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353SERBSF10,620

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SHIVER

SOIL & MATERIAL ENGINEERS INC.

GEOTECHNICAL INVESTIGATION REPORT
CITY OF WILMINGTON PROPERTY LEASED BY
SOUTHERN WOOD PIEDMONT COMPANY
WILMINGTON, NORTH CAROLINA

CITY of WILMINGTON
North Carolina

P.O. BOX 1810
28402

OFFICE OF THE CITY MANAGER
(919) 762-4323

April 5, 1982

RECEIVED
APR 6 1982
WILMINGTON REGIONAL OFFICE
DEM

Mr. Rick Shiver
Regional Hydrologist
Div. of Environmental Management
N. C. Department of Natural Resources &
Community Development
7225 Wrightsville Avenue
Wilmington, N. C. 28403

Dear Mr. Shiver:

Per your discussion and subsequent letter to Mr. Hugh Caldwell, enclosed is one (1) copy of the Geotechnical Investigation Report prepared by Soil and Material Engineers, Inc.

We would point out that this study cost the City several thousand dollars and we would appreciate your cooperation in referring all inquiries for copies of the report to the City.

Sincerely,

Robert G. Cobb
City Manager

RGC/JB:ds
Enclosure

cc: Robert F. Coleman, Jr., Director of Public Works
R. Michael Jones, City Attorney
John Bauer, Management Analyst
Hugh Caldwell, Staff Engineer

SOIL & MATERIAL ENGINEERS INC. ENGINEERING-TESTING-INSPECTION

3109 Spring Forest Road, Box 58069, Raleigh, NC 27658-8069, Phone (919) 872-2660

March 3, 1982

City of Wilmington, North Carolina
Post Office Box 1810
Wilmington, North Carolina 28402

Attention: Mr. Hugh Caldwell

Reference: Geotechnical Investigation Report
City of Wilmington Property Leased by
Southern Wood Piedmont Company
Wilmington, North Carolina
S&ME Job No. RS-1759

Gentlmen:

Soil and Material Engineers, Inc. has completed the authorized subsurface investigation, laboratory testing, and geotechnical engineering evaluation for the referenced project. This report presents analyses and evaluations of foundation and groundwater conditions, and preliminary recommendations for foundation construction on site.

In brief, fill overlying compressible organic deposits will require foundation systems and site preparation procedures that will either: 1) limit foundation loadings; 2) require improvement of surface soils; or 3) transmit foundation loads to deeper, more competent strata. Due to the variability of subsurface conditions across the site additional detailed subsurface investigations should be conducted as specific development plans are conceived.

A limited groundwater analysis was conducted as part of this investigation. The sampling and testing indicates that the groundwater beneath the site is contaminated, and some contaminant concentrations are above maximum concentrations recommended for chlorinated drinking water. The individual contaminants are identified in the body and Appendix of the report. It is likely that at least some of the groundwater contamination has resulted from Southern Wood Piedmont Company's operation on site. Additional groundwater study is recommended.

Soil and Material Engineers, Inc. is pleased to be of technical assistance to you on this project. We look forward to assisting you on additional phases of investigation of subsurface conditions on this site. If there are any questions concerning the enclosed report, do not hesitate to contact us.

Very truly yours,

SOIL & MATERIAL ENGINEERS, INC.

Robert J. Owens
North Carolina Registration No. 5160

RJO/ya

GEOTECHNICAL INVESTIGATION REPORT
CITY OF WILMINGTON PROPERTY LEASED BY
SOUTHERN WOOD PIEDMONT COMPANY
WILMINGTON, NORTH CAROLINA

Contract No. CON 9-881
S&ME Job No. RS-1759

March 3, 1982

GEOTECHNICAL INVESTIGATION REPORT
CITY OF WILMINGTON PROPERTY LEASED BY
SOUTHERN WOOD PIEDMONT COMPANY
WILMINGTON, NORTH CAROLINA

INTRODUCTION

Soil and Material Engineers, Inc. has completed a preliminary geotechnical investigation of the City of Wilmington property currently leased by Southern Wood Piedmont Company in Wilmington, North Carolina. This investigation was authorized by execution of City of Wilmington contract no. CON 9-881, received on October 22, 1981. The preparation of this report was financed in part through a grant provided by the North Carolina Coastal Management Program and through funds provided by the Coastal Zone Management Act of 1972, as amended, which is administered by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration. The purpose of this investigation and analysis was to determine the general subsurface conditions, to establish the suitability of site soils for possible development, and determine groundwater quality at various locations across the site.

The exploration and analysis includes drilling of five soil borings, installation of five groundwater monitoring wells and an engineering evaluation regarding generalized foundation conditions and an assessment of groundwater quality across the site. This report presents the findings of the exploration, the results of the groundwater analysis and an engineering analysis. Preliminary recommendations are presented for potential foundation support and site development considerations. The Site Boring Plan, Subsurface Data Sheet, Test Boring Records, and Groundwater Analysis Test Results are included in the appendix to this report.

PROJECT AND SITE DESCRIPTION

The site is located at the west end of Greenfield Street and is bounded on the east by the Surry Street right-of-way and on the west by the Cape Fear River. The site measures approximately 1,100 feet by 1,600 feet in the north-south and the east-west directions, respectively. Based on topographic information provided by the City of Wilmington, the site is relatively flat with ground surface elevations generally varying from 6 feet to 1 foot, (mean sea level datum). Surface drainage across the site is from the northwest to the southeast; generally away from the Cape Fear River in a, east-southeasterly direction, to a drainage ditch along the eastern boundary of the site. The ditch is a tributary to Greenfield Creek which empties into the river.

The 45 acre site is currently leased by Southern Wood Piedmont Company who operates a wood preservative treating operation on the site.

Raw and dressed lumber is delivered to the facility where the raw lumber is debarked and kiln dried in on site facilities. The lumber is then treated using cresote, pentachloraphenol or chrome-cooper-arsenic as the wood preservative. The chemicals necessary for these treating processes are stored on-site in tanks adjacent to the respective treating facility. Additional tanks for cresote storage are located in the southwest property corner.

Treated wood products and raw lumber, awaiting treatment, are stored on the site. Numerous rail lines for operating the companys' cranes and railroad cars traverse the area. These rails provide the major transportation means for handling of the wood products on site.

Storage tanks, and structures with significant loads or where grades must be maintained, are pile supported. Lightly loaded structures and sheds are supported on shallow spread footing foundations. Floors which are non-pile supported have, in some instances, required periodic releveling.

The site investigation has provided generalized information concerning subsurface conditions across the site. Specific site development plans were not available at the time of the investigation. Therefore, this report provides preliminary information regarding foundation support systems and site development procedures. More detailed information regarding specific site development plans will require additional information regarding structure loads, elevations and settlement tolerances as well as a more thorough subsurface investigation program.

EXPLORATION AND LABORATORY TESTING PROCEDURES

Exploration of subsurface conditions was performed by drilling five widely spaced borings across the site to a maximum depth of 50 feet below the ground surface. This corresponds to about the upper elevation of the Castle Hayne formation at this site. The approximate locations of the borings were selected by engineers from Soil & Material Engineers, Inc. to provide basic stratigraphic data as well as data on anticipated groundwater gradients and potential site pollution sources. Specific boring locations were estabilished in the field by mutual agreement between representative of the City of Wilmington, Southern Wood Piedmont Company and representatives of Soil and Material Engineers, Inc. The boring were located in plan and elevation by representatives of the City of Wilmington.

Soil test borings were drilled with a truck-mounted drill rig utilizing hollow stem augers to advance the boring, and at the completion of drilling the borehole was grouted. Soil samples were obtained at regular intervals using a split barrel sampling device. Standard penetration resistance or N-values are indicated on the Test Boring Records. These values indicate the number of blows per foot (bpf) required to drive the sampler with a standard driving energy.

The drilling records were reviewed and the depths required for the groundwater monitoring wells were established. The wells were installed

in boreholes adjacent to the test borings and were constructed using a 5-foot slotted stainless steel well screen attached to 2-inch nominal I.D. PVC pipe. The pipe was coupled using threaded connections, and solvents were not introduced in the borehole. The depths to the bottom of the well screen vary between 7.5 feet and 18 feet below the ground surface (elevation -3.1 feet to -14.0 feet) and are indicated on the Test Boring Records.

The split spoon samples were visually classified by a geotechnical engineer on the basis of texture and plasticity according to the Unified Soil Classification System. Utilizing the information obtained from the visual classification of the soil samples and the field boring logs, the geotechnical engineer grouped the various soil types indicated on the Test Boring Records. Since the site soils represent Coastal Plain and fluvial sediments, the stratification lines between the soil zones indicated on the Test Boring Records are interpretive because the actual transitions may be very gradual.

Samples of groundwater from the wells were obtained at least 72 hours after completion of the well installations. Prior to obtaining groundwater samples, the wells were bailed to remove at least two well volumes of water from the well. This sampling procedure is recommended by the Environmental Protection Agency (EPA) to more nearly assure that the groundwater sample is representative of existing conditions and not affected by possible well contamination or dilution. A stainless steel bailer which was thoroughly rinsed between sampling locations to minimize cross-contamination, was used in the bailing and water sampling process. The water samples were placed in appropriate containers for various test procedures, and preservatives were added to the containers according to standard groundwater testing protocol. The samples were placed in a refrigerated container for transport, and delivered to the testing laboratory within 24 hours of the initiation of the sampling.

Initially, the groundwater samples were analyzed by atomic absorption and gas chromatograph/mass spectrometer for inorganic and volatile components in order to identify the presence of selected priority pollutants. The results of this testing is included in the appendix of this report. After the results of the testing were received, additional, detailed analysis was performed on samples from well number 2. This testing was suggested when concentrations of phenols greater than suggested chlorinated drinking water standards were obtained from this well. The additional testing consisted of more detailed testing to detect contaminants in the base-neutral, acid and pesticide fractions of the water samples. The results of this additional testing for well number 2 is also contained in the appendix of this report.

SUBSURFACE CONDITIONS

Wilmington is located in the Coastal Plain physiographic province of North Carolina. Geologically, the Coastal Plain materials consist of unconsolidated sediments which generally dip seaward at the rate of several feet per mile. The Coastal Plain formation consists primarily of marine sands, silts, clays and irregular limestone beds which were deposited from about 130 to 20 million years ago. The older marine formations have since been covered

with non-marine deltaic deposits of sands, silts and organic materials from the Cape Fear River.

Subsurface conditions encountered by the test borings generally consist of 3 to 18 feet of very loose to medium dense, (N=1 to 40 bpf), fine to medium sand fill with wood and cinders. The fill is overlying an organic silt or peat layer which extends to depths varying between 8 and 18 feet. The organic layer varies from 5 to 19 feet in thickness, and tends to increase in thickness toward the river. These materials are of very loose density or very soft consistency with blow counts ranging from 0 to 3 bpf. Fine to medium sands generally of loose to medium density are encountered below the soft organics and continue to 42 to 45.5 feet below the surface where the top of the Castle Hayne limestone formation is encountered. All of the borings terminated in the Castle Hayne formation which is a cemented calcareous sandy silt.

Groundwater was encountered at elevations varying between 3.0 feet and 1.4 feet msl. The groundwater surface generally dipped toward the South paralleling the river. Because of the site's proximity to the river, river level fluctuations will probably result in groundwater fluctuations across most or all the site.

GROUNDWATER ANALYSIS

The initial groundwater analysis indicated that the recommended drinking water standards were exceeded for iron, (100 parts per billion, ppb) at all five test well locations (Note: one part per billion, ppb, is equivalent to 1/1000 part per million, ppm, or milligram/liter, mg/l). Furthermore, concentrations of chloroform exceeding the proposed federal criteria of 0.21 ppb were obtained at well numbers 1, 2, and 5. Chromium limits (50 ppb maximum) were equaled at well location number 4, and total phenol limits (1 ppb maximum) were exceeded at well numbers 1, 2 and 5. Well number 2 had the highest concentration of phenols, exceeding the values at well numbers 1 and 5 by approximately four to eight times. The elevated concentration of phenols in well number 2 is considered to be directly related to the location of this well relative to plant operations. Based on the high concentration of phenols in the vicinity of well 2, additional testing was conducted.

A listing of the results of expanded testing of well 2 water samples is included in the appendix. The following is a tabulation summarizing test results which indicate concentrations of "Priority Pollutants" and values exceeding the proposed Federal criteria for "Priority Pollutants" in drinking water.

Chemical	Proposed Federal Criteria (ppb)	Concentration Water Samples Well #2 (ppb)
Acenaphthene	20.0	340
Benzene	1.5	45
Chloroform	0.21	9*
Ethylbenzene	1100	40*
Pentachlorophenol	140	570
Toluene	12.4	100
2,4 Dimethylphenol	No Criteria Established.	50

** Does not exceed proposed maximum

* Wells Nos. 1 and 5 had chloroform contents of 11 and 16 ppb, respectively, based on initial phase of testing. These values also exceed suggested drinking water standards.

ANALYSIS AND RECOMMENDATIONS

Foundations: For construction purpose, this site is typical of other sites located along the river front. The relatively weak and compressible organic silt and peat layer present the major constraint to foundation construction and overall site development. Several procedures are commonly considered for site development of such sites to support relatively light or moderately loaded facilities. These consist of, 1) distributing loads at the surface below the limiting foundation pressure determined by strength characteristics of the underlying weak soils and accepting potential settlements; 2) extensive preloading of weak and compressible soils in order to improve soil strength and mobilize the majority of anticipated settlement prior to developing site facilities; or 3) transfer structure loads to underlying more suitable soils with deep foundations. The relative merits of these site improvement or foundation support systems are discussed in the following paragraphs.

Very light loads with some settlement tolerance such as those associated with warehouses and steel frame buildings, can probably be supported on shallow footings with minimum site preparation and grading. Light to moderately heavy structures, particularly structures sensitive to differential settlement can not be supported on shallow footings without special site preparation such as extensive preloading. Moderately heavy to heavy structures, such as large storage tanks and production plants, must be supported on deep foundations bearing below the organic zone.

Deep foundations will derive their support from skin friction and end bearing resistance from the non-fill sands overlying the Castle Hayne limestone formation and the Castle Hayne formation itself. The thickness and density of the sand strata varies significantly from boring to boring. The sand layer varies from 3 to 25 feet in thickness with relative densities varying from 2 to 30 blows per foot of sampler penetration. Therefore, lateral and end bearing capacities within the sand strata will be highly

variable across the site. The surface of the Castle Hayne formation, however, is found at relatively uniform depth (approximately 45 to 50 feet below the groundsurface) and relative densities at the boring locations are similar. Because of the high penetration resistance of the formation, deep foundations in this stratum will derive their capacity chiefly from end bearing.

Suitable deep foundations could range from relatively low capacity timber piles (allowable loads of 15 to 25 tons) to moderately loaded precast concrete piles (allowable loads of 40 to 50 tons) to heavily loaded cast-in-place concrete pipe piles or H-piles (allowable loads of 40 to 60 tons).

Each pile type and allowable load is applicable to a particular structure. Therefore, pile types must be selected after more specific design information is available.

Groundwater Anlaysis: Many factors affect groundwater movements beneath a site. The following paragraphs briefly describe some of the major factors affecting groundwater flow, and how they may relate to flow of groundwater beneath this site. A discussion of detected groundwater contaminants follows. Recommendations for additional study concludes this portion of the report.

Surface exposure of groundwater such as oceans, lakes, rivers and streams provide local base gradients for regional groundwater flow. The oceans provide the overall base gradient for groundwater flow. More locally groundwater surfaces often form a subdued replica of the surface topography.

A variation in groundwater flow often occurs between aquifers separated by aquitards. Variation of both flow direction and head potential may result when recharge areas or individual base gradients affecting each aquifer are different. Man's activity may also affect natural groundwater surfaces. These influences may consist of but are not limited to, such activities as pumping from wells, dewatering by ditches or local sources of recharge. Tidal fluctuations may also influence groundwater surfaces locally.

An estimation of groundwater flow direction at the Southern Wood Piedmont Company facility is based on analysis of water levels at five widely separated well locations. These observations indicated the apparent groundwater flow direction of the site is parallel to the river and trends toward the south. Factors which may locally contribute to this behavior may include: 1) proximity of site to river 2) topography sloping locally away from the river; 3) the presence of the ditch near the southeast property corner and proximity to Greenfield Creek to the south.

The exploration program indicates that two relatively permeable strata, the upper sand fills and the granular virgin soils below the peats, are present at the site. These strata are separated by an organic layer consisting of organic silts and peat at all boring locations. This organic layer is relatively impermeable and may act as an aquitard between the more permeable sand layers.

Part of this investigation was to sample the groundwater to determine if contamination exists at the boring locations. Since the organic layer is relatively impermeable, it was reasoned that contaminants released at the surface would likely be concentrated above the organic layers. Therefore, four of the five wells were installed to sample groundwater above the organic silt and peat layer. Well number 5 penetrated into the lower virgin sand layer because the upper sand fill layer is thin in this vicinity and the groundwater level provided only a thin water bearing zone for sampling.

As indicated by the tabulated groundwater analysis results contained in the Appendix and discussed in previous sections of this report, a number of chemicals and chemical compounds not normally occurring in uncontaminated groundwaters were detected in the groundwater analysis. The contaminants anthracene, chromium, flourene and pentachlorophenol most probably originated from Southern Wood Piedmont Companys' wood treating processes. However, a more detailed investigation would be required to determine with certainty that some contamination did not originate up gradient of the site. The pentachlorophenol probably is associated with the wood treatment process. The chromium may result from the chrome-copper-arsenic treating procedure. The anthracene, and fluorene, as well as other organic chemical constituents are likely to have resulted from the creosote treatment process. The chloroform may be related to the degradation of the wood treating processing chemicals or to some, as yet unidentified degradation source.

Limited analysis of samples from well 5 indicate phenol and chloroform concentrations of 110 and 16 ppb, respectively in sands below the organic zone. Based on the available piezometric data, this well is located hydraulically up gradient from the treating facility and indicates some activity in this area or off site which has contributed to groundwater degradation indicated by the wells. This fact should be further explored.

As indicated in a previous section of this report, the analyses indicate that groundwater degradation was occured and result in some hazardous waste concentrations greater than recommended by the drinking water standards. To refine the extent, depth and magnitude of the contaminantes and to develop a scheme for mitigating these contaminantes in the groundwater, much more detailed field study, sampling program and analysis must be undertaken. Such a study must more thoroughly investigate groundwater conditions affecting the study area to evaluate the extent and rate of migration of the chemical contaminant constituents that have entered the groundwater. Groundwater gradients in the upper and lower sand strata can be determined by installing nested wells with well screens sealed at various depths at additional locations both on and off-site. In conjunction with this analysis, additional exploratory borings should be drilled to determine the continuity or discontinuity of the organic zone (aquitard), and testing should be performed to establish the permeability characteristics of the aquifer(s) and aquitard. Furthermore, mechanisms for communication of contamination between the aquifers, if present, should also be studied and additional investigation and research should be directed towards identifying

and evaluating the degree of influence of the various factors affecting the groundwater flow, (i.e. tidal affects, existing well pumpage, recharge areas, etc.).

Detailed chemical analysis of additional groundwater samples obtained from new well locations must be made to monitor contaminants in the groundwater plume and to verify the contamination source(s). Local sources of similar contaminants, (spill areas, tank forms, pump stations, rail lines, etc.) should also be identified. A complete analysis of the solutions used in the wood treating process should be performed to identify their chemical constituents and to determine if other sources of contaminants may also be contributing to the problem.

Based upon the limited scope of this investigation, a specific remedy for containment and/or removal of existing contaminants cannot be developed. A more detailed investigation and groundwater hydrology analysis will be required to identify the extent of contamination and develop remedial action alternatives. This study should be initiated in the near future to develop sufficient detailed groundwater information to evaluate the problem. The appropriate regulatory groups should be notified of the presence of contaminants and the preliminary actions that have been taken by the City of Wilmington.

Soil and Material Engineers, Inc. appreciates the opportunity of assisting you on this project. If you have any questions concerning this report, please contact us.

Very truly yours,

SOIL & MATERIAL ENGINEERS, INC.

B. Dan Marks, Ph.D., P.E.
North Carolina Registration No. 9631

Robert J. Owens, P.E.
North Carolina Registration No. 5160

BDM/RJO/ya

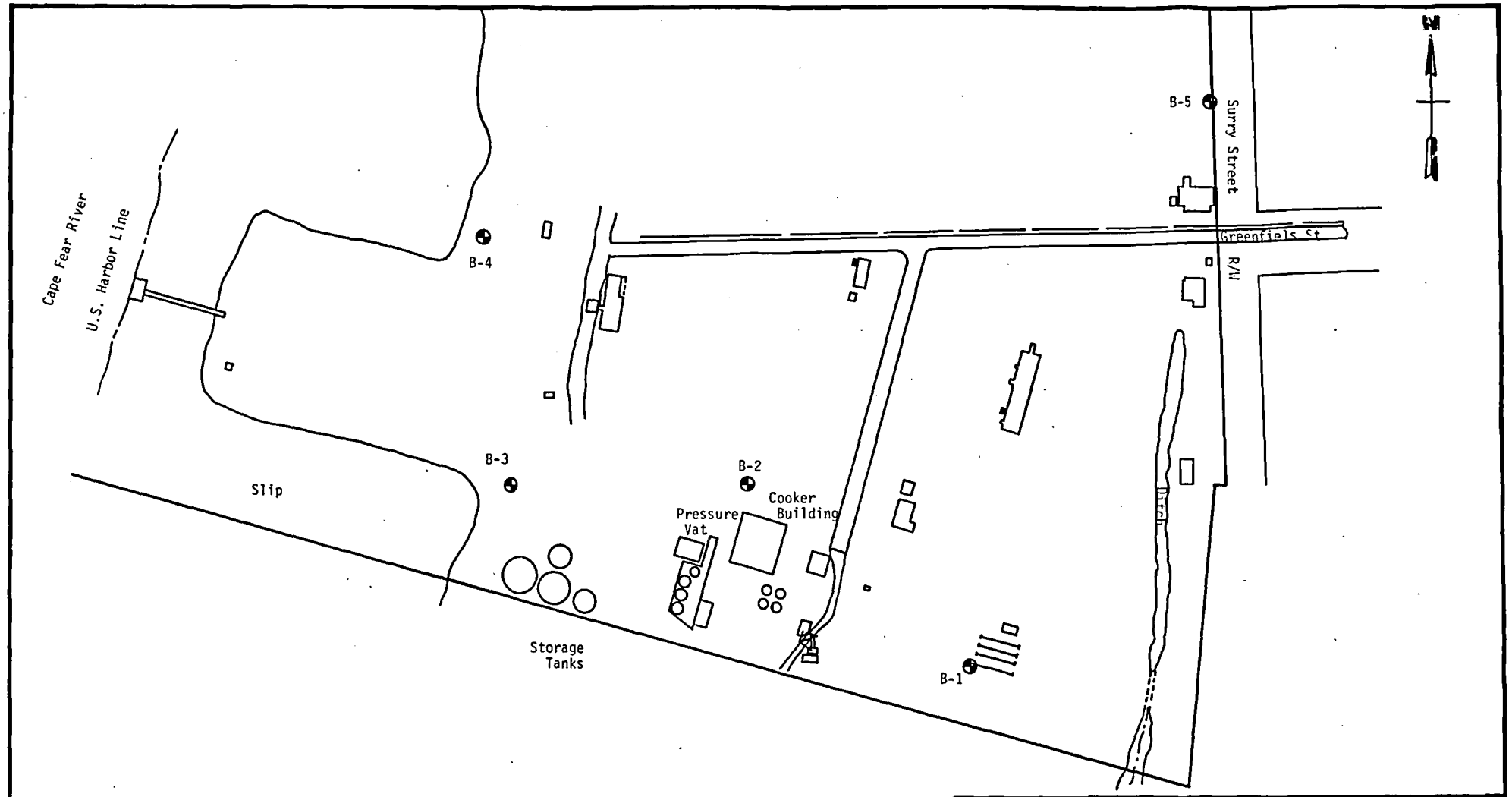
SUMMARY OF LABORATORY CHEMICAL ANALYSIS FOR SELECTED PARAMETERS

Contaminant	Drinking Water Standards**	Well No. 1	Well No. 2	Well No. 3	Well No. 4	Well No. 5
Fe ppb*	< 300	58,100	72,400	21,100	72,100	1,200
Cu ppb	< 1,000	< 25	100	150	< 25	< 25
Ni ppb	< 100	< 50	< 50	< 50	< 50	< 50
Cr ppb	< 50	< 50	< 50	< 50	50	< 50
As ppb	< 50.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0
Total Phenols as Phenol ppb	< 1	180	850	< 50	< 50	110
Cyanides as CN ppb	< 50	< 100	< 100	< 100	< 100	< 100

* 1ppb (part per billion) = 0.001 ppm (part per million)
1ppb = 1 μg/l (microgram/liter)
1ppm = 1 mg/l (miligram/liter)

** Standards are based on combination of recommended and legislated criteria. Reference "Groundwater", Freeze, R.A. and Cherry, J.A., Prentice-Hall, Inc., 1979, page 386

ATTACHMENTS

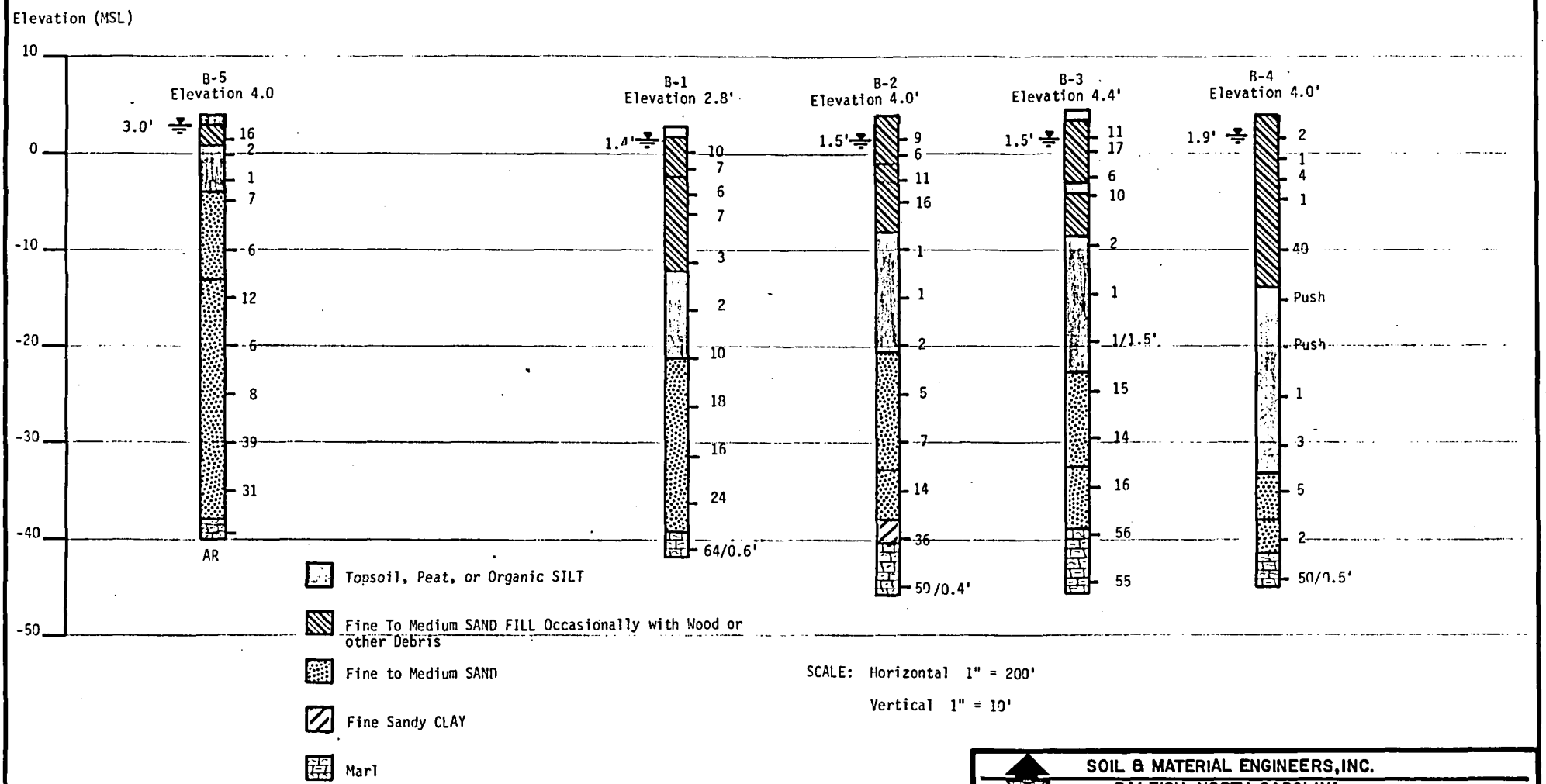


SOIL & MATERIAL ENGINEERS, INC.
RALEIGH, NORTH CAROLINA

Boring Location Plan
Southern Wood Piedmonts
City of Wilmington Property
Wilmington, N. C.

DRWN. BY: RB	CHKD. BY: PLB
JOB NO.: RS-1759	DATE: 12-4-81
SCALE: Graphic	SHEET 1 OF 2

DUNCAN-PARNELL, INC., RALEIGH 681



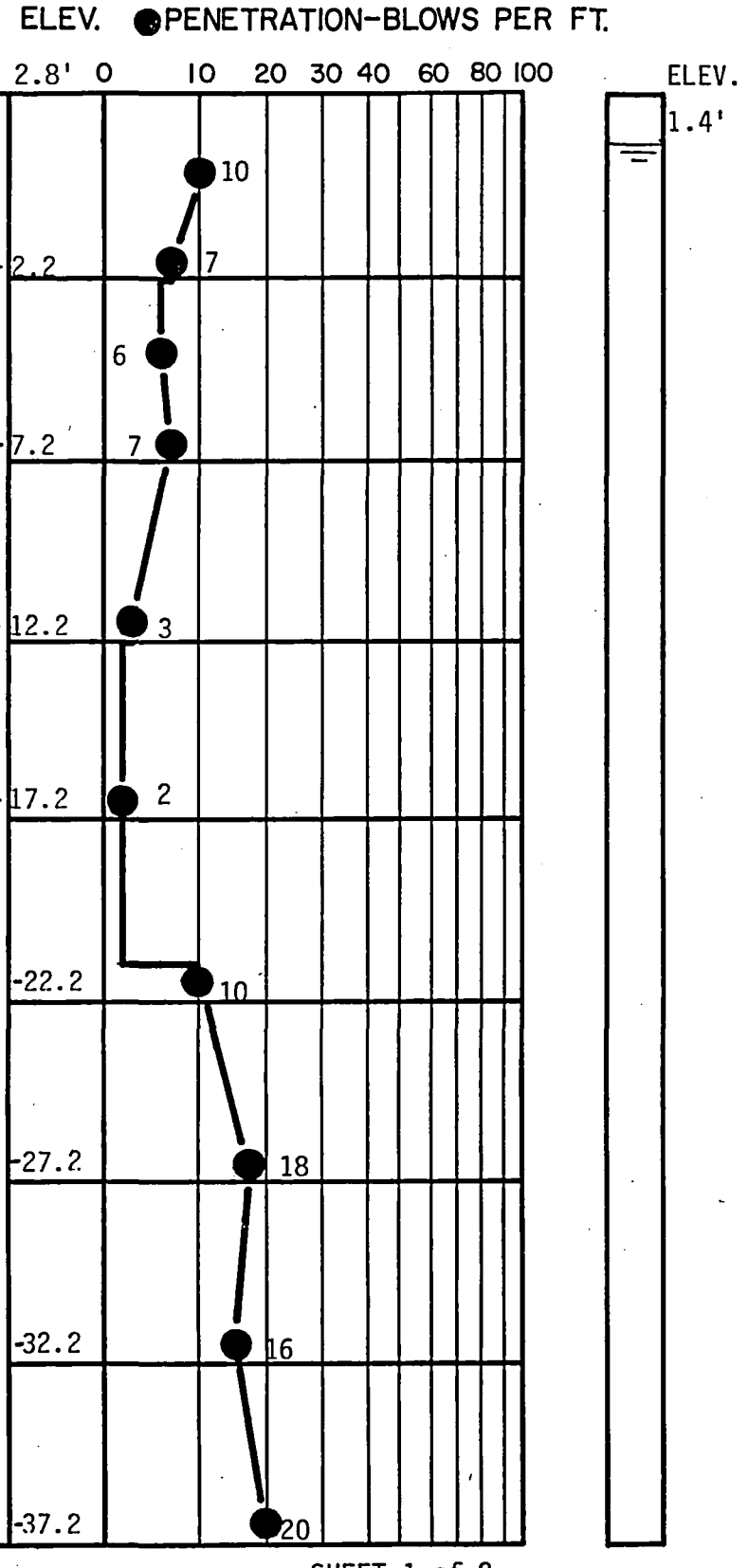
SOIL & MATERIAL ENGINEERS, INC.
RALEIGH, NORTH CAROLINA

Subsurface Data
Southern Wood Piedmont
City Of Wilmington Property
Wilmington, N. C.

DRWN. BY: MM	CHKD. BY: PLB
JOB NO.: RS-1759	DATE: 12-8-81
SCALE:	SHEET 2 OF 2

DUNCAN-PARNELL, INC., RALEIGH 881

DEPTH FT.	DESCRIPTION
0.0	
1.0	TOPSOIL
	Gray and Brown Medium Dense to Loose Fine to Medium SAND
5.0	
	Brown Gray Loose Fine SAND
15.0	
	Black Very Soft Organic SILT. Trace Fine SAND with Root and Wood Fragments.
24.0	
	Tan and Gray Medium Dense Fine SAND
40.0	



SHEET 1 of 2

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-24HR.
WATER TABLE-1HR.

BORING NO. B-1
DATE DRILLED 11/3/81
JOB NO. RS-1759

SOIL & MATERIAL ENGINEERS, INC.

SM-14

DEPTH FT.	DESCRIPTION	ELEV.	●PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
40.0		-37.2	
42.0	Gray MARL		
44.8		-42.2	64/0.6'
	Auger Refusal @ 44.8'		
	Boring Terminated @ 44.8'		
	A 2-inch well was installed adjacent to the boring location. The well had a five foot slotted stainless steel well screen. The tip elevation of the well screen was set at elevation -12.2 feet (M.S.L.)		

SHEET 2 of 2

TEST BORING RECORD

BORING NO. B-1
DATE DRILLED 11/3/81
JOB NO. RS-1759

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

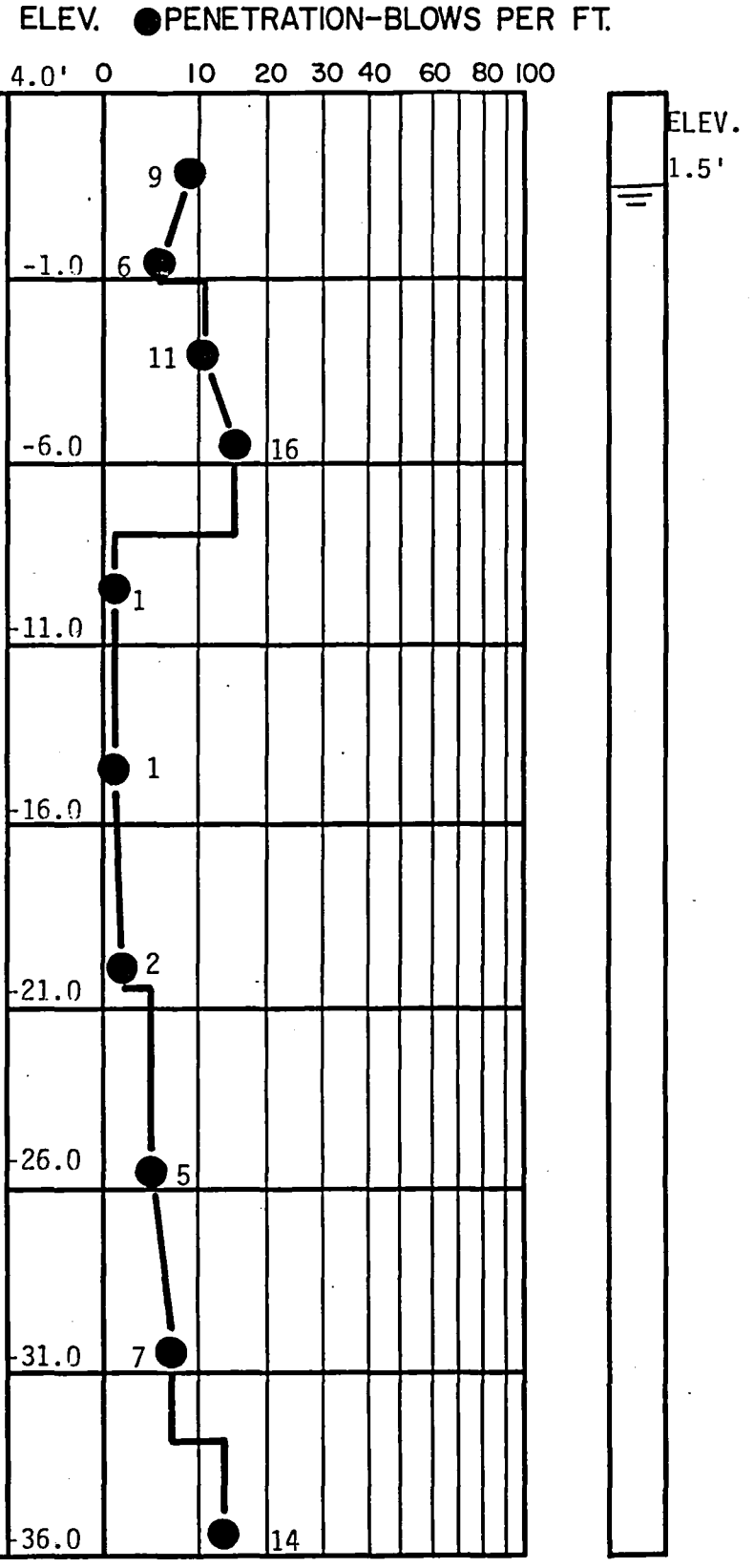
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

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

SOIL & MATERIAL ENGINEERS, INC.

SM-14

DEPTH FT.	DESCRIPTION
0.0	Tan Brown and Gray Medium Dense Silty SAND FILL Trace Gravel and Cinders.
5.0	Gray and Tan Medium Dense Fine to Medium SAND
12.0	Dark Gray Very Soft Fibrous Silty PEAT and Organic SILT
24.5	Tan and Gray Loose Fine SAND Some Wood Fragments
37.0	Tan and Gray Medium Dense Fine to Medium SAND
40.0	



SHEET 1 of 2

TEST BORING RECORD

BORING NO. B-2
DATE DRILLED 11/4/81
JOB NO. RS-1759

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

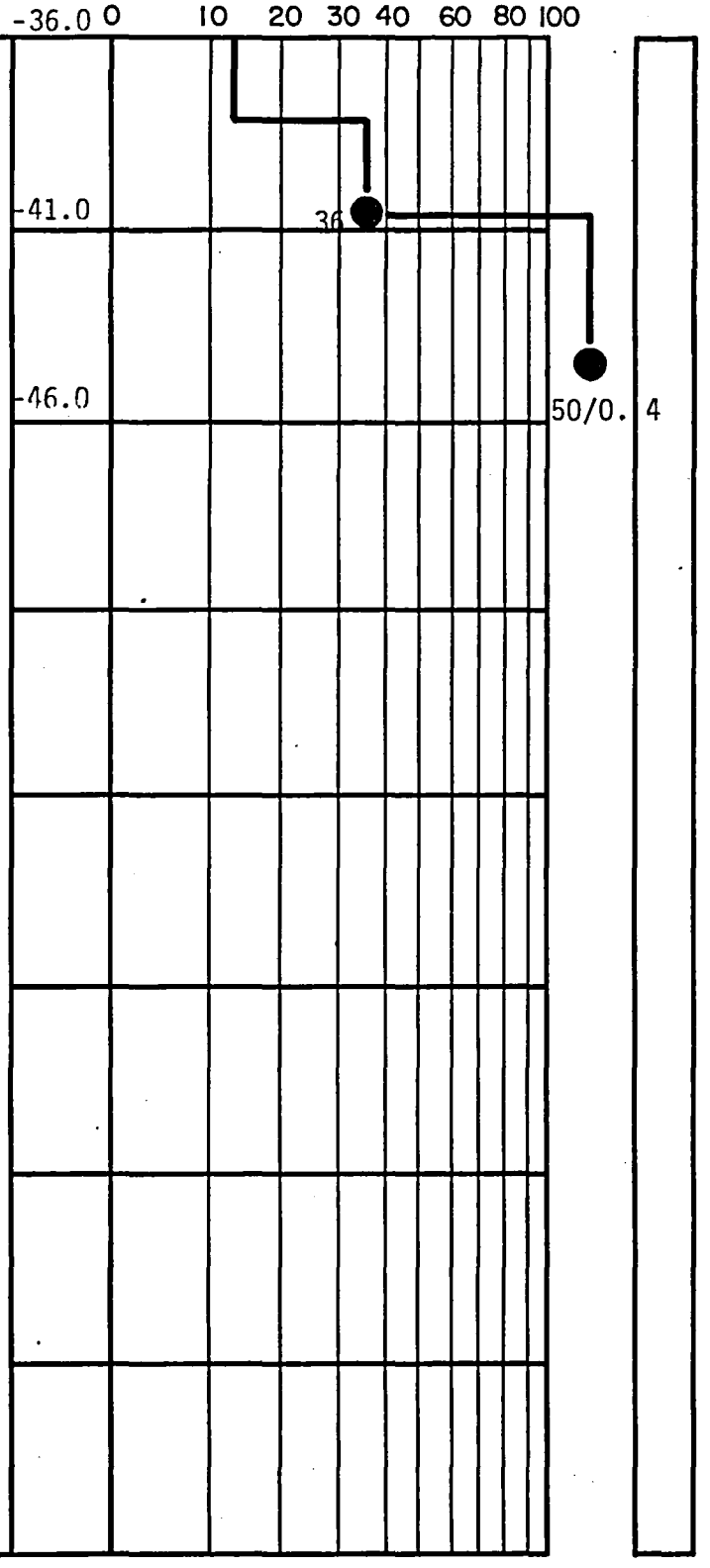
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

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

SOIL & MATERIAL ENGINEERS, INC.

DEPTH FT.	DESCRIPTION	ELEV.
40.0		-36.0
42.0	Gray Medium Fine Sandy CLAY	
44.5	Gray MARL	-41.0
48.9	Boring Terminated @ 48.9'	-46.0

A 2-inch well was installed adjacent to the boring location. The well had a five foot slotted stainless steel well screen. The tip elevation of the well screen was set at elevation -8.0feet (M.S.L.)



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.

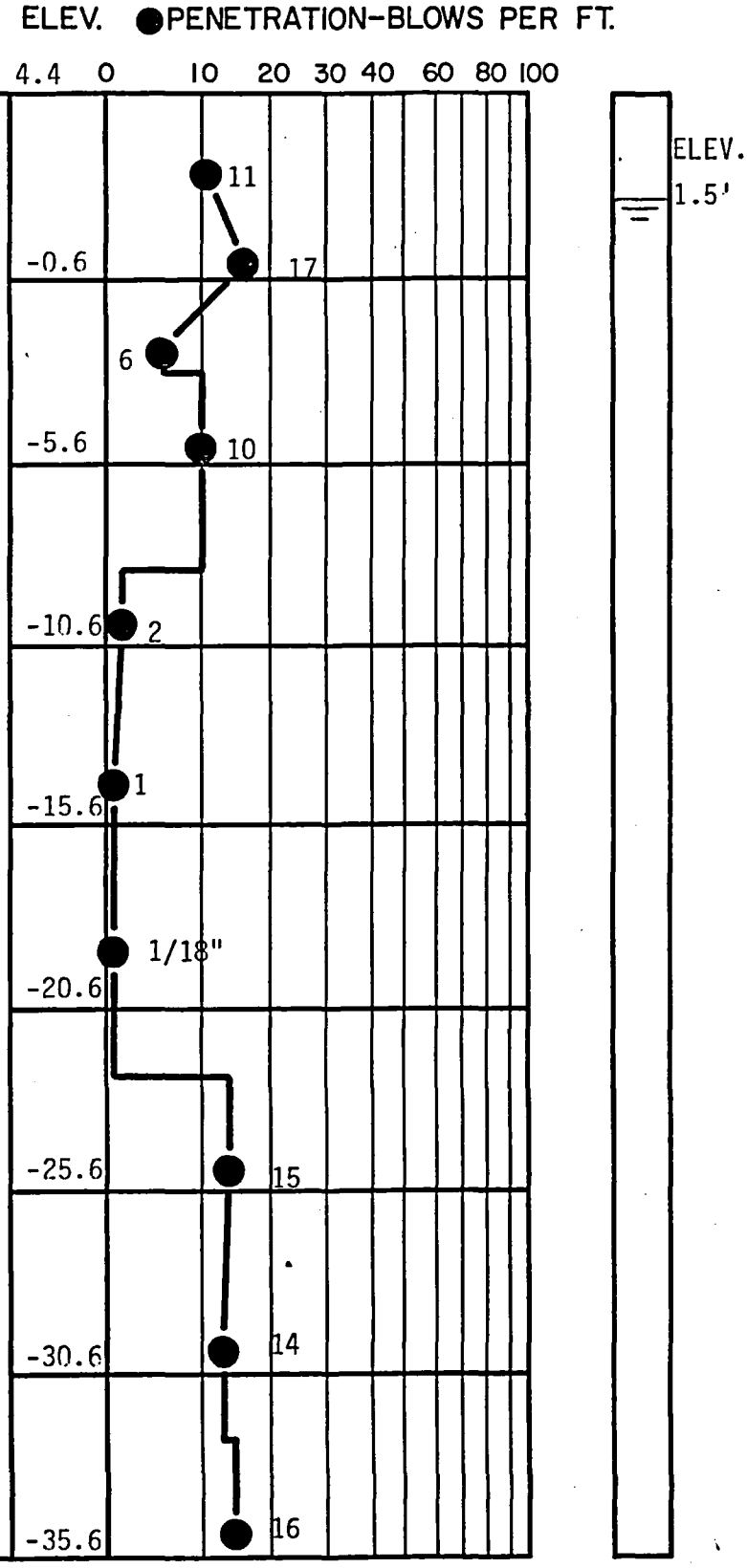
UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE-24HR.
WATER TABLE-1HR.

TEST BORING RECORD

SHEET 2 of 2
BORING NO. B-2
DATE DRILLED 11-4-81
JOB NO. RS-1759

SOIL & MATERIAL ENGINEERS, INC.

DEPTH FT.	DESCRIPTION
0.0	
1.0	TOPSOIL
	Tan and Gray Medium Dense Fine to Medium SAND FILL Trace SILT
7.5	
8.5	Black Soft Organic SILT Trace SAND*
	Tan and Gray Medium Dense Fine to Medium SAND
13.0	
	Black and Brown Organic SILT and PEAT With Wood Fragments
27.0	
	Tan and Gray Medium Dense Fine to Medium SAND
37.0	
40.0	*With Wood Fragments



SHEET 1 of 2

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.

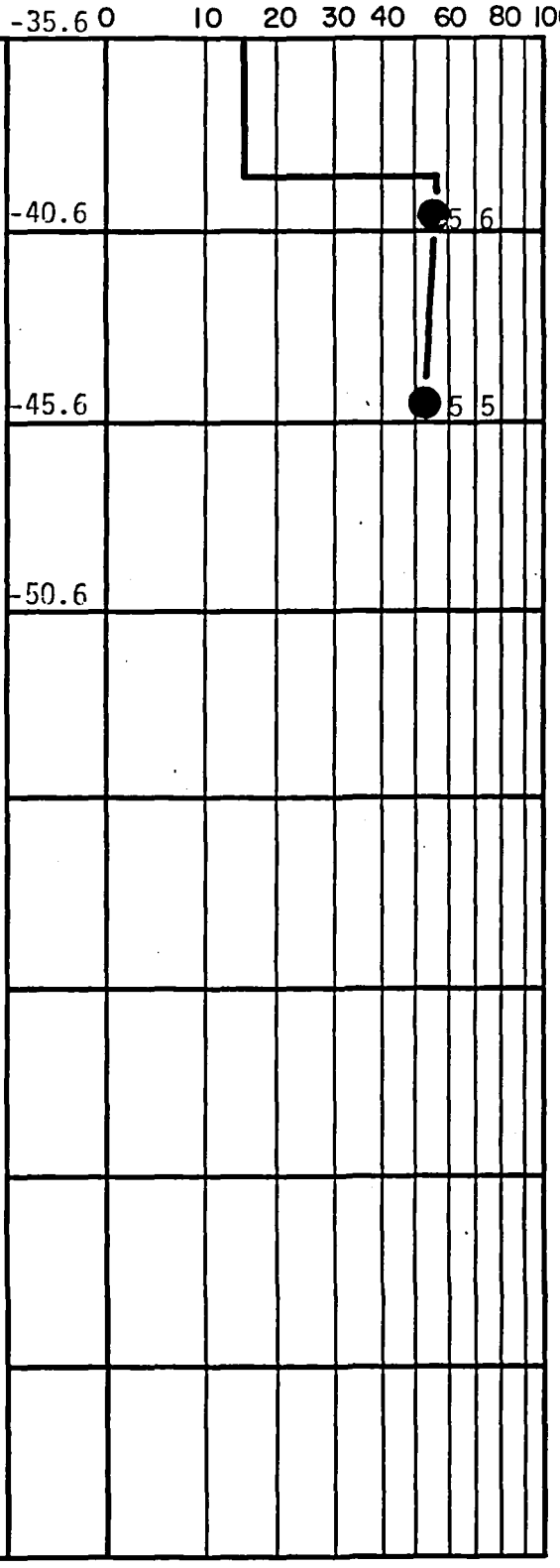
UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE-24HR.
WATER TABLE-1HR.

BORING NO. B-3
DATE DRILLED 11/3/81
JOB NO. RS-1759

SOIL & MATERIAL ENGINEERS, INC.

DEPTH FT.	DESCRIPTION	ELEV.
40.0	Tan and Gray Medium Dense Fine SAND	-35.6
43.5	Gray MARL	-40.6
50.0	Boring Terminated @ 50.0'	-45.6
		-50.6

A 2-inch well was installed adjacent to the boring location. The well had a five foot slotted stainless steel well screen. The tip elevation of the well screen was set at elevation -3.1 feet (M.S.L.)



SHEET 2 of 2

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.

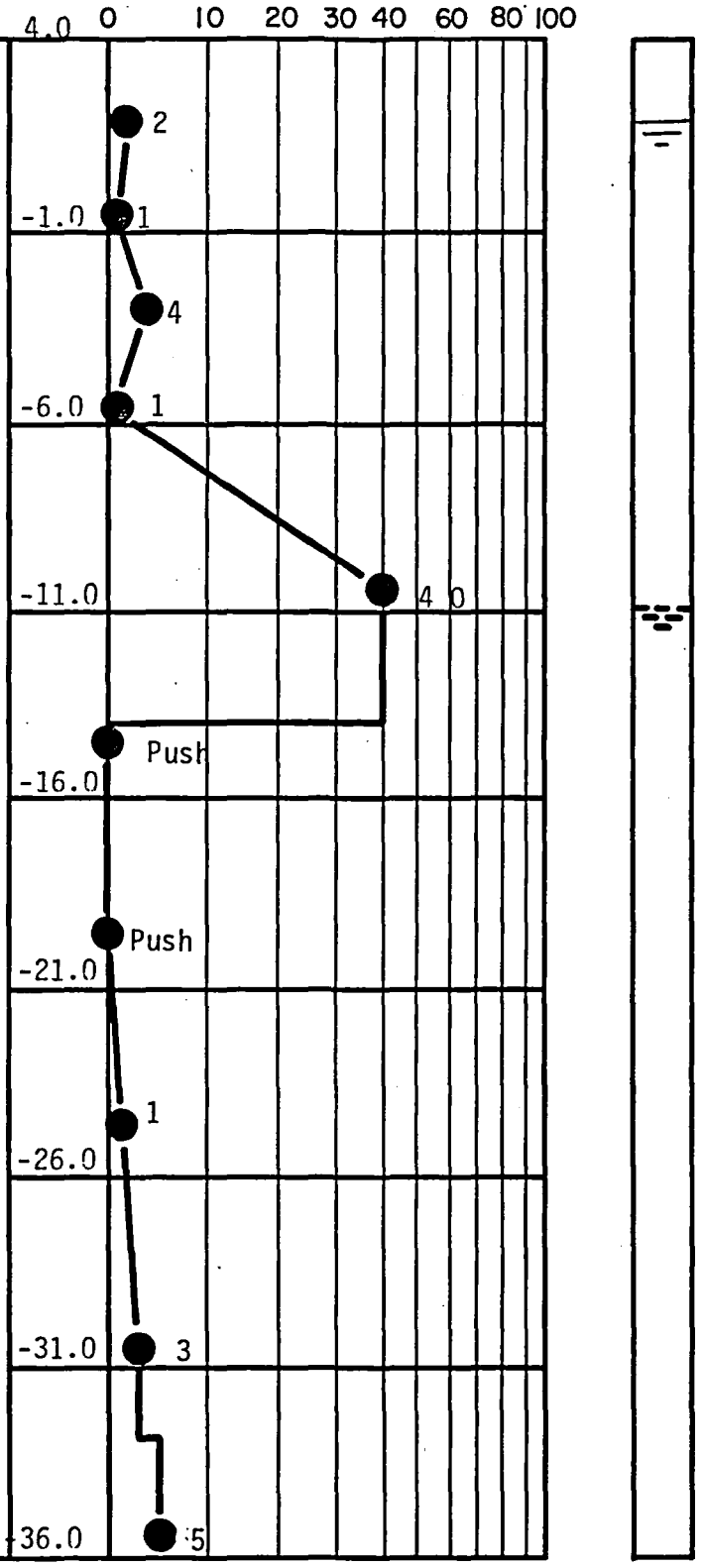
UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE-24HR.
WATER TABLE-1HR.

BORING NO. B-3
DATE DRILLED 11-3-81
JOB NO. RS-1759

SOIL & MATERIAL ENGINEERS, INC.

SM-14

DEPTH FT.	DESCRIPTION
0.0	Brown and Gray Fine Silty SAND and WOOD FILL
18.0	Brown and Gray Very Soft Clayey SILT With Some Organics
37.0	Gray and Tan Loose Fine to Medium SAND
40.0	



SHEET 1 of 2

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.

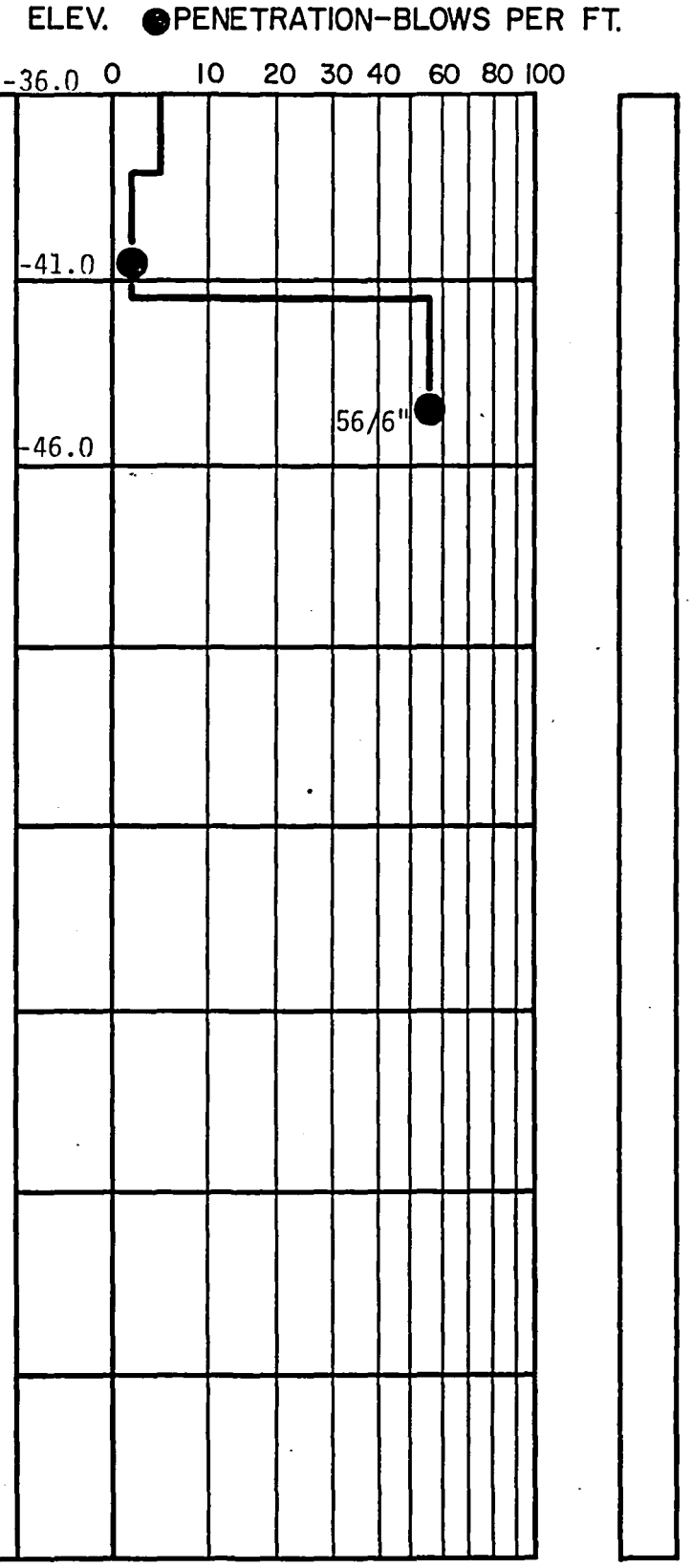
UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE-24 HR.
WATER TABLE-1 HR.

BORING NO. B-4
DATE DRILLED 11/3-11/4/81
JOB NO. RS-1759

SOIL & MATERIAL ENGINEERS, INC.

DEPTH FT.	DESCRIPTION	ELEV.
40.0		-36.0
42.0	Gray and Tan Very Loose Fine to Coarse SAND	-41.0
45.5	Gray MARL	
49.0		-46.0
	Boring Terminated @ 49.0'	

A 2-inch well was installed adjacent to the boring location. The well had a five foot slotted stainless steel well screen. The tip elevation of the well screen was set at elevation -14 feet (M.S.L.)



SHEET 2 of 2

TEST BORING RECORD

BORING NO. B-4
DATE DRILLED 11/3-11/4/81
JOB NO. RS-1759

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

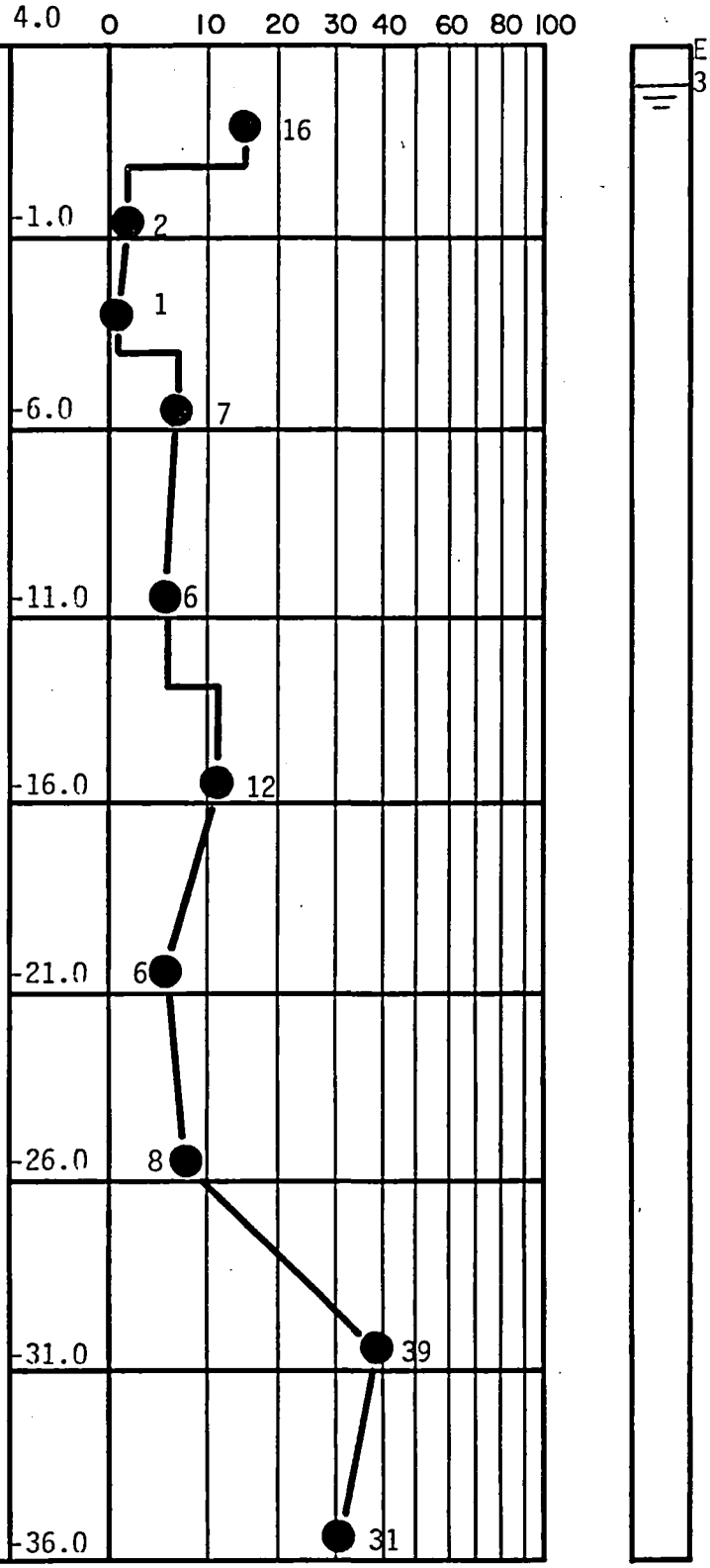
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

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

SOIL & MATERIAL ENGINEERS, INC.

SM-14

DEPTH FT.	DESCRIPTION
0.0	
1.0	TOPSOIL
	Tan and Gray Medium Dense Fine SAND FILL with Clayey Fine to Medium *
3.0	
	Gray Very Soft Organic SILT and PEAT
8.0	
	Gray and Tan Medium Dense Fine SAND Trace to Some SILT
17.0	
	Gray and Tan Loose to Dense Fine SAND
	*SAND Layers
40.0	



SHEET 1 of 2

TEST BORING RECORD

BORING NO. B-5
DATE DRILLED 11/4/81
JOB NO. RS-1759

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-24HR.
WATER TABLE-1HR.

SOIL & MATERIAL ENGINEERS, INC.

SM-14

DEPTH FT.	DESCRIPTION	ELEV.	●PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
40.0		-36.0	
42.0	Gray MARL		
44.0		-41.0	
	Auger Refusal 44.0' Boring Terminated @ 44.0'		
	A 2-inch well was installed adjacent to the boring location. The well had a five foot slotted stainless steel well screen. The tip elevation of the well screen was set at elevation -11 feet (M.S.L.)		

SHEET 2 of 2

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-24HR.
WATER TABLE-1HR.

BORING NO. B-5
DATE DRILLED ~~11/4/81~~
JOB NO. RS-1759

SOIL & MATERIAL ENGINEERS, INC.

Attachments to the preceeding report include the following:

1) A listing of the Priority Pollutants as established by the Environmental Protection Agency; and 2) raw test data which presents the detection limit and the amount of pollutant detected in samples tested.

In analysis of selected samples, Sample No. 81-S-002 was subjected to tests to determine contents of the 130 priority pollutants. Subsequent to testing of this sample, all other samples were tested for pollutants by catagory as indicated by detectable pollutants contained in the initial sample. All other priority pollutants were determined to be below detectable limits.

The raw data, presented in tabular form, indicates the detection limit for each compound and the amount of pollutant detected in the sample. For compounds having detectable amounts, the proposed allowable concentration is presented in parentheses following the detection limit.

PROPOSED FEDERAL CRITERIA FOR "PRIORITY POLLUTANTS" IN DRINKING WATER

In settling a lawsuit brought by the **Natural Resources Defense Council,** the federal Environmental Protection Agency (EPA) agreed to set drinking water criteria for 65 classes of toxic "priority pollutants", including 129 individual compounds. So far the EPA has proposed criteria for 96 of the 129. In several cases, the proposed criterion was set on the basis of chemical toxicity; in many other cases the criterion was set on the basis of the carcinogenicity (cancer-causing ability) of the chemicals. Except as noted in the table, for carcinogens the EPA proposed three different criteria: a criterion that would permit cancer in one person in 10 million drinking the chemical at the proposed level for a lifetime; a criterion that would permit cancer in one person in a million; and a criterion that would permit cancer in one person in 100,000. The criteria presented below are the middle of the proposed range -- in other words, these criteria would permit cancer in one person in one million. To get the other two criteria for carcinogenic chemicals, divide the tabled value by 10 (to get the one in 10 million criterion), or multiply the tabled value by 10 (to get the one in 100,000 criterion). These data are reproduced from Marshall Sittig, **Priority Toxic Pollutants -- Health Impacts and Allowable Limits** (Park Ridge, NJ: Noyes Data Corp., 1980).

CHEMICAL	PROPOSED CRITERION (ppb)*	CARCINOGEN?
Acenaphthene	20.0	No
Acenaphthylene -- See Polynuclear aromatic hydrocarbons		No
Acrolein	6.72	No
Acrylonitrile	0.0084	Yes
Aldrin/dieldrin	0.0000045	Yes
Antimony and compounds	145.0	No
Arsenic and compounds	0.002	Yes
Asbestos	30,000 fibers per liter	Yes
BCEE -- See Bis(2-chloroethyl) ether		
BCIE -- See Bis(2-chloroisopropyl) ether		
BCME -- See Bis(chloromethyl) ether		
Benzene	1.5	Yes
Benzidine	0.000167	Yes

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Available from: Environmental Research Foundation,
29 Pine Knoll Drive, Lawrenceville, NJ 08648

CHEMICAL	PROPOSED CRITERION (ppb)*	CARCINOGEN?
Benzo(a)anthracene -- See Polynuclear aromatic hydrocarbons		No
Benzo(a)pyrene	0.00097	Yes
3,4-Benzofluoranthene -- See Polynuclear aromatic hydrocarbons		No
Benzo(j)fluoranthene -- See Polynuclear aromatic hydrocarbons		Yes
Benzo(k)fluoranthene -- See Polynuclear aromatic hydrocarbons		No
Benzo(ghi)perylene -- See Polynuclear aromatic hydrocarbons		No
Beryllium and compounds	0.0087	Yes
BHC -- See Hexachlorocyclohexane		
Bis(2-chloroethyl) ether	0.042	Yes
Bis(2-chloroisopropyl) ether	1.15	Yes
Bis(chloromethyl) ether	0.000002	Yes
Bromodichloromethane	2.0	No
Bromomethane (methyl bromide)	2.0	No
Cadmium and compounds	10.0**	Yes
Carbon tetrachloride	0.26	Yes
Chlordane	0.00012	Yes
Chloroform	0.21	Yes
Chloromethane (methyl chloride)	2.0	No
2-Chlorophenol	0.3	No
Chromium and compounds	0.0008 (Cr-VI)	Yes
Copper and compounds	1000	No
Cyanides	200	No
DDT and metabolites	0.000098	Yes
Dibenzo(a,h)anthracene (DBA)	0.00043	Yes
Di-n-butyl phthalate	5000	No
Dichlorobenzenes	230	No
Dichlorobenzidine	0.00169	Yes
Dichlorodifluoromethane	3000	No
1-2-Dichloroethane	0.7	Yes
Dichloroethylene	0.13	Yes
Dichloromethane (methylene chloride)	2.0	No
2,4-Dichlorophenol	0.5	No
Dichloropropane/propene	200.0/0.63	No
Dieldrin -- See Aldrin/dieldrin		
Di-2-ethylhexyl phthalate	10000	No
Diethyl phthalate	60000	No

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CHEMICAL	PROPOSED CRITERION (ppb)*	CARCINOGEN?
2,4-Dimethylphenol	***	Yes
Dimethyl phthalate	160000	No
4,6-Dinitro-o-cresol	12.8	No
2,3-Dinitrophenol	68.6	No
2,4-Dinitrophenol	68.6	No
2,5-Dinitrophenol	68.6	No
2,6-Dinitrophenol	68.6	No
3,4-Dinitrophenol	68.6	No
3,5-Dinitrophenol	68.6	No
Dinitrotoluenes	0.074	Yes
Dioxin -- See Tetrachlorodibenzo-p-dioxin		
Diphenylhydrazines	0.04	Yes
Endosulfan	100	No
Endrin	1.0	No
Ethylbenzene	1100	No
Fluoranthene	200	No
HCH -- See Hexachlorocyclohexane		
Heptachlor	0.000023	Yes
Hexachlorobenzene	0.000125	Yes
Hexachloroethane	0.79	Yes
Hexachlorobutadiene	0.077	Yes
Hexachlorocyclohexane (BHC)	0.000021	Yes
Hexachlorocyclopentadiene	1.0	No
Indeno(1,2,3-cd)pyrene -- See Polynuclear Aromatic Hydrocarbons		Yes
Isophorone	460	No
Lead and compounds	50	No
Lindane -- See Hexachlorocyclohexane		
Mercury and compounds	0.2	No
Monochlorobenzene	20	No
Naphthalene	143	No
Nickel and compounds	133	No
Nitrobenzene	30	No
N-nitrosodiethylamine	0.00092	Yes
N-Nitrosodimethylamine	0.0026	Yes
N-Nitrosodi-n-butylamine	0.0013	Yes
N-nitrosopyrrolidine	0.011	Yes

CHEMICAL	PROPOSED CRITERION (ppb)*	CARCINOGEN?
Pentachlorobenzene	0.5	No
Pentachlorophenol	140	No
Phenol	3400	No
Polychlorinated biphenyls (PCBs)	0.000026	Yes
Polynuclear aromatic hydrocarbons (PAH) (Total of 6 compounds together)	0.00097	Yes
Selenium and compounds	10	No
Silver and compounds	10	No
Tetrachlorobenzene	17	No
Tetrachlorodibenzo-p-dioxin	0.000000046	Yes
1,1,2,2-Tetrachloroethane	0.18	Yes
Tetrachloroethylene	0.2	Yes
Thallium and compounds	4.0	No
Toluene	12.4	No
Toxaphene	0.000047	Yes
Tribromomethane (bromoform)	2	No
Trichlorobenzene	13	No
1,1,2-Trichloroethane	0.27	Yes
Trichloroethylene	2.1	Yes
Trichlorofluoromethane	32000	No
2,3,4-Trinitrophenol	10	No
2,3,5-Trinitrophenol	10	No
2,3,6-Trinitrophenol	10	No
2,4,5-Trinitrophenol	10	No
2,4,6-Trinitrophenol (picric acid)	10	No
Vinyl chloride	51.7	Yes
Vinylidene chloride -- See Dichloroethylene		
Zinc and compounds	5000	No

* Parts per billion, or micrograms per liter.

** Criterion based on toxicity, not carcinogenicity; for this chemical, it is not appropriate to adjust the criterion to achieve a different level of risk.

*** Data insufficient to set a criterion; contact should be minimized.

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Industrial & Environmental Analysts, Inc.
P.O. Box 626 • Essex Junction, Vermont 05452 • 802-878-5138

Sample# 81-S-001-V Origin Soil and Material Engineers

Liason Peter Brady Date 12/1/81

VOLATILE FRACTION

COMPOUND	FORMULA	Detection Limit (ug/l)	Amount* (ug/l)
Chloromethane	C.H3.CL		
Bromomethane	C.H3.BR		
Vinyl chloride	C2.H3.CL		
Chloroethane	C2.H5.CL		
Methylene chloride	C.H2.CL2		
Trichlorofluoromethane	C.CL3.F		
1,1-Dichloroethene	C2.H2.CL2		
Bromochloromethane (SS)	C.H2.CL.BR		
1,1-Dichloroethane	C2.H4.CL2		
trans-1,2-Dichloroethene	C2.H2.CL2		
Chloroform	C.H.CL3	"	(0.21)
1,2-Dichloroethane	C2.H4.CL2		
1,1,1-Trichloroethane	C2.H3.CL3		
Carbon Tetrachloride	C.CL4		
Bromodichloromethane	C.H.CL2.BR		
1,2-Dichloropropane	C3.H6.CL2		
trans-1,3-Dichloropropene	C3.H4.CL2	10	
Trichloroethene	C2.H.CL3		
Dibromochloromethane	C.H.CL.BR2		
cis-1,3-Dichloropropene	C3.H4.CL2		
1,1,2-Trichloroethane	C2.H3.C13		
Benzene	C6.H6		
2-Chloroethylvinyl Ether	C4.H7.CL.O		
2-Bromo-1-chloropropane (SS)	C3.H6.CL.BR		
Bromoform	C.H.BR3		
Tetrachloroethene	C2.CL4		
1,1,2,2-Tetrachloroethane	C2.H2.CL4		
1,4-Dichlorobutane (SS)	C4.H8.CL2		
Toluene	C7.H8		
Chlorobenzene	C6.H5.CL		
Ethylbenzene	C8.H10		
Acrolein	C3.H4.O	100	
Acrylonitrile	C3.H3.N	100	

* No entry indicates below detection limit

Industrial & Environmental Analysts, Inc.
P.O. Box 626 • Essex Junction, Vermont 05452 • 802-878-5138

Sample# 81-S-002-V Origin Soil and Material Engineers

Liason Peter Brady Date 12/1/81

VOLATILE FRACTION

COMPOUND	FORMULA	Detection Limit (ug/l)	*Amount (ug/l)
Chloromethane	C.H3.CL		
Bromomethane	C.H3.BR		
Vinyl chloride	C2.H3.CL		
Chloroethane	C2.H5.CL		
Methylene chloride	C.H2.CL2		
Trichlorofluoromethane	C.CL3.F		
1,1-Dichloroethene	C2.H2.CL2		
Bromochloromethane (SS)	C.H2.CL.BR		
1,1-Dichloroethane	C2.H4.CL2		
trans-1,2-Dichloroethene	C2.H2.CL2		
Chloroform	C.H.CL3		9 (0.21)
1,2-Dichloroethane	C2.H4.CL2		
1,1,1-Trichloroethane	C2.H3.CL3		
Carbon Tetrachloride	C.CL4		
Bromodichloromethane	C.H.CL2.BR		
1,2-Dichloropropane	C3.H6.CL2		
trans-1,3-Dichloropropene	C3.H4.CL2	10	
Trichloroethene	C2.H.CL3		
Dibromochloromethane	C.H.CL.BR2		
cis-1,3-Dichloropropene	C3.H4.CL2		
1,1,2-Trichloroethane	C2.H3.C13		
Benzene	C6.H6		45 (1.5)
2-Chloroethylvinyl Ether	C4.H7.CL.O		
2-Bromo-1-chloropropane (SS)	C3.H6.CL.BR		
Bromoform	C.H.BR3		
Tetrachloroethene	C2.CL4		
1,1,2,2-Tetrachloroethane	C2.H2.CL4		
1,4-Dichlorobutane (SS)	C4.H8.CL2		
Toluene	C7.H8		100 (12.4)
Chlorobenzene	C6.H5.CL		
Ethylbenzene	C8.H10		40 (1100)
Acrolein	C3.H4.O	100	
Acrylonitrile	C3.H3.N	100	

*No entry indicates below detection limit.

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Sample # 81-S-002-V Date 12/1/81

Please Note: In addition to the priority pollutants found in this sample the following compounds were identified by library search only. This form of identification is by no means 100% accurate. It does, however, alert you to the fact that there is a compound in the sample with either the structure indicated or something similar to it

Acetone
2-methyl-1-propanol
2-methyl-3-pentanone
2-hexanone
3-hexanone
2-methyl propanoic acid anhydride * FREE ACID
2-4-dimethyl-3-pentanone (largest peak)
2,5-Hexanedione