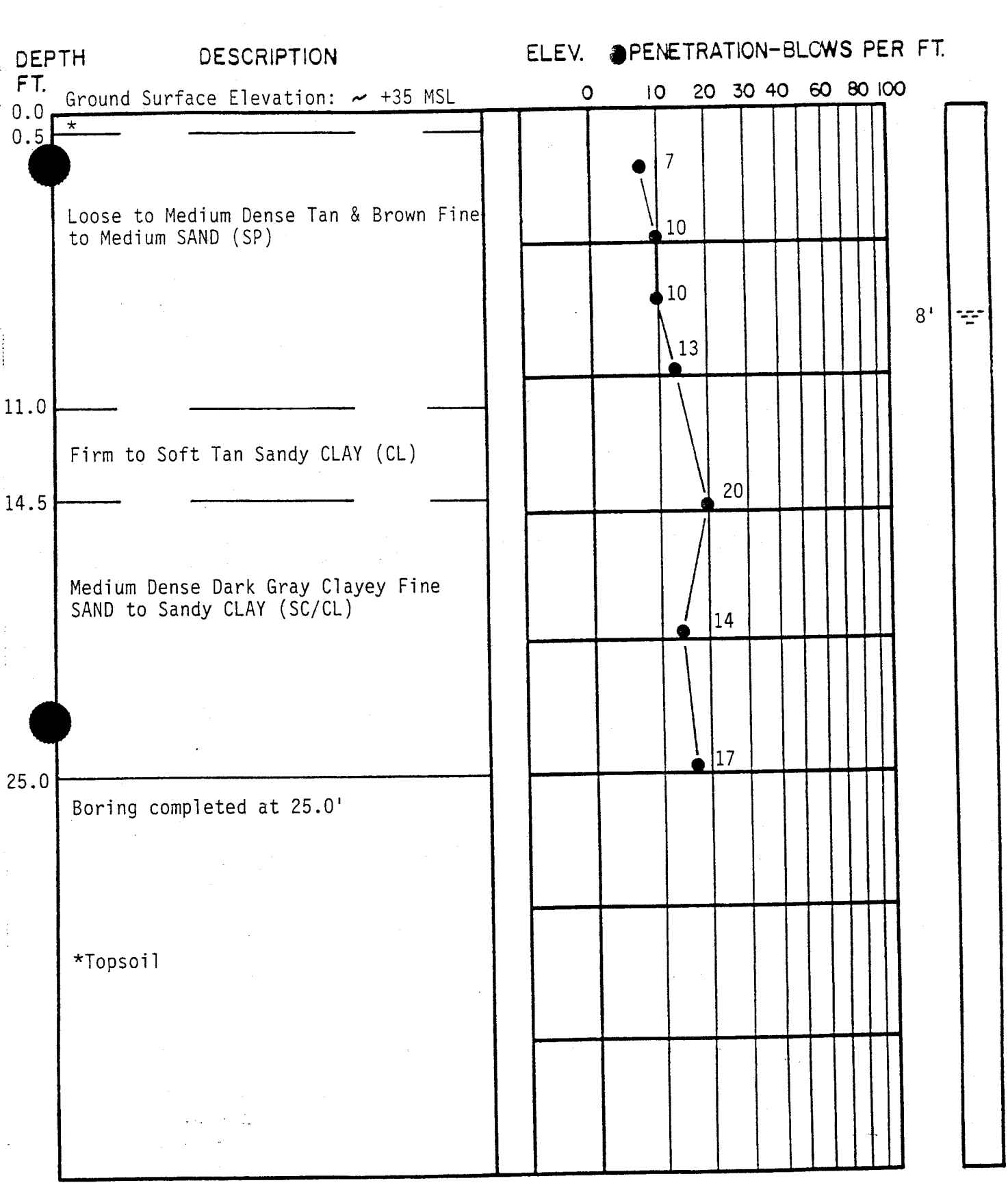
BORING NO. B-19
DATE DRILLED 3-16-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24HR.
WATER TABLE-1HR.

S&ME



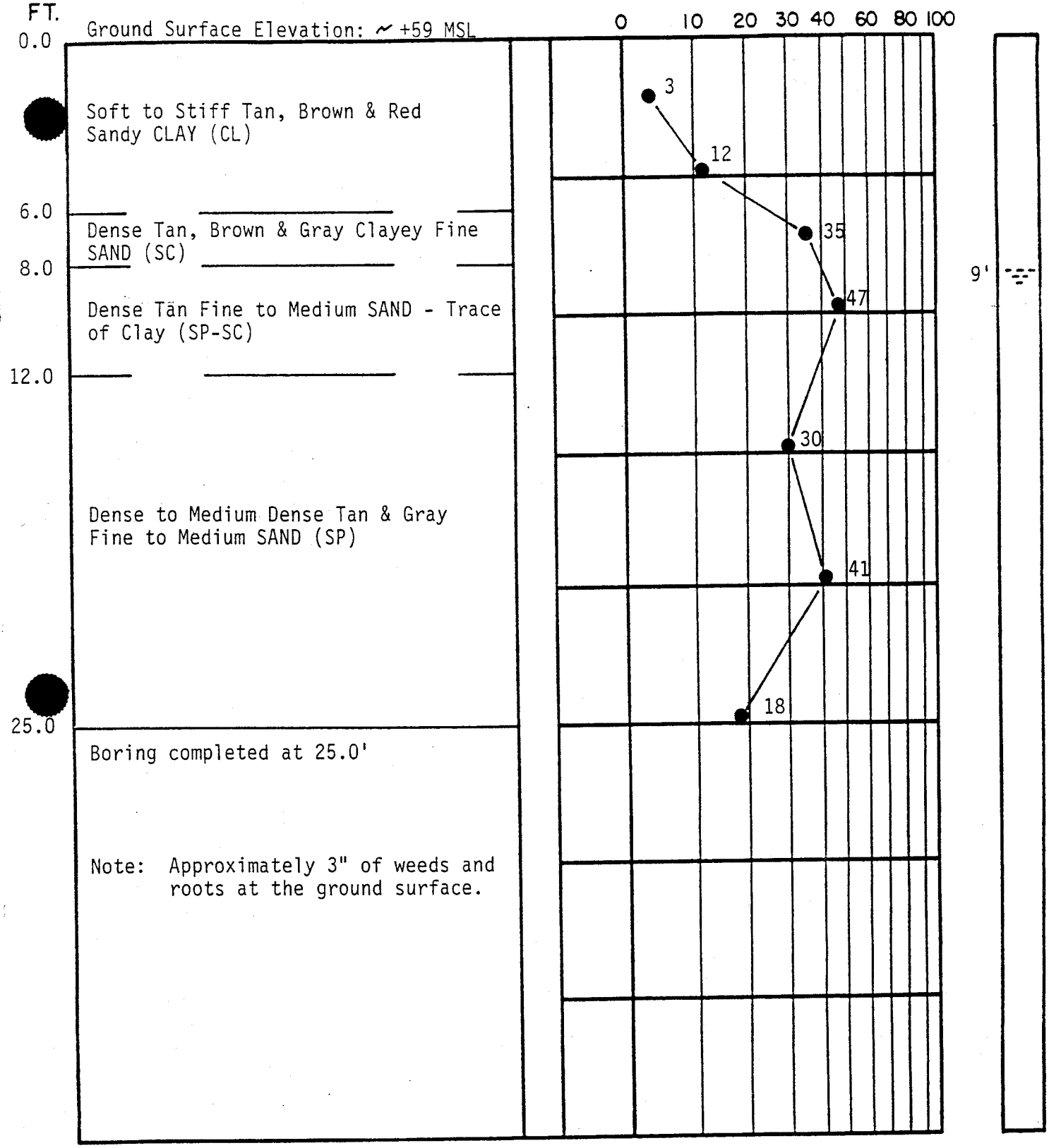
TEST BORING RECORD

BORING NO. B-21
DATE DRILLED 3-12-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



TEST BORING RECORD

BORING NO. B-22
DATE DRILLED 4-5-94
JOB NO. 1063-93-447

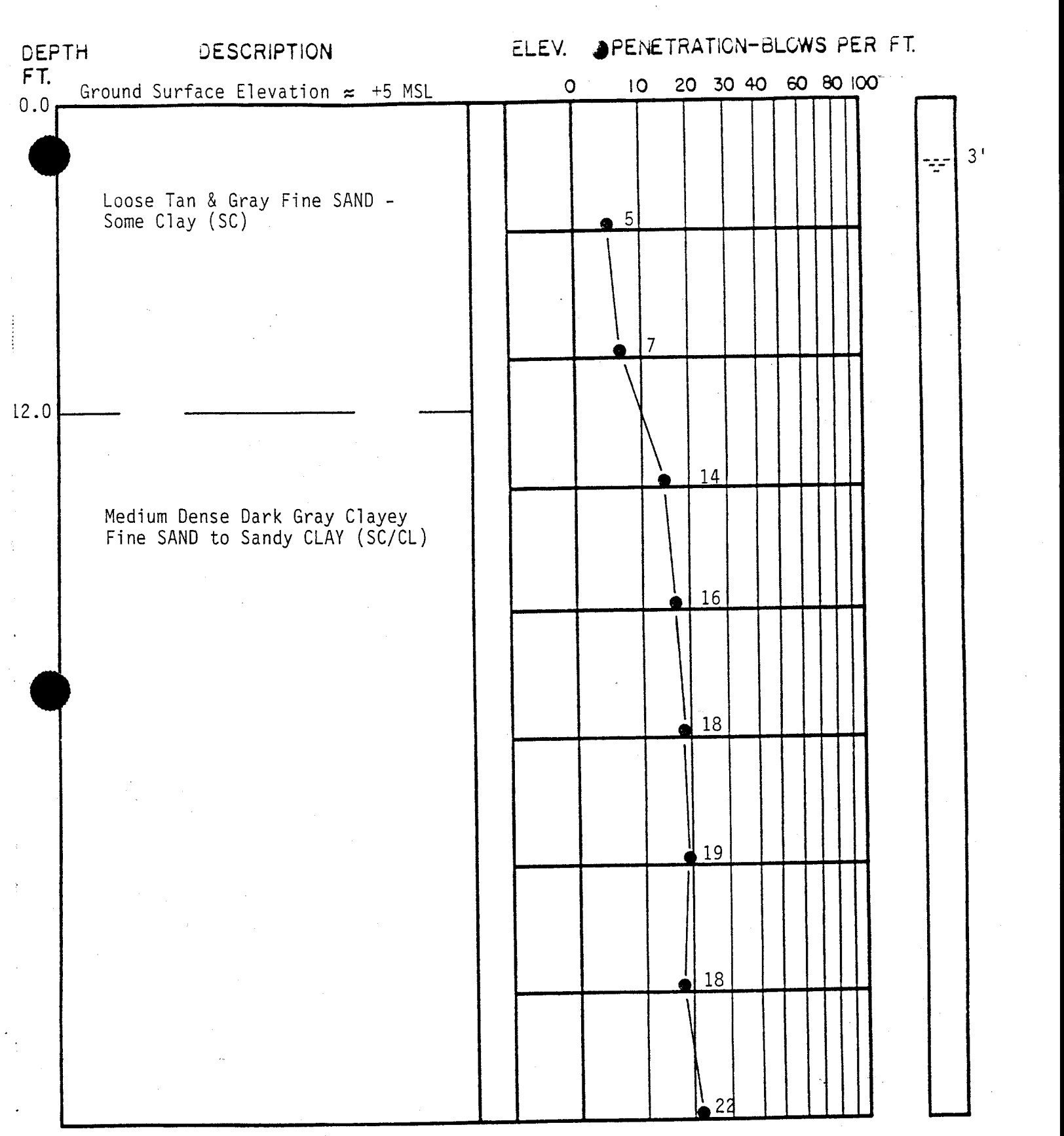
BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR.
WATER TABLE-1 HR.

S&ME

SM-...



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

TEST BORING RECORD

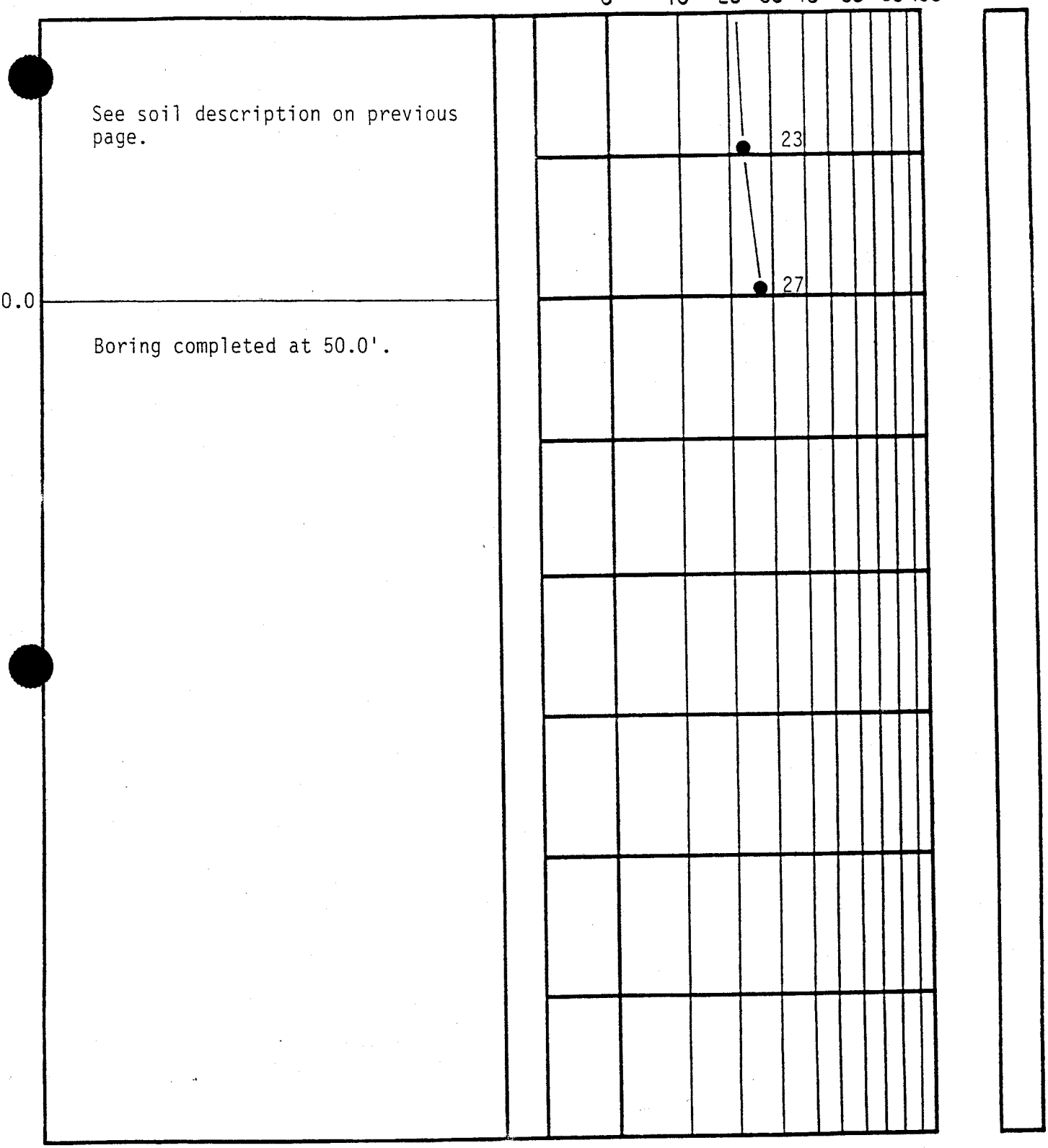
BORING NO. B-23
DATE DRILLED 2-17-94
JOB NO. 1063-93-447

S&ME

DEPTH FT.	DESCRIPTION	ELEV.

PENETRATION-BLOWS PER FT.

0 10 20 30 40 60 80 100



See soil description on previous page.

50.0

Boring completed at 50.0'.

TEST BORING RECORD

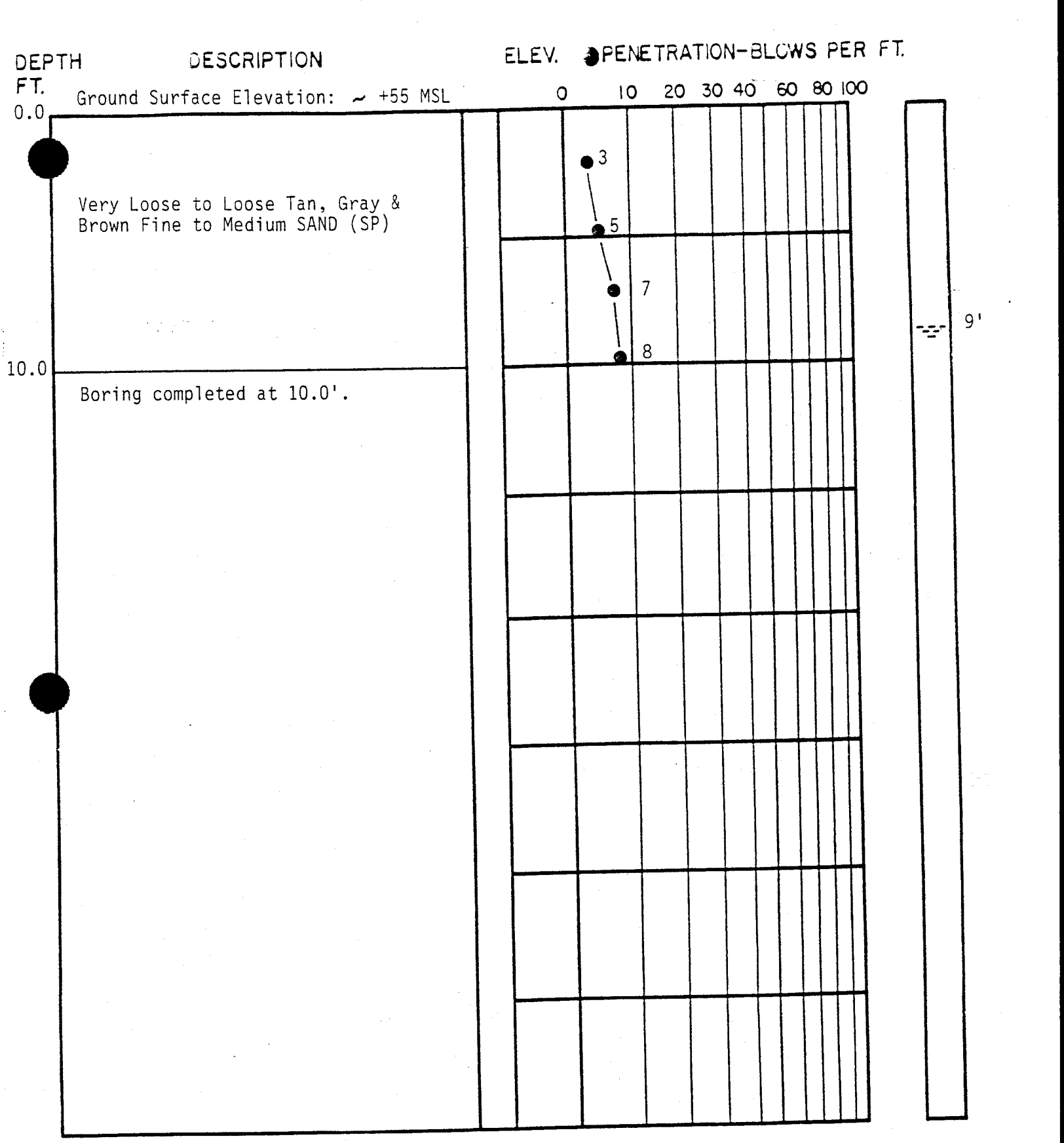
BORING NO. B-23
DATE DRILLED 2-17-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



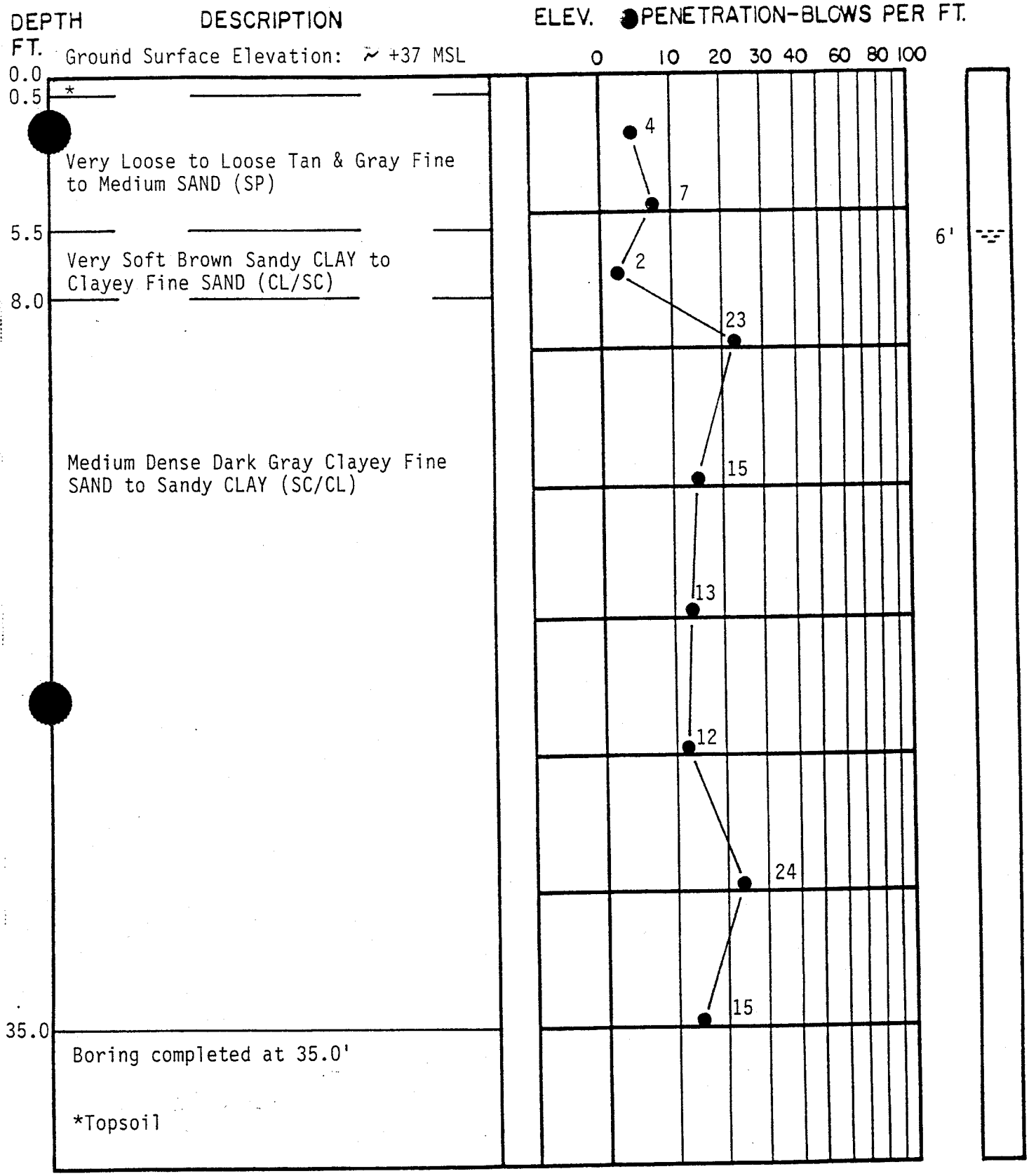
BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

TEST BORING RECORD

BORING NO. B-24
DATE DRILLED 3-16-94
JOB NO. 1063-93-447

S&ME



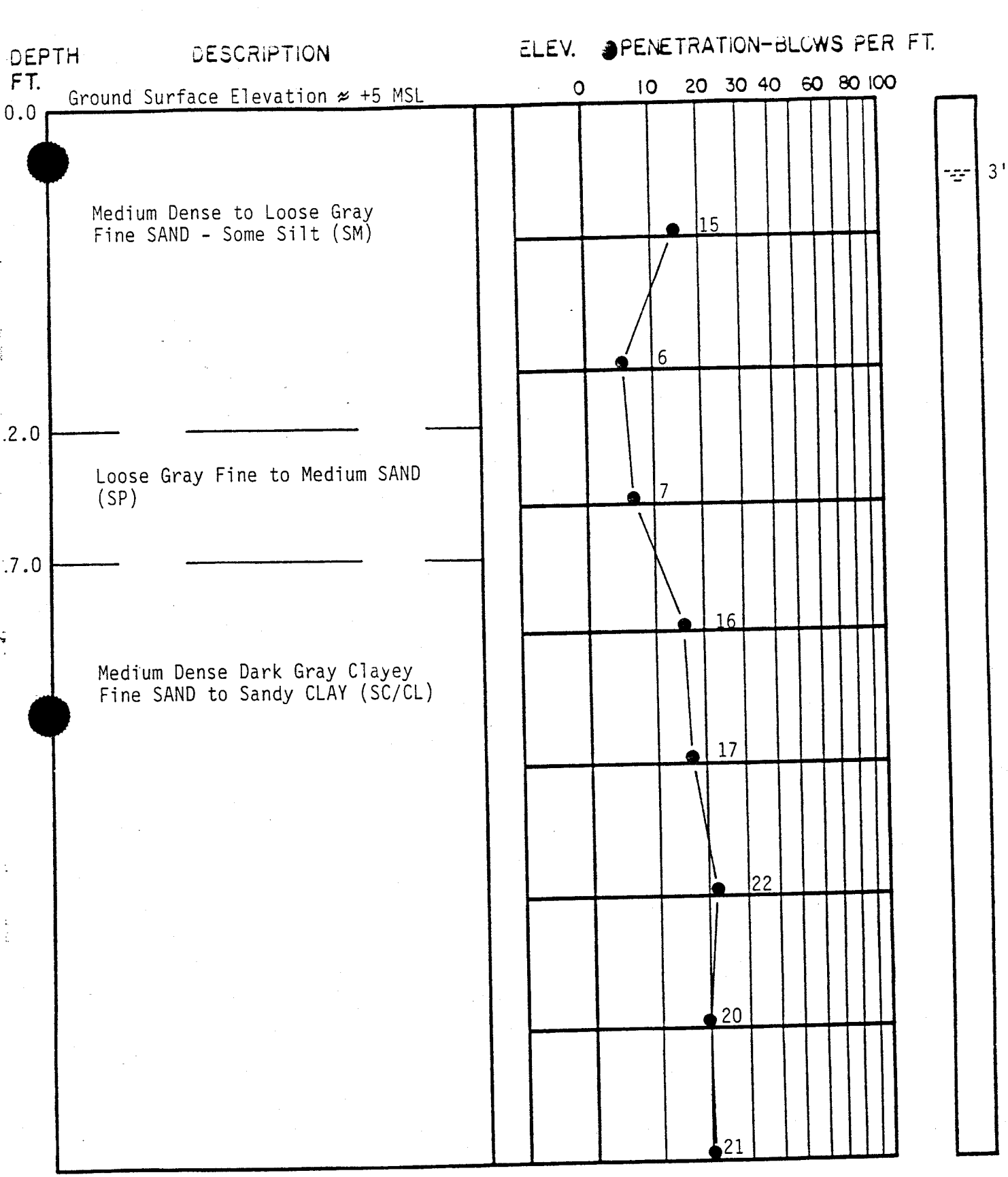
BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

TEST BORING RECORD

BORING NO. B-26
DATE DRILLED 3-12-94
JOB NO. 1063-93-447

S&ME



TEST BORING RECORD

BORING NO. B-27
DATE DRILLED 2-16-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME

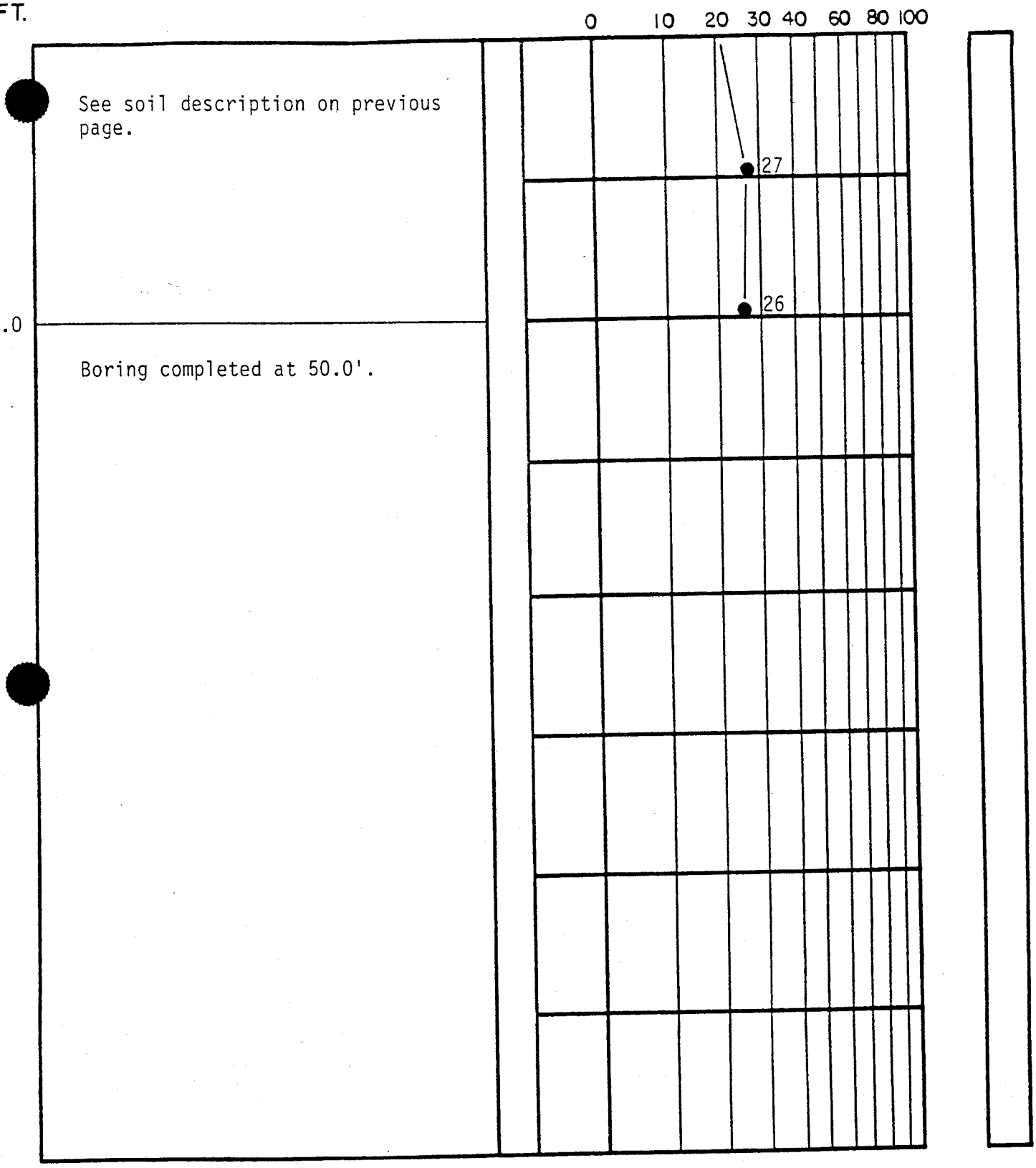
DEPTH FT.

DESCRIPTION

ELEV.

PENETRATION-BLOWS PER FT.

0 10 20 30 40 60 80 100



See soil description on previous page.

50.0

Boring completed at 50.0'.

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50% ROCK CORE RECOVERY

LOSS OF DRILLING WATER

WATER TABLE- 24 HR.

WATER TABLE-1 HR.

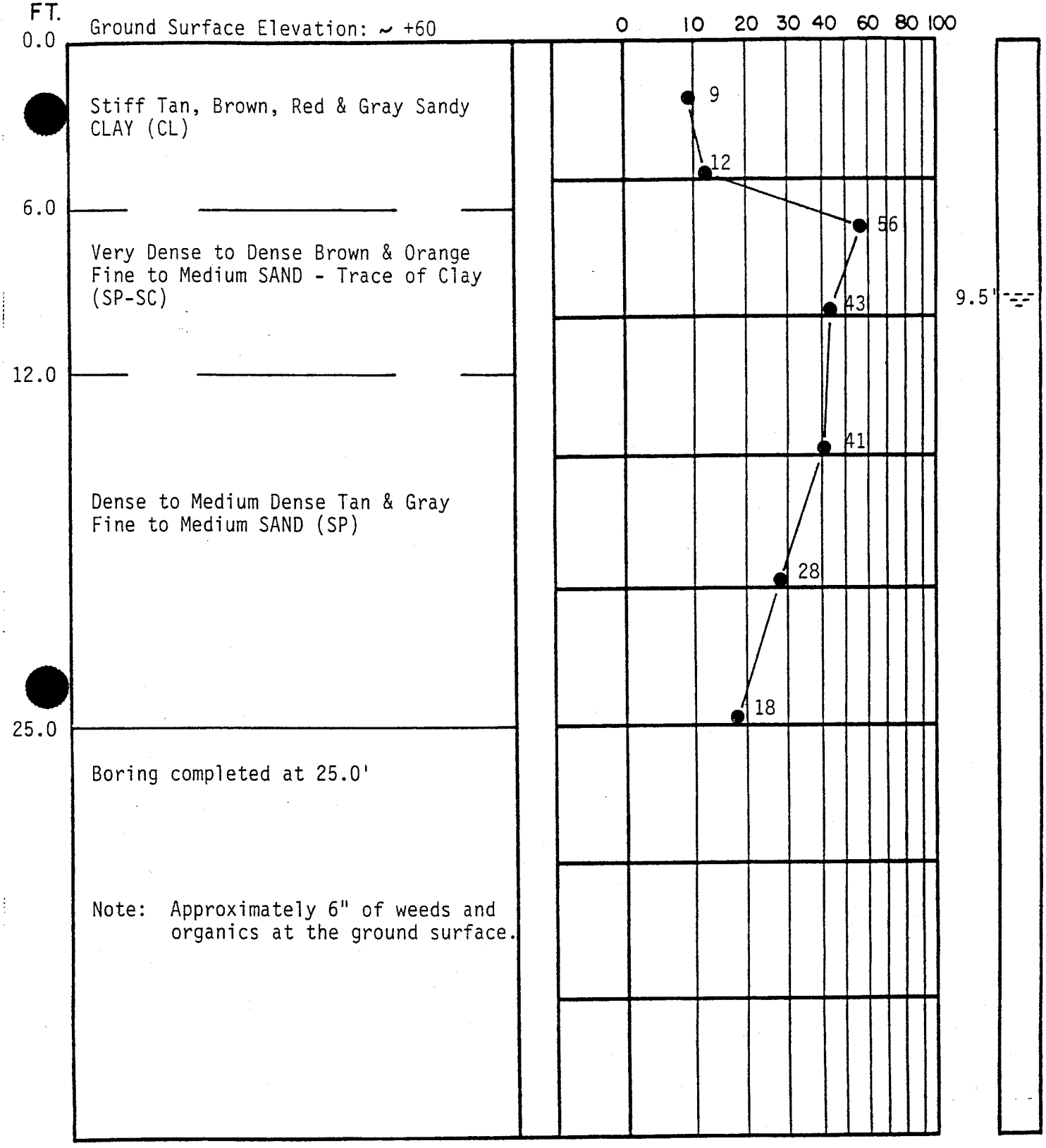
TEST BORING RECORD

BORING NO. B-27

DATE DRILLED 2-16-94

JOB NO. 1063-93-447

S&ME



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

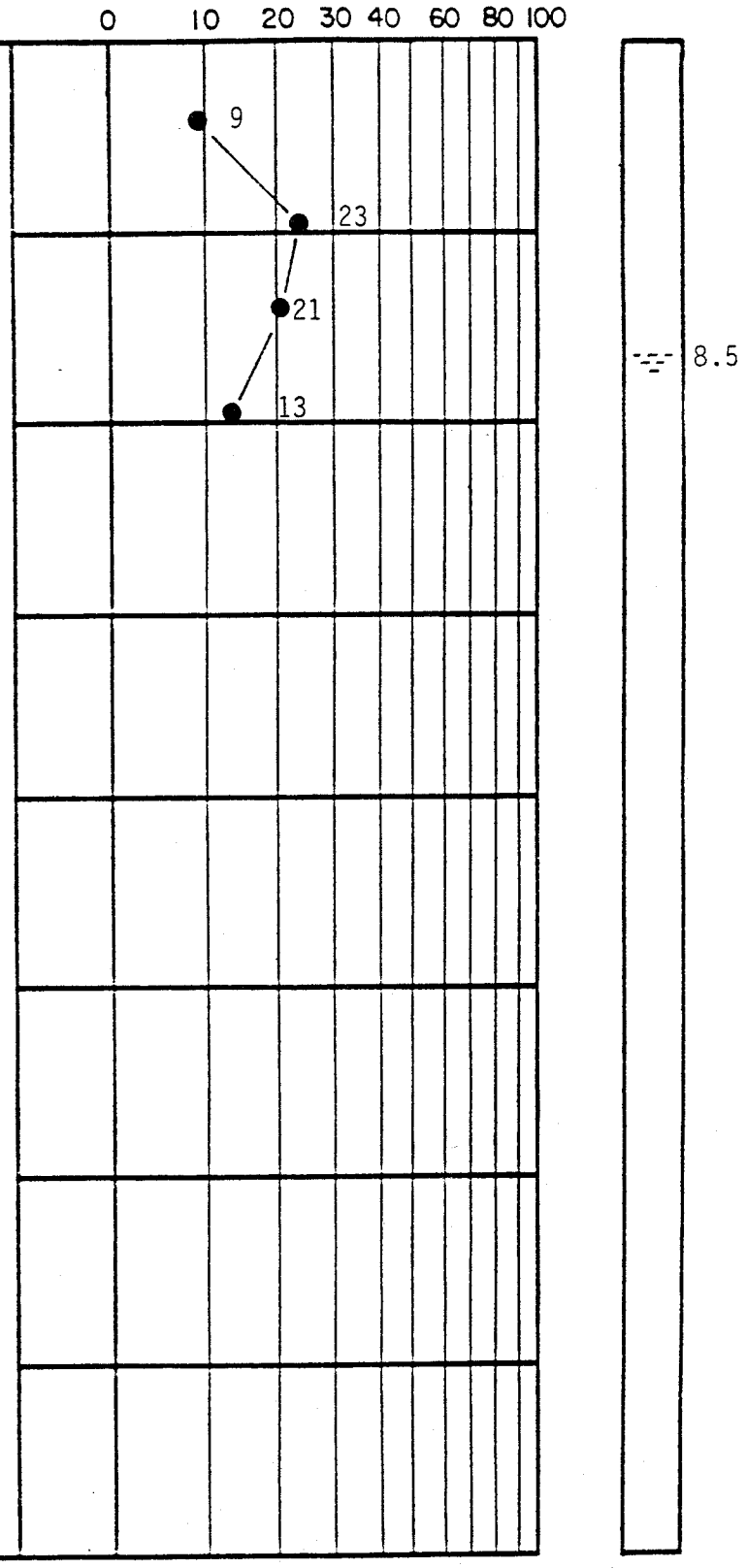
UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR.
WATER TABLE-1 HR.

TEST BORING RECORD

BORING NO. B-28
DATE DRILLED 4-5-94
JOB NO. 1063-93-447

S&ME

DEPTH FT.	DESCRIPTION	ELEV.
0.0	Ground Surface Elevation: ~ +54 MSL	
1.0	Brush & Tan Fine Sand	
	Loose to Medium Dense Orange & Brown Fine to Medium SAND - Some Clay (SC)	
5.5		
	Medium Dense Tan Fine to Medium SAND (SP)	
10.0		
	Boring completed at 10.0'.	



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

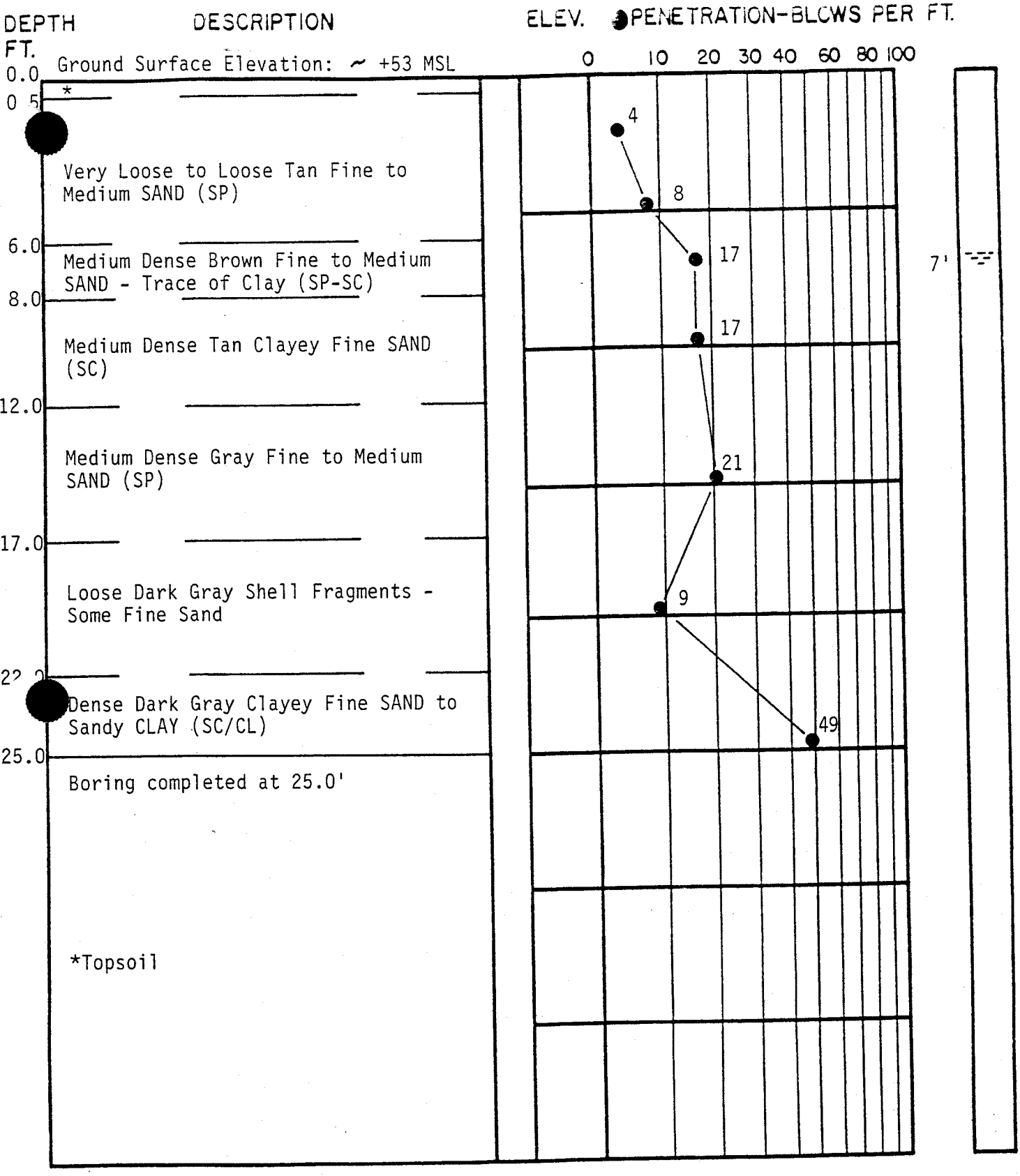
UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR
WATER TABLE-1 HR

TEST BORING RECORD

BORING NO. B-29
DATE DRILLED 4-18-94
JOB NO. 1063-94-447

S&ME

GM-14



TEST BORING RECORD

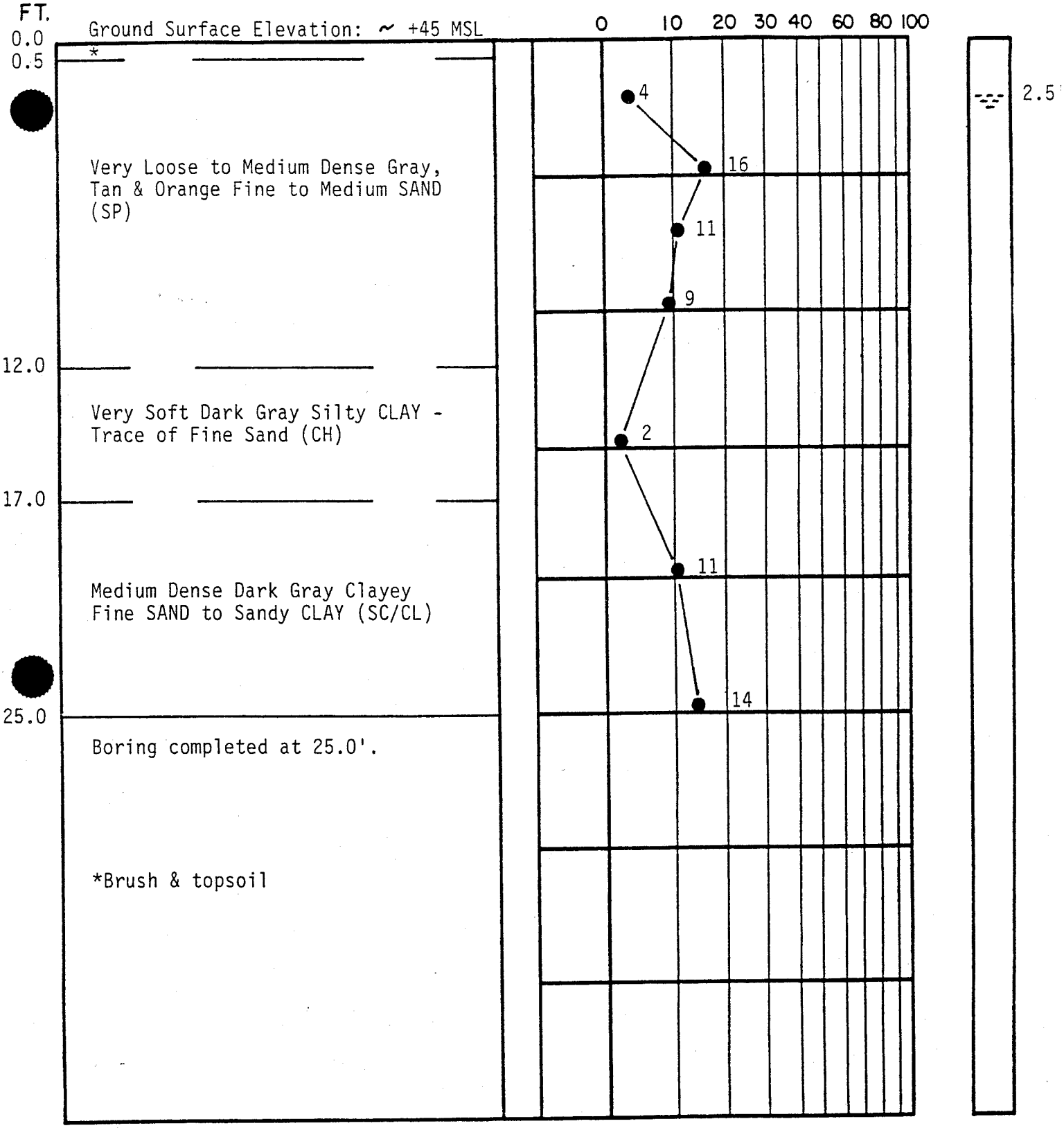
BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

BORING NO. B-31
DATE DRILLED 3-15-94
JOB NO. 1063-93-447

S&ME



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

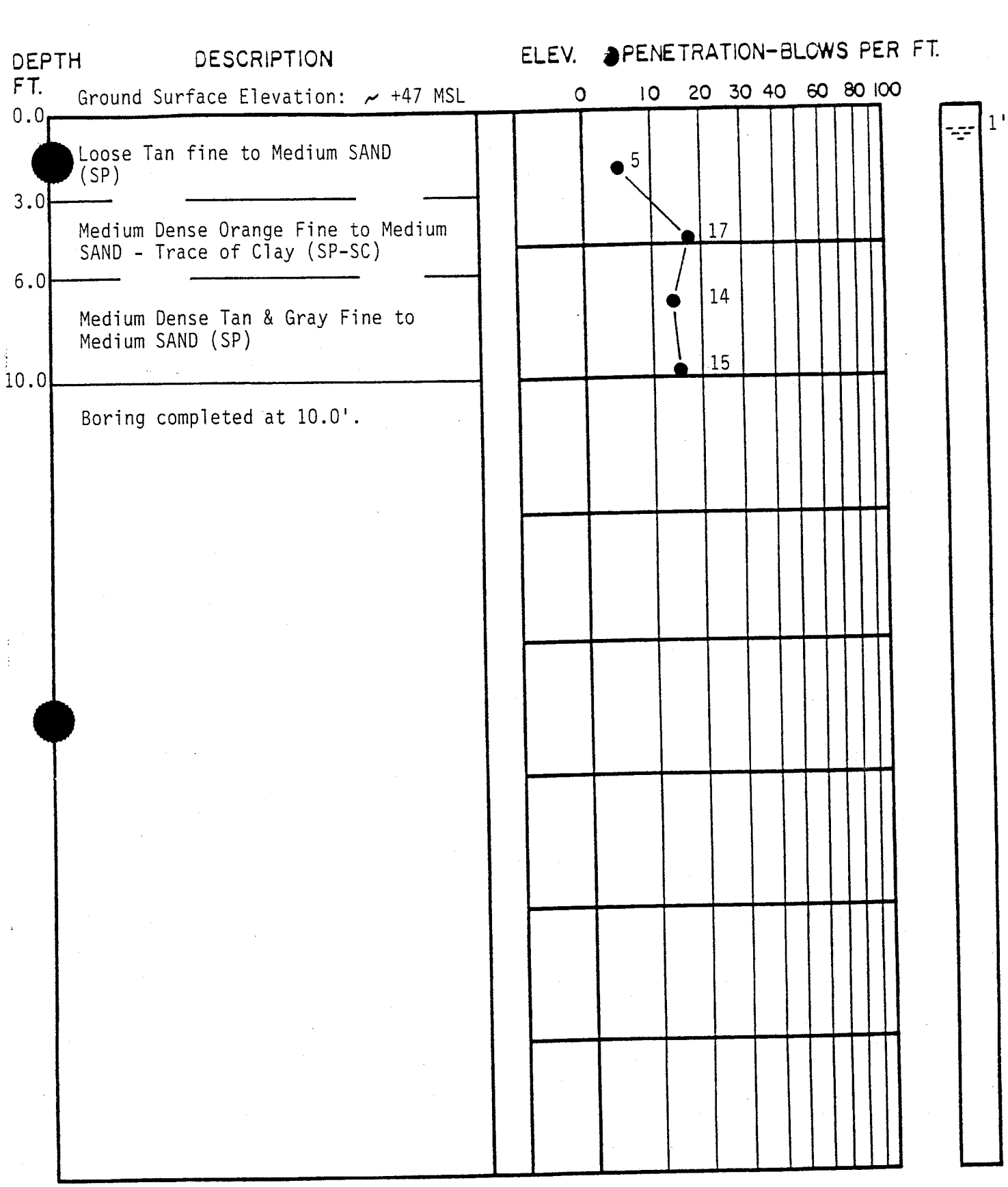
UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

TEST BORING RECORD

BORING NO. B-32
DATE DRILLED 3-23-94
JOB NO. 1063-93-447

S&ME

SM-1



TEST BORING RECORD

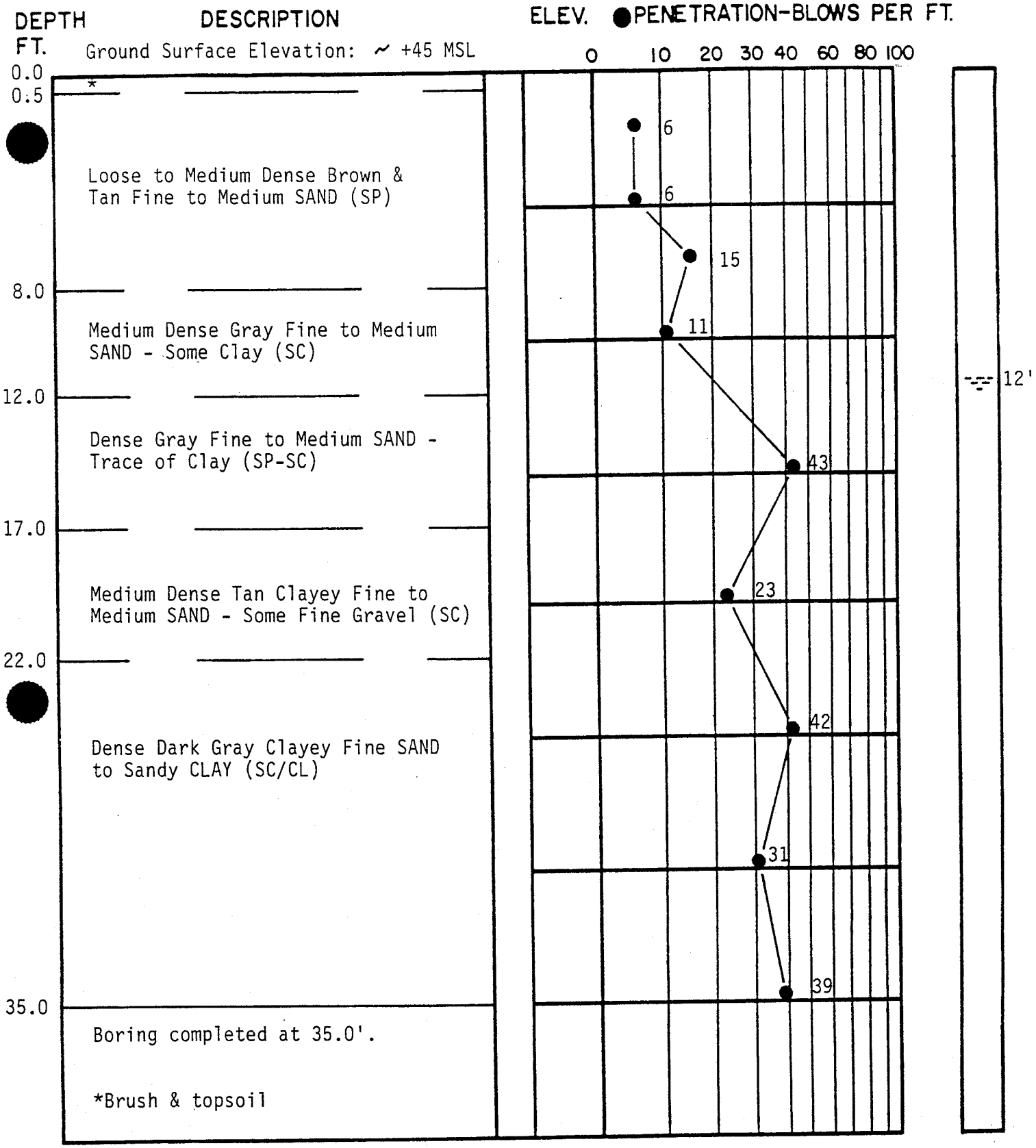
BORING NO. B-35
DATE DRILLED 3-16-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

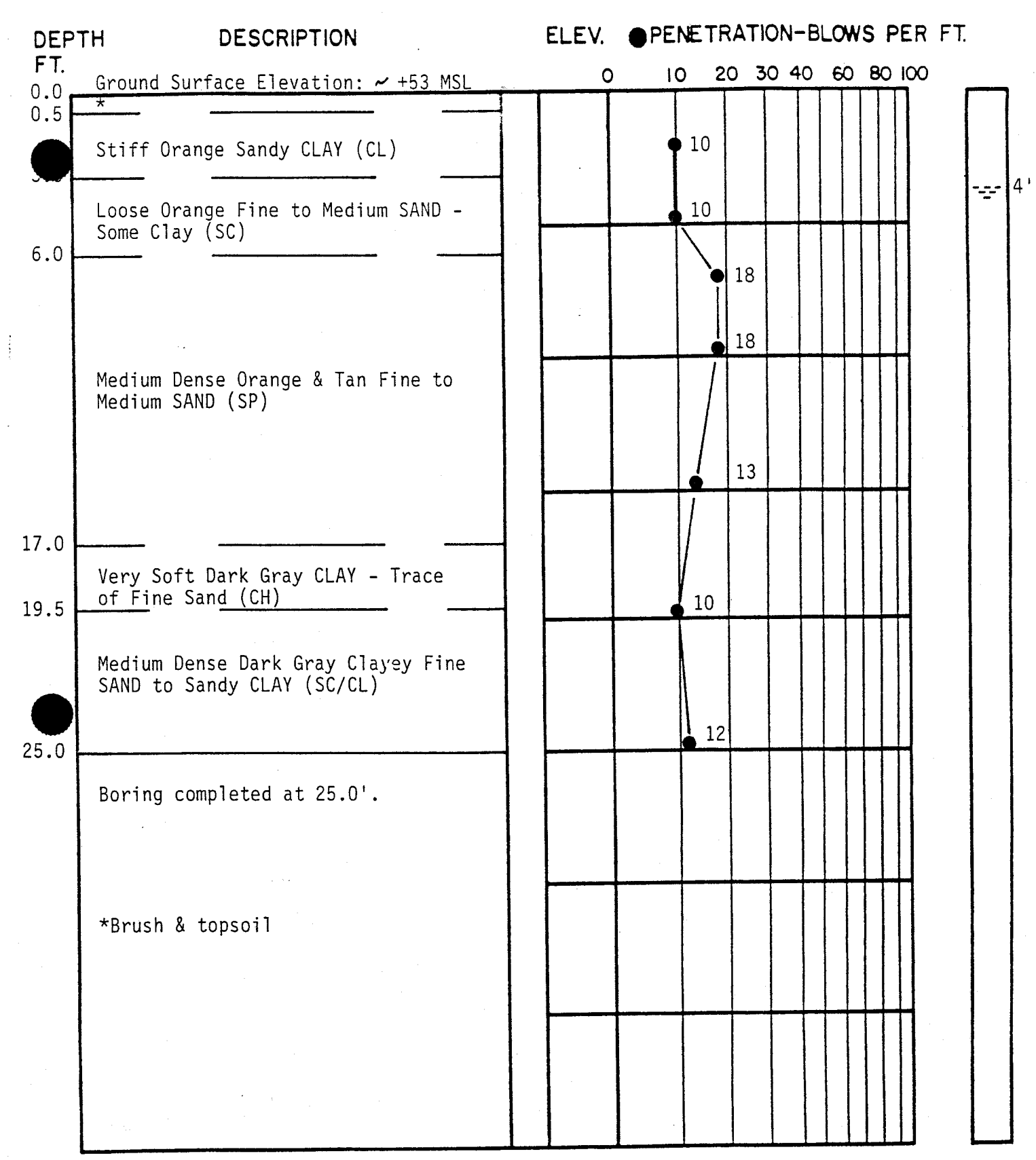
UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

SM-1a

TEST BORING RECORD

BORING NO. B-36
DATE DRILLED 3-21-94
JOB NO. 1063-93-447

S&ME



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

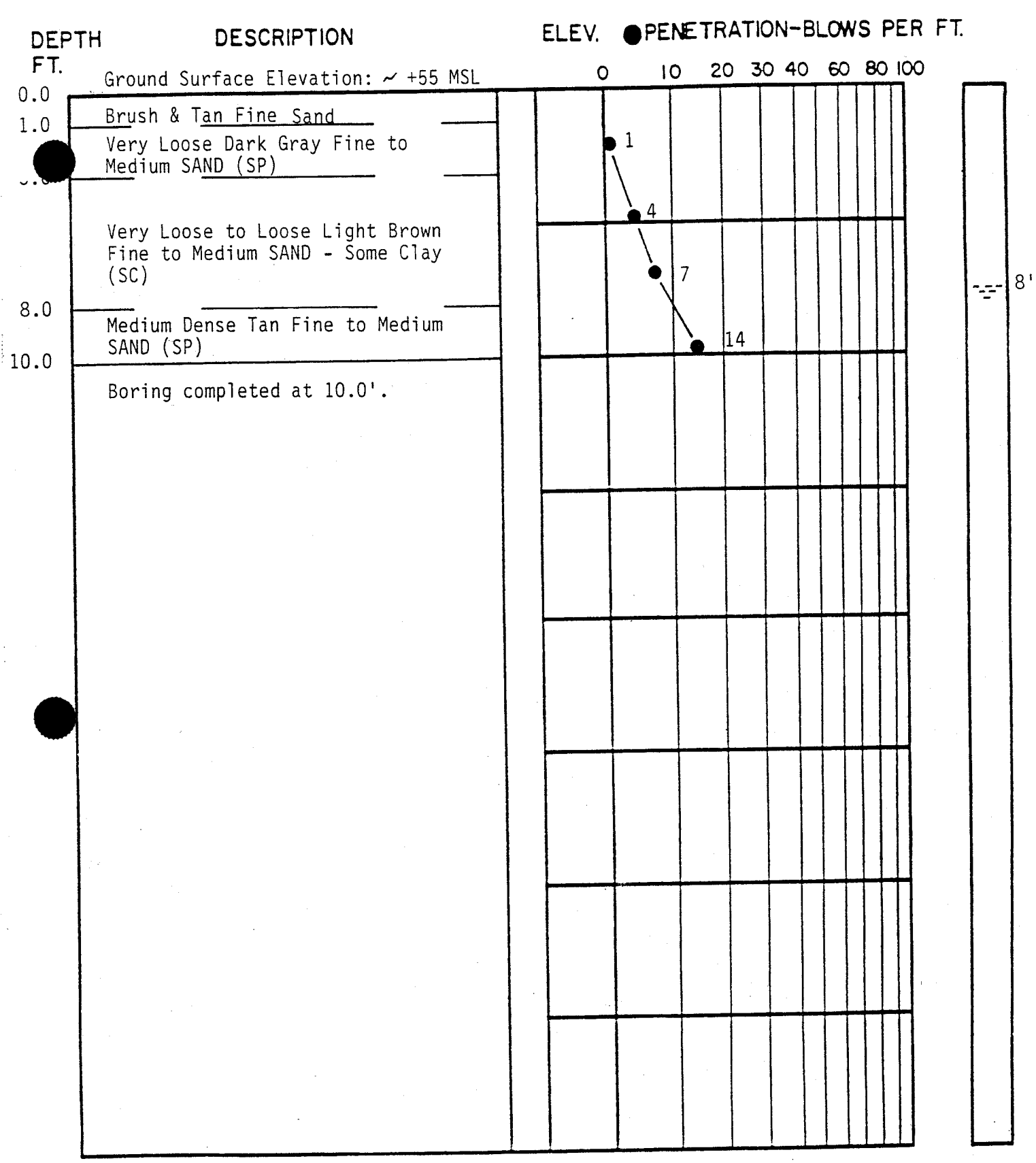
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR.
WATER TABLE-1 HR.

TEST BORING RECORD

BORING NO. B-37
DATE DRILLED 3-23-94
JOB NO. 1063-93-447

S&ME



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

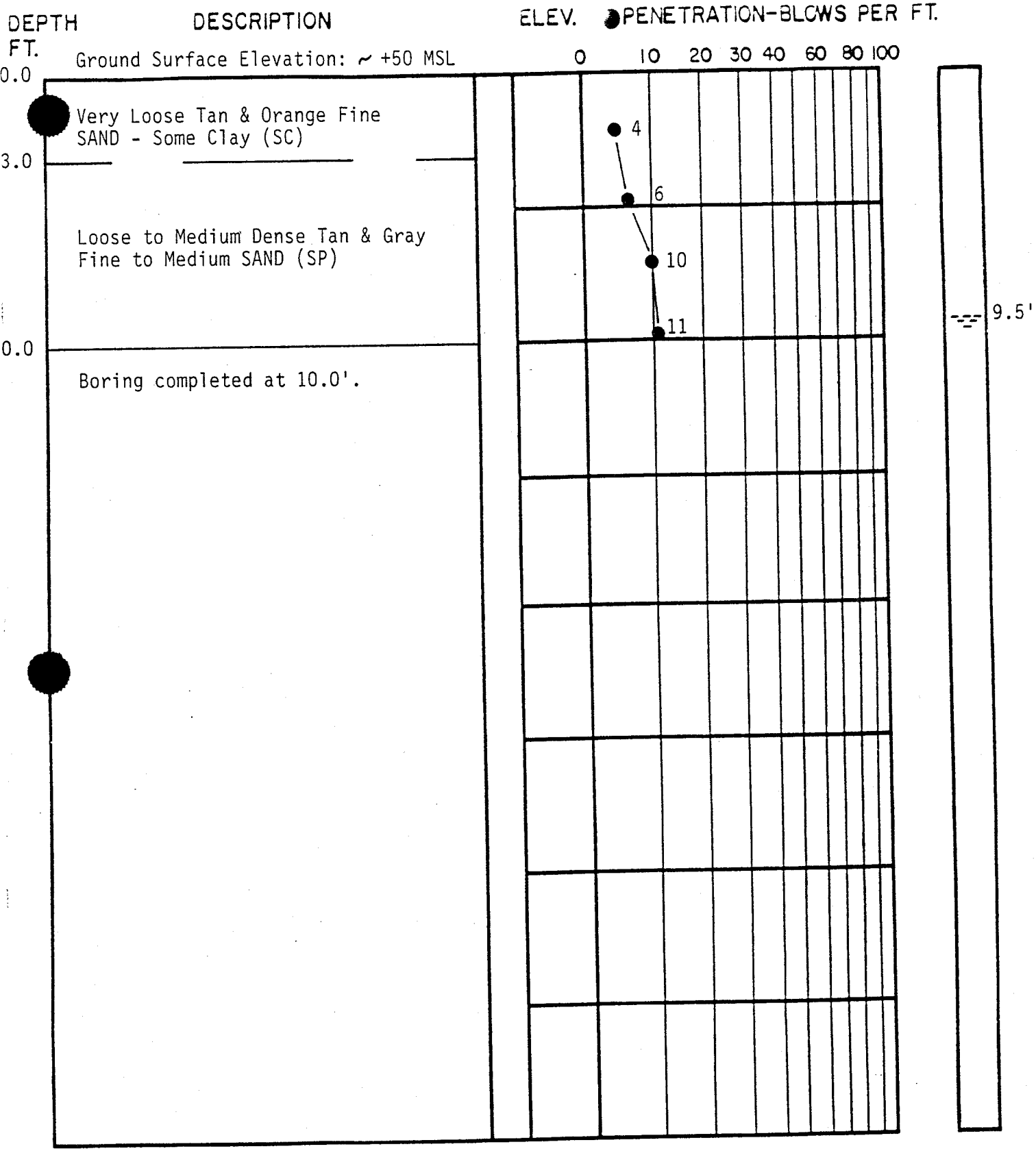
UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR
WATER TABLE-1 HR

TEST BORING RECORD

BORING NO. B-38
DATE DRILLED 4-18-94
JOB NO. 1064-93-447

S&ME

SM-14



TEST BORING RECORD

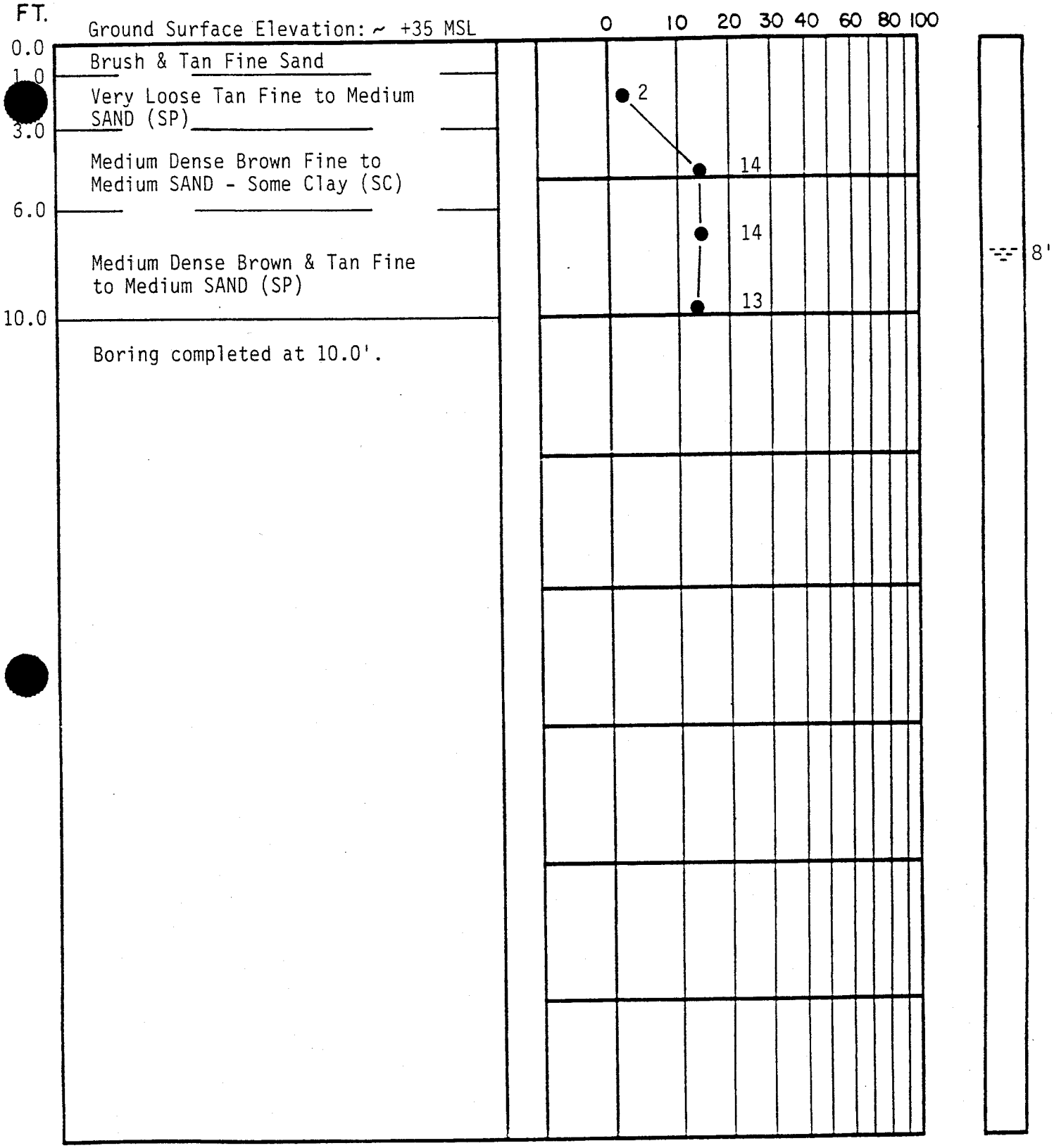
BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24HR.
WATER TABLE-1HR.

BORING NO. B-39
DATE DRILLED 3-16-94
JOB NO. 1063-93-447

S&ME



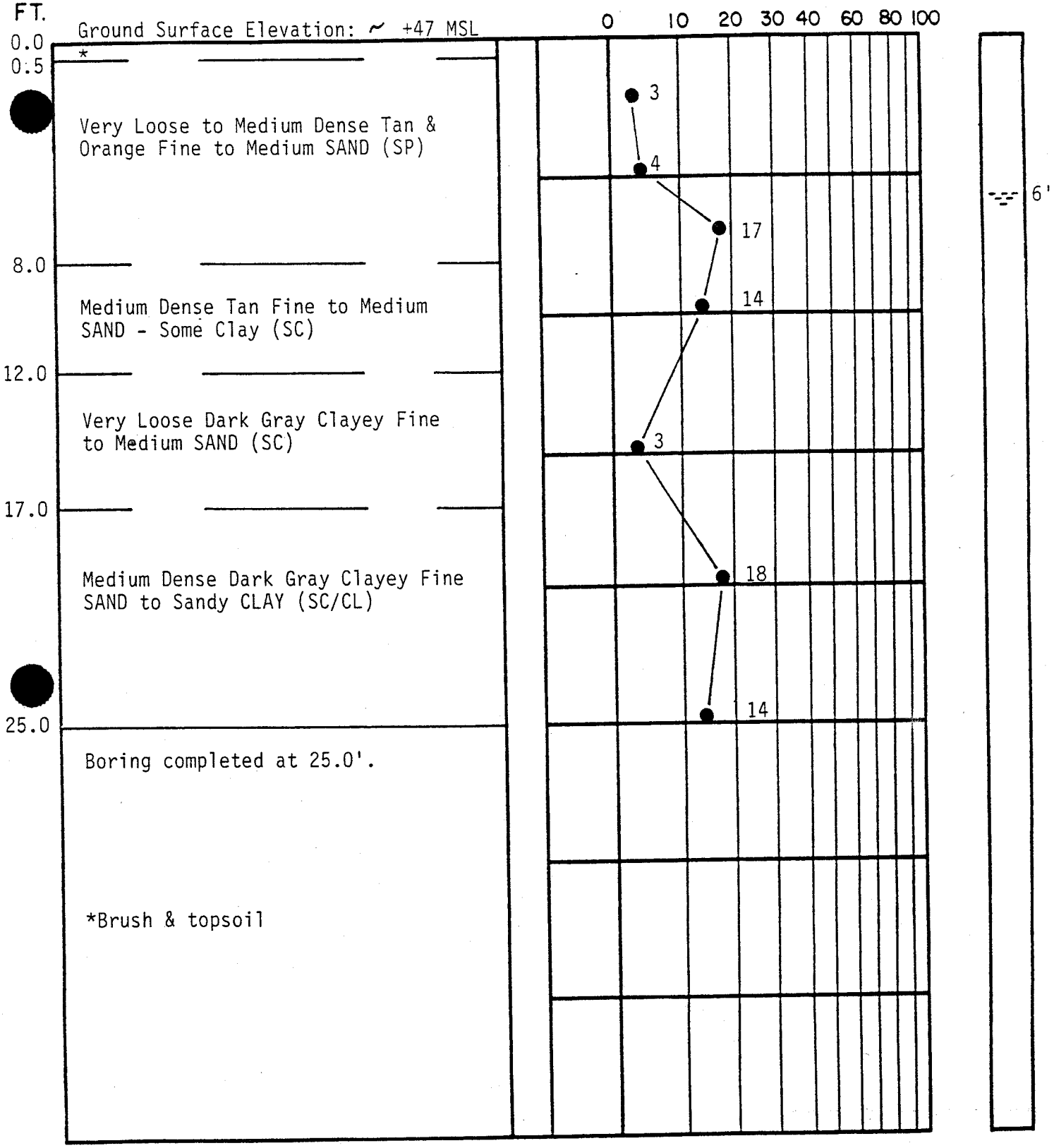
BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR
WATER TABLE - 1 HR.

TEST BORING RECORD

BORING NO. B-40
DATE DRILLED 4-18-94
JOB NO. 1063-93-447

S&ME



TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

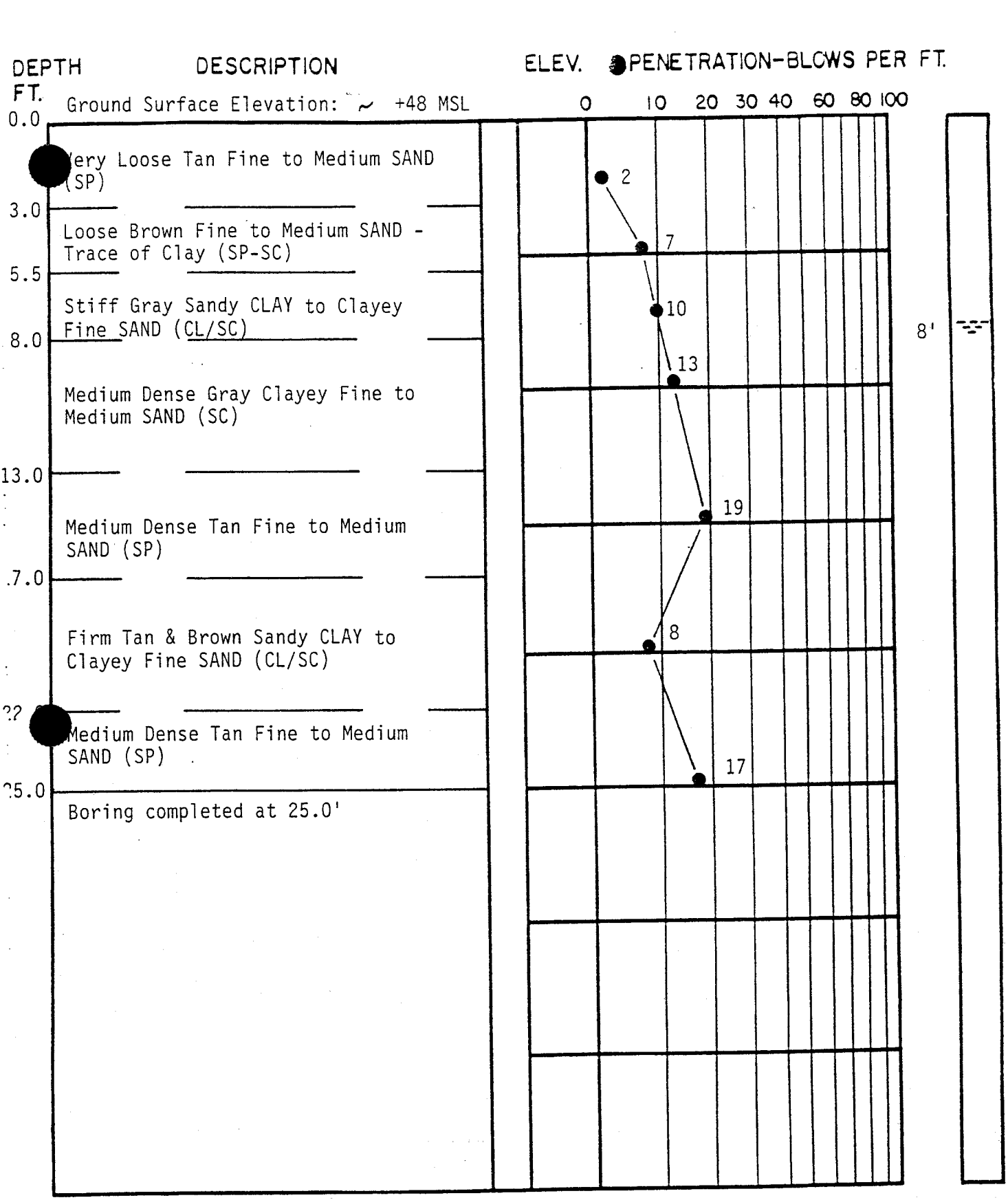
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR.
WATER TABLE-1 HR.

BORING NO. B-41
DATE DRILLED 3-21-94
JOB NO. 1063-93-447

S&ME

SM-1



TEST BORING RECORD

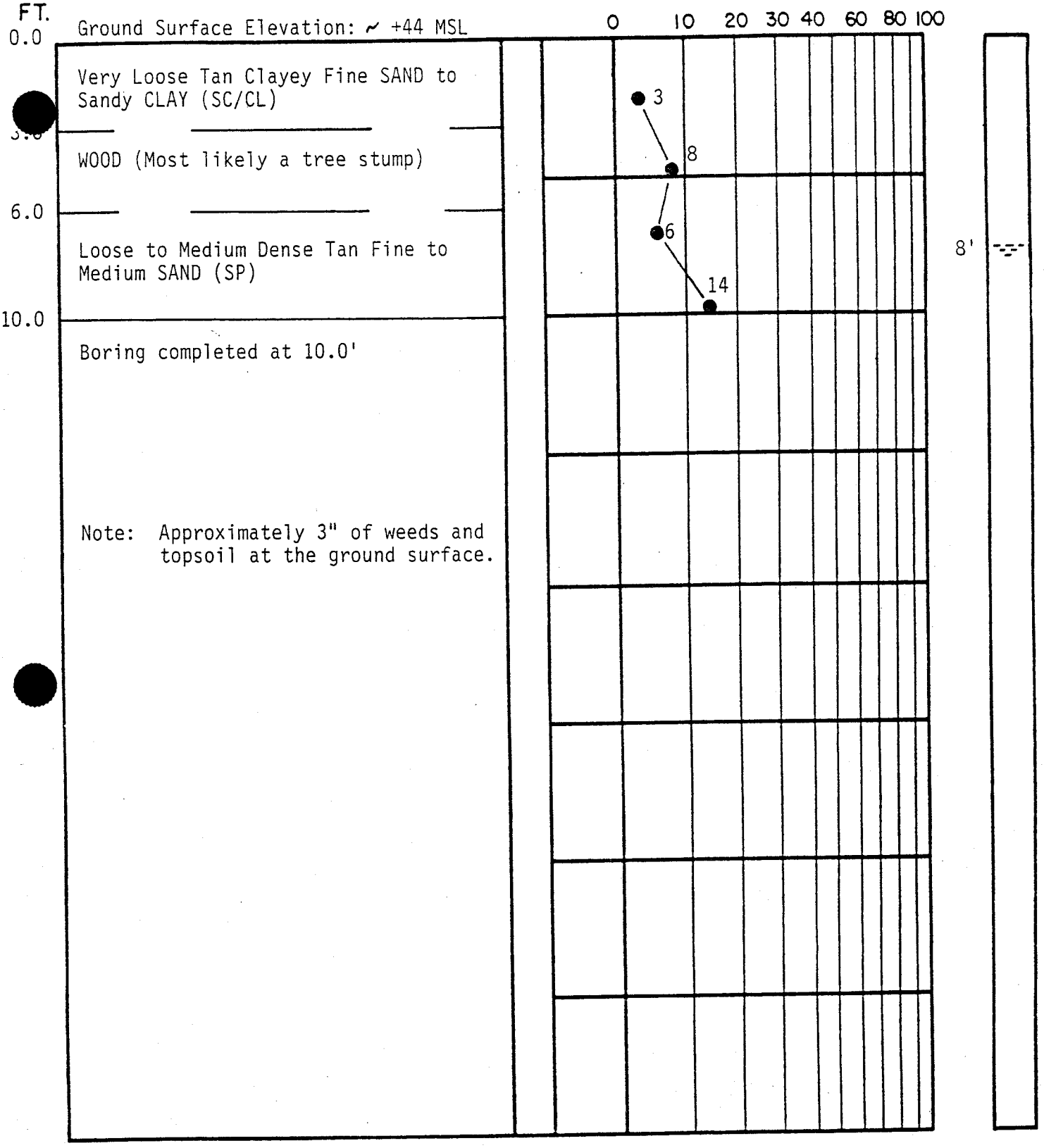
BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24HR.
WATER TABLE-1HR.

BORING NO. B-42
DATE DRILLED 3-12-94
JOB NO. 1063-93-447

S&ME



TEST BORING RECORD

BORING NO. B-43
DATE DRILLED 4-8-94
JOB NO. 1063-93-447

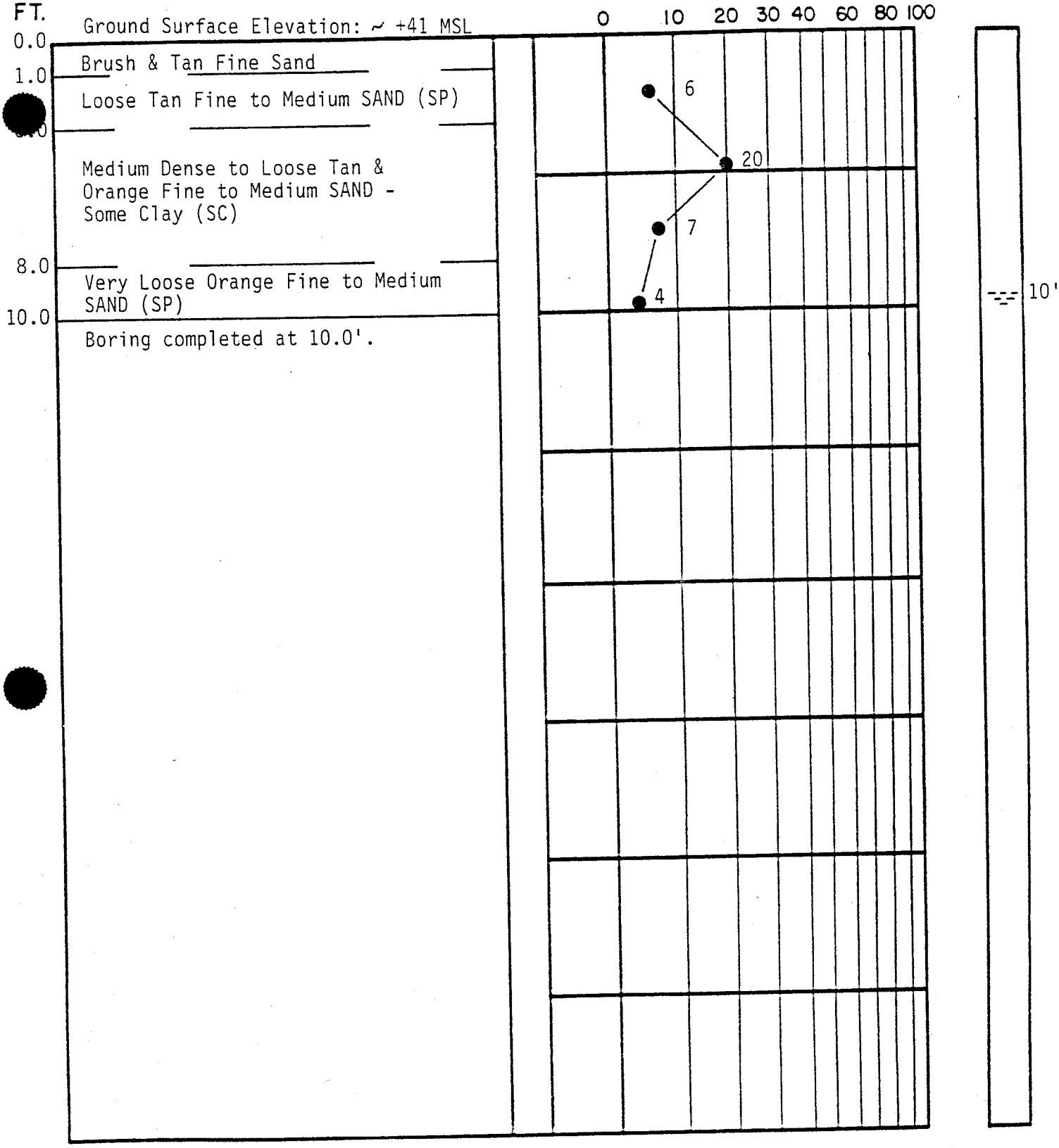
BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME

SM-14



TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

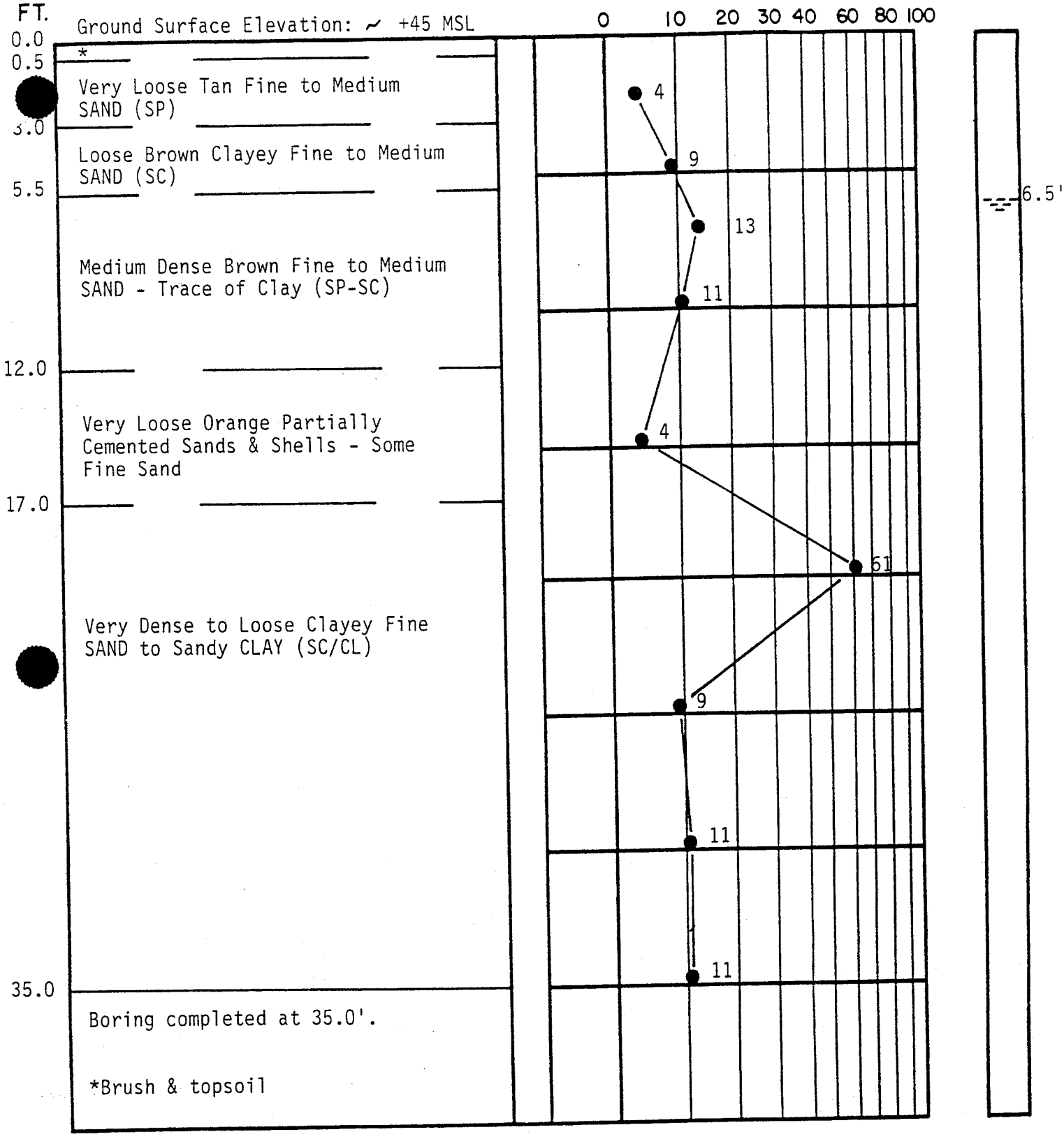
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR
WATER TABLE-1 HR

BORING NO. B-44
DATE DRILLED 4-18-94
JOB NO. 1063-93-447

S&ME

SM-14



TEST BORING RECORD

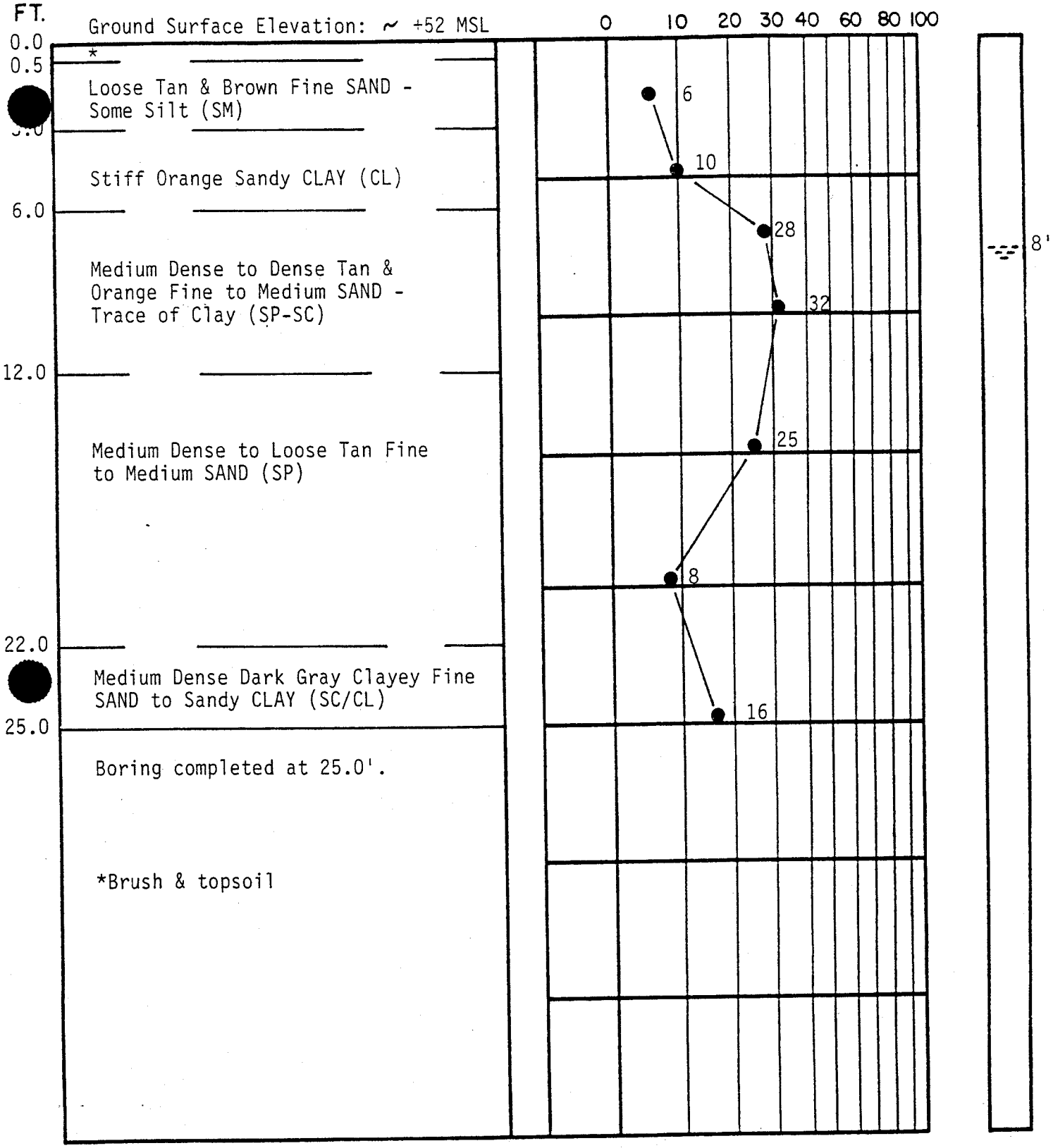
BORING NO. B-45
DATE DRILLED 3-21-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



TEST BORING RECORD

BORING NO. B-46
DATE DRILLED 3-23-94
JOB NO. 1063-93-447

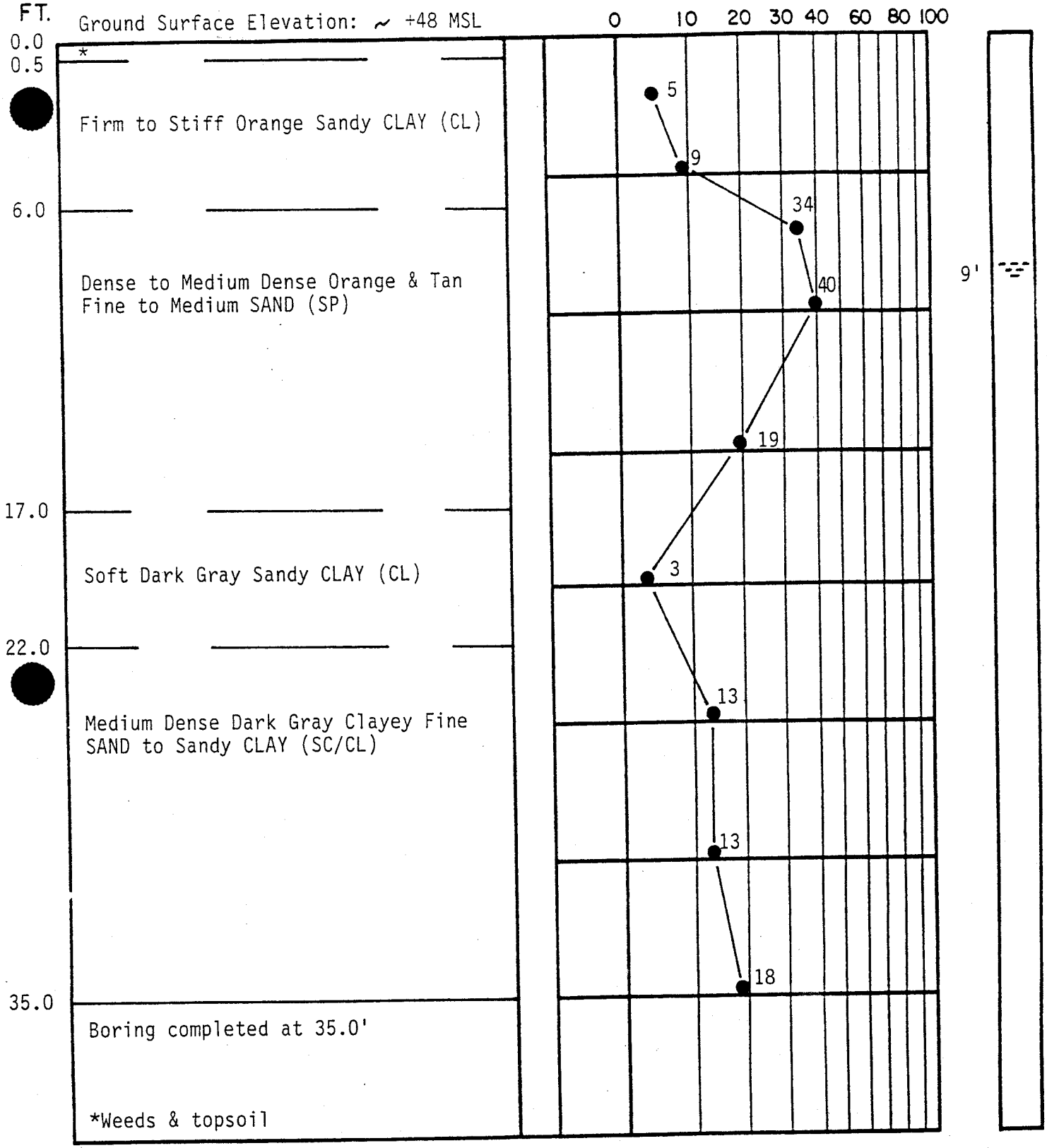
BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR.
WATER TABLE-1 HR.

S&ME

SM-14



TEST BORING RECORD

BORING NO. B-47
DATE DRILLED 3-21-94
JOB NO. 1063-93-447

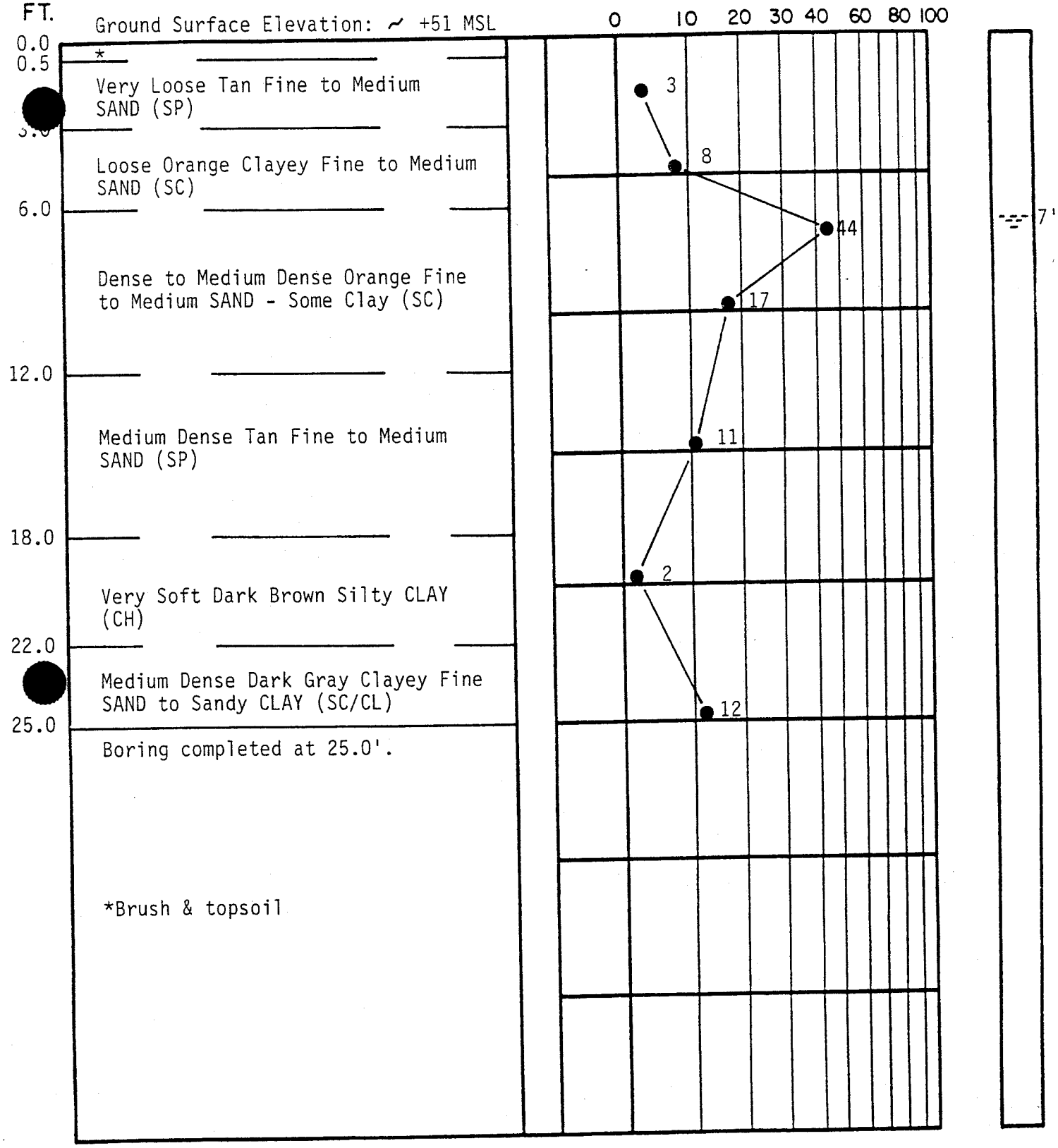
BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR.
WATER TABLE-1 HR.

S&ME

SM-1



TEST BORING RECORD

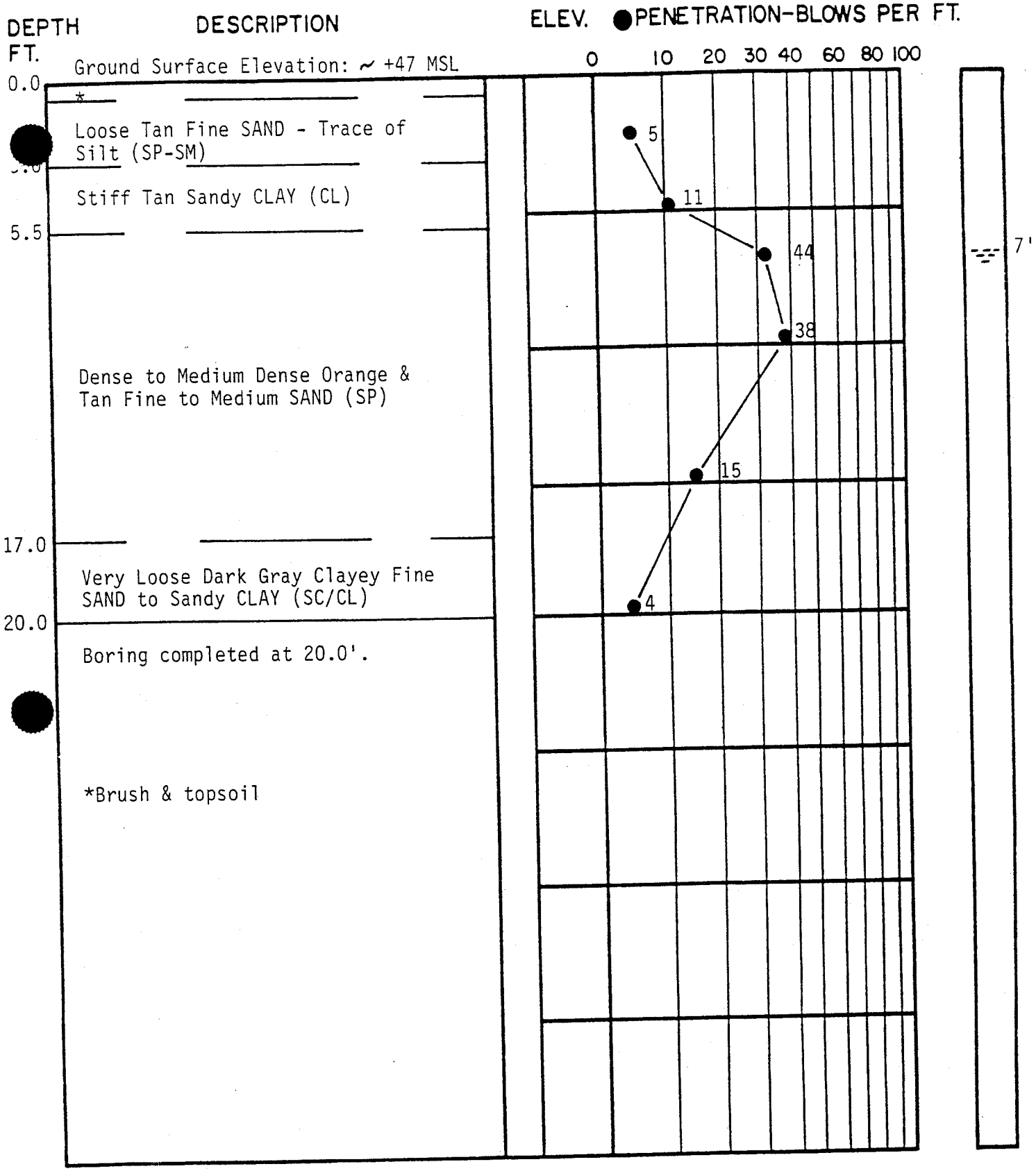
BORING NO. B-49
DATE DRILLED 3-21-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



TEST BORING RECORD

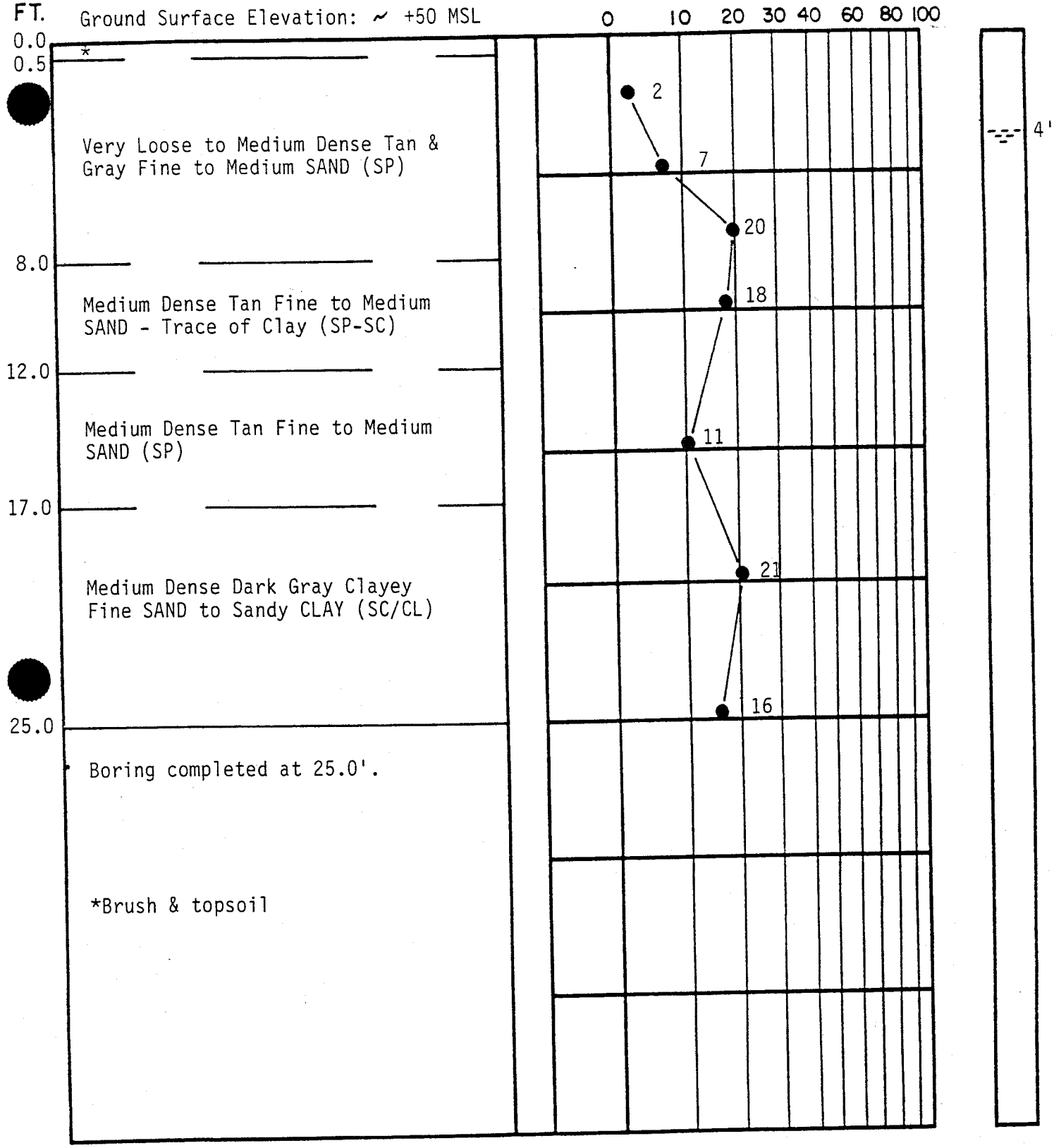
BORING NO. B-50
DATE DRILLED 3-25-94
JOB NO. 1053-94-447

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR.
WATER TABLE-1 HR.

S&ME



TEST BORING RECORD

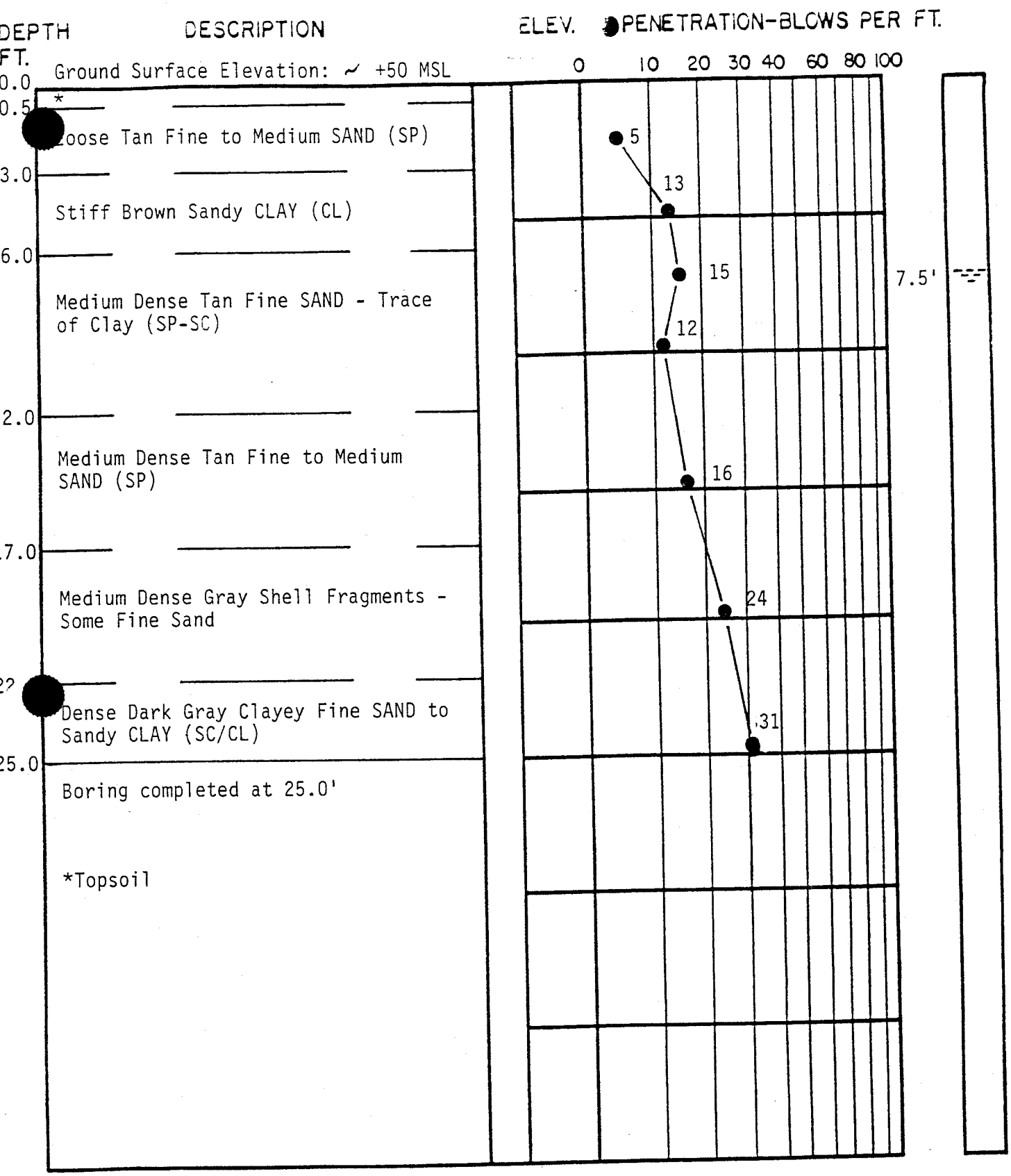
BORING NO. B-51
DATE DRILLED 3-21-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR.
WATER TABLE-1 HR.

S&ME



TEST BORING RECORD

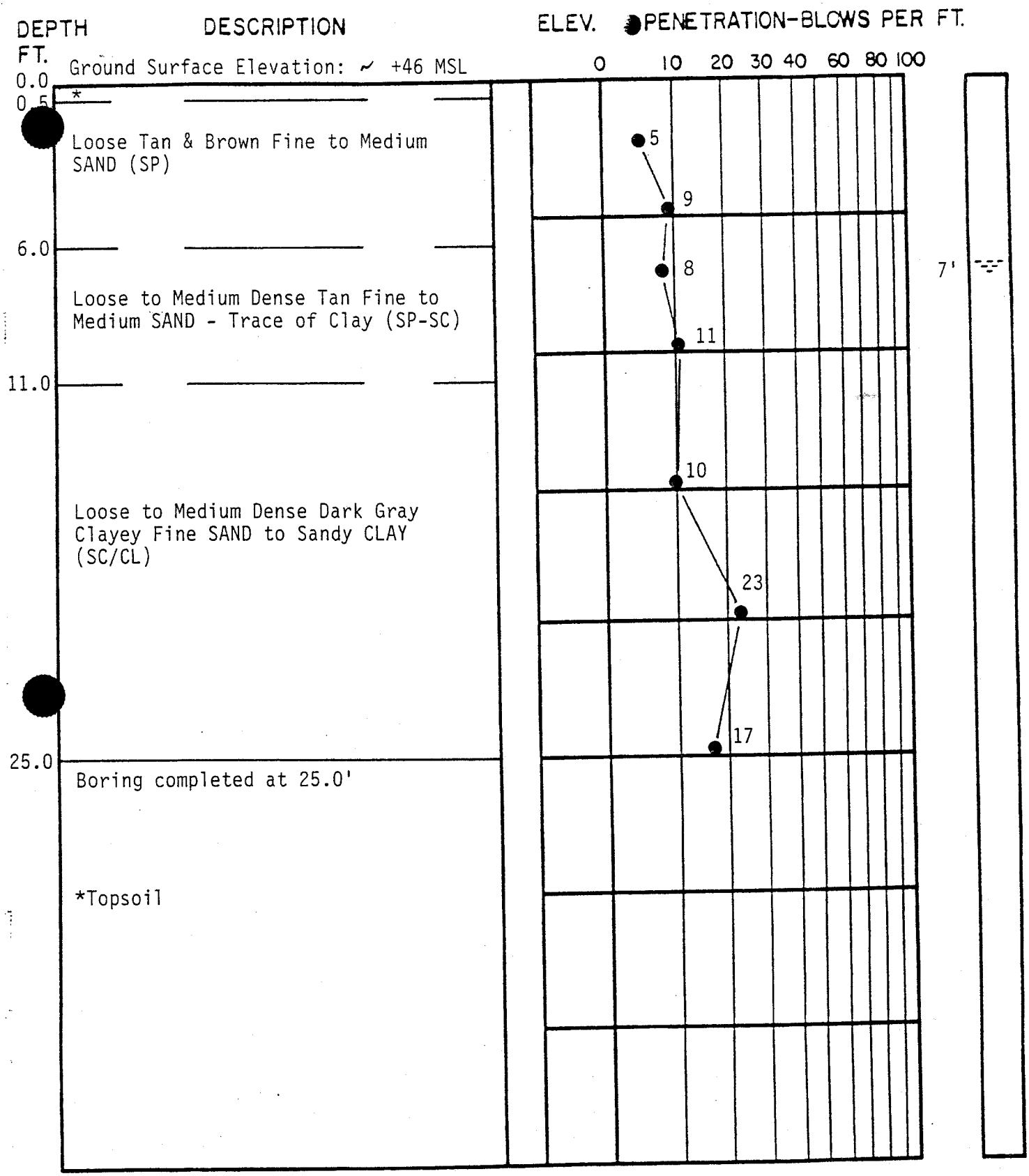
BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

BORING NO. B-53
DATE DRILLED 3-15-94
JOB NO. 1063-93-447

S&ME



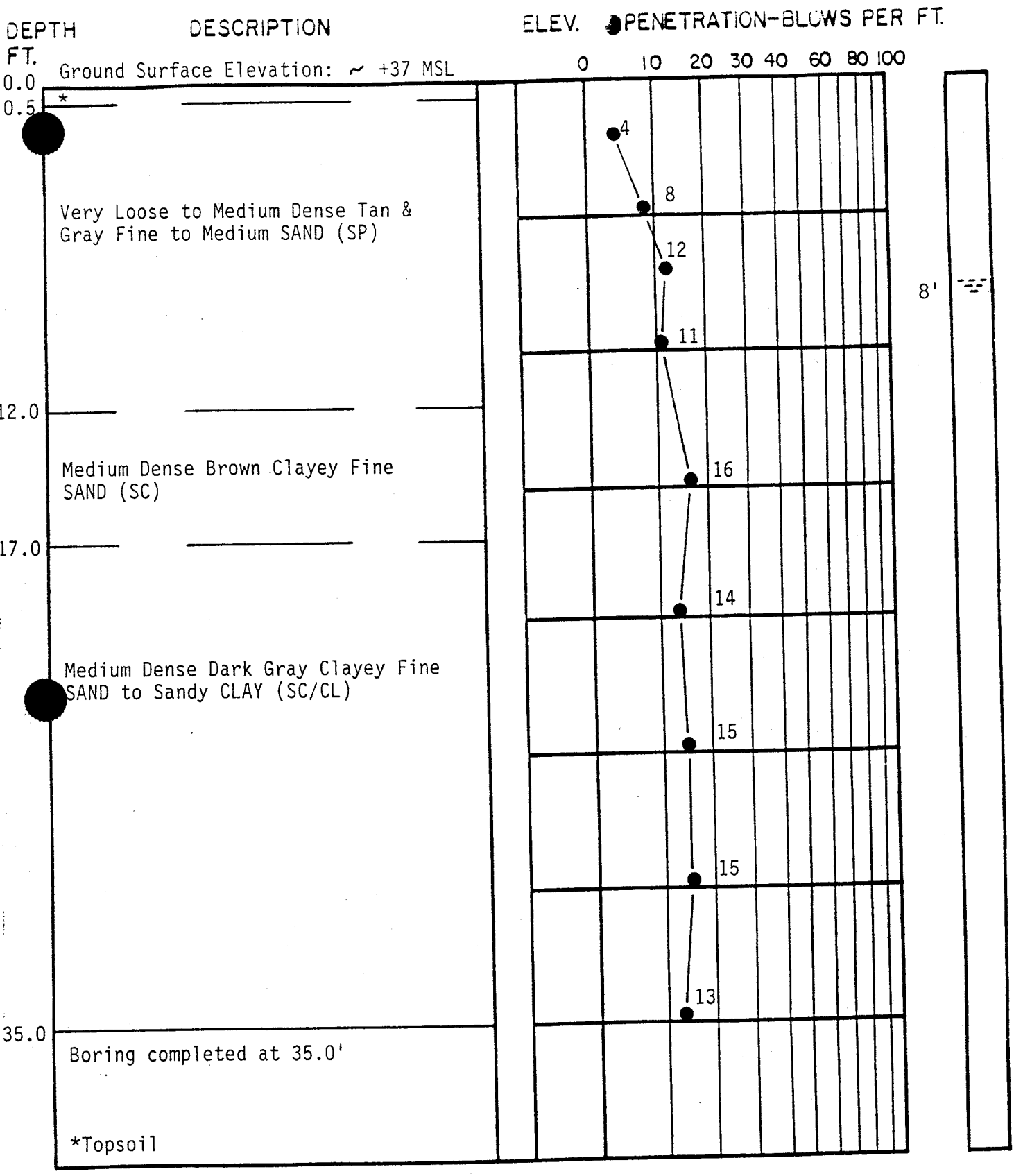
TEST BORING RECORD

BORING NO. B-55
DATE DRILLED 3-12-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

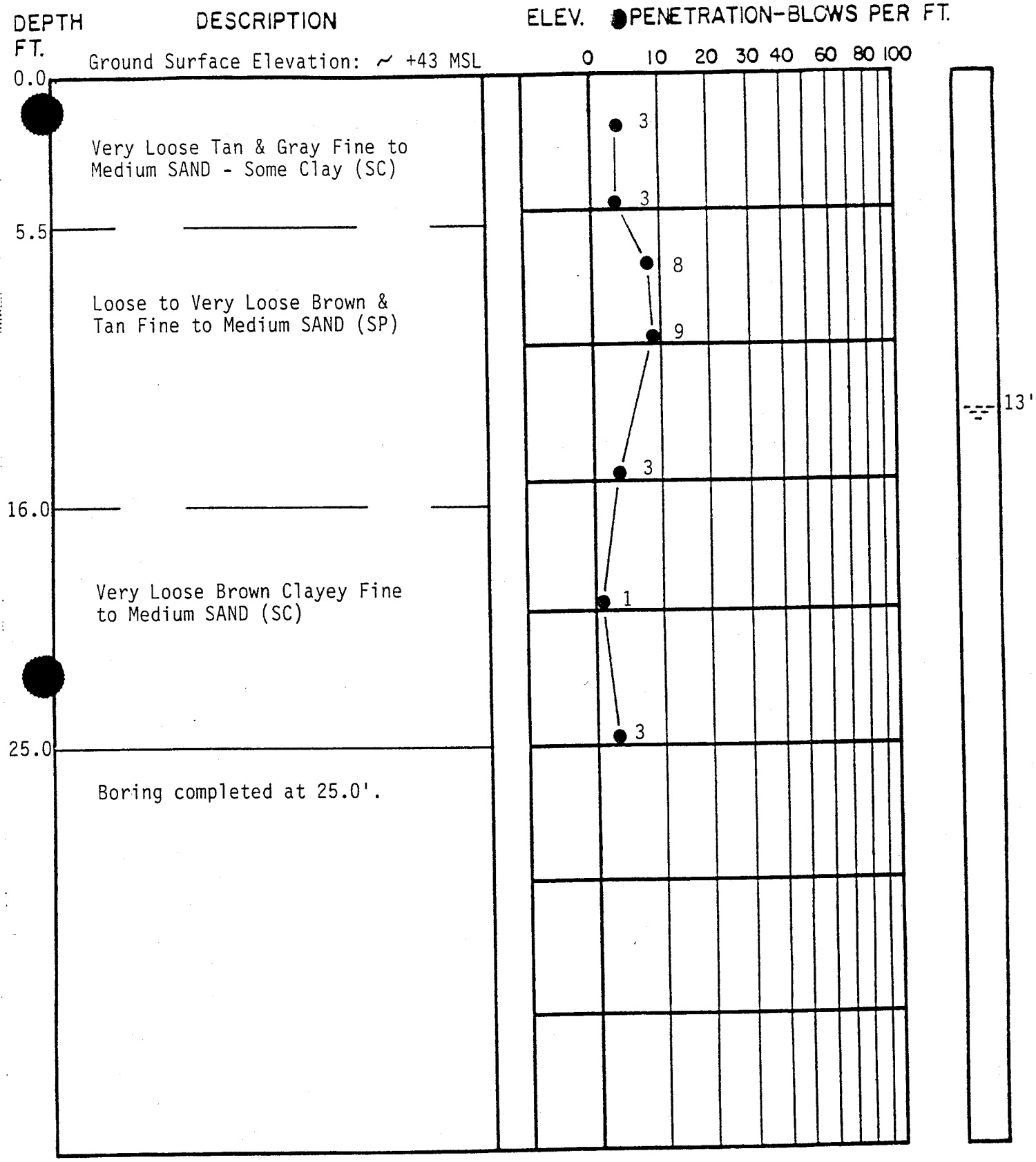
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

TEST BORING RECORD

BORING NO. B-56
DATE DRILLED 3-15-94
JOB NO. 1063-93-447

S&ME



TEST BORING RECORD

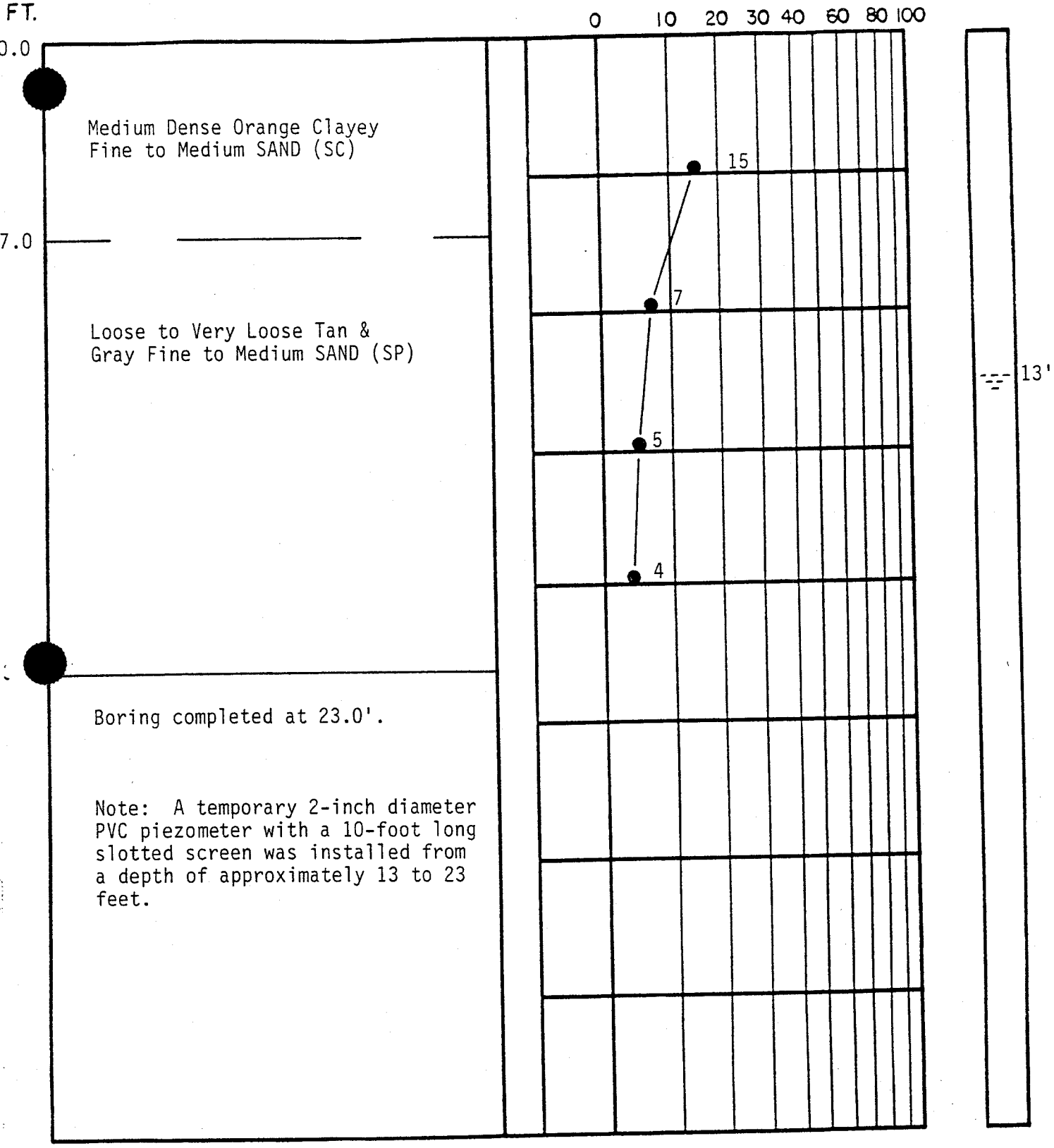
BORING NO. B-57
DATE DRILLED 3-8-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



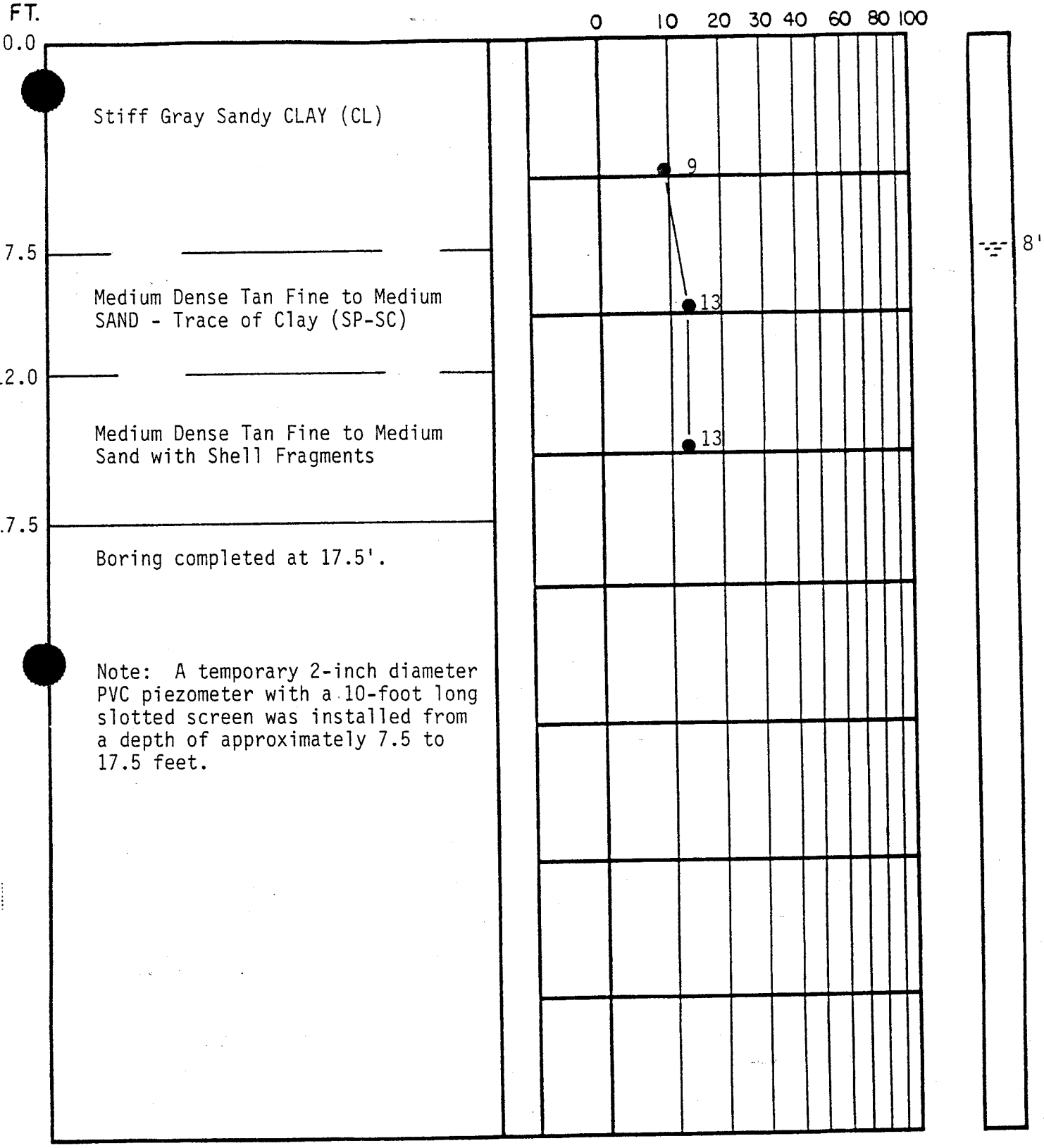
TEST BORING RECORD

BORING NO. MW-1
DATE DRILLED 2-17-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



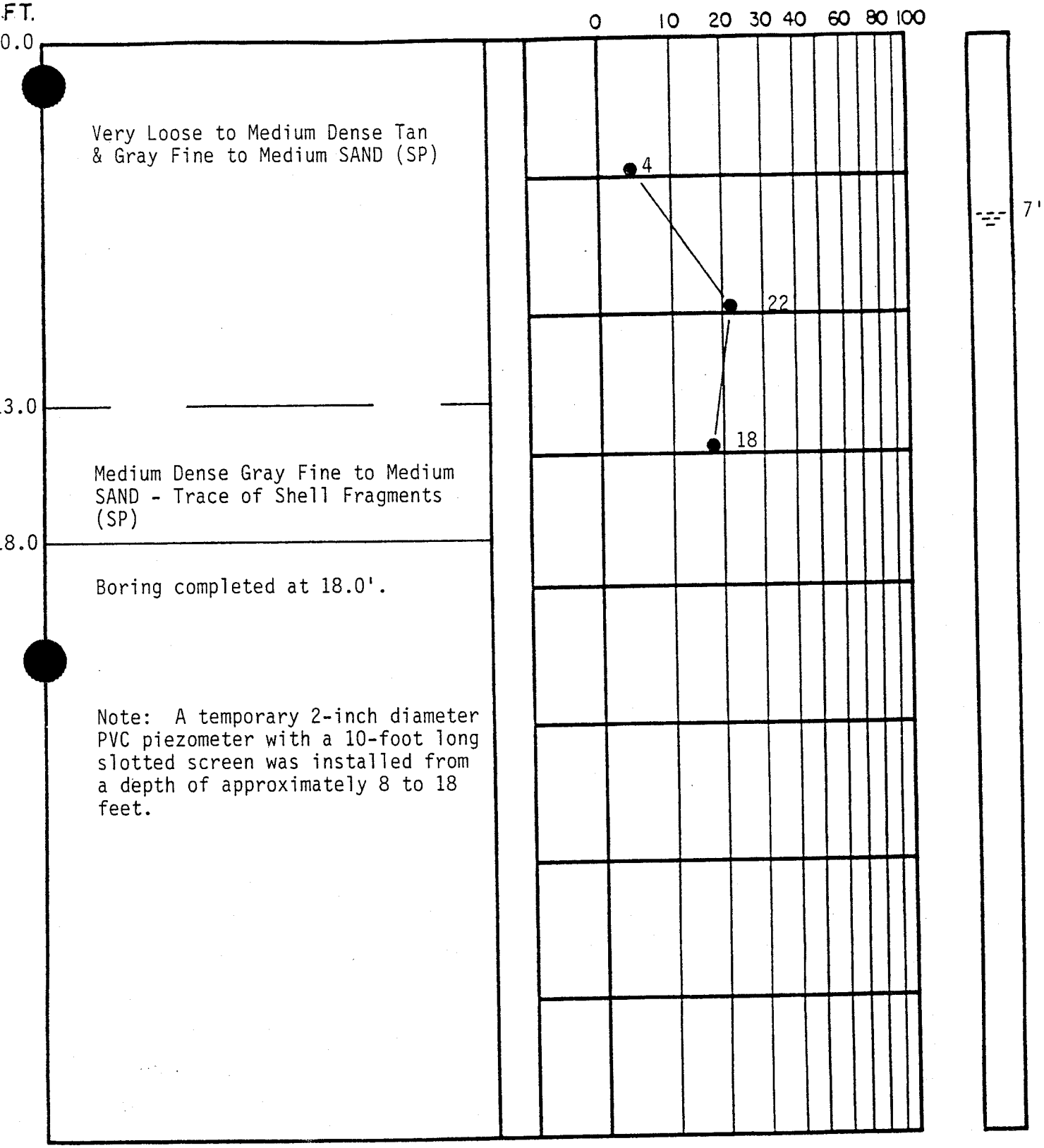
TEST BORING RECORD

BORING NO. MW-2
DATE DRILLED 2-16-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE 24 HR.
WATER TABLE-1 HR.

S&ME



TEST BORING RECORD

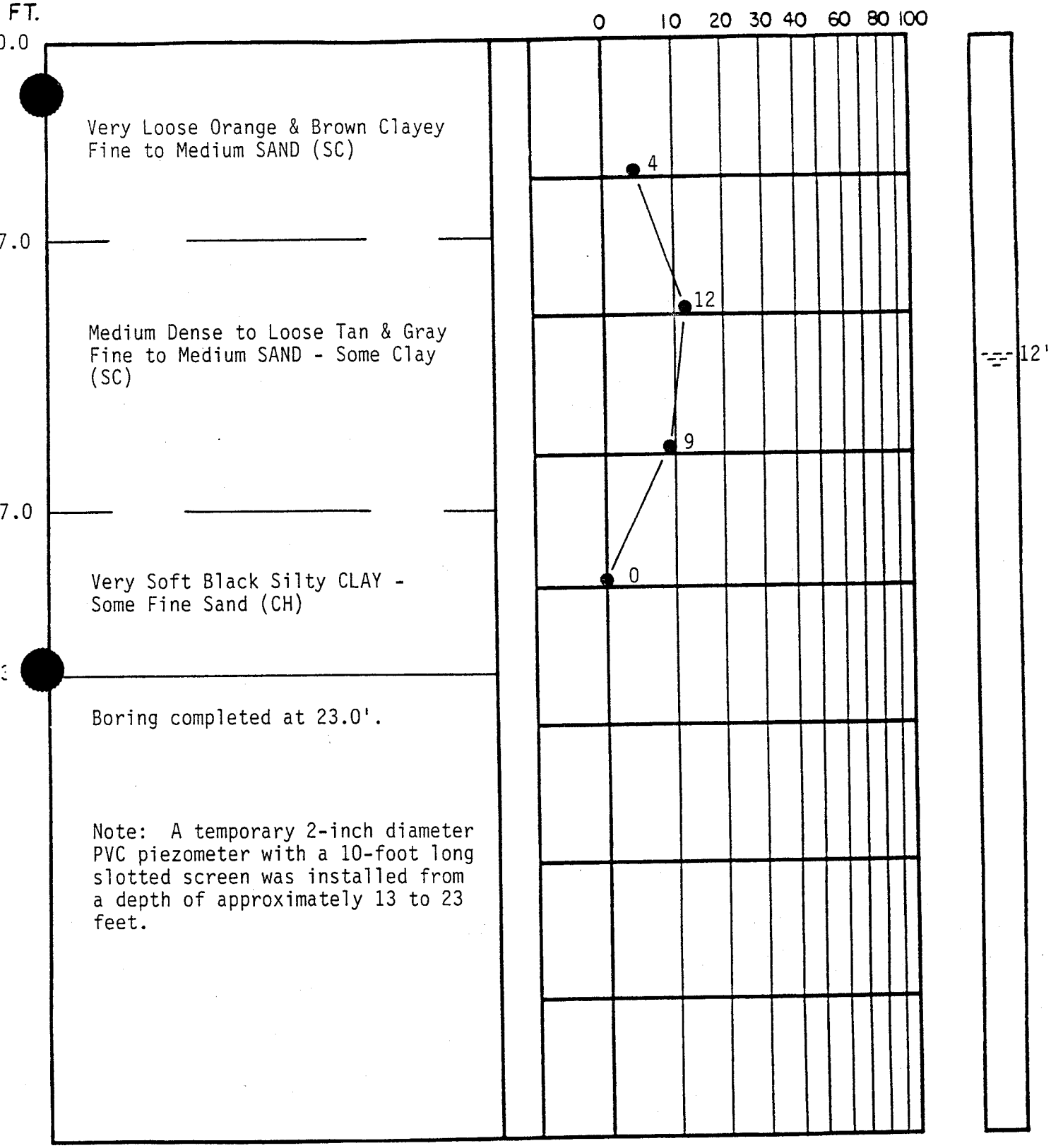
BORING NO. MW-3
DATE DRILLED 2-16-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



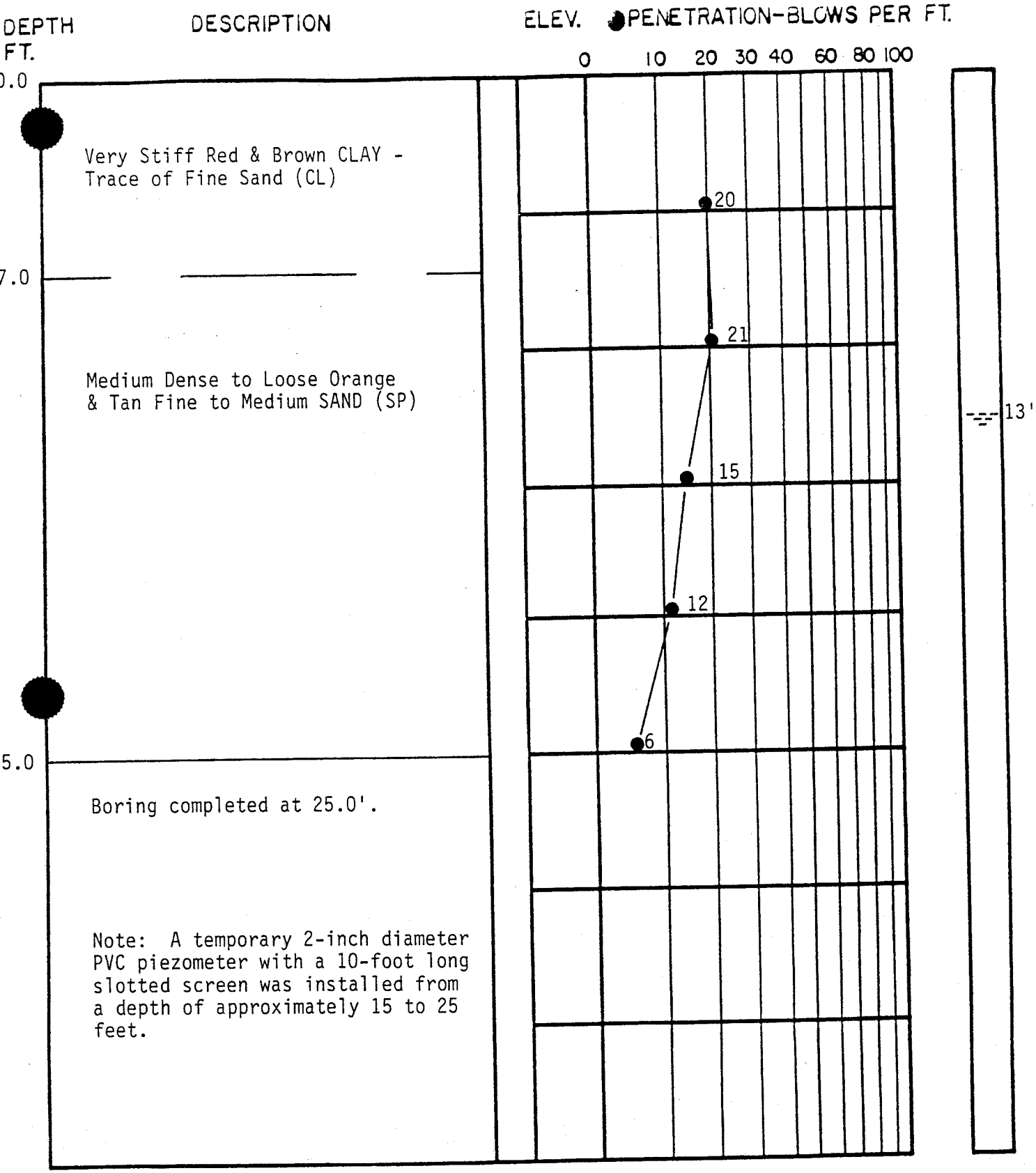
TEST BORING RECORD

BORING NO. MW-4
DATE DRILLED 2-16-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



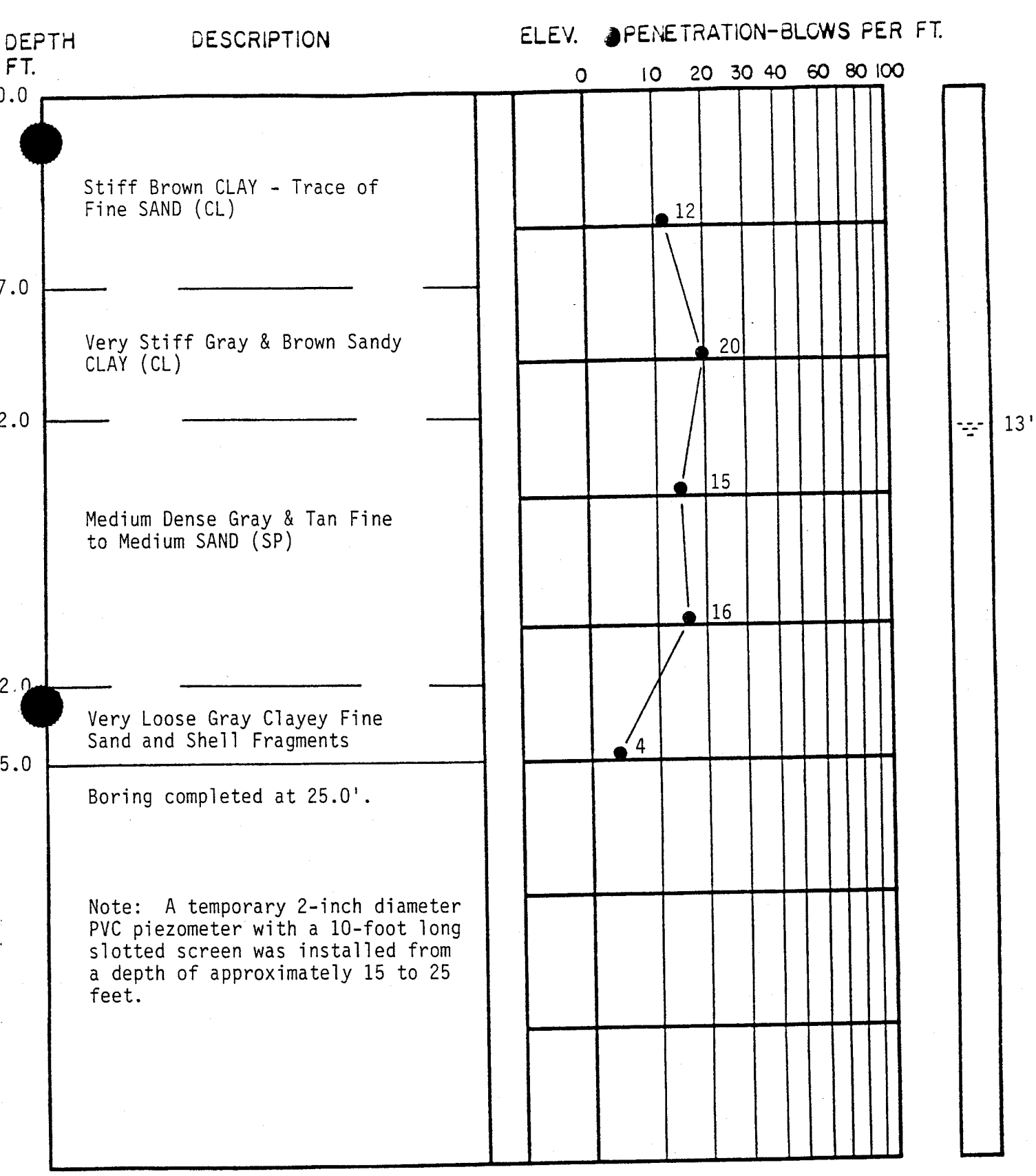
TEST BORING RECORD

BORING NO. MW-5
DATE DRILLED 2-16-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME



TEST BORING RECORD

BORING NO. MW-6
DATE DRILLED 2-17-94
JOB NO. 1063-93-447

BORING AND SAMPLING MEETS ASTM D-1586
DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE- 24 HR.
WATER TABLE-1 HR.

S&ME

5

SECTION 5

Rule .0504(1)(d) Conceptual Design Plan

The conceptual design plan for the proposed landfill site includes site development drawings that delineate the area of the landfill units, leachate facilities, buffer area, and facility infrastructure. The plan also includes drawings which delineate the limits of grading and include borrow and stockpile areas, define phase of development and preliminary contours for the first 5 years of planned operation, show the location of access roads, sedimentation basins, leachate pipelines, and final contours of the landfill units. The drawings also include the general grade and flow direction of drainage layer and leachate collection system. The conceptual design plan consists of the following drawings:

	Cover Sheet
Sheet 1	Existing Site Conditions Plan
Sheet 2	Access Road / Leachate Force Main and Borrow Site Location Plan
Sheet 3	Phase 1, 2 – Base Grade Plan
Sheet 4	Phase 1, 2 – Final Development Plan
Sheet 5	Phase 1 - Base Grade Plan
Sheet 6	Phase 1 - Final Development Plan
Sheet 7	Liner and Leachate Management Details
Sheet 8	Liner and Leachate Management Details
Sheet 9	Liner and leachate Management Details
Sheet 10	Surface Water Management Details
Sheet 11	Surface Water Management Details

The conceptual design drawings were based upon the waste quantities and waste types provided in Section 8 of this application. Based upon past Mill waste generation rates, each landfill phase is designed to contain 300,000 cubic yards of waste per year. The design operating life of each phase is 3 years. Therefore, each landfill phase is designed to contain approximately 1,000,000 cubic yards of waste. Conceptual design drawings are provided for the first two phases of landfill development, or the first six years of landfill operation. The operational life of the landfill phases could go beyond 3 years since the bulk of the waste produced by the Mill (wood chips and sludge for example) could be suitable for re-use or land application.

The proposed initial landfill phases will be located in the southeastern portion of the site area. This area was selected for initial development since it has the least impact to potential archaeological sites, and initial development in this area of the site would allow time for archaeological assessment and recovery in the northern portion of the site where several archaeological sites have been identified. Utilization of the southeastern portion

of the site for initial development also has the operational advantge of allowing the central section of the site to be used as a borrow area for clay liner material, structural fill, and landfill cover.

In the conceptual design plans, access to the landfill site is shown via a road wholely on International Paper property. The proposed route requires a bridge across Livingston Creek in the vicinity of the Mill's wastewater treatment basins. The landill site can also be accessed by public roads as shown on the Areial Photograph included as Figure 2-1 of this application. International Paper may choose either option for site access for initial and future operations. Leachate generated in the landfill will be conveyed by above ground and underground pipeline along the road identified on the conceptual design drawing. If public roads are used for vehicular access to the landfill, then a pipe bridge will be concstructed across Livingston Creek for leachate conveyance from the landfill cells and lift station to the Mill's wastewater treatment basins. Since the basins are designed to treat and discharge up to 40 million gallon per day (mdg) of wastewater, leachate generated in the landfill cells will have little impact on the Mill's wastewater discharge.

The conceptual design plan includes two details for the landfill liner. A 60-mil HDPE membrance over 2 feet of compacted clay soil, and a 60-mil HDPE geomembrane over a bentonite geocomposite which in turn is over 18 inches of compacted clay soil. Due to the sandy nature of the soils in Columbus and neighboring Counties to the landfill site, sufficient quantities of low permeability clay material may not be available for liner construction of all the landfill phases. During the construction permit application stage, the two liner system designs shown on the drawings, and potentially other designs, will be developed and discussed with the Division of Solid Waste. The liner design will be finalized after approval of the design by the Division.

The base grades identified for the initial phases in the conceptual design drawings are preliminary. The final base grades will be established based upon the seasonal high water table established through discussion of the groundwater elevation data with the Division of Solid Waste.

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SECTION 6

Rule .0504(1)(e) Local Government Approval

The columbis County Board of Commssioners approved International Paper's plan to site an industrial waste landfill on the proposed site during a meeting on September 8, 1998. A copy of the resolution is enclosed. The proposed landfill site is not zoned, and a copy of a letter from the Columbus County Commissioner is also enclosed in this section.

RESOLUTION

FOR THE COLUMBUS COUNTY BOARD OF COMMISSIONERS APPROVAL OF INTERNATIONAL PAPER'S PLANS TO SITE AN INDUSTRIAL SOLID WASTE FACILITY

WHEREAS, International Paper proposes to develop, own and operate a new industrial solid waste disposal facility in accordance with General Statutes of the State of North Carolina, North Carolina Administrative Code Title 15A, Chapter 13B Section 0504, and any other laws and regulations of the State of North Carolina as may be applicable; and

WHEREAS, International Paper requires facilities for proper disposal of solid wastes generated at its facilities and the existing disposal facility is nearing its capacity; and

WHEREAS, International Paper owns the 480 acres of land immediately east of its Riegelwood Mill site in Ransom Township, Columbus County, North Carolina, on which the disposal site is proposed; and

WHEREAS, the parcel proposed for development of International Paper's new disposal site lies within Columbus County and does not lie within any incorporated city or town nor within the extraterritorial zoning jurisdiction of any city or town.

BE IT THEREFORE RESOLVED, that the Columbus County Board of Commissioners approves the proposed site for International Paper's solid waste disposal facility, and requests that all state approvals be granted and permits issued so that the project can proceed.

ADOPTED this 8th day of September 1998.

COLUMBUS COUNTY BOARD OF COMMISSIONERS

By: David L. Dutton Jr.

David L. Dutton, Jr., Chairman

ATTESTED BY:

Ida L. Smith

Ida L. Smith, Clerk to Board

7

SECTION 7

Rule .0504(1)(f) Compliance with Rule .0503 (1)

This section describes the proposed landfill site's compliance with the siting and design requirements listed in the rule cited above. The requirements of the rule are in italic type, and a discussion of the site's compliance with the rule are in plain type.

Disposal sites shall comply with the following requirements in order for a permit to be issued:

(1) A site shall meet the following siting requirements:

(a) A site located in a floodplain shall not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain or result in washout of solid waste so as to pose a hazard to human life, wildlife or land or water resources.

The 100-year flood plain of the Cape Fear River, that forms the northern border of the proposed landfill site, is show on the aerial photograph provided in Section 3 of this application. The elevation of the 100-year flood plain is approximately 39 feet National Geodetic Vertical Datum. The toe of waste disposal dikes are located above the 40-foot contour interval as shown of the Base Plan contained in the Conceptual Design Plan of Section 5. Therefore, the landfill would not restrict the flow of the 100-year flood. Also the landfill would not reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human life, wildlife or land or water resources

(b) A site shall be located in consideration of the following:
(i) A site shall not cause or contribute to the taking of any endangered or threatened species of plants, fish, or wildlife.

The United States Fish and Wildlife Service (USFWS) lists 5 species under Federal protection for Columbus County, North Carolina. These species are listed in the following Table.

Federally Protected Species for Columbus County

Scientific Name	Common Name	Federal Status	Habitat
Picoides borealis	Red-cockaded woodpecker	E	Old growth pine stands
Acipenser brevirostrum	Short-nosed sturgeon	E	Lower section of large rivers
Menidia extensa	Waccamaw silverside	T	Lake Waccamaw
Thalictrum cooleyi	Cooley's meadowrue	E	Wet bogs and savannahs
Lysimachia asperulaefolia	Rough-leaved loosestrife	E	Edge of pocosoins

Notes:
E Endangered-A species that is threatened with extinction throughout all or a significant portion of its range.
T Threatened-A species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

A review of files at the North Carolina Natural Heritage Program indicated that there are no recorded sightings of any of these federally-listed species at the proposed landfill site. A walkover of the site by Earth Tech biologists in November 1998 revealed that the site has been clear cut and that no habitat for any of theses species are present on the site. None of these species were observed on the site during the site visit. However, there are a number of records for state-listed species and unique plant communities listed for the bluffs along the Cape Fear River. State-listed species include Florda adder's-mouth (*Malaxis spicata*) listed as Significantly Rare, shadow-witch (*Pontheva racemosa*) listed as Significantly Rare, and large-leaved grass-of-parnassus (*Parnassia grandifolia*) a species under consideration for listing. None of these state listed species are candidate species that are being considered by the USFWS for listing as threatened or endangered, and none of the state listed species are on the upland areas of the site where the landfill would be located.

(ii) A site shall not result in the destruction or adverse modification of the critical habitat of endangered or threatened species as identified in 50 C.F.R. Part 17 which is hereby incorporated by reference including any subsequent amendments and editions.

Based on records with the USFWS the only critical habitat in Columbus County is for the Waccamaw silverside, and consists of Lake Waccamaw and a portion of Big Creek. This area is over 10 miles west of the proposed landfill site. Therefore, the proposed landfill

will not result in the destruction or adverse modification of critical habitat of endangered or threatened species.

(iii) a site shall not damage or destroy an archaeological or historical site: and

International Paper contracted with Coastal Carolina Research to conduct an archaeological survey of the approximately 200-acre site in June and July 1995. During the survey, 48 archaeological sites were recorded. Permanent datum points were placed in each site by David Goldston Surveyors, and their position plotted as provided in Figure 7-1. Of the 48 sites identified, 21 had only prehistoric components, 9 had only historic components, and 18 had both prehistoric and historic components.

In 1997, Coastal Carolina Research in association with Archaeological Research Consultants conducted intensive archaeological study and testing of 21 sites of the 48 sites identified in the 1995 survey. The study was designed to determine if these sites contained quantities that would make them eligible for the National Register of Historic Places.

The study was undertaken in compliance with Section 106 of the National Historic Preservation Act of 1966, codified as 36 CFR Part 800. The scope of the investigations was consistent with the Secretary of the Interior's *Standards and Guidelines for Historic Preservation Projects* (Federal Register, Vol 48, No. 190, September 1983, P. 44716-44742, et seq.). The report prepared by Coastal Carolina Research in January 1997 describing the results of the study conformed to *Guidelines for the Preparation of Reports of Archaeological Surveys and Evaluations,* issued by the North Carolina State Historic Preservation Office (SHPO).

The study consisted of background research and on-site testing of potential sites. Background research consisted of the examination of records and deeds at the NC State Historic Preservation Office, the State Library of North Carolina, the Columbus County Library, the Columbus County Courthouse, the Brunswick County Library, the New Hanover Historic Society, and library at Coastal Carolina Research. In additional, knowledgeable individuals were sought out for information on historic occupations within or near the site area.

On-site investigations consisted of shovel testing and excavation units, with remote sensing on historic sites. The shovel tests, remote sensing, and surface indications were used to guide the placement of excavations units.

The location of planned landfill cells, site roads, borrow areas, and archaeological sites are provided in Figure 7-1; and the following summary description of each site were taken from *Archaeological Testing, Neils Eddy Tract, International Paper Riegelwood Operations Riegelwood, Columbus County, North Carolina,*

Coastal Carolina Research and Archaeological Research Consultants, January 1997.

The sites were assessed against the criteria of eligibility for the National Register of Historic Places. These criteria require that the quality of significance in American history, architecture, culture, and archaeology should be present in sites that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that the sites:

A. Are associated with events that have made a significant contribution to the broad pattern of our history; or

B. are associated with the lives of persons significant in our past; or

C. embody the distinctive characteristics of a type, period, or method of construction or that represent the work of a master, or that possess high artistic values, or individual distinction, or

D. have yielded, or may be likely to yield, information important in prehistory or history (Federal Register 1981).

Site 31CB80. This small Middle and Late Woodland site was tested with a series of shovel tests and excavation units. Few of the shovel tests were positive. Although artifacts were recovered from the excavation units, no evidence of intact remains was encountered. The testing indicated that the site does not appear eligible for the National Register of Historic Places, and no additional work is recommended.

Site 31CB83. This small Middle and Late Woodland site was tested with a series of 18 shovel tests and four test units. Artifacts were recovered from a number of shovel tests and from the test units, but no apparent cultural features were encountered. The testing indicated that the site does not appear eligible for the National Register of Historic Places, and no additional work is recommended.

Site 31CB84. A feature had been encountered in this small Middle and Late Woodland site during the survey phase. Three cultural features were noted, two of which yielded prehistoric artifacts. Other artifacts were recovered from the soil matrix of the unit. This small site has the potential to yield information on the Middle and Late Woodland periods on the southern Coastal Plain of North Carolina, a region which is poorly defined for the prehistoric period. This site appears eligible for the National Register of Historic Places under Criterion D.

Site 31CB86. This feature is part of the Neils Eddy Archaeological District and had previously been determined eligible for the National Register of Historic Places. Intensive excavations were conducted at this site to guide the development of a data recovery plan. Test units encountered a chimney base, a brick rubble pile likely from the house walls, and stratified midden deposits. The testing had provided sufficient information to conduct data recovery on the site if required for landfill development.

Site 31CB88. This site in the Neils Eddy Archaeological District was subject to a program of remote sensing to guide placement of test units. Units encountered a variety of cultural features indicating the survival of intact deposits. Because this site is part of the National Register-eligible district, a program of data recovery was recommended if the site would be impacted by the proposed landfill.

Sites 31 CB89,90,9192,93 and 98. These six sites are part of the Neils Eddy Archaeological District. Two of the sites, 31CB92 and 31CB98 appear to have retained intact deposits, while the remaining four sites appeared less promising. Sites 31CB91 and 31CB93 may be a single site rather than two as originally recorded. It was recommended that data recovery efforts be concentrated on site 31CB92 if the site would be impacted by the proposed landfill, and no additional work should be undertaken at the remaining sites in this cluster.

Site 31CB94. This site was investigated by a combination of remote sensing and excavation units. Although the prehistoric component does not appear to retain significant information, the historic component appears to be the earliest historic period site in the tract and dates to the early eighteenth century. This historic component of this site dates to the initial settlement of the Cape Fear region, and the site appears eligible for the National Register of Historic Places under Criteria A and D.

Site 31CB99. This large prehistoric site had been occupied during the Middle Archaic, and Middle and Late Woodland Periods. A series of shovel tests and four excavation units yielded a number of artifacts, but no evidence of cultural features. This site does not appear eligible for the National Register of Historic Places, and no additional archaeological work was recommended.

Site 31CB105. This site was determined eligible for the National Register of Historic Places after the survey phase.

Site 31CB110. Excavation units encountered cultural features, one of which may represent a cellar hole. Testing documented the survival of substantial components of the site. The site appears to date to the early eighteenth century. Dating to the period of the initial settlement of the Cape Fear, the site appears eligible for the National Register of Historic Places under Criteria A and D.

Site 31CB111. This site dates to the mid-eighteenth century and yielded a number of surface artifacts during the survey phase. Very few artifacts were recovered during the testing phase, however, and no cultural features were encountered in the excavation units. This site does not appear eligible for the National Register of Historic Places, and no additional archaeological investigations were recommended.

Site 31CB114. This prehistoric site dates to the Middle and Late Woodland periods. A series of shovel tests and excavation units encountered cultural features and what appeared to be stratified deposits. The site appears eligible for the National Register of Historic Places under Criteria D.

Site 31CB117. This Middle and Late Woodland site was investigated by a series of shovel tests and excavation units. Few of the shovel tests were positive. Although a small number of artifacts were recovered from the test excavations, the site does not appear to contain the potential to yield significant information. This site does not appear eligible for the National Register of Historic Places, and no additional archaeological work was recommended.

Site 31CB121. This small prehistoric site was investigated with a series of shovel tests and excavation units. While artifacts were recovered below the surface, there was no evidence of cultural features. This site does not appear to retain significant information and does not appear eligible for the National Register of Historic Places. No additional archaeological work is recommended.

Site 31CB122. This small historic site appears to date to the second half of the eighteenth century. Although from the same time period as 31CB86 and others in the Neils Eddy District, this site contrasts with those in size and artifact types. This may represent a small yeoman farmstead, and appears eligible for the National Register of Historic Places under Criteria A and D.

Site 31CB127. This Middle and Later Woodland site had many positive shovel tests, but excavation of units did not yield evidence of cultural features. Although this site contained artifacts in below surface contexts,

it does not appear to have the ability to yield significant information. It does not appear eligible for the National Register of Historic Places.

The 21 sites investigated by Coastal Carolina Research in the Neils Eddy tract determined that nine of the sites appear eligible for listing in the National Register of Historic Places. The investigations revealed the presence of intact cultural remains at nine sites, 31CB84, 31CB86, 31CB88, 31CB92, 31CB94, 31CB105, 31CB110, 31CB114 and 31CB122. The remaining twelve sites do not appear eligible for the National Register of Historic Places or would not yield additional significant information and no additional work was recommended. For eligible sites that would be affected by the proposed landfill construction, it is intended to recover the information important to the understanding of the historic properties to avoid an adverse effect under Section 106 of the National Historic Preservation Act. International Paper will devise a program of data recovery in consultation with the SHPO, the USACE, and the Advisory Council on Historic Preservation. International Paper has started on this program and has completed data recovery on site 31CB114 on the western side of the site. The site is a multcomponent prehistoric site of small ephemeral camps from the Middle Archaic to Middle Woodland. The results of the data recovery were documented in a report prepared by New South Associates, *Data Recovery at 31SB114, Columbus County, North Carolina,* and the report was sent to the Office of State Archaeology, NC Division of Archives and History in March 1999.

(iv) a site shall not cause an adverse impact on a state park, recreation, or scenic area, or any other lands included in the state nature and historic preserve.

As shown in the area topographic map provided in Section 3 of this application, no state parks, recreation or scenic areas, or other lands inluded in the state nature and historic preserve located in the immediate vicinity of proposed landfill site.

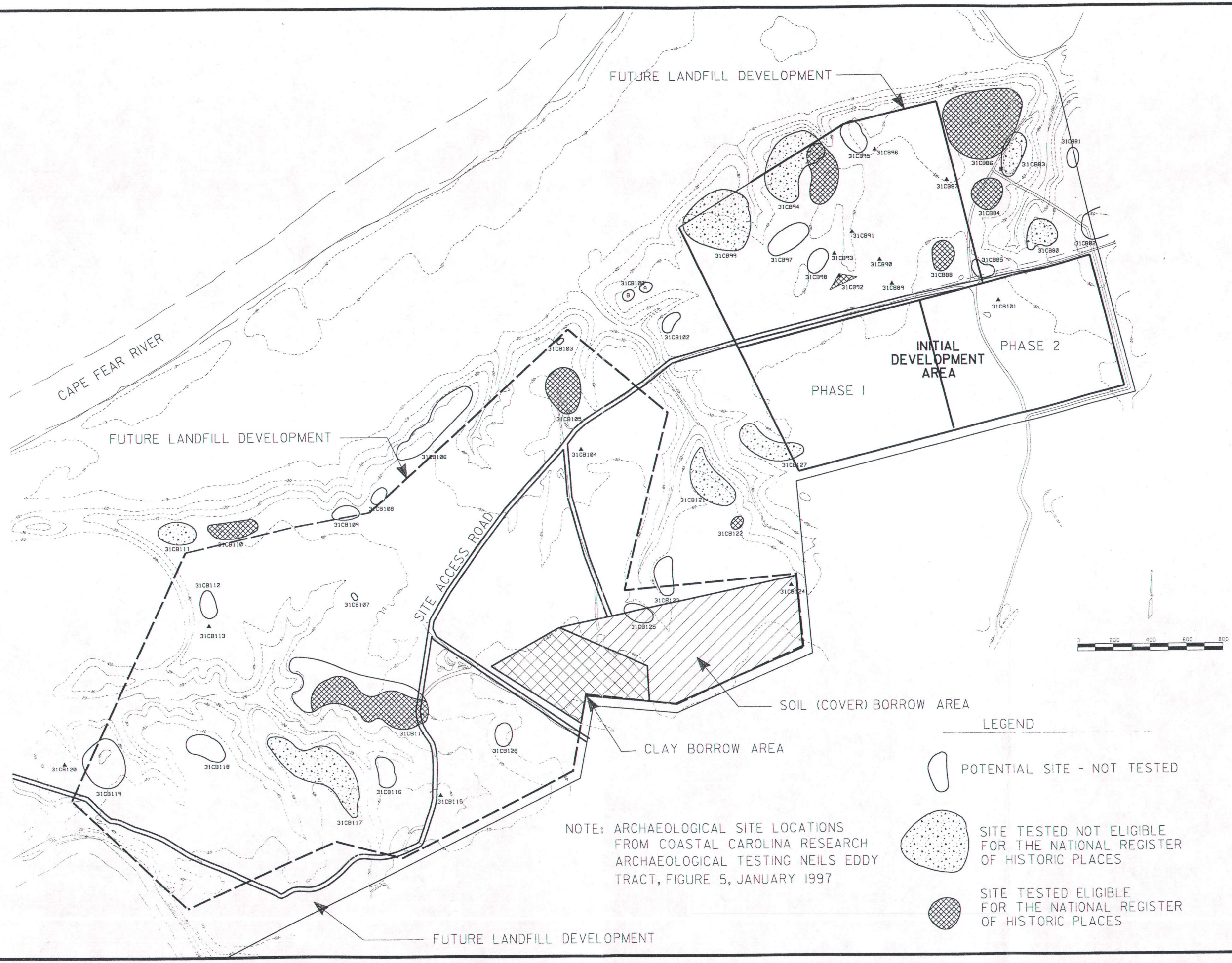
(c) A new site disposing of putrescible wastes shall not be located within 10,000 feet of an airport runway used by turbojet aircraft or within 5,000 feet of an airport runway used by piston-type aircraft; and

As shown in topographic map provided in Section 3 of this application, there are no airport runways located within 10,000 feet of the proposed landfill site.

(d) A site shall have available adequate suitable soils for cover either on-site or from off-site.

The Operational Requirements for Sanitary Landfills contained in Rule .0505(3)(c) states that final cover shall consist of at least two feet of suitable compacted earth. The borrow area for landfill liner and cover material is located in the southern portion of the site as shown on the Figure 7-1. The depth to

groundwater in this portion of the site ranges from 6 to 10 feet below ground surface. The soils at depths of 1 to 6 feet below ground surface in the cover borrow area consist predominantly of sandy clay which would be suitable for cover. The first two landfill cells occupy approximately 29 acres, and will require 100,000 cubic yards of soil for the final cover. The soil borrow area shown on Figure 7-1 is 11.2 acres, and 5.5 feet of soil excavated from this area will yield suficient soil to provide final cover for the first two cells. Therefore, the site has suffcient and suitable soils for cover.



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EARTH TECH

INTERNATIONAL PAPER
RIEGELWOOD, NORTH CAROLINA

ARCHAEOLOGICAL SITES

DATE
PROJECT NO 33004
FILENAME
SHEET NO
DRAWING NO 7-1

8

SECTION 8

Rule .0504(1)(g) Solid Waste and Monitoring Report

This section includes a report indicating the following: (i) population and area to be served; (ii) type, quantity and source of waste; (iii) the equipment that will be used for operating the site; (iv) a proposed groundwater monitoring plan including well location and schematics showing proposed screen interval, depth and construction. It is believed that the Geologic and Hydrological Study included in Section 4 of this application contains sufficient information to fully characterize the site.

(i) population and area to be served;

The proposed landfill will serve for disposal of industrial solid waste generated at International Paper's Riegelwood Mill and Armour Saw Mill.

(ii) type, quantity and source of waste;

International Paper operates a pulp and paper mill in Riegelwood, North Carolina. The estimated waste quantities and types of waste to be placed in the proposed landfill are as follows:

WASTE	ESTIMATED QUANITTY (TONS/WEEK)	ESTIMATED QUANTITY (YD^3/WEEK)
Woodyard	480	1,350
BoilerAsh	140	190
Grits	130	150
Dregs	400	400
General Mill	70	460
Sawmill Waste : Ash	60	70
Sawmill Waste: Bark/Wood	50	50
Sludge	3,000	3,200
TOTAL	**4,330**	**5,870**

Woodyard waste is composed of old logs and wood chips, bark, wood chips mixed with soil, and miscellaneous types of wood. Boiler ash is ash from the moving grate from the power boilers, and fly ash collected from particulate control equipment. Grits are caustic rejects from lime slakers used in the process. Dregs are kiln wastes recovered in the dreg filter. General mill waste includes

loose trash from the mill, dirt, and biosolids from the paper making operation. As described in the above table, the sawmill waste is comprised of ash, bark and miscellaneous types of wood. Sludge is generated in the wastewater treatment process, and can originate from clarifiers or pond/lagoons. Sludge can be in the form of dewatered sludge (mechanically dewatered) or in the form of thickened sludge (thickened by natural evaporation and consolidation in the sludge ponds.

Any Ref Pon Sludge

(iii) the equipment that will be used for operating the site;

Construction equipment such as dozers, loaders, and sheepfoot rollers will be used to operate the landfill.

iv) a proposed groundwater monitoring plan including well location and schematics showing proposed screen interval, depth and construction; and

A series of seven groundwater monitoring wells, located hydraulically downgradient of the proposed landfill phases will be used to monitor groundwater quality from the landfill and provide for detection of any leakage of constituents from the landfill. In addition one monitoring wells will be located upgradient of each proposed phases and will be used to establish background concentrations for the groundwater monitoring system.

A groundwater elevation contour map with proposed groundwater monitoring well and surface water sampling locations for the first two phases of proposed landfill is shown in Figure 8-1. This map depicts groundwater elevations for May 21, 1999. seven rounds of groundwater elevation data have been collected for the facility since the beginning of this year. The May data shows the water table at a potential seasonal high level for these measurement dates. December data shows water table elevations higher than the May data by approximately 0.5 feet, but the December elevations could be the result of Hurricane Floyd historic high water table elevations.

While general groundwater flow directions for this area are towards the Cape Fear River, local flow directions on the scale of the proposed cell resolve into a more complex regime which is influenced by the site topography. The drainage features, which incise the site, strongly influence local groundwater flow directions. Based on observations in the field by Earth Tech personnel, the streams receive their base flow from groundwater, and although one spring was found, general observations do not indicate that the water table is typically very high above the stream bottoms. If this were the case, numerous springs or seeps would be expected along the banks of the drainage features. Therefore, the groundwater contours have been drawn to reflect Earth Tech's interpretation that the water table intersects the drainage features at or near their base elevation.

The representative groundwater flow lines in Figure 8-1 are provided to illustrate the flow directions in the area of the first two phases. Because of the incised drainage features, groundwater flow appears to be radially outward from the topographic high located on the south side of the proposed phases. This results in most of the outer edge of the phases being downgradient of some portion of the waste. Therefore, downgadient groundwater monitoring wells are proposed along most of the periphery of the two phases. The wells are placed at the toe of the embankment on the eastern and western sides due to topography and property line restrictions and will be approximately 50 feet from the edge of the phase. Downgradient monitoring wells to the north of the proposed phases are approximately 250 feet from the edge of the phases based upon point of compliance requirement of Rule 13B.1631. Lateral spacing of the wells within 50 feet of the phases is approximately 400 feet, while lateral spacing of the wells 250 feet from the phases is approximately 600 feet. Wells further away are able to monitor a larger expanse of the landfill due to some dispersion of the groundwater flow.

Monitoring of water levels in the wells and piezometers already installed indicate water table fluctuations in the shallow wells of two to six feet. Based upon data obtained from installation of the deep piezometers, the estimated top of the Pee Dee Formation is 31 - 33 feet (msl). The ground elevation in the vicinity of the proposed monitoring wells is approximately 50 feet. Therefore, the estimated depth of the proposed monitoring wells is 17 to 19 feet. For these reasons 10-foot or 15-foot screened intervals are proposed to insure that the wells can be sampled year round. The screened interval will be installed to intersect the shallow water table with the seasonal high water table within the screened interval. A schematic showing typical construction of these wells is shown in Figure 8-2.

The upgradient and downgradient monitoring wells will be sampled for four consecutive individual samples at the initiation of monitoring, then both upgradient and downgradient wells will be sampled on a semi-annual schedule. Sampling will be conducted for the parameters listed in the table below. These constituents were selected based on site specific, groundwater chemistry data collected at the existing landfill.

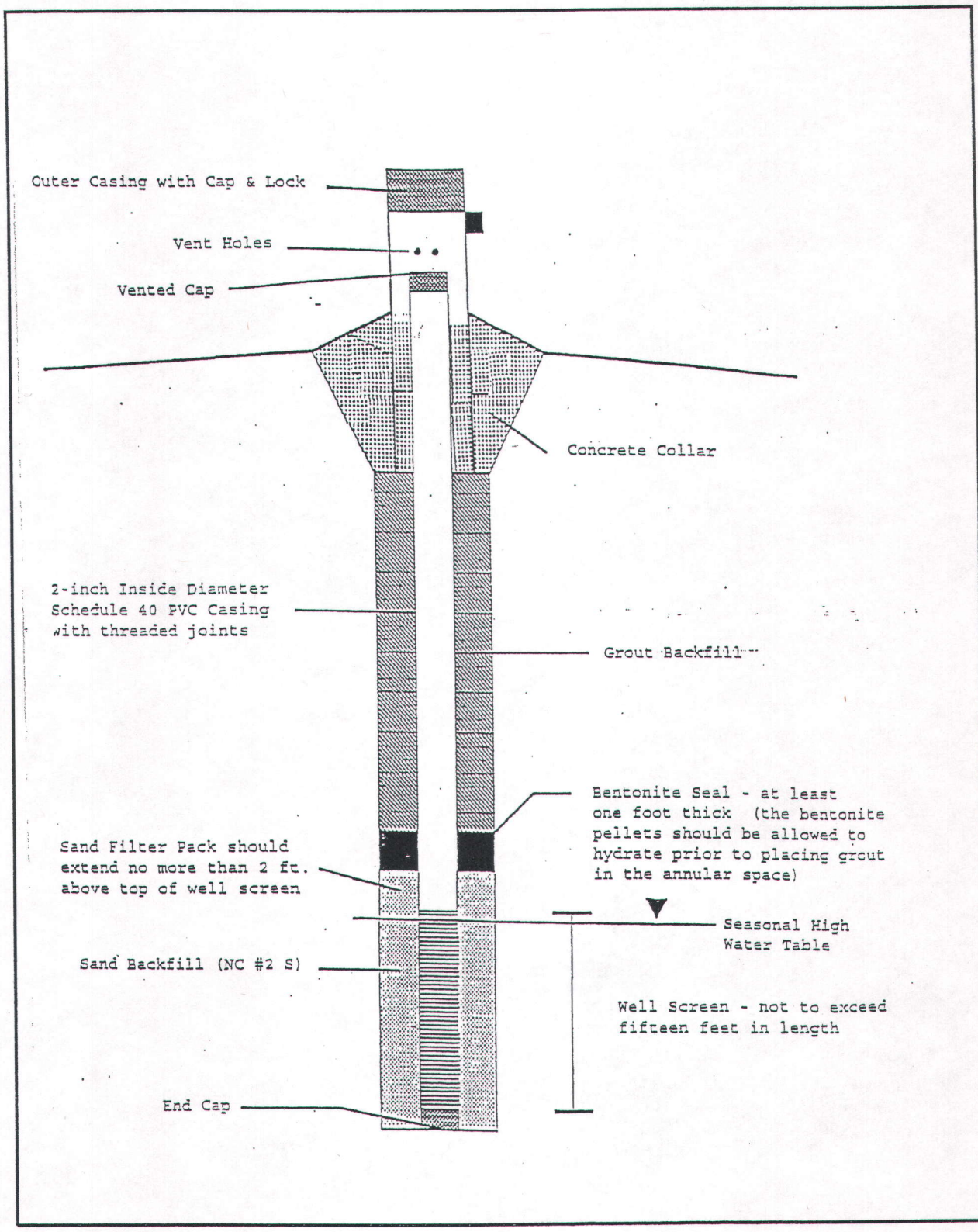
General Analytical Parameters

BOD
COD
TOX, as Cl
TOC, as C
TDS
pH
Conductivity

Sulfate Gravimetric, as SO_4
Chloride

Sampling and analysis procedures will follow the protocols specified in the "North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities" prepared by the Solid Waste Section of the Department of Environment and Natural Resources. Samples will be collected using a laboratory decontaminated Teflon bailer and submitted for analysis to a North Carolina certified laboratory.

Surface Water – Upgradient and downgradient surface water samples will be collected on a semi-annual basis at the two locations shown on Figure 8-2. These samples will be analyzed for the same constituents as the groundwater samples.



EARTH TECH

FIGURE 8-2

WELL SCHEMATIC

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