PHASE 1 RFI/EXTENT OF CONTAMINATION INVESTIGATION REPORT

HOUSTON WOOD PRESERVING WORKS
4910 LIBERTY ROAD
HOUSTON, TEXAS

MAY 23, 1996

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PHASE 1 RFI/EXTENT OF CONTAMINATION INVESTIGATION REPORT

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4910 Liberty Road
Houston, Texas

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EXECUTIVE SUMMARY[1]

Pursuant to Post-closure Care Permit Number HW-50343-000 (Permit), and Compliance Plan Number CP-50343 (Compliance Plan) issued by the Texas Natural Resource Conservation Commission (TNRCC) on June 20, 1994, and the approved RCRA Facility Investigation (RFI) Work Plan and Extent of Contamination (EOC) Investigation Work Plan, Southern Pacific Transportation Company (SPTCo) concurrently performed Phase 1 of the RFI and EOC Investigations at the former Houston Wood Preserving Works (HWPW), 4910 Liberty Road, Houston, Texas. This combined RFI/EOC Investigation report documents field activities, data, and analyses derived from the Phase 1 Investigation of five Investigation Units containing ten Solid Waste Management Units (SWMUs) and six Areas of Concern (AOC).

Cone penetrometer (CPT) soundings were used to characterize the geology onsite and offsite. Very fine-grained sand is present as a thin laterally continuous layer (UTZ) across the site, and as a thin discontinuous layer (STZ) beneath the western one-third of the site. A water well survey conducted under Phase 1 indicates that there are no users of ground water within a 1 mile radius of the site.

Laser-induced fluorescence (ROST™) was used in combination with CPT to provide real-time data indicative of subsurface creosote impact in soils. The Hydropunch™ technique was used to collect ground water samples. Evaluation of CPT/ROST™, Hydropunch™, and ground water monitoring well data indicated that the primary source areas onsite are the former process areas. The primary source area affecting the offsite area in the vicinity of the closed surface impoundment is suspected to be the Inactive Wastewater Lagoon, which was dry during the investigation. Hydropunch™ ground water samples collected downgradient of the closed surface impoundment, TNRCC Permit Unit No. II.B.1, indicate that the permitted unit does not appear to be a significant source of ground water contamination offsite.

The primary contaminants of concern found in site soils and ground water were benzene, toluene, ethylbenzene, and total xylenes (BTEX), and creosote constituents such as naphthalene and related polynuclear aromatic hydrocarbons (PAHs).

This report provides the proposed scope of work and objectives for further investigation of the site under Phase 2 of the RFI and EOC Investigations. The proposed Phase 2 Investigation includes a soil boring program, monitoring well installation, Hydropunch™ ground water sampling offsite, fluids motion analyses, and risk assessment/risk reduction evaluation under TNRCC Subchapter S Risk Reduction Standard No. 3 regulations.

[1] Please refer to the full text for complete explanation and supporting information.

1.0 INTRODUCTION

This combined Phase I RCRA Facility Investigation/Extent of Contamination Investigation Report was prepared by Terranext on behalf of Southern Pacific Transportation Company (SPTCo) at the request of the Corrective Action and Permits Section of the Texas Natural Resource Conservation Commission's (TNRCC) Industrial and Hazardous Waste Division. The primary purpose of the report is to document and present findings from field investigation activities conducted at the site in November and December 1995, in accordance with the approved RCRA Facility Investigation (RFI) and Extent Of Contamination (EOC) Work Plans. The purpose, objectives and scope of work for proposed further investigation under Phase 2 is provided in Section 5.0 of this report.

Pursuant to Post-closure Care Permit Number HW-50343-000 (hereinafter, Permit) and Compliance Plan Number CP-50343 (hereinafter, Compliance Plan), issued by the TNRCC on June 20, 1994, SPTCo prepared two Work Plans to investigate the extent of onsite and offsite contamination in soil and ground water at the former Houston Wood Preserving Works (HWPW), 4910 Liberty Road, Houston, Texas (Figure 1-1). The two required Work Plans were prepared on behalf of SPTCo by Industrial Compliance, now *Terranext*, and are outlined in the following paragraphs.

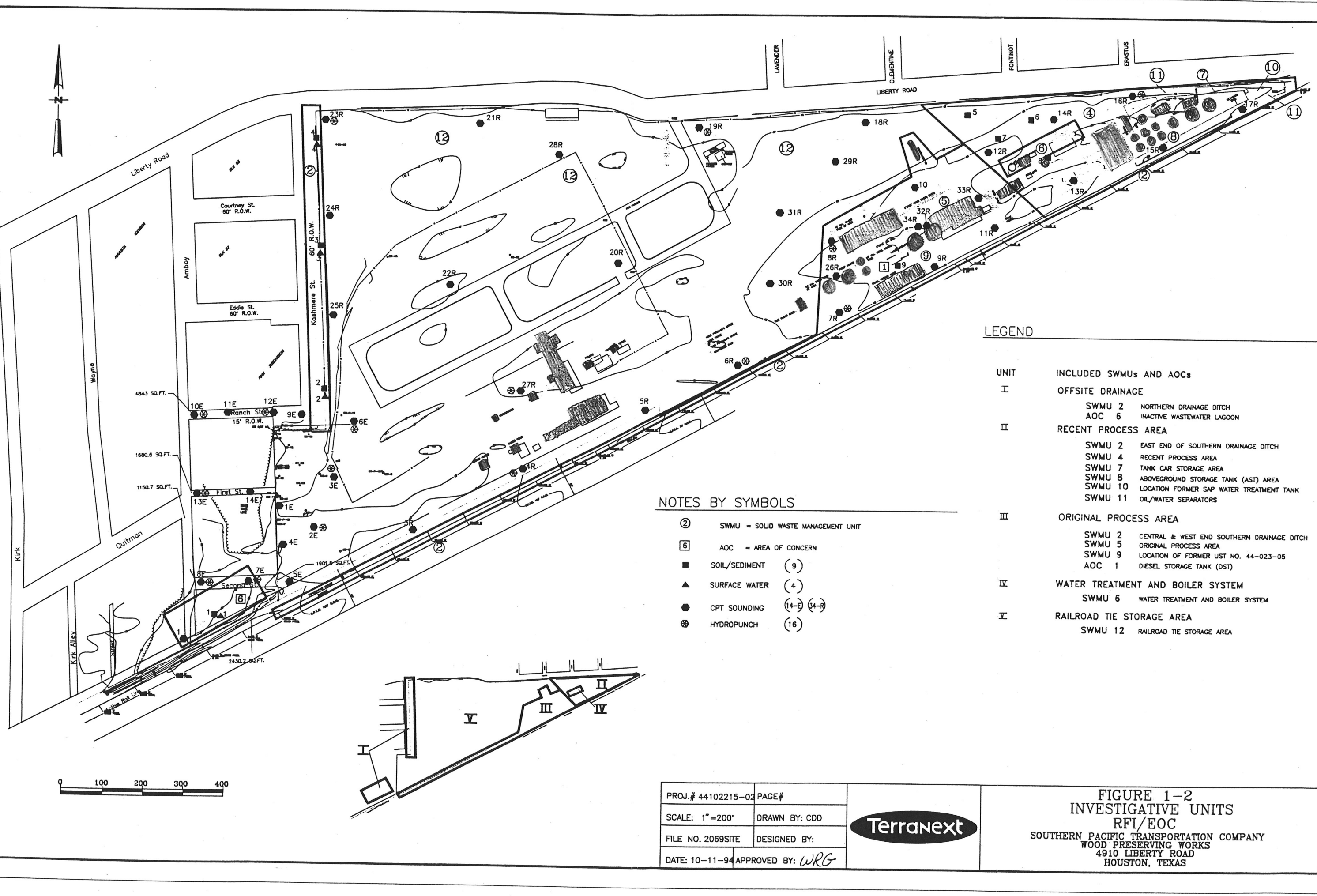
Provision VIII of the Permit requires the completion of an RFI. The purpose of the RFI is to determine whether hazardous waste and/or hazardous constituents listed in 40 CFR Part 261, Appendix VIII or 40 CFR Part 264, Appendix IX have been released into the environment from the Industrial Solid Waste Management Units (SWMUs) and Areas of Concern (AOC) identified in the Permit. Pursuant to the Permit, an RFI Work Plan was prepared and submitted by SPTCo to the TNRCC on October 14, 1994. The RFI Work Plan was approved by TNRCC with modifications on October 16, 1995.

The EOC Work Plan was prepared by SPTCo to comply with the requirements of the Permit and more specifically, the Compliance Plan. The Compliance Plan requires assessment of the extent of contamination offsite in ground water attributable to past operation of the closed surface impoundment, TNRCC Permit Unit No. II.B.1, located in the southwestern-most portion of the site and, based on the results of the investigation, an assessment of the necessity and feasibility of ground water remediation. The EOC Work Plan was submitted by SPTCo on May 19, 1995, and was approved by the TNRCC on September 29, 1995.

1.1 RCRA Facility Investigation Work Plan

Five Investigation Units containing ten SWMUs and six AOCs were delineated in the Data Collection Plan portion of the RFI Work Plan as shown on Figure 1-2. The approved soil and ground water investigation proposed the use of cone penetrometer testing (CPT) and Hydropunch™ sampling to characterize the geology and hydrology of the facility and to determine whether a release of hazardous waste or hazardous constituents had occurred at the facility. During the RFI Work Plan review period conducted by the TNRCC, SPTCo proposed the use of an innovative technology known as the Rapid Optical Screening Tool (ROST™). The ROST™ technology was used in combination with the CPT to provide real-time data relative to the magnitude and extent of subsurface creosote contamination through the use of laser-induced fluorescence (LIF). Technical information describing the ROST™ system, and written correspondence verifying communication to the TNRCC of the addition of the ROST™ technology to the RFI and EOC Investigations are provided in Appendix A.

In addition to the subsurface investigation protocol using CPT/ROST™ and Hydropunch™, the collection of surface soil samples and surface water samples was proposed to determine if creosote compounds could be detected in areas where historic releases may have occurred in the North Drainage Ditch and ponded area (SWMU 2, AOC 6, Unit I), the Original Process Area (Unit III) and the Recent Process Area (Unit II).



LEGEND

UNIT	INCLUDED SWMUs AND AOCs	
I	OFFSITE DRAINAGE	
	SWMU 2	NORTHERN DRAINAGE DITCH
	AOC 6	INACTIVE WASTEWATER LAGOON
II	RECENT PROCESS AREA	
	SWMU 2	EAST END OF SOUTHERN DRAINAGE DITCH
	SWMU 4	RECENT PROCESS AREA
	SWMU 7	TANK CAR STORAGE AREA
	SWMU 8	ABOVEGROUND STORAGE TANK (AST) AREA
	SWMU 10	LOCATION FORMER SAP WATER TREATMENT TANK
	SWMU 11	OIL/WATER SEPARATORS
III	ORIGINAL PROCESS AREA	
	SWMU 2	CENTRAL & WEST END SOUTHERN DRAINAGE DITCH
	SWMU 5	ORIGINAL PROCESS AREA
	SWMU 9	LOCATION OF FORMER UST NO. 44-023-05
	AOC 1	DIESEL STORAGE TANK (DST)
IV	WATER TREATMENT AND BOILER SYSTEM	
	SWMU 6	WATER TREATMENT AND BOILER SYSTEM
V	RAILROAD TIE STORAGE AREA	
	SWMU 12	RAILROAD TIE STORAGE AREA

NOTES BY SYMBOLS

- ② SWMU = SOLID WASTE MANAGEMENT UNIT
- [6] AOC = AREA OF CONCERN
- ■ SOIL/SEDIMENT (9)
- ▲ SURFACE WATER (4)
- ⬢ CPT SOUNDING (14-E) (34-R)
- ⊛ HYDROPUNCH (16)

PROJ.# 44102215-02	PAGE#	Terranext	FIGURE 1-2 INVESTIGATIVE UNITS RFI/EOC SOUTHERN PACIFIC TRANSPORTATION COMPANY WOOD PRESERVING WORKS 4910 LIBERTY ROAD HOUSTON, TEXAS
SCALE: 1"=200'	DRAWN BY: CDD		
FILE NO. 2069SITE	DESIGNED BY:		
DATE: 10-11-94	APPROVED BY: WRG		

1.2 Extent of Contamination Work Plan

In accordance with Provision VIII of the Compliance Plan, the EOC Work Plan was designed to obtain data to evaluate the extent of contamination and parameters necessary to design a remediation system, if warranted, to effectively reduce concentrations of hazardous constituents in the ground water to the levels presented in the Ground Water Protection Standard of Provision IV of the Compliance Plan.

The objectives of the EOC Work Plan were to obtain data relative to the Upper Transmissive Zone (UTZ, +35-foot elevation) and the Secondary Transmissive Zone (STZ, +15-foot elevation), both onsite and offsite downgradient from the closed surface impoundment. The data to be obtained included the amount, hazardous properties, environmental fate, persistence, mobility, and form of hazardous constituents believed associated with the closed surface impoundment, including information related to the site geology, hydrology, and hydrogeology.

CPT soundings in combination with the ROST™ real-time contaminant detection system were used to define the subsurface lithology and to delineate the extent of creosote contamination in subsurface soils at locations shown in Figure 1-2. Hydropunch™ ground water samples were proposed to delineate the extent of contamination offsite and downgradient of the closed surface impoundment. The contaminants of concern in ground water are specified in Table I of the Compliance Plan. Table 1-1 presents these constituents and the required detection limits.

TABLE 1-1
COMPLIANCE PLAN TABLE I - GROUND WATER ANALYTES

Hazardous Constituents	Detection Limits (mg/l)
Acenaphthene	ND (0.010)
Acenaphthylene	ND (0.010)
Anthracene	ND (0.010)
Benzene	ND (0.005)
Benzo(A)anthracene	ND (0.010)
Benzo(A)pyrene	ND (0.010)
Bis(2-ethylhexyl)phthalate	ND (0.010)
Bis(2-chloroethoxy)methane	ND (0.010)
Chlorobenzene	ND (0.005)
2-Chloronaphthalene	ND (0.010)
Chrysene	ND (0.010)
Dibenzofuran	ND (0.010)
1,2-Dichloroethane	ND (0.005)
Dichloromethane (methylene chloride)	ND (0.005)
2,4-Dimethylphenol	ND (0.010)
Di-n-butyl phthalate	ND (0.010)
4,6-Dinitro-o-cresol	ND (0.050)
2,4-Dinitrotoluene	ND (0.010)
2,6-Dinitrotoluene	ND (0.010)
1,2-Diphenylhydrazine	ND (0.010)
Ethylbenzene	ND (0.005)
Fluoranthene	ND (0.010)
Fluorene	ND (0.010)
2-Methylnaphthalene	ND (0.010)
Naphthalene	ND (0.010)
Nitrobenzene	ND (0.010)
4-Nitrophenol	ND (0.050)

TABLE 1-1
COMPLIANCE PLAN TABLE I - GROUND WATER ANALYTES
(Continued)

Hazardous Constituents	Detection Limits (mg/l)
N-Nitrosodiphenylamine	ND (0.010)
Pentachlorophenol	ND (0.050)
Phenanthrene	ND (0.010)
Phenol	ND (0.010)
Pyrene	ND (0.010)
Toluene	ND (0.005)
Xylenes	ND (0.005)

ND Not detectable at Practical Quantitation Limit (PQL) as determined by the analytical methods of the EPA publication SW-486, Test Methods for Evaluating Solid Waste, Third Edition, November 1986, and as listed in the July 8, 1987, edition of the Federal Register and later editions. PQL is indicated parentheses.

The TNRCC requested that the results of the CPT/ROST™ and Hydropunch™ field investigation under Phase 1 be provided prior to the placement and installation of additional monitoring wells. Therefore, the installation of monitoring wells is proposed under the Phase 2 Investigation (Section 5.0) based upon the results of the Hydropunch™ sampling and analyses. This Phase 1 RFI/EOC Investigation Report documents the results of the first phase of the site investigation.

1.3 Summary of Previous Studies

Two field investigations have previously been performed at the closed surface impoundment. investigation. The first investigation was performed in 1984 by Professional Service Industries, Inc. This investigation entailed the installation of four monitoring wells, designated MW-1, MW-2, MW-3, and MW-4, and collection of ground water samples for

chemical analysis. In 1991, as part of a Part B Application for the closed impoundment, Geo Associates installed four ground water monitoring wells (designated MW-5, MW-7, MW-8, and MW-9), three piezometers (designated P-10, P-11, and P-12), and drilled seven exploratory borings. Geo Associates also performed three slug tests and collected ground water and soil samples for chemical analysis.

In September 1994, pursuant to Paragraph XI the Compliance Plan, SPTCo installed two nested point of compliance (POC) wells (MW-10A, MW-10B, MW-11A, MW-11B) within the UTZ and STZ at the downgradient boundary of the surface impoundment. These wells were monitored quarterly for a one-year period, and have been integrated into the current semi-annual ground water monitoring program. Boring logs for each well were provided to the TNRCC in October 1994.

1.4 Ground Water Monitoring

In accordance with the provisions of Paragraph VI of the Compliance Plan, SPTCo has conducted periodic ground water monitoring for potential contaminants of concern listed in Table I of the Compliance Plan for all existing on-site wells. A summary of ground water monitoring reports is provided in Table 1-2.

Having previously completed quarterly ground water monitoring for all on-site wells for approximately two years, SPTCo conducted the first semi-annual period of 1996 ground water sampling related to the closed surface impoundment area on January 23 and 24, 1996. Ten ground water monitor wells (MW-1a, MW-2, MW-3, MW-4, MW-5, MW-7, MW-8, MW-9, MW-10A, and MW-11A) completed in the UTZ, and two monitor wells (MW-10B and MW-11B) and three piezometers (P-10, P-11, and P-12) completed in the STZ were sampled during the first semi-annual sampling event of 1996.

TABLE 1-2
GROUND WATER MONITORING REPORT SUMMARY

	Report Date
1985	
1st Qtr 1985 Analytical Results	April 1985
2nd Qtr 1985 Analytical Results	July 1985
3rd Qtr 1985 Analytical Results	October 1985
4th Qtr 1985 Analytical Results	January 1986
1986	
1st Qtr 1986 Analytical Results	March 1986
2nd Qtr 1986 Analytical Results	July 1986
3rd Qtr 1986 Analytical Results	October 1986
4th Qtr 1986 Analytical Results	December 1986
1987	
1st Qtr 1987 Analytical Results	April 1987
2nd Qtr 1987 Analytical Results	June 1987
4th Qtr 1987 Analytical Results	January 1988
1991	
Summary of 1991 Analytical Results	March 1992
1992	
2nd Qtr 92 MW Summary/Analytical Results	August 1992
3rd Qtr 92 MW Summary/Analytical Results	March 1993
4th Qtr 92 MW Summary/Analytical Results	April 1993
1993	
1st Qtr 93 MW Summary/Analytical Results	June 1993
2nd Qtr 93 MW Summary/Analytical Results	September 1993
3rd Qtr 93 Monitoring/Sampling Report	December 1993
4th Qtr 93 Monitoring/Sampling Report	November 1993
1994	
1st Qtr 94 Monitoring/Sampling Report	May 1994
3rd Qtr 94 Monitoring/Sampling Report	August 1994
4th Qtr 94 Monitoring/Sampling Report	December 1994
1995	
1st Qtr 95 Monitoring/Sampling Report	March 1995
2nd Qtr 95 Monitoring/Sampling Report	June 1995
3rd Qtr 95 Monitoring/Sampling Report	August 1995
1996	
1st Semiannual Period 1996 Semiannual Monitoring/Sampling Report	March 1996

The results of the first semi-annual ground water monitoring event were documented in the First Semi-annual Period 1996, Semi-annual Monitoring And Sampling Report, dated March 22, 1996. Reports for previous quarterly ground water monitoring events were prepared in accordance with the schedule outlined in the Compliance Plan, and are on file with the TNRCC's Permits Section of the Industrial and Hazardous Waste Division.

Concentration versus time graphs were provided in the semi-annual ground water monitoring report for each monitor well and piezometer for benzene, toluene, ethylbenzene, and total xylenes (BTEX) and for polynuclear aromatic hydrocarbons (PAHs).

1.5 Offsite Access

Authorization to access offsite areas was required prior to conducting activities under the EOC Investigation. Private property owners and the City of Houston were contacted to obtain access to areas to perform the required investigation.

1.5.1 Private Property

Permission to access private properties adjacent to the HWPW site was solicited by SPTCo from approximately 48 individual property owners. SPTCo hired a Houston, Texas consulting firm (Allen, Williford, and Seale) to assist SPTCo in the identification of owners of adjacent properties along the western portion of the site near the closed surface impoundment. Since June 1995, Terranext has conducted three complete mailings on behalf of SPTCo to all non-responsive property owners. Through December 1995, a total of only 15 private property owners had granted permission for SPTCo to access their property for the environmental investigation.

1.5.2 City of Houston Property

The City of Houston possesses several rights-of-way (ROW) in the EOC investigation area which currently exist as platted but unpaved streets. The pertinent ROWs consist of Ranch Street, First Street, and Second Street shown on Figure 1-2. Permit applications to access city ROWs for environmental test borings or permanent installations (e.g., monitoring wells) were completed and submitted to the City of Houston Department of Public Works and Engineering.

The City of Houston access permits were issued on June 28, 1995. Permit Nos. MW 95-06-05, MW 95-06-06, MW 95-06-07, and MW 95-06-08 were issued for the work to be performed on Ranch Street. Permit Nos. MW 95-06-09 and MW 95-06-10 were issued for the work on Second Street. Permit Nos. MW 95-06-11 and MW 95-06-12 were issued for work on First Street. These permits remain valid for one calendar year from the issuance date. Any additional work in the ROWs will require additional permits.

Prior to performing the CPT/Hydropunch™ work for the EOC Investigation, the ROWs were located by a licensed surveyor. Survcon, Inc. (Survcon) of Houston, Texas was contracted to locate and stake the ROW boundaries for Ranch Street, First Street, and Second Street. After locating the ROWs, clearing of overgrown vegetation was subcontracted and completed to allow access by the CPT vehicle. Ranch Street and First Street were accessed directly from Amboy Street. Second Street was accessed from SPTCo property. Road base material was laid down to support the weight of the CPT/ROST™ vehicle and the facility's security fence was temporarily removed to allow access to Second Street.

1.6 Wetlands Permit

The 0.28-acre area offsite along the southwest corner of the HWPW site, referred to as

Inactive Wastewater Lagoon (AOC 6), is frequently saturated with ponding storm water. A wetlands delineation was conducted by Terranext on behalf of SPTCo in September 1994, to characterize the nature and extent of the wetlands. On May 22, 1995, SPTCo filed a permit application with the U.S. Army Corps of Engineers, Galveston District, for Nationwide Permits No. 5, 6, and 26. On June 13, 1995, the Corps of Engineers provided authorization to conduct investigation activities in this area.

The wetland area is comprised of the City of Houston ROWs (for 2nd Street and Amboy Street) and five to six privately-owned parcels of land, from which only two access agreements have been executed (as of March 1996). This area is a natural topographic depression within the local drainage basin, and was not constructed as a containment pond, wastewater lagoon or any other designed structure. In November 1995, at the start of the EOC Investigation, the lagoon area was completely dry and covered with grassy vegetation.

2.0 INVESTIGATION ACTIVITIES

2.1 Facility Description

As described in the Permit and Compliance Plan, the site consists of a 33-acre tract of land that was formerly operated as SPTCo's Houston Wood Preserving Works, including the closed surface impoundment (TNRCC Permit Unit No. II.B.1) located in the southwestern-most portion of the site. The facility is located 4910 Liberty Road, Houston, Harris County, Texas, approximately 1.5 miles northeast of the intersection of Highway 59 and Interstate Highway 10. The property to the north and west is mixed residential and light industrial, with heavy industrial usage further southwest. The property to the east and south is owned by SPTCo and is presently used for storage and railroad support operations and for an intermodal yard.

Two National Priority List (NPL) sites are located approximately 1.5 miles northwest of the site. The North Cavalcade Street (EPA ID No. TXD980873343) and South Cavalcade Street (EPA ID No. TXD980810386) sites are former wood preserving operations with contaminated soil and ground water. The closed surface impoundment is in the drainage area of Segment No. 1007 of the San Jacinto River Basin (North Latitude 29°47'14" and West Longitude 95°18'60"). Average elevation of the facility is approximately 46 feet above mean sea level (msl).

The closed surface impoundment is approximately 180 feet long and 106 feet wide and is currently flat, grass-covered vacant property. The southern side of the impoundment is bordered by an earthen berm, approximately 2 feet high, 3 feet wide, and 100 feet long. A portion of the property boundary contains a chain link security fence, located along the northern and western sides of the closed surface impoundment. The permitted unit is fully enclosed by fencing and required signs are posted. The original surface impoundment

dimensions were approximately 106 by 180 feet at the surface, and extended to a depth of approximately 7 feet below ground surface, yielding a potential capacity of approximately 4,950 cubic yards. A clay liner was installed during the original impoundment construction; during closure, after contaminated materials were removed, the impoundment was filled and revegetated. The Compliance Plan requires the EOC Investigation to delineate offsite contamination in ground water attributable to the closed surface impoundment.

The Permit lists ten SWMUs and six AOCs that must be investigated during the performance of the RFI. The RFI Work Plan established the rationale and approach to the onsite investigation. The SWMUs and AOCs were investigated in areas referred to as investigation units, as identified below and as shown on Figure 1-2 (page 1-4).

Investigation Unit	Description/SWMU or AOC Included
I	OFFSITE DRAINAGE (northwest & southwest)
	SWMU 2 - Northern Drainage Ditch AOC 6 - Inactive Wastewater Lagoon
II	RECENT PROCESS AREA
	SWMU 2 - East end of Southern Drainage Ditch SWMU 4 - Recent Process Area SWMU 7 - Tank Car Storage Area SWMU 8 - Aboveground Storage Tank Area SWMU 10 - Location Former Sap Water Trtmt. Tank SWMU 11 - Oil/Water Separators
III	ORIGINAL PROCESS AREA
	SWMU 2 - Central & West Ends So. Drainage Ditch SWMU 5 - Original Process Area SWMU 9 - Location of Former UST No. 44-023-05

AOC 1 - Diesel Storage Tank

IV WATER TREATMENT AND BOILER SYSTEM

SWMU 6 - Water Treatment and Boiler System

V RAILROAD TIE STORAGE AREA

SWMU 12 - Railroad Tie Storage Area

The CPT/ROST™ and Hydropunch™ protocol was used in each investigation unit to characterize the geology and hydrology of the facility and to determine whether a release of hazardous waste or hazardous constituents occurred that is attributable to the SWMUs and/or AOCs within each respective investigation unit.

2.2 Regional Hydrogeology

In accordance with the latest nomenclature by the U.S. Geological Survey, the formations that supply water wells in the Harris County area are, from the oldest to the youngest: the Goliad Sand of Pliocene Age; the Willis Sand, Bentley Formation, Montgomery Formation, and Beaumont Clay of Pleistocene Age; and Alluvium of Pleistocene and Recent Ages. From oldest to youngest, the two aquifer subdivisions are the Evangeline Aquifer, and the Chicot Aquifer.

The HWPW property overlies the aquifers of the Chicot hydrogeologic unit. This unit yields small to moderate quantities of fresh water in Harris County. In the region, ground water used for local drinking water is typically produced from the Evangeline aquifer located at a depth of 900-1,000 feet below surface. However, 90 percent of Houston's water supply is obtained from surface water supplies.

At the request of SPTCo, a records search was performed by Agency Information Consultants, Inc. (AIC) of Austin, Texas to identify water wells within a one-mile radius of the site. Table 2-1 summarizes the results of the AIC well search. Of the nine wells located by AIC, two were owned by the city of Houston, six were owned by the Harris-Galveston Coastal Subsidence District for observation, and one well was a privately-owned well which has been plugged. City well Number LJ-65-14-406 was drilled in 1944 with a screened interval of 1,142 feet to 1,969 feet. City well Number LJ-65-14-759 was drilled in 1938, and has a screened interval of 461 feet to 1,279 feet, and is not in use. The well search report is presented in Appendix B.

2.3 Site Hydrogeology

Limited hydrogeologic data is available for the site. The only site specific information on ground water depths, hydraulic gradient, ground water flow direction, and ground water flow velocity is obtained from the ground water monitoring network related to the closed surface impoundment (permitted unit). As described in the EOC Work Plan, the lithologic units that underlie the site to a depth of approximately 60 feet are the upper cohesive unit (UCU), upper transmissive zone (UTZ), middle cohesive unit (MCU), secondary transmissive zone (STZ), and lower cohesive unit (LCU). A detailed description of the lithology of these units is presented in Section 3.1.

The hydrogeology of the area around the surface impoundment was characterized based on the data collected from the eleven existing monitoring wells and three piezometers that comprise the ground water monitoring network during the time interval of June 1994 through December 1995.

Table 2-1. WATER WELLS WITHIN 1-MILE RADIUS

State I.D. No.	Owner	Total Depth (ft)	Water Level Measured in Casing (ft)	Use	Date Drilled	Screen Interval (ft)	Producing Aquifer	Current Status
LJ-65-14-406	City of Houston Northeast #3	1993	111	Public Supply	1944	1142-1969	Unknown	Unknown
LJ-65-14-735	Harris-Galveston Subsidence District	1596	398	Observation	1980	1567-1577	Evangeline	Unknown
LJ-65-14-738	Harris-Galveston Subsidence District	487	265	Observation	1980	472-482	Chicot	Unknown
LJ-65-14-742	Harris-Galveston Subsidence District	1035	326	Observation	1980	1020-1030	Evangeline	Unknown
LJ-65-14-745	Harris-Galveston Subsidence District	298	163	Observation	1980	283-293	Chicot	Unknown
LJ-65-14-746	Harris-Galveston Subsidence District	2170	394	Observation	1980	2099-2119	Evangeline	Unknown
LJ-65-14-759	City of Houston	1291	Unknown	Unused	1938	461-1279	Unknown	Unused
65-14-7	Williams Const.	280	Unknown	Domestic	1965	Unknown	Unknown	Plugged
65-14-7J	Harris-Galveston Subsidence District	487	Unknown	Test	1980	472-482	Unknown	Unknown

1. Research performed by Agency Information Consultants, Inc.

Analyses of the hydrogeologic data identified an unconfined ground water system within the UTZ, and an unconfined system within the STZ. The depth to the water table within the UTZ fluctuates seasonally. During the 3rd and 4th quarters of 1994, and 3rd quarter of 1995 (summer and fall season 1994 and summer 1995), the depth to ground water ranged from 0.2 to 6.82 feet below grade and averages approximately 4.5 feet below grade. During the 1st and 2nd quarter of 1995 (winter and spring 1995), the depth to ground water ranged from approximately 0.2 to 3.3 feet below grade, and averaged approximately 1.5 feet below grade. The water table is typically higher during the 1st and 2nd quarters due to seasonal precipitation peaks in the region during winter and spring seasons.

The ground water flow direction within the UTZ also varies seasonally. During the 3rd and 4th quarters of 1994, and 3rd quarter 1995, the ground water direction was primarily to the northwest and west with an average approximate hydraulic gradient of 0.005 feet/foot. During the 1st and 2nd quarters of 1995, the ground water flow direction in the UTZ was primarily to the southwest with an average gradient of approximately 0.015 feet/foot.

The ground water surface elevation in the STZ also fluctuates seasonally. During the 3rd and 4th quarters of 1994, and 3rd quarter of 1995, the depth to ground water ranged from 2.0 to 6.7 feet below grade and averaged approximately 4.4 feet below grade. During the 1st and 2nd quarters of 1995, the depth to ground water ranged from approximately -0.08 (potentiometric surface above ground level) to 2.42 feet below grade and averaged approximately 2.0 feet below grade. The seasonal water table fluctuation in the STZ is less pronounced than observed in the UTZ as a result of its depth (approximately 15 feet deeper than the UTZ) and lack of significant recharge during precipitation events.

The ground water flow direction in the STZ during the monitored period was predominantly to the northwest. The hydraulic gradient in the STZ remained fairly constant at approximately 0.006 feet/foot.

2.4 Field Procedures

Previous investigations conducted at the site have been limited to the vicinity of the closed surface impoundment and have provided little information relative to the site geologic conditions and the distribution of impacts related to historical wood preserving operations which occurred onsite over 1,000 feet east of the closed surface impoundment. Published regional geologic information indicated the property is underlain by deltaic deposits which was supported by the results of the previous investigations. However, inherent with deltaic deposits, significant lateral and vertical lithologic variations were identified. A review of the historical operations indicated that wood preserving activities using creosote and extenders were performed at several locations on the property.

The objectives of the Phase 1 investigation were to obtain information relative to the site geology, approximate the magnitude and distribution of creosote and extender, and determine the concentrations of creosote constituents in ground water, surface water, and surface soils. The primary investigative tools employed in this investigation were:

- Cone penetrometer (CPT) soundings
- Rapid Optical Screening Tool (ROST™) profiles
- Hydropunch™ sampling
- Surface soil/sediment sampling

When combined, these tools enabled the characterization of the site geologic framework and the distribution of creosote. A discussion of these investigative tools is presented in the following subsections.

2.5 CPT/ROST™ Program

The CPT/ROST™ portion of the investigation commenced on November 14, 1995, and was completed on November 19, 1995. The CPT soundings and ROST™ profiles were performed simultaneously using the CPT equipment as the delivery system for the ROST™.

The use of the ROST™ technology was not contained in the EOC or RFI Work Plans but was added to the field investigation program after discussion with, and approval by the TNRCC. The purpose of the RFI and EOC investigations was to assess the extent of creosote/extender at the site. The ROST™ allows for real-time investigation of the site without generating investigation-derived wastes typically associated with conventional drilling and sampling techniques.

The RFI and EOC Investigations were performed concurrently to allow for the identification of sources or trends onsite during the RFI, that may have an impact on the offsite area investigated under the EOC Investigation.

The RFI and EOC Investigation Work Plans proposed a total of 42 CPT soundings. For the EOC investigation, 14 CPT sounding locations were preplanned and three soundings were to be field-located, for a total of 17 soundings. For the RFI, a total of 25 CPT soundings was proposed, with five locations added in Unit V in accordance with TNRCC comments.

Based on field-evaluation of the distribution and degree of hydrocarbons in the soil profiles, the CPT/ROST™ program was slightly modified. A total of 14 CPT/ROST™ soundings was performed both onsite and offsite, in the vicinity of the closed surface impoundment for the EOC investigation. In accordance with TNRCC's request for additional CPT soundings in the Tie Storage Area (SWMU 12, Unit V), 32 CPT/ROST™ soundings were performed onsite (in addition to onsite CPTs for the EOC Investigation) for a total of 46 CPT/ROST™

soundings. A description of the CPT and ROST™ equipment and procedures are presented separately below.

2.5.1 CPT Sounding Procedure

The CPT soundings were performed in accordance with the procedures described in the EOC and RFI Work Plans. The total depth of CPT soundings ranged from 22 to 60 feet with the termination depth dependent upon the following factors: the depth at which the base of the STZ was encountered; the vertical distribution of petroleum hydrocarbon compounds as indicated by the ROST™ profile; and CPT refusal caused by cemented layers encountered within the UTZ and STZ. Of the 46 CPT soundings, 10 soundings encountered refusal. Eight of the CPT refusals occurred in the STZ in the southwest portion of the property, and two occurred within the UTZ in the eastern portion of the property. Figure 2-1 illustrates the CPT/ROST™ locations and CPT sounding profiles are provided in Appendix C. The "R" and "E" designations used with CPT sounding identification numbers indicate which investigation work plan the CPT/ROST™ soundings were performed under (i.e., "E" refers to EOC Investigation related CPTs, and "R" refers to RFI-related CPTs).

Due to shallow subsurface obstructions at some CPT/ROST™ locations, a 4-inch diameter hole was drilled with a gasoline powered auger to pre-drill to approximately 3 feet below surface prior to pushing the CPT cone. This pre-drilling procedure was needed to minimize the risk of damaging the CPT/ROST™ equipment.

The CPT system was housed in the cabin of a 20-ton truck. The penetrometer cone was pushed into the subsurface at a constant controlled rate of 2 centimeters per second (cm/sec) while the data acquisition system recorded and plotted the data from the instrument. The data acquisition system had a total of four recording channels to record the cone tip resistance, sleeve friction resistance, depth, and pore pressure. The electrical signals were

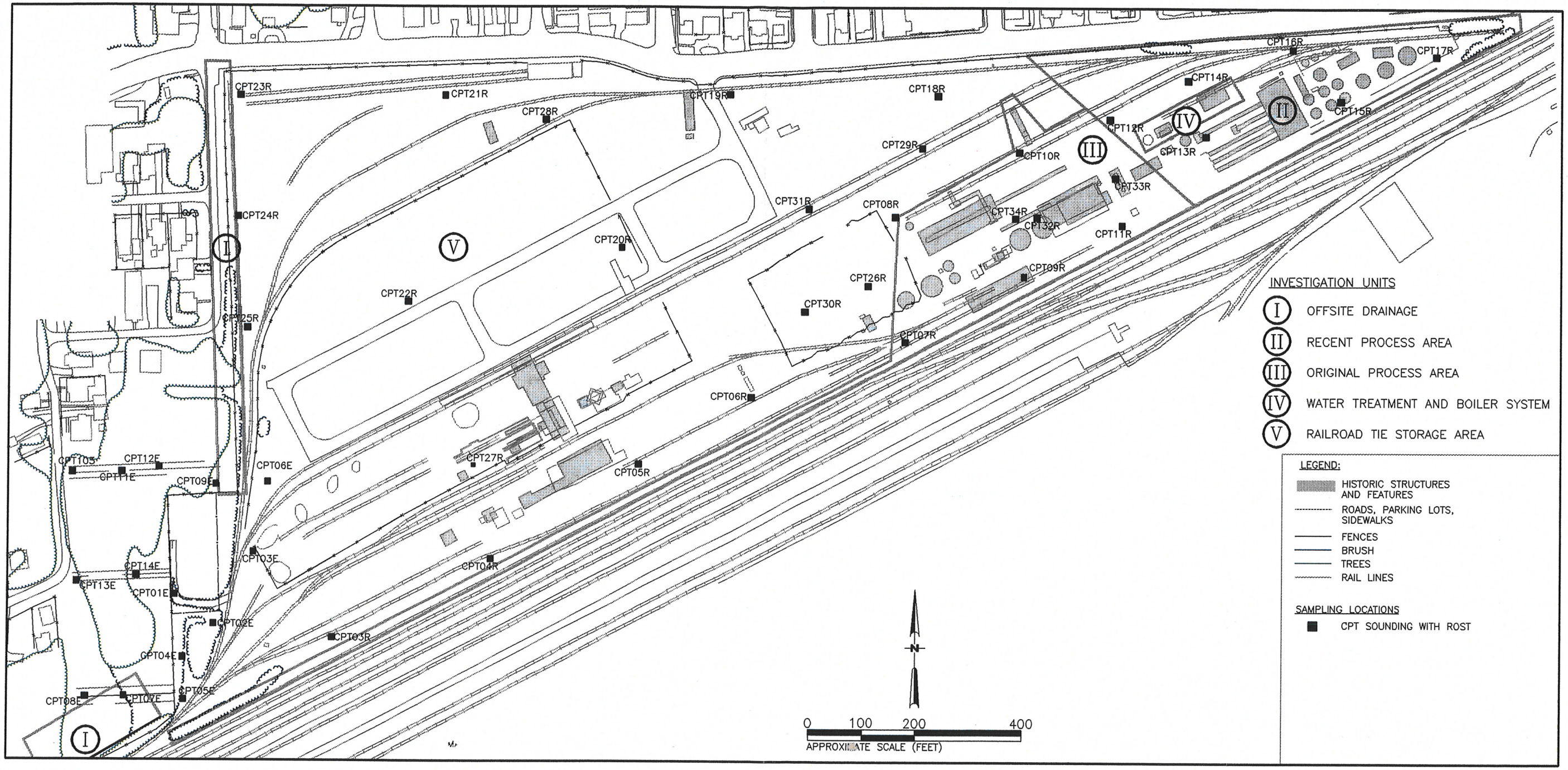


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FIGURE 2-1
CPT/ROST LOCATIONS

SPTCo: HOUSTON WOOD PRESERVING WORKS SITE
HOUSTON, TEXAS

plotted in milli-volts (mv) during the sounding and recorded to the hard drive of a Toshiba lap top portable computer.

Two pore pressure dissipation tests were conducted, one in the UTZ and one in the MCU. The dissipation tests were performed by stopping the cone penetration and allowing the pore pressure to dissipate. The data acquisition system recorded the pore pressure versus time during the dissipation test.

The CPT cones were laboratory calibrated before the field work and field checked before each sounding. The laboratory calibration procedure consisted of applying a series of known loads and hydraulic pressures to the probe and recording the transducer outputs. The field check consisted of a zero load check and a vacuum check on the piezometer during the de-airing procedure. After each sounding, the cone was decontaminated and the tip disassembled for cleaning and de-airing. The passages leading from the tip to the piezometer transducer were cleaned with a wire and flushed with de-aired, deionized water using a syringe. After the de-airing process, the tip was sealed in a membrane to prevent loss of saturation during the CPT setup.

Decontamination of the CPT equipment was performed as the rods were extracted from the ground. Rods were washed twice with an Alconox® and potable water solution and rinsed with distilled water. Wash water was stored in 55-gallon drums during the day and emptied into the decontamination pad at the end of the day. All open CPT holes were tremie-grouted with a bentonite cement grout from total depth to surface.

2.5.2 CPT Data Analysis

Field plots of the cone tip resistance, sleeve friction resistance, friction ratio, and pore pressure versus depth were made in the field and immediately interpreted so that necessary adjustment could be made in the field.

2.5.3 ROST™ Procedure

The ROST™ technology, marketed by Loral Defense Systems-Eagan (Loral), uses LIF spectroscopy to detect in-situ petroleum hydrocarbons in unconsolidated deposits. This technology has been successfully used by Loral at creosote-impacted facilities in California, Washington, and West Virginia, and is currently under evaluation by U.S. EPA's Office of Innovative Technologies.

The ROST™ sapphire window was connected to the CPT cone and was used in conjunction with the CPT soundings at all 46 CPT sounding locations. This tool configuration provided near continuous information regarding the subsurface lithology and distribution of hydrocarbons. The ROST™ data sheets for each profile are provided in Appendix C.

The technology operates on the principle that as hydrocarbon molecules absorb light, their energy state is increased, and in turn releases energy in the form of fluoresced light. Typically, heavier hydrocarbon molecules emit light of longer wavelength than lighter hydrocarbon molecules. Therefore, by measuring the wavelength(s) and intensity of the emitted light, an estimation can be made regarding the relative amount and type of hydrocarbon molecules present.

Before field activities began, Loral conducted bench tests of the creosote/extender samples collected from the site and found the expected peak response for creosote/extender to be

approximately 470 nanometers (nm). Therefore, based on Loral's recommendation, the fluorescence versus depth (FVD) profiles were performed at a wavelength of 450 nm, and the wavelength time measurements (WTM) were performed at a wavelength range of 300 to 500 nm. The ROST™ reference solution, Loral's standard M1 reference, was used as a quality control check prior to conducting each test to ensure that performance of the system was within specifications. A description of this calibration is provided in Section 2.0 of Loral's portion of the Fugro/Loral report in Appendix C. Fluorescence intensities are measured as a percentage of the reference solution, and are displayed as peaks extending across the horizontal axis of the FVD log.

The ROST™ uses a pulsed laser light transferred via a fiber optic cable to a unit that attaches to a standard CPT cone. The light is directed through a sapphire window onto the soil surface. That portion of fluoresced light which is returned through the sapphire window, enters a second fiber optic cable and is directed to the surface equipment in the CPT rig where it is analyzed for spectral (wavelength), temporal (time-resolved), and intensity characteristics. During the RFI and EOC investigations, the location of the sapphire window on the CPT assemblage was 2.5 feet above the bottom of the CPT cone. For example, if the CPT cone was pushed to 40 feet, the total depth of the sapphire window would be 37.5 feet. The variations in depth between CPT profiles and ROST™ fluorescence were accounted for during the review of all data. The ROST™ sapphire window was decontaminated in the same procedure used for the CPT rods and cone.

Two types of analyses were performed during the RFI and EOC investigations: a continuous vertical log recording intensity of a selected wavelength versus depth (fluorescence versus depth or FVD); and wavelength versus time for a point in the soil column (wavelength versus time matrices or WTM).

When the FVD analysis was used, a wavelength was selected based on its ability to match the wavelength of the targeted compound (i.e., the peak wavelength produced by a creosote compound), and was monitored during a continuous vertical sounding. The ROST™ laser light was pulsed at a rate of 50 pulses/second as the CPT cone was advanced at a rate of 2 cm/second. The fluorescence was detected between light pulses and averaged to a single one second interval data point with a digital oscilloscope.

The WTM entailed stopping the advancing CPT probe and reading the fluorescence response at different wavelengths with a tunable monochrometer. The monochrometer was programmed to cycle through a pre-set range of wavelengths of 300 nm to 500 nm, in 10 nm increments. In addition to the intensity, the response period (lifetime) of each wavelength was also measured. Wavelength versus time was then charted to produce WTM plots. Similar to the chart of EPA Method 8015(M) speciation analysis, a WTM pattern is distinctive for the various hydrocarbon fuel types. Fluorescence intensity data were provided in a strip chart form similar to the standard CPT log.

2.5.4 ROST™ Data Analysis

As the CPT cone was advanced, a real-time display of the FVD was reviewed and utilized, in conjunction with the geologic data provided by the CPT, to determine the depth of each sounding. Real-time review of the FVD and WTMs were made in the field and interpreted so that the CPT/ROST™ profile depths could be adjusted to ensure that Phase 1 objectives were met during the investigation. These objectives were to obtain CPT/ROST™ data to the base of the STZ, or to depths where no fluorescence was measured to an approximate 60 foot maximum depth.

2.6 Hydropunch™ Sampling Program

After review of the data generated by the CPT/ROST™ investigation which indicated that creosote had migrated into the UTZ and STZ, a Hydropunch™ program was designed to collect data relative to the distribution of creosote constituents in the ground water in these units. The initial work plan identified 17 Hydropunch™ samples for the EOC investigation, seven in the UTZ, three in the middle confining unit (MCU), and seven in the STZ. The number and location of Hydropunch™ samples to be collected for the RFI investigation was not preplanned, but was dependent on results of the CPT investigation. Figure 2-2 illustrates the actual Hydropunch™ sampling locations. The rationale for each of the Hydropunch™ sampling locations is described in Table 2-2.

Based on the additional geologic data and creosote distribution information developed using CPT/ROST™, the Hydropunch™ program was modified to include a total of 31 Hydropunch™ samples. Nineteen Hydropunch™ samples were attempted in the vicinity of the closed surface impoundment, eight in the UTZ, four in the MCU, and seven in the STZ. To characterize ground water chemistry in the other portions of the property a total of 12 Hydropunch™ samples were collected at various locations within the RFI Investigation Units.

2.7 Hydropunch™ Sampling Procedures

On December 4, 1995, the Hydropunch™ sampling activities were initiated and the field work was completed on December 7, 1995. The sampling was performed using the CPT vehicle with a 14-ton hydraulic system. Fugro utilized 1¾-inch inside diameter (I.D.), 12-inch long stainless steel screens and 1¼-inch I.D. steel rods. Ground water samples were collected using 18-inch long stainless steel bailers.

TABLE 2-2
HYDROPUNCH SAMPLE LOCATIONS RATIONALE
RFI/EOC Phase 1 Investigation

Hydropunch Sample No.	Rationale/Location	Geologic Horizon and Depth from which sample will be collected.
HP01UTZ HP01MCU HP01STZ	Screen for creosote constituents in ground water downgradient of the surface impoundment. Probes to be located near CPT07E.	UTZ - 17 feet MCU - 25 feet STZ - 33 feet
HP02UTZ HP02MCU HP02STZ	Screen for creosote constituents in ground water downgradient of the surface impoundment. Probes to be located near CPT13E.	UTZ - 18 feet MCU - 25 feet STZ - 35 feet
HP03UTZ HP03STZ	Screen for creosote constituents in ground water downgradient of the surface impoundment. Probes to be located near CPT10E.	UTZ - 15 feet STZ - 35 feet
HP04UTZ HP04MCU HP04STZ	Screen for creosote constituents in ground water downgradient of the surface impoundment. Probes to be located near CPT12E.	UTZ - 15 feet MCU - 25 feet STZ - 32 feet
HP05UTZ HP05MCU HP05STZ	Screen for creosote constituents in ground water upgradient of the surface impoundment. Probes to be located near CPT06E.	UTZ - 17 feet MCU - 27 feet STZ - 32 feet
HP06UTZ HP06STZ	Screen for creosote constituents in ground water upgradient of the surface impoundment. Probes to be located near CPT03E.	UTZ - 20 feet STZ - 35 feet

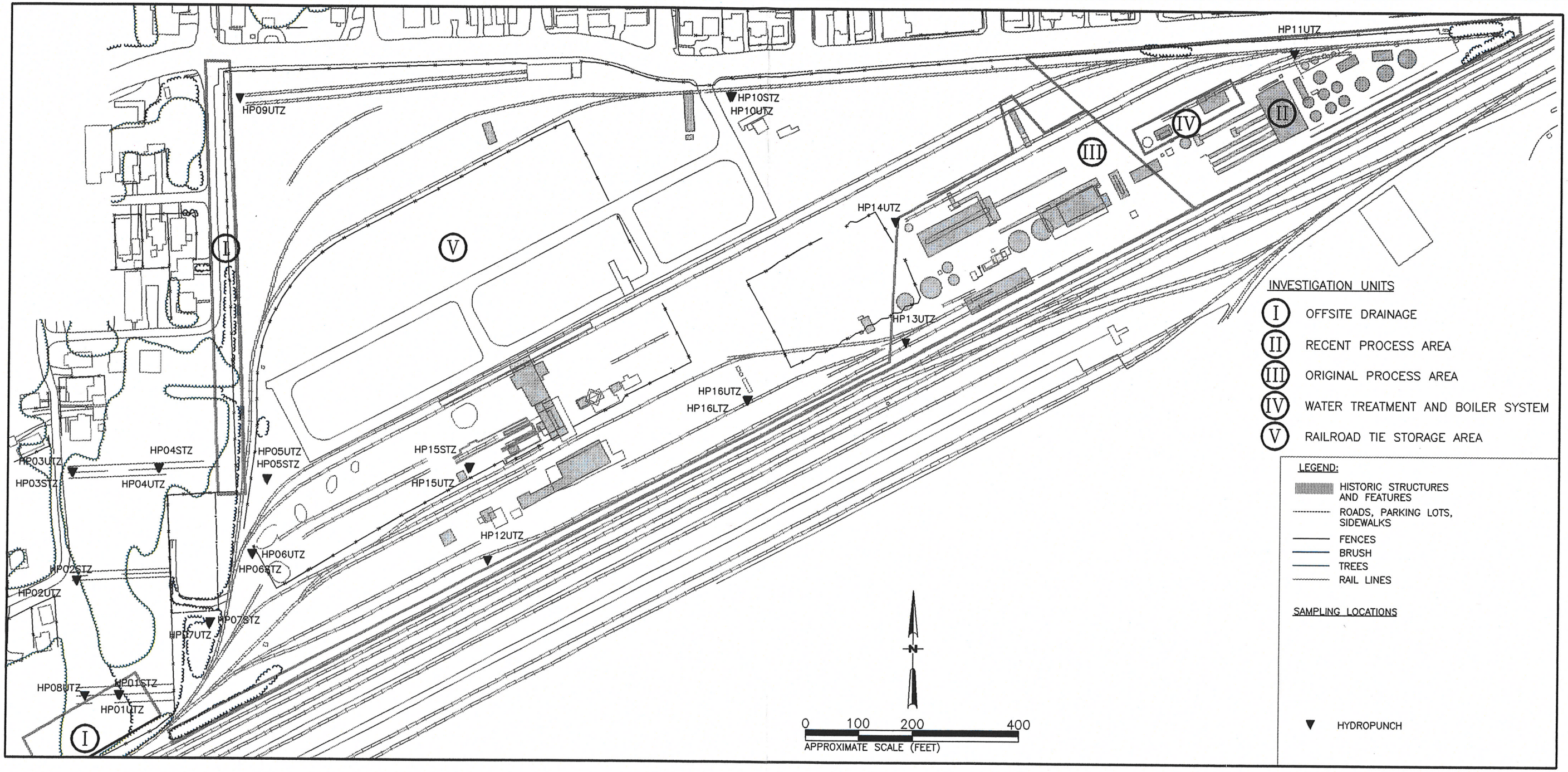
TABLE 2-2
HYDROPUNCH SAMPLE LOCATIONS RATIONALE
RFI/EOC Phase 1 Investigation

Hydropunch Sample No.	Rationale/Location	Geologic Horizon and Depth from which sample will be collected.
HP07UTZ HP07STZ	Screen for creosote constituents in ground water upgradient of the surface impoundment. Probes to be located near CPT02E.	UTZ - 20 feet STZ - 35 feet
HP08UTZ	Screen for creosote constituents in ground water downgradient of the surface impoundment. Probe to be located near CPT08E.	UTZ - 15 feet
HP09UTZ	Screen for creosote constituents in ground water in northwest corner of WPW property in area of low ROST fluorescence. Probe to be located near CPT023R.	UTZ - 15 feet
HP10UTZ HP10STZ	Screen for creosote constituents in ground water along north property boundary in area of low ROST fluorescence. Probes to be located near CPT19R.	UTZ - 17 feet STZ - 32 feet
HP11UTZ	Screen of creosote constituents in ground water along northeast property boundary in area of high ROST fluorescence. Probe to be located near CPT16R.	UTZ - 15 feet
HP12UTZ HP12STZ	Screen for creosote constituents in ground water along southwest property boundary in area of low ROST fluorescence. Probes to be located near CPT04R.	UTZ - 15 feet STZ - 35 feet

TABLE 2-2
HYDROPUNCH SAMPLE LOCATIONS RATIONALE
RFI/EOC Phase 1 Investigation

Hydropunch Sample No.	Rationale/Location	Geologic Horizon and Depth from which sample will be collected.
HP13UTZ	Screen for creosote constituents in ground water along northern property boundary in area of high ROST fluorescence. Probe to be located near CPT7R.	UTZ - 15 feet
HP14UCU HP14UTZ	Screen for creosote constituents in ground water in SWMU5 in area of high ROST fluorescence. Probes to be located near CPT8R.	UCU - 12 feet UTZ - 21 feet
HP15UTZ HP15STZ	Screen for creosote constituents in ground water downgradient of SWMU5. Probes to be located near CPT27R.	UTZ - 17 feet STZ - 35 feet
HP16UTZ	Screen for creosote constituents in ground water along southern property boundary. Probe to be located near CPT6R.	UTZ-

UTZ - Upper Transmissive Zone
MCU - Middle Clay Unit
STZ - Secondary Transmissive Zone



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Target intervals were selected for ground water collection based on CPT/ROST™ logs. The rig was positioned immediately adjacent to the original CPT/ROST™ hole and the sampler was pushed to the target interval. When the desired depth was reached, the push rods were retracted to expose the screen to the water-bearing zone. Following a short waiting period, a small-diameter bailer was lowered through the push rods to collect a ground water sample.

The bailer was pulled to the surface and the ground water transferred into laboratory-supplied sample containers. If the water-bearing zone would not recharge sufficiently to enable collection of a sample within 1 to 24 hours, dependent upon the expected formation yield and equipment constraints, the Hydropunch™ location was abandoned. Of the 31 Hydropunch™ samples attempted, six sample locations did not yield sufficient water to the Hydropunch™ sampler. Of the these six locations, four were in the MCU, one was in the UCU, and one was in the STZ. Immediately upon retrieval of the bailer from the Hydropunch™ sampler, the water sample was transferred from the bailer to the sample containers which were immediately labeled and placed in ice filled coolers. Under chain-of-custody (COC) control, the ground water samples were submitted to the PACE, Inc. (Pace) laboratory located in Houston, Texas for volatile organic compounds (VOC)(U.S. Environmental Protection Agency [EPA] Method 8260), PAHs (EPA method 8270), and total dissolved solids (TDS) (EPA Method 160.1) analyses.

Immediately following the collection of ground water samples, the sampler and push rods were pulled and each hole was tremie-grouted to surface.

Upon completion of the collection of each Hydropunch™ sample, the rods and sampler used to collect the water sample were transported to the decontamination pad on the SPTCo property for decontamination. The equipment was washed with a high pressure steam cleaner using potable water and Alconox®. The samplers were then rinsed with potable water.

2.8 Surface Soil/Sediment Sampling Field Procedure

The RFI Work Plan specified surface soil and surface water samples be collected and analyzed to determine the presence of hazardous substances from current and past discharges to the respective locations (Figure 2-3). The surface soil/sediment samples were collected on December 13, 1995.

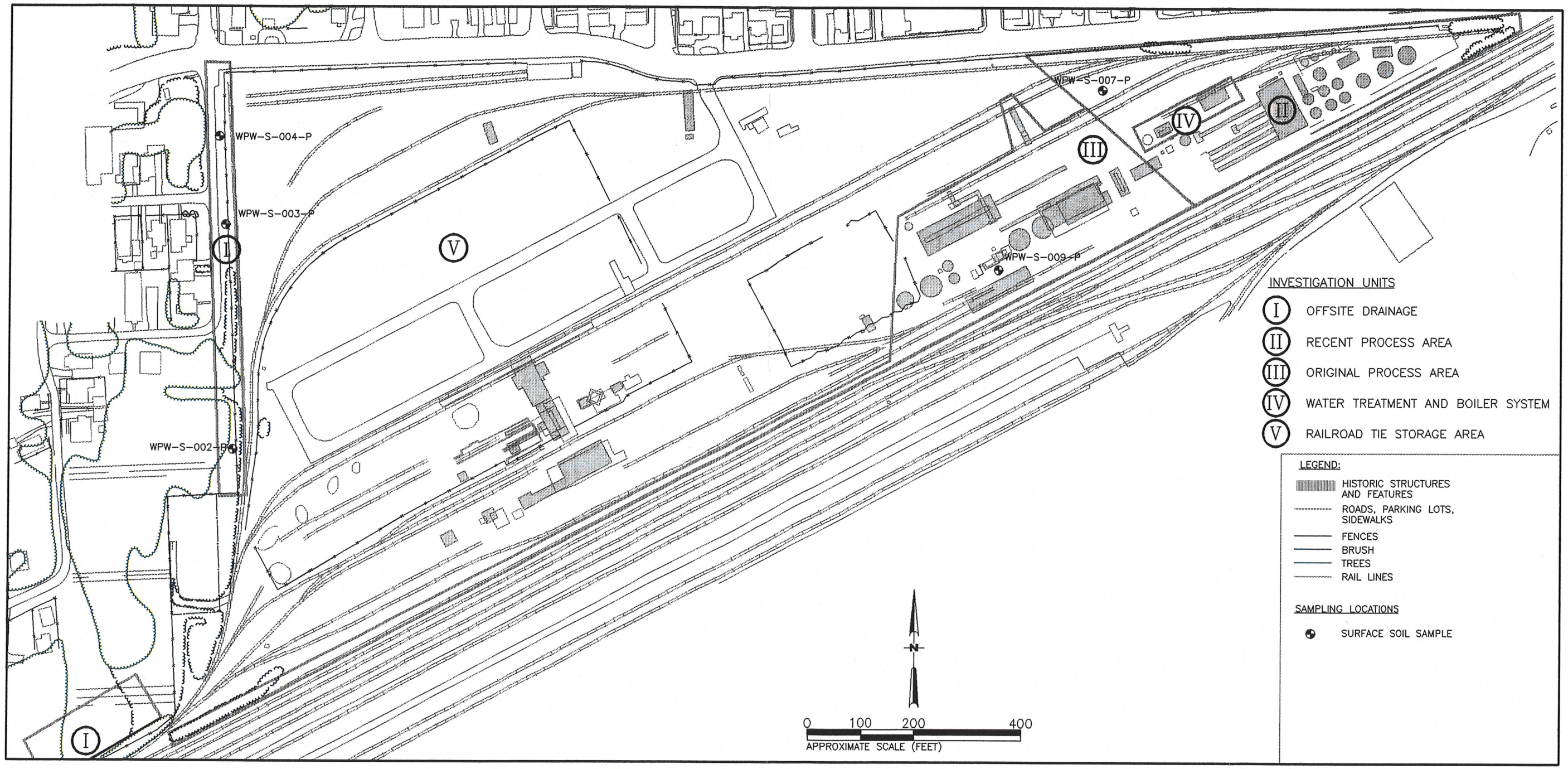
2.8.1 Surface Soil Sampling Procedures

Four shallow soil samples were proposed for the EOC investigation: three samples from the North Drainage Ditch (SWMU 2, Unit I) and one sample from the Inactive Wastewater Lagoon (AOC 6, Unit I), both corresponding to Investigation Unit I. The approximate locations of surface soil samples collected is shown on Figure 2-3.

Five shallow soil samples were proposed for the RFI. Four samples were proposed for the Recent Process Area (Unit II) and one sample was proposed for the Original Process Area (Unit III).

Shallow soil samples were collected from the designated locations and composited from depths between 0 to 6 inches below ground surface. Each soil sample was placed directly into laboratory supplied glass soil jars with Teflon® lined lids and filled as completely as possible to minimize headspace. Upon collection, each sample was labeled and placed directly on ice in a laboratory supplied cooler. The soil samples were transported under COC control to the Pace laboratory for VOC analysis (EPA Method 8260) and PAH analysis (EPA Method 8270).

Between samples, the stainless steel spoon was decontaminated with a brush using an Alconox® and distilled water solution. The spoon was then rinsed twice with distilled water.



INVESTIGATION UNITS

- (I) OFFSITE DRAINAGE
- (II) RECENT PROCESS AREA
- (III) ORIGINAL PROCESS AREA
- (IV) WATER TREATMENT AND BOILER SYSTEM
- (V) RAILROAD TIE STORAGE AREA

LEGEND:

- HISTORIC STRUCTURES AND FEATURES
- ROADS, PARKING LOTS, SIDEWALKS
- FENCES
- BRUSH
- TREES
- RAIL LINES

SAMPLING LOCATIONS

- SURFACE SOIL SAMPLE

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FIGURE 2-3
SURFACE SOIL SAMPLE LOCATIONS

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HOUSTON, TEXAS

2.8.2 Sediment and Surface Water Sampling

The RFI work plan specified the collection of sediment samples beneath standing water to assess the presence of hazardous substances from current and past discharges to surface water bodies. The procedure for collection of sediment samples was to utilize either a disposable trowel or an Ekman bottom dredge sampler.

Additionally, four surface water samples were proposed to be collected for the EOC investigation: one from the Inactive Wastewater Lagoon (AOC 6, Unit I) and three from the North Drainage Ditch (SWMU 2, Unit I). The samples were to be collected using either the sample container or a weighted-bottle sampler depending on the depth of the water.

However, during the RFI and EOC investigations, the North Drainage Ditch (SWMU 2, Unit I) and the Inactive Wastewater Lagoon (AOC 6, Unit1) were completely dry and, therefore, no sediment or surface water samples were collected. Furthermore, access to the Inactive Wastewater Lagoon (AOC 6, Unit 1) through private property could not be obtained.

2.9 Crystalline Precipitate Sampling

The RFI work plan specified the collection of a grab sample of the white crystalline precipitate associated with the water treatment plant (SWMU 6, Unit IV). Sample WPW-M-001-P was collected from a pipe extending from an existing cinder block tank and the adjacent ground surface on December 13, 1995. A decontaminated stainless steel knife was used to collect the precipitate sample. The precipitate was placed directly into a laboratory-supplied glass sample jar. The sample jar was labeled and placed directly into an ice-filled cooler. The precipitate sample was transported under COC control to Pace laboratory for

cation/anion balance analysis by Standard Methods, 18th Edition, 1030S. The results of the analysis are provided in Section 3.4.3 of this report.

3.0 FIELD RESULTS/DATA ANALYSIS

3.1 Analysis of CPT Data

The lithology of the deposits to a depth of 60 feet below the site was determined through implementation of CPT sounding program. A lithologic interpretation of the CPT data was performed in the field using a computer program that incorporates the Campanella and Robertson Classification method. To verify that the lithologic interpretation prepared by the computer program was consistent with site conditions, CPT sounding CPT01E was performed adjacent to the existing monitoring well MW-11B. A comparison of the computer's lithologic interpretation of CPT01E with the soil boring log for MW-11B, indicated that CPT sounding program correctly identified the cohesive soils (clays and silts) and granular soils (sand and silty sand) that underlie the site.

The CPT data interpretations were used to develop north-south and east-west cross-sections throughout the site. These cross-sections, provided at the end of Section 3.0, show the cone responses, lithologic interpretations, and the fluorescence responses as measured by the ROST™.

Based on the computer program interpretation of the CPT data and logs of the borings from POC well nests (MW-10A, MW-10B, and MW-11A, MW-11B) installed by Terranext, the site geology to a depth of 60 feet in descending order consists of: fill; an upper cohesive unit (UCU); an upper transmissive zone (UTZ); a middle cohesive unit (MCU); a secondary transmissive unit (STZ); and a lower cohesive unit (LCU). A description of each lithologic unit is presented in the following subsections.

3.1.1 Fill Material

Fill was encountered in all the CPT soundings performed onsite. Available data indicates that the fill material averages approximately 3 feet in thickness. CPT soundings performed offsite did not encounter fill. The fill was indicated on the CPT sounding logs primarily as interbedded layers of clay, silt, sand or silty sand within the approximate depth interval of 0 to 6 feet below grade. Visual examination of the fill was performed during drilling of the CPT/ROST™ pilot boreholes. Based on these observations, the fill primarily consists of a mixture of gravel, clay, construction debris, and railroad ties. The fill layer is unconformably underlain by the UCU.

3.1.2 Upper Cohesive Unit (UCU)

The UCU is defined as the layer of cohesive soils (clays and silts) that overlie the UTZ. The UCU ranges from 8 to 14 feet in thickness and was encountered in all the CPT/ROST™ soundings and previously completed monitoring well borings. Based on the lithologic description from the boring logs for MW-10A, MW-10B, and MW-11A, the UCU beneath the western portion of the site consists of: silty clay that is gray in color; stiff to very stiff in consistency; laminated; moist; with indications of plant material, calcium carbonate and iron oxide nodules, root holes, and lenses of sandy clay. The UCU is conformably underlain by the UTZ.

3.1.3 Upper Transmissive Zone (UTZ)

The sand layer identified by the CPT soundings and boring logs within the approximate depth interval of 15 to 25 feet below grade is referred to as the UTZ. Based on the CPT and monitoring well log data, the UTZ consists of a continuous sand layer present across the entire site, and the offsite study area. As presented on cross-sections A-A', B-B', and C-C'

at the end of Section 3.0, the UTZ is thickest on the east end of the property (10 feet thick) and gradually thins from east to west to less than 4 feet thick. The UTZ was encountered in all the CPT soundings and monitoring well borings, and ranges from approximately 0.5 to 11 feet in thickness.

Based on the lithologic description from the boring logs for MW-10A, MW-10B, and MW-11A, and sand adhered to the Hydropunch™ sampler from ground water samples collected in the UTZ, the UTZ beneath the western portion of the site consists of: sand and silty sand that is light greenish-gray to light gray in color; very fine-grained; wet; and contains plant material and 10 to 25 percent clay. The UTZ sand thickness (Isopach) data illustrated on Figure 3-1 indicates an undulated surface suggesting possible lobe or dune structures which are generally found in a braided stream environment.

A refusal zone was encountered in the upper portion of the UTZ, at CPT32R and CPT34R, at a depth of approximately 21 feet. The refusal zones may be attributed to a carbonate cemented sand layer observed in the upper portion of the STZ as observed in the boring log for MW-11A. Similar cemented sand layers have been documented in the Houston area which corresponded to inner-channel deposits, typically in the thickest portion of the channel. The UTZ conformably overlies the MCU.

3.1.4 Middle Cohesive Unit (MCU)

The MCU is identified as the layer of cohesive soils (clays, silty clays, sandy clays, clayey silts, silts, and sandy silts) that underlies the UTZ, and overlie the STZ. At locations where the STZ is not present, the base of the MCU is estimated to occur at a depth of approximately 40 feet. The MCU was encountered in all the CPT/ROST™ soundings as well as the borings for POC well nests (MW-10A, MW-10B, and MW-11A, MW-11B) and ranges from approximately 10 to 20 feet in thickness. Based on the boring logs for the POC

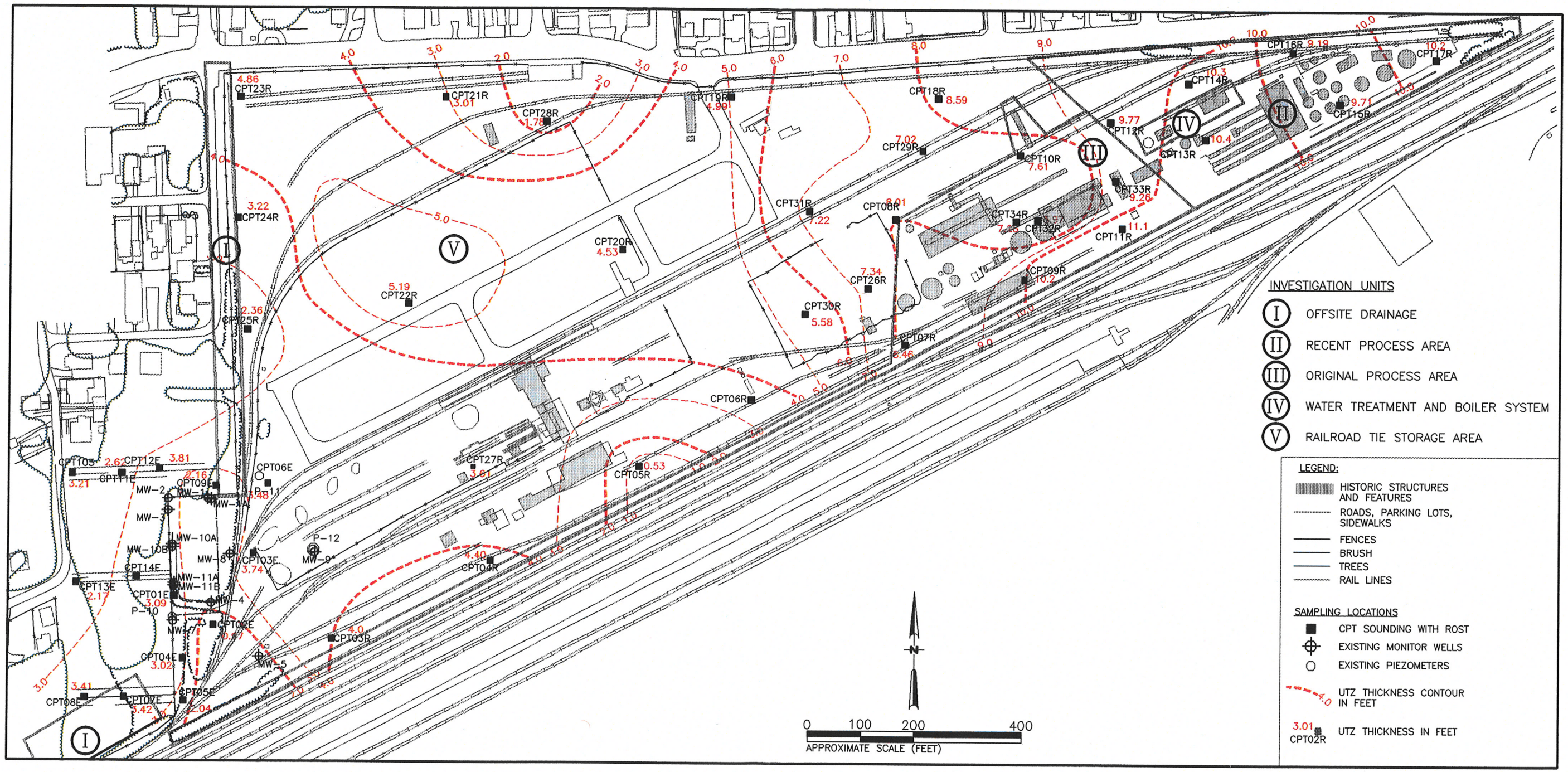

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FIGURE 3-1
UPPER TRANSMISSIVE ZONE ISOPACH MAP

SPTCo: HOUSTON WOOD PRESERVING WORKS SITE
HOUSTON, TEXAS

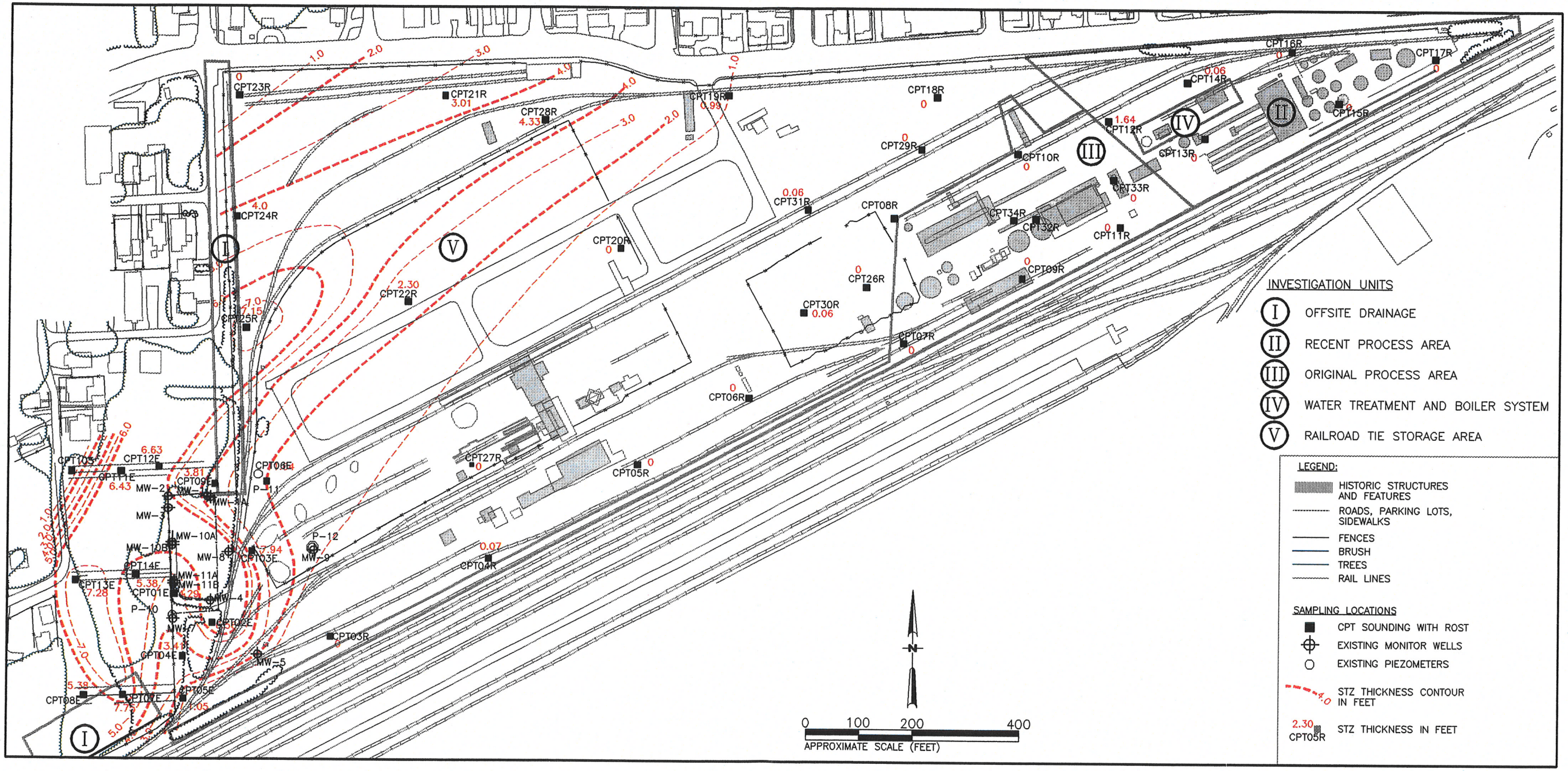

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FIGURE 3-2
SECONDARY TRANSMISSIVE ZONE ISOPACH MAP

SPTCo: HOUSTON WOOD PRESERVING WORKS SITE
HOUSTON, TEXAS

wells, the MCU beneath the western portion of the site consists of: clay, silty clay, and sandy clay that is mottled gray and reddish brown in color; very stiff to hard in consistency; has a high plasticity; is moist; and contains lenses of silty sand and slickensided fractures. The MCU conformably overlies the STZ or LCU where the STZ is absent.

3.1.5 Secondary Transmissive Zone (STZ)

The STZ is defined as the sand layer that underlies the MCU within the depth interval of approximately of 25 to 35 feet below grade. The STZ was encountered in EOC Investigation CPT soundings, CPT01E through CPT14E, and RFI locations: CPT19R, CPT21R, CPT22R, CPT24R, CPT25R, CPT26R, and CPT27R, and ranges from 0 to 7.5 feet in thickness. Based on the boring logs for the POC wells (Appendix E), the STZ consists of: silty sand and sand that is brown and gray mottled, very fine-grained, and very dense in consistency.

The CPT data suggest that the STZ is a distributary mouth deposit located in a channel beneath the west one-third of the site. As shown on the Figure 3-2, the STZ channel is characterized by narrow width and steep banks, and appears to be aligned in a north-south orientation beneath the Inactive Wastewater Lagoon (AOC 6, Unit I) and the closed surface impoundment. The channel bends to the northeast at the approximate location of CPT25R. The estimated maximum thickness of the STZ channel is approximately 7.5 feet at CPT13E. Refusal was encountered at several location within the channel; therefore the actual thickness can only be estimated. Outside of the STZ channel, the zone quickly thins and is remnant or absent east of the line defined by CPT/ROST™ soundings CPT03R, CPT27R, and CPT20R, which are located near the middle portion of the Tie Storage Area (SWMU 12/Unit V).

3.1.6 Lower Cohesive Unit (LCU)

The LCU is defined as the layer of primarily cohesive soils that underlie the STZ or MCU. The base of the LCU was not encountered during the investigation. The maximum thickness of the LCU that was penetrated was approximately 20 feet in sounding CPT33R. Based on the logs of borings for MW-10B and MW-11B, the upper 8 feet of the LCU beneath the western portion of the site consist of: clay and sandy clay that is brown and gray mottled; hard in consistency, has a high plasticity, and contains slickenside fractures. The CPT data indicated that the LCU contains discontinuous lenses of silty sand and sand beneath the eastern portion of the site.

3.2 Analysis of ROST™ Data

The ROST™ data derived from the RFI and EOC investigations were analyzed to qualitatively estimate the extent and magnitude of petroleum hydrocarbons in the subsurface environment. As discussed in Section 2.5.3, the ROST™ was calibrated to detect long-chain petroleum hydrocarbon compounds typically contained in both creosote and diesel fuel, and was performed simultaneously with the CPT soundings.

The ROST™ FVD and WTM data indicated that long-chain hydrocarbons indicative of creosote and diesel fuel were present in the subsurface in mainly four areas of the property, the Original Process Area (Unit III), the Recent Process Area (Unit II), the Offsite Drainage Area (SWMU 2, Unit I), and the eastern half of the Tie Storage Area (Unit V). To a lesser degree, the FVD also indicated the presence of long-chain hydrocarbons in the subsurface beneath the western half of the Tie Storage Area (Unit V). For the purpose of differentiating between the two required investigations (i.e., RFI and EOC Investigations), the ROST™ results analysis are divided into the following sections: Offsite/EOC, and Onsite/RFI.

3.2.1 Offsite/EOC

As shown on Figure 2-1 (page 2-10), a total of 14 FVD profiles (CPT- 01E, 02E, 03E, 04E, 05E, 06E, 07E, 08E, 09E, 10E, 11E, 12E, 13E, and 14E) were performed as part of the Offsite/EOC Investigation. The individual ROST™ data sheets are provided in the *Cone Penetrometer and Related Services* report prepared by Fugro Geosciences/Loral, included in Appendix C. The FVD profiles were performed on a grid surrounding the former surface impoundment to collect linear profile data for evaluation of subsurface conditions. Cross-sections C-C', D-D', and E-E', provided at the end of Section 3.0, present FVD profile cross-sections through the Offsite/EOC investigation area. Figure 3-3 illustrates the cross section locations. These FVD profiles ranged from 29.7 to 41 feet in depth. Profiles CPT-01E, 04E, 06E, 08E, 09E, 11E, 12E, and 14E encountered refusal at an average depth of approximately 34 feet. A likely cause of the refusal may have been a layer of carbonate cementation within the upper portion of the STZ sand.

Background fluorescence as indicated by no appreciable FVD peaks, is considered to be equivalent to zero (0) percent of the ROST™ calibration reference solution. Above background fluorescence was detected in the UCU of all 14 FVD profiles, primarily in the upper-most 5 feet. To a lesser degree, above background fluorescence occurrences were also detected in the UTZ, MCU, and STZ. The greatest depth at which above background fluorescence was measured was 41 feet below grade in CPT03E. In comparison to the reference solution used to calibrate the ROST™ instrument prior to each profile sounding, the fluorescence measured in 12 of the 14 profiles was below 10 percent of the reference solution. The highest fluorescence measured in the vicinity of the closed surface impoundment was 15 percent of the reference solution in CPT08E within the UCU. The highest fluorescence values were measured in profiles CPT07E and CPT08E located along the northern edge of the interior of the Inactive Wastewater Lagoon (AOC 6, Unit I).

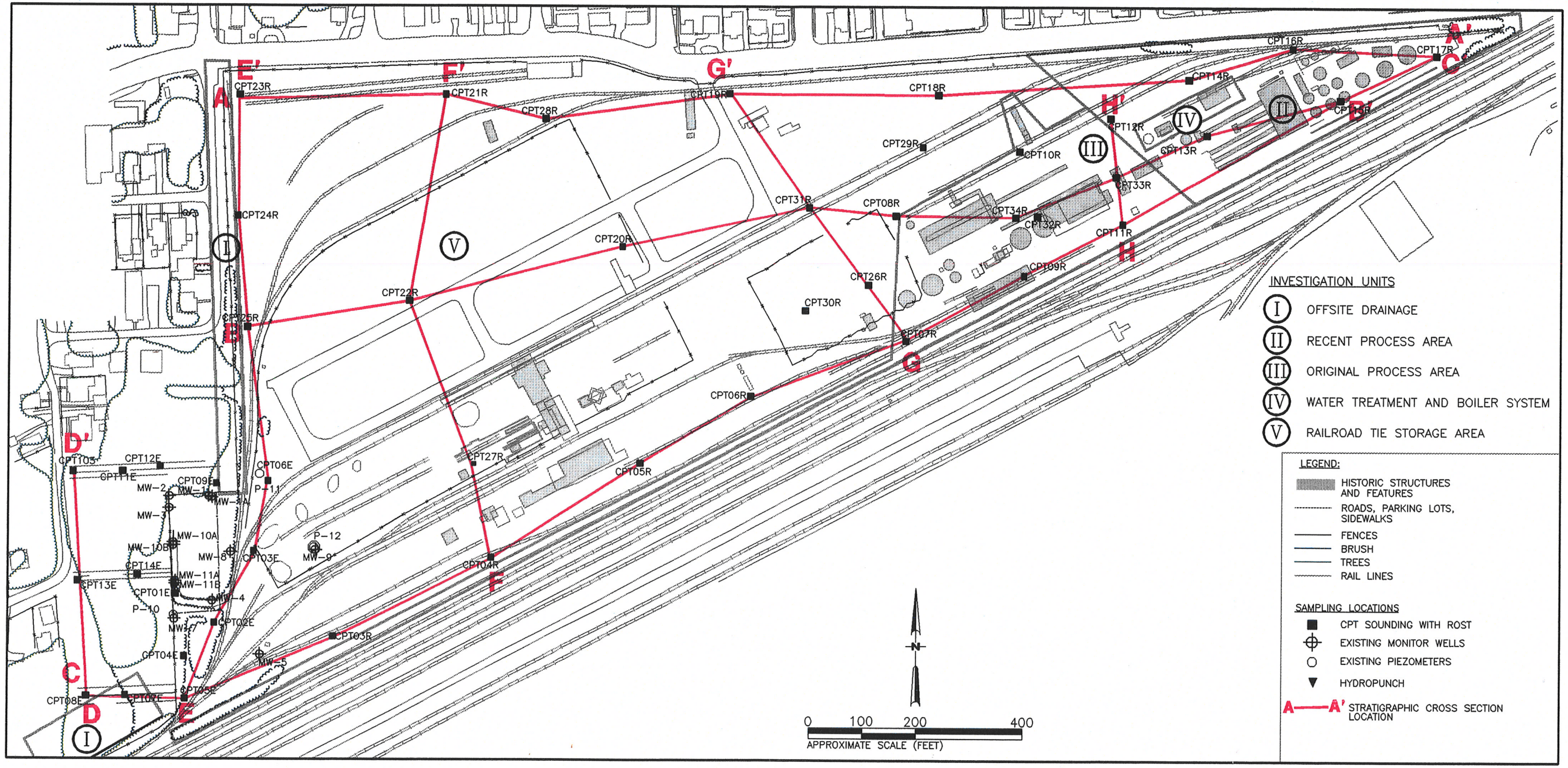

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FIGURE 3-3
CPT/ROST CROSS SECTIONS

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HOUSTON, TEXAS

FVD profile CPT01E was performed adjacent to existing monitoring well MW-11B to check the performance of the ROST™ at a location where hydrocarbons have historically been detected in the subsurface. On the boring log for MW-11B (Appendix E), a very thin layer of black oily material characteristic of creosote was recorded at a depth of approximately 32 feet below grade within the upper portion of the STZ. Drilling evidence suggested that this oily material may be migrating along the top of a layer of carbonate cemented sand. The FVD profile for CPT01E recorded above background fluorescence at a depth of 32 feet. The CPT cone for CPT01E encountered refusal at 34 feet, presumably caused by the layer of carbonate cemented sand. These findings indicated that the CPT/ROST™ profile for CPT01E correlated well upon comparison to the boring log for MW-11B in both lithology and creosote hydrocarbon distribution.

A total of 22 WTMs were collected as part of the EOC investigation to obtain information on the types of hydrocarbons detected by the FVD profiles. Seventeen WTMs exhibited the signature indicative of PAHs which are typical constituents of creosote. Four of the WTMs: WCPT03EC (collected at 32.97 feet), WCPT08EA (collected at 1.27 feet), WCPT08EB (collected at 4.93 feet), and WCPT14EA (collected at 29.70 feet) exhibited signatures characteristic of a mixture of short-chain and long-chain hydrocarbons indicating a possible mixture of diesel fuel and creosote. The wavelength signature from WCPT04EC was weak, presumably due to low concentrations of PAHs in soil and consequently, the specific family of hydrocarbons detected in the FVD profile could not be identified.

As a quality control check, the WTM designated WCPT01EA was collected at a depth at which the FVD profile indicated background or zero fluorescence. The absence of a definitive wavelength signature in WCPT01EA verified the that the FVD and WTM profiles were consistent.

3.2.2 Onsite/RFI

The Onsite/RFI investigation entailed an assessment of the subsurface distribution of creosote/extender in the following Investigation Units: Offsite Drainage Area (Unit I), Recent Process Area (Unit II), Original Process Area (Unit III), and the Tie Storage Area (Unit V). Within these four investigation units, a total 32 FVD profiles were performed and a total of 72 WTMs were collected in conjunction with the Onsite/RFI investigation. The ROST™ results, sorted by RFI Investigation Unit, are presented in the following subsections.

3.2.2.1 Original Process Area - Investigation Units III & IV

As shown on Figure 2-1 (page 2-10), a total of nine FVD profiles (CPT- 07R, 08R, 09R, 10R, 11R, 26R, 32R, 33R, and 34R) were performed in the Original Process Area (Unit III), which for Phase 1 includes Unit IV - the Water Treatment and Boiler System. FVD profiles were performed on a grid within the Original Process Area to collect data for linear profiles and to evaluate subsurface conditions near known locations of former process equipment areas. Cross-sections B-B', C-C', and G-G', provided at the end of Section 3.0, present FVD profile cross-sections through the site including the Original Process Area. These FVD profiles ranged in total depth from 19.0 to 57.5 feet. Profiles CPT32R and CPT34R encountered refusal at a depth of approximately 21 feet. As stated in Section 3.2.1, a layer of carbonate cemented sand was assumed to be the likely cause for the refusal.

Above background fluorescence was detected in all nine FVD profiles and was distributed throughout the UCU, UTZ, and MCU. As discussed in Section 3.1.5, the STZ pinches out in the eastern portion of the site, and appears to absent beneath Unit III. The greatest depth at which above background fluorescence was measured was 57 feet below grade in CPT-26R. Fluorescence was measured at values higher than 100 percent of the calibration reference solution in CPT- 08R, 10R, 26R, 32R, and 34R. In these five profiles, the highest

fluorescence was measured primarily in the UTZ. In general, the highest fluorescence values measured in Unit III were measured in profiles located within the immediate area comprising the old treatment retorts and processing equipment.

A total of 24 WTMs were obtained in the Original Process Area (Unit III) to gather information on the types of hydrocarbons that were detected by the FVD profiles. Twenty-three WTMs exhibited a wavelength signature indicative of PAHs which are typically contained in creosote.

As a quality control check, the WTM designated WCPT09RD, was collected at a depth at which the FVD profile indicated no measurable fluorescence. The absence of a definitive wavelength signature in WCPT09RD verified the FVD profile information relative to the absence of creosote at a depth of 58.76 feet at CPT09R.

3.2.2.2 Recent Process Area - Investigation Unit II

As shown on Figure 2-1 (page 2-10), a total of six FVD profiles (CPT- 12R, 13R, 14R, 15R, 16R, and 17R) were performed in the Recent Process Area (Unit II). FVD profiles were performed on a grid within the Recent Process Area (Unit II) to collect data for linear profiles and to evaluate subsurface conditions near known locations of former process equipment areas. Cross-sections A-A', B-B', C-C', and H-H', provided at the end of Section 3.0, present FVD profile cross-sections through Unit II. The FVD profiles performed in the Recent Process Area ranged from a total depth of 46 to 56 feet.

Above background fluorescence was detected in all six FVD profiles and was distributed throughout the UCU, UTZ, and MCU. As discussed in Section 3.1.5, the STZ pinches out in the eastern one-third of the site and appears to be absent from beneath the Recent Process Area (Unit II). The greatest depth at which above background fluorescence was measured

was 53 feet below grade in CPT12R. Fluorescence was measured at values higher than 100 percent of the reference solution in the MCU of CPT14R and the UCU of CPT16R.

A total of 16 WTMs were collected in the Recent Process Area (Unit II) to obtain information on the types of hydrocarbons detected by the FVD profiles. Fifteen WTMs exhibited a wavelength signature indicative of PAHs characteristic of creosote.

As a quality control check, the WTM designated WCPT017RB was collected at a depth at which the FVD profile indicated background fluorescence. The WTM WCPT17RB did not indicate the presence of hydrocarbons therefore verifying the FVD profile measurements.

3.2.2.3 Tie Storage Area - Unit V

As shown on Figure 2-1 (page 2-10), a total of 22 FVD profiles (CPT- 02E, 03E, 04E, 05E, 06E, 03R, 04R, 05R, 06R, 18R, 19R, 20R, 21R, 22R, 23R, 24R, 25R, 27R, 28R, 29R, 30R, and 31R) were performed in the Tie Storage Area (Unit V). Five of these profiles (CPT- 02E, 03E, 04E, 05E, and 06E) provide information within the southwest corner of the Tie Storage Area (Unit V) as well as providing geologic and hydrocarbon distribution information upgradient of the closed surface impoundment as part of the EOC Investigation.

FVD profiles were performed on a grid within the Tie Storage Area (Unit V) to collect data for linear profiles and to evaluate subsurface conditions near known locations of individual tie storage areas. Cross-sections A-A', B-B', C-C', E-E', F-F', and G-G', provided at the end of Section 3.0, present FVD profile cross-sections through the Tie Storage Area. The individual FVD profiles in this area ranged in total depth from 46 to 56 feet, with the exception of the profile for CPT24R which encountered refusal at a depth of approximately 33 feet. Above background fluorescence was measured in all 22 FVD profiles associated with the Tie Storage Area (Unit V).

Within the central portion of the Tie Storage Area (Unit V), designated as the area encompassed by profiles CPT- 03R, 06R, 19R, 20R, 21R, and 23R, fluorescence in all six profiles was detected below 25 percent of the calibration reference solution, and was primarily contained in the UCU. To a lesser degree, fluorescence was also detected in the UTZ and MCU, as well as the STZ in east-central portion of Unit V where the STZ lithologic unit is present. In the central portion of the Tie Storage Area (Unit V), above background fluorescence was detected at a maximum depth of 37 feet in CPT03R.

The eastern portion of the Tie Storage Area (Unit V) corresponding to profiles CPT- 18R, 29R, 30R, and 31R, contained the highest and most widely distributed fluorescence detection in Unit V. Fluorescence in the eastern portion was measured at values generally below 50 percent of the calibration reference solution and was distributed throughout the UCU, UTZ, and MCU, and within the STZ at locations where the sand unit is present. Florescence was measured at values higher than 100 percent of the reference solution in profile CPT30R within the MCU. In the eastern portion of Unit V, above background fluorescence was detected at a maximum depth of 50 feet in CPT30R.

The southwestern portion of the Tie Storage Area (Unit V) containing profiles 02E, 03E, 04E, and 05E was discussed in Section 3.2.1.

Excluding the profiles performed as part of the Offsite/EOC investigation (CPT-02E, 03E, 04E, 05E, and 06E) a total of 29 WTMs were collected in Unit V. Twenty-three of these WTMs exhibited a wavelength signature indicative of PAHs typically characteristic of creosote. Three of the WTM signatures: WCPT18RB, WCPT19RB, and WCPT22RC, were characteristic of a mixture of short-chain and long-chain hydrocarbons indicative of diesel fuel and creosote. Both WCPT18RB and WCPT19RB were collected in the UTZ at a depth of approximately 20 feet below grade, and WCPT22RC was collected in the STZ at a depth of approximately 35 feet below grade.

As a quality control check, three WTMs, designated WCPT04RA, WCPT21RA, and WCPT23RB, were collected at a depth at which the FVD profile indicated background fluorescence. The WTMs did not indicate the presence of hydrocarbons therefore verifying the FVD profile measurements.

3.2.2.4 Offsite Drainage - Unit I

Four CPT/ROST™ locations were proposed in the RFI Work Plan in the Offsite Drainage Area (Unit I). The three CPTs proposed within the Northern Drainage Ditch (SWMU 2) were relocated to the west approximately 25 feet from the ditch due to the presence of railroad tracks adjacent to the fence-line on the west portion of the property. These profiles, CPT- 23R, 24R, and 25R, are summarized in the discussion for Unit V, Tie Storage Area.

Three surface soil samples were collected from the depression along the west boundary of the property referred to as the Northern Drainage Ditch (SWMU 2); the results are summarized in Section 3.4.2 of this report.

The CPT/ROST™ location proposed for the southwest corner of the offsite Inactive Wastewater Lagoon (AOC 6) was not performed due to failure to obtain solicited access from private property owners. CPT07E sounding was performed in the Second Street easement as part of the EOC investigation, and is within AOC 6, Unit I.

3.3 Hydropunch™ Results

As part of the RFI and EOC investigations, ground water samples were collected using the Hydropunch™ sampling system. The overall objective of the Hydropunch™ program was to assess the ground water chemistry beneath the site relative to the Potential Contaminants of Concern outlined in Table I of the Compliance Plan (see Table 1-1). The purpose of the

ground water samples collected for the offsite/EOC investigation was to delineate the extent of offsite creosote impacted ground water, if any, associated with the closed surface impoundment. Hydropunch™ sampling was performed for the onsite/RFI investigation to obtain information relative to the distribution of creosote and extender constituents in ground water across the entire site.

As shown on Figure 2-2 (page 2-19), a total of 26 primary ground water samples were collected using the Hydropunch™ system, including 15 for the offsite/EOC investigation and 11 for the onsite/RFI investigation.

In addition to the 26 primary samples, a total of 10 quality control (QC) samples were also collected and analyzed to evaluate if cross-contamination occurred during decontamination, field sampling, or sample transport. The QC samples consisted of two equipment blanks, five trip blanks, and three field blanks. Tables 3-1 and 3-2 present the analytical results for the ground water samples and QC samples. Laboratory data sheets and chain-of-custody documentation is provided in Appendix D.

Of the 26 primary samples, 23 were analyzed for VOCs by EPA Method 8260 and PAHs by EPA Method 8270 as outlined in Table I and Table II of the site Compliance Plan. The VOC compounds consisted of benzene, toluene, ethylbenzene, total xylenes, 1,2-dichloroethane, chlorobenzene, methylene chloride, and when specifically requested due to slow recharge, naphthalene.

TABLE 3-1
GROUND WATER SCREENING RESULTS FOR VOC CONSTITUENTS

Sample ID Number	Sample Depth (ft)	Benzene (µg/L)	Ethylbenzene (µg/L)	Toluene (µg/L)	Total Xylenes (µg/L)	Naphthalene (µg/L)
HP01-UTZ	17-18	<25	100	<25	1300	N/A
HP01-STZ	35-36	<5	<5	<5	<5	N/A
HP02-UTZ	18-19	<5	<5	<5	<5	N/A
HP02-STZ	35-36	<5	<5	<5	<5	N/A
HP03-UTZ	15-16	<5	<5	<5	<5	N/A
HP03-STZ	35-36	<5	<5	<5	<5	<10
HP04-UTZ	15-16	<5	<5	<5	22	N/A
HP04-STZ	32-33	<5	24	<5	18	N/A
HP05-UTZ	17-18	<5	<5	<5	<5	N/A
HP05-STZ	32-33	<5	<5	<5	<5	N/A
HP06-UTZ	20-21	<5	<5	<5	<5	N/A
HP06-STZ	35-36	<5	<5	<5	<5	N/A
HP07-UTZ	20-21	<5	<5	<5	7	N/A
HP07-STZ	35-36	<5	<5	<5	<5	N/A
HP08-UTZ	16-17	<50	240	<50	2,100	N/A
HP09-UTZ	15-16	<5	<5	<5	<5	<10
HP10-UTZ	17-18	<5	<5	<5	<5	N/A
HP10-STZ	32-33	<5	<5	<5	<5	<10
HP11-UTZ	15-16	80	1,100	10	900	3,700
HP12-UTZ	15-16	<5	<5	<5	<5	N/A
HP13-UTZ	15-16	<5	33	<5	30	N/A
HP14-UTZ	21-22	16	270	410	850	N/A
HP15-UTZ	17-18	<5	<5	<5	<5	N/A
HP15-STZ	35-36	<5	<5	<5	<5	N/A
HP16-UTZ	17-18	<5	<5	<5	<5	<10
HP16-LTZ	49-50	<5	<5	<5	<5	N/A
EB-01		<5	<5	<5	<5	<10
EB-02		<5	49	82	190	N/A
FB-01		5	<5	<5	<5	<10
FB-02		<5	<5	<5	<5	<10

TABLE 3-1 (Continued)
GROUND WATER SCREENING RESULTS FOR
VOC CONSTITUENTS

Sample ID Number	Sample Depth (ft)	Benzene (μg/L)	Ethylbenzene (μg/L)	Toluene (μg/L)	Total Xylenes (μg/L)	Naphthalene (μg/L)
FB-03		<5	<5	<5	<5	<10
TB (12/4)		<5	<5	<5	<5	<10
TB (12/5)		<5	<5	<5	<5	N/A
TB_1(12/6)		<5	<5	<5	<5	<10
TB_2(12/6)		<5	<5	<5	<5	<10
TB (12/7)		<5	<5	<5	<5	N/A

Table Notes:
μg/L - Concentrations measured in micrograms per liter.
N/A - Indicates naphthalene concentration reported on Table 3-2.
EB - Equipment blank
FB - Field blank
TB - Trip blank (placed in cooler)

TABLE 3-2
GROUND WATER SCREENING RESULTS
FOR DETECTED PAH CONSTITUENTS

Sample ID Number	Sample Depth (ft)	2,6-DNT (µg/L)	2-MNL (µg/L)	ANP (µg/L)	DBP (µg/L)	DBF (µg/L)	2,4-DMP (µg/L)	NB (µg/L)	PT (µg/L)	Fluor (µg/L)	Nap (µg/L)
HP01-UTZ	17-18	<10	65	120	12	50	<10	<10	50	68	2200
HP01-STZ	35-36	<10	<10	100	15	<10	<10	<10	<10	<10	<10
HP02-UTZ	18-19	<10	<10	<10	15	<10	<10	<10	<10	<10	<10
HP02-STZ	35-36	<10	<10	<10	25	<10	<10	<10	<10	<10	<10
HP03-UTZ	15-16	<10	<10	<10	19	<10	<10	<10	<10	<10	<10
HP03-STZ	35-36	<10	<10	<10	27	<10	<10	<10	<10	<10	N/A
HP04-UTZ	15-16	11	34	23	14	<10	<10	<10	<10	32	260
HP04-STZ	32-33	<10	<10	<10	10	<10	<10	<10	<10	45	46
HP05-UTZ	17-18	<10	62	108	19	58	<10	<10	<10	53	<10
HP05-STZ	32-33	<10	<10	<10	17	<10	<10	<10	<10	<10	<10
HP06-UTZ	20-21	<10	<10	<10	19	<10	<10	<10	<10	<10	<10
HP06-STZ	35-36	<10	<10	<10	34	<10	<10	<10	<10	<10	<10
HP07-UTZ	20-21	<10	60	89	17	28	<10	<10	12	53	700
HP07-STZ	35-36	<10	<10	<10	18	<10	<10	<10	<10	<10	<10
HP08-UTZ	16-17	<10	140	30	17	53	95	41	40	50	1,100
HP09-UTZ	15-16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HP10-UTZ	17-18	<10	<10	11	20	<10	<10	<10	<10	<10	<10
HP10-STZ	32-33	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HP11-UTZ	15-16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HP12-UTZ	15-16	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
HP13-UTZ	15-16	<50	210	210	<50	100	<50	<50	<50	110	1,200
HP14-UTZ	21-22	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	12,000
HP15-UTZ	17-18	<10	<10	<10	17	<10	<10	<10	<10	<10	<10
HP15-STZ	35-36	<10	<10	<10	11	<10	<10	<10	<10	<10	<10
HP16-UTZ	17-18	<10	<10	<10	<10	<10	<10	<10	<10	<10	N/A
HP16-LTZ	49-50	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
EB-02		<10	<10	<10	<10	- <10	<10	<10	<10	<10	<10

µg/L - Concentrations measured in micrograms per liter.
N/A - Sample not analyzed for PAHs other than naphthalene as reported on Table 3-1.
2,6-DNT - 2,6-Dinitrotoluene 2-MNL - 2-MethylnaphthaleneANP - Acenaphthene
DBP - Di-n-Butylphthalate2,4-DMP - 2,4-Dimethylphenol
NB - NitrobenzenePT - Phenanthrene
DBF - DibenzofuranFluor - Fluorene
Nap - Naphthalene

Due to low ground water yields in three of the Hydropunch™ locations (HP09UTZ, HP10STZ, and HP11UTZ), only two 40-milliliter (ml) vials could be filled. Consequently, these three samples were only analyzed for VOCs (EPA Method 8260) and naphthalene (EPA Method 8270). Additionally, four samples, HP05UTZ, HP12UTZ, HP16LTZ, and HP13UTZ, were also analyzed for total dissolved solids (TDS).

The analytical results discussion was divided into two sections: the Offsite/EOC results and the Onsite/RFI results.

3.3.1 Offsite/EOC

The ground water sample locations were selected based on the results of the geologic and hydrocarbon distribution data obtained from the CPT/ROST™ investigation. Analysis of the CPT/ROST™ wavelength signatures indicated three areas in the vicinity of the closed surface impoundment exhibiting different depths of hydrocarbon impact in subsurface soils. These three areas are: 1) the southwest portion of the Tie Storage Area (Unit V) immediately east of the closed surface impoundment (onsite); 2) the area downgradient to the northwest and west of the closed surface impoundment (offsite); and 3) the area southwest of the closed surface impoundment (offsite) located in the northern portion of the Inactive Wastewater Lagoon (AOC 6, Unit 1).

East of Closed Surface Impoundment

Six ground water samples (HP05UTZ, HP05STZ, HP06UTZ, HP06STZ, HP07UTZ, and HP07STZ) were collected from the UTZ and STZ onsite in the area immediately east of the closed surface impoundment. These six ground water samples were collected to evaluate the concentrations of creosote/extender constituents in ground water in the UTZ and STZ between the permitted unit (impoundment) and the Tie Storage Area (Unit V).

No VOCs were detected in the six ground water samples collected east of the closed surface impoundment with the exception of xylenes reported at a concentration of 7 micrograms per liter (μg/L) in sample HP07UTZ. Detection of PAHs in samples collected from the UTZ consisted of 2-methylnaphthalene, acenaphthene, di-n-butylphthalate, dibenzofuran, fluorene, naphthalene, and phenanthrene. The compound detected at the highest concentration was naphthalene at 700 μg/L in HP07UTZ. Total PAH concentrations results ranged from 19 μg/L in HP06UTZ to 959 μg/L in HP07UTZ. Analysis for PAHs in the STZ samples detected only di-n-butylphthalate at an average concentration of 23 μg/L. Di-n-butylphthalate is a common laboratory contaminant detected at nearly equal concentrations in each sample.

Southwest of Closed Surface Impoundment

Three ground water samples (HP01UTZ, HP01STZ, and HP08UTZ) were collected to investigate ground water in the area southwest of closed surface impoundment. Two of the three ground water samples, HP01UTZ and HP08UTZ, contained VOC concentrations above the laboratory detection limit, specifically ethylbenzene and total xylenes. In HP01UTZ, ethylbenzene and xylenes were detected at concentrations of 100 μg/L and 1,300 μg/L, respectively. In HP08UTZ ethylbenzene was detected at 240 μg/L, and total xylenes was detected at 2,100 μg/L. The detection of these VOCs indicate the possibility of a slightly different contaminant composition compared to the area east of the impoundment.

The PAH analysis detected 2,4-dimethylphenol, 2-methylnaphthalene, acenaphthene, di-n-butylphthalate, dibenzofuran, fluorene, naphthalene, nitrobenzene, and phenanthrene. The compound detected at the highest concentration was naphthalene at 2,200 μg/L in HP01UTZ. The total PAHs results were: HP01UTZ - 2,565 μg/L; HP01STZ - 115 μg/L; and HP08UTZ -1,566 μg/L.

Northwest and West of Closed Surface Impoundment

Six ground water samples (HP02UTZ, HP02STZ, HP03UTZ, HP03STZ, HP04UTZ, and HP04STZ) were collected in the downgradient area northwest and west of closed surface impoundment. Of the six ground water samples, two (HP04UTZ and HP04STZ) contained either VOCs or PAHs (other than di-n-butylphthalate, a suspected laboratory contaminant). Sample HP04UTZ contained total xylenes at 22 μg/L and a total PAH concentration of 374 μg/L. Sample HP04STZ contained ethylbenzene at 24 μg/L, total xylenes at 18 μg/L, and total PAHs at 101 μg/L.

3.3.2 Onsite/RFI

The CPT/ROST™ data indicated a wide range in hydrocarbon distribution as represented by FVD fluorescence profiles within the RFI Investigation Units. Ground water samples pertaining to the onsite/RFI were collected with the Hydropunch™ system in the Original Process Area (Units III & IV), the Recent Process Area (Unit II), and the Tie Storage Area (Unit V) to obtain information on the distribution of creosote constituents in ground water in areas of varying fluorescence as measured by the FVD profiles.

Original Process Area - Unit III

Two ground water samples, HP13UTZ and HP14UTZ, were collected in the Original Process Area (Unit III). The purpose of these samples was to obtain data on the concentration of fluorescence as indicated by the FVD profiles for CPT/ROST™ locations CPT07R and CPT08R. Sample HP13UTZ contained ethylbenzene at 33 μg/L and total xylenes at 30 μg/L. HP14UTZ contained benzene at 16 μg/L, ethylbenzene at 270 μg/L, toluene at 410 μg/L, and total xylenes at 850 μg/L.

The PAH analysis for HP13UTZ detected 2-methylnaphthalene at 210 μg/L, acenaphthene at 210 μg/L, dibenzofuran at 100 μg/L, fluorene at 110 μg/L, and naphthalene at 1,200 μg/L. In HP14UTZ the only PAH detected was naphthalene at 12,000 μg/L.

Recent Process Area - Unit II & IV

One ground water sample, HP11UTZ, was collected from the Recent Process Area (Unit II), which for Phase 1 included the Water Treatment and Boiler System (SWMU 6), within a depth interval that contained high fluorescence as indicated by FVD profile CPT16R. This sample was only analyzed for VOCs due to the very slow recharge rate of the UTZ in this area. The VOCs detected in the sample were benzene (80 μg/L), ethylbenzene (1,100 μg/L), toluene (10 μg/L), total xylenes (900 μg/L), and naphthalene (3,700 μg/L).

Tie Storage Area - Unit V

As part of the RFI investigation, eight ground water samples (HP09UTZ, HP10UTZ, HP10STZ, HP12UTZ, HP15UTZ, HP15STZ, HP16UTZ, and HP16LTZ) were collected in the Tie Storage Area (Unit V). These ground water samples were collected adjacent to areas of low fluorescence as indicated by the FVD profiles for CPT- 04R, 06R, 19R, 23R, and 27R. The purpose of the ground water samples was to determine if dissolved-phase compounds exist in the areas beneath the Tie Storage Area (SWMU 12) as a result of historical operations.

None of the eight Tie Storage Area (Unit V) ground water samples contained VOCs at concentrations above laboratory detection limits. Of the five samples that were analyzed for PAHs, acenaphthene was detected at a concentration of 11 μg/L in HP10UTZ. Di-n-butylphthalate was also detected in samples HP10UTZ (20 μg/L), HP15UTZ (17 μg/L), and HP15STZ (11 μg/L).

3.4 Surface Soil Samples

3.4.1 Offsite/EOC

Three surface soil samples (WPW-S-002-P, WPW-S-003-P, and WPW-S-004) were collected from the North Drainage Ditch (SWMU 2, Unit I) and were analyzed for VOCs by EPA Method 8260, and PAHs by EPA Method 8270 in accordance with the Potential Contaminants of Concern listed in Table I and II of the Compliance Plan. Sample analysis was performed by Pace.

Of the three samples collected in the North Drainage Ditch, only one sample contained detectable concentrations of the target analytes. Sample WPW-S-004-P contained detectable concentrations of benzo(a)anthracene (1,100 micrograms per kilogram (μg/kg)), benzo(a)pyrene (360 μg/kg), chrysene (1,400 μg/kg), fluoranthene (2,600 μg/kg), and pyrene (2,800 μg/kg). These compounds are consistent with coal tar derivatives, such as those associated with creosote.

One surface soil/sediment sample (WPW-S-001-P) was proposed to be collected from the Inactive Wastewater Lagoon (AOC 6, Unit I). Due to private property access issues, this sample was not collected.

3.4.2 Onsite/RFI

One surface sample was collected from within the Recent Process Area (Unit II) and analyzed for VOCs by EPA Method 8260 and PAHs by EPA Method 8270.
Sample WPW-S-007-P was collected near CPT12R. This sample contained detectable concentrations of benzo(a)pyrene (670 μg/kg), chrysene (6,200 μg/kg), fluoranthene (22,000

μg/kg), naphthalene (1,200 μg/kg), phenanthrene (19,000 μg/kg), and pyrene (15,000 μg/kg). All of the detected compounds are consistent with coal tar derivatives.

Surface soil samples were proposed for the Original Process Area (Unit III) in areas of visible surface staining. However, there were no readily apparent areas observed to have surface staining. One sample (WPW-S-009-P) was collected in the Original Process Area adjacent to the diesel aboveground storage tank (SWMU 8). This sample was analyzed by EPA Methods 8260 and 8270. No target analytes were detected above laboratory detection limits in sample WPW-S-009-P.

3.4.3 Crystalline Precipitate from SWMU 6

One crystalline precipitate sample was collected from the water treatment area and boiler system area (SWMU 6, Unit IV). The sample was analyzed for cation/anion balance by Standard Methods, 19th Edition, 1030S. Sample WPW-M-001-P was collected from a pipe extending from an existing cinder block tank and the adjacent ground surface. The sample contained detectable concentrations of total sodium (370,000 mg/kg), total potassium (60 mg/kg), total iron (350 mg/kg), total magnesium (20 mg/kg), total aluminum (10 mg/kg), sulfate as SO4 (8,800 mg/kg), chloride (482,000 mg/kg), and total alkalinity as CaCO3 (500 mg/kg).

3.5 Surface Water

Four surface water samples were proposed to be collected for the EOC in Investigation Unit I. During the period of the Phase 1 investigation, the North Drainage Ditch (SWMU 2, Unit I) was completely dry and no surface water samples were collected.

Similarly, proposed surface water samples in the Inactive Wastewater Lagoon (AOC 6, Unit 1) could not be collected due to the lack of standing water as a result of dry conditions.

Cross–Section A–A'

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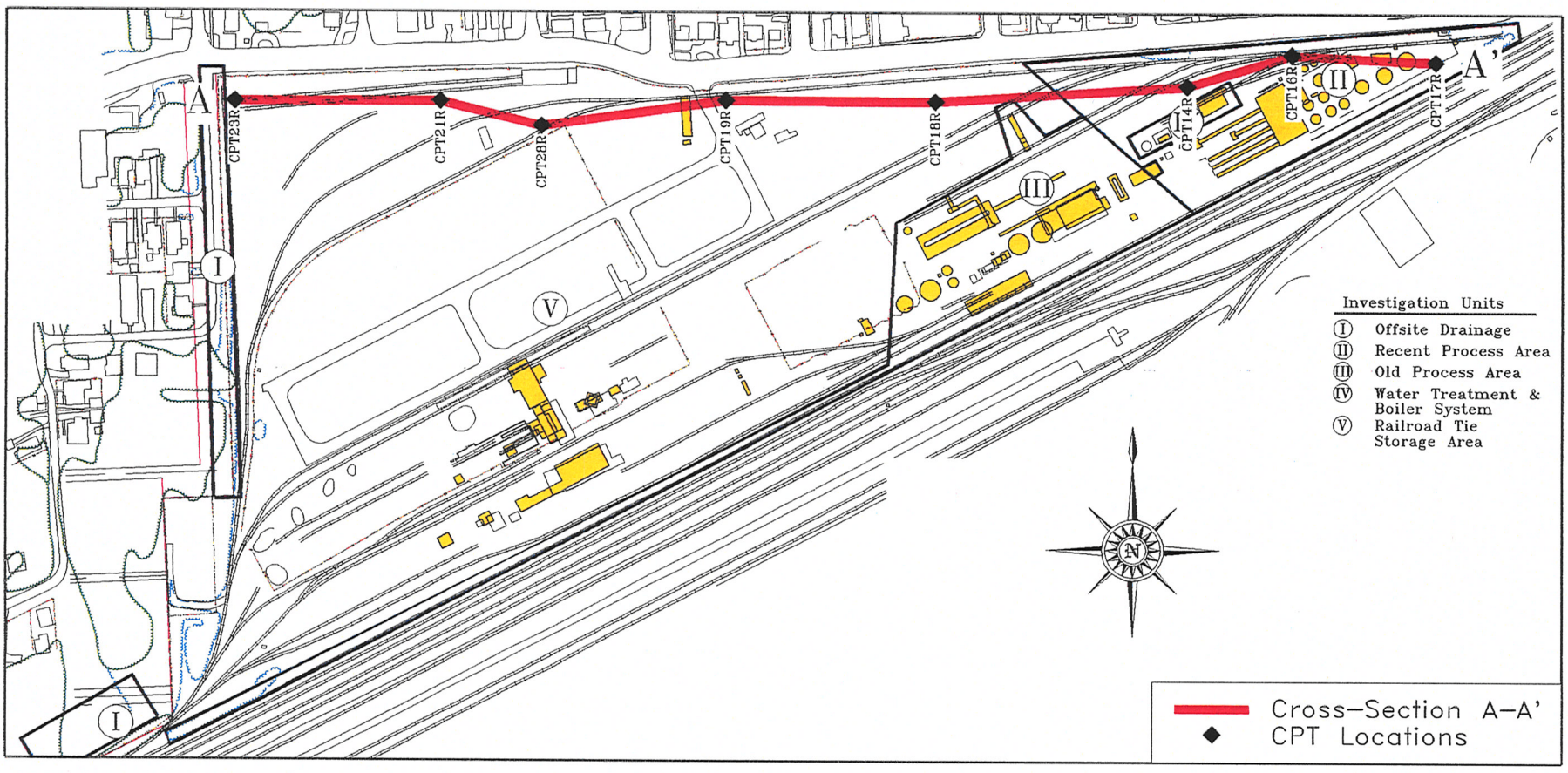

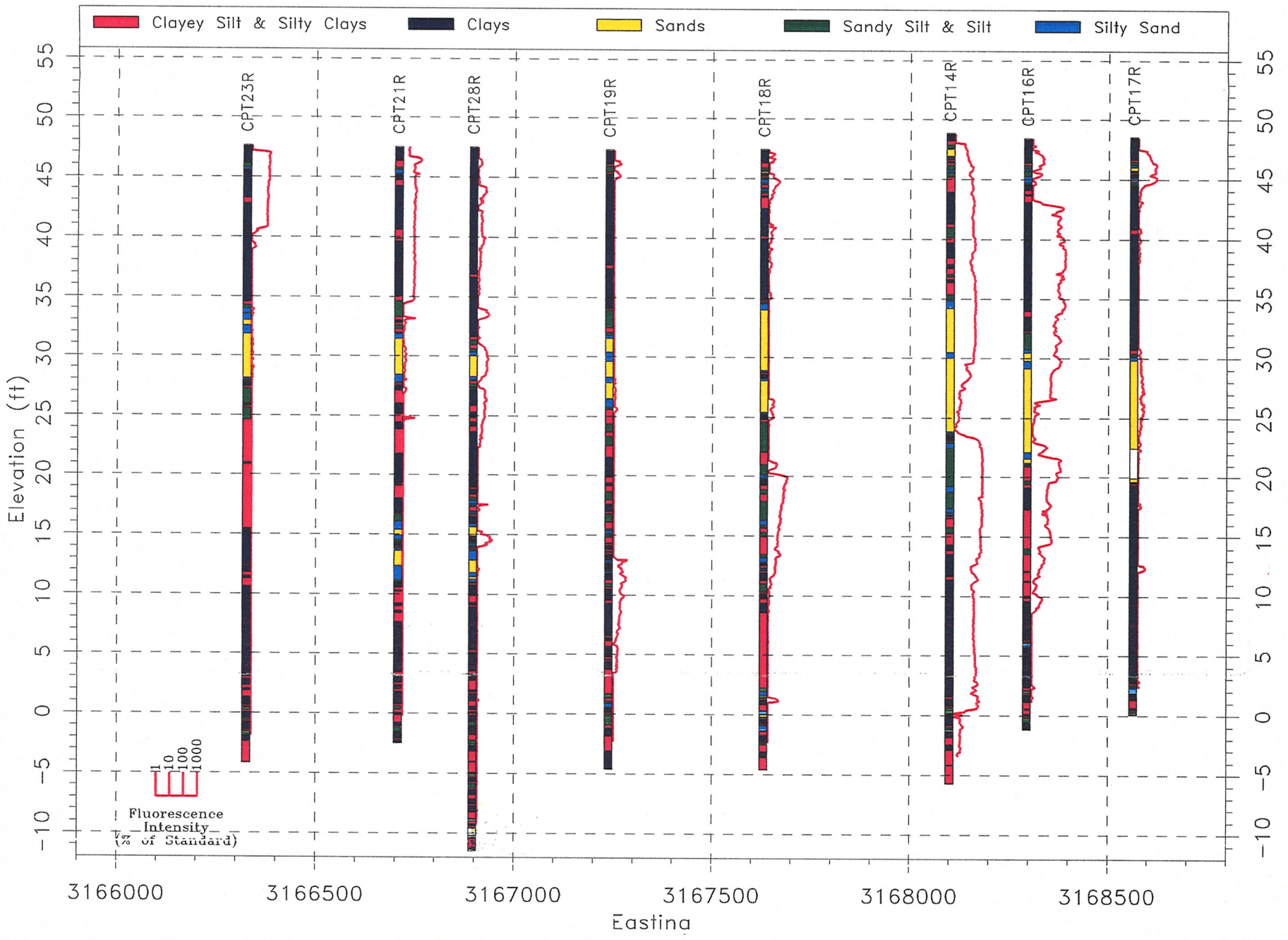

Cross–Section A–A'

Cross-Section B-B'

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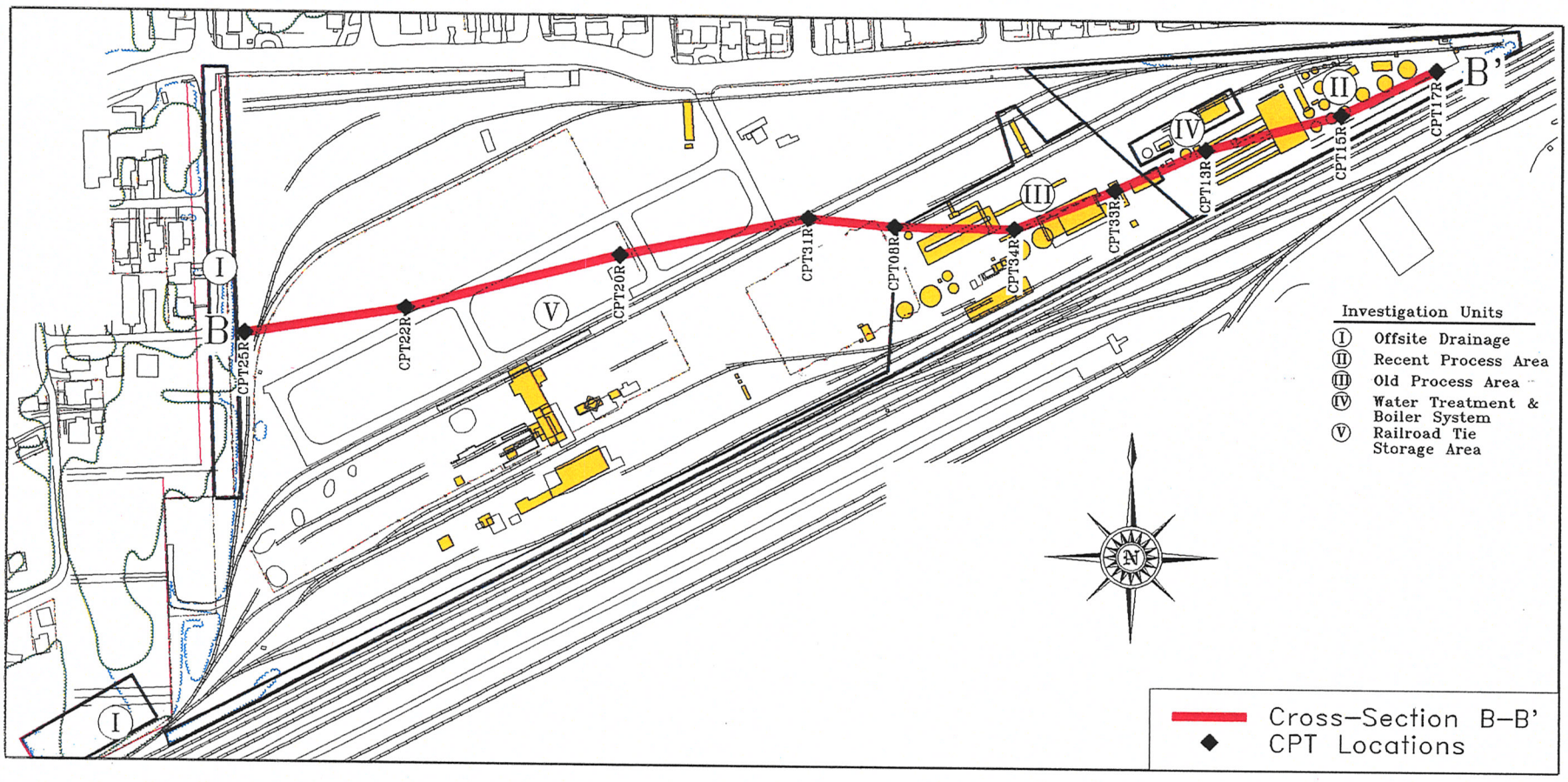

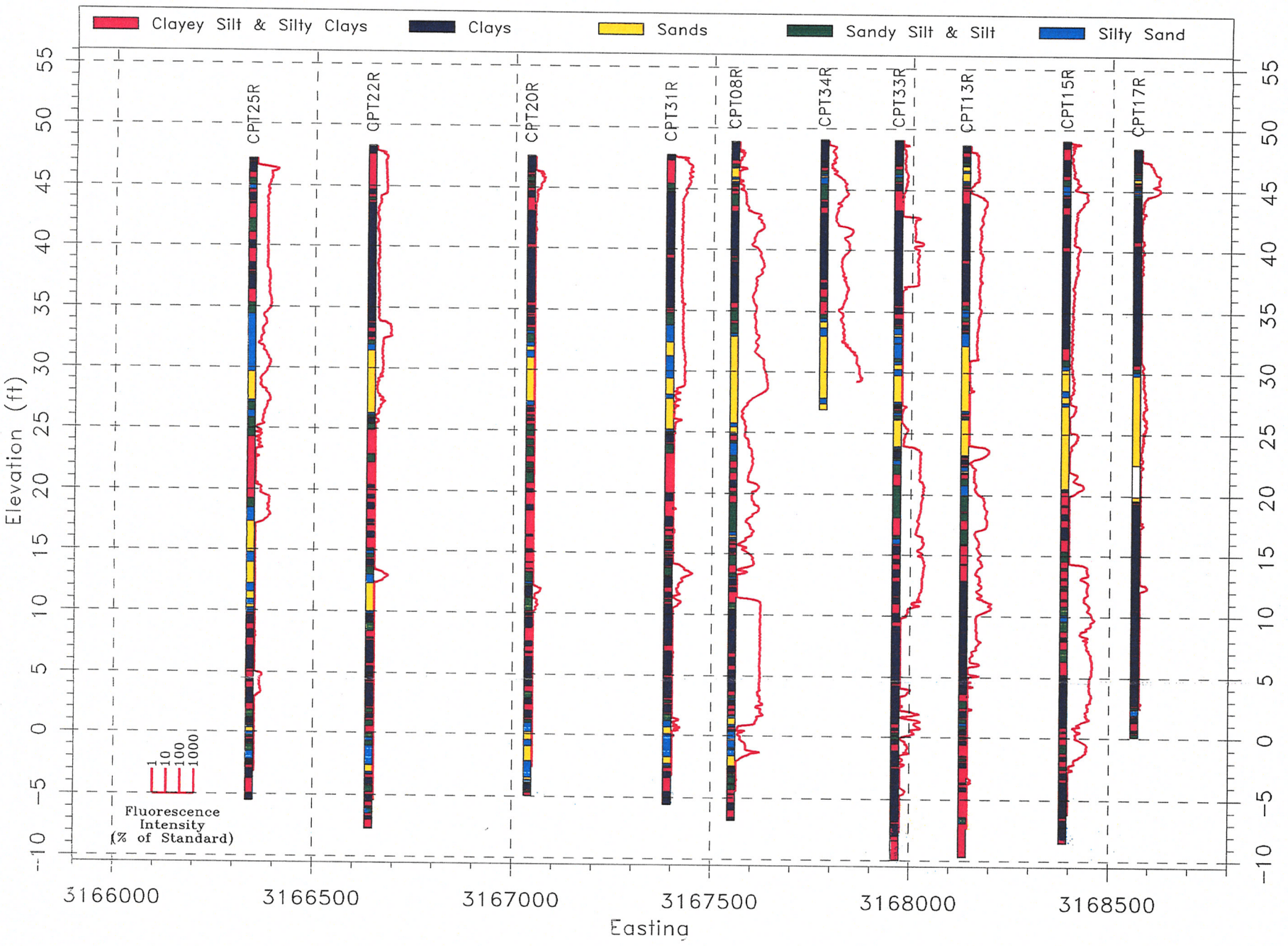

Cross-Section B-B'

Cross–Section C–C'

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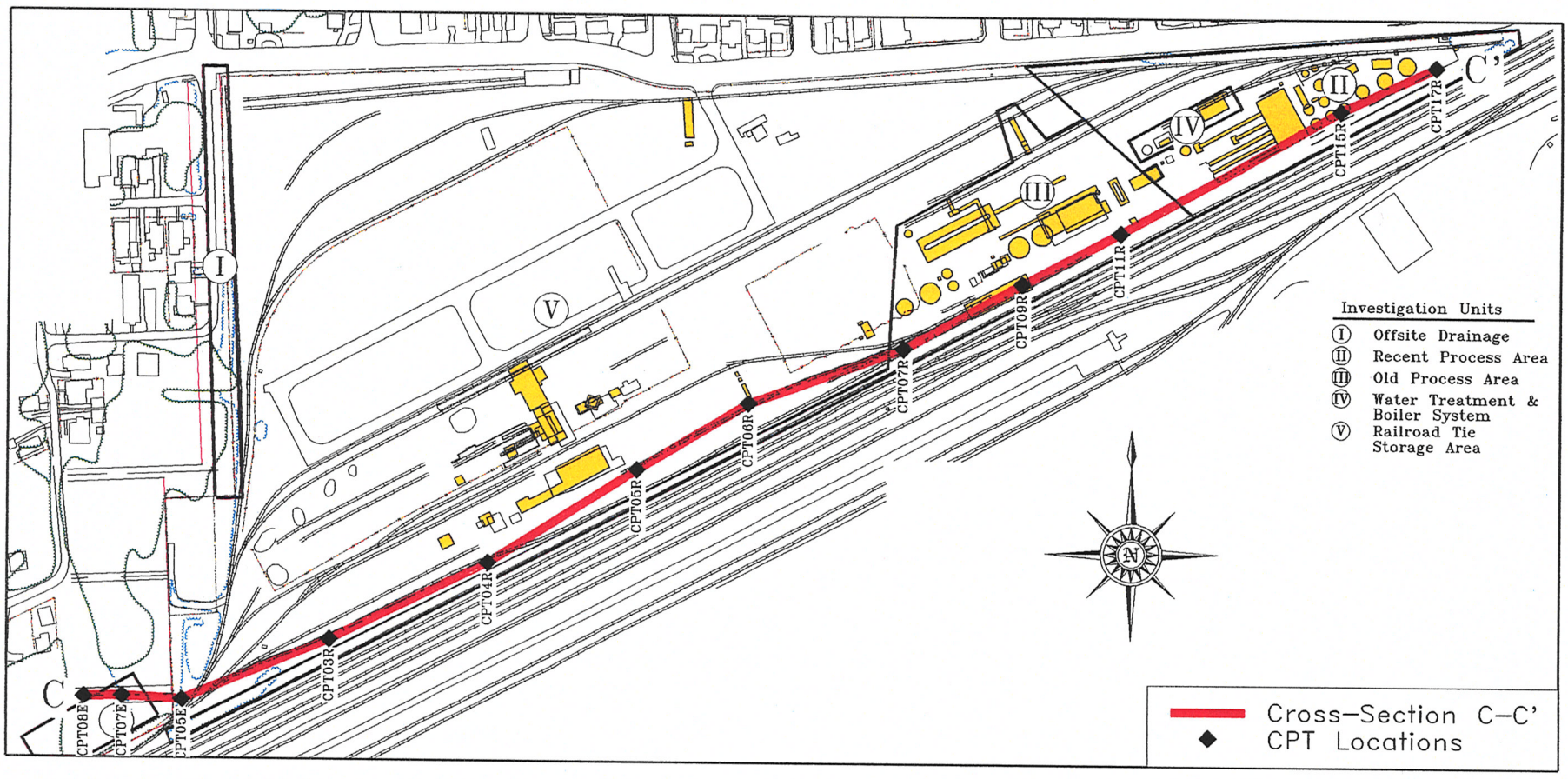

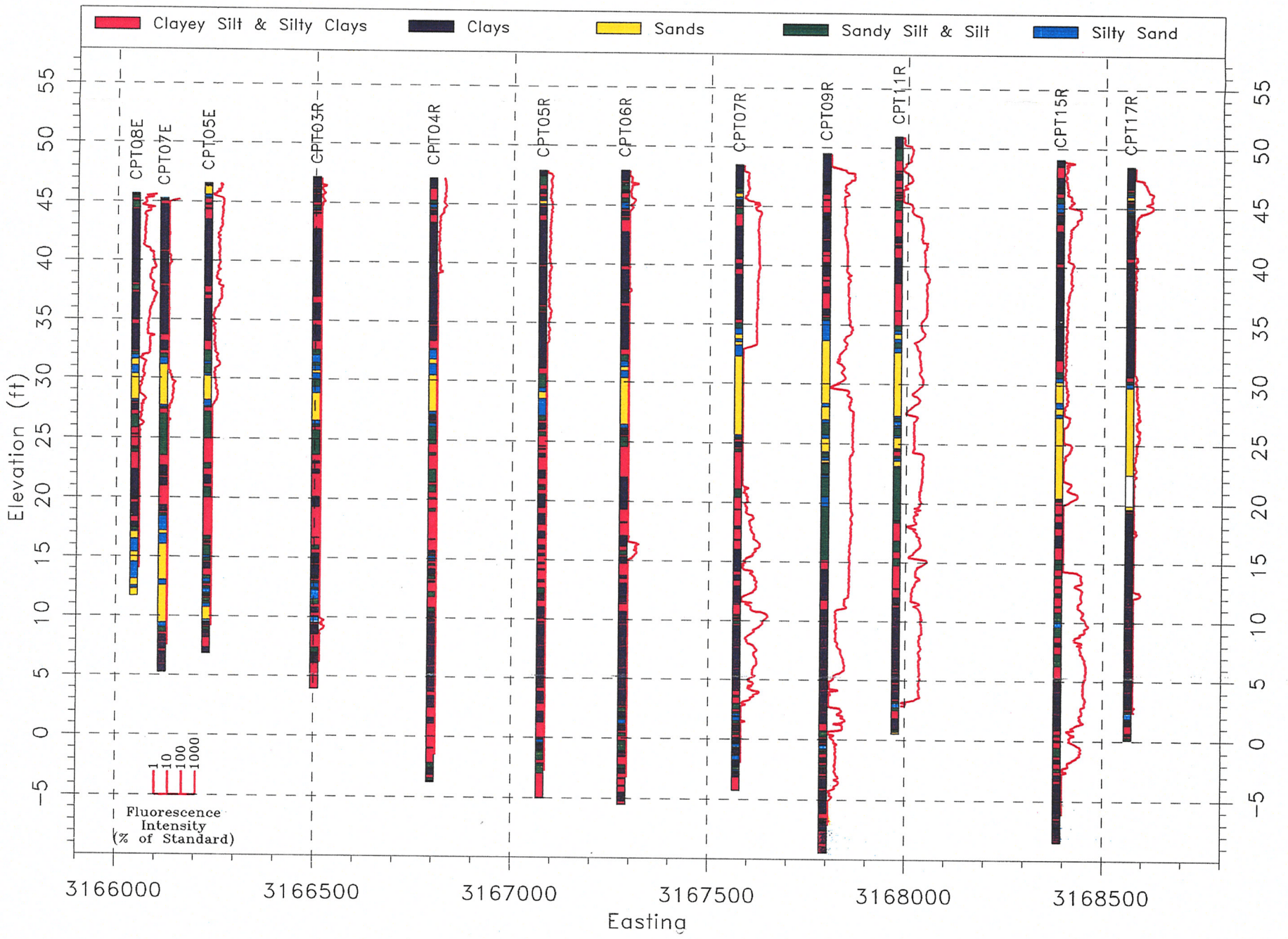

Cross–Section C–C'

Cross-Section D-D'

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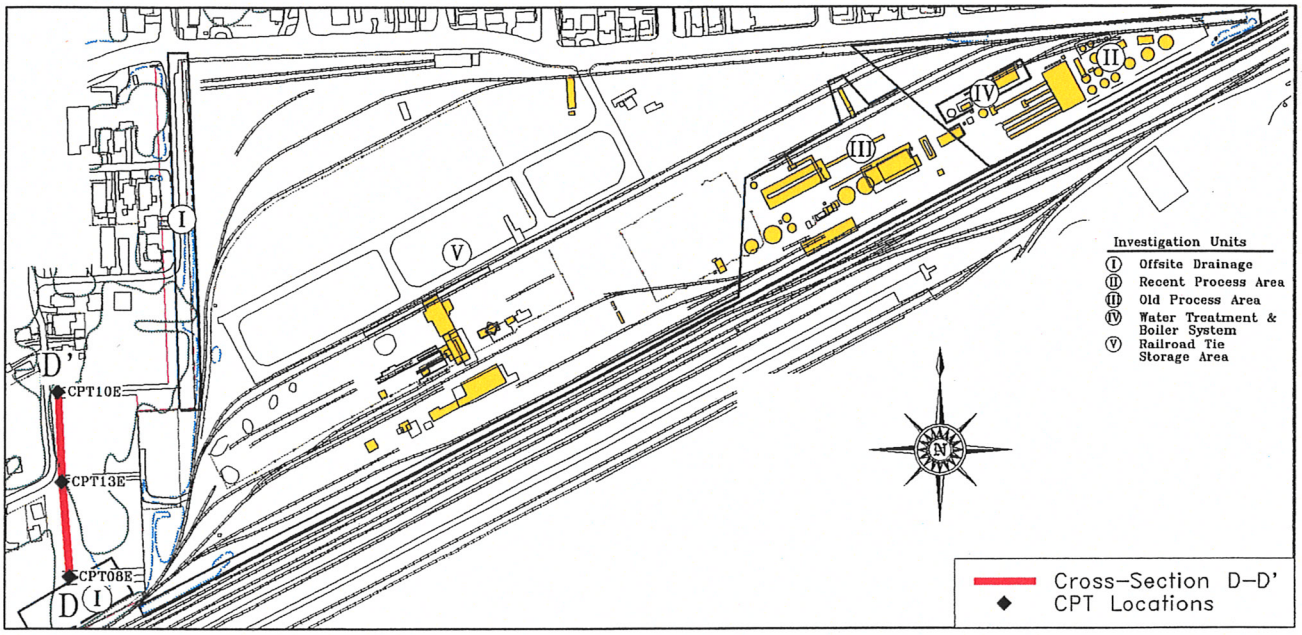

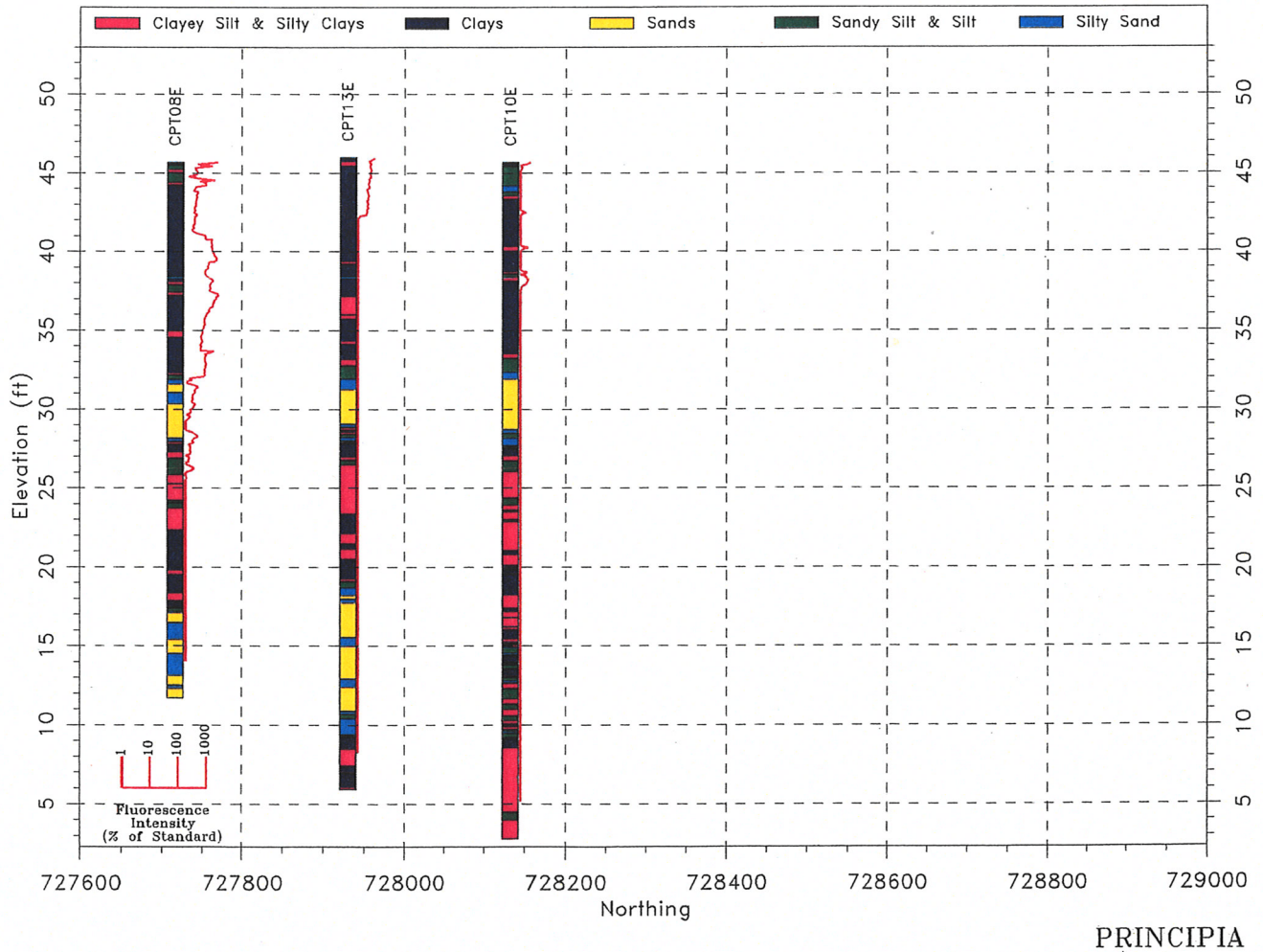

PRINCIPIA

Cross-Section E-E'

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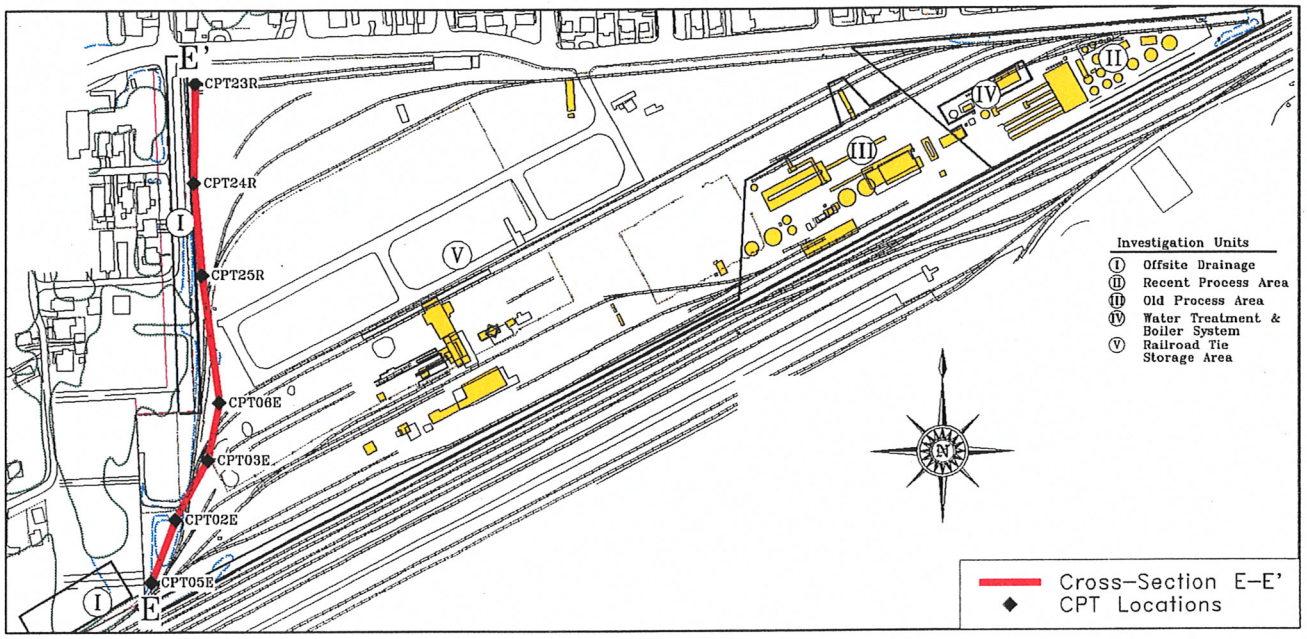

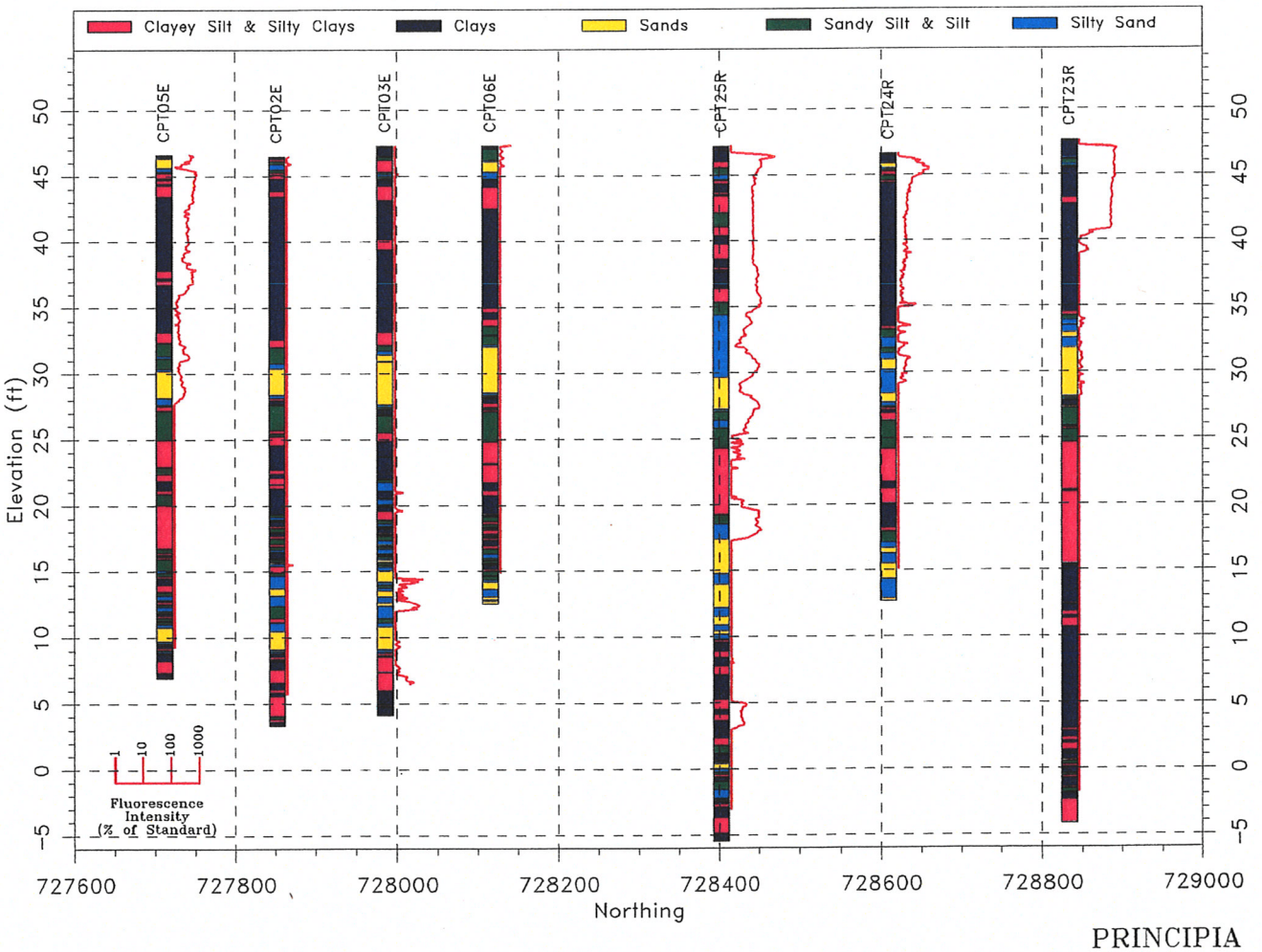

PRINCIPIA

Cross-Section F-F'

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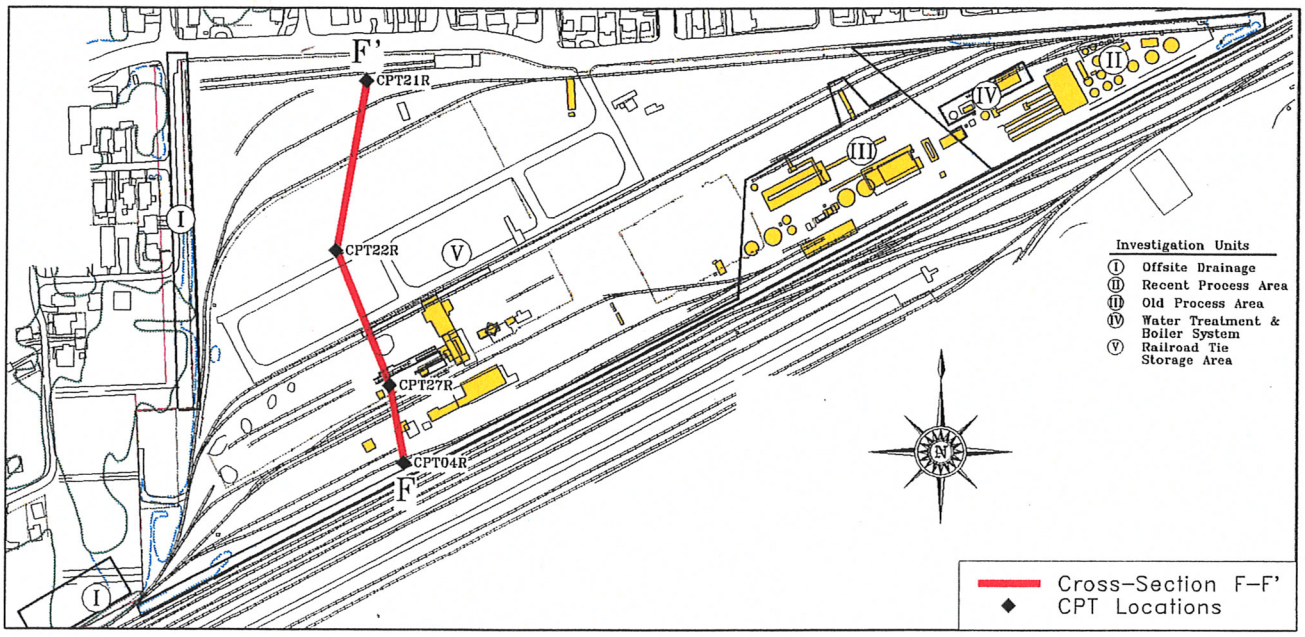

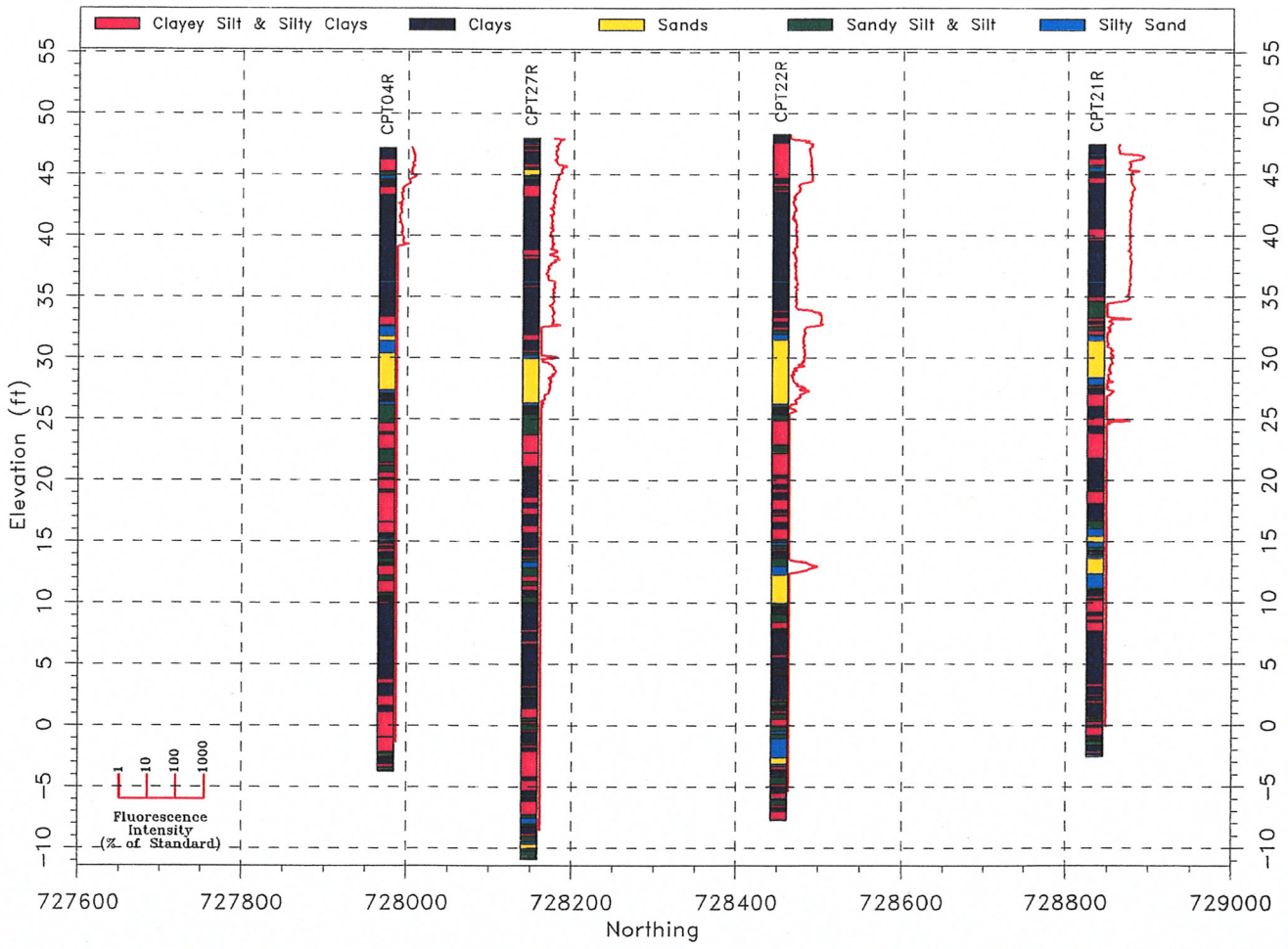

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Cross-Section G-G'

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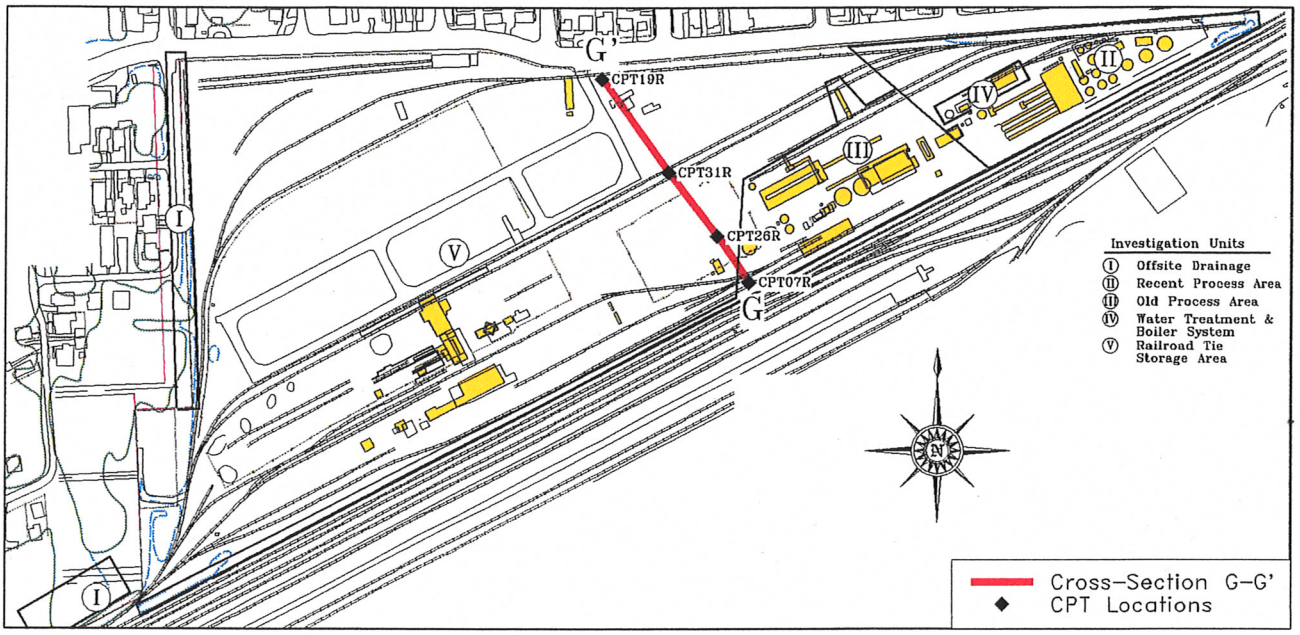
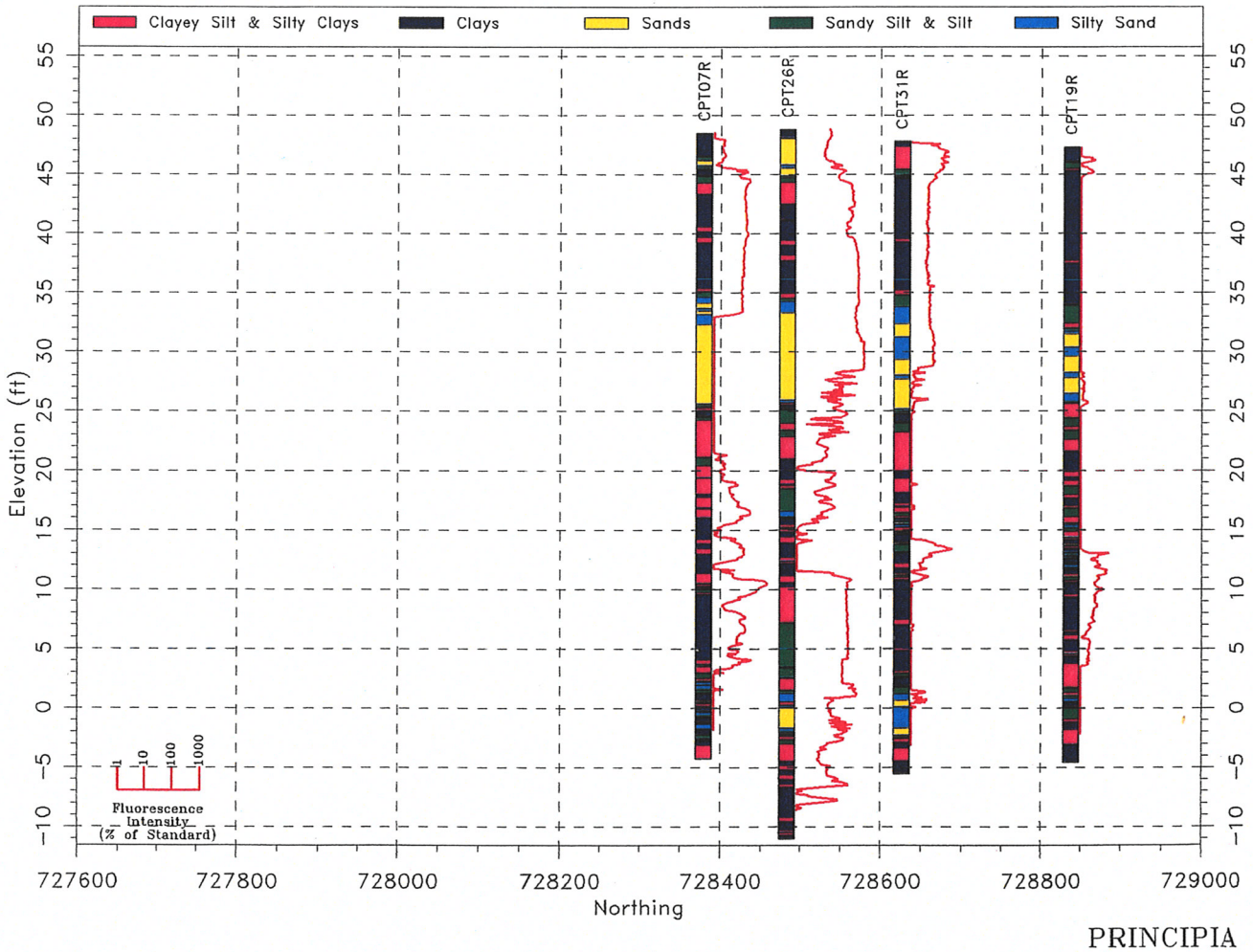
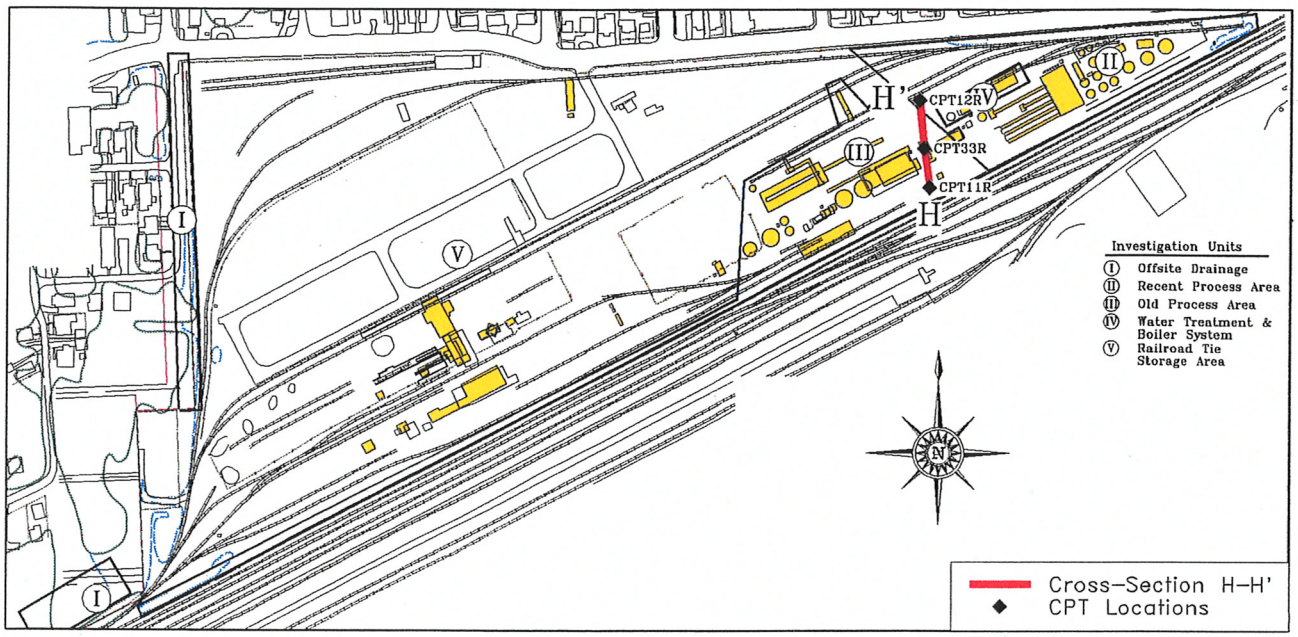


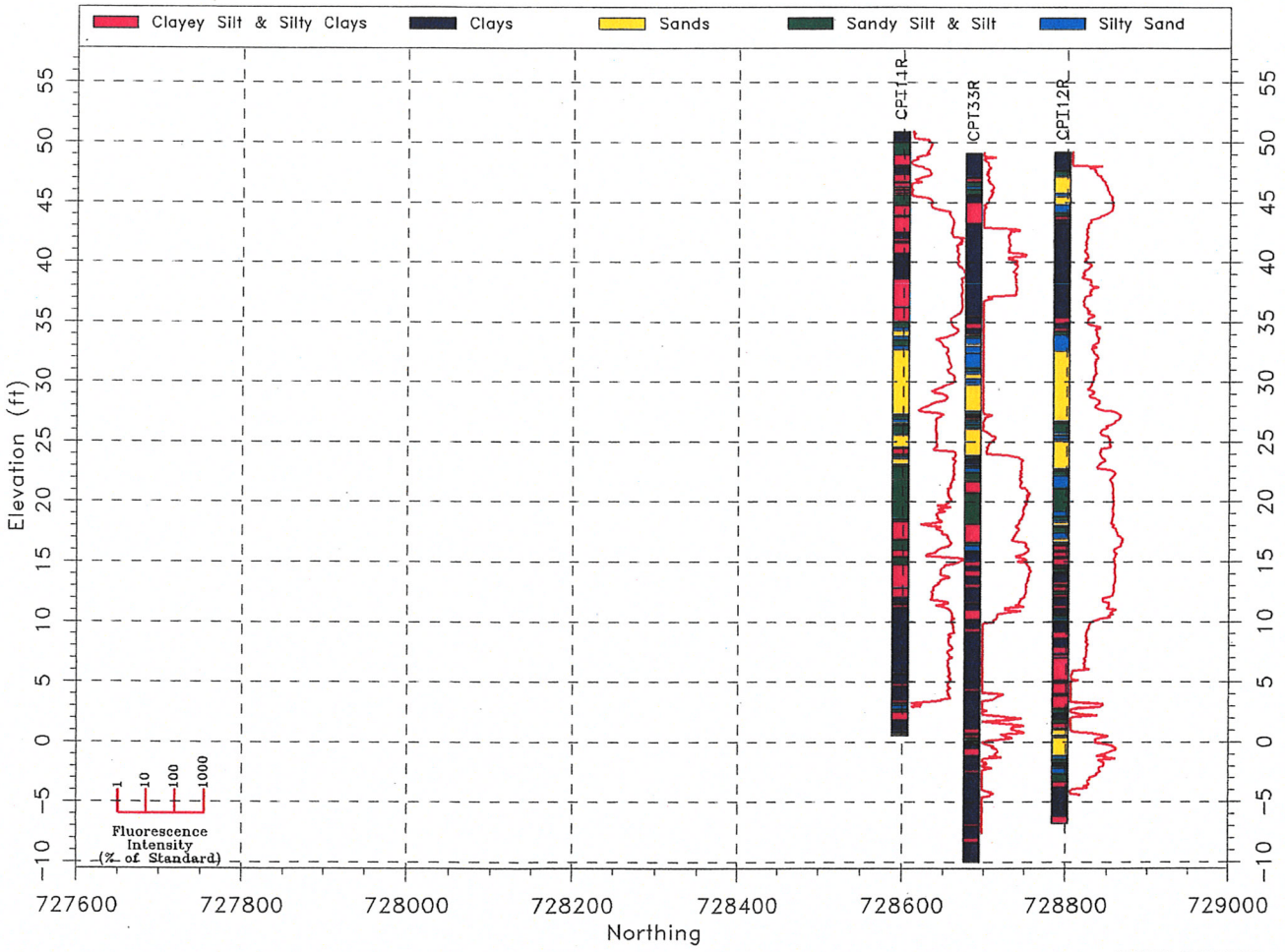


PRINCIPIA

Cross–Section H–H'

SPTCo: Houston Wood Preserving Works Site





PRINCIPIA

4.0 PHASE 1 CONCLUSIONS

The following conclusions were developed, based upon the data presented in this report, to provide an overview of the site characteristics as determined through completion of the Phase 1 Investigation.

4.1 Regional/Site Hydrogeology

As shown in the geologic cross-sections provided at the end of Section 3.0, the predominant lithology beneath the site is clay. Very fine-grained sand is present as a thin laterally continuous layer (UTZ) across the site, and as a thin discontinuous layer (STZ) beneath the western one-third of the site (refer to Figures 3-1, 3-2, pages 3-4 and 3-6). The relatively low transmissivities commonly associated with the clays and very fined-grained sand beneath the site indicate that these deposits are not viable current or future potable water sources. The water well survey conducted under Phase 1 (Section 2.2 and Appendix B) indicated that there is no shallow ground water use within a 1-mile radius of the site.

4.2 Offsite/EOC Chemical Distribution

Creosote impact to ground water and soil detected in the EOC investigation area is believed, based upon available data, to be attributable to sources other than the closed surface impoundment. The sources may include the Inactive Wastewater Lagoon (AOC 6) and possibly former activities associated with a localized creosote source area on the west boundary of the Tie Storage Area (SWMU 12). The following paragraphs provide support for this conclusion.

4.2.1 Soils

The former surface impoundment was a shallow pit approximately 7 feet deep excavated and clean closed with the concurrence of the Texas Water Commission (predecessor agency to the TNRCC) in 1984. The boring logs for the two POC well clusters (Appendix E) installed on the downgradient property boundary at the impoundment, and CPT/ROST™ sounding CPT01E (Section 3.0 and Appendix C) indicate that the UCU, UTZ, and MCU at the surface impoundment are less impacted by creosote than the deeper STZ.

A release from the former surface impoundment would more likely have impacted the UCU, UTZ, and MCU, rather than the STZ. The impact of creosote constituents to the STZ appears to be from a source other than the closed surface impoundment.

A possible source of the creosote constituents detected in the STZ and UTZ near the surface impoundment is a localized creosote source located within the Tie Storage Area near CPT25R. The ROST profile for CPT25R, which is located approximately 300 feet north of the surface impoundment, contained measurable fluorescence within the depth intervals of 0 to 30 feet and 42.5 to 45 fee which includes the fill layer, UCU, UTZ, and STZ layers. This potential creosote source area is targeted for additional investigation as indicated in Section 5.0.

The other likely source of creosote constituents in the UTZ and STZ around the former surface impoundment is the Inactive Wastewater Lagoon. The ROST profiles from CPT07E and CPT08E contained measurable fluorescence within the depth of 0 to 20 feet which includes the UCU and UTZ which is consistent with the historical flooding of this SWMU with creosote form the former Process Areas.

CPT/ROST™ profiles for CPT08E, CPT07E, and CPT05E (cross-section C-C') and CPT03E (cross-section E-E') show no measurable fluorescence below a depth of approximately 20 feet (near the top of the MCU). The data indicate that the cohesive soils that comprise the MCU have retarded the vertical downward migration of creosote.

4.2.2 Ground Water

Quarterly and semi-annual ground water monitoring reports documenting ground water monitoring in the vicinity of the closed surface impoundment since 1985 show that ground water in the UTZ, upgradient of the surface impoundment, is impacted by creosote constituents at concentrations higher than UTZ ground water downgradient of the surface impoundment.

The objective of the EOC investigation was to delineate ground water contamination downgradient and offsite that is attributable to the permitted unit (closed surface impoundment). Hydropunch™ ground water samples, HP02UTZ, HP02STZ, HP03UTZ, and HP03STZ, collected offsite and downgradient of the permitted unit, revealed no impact to ground water within 200 feet from the surface impoundment. Based on observations since 1985, and the results of the Phase 1 Investigation, the closed surface impoundment is not a significant source of creosote contamination in offsite ground water.

Ground water samples collected in the Inactive Wastewater Lagoon, HP01UTZ, HP01STZ, and HP02UTZ, indicate that ground water in both the UTZ and STZ is impacted with creosote. The creosote impacted ground water in this area of the site can be attributed to the historical flooding of the SWMU with creosote runoff from the former process areas.

As indicated in Section 3.0, and as described in detail in Appendix F of this report, the dissolved-phase ground water plumes consist primarily of the most soluble and aerobically

degradable creosote/extender constituents: BTEX, naphthalene, and acenaphthene. The long-chain PAHs (anthracene, fluoranthene, etc.) have very limited solubility in ground water (refer to Appendix F) and are present in the ground water at only low concentrations.

Post-closure quarterly and semi-annual ground water monitoring data related to the surface impoundment, provided to TNRCC in periodic reports summarized in Table 1-2 (page 1-9), indicate that creosote constituents are undergoing natural attenuation and have considerably decreased in concentration over the monitoring period since monitoring began in December 1984. For example, the concentration of naphthalene in ground water samples from MW-2 has decreased from 2,700 μg/L in February 1986 to <10 μg/L in January 1996.

4.3 Onsite/RFI Chemical Distribution

4.3.1 Soils

CPT/ROST™ profiles CPT- 08R, 34R, 33R, 13R, 14R, 09R, and 11R (performed in the former process areas onsite), measured the highest fluorescence values and thickest intervals of above background florescence during the Phase 1 Investigation. The results indicate that the primary creosote source areas onsite are the Original Process Area (SWMU 5) and the Recent Process Area (SWMU 4).

As indicated by the fluorescence data for CPT/ROST™ soundings completed within the Original Process Area and Recent Process Area, creosote has migrated at varying degrees vertically through the soil column to a depth of approximately 60 feet. The decrease in fluorescence below a depth of approximately 50 feet as shown on CPT/ROST™ soundings CPT08R, CPT33R, CPT15R (cross-section B-B') and soundings CPT07R, CPT09R, and CPT11R (cross-section C-C') indicates that the cohesive soils that comprise the LCU have effectively retarded the vertical migration of the creosote.

CPT/ROST™ profiles CPT23R, CPT21R, and CPT28R (cross-section A-A') CPT22R and CPT20R (cross-section B-B'), and CPT05E, CPT03R, and CPT04R (cross-section C-C') indicate that, with the exception of the localized area near CPT25R on the west property boundary, the Tie Storage Area (SWMU 12, Unit V) is not a major source of creosote contamination. The fill and upper portion of the UCU to an average depth of approximately 6 feet has been impacted by the former staging and storage of treated rail ties in this area.

As discussed in Section 3.4, the surface soil sample analytical results and visual inspection of the property indicate that surface soils are moderately impacted within the Recent Process Area. Analytical results from soil samples indicate that surface soil within the Northern Drainage Ditch (SWMU 2, Unit I) contains low concentrations of PAHs.

4.3.2 Ground Water

Ground water analytical results from the Hydropunch™ screening (refer to Tables 3-1, 3-2, pages 3-17 and 3-19) performed in the Phase 1 Investigation indicate that the dissolved-phase constituents include the most soluble and aerobically degradable creosote/extender constituents: BTEX and naphthalene. The highest concentrations of contaminants in ground water onsite were detected at location HP14UTZ in the Original Process Area (SWMU 5).

As described fully in Appendix E, most creosote constituents (primarily PAHs) have very limited solubility in ground water. Proposed future activities under the next phase of work will address the relationship between soil contamination and the possible impact to ground water.

5.0 PROPOSED PHASE 2 INVESTIGATION

The RCRA facility investigation will continue at the site under proposed Phase 2 activities. Quantitative soil, ground water and hydrogeologic data will be obtained through field activities proposed under Phase 2. The objectives, scope and rationale of proposed Phase 2 activities are described in the following sections.

5.1 Objectives

The objectives of the Phase 2 Investigation are to:

- determine the vertical extent of BTEX, PAH, and creosote migration in soil within areas shown to be most significantly impacted from past releases;
- confirm, compare and, if possible, correlate soil borings and soil sampling data with existing CPT and ROST™ data;
- determine lateral extent of offsite impact attributable to the inactive wastewater lagoon (AOC 6);
- collect representative ground water samples and obtain hydrogeologic data across the entire site;
- develop and apply fate and transport analyses to predict possible contaminant levels offsite and support natural attenuation of contaminants in the subsurface;
- collect data to assess natural attenuation processes in soil and ground water;
- obtain an understanding of the relationship between concentrations of contaminants in soil, and how these concentrations have or may affect ground water quality;
- derive risk-based concentrations through risk assessment using available site data; and,

- subsequently modify the Compliance Plan and the Permit as necessary to assure that site-specific elements form the basis for any further investigation, corrective measures, and post-closure activities required under the Permit.

The rationale and proposed scope of work for the next phase of the RFI (Phase 2) are outlined in the following paragraphs.

5.2 Investigation Approach

As described in the findings and conclusions of the Phase 1 RFI/Extent of Contamination Investigation in this report (Sections 3.0 and 4.0), the CPT/ROST™ and Hydropunch™ investigation results indicate that the source of the creosote contamination is not attributable to any single discernable SWMU. Rather, the sources of contamination onsite include the Original Process Area (SWMU 5, Unit III) and Recent Process Area (SWMUs 2, 4, 7, 8, 10, and 11, Unit II), and runoff from the Tie Storage Area (SWMU 12, Unit V).

Offsite, ground water samples collected offsite and downgradient to the closed surface impoundment indicated that the extent of ground water contamination attributable to the permitted unit has been defined. Ground water samples collected in the area southwest of the closed surface impoundment indicate that the Inactive Wastewater Lagoon (AOC 6) may be a source of contamination.

The CPT/ROST™ and Hydropunch™ data demonstrate that subsurface soils in the eastern portion of the site, where the two process areas formerly existed, are impacted to a greater degree and extent than the subsurface soils in the Tie Storage Area (Unit V). Additionally, the STZ sand layer is present only beneath the western third of the site (Figures 3-1 and 3-2, pages 3-4 and 3-6; Section 3.0); thus creating two distinct hydrogeologic regimes.

The primary source areas of PAH contamination in the subsurface have been identified as described in Sections 3.0 and 4.0 of this report; therefore, further investigation proposed for Phase 2 will be focused in scope to provide an understanding of the relationships between the soil contamination and limited impact to ground water observed, the vertical extent of creosote migration in soils, the areal distribution of creosote impacted ground water, and the risks to human health posed by the site conditions.

SPTCo proposes to maintain the phased investigation approach to meet the objectives of the required RFI and EOC investigations so that information gathering is based upon findings of each previous investigative effort. To approach further investigation, risk assessment, and possible corrective measures at this site from the perspective of individual SWMUs is technically indefensible due to the apparent wide distribution of PAHs in soils and commingling of past releases of creosote and extender, and is therefore not proposed. For the purposes of the Phase 2 Investigation, the site will consist of three primary investigation areas: 1) the off-site Inactive Wastewater Lagoon area (new Area I); 2) the Tie Storage Area including the permitted unit (new Area II), and 3) the Former Process Areas (new Area III). In this manner, investigation of the site will be performed most appropriately and effectively through consolidation of the SWMUs and AOCs.

The following information will be obtained in the Phase 2 Investigation:

- Determination of the vertical extent of creosote in subsurface soils within the former process areas (i.e., areas of highest percent relative fluorescence).
- Quantitative data from laboratory analyses of soil samples to compare to and correlate with and verify CPT/ROST™ data collected during Phase 1.
- Chemical analyses for constituents of concern for ground water samples collected from within the UTZ and STZ (where present), onsite.

- The nature and extent of impacted ground water in the vicinity of the Inactive Wastewater Lagoon (Area I). (Additionally, the vertical extent of soil contamination will be determined in this Area).

- The direction of ground water flow, hydraulic conductivity, transmissivity, and related hydrogeologic data for the UTZ and STZ, onsite.

- Migration potential for creosote, and the potential for offsite impact from historical onsite releases.

- Information relative to the natural attenuation processes occurring at the site.

- Health-based risks related to site subsurface conditions and surface soil PAH concentrations in Areas I, II and III.

The following subsections describe the field program and scope of work proposed under the Phase 2 Investigation.

5.3 Soil Boring and Sampling Program

5.3.1 Scope and Objectives

Four soil borings, exclusive of the eight borings related to well installation (described in Section 5.4), are proposed to delineate the vertical extent of creosote impact in soils. These four borings, plus one STZ monitoring well boring (proposed well MW-12B, near CPT25R), will aid in:

- defining the vertical extent of soil contamination;

- a determination of the lithology below a depth of 60 feet;

- determining the distribution of creosote with depth and within the five hydrologic units: UCU, UTZ, MCU, LCU, and the STZ.

- the confirmation, comparison, and possible correlation of CPT and ROST™ fluorescence data collected during Phase 1 with data collected from the soil borings;
- the determination of the potential for natural attenuation; and,
- the hydrogeologic characterization of the site.

Prior to drilling the soil borings, CPT soundings will be performed to depths below the extent of creosote contamination as indicated by existing ROST™ fluorescence data, or to a maximum depth of approximately 100 feet. The purpose of the CPT soundings is two-fold: 1) to confirm the previous site lithology based upon CPT soundings, and 2) to define the site lithology at depths below the previous CPT soundings.

The borings will be continuously sampled and lithologic descriptions recorded. A minimum of six soil samples will be collected from each soil boring. To determine the vertical extent of creosote-impacted soil, soil samples will be collected from the base of the each exploratory soil boring. The exploratory soil borings will be terminated at a depth 5 feet below the depth at which clean soil (soil that is not impacted by creosote) has been identified by field screening procedures.

For ROST correlation and assessment of potential spatial variations in the creosote chemistry, the soil sample collection depths will be targeted to intervals of low fluorescence (0 to 30%), medium fluorescence (30% to 70%), and high fluorescence (>70%) within the five lithologic units.

Select soil samples will be collected from each boring for VOC analysis by EPA Method 8260 and PAH analyses by EPA Method 8270. Each soil sample collected for ROST™ correlation as described in Section 5.3.3 will be homogenized and split for concurrent testing by bench scale ROST™ and modified EPA Method 418.1 for total recoverable petroleum hydrocarbons (TRPH).

Two of the six soil samples will be collected from the UTZ and STZ respectively, in each boring for hydrogeologic and natural attenuation analyses as described in Section 5.7.1.

5.3.2 Proposed CPT Sounding and Soil Boring Locations

The data collected as part of the Phase 1 investigation identified areas with differing creosote distribution characteristics. These contaminant distribution characteristics, summarized in Section 3.0, were used in determining placement of the proposed soil borings. The five proposed soil borings are identified in Figure 5-1 and are located as follows:

- SB01 - Inactive Wastewater Lagoon (AOC 6, Area I), near CPT07E;
- SB02 - Tie Storage Area (SWMU 12, Area II), near CPT20R;
- SB03 - Original Process Area (SWMU 5, Area III), near CPT08R;
- SB04 - Recent Process Area (SWMU 4, Area III), near CPT13R; and
- Boring MW-12B - soil boring for STZ well in Tie Storage Area, near CPT25R.

Soil boring SB01 and CPT sounding CPT35 are to be located in the offsite drainage area (Inactive Wastewater Lagoon). Data collected during the Phase 1 investigation indicates that creosote has migrated from the ground surface downward to a depth of approximately 17 feet in this area. This is also an area of the site where creosote has historically ponded and where the STZ is present.

Boring SB-02 and CPT36 will be installed in the Tie Storage Area adjacent to CPT20R. Based upon the Phase 1 investigation, creosote appears to have migrated downward from the ground surface to an average depth of approximately 7 feet in the Tie Storage Area, with creosote also present within the transmissive layers at depths of 20 and 35 feet. This location is also near the edge of the STZ; therefore, soil boring data will be used to help characterize the hydrogeology of the site in this area.

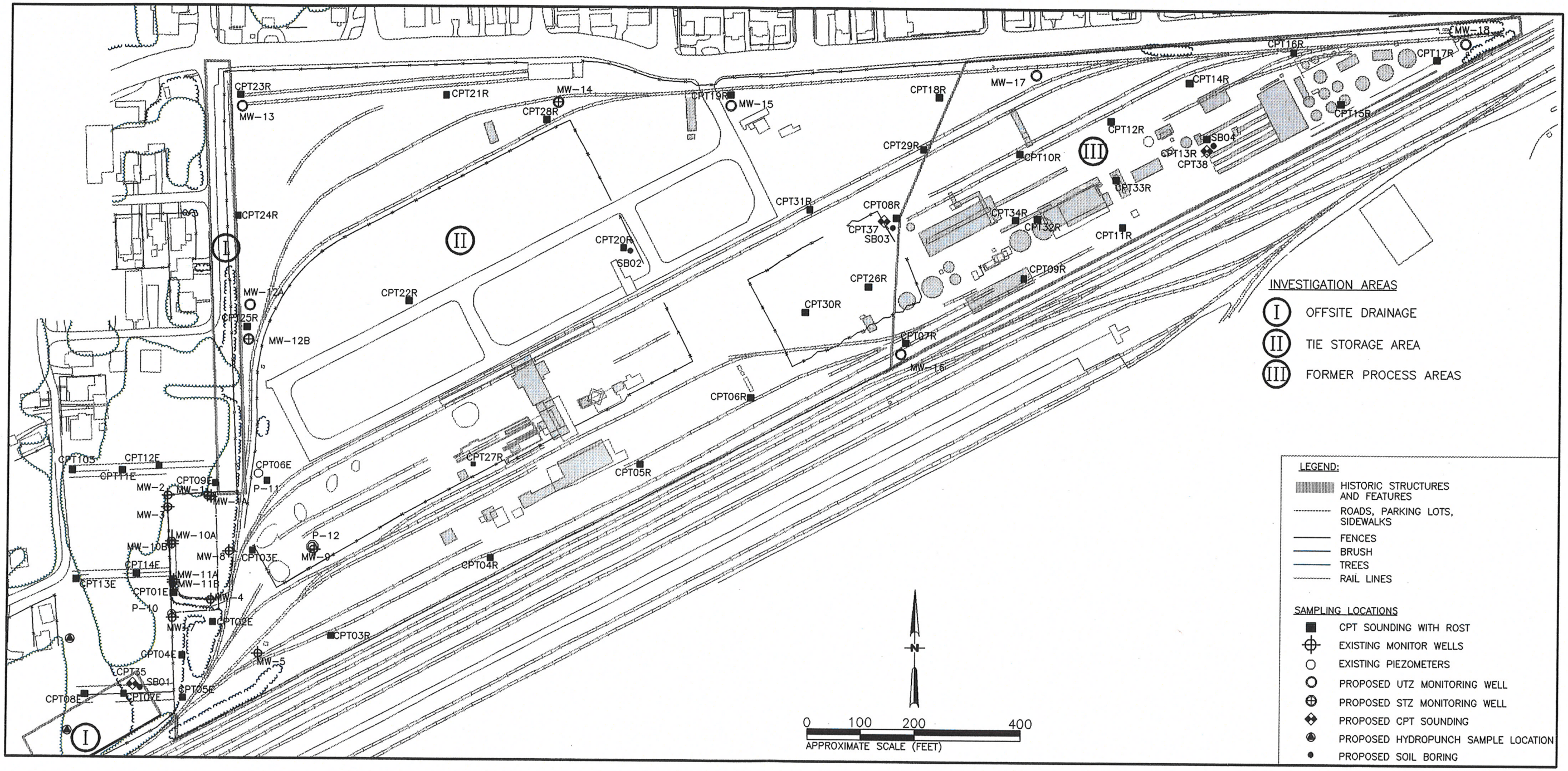


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FIGURE 5-1
PROPOSED PHASE 2 CPT, SOIL BORING, HYDROPUNCH AND MONITORING WELL LOCATIONS
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HOUSTON, TEXAS

Boring SB-03 and CPT37 are to be installed in the Original Process Area adjacent to CPT08R. Data collected during the Phase 1 investigation indicated this area to be a primary source area, as high fluorescence readings were recorded throughout the entire depth of the profile. In addition, this is an area where the LCU is present and further characterization of this cohesive unit will be possible through the collection of data at this location.

Similarly, Phase 1 data indicated creosote impact in soils from the ground surface to depths of approximately 60 feet in the Recent Process Area. Thus, soil boring SB-04 and CPT38 will be completed in this area adjacent to CPT13R, where moderate creosote fluorescence was indicated to be present throughout the entire depth of the profile. This proposed boring will also be useful in further characterizing the different hydrologic units, as the LCU is present in this area.

Soil boring MW-12B will be installed in the Tie Storage Area adjacent to CPT25R to obtain data on the chemistry and distribution of creosote near the North Drainage Ditch (SWMU 2, Area II), and to further characterize the hydrogeology and extent of contamination in this area of the site.

5.3.3 ROST™ Correlation Methodology

The ROST™ system sensitivity (i.e., ratio of fluorescence intensity to concentration) is a function of contaminant type and soil type. To produce a quantitative extrapolation of Phase 1 ROST™ data to PAH compounds which fluoresce and are creosote based, data collected from the Phase 2 investigation will be analyzed to develop calibration curves of relative fluorescence indicative of the location and total concentration of petroleum hydrocarbons.

A soil sample impacted with petroleum hydrocarbons may exhibit a fluorescence response that is proportional to the contaminant concentration. The calibration is typically developed based

on total recoverable hydrocarbon (TRPH) concentration which includes fluorescing and non-fluorescing compounds; therefore, site specific exceptions sometimes occur. Fluorescing PAHs may occur in different relative proportions to total hydrocarbon concentration for different samples and areas of the site; thus, it is possible that the correlation proposed herein will not be obtainable or definable. However, Loral (now Lockheed/Martin, ROST™ proprietor) has undertaken previous case studies relative to efforts to obtain calibration curves, and success has been achieved at related sites.

5.3.3.1 Purpose and Objective

The purpose and objective of developing a correlation of ROST™ relative fluorescence readings and actual concentration of TRPH is to maximize the usefulness and validity of ROST™ screening investigation conducted under Phase 1. A more quantitative delineation of the extent and concentration of creosote in the subsurface would be achieved through a reliable correlation curve; however, this is not essential to the success of proposed Phase 2 investigations. In the event that a distinct, definable correlation is not possible, previous ROST™ fluorescence data will remain incorporated into final site characterization in more qualitative terms as compared to a direct extrapolation via statistical correlation.

5.3.3.2 Development of Calibration Curves

The scope of the proposed Phase 2 Investigation includes the collection of soil samples in each critical site strata at varying degrees of contamination levels. Boring locations and sample depths were selected to collect samples representative of the important soil types. Additionally, soil samples will be collected in areas of low, moderate, and high relative fluorescence based on ROST™ data collected during Phase 1. A representative sampling of site soils will be obtained to develop calibration curves to convert ROST™ fluorescence intensities to concentration units, specifically TRPH, by modified EPA Method 418.1. In

addition, creosote-based chemical data will be reviewed and analyzed with the objective of establishing useful correlations to ROST™ fluorescence intensities. In the event these analyses support development of other correlations, estimates of soil concentrations of specific compounds of concern will be extrapolated from Phase 1 ROST™ data.

Method 418.1 is typically used by Loral at creosote impacted sites as a gross measure of petroleum hydrocarbon compounds. If a correlation is obtained, the fluorescing compounds, which are a subset of the TRPH, are detected and quantified concurrently with other non-fluorescing compounds. This results in site-specific scatter plots of ROST™ fluorescence measurements and TRPH concentration derived from laboratory analyses of homogenized soil samples from the site. To avoid uncertainties caused by differing fluorescence response relative to different matrix types (i.e., soil types), a data set will be developed for each distinct and definable stratigraphic layer.

SPTCo will work closely with Loral to derive site-specific calibration curves. Loral Standard Operating Procedure No. 101 for Bench Top Fluorescence Intensity Measurements, included in Appendix A, will be used as a general guide to derive statistically defensible correlations of ROST™ data indicative of TRPH. If the data exhibits good linear characteristics, a best fit correlation will be derived utilizing standard least squares regression techniques. The least squares line will be utilized to relate fluorescence intensity to concentration values in soils as TRPH.

Correlation of ROST™ data to actual concentrations may involve additional empirical evaluations beyond simple linear regression. Laboratory values of over 1,500 to 3,000 mg/kg or very low values may not lend themselves to good linear regression. Actual ranges of data linearity are dependent on site specific conditions. These non-linear data sets (if obtained) will be evaluated to develop non-linear, or tabular relationships between the two values (ROST™ and concentration). The process of developing a relationship between ROST™ and

actual concentration data is not rigid; rather, it is subject to the statistical characteristics of the data obtained which can only be known after data collection. Identification of factors which may potentially interfere with fluorescence such as varying soil types, is essential in the process of good data analysis.

5.4 Monitoring Wells

5.4.1 Objectives

Monitoring wells are proposed to provide the following:

- lithology and soil characteristics collected from monitor well borings;
- determination of the ground water flow direction(s);
- determination of hydraulic gradient in the UTZ and STZ;
- representative samples of ground water;
- data to provide an understanding of the relationship between contaminant concentrations in soil and partitioning of compounds in ground water;
- slugs test data to estimate the hydraulic conductivity of the UTZ and STZ;
- reproducible data over a period of time that will allow for statistical evaluation of data, if warranted;
- ground water chemistry data near the property boundaries on the east, west, and northern portions of the site to provide indications of possible impact to ground water offsite; and,
- data gathered will be used in fate and transport analyses to help identify the potential degree and extent of possible offsite impact.

5.4.2 Scope of Well Installation

SPTCo proposes to install six, 2-inch PVC ground water monitoring wells in the UTZ, and two 2-inch wells in the STZ, onsite.

5.4.2.1 Proposed Monitoring Well Locations

Proposed monitoring wells MW-12A and MW-12B will be installed adjacent to the west-central property boundary near CPT25R. These wells will provide information relative to the hydraulic gradient, hydraulic conductivity, geology, and contaminant concentrations in the UTZ and STZ in Area I on the west property boundary. Proposed well MW-12A will be screen in the UTZ, and well MW-12B will be screened in the STZ. Proposed monitoring well locations are shown on Figure 5-1 (page 5-7).

Proposed monitoring well MW-13 will be installed in the northwest corner of the site near CPT23R. This well will be installed to obtain information on the hydraulic gradient, hydraulic conductivity, geology, and contaminant concentrations in the UTZ at the northwest property boundary, and will provide hydrogeologic information beneath the Tie Storage Area.

Proposed monitoring well MW-14 will be installed near the north property boundary adjacent to CPT28R. This well will be screened in the STZ to obtain information on the hydraulic gradient, hydraulic conductivity, geology, and contaminant concentrations in the center of the STZ channel at the property boundary. Isopach maps indicate that the thickness of the STZ is greatest in this area onsite.

Proposed monitoring well MW-15 will be installed near the north property boundary adjacent to CPT19R. This well will be installed to obtain information on hydraulic gradient,

hydraulic conductivity, geology, and contaminant concentrations in the UTZ in the assumed hydraulic downgradient direction from the Original Process Area (SWMU 5, Area III) and Hydropunch™ ground water sample HP14UTZ which contained the highest detected concentration of dissolved PAHs.

Proposed monitoring well MW-16 will be installed near the south property boundary within the Original Process Area (SWMU 5, Area III) adjacent to CPT07R. This well will be installed to obtain information on hydraulic gradient, hydraulic conductivity, geology, and contaminant concentrations in the UTZ near the primary creosote source area.

Proposed monitoring well MW-17 will be installed near the north property boundary. This well will be installed to obtain information on hydraulic gradient, hydraulic conductivity, geology, and contaminant concentrations in the UTZ in the assumed hydraulic downgradient direction from the Recent Process Area (Area III).

Proposed monitoring well MW-18 will be installed near the east property boundary within the Recent Process Area adjacent to CPT17R. This well will be installed to obtain information on hydraulic gradient, hydraulic conductivity, geology, and contaminant concentrations in the UTZ near the primary creosote source area.

5.4.2.2 Ground Water Flow

The eight proposed monitoring wells, six in the UTZ and two in the STZ, will be surveyed by a Texas licensed land surveyor and a base map combining the existing and new wells will be prepared. Static water level elevations obtained from the new and existing wells will be placed on the base map, and will be used to estimate the ground water flow direction(s) and hydraulic gradient in the UTZ and STZ (where present) across the site.

5.5 Hydropunch™ Samples

As indicated through CPT/ROST™ and Hydropunch™ activities performed in the offsite area, downgradient of the closed surface impoundment, the permitted unit is not a source of significant offsite contamination. Phase 1 EOC Investigation activities indicated however, that the Inactive Wastewater Lagoon (AOC 6) may be a source of contamination detected in the offsite area southwest of the closed impoundment.

To determine if AOC 6 is a source of ground water contamination in the offsite area west of the site, SPTCo proposes to collect a minimum of four Hydropunch™ ground water samples from accessible property in the offsite area west and northwest of AOC 6. The objective of this study will also be to attempt to delineate possible offsite impact in ground water attributable to the Inactive Wastewater Lagoon. Two of the proposed Hydropunch™ locations are presented on Figure 5-1 (page 5-7). Additional Hydropunch™ locations will be determined in the field based upon access to city ROWs and/or private properties.

Hydropunch™ ground water samples will be analyzed for the chemical constituents described in Section 5.7.2.

5.6 Surface Soil Samples

Surface soil samples will be collected onsite to provide necessary data to determine the distribution and concentrations of BTEX and PAHs in surface soils and to allow for the evaluation of possible health risks as described in Section 5.9 of this report. The objectives for the collection of surface soil samples are to:

- define the nature and extent of creosote and BTEX contaminants in surface soils in the Tie Storage Area (Area II) and the Former Process Areas (Area III);

- help provide sufficient soil data for conducting a Risk Reduction Standard No. 3 risk assessment; and,

- provide a basis to identify areas of surface soils in Areas II and III that meet or attain risk-based cleanup levels as calculated in the risk assessment.

In accordance with EPA RFI Guidance document EPA 530/SW89-031, a systematic grid established at 200-foot centers is proposed for the collection of surface soil samples from within the two investigation areas. Figure 5-2 shows the systematic grid and proposed sample locations.

A total of 20 surface soil samples will be collected within the Tie Storage Area (Area II). Surface soil samples will be collected at each grid node from the depth interval of 0 to 6 inches.

A total of nine surface soil samples will be collected within the Former Process Areas (Area III) at each grid node shown on Figure 5-2 from the depth interval of 0 to 6 inches.

Each surface soil sample will be collected with appropriate sampling equipment, sealed in a glass sample jar, and will be analyzed for PAHs by EPA Method 8270.

5.7 Analytical Program

5.7.1 Soil Analysis

Soil samples will be continuously collected from the proposed soil borings and from borings, as described in Section 5.3, during installation of the proposed monitoring wells. Select soil samples will be analyzed for some or all of the following: VOCs by EPA Method 8260,

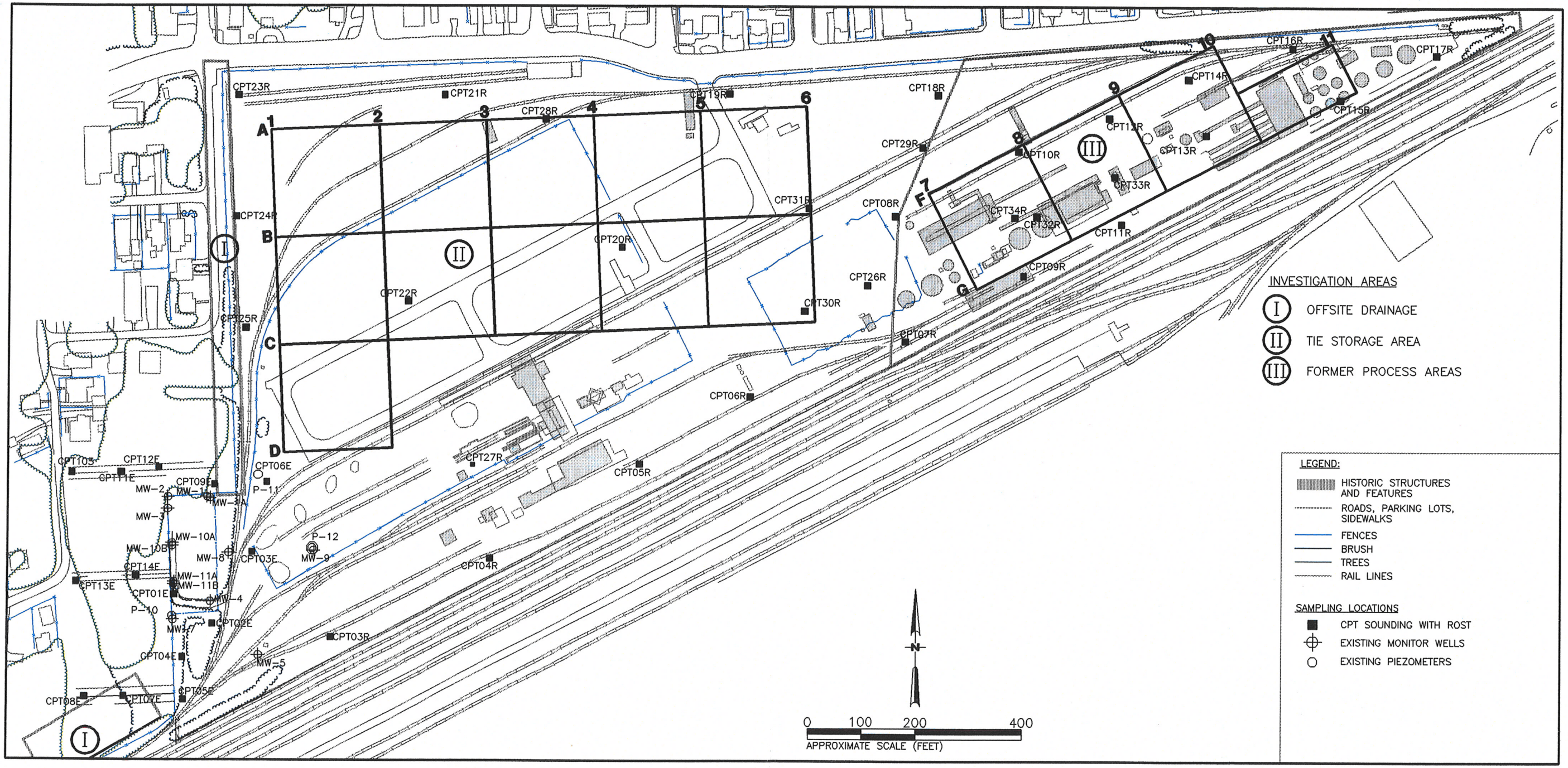

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FIGURE 5-2
PROPOSED PHASE 2 SURFACE SOIL SAMPLE GRID

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PAHs by EPA Method 8270, microbial assay, total organic content, pH, grain size distribution, moisture content, density, and specific gravity.

In addition to the VOC and PAH analyses above, as provided in Section 5.3.3, select soil samples will also be analyzed for TRPH by modified Method 418.1. Appropriate statistical analyses will be performed concurrently with the collection of quantitative soil data to provide a comparison to ROST™ fluorescence data obtained in Phase 1.

Surface soil samples described in Section 5.6 will be analyzed for PAHs by EPA Method 8270.

5.7.2 Ground Water Analysis

After the installation of the monitoring wells, ground water samples will be collected from each well and analyzed for VOCs by EPA Method 8260, PAHs by EPA Method 8270, TDS by EPA Method 160.1, and total suspended solids (TSS) by EPA Method 160.2.

Insitu measurement of the ground water dissolved oxygen concentrations, redox potential, specific conductance, temperature, and pH will be obtained with portable electronic meters.

5.8 Analyses of Creosote Mobility and Ground Water Movement

The proposed scope of the Phase 2 investigations will provide data necessary for the analysis of fluid motions that may occur within the subsurface media at the site. Fluid motions refer to both the potential mobility of creosote and any ground water flows that may occur in its vicinity. During and following Phase 2 data collection, the character of subsurface fluid motions will be analyzed. Specifically, the impetus to motions caused by subsurface pressure

gradients will be analyzed both within the site and its immediate vicinity. In addition, preliminary analysis will also be conducted to evaluate whether, or not:

- significant creosote and ground water motions can occur under conditions encountered within the site and in its vicinity, why and how they are caused and which site features influence them;
- the occurence of these fluid motions is significant, they exhibit transients or cyclical characteristics, and whether these characteristics have altered appreciably with time;
- the behavior of the physically altered creosote can be represented as a fluid in motion or more properly as a thixotropic solid which contributes only marginally to motion; and,
- ground water within the site has had sufficient residence-time contact with the creosote to become significantly contaminated, and whether the vertical and horizontal extent of any such potential contamination are significant.

Site data collected during Phase 1 will be combined with data proposed to be obtained during Phase 2 to prepare a unified database required for the analyses of potential subsurface movements of creosote and ground water in contact with it. During Phase 2 such analyses are intended to be conducted with advanced techniques of site data interpretation. For instance, the travel times of the creosote "front" will be estimated with particle-tracking or streak-line analysis. These analyses employ values of variables such as gradients in potentiometric heads, interpreted magnitudes and directions of fluid motions as well as values such as hydraulic conductivity, density and viscosity of creosote, thickness ranges of creosote, and other applicable values.

The tracking of particles released in various segments of the site as well as the appropriate streak lines will allow a clearer understanding of the magnitudes and directions of potential movements of creosote and contaminated ground water.

5.9 Baseline Risk Assessment

Following the collection and analyses of data from the Phase 2 Investigation, a baseline risk assessment (risk assessment) will be performed for the site using Texas Risk Reduction Standard Number 3 (RRS No. 3) as outlined in Texas Administrative Code §335.553. The objectives of the risk assessment will be to evaluate current and potential future human health risks that are posed by chemicals present in soil and ground water at the site and as necessary, develop cleanup levels for site-related chemicals of concern in soil and ground water that are protective of human health.

The risk assessment will include the following components: 1) data evaluation; 2) exposure assessment; 3) toxicity evaluation; 4) risk characterization; 5) and as necessary, development of risk-based cleanup levels. An evaluation of exposure and risk assessment uncertainties will also be presented in the risk assessment report. The components of the risk assessment are described in the following subsections.

5.9.1 Data Evaluation

The risk assessment will present a thorough evaluation and summary of all chemical occurrence data in ground water and soil collected during the Phase 1 and Phase 2 site investigations. This summary will include statistical evaluations of the data and a tabulation of the maximum, minimum, arithmetic average, and 95% upper confidence limit of the arithmetic mean concentrations of the site-related chemicals of concern.

The occurrence of chemicals not attributable to site-related sources (such as phthalates, methylene chloride, and others that may result from laboratory or other sources of contamination) will be evaluated using procedures outlined in Chapter 5 of *Risk Assessment*

Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Reasons for eliminating a chemical as a contaminant of concern will be discussed in the risk assessment.

5.9.2 Exposure Assessment

The exposure assessment will characterize the human exposure setting for soils and ground water at the site in accordance with current and reasonably anticipated future use of the site. The exposure assessment will include a physical characterization of the site, an evaluation of potentially exposed current and potential future human populations, an identification of potential exposure pathways, points of exposure, and routes of exposure to chemicals in soil and ground water. For complete exposure pathways, estimates of potential human exposure to contaminants of concern in ground water and soil will be calculated using a combination of site-specific data and default exposure factors.

SPTCo intends to evaluate human exposure to the contaminants of concern based on future use of the site as an industrial facility.

Fluid motions analyses will be used to evaluate the potential for chemicals of concern to migrate to off-site points of exposure, and to estimate concentrations of the site-related contaminants of concern at off-site locations.

As necessary, additional exposure models will be used to evaluate exposure to chemicals that have not been described in Texas Administrative Code §335.553. To evaluate human exposure to chemicals from the release of VOCs from shallow ground water, the American Society for Testing and Materials (ASTM), *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* may be used to help evaluate exposure potential.

5.9.3 Toxicity Evaluation

The toxicity evaluation will tabulate all reference doses, slope factors, and information regarding target organs for the chemicals of concern in soil and ground water. Reference doses and slope factors will be retrieved from USEPA's Integrated Risk Information System (IRIS), Health Effects Assessment Tables (HEAST), or other USEPA sources of provisional reference doses and slope factors.

5.9.4 Risk Characterization

Given calculated estimates of exposure to chemicals in soil and ground water and the compiled reference doses and slope factors, quantitative estimates of noncancer and carcinogenic risk will be calculated for each complete exposure pathway relevant to current and reasonable future use of the site. Risk calculations will be presented for each chemical and exposure pathway.

Uncertainties associated with exposure and toxicological assessments will be presented and discussed in detail. If possible, the magnitude of these uncertainties will be quantified.

5.9.5 Development of Risk-Based Cleanup Levels

Risk-based cleanup levels will be calculated for site-related chemicals in soil and ground water. Cleanup concentrations (i.e., noncancer and cancer risk-based cleanup levels for chemicals in soil and ground water) will be back-calculated from acceptable risk levels on the basis of exposure factors and toxicity values relative to the contaminants of concern. For potential carcinogens, soil and ground water cleanup concentrations corresponding to the 1×10^{-4}, 1×10^{-5}, and 1×10^{-6} lifetime cancer risk will be calculated. For noncarcinogenic chemicals (designated "system toxicants" in RRS No. 3), soil and ground water cleanup

concentrations will be calculated based on a hazard index of one for each chemical. As necessary, the soil cleanup concentration for noncarcinogenic chemicals will be modified to account for exposure to multiple chemicals with the same noncarcinogenic effect. In accordance with RRS No. 3, the cleanup levels for potential carcinogens and noncarcinogens in soil and ground water may also be modified based on technical limitations, effectiveness, and practicability of achieving the cleanup level.

5.10 Phase 2 Investigation Work Plan

Within 60 days from TNRCC approval of the Phase 2 Investigation scope of work outlined in this report, a Phase 2 Work Plan will be developed as a supplement to approved RFI and EOC Work Plans to provide further details of the investigation. The work plan will contain a detailed description of the field and analytical programs and a schedule for completion of Phase 2.

5.11 Phase 2 Investigation Report

The results of Phase 2 Investigation will be documented and clearly presented in the form of a comprehensive site investigation report. The Phase 2 RFI Report will include:

- Investigation methods and procedures
- Results of CPT/ROST™ comparisons and correlation
- Field measurements and analytical data
- Identification of the vertical extent of creosote impacted soil
- Extent of contamination contoured as isopachs or isopleths
- Ground water flow directions, gradients, and rates
- An assessment of fluid motions and natural attenuation processes

Relevant data from the Phase 1 RFI/EOC Investigation will be incorporated in the report, as appropriate. Any proposed further site investigation will be described in the Phase 2 Investigation Report. The Phase 2 report may contain an outline of the scope of work for the Corrective Measures Study required by paragraph VIII.I.3 of the Permit.

The Baseline Risk Assessment report will be provided separately, subsequent to submittal of the Phase 2 Investigation Report.

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APPENDIX A

ROST™ LITERATURE, LORAL SOP No. 101 & LETTERS TO TNRCC

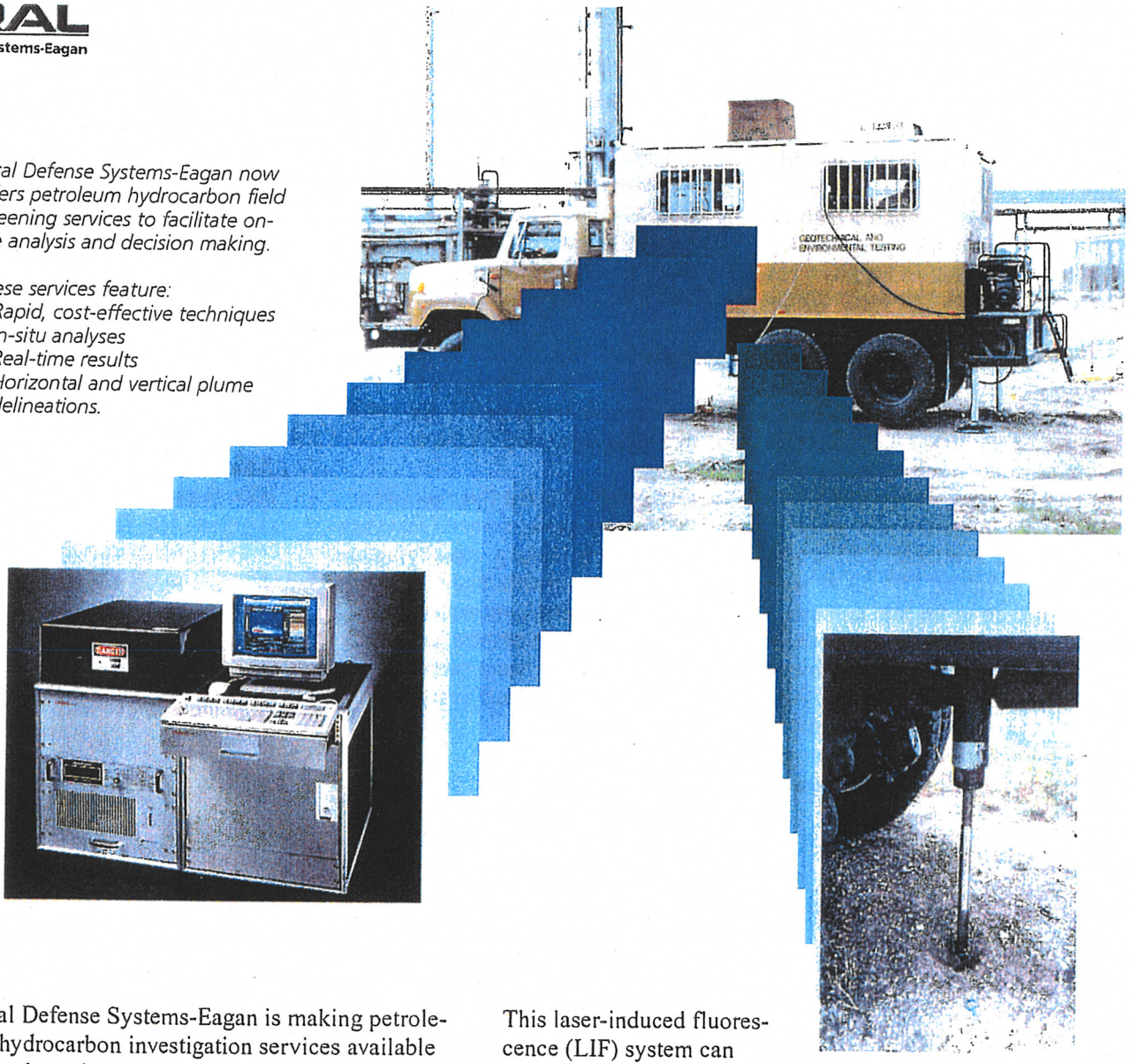
Rapid Optical Screening Tool (ROST℠) Services

A revolutionary method of site characterization

LORAL
Defense Systems-Eagan

Loral Defense Systems-Eagan now offers petroleum hydrocarbon field screening services to facilitate on-site analysis and decision making.

These services feature:
- *Rapid, cost-effective techniques*
- *In-situ analyses*
- *Real-time results*
- *Horizontal and vertical plume delineations.*



Loral Defense Systems-Eagan is making petroleum hydrocarbon investigation services available throughout the world, using a revolutionary site characterization technology known as the Rapid Optical Screening Tool (ROST™) System. Loral has successfully employed this on-site characterization system for Fortune 500 companies in the petroleum and manufacturing sectors, as well as for a number of government clients.

This laser-induced fluorescence (LIF) system can detect aromatic hydrocarbon components in subsurface soils and groundwater, allowing for rapid delineation of the horizontal and vertical extent of the affected area. In addition, the ROST System can be used to fingerprint the type of petroleum components present. Through the use of wavelength-time-matrices, the ROST System can help indicate the

type of petroleum product and can sometimes be used to differentiate among two or more plumes.

The ROST System provides expedited, real-time field screening for petroleum aromatic hydrocarbon contamination. In contrast, traditional methods employed during environmental site characterizations are often time consuming and provide limited soil and ground water quality data.

The ROST/CPT System

Used in conjunction with cone penetrometer test (CPT) equipment, the ROST System employs a wavelength-tunable high energy pulsed ultraviolet laser. Light from this laser is launched through a fiber optic cable in the CPT probe and directed out through a sapphire window onto the soil. The resulting fluorescence is returned to the surface in a separate fiber optic cable and analyzed.

The use of the ROST/CPT System as a petroleum contaminant screening tool provides the investigator a degree of automation and speed never before available. CPT trucks, typically weighing 20 tons or more, can be driven to the site and can traverse a variety of terrain conditions to arrive at a sampling location. The CPT vehicle hydraulically pushes a probe into the subsurface using the reactive mass of the vehicle to provide a 2 cm per second downward motion.

While the ROST System collects contaminant data, the CPT truck collects data for determining soil type, soil conductivity, pore pressure, etc. Thus, at each sample field location, an integrated vertical profile of the contaminant and the associated soil stratigraphy are available in real time. As a result, on-site decision making and effective use of resources are greatly improved. In fact, use of the ROST System can result in significant time and cost savings in the site characterization process.

Meeting Future Characterization Requirements

The ROST System can reliably and accurately detect the presence of aromatic hydrocarbons. The results from ROST tests correlate quite closely with laboratory methods. The ROST System has been tested by the U.S. Environmental Protection Agency and by several European regulatory agencies, and has been shown to be a highly effective field-screening system.

As a result of using this innovative technology, environmental investigators are now finding, classifying and mapping the distribution of petroleum hydrocarbon contamination in days, rather than months, as well as generating significant savings in drilling and analytical costs.

The ROST System has been successfully integrated with CPT vehicles from major cone penetrometer companies. (ROST is normally a temporary installation onboard a CPT truck.) Service work using ROST is now available through Loral Defense Systems-Eagan and its partners in North America and Europe, with units strategically located around the United States and Europe to minimize mobilization costs.

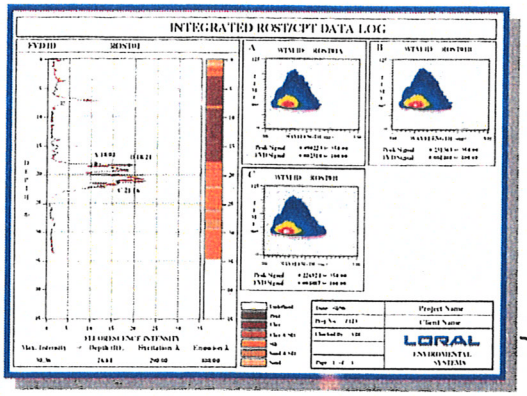
If your environmental characterization efforts involve aromatic hydrocarbons in soil or groundwater, the ROST System may be the solution you need. Call us with your specific requirements, and we'll tell you how ROST can best be used at your site.

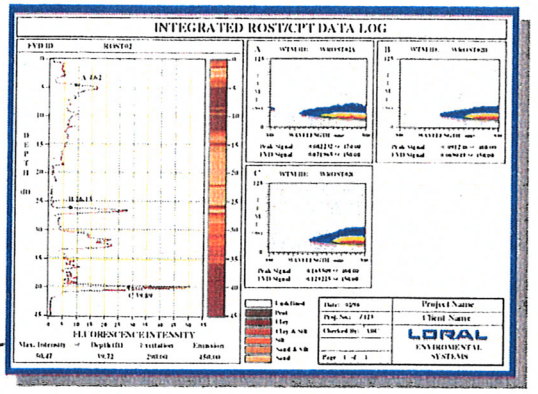
ROST is a trademark and service mark of Loral Defense Systems-Eagan.

For more information about the ROST System or associated ROST Services, please contact:

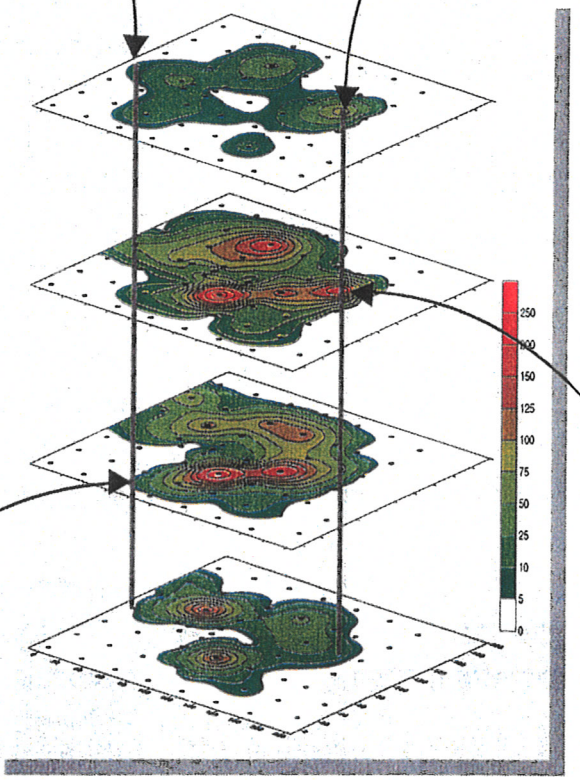
Loral Defense Systems-Eagan
Environmental Systems
P.O. Box 64525
St. Paul, MN 55164-0525
Phone: (612) 456-4000
Fax: (612) 456-3098

RAPID OPTICAL SCREENING TOOL (ROST™)
AUTOMATED SYSTEM DISPLAYS



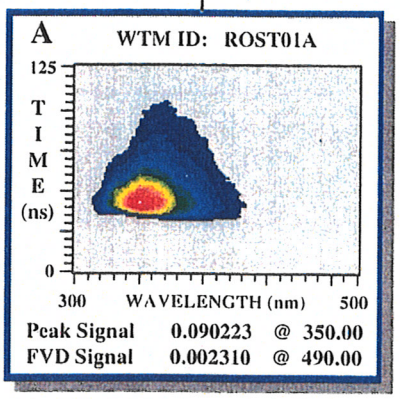


The integrated ROST/ CPT logs display continuous flourescence intensity of contaminant alongside soil stratigraphy data at each push location.

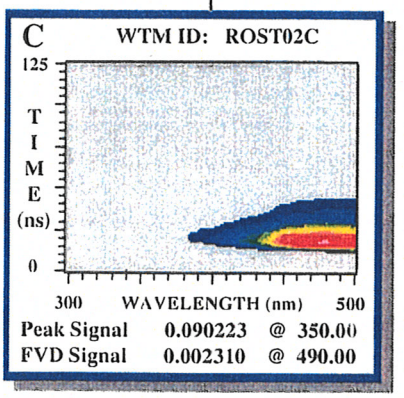


Integration of data from several push locations provide a visual image of the plume.

Field logs allow personel to make informed, real-time decisions related to measurements and sampling.



Wavelength - Time Matrix (WTM) logs are used to finger-print the type of hydrocarbon contamination and differentiate among varying plumes at the site.



LORAL

Rapid Optical Screening Tool (ROST™)

This table contains examples of aromatic hydrocarbon compounds and petroleum-based products known to be detectable by the Rapid Optical Screening Tool System. Additional compounds not on this list may also be detectable by the ROST System. Compounds or products not listed can be submitted to Loral for pre-testing to determine the applicability of the ROST System to a given project.

Gasoline	Acenaphythylene
Aviation Fuel	Anthracene
Diesel Fuel	Benzo (A) Anthracene
Liquefied Petroleum Gas	Benzo (A) Pyrene
JP-4, JP-5, and Jet-A Fuels	Benzo (B) Fluoranthene
Mineral Spirits	Chrysene
Fuel Oil	Dibenzo (A,H) Anthracene
Transformer Oil	Fluoranthene
Lubricating Oil	Fluorene
Tar	Indeno (1,2,3,-CD) Pyrene
Creosote	Naphthalene
Asphalt	Phenanthrene
Naphta Solvents	Pyrene
Hydraulic Fluid	1-Methyl Naphthalene
Natural Gas Condensate	2-Methyl Naphthalene
Petroleum Distillates and Raffinates	Benzene
Kerosene	Toluene
Turpentine	Ethylbenzene
Varsol	Xylenes
Motor Oil	

For further information, contact Loral Defense Systems-Eagan, Environmental Systems, at (612) 456-4000.

LORAL
Defense Systems Eagan

ROST is a registered trademark.

WAVELENGTH-TIME MATRIX (WTM) INTERPRETATION

Wavelength-Time Matrices (WTMs) are three dimensional representations that relate fluorescence intensity to emission wavelength and to fluorescence decay time following the pulsed excitation. Many common fuel products exhibit characteristic WTM signatures which can be used for qualitative analyses and identification purposes. WTMs obtained during a ROST/CPT test can be compared with WTMs of common petroleum products or with WTMs generated from specific materials recovered from the site.

The wavelength at which the maximum fluorescence intensity occurs (*Peak Signal)* on the WTM is a general indicator of petroleum hydrocarbon (PHC) composition. The fluorescence intensity distribution of aromatic hydrocarbons shifts to longer wavelengths with increasing molecular weight. Lighter PHC products, such as those composed predominantly of lower molecular weight compounds, reach peak fluorescence intensity at relatively shorter wavelengths. In contrast, heavier products composed of larger molecular weight compounds exhibit most of their fluorescence at longer wavelengths.

The Peak Signal recorded at the highest intensity point indicates the maximum relative strength of the fluorescence signal. The fluorescence intensity on a WTM is represented by contour lines or by color coded contour intervals referenced to the amplitude of the peak signal.

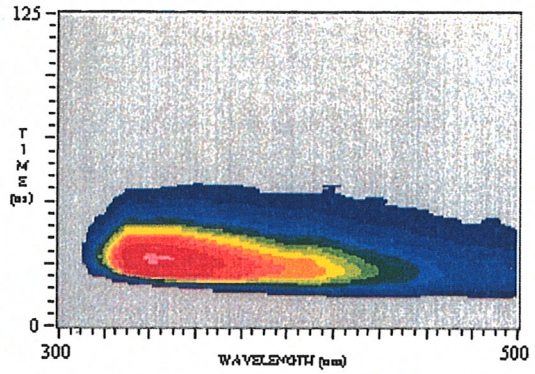
The fluorescence decay time, represented along the vertical axis of the WTM, further aids in defining the PHC type. The WTM signature of *Gasoline* tends to be elongated along the wavelength axis, but with short to moderate extension along the time axis. The *Jet Fuel* (*JP-4*) WTM has a characteristic compact triangular shape and a long fluorescence decay time. *Diesel Fuel* WTMs are less symmetric than those from gasoline or jet fuel, and tend to have a broad fin pattern along the time axis. *Heavy PHC products such as Coal Tar* have an elliptical shape like gasoline but are shifted to much longer wavelengths.

The shape of the WTM is independent of concentration for a particular petroleum product, but is sensitive to the PHC material composition and to soil oxygen content. The amplitude of the WTM, which is indicated by the peak signal, is proportional to the concentration. The amplitude may be affected by soil matrix and oxygen content.

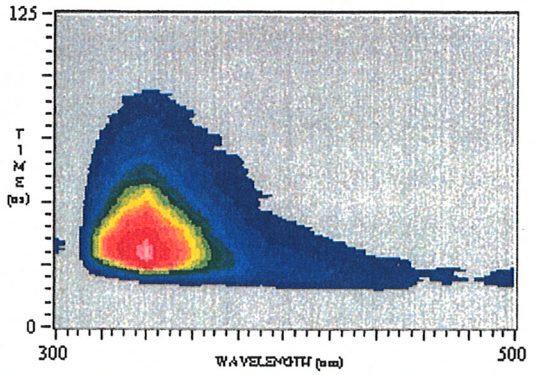
The four WTM plots of common petroleum products presented here are intended to be used only as a guide for qualitative comparison. Should more precise characterization of WTMs be required, additional spectroscopic evaluation of site specific samples can be conducted by Loral.

WTM Signatures of Common Petroleum Products

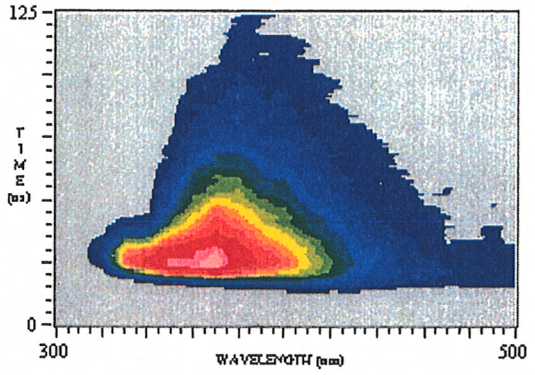
Gasoline **Peak Signal 0.183 @ 340nm**



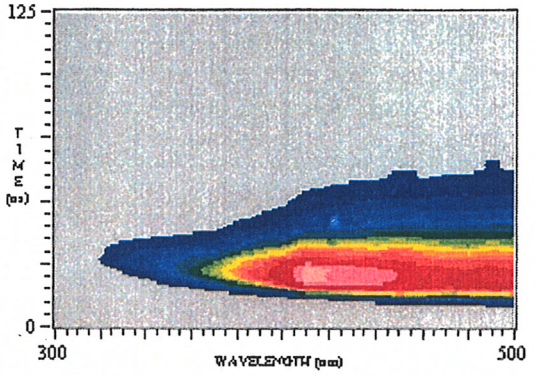
Jet Fuel (JP-4) **Peak Signal 0.176 @ 340nm**



Diesel Fuel **Peak Signal 0.182 @ 370nm**



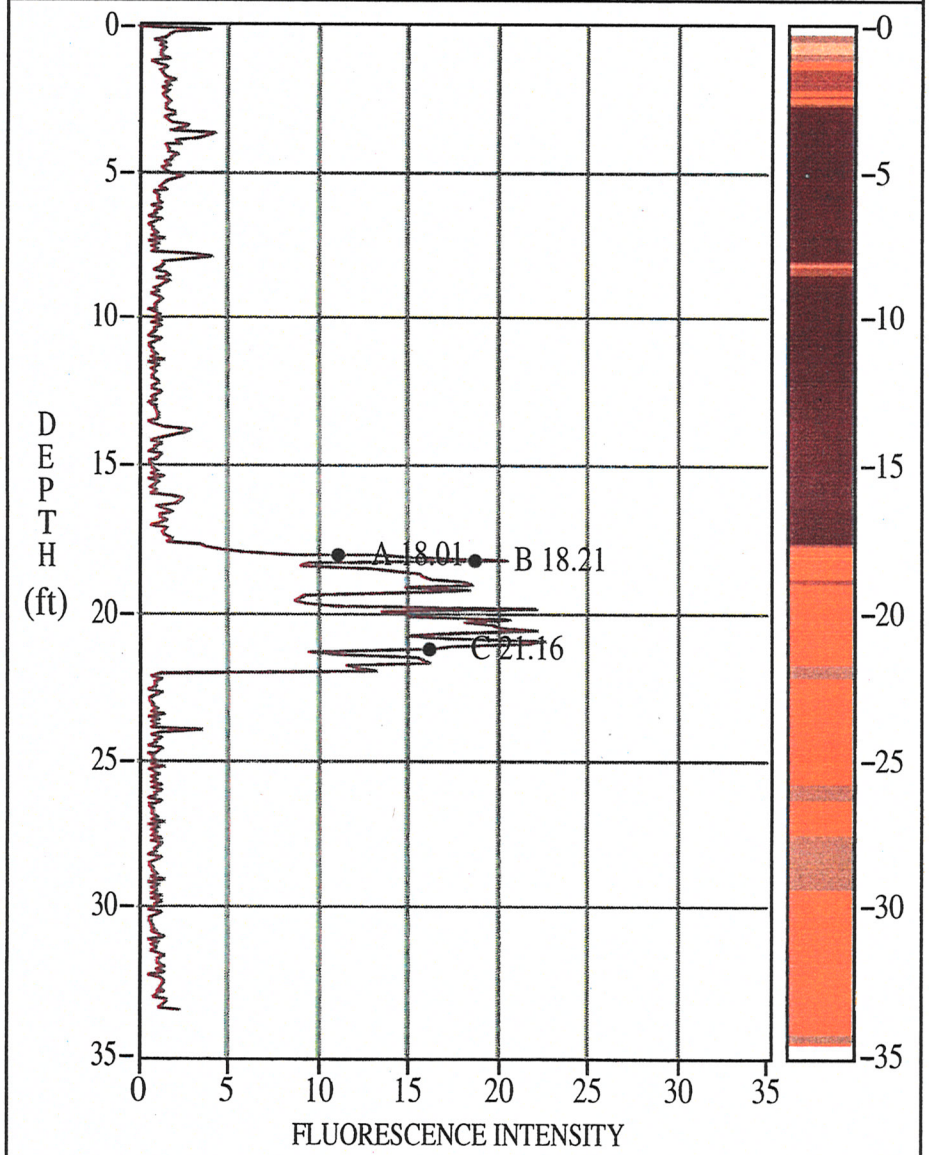
Coal Tar **Peak Signal 0.127 @ 410nm**



LORAL

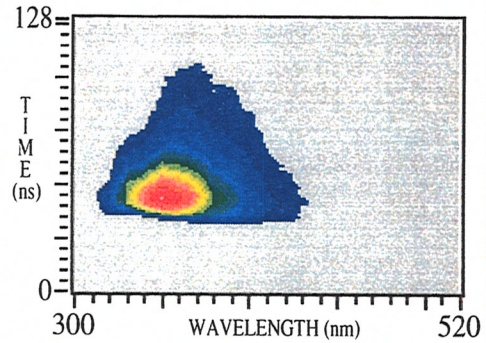
INTEGRATED ROST/CPT DATA LOG

FVD ID : ROST01



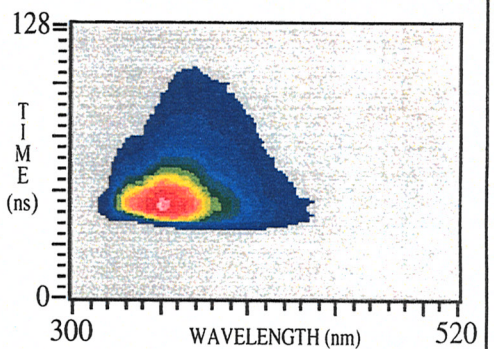
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
22.64	20.90	290.00	400.00

A WTM ID : ROST01A



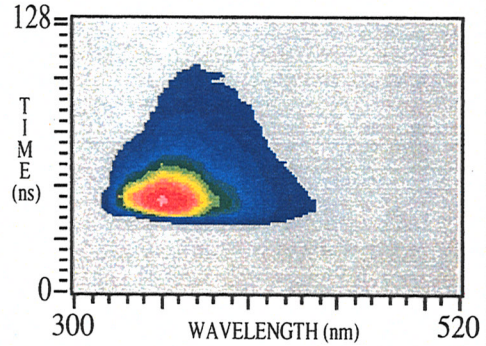
Peak Signal (pVs)	2267.61 @ 350.00
FVD Signal (pVs)	773.67 @ 400.00

B WTM ID : ROST01B



Peak Signal (pVs)	5737.42 @ 360.00
FVD Signal (pVs)	2060.09 @ 400.00

C WTM ID : ROST01C

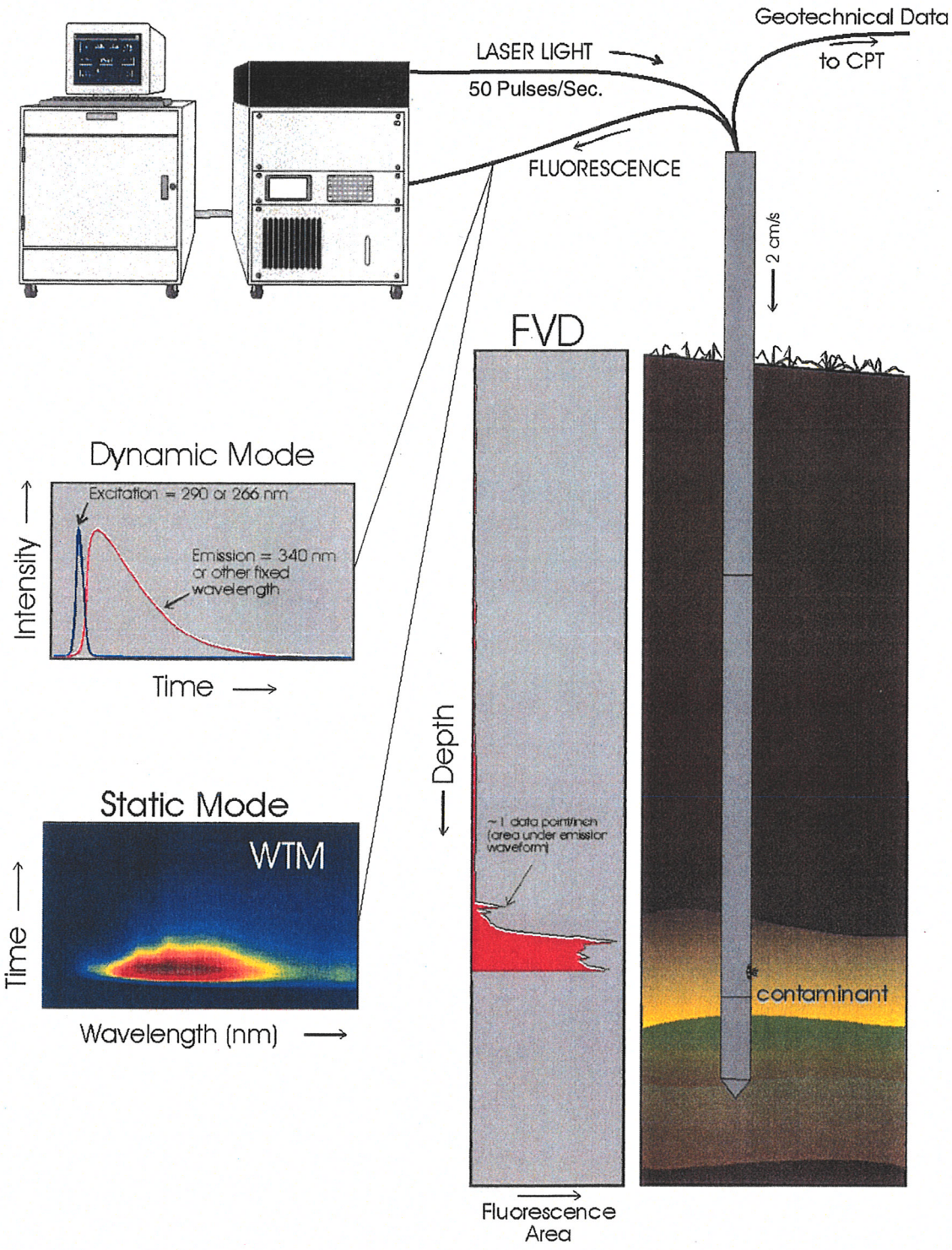


Peak Signal (pVs)	5459.39 @ 360.00
FVD Signal (pVs)	2035.39 @ 400.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

Date: 9/16/95	Project Name
Proj. No.: Z123	Client Name
Checked By: ABC	LORAL ENVIRONMENTAL SYSTEMS
Page 1 of 1	

ROST™/CPT System Concept



LORAL

IN-SITU TESTING SERVICES

Piezocone Penetrometer

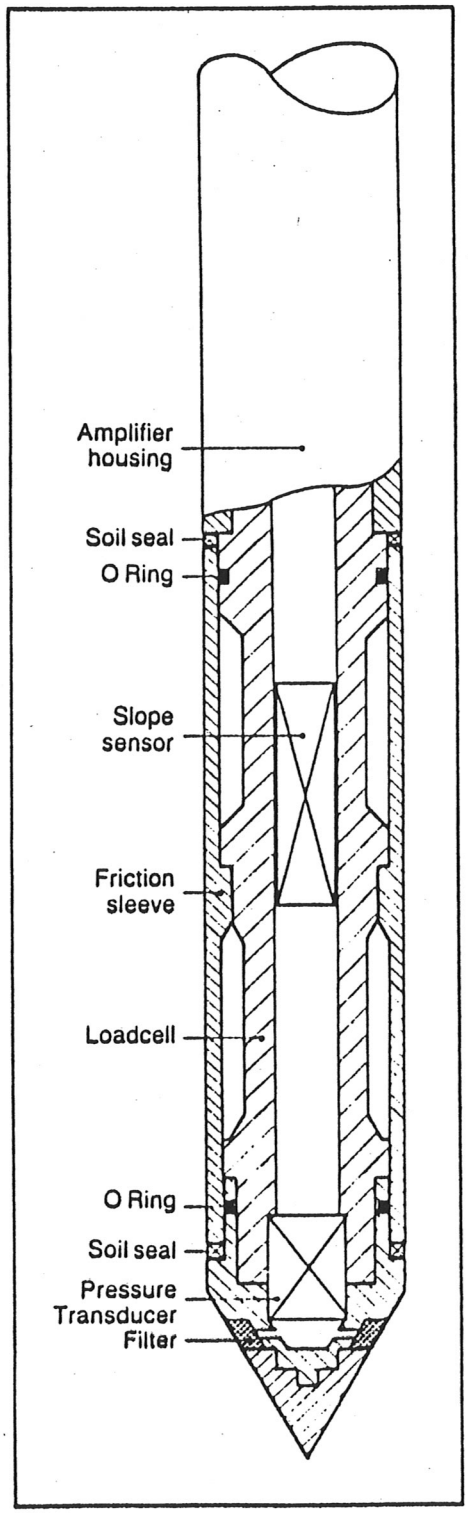


FIGURE 1: Fugro Piezocone Penetrometer

The Fugro Piezocone Penetrometer gives a continuous recording of the dynamic pore pressure, cone resistance and sleeve friction during penetration. A standard friction cone penetrometer has been modified to incorporate a pressure transducer to measure pore pressure. A porous ceramic filter is built into or above the tip of the cone. Figure 1 shows the basic layout of a 10 cm^2 piezocone.

The pressure transducer's element is placed at the same level as the porous stone and is therefore in direct contact with the pore water that enters through the filter. There are no cavities that may affect the response of the pressure transducer. The pressure transducer is of the piezo-resistive type and has a high output signal. Only a 0.2 mm^3 water displacement is needed for a full range response.

Various types of piezocone penetrometers have been designed, which include 10 and 15 cm^2 three-channel, as well as 1 and 10 cm^2 two-channel types (no sleeve friction measurement). For research purposes, a six-channel 5 cm^2 cone has been constructed, which incorporates four piezo elements at different levels.

Piezocone penetrometers are pushed into the soil at a constant rate of 20 mm/s. On request, other penetration rates can be offered. During penetration, the dynamic pore water pressures are recorded continuously and simultaneously with the cone resistance and sleeve friction, if applicable. When the penetration test is stopped at any level, dissipation of the pore pressure can be recorded on a time scale for obtaining permeability data on the soil.

All measurements can be recorded on magnetic media to facilitate data processing. This allows easy preparation of derived data such as q_t, B_q, etc.

A typical result of a piezocone penetration test (PCPT) is given on Figure 2.

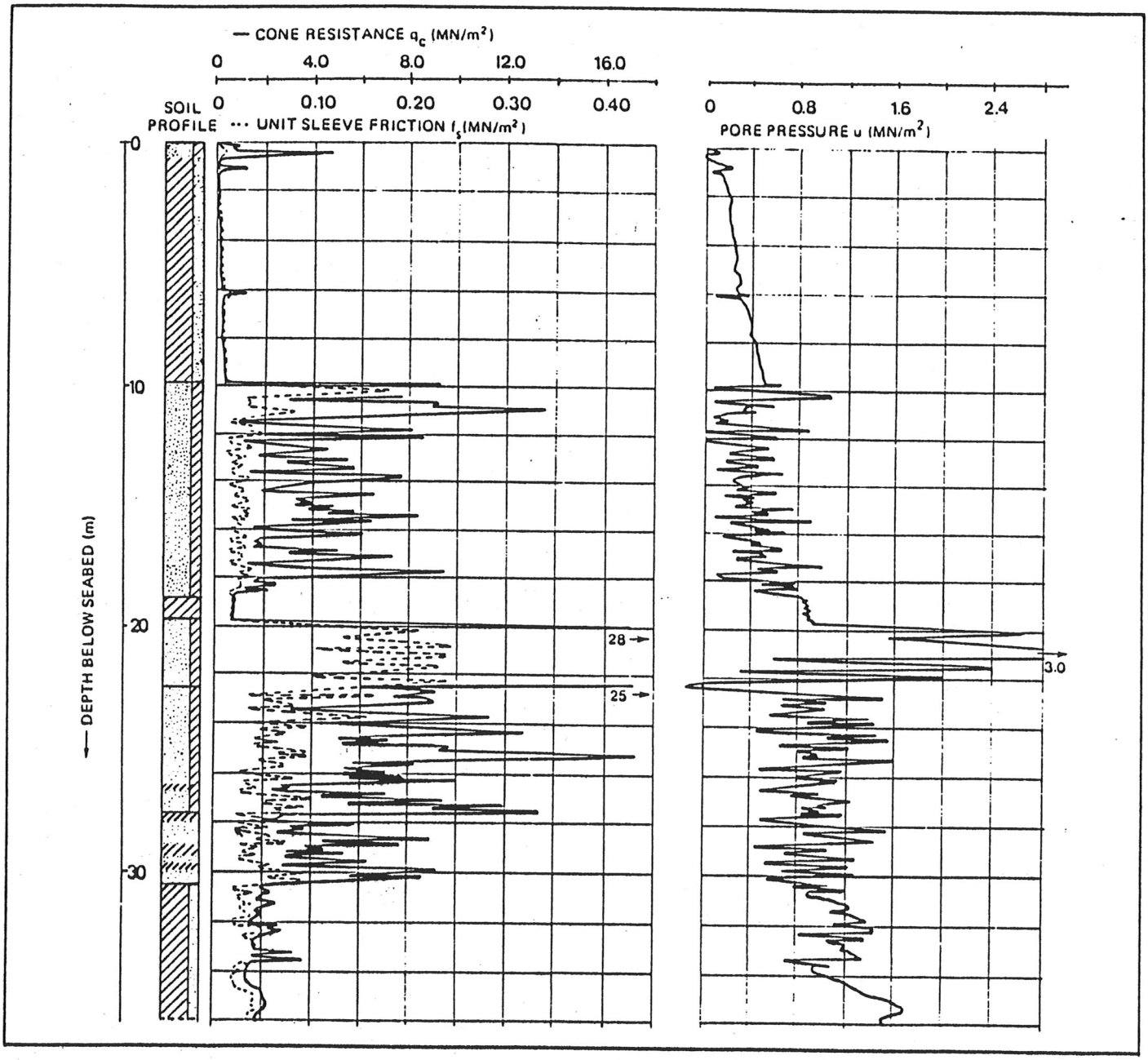


FIGURE 2 : Results obtained using the piezocone penetrometer

Fugro Geosciences, Inc.
6105 Rookin
Houston, Texas 77074
Phone (713) 778-5580
Fax (713) 778-5501

Fugro Geosciences, Inc.
13049 East Florence Avenue
Santa Fe Springs, California 90670
Phone (310) 903-0055
Fax (310) 903-9005

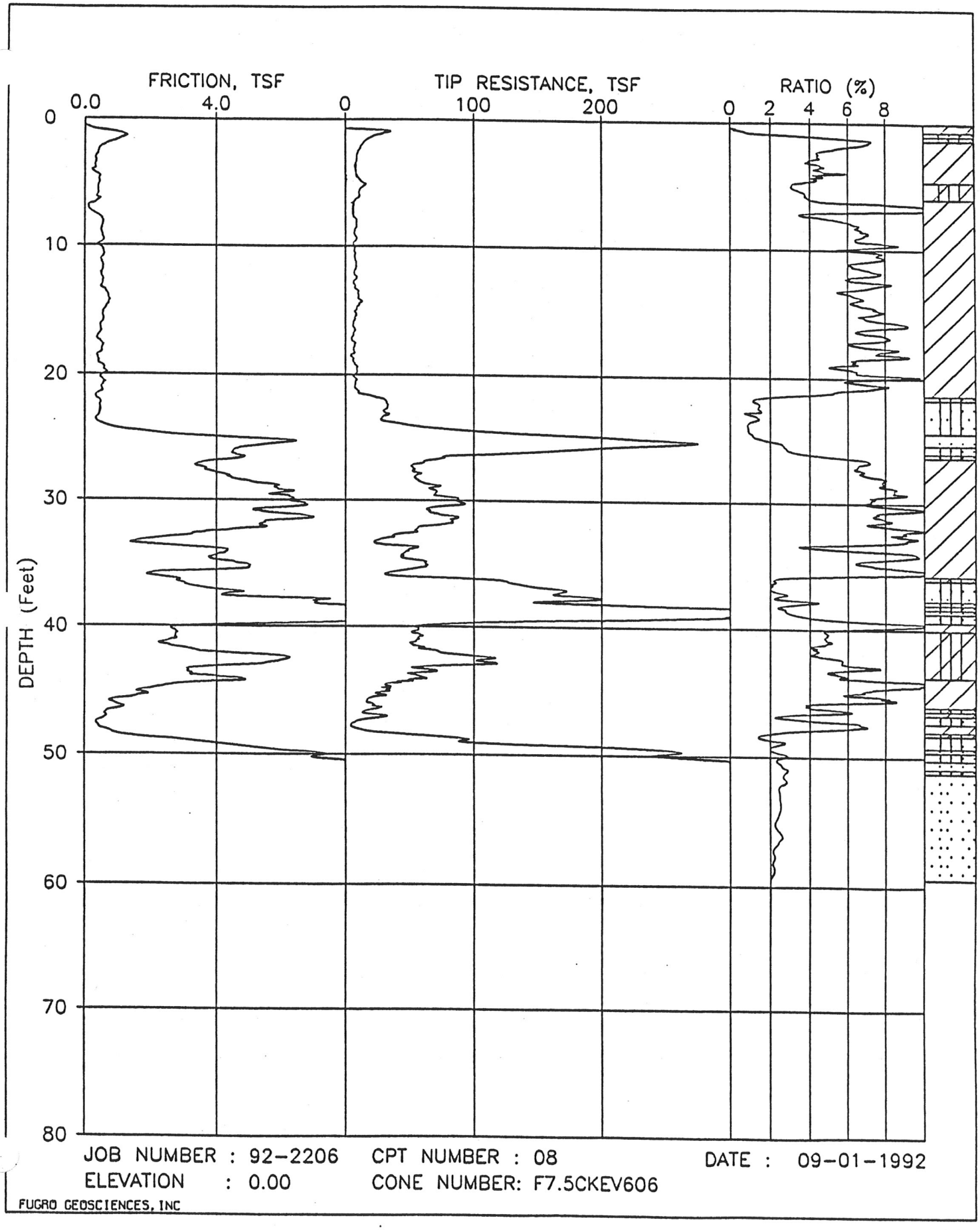
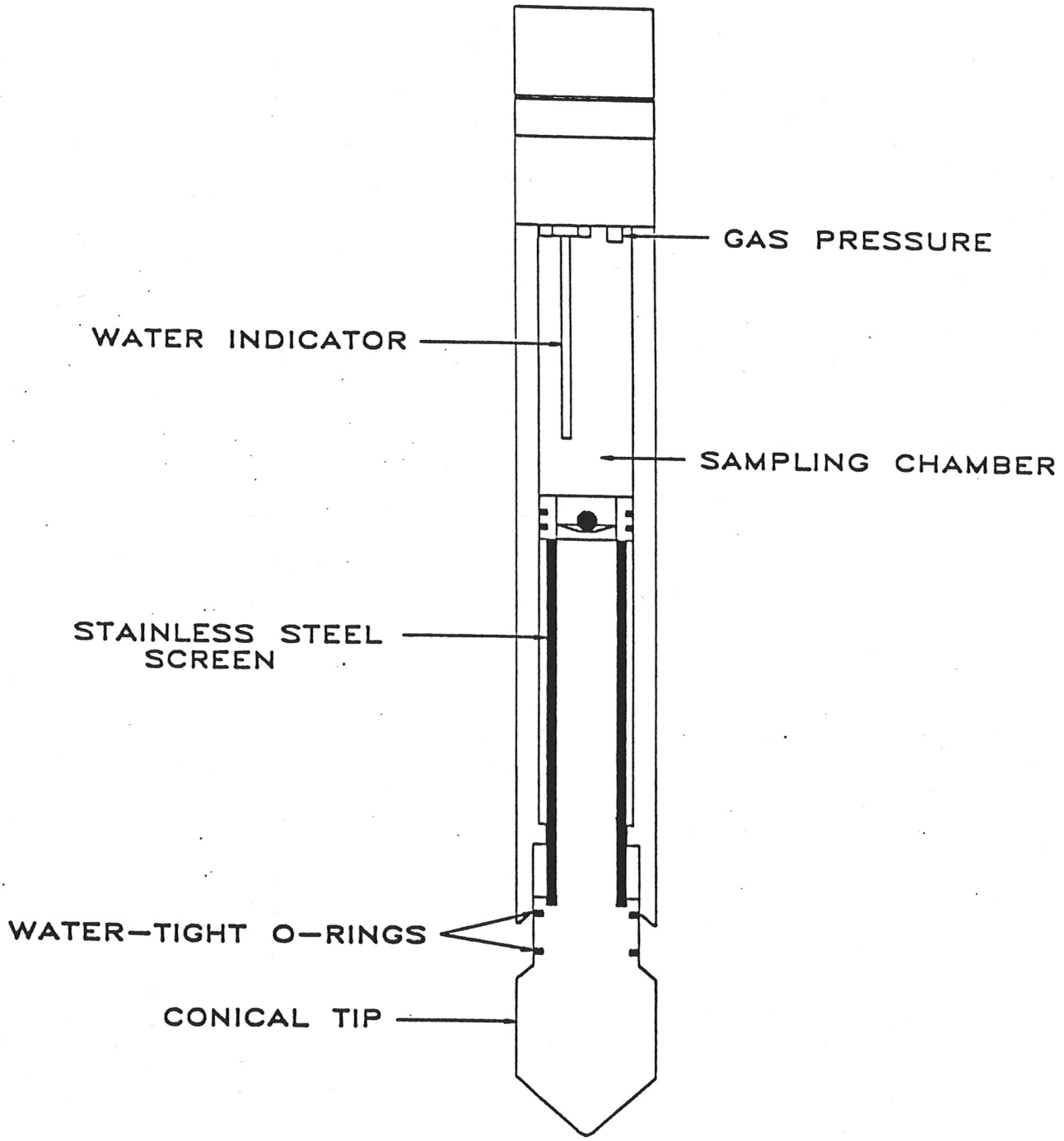

FRICTION, TSF
0.0
4.0
TIP RESISTANCE, TSF
0
100
200
RATIO (%)
0
2
4
6
8
DEPTH (Feet)
0
10
20
30
40
50
60
70
80
JOB NUMBER : 92-2206
CPT NUMBER : 08
DATE : 09-01-1992
ELEVATION : 0.00
CONE NUMBER: F7.5CKEV606
FUGRO GEOSCIENCES, INC

PLATE 2



PUSH-IN HYDRO TRAP SAMPLER

PLATE 4

Standard Operating Procedure No. 101
Bench Top Fluorescence Intensity Measurements

Step Number	Procedure
1	Ensure that the system is set up with the fiber optic cable length, window type, and excitation that is consistent with the field work.
2	Ensure that the entire cone sub-assembly is held firmly in place and properly supports the sample clamping apparatus.
3	Start the laser system as normally operated and as described in the ROST operator's manual. **Note: In all the following steps, expose the sample or reference solution to excitation energy for the shortest time possible to accomplish the step. This will minimize the effects of photodegradation, volatilization, etc.**
4	Save the reference signal and perform a WTM on the reference solution, the bare window, and a representative sample of the material being tested. Adjust the system as necessary.
5	Define a WTM experiment with the desired parameters for excitation wavelength, emission wavelength and slit width. These operating parameters should be similar to those that were used in the field data acquisition process.
6	Save the reference signal at the same emission wavelength used in the acquisition of the field data. This emission wavelength will be used for all sample analysis.
7	Start the WTM experiment, giving it a name and comments associated with the source of the samples. Record the information on cable, mirror, cone, etc., in the comments field.
	Perform the following steps for each different sample
8	If the sample is liquid, position the window horizontally and put a few drops of the liquid right on the sapphire window. Additional liquid may be added to the window during the experiment to have an adequate volume of sample in contact with the window throughout the sampling process. Alternatively, put the liquid sample into a cuvette and place it over the cone window. If the sample is solid (soil), **homogenize** the sample, fasten the soil clamping apparatus over the window and insert the **homogenized** sample into the device, ensuring that the sample is in contact with the sapphire window.
9	Once the homogenized sample has been placed in the sampling device, a full range (300 to 500 nm) WTM is acquired for identification analysis. Record the identity of the sample and any other comments about it. Give the associated WTM file a name related to the particular sample.
10	Remove the sample from the window, return it to the source container, and thoroughly clean the window with alcohol.
11	A different portion of the homogenized sample is placed into the sampling device and a narrow band WTM (e.g. 340 to 340.5 nm in 0.1 nm steps) is performed to obtain fluorescence intensity at the monitored emission wavelength. Remove the sample from the window, return it to the source container, and thoroughly clean the window with alcohol
12	Repeat this step for a total of three fluorescence intensity readings for the sample.
13	Calculate standard deviation of the three intensity values. The standard deviation must be below 20%. If the standard deviation is greater than or equal to 20%, collect additional intensity readings until standard deviation of all of the tests is less than 20%, or disqualify the sample.
14	The remainder of the homogenized sample will be labeled and preserved in accordance with standard laboratory protocol. Sample will be sent by overnight courier to an environmental testing laboratory for Total Recoverable Hydrocarbons (TRPH) by EPA method 418.1 or other suitable TPH test methods.
15	After receipt of the laboratory data, the fluorescence intensity and laboratory values for each sample will be tabulated. A "Best-Fit Line" will be developed to illustrate the relationship between fluorescence intensity and laboratory values in mg/kg using the following statistical method: 1) plot a scatter diagram of fluorescence intensity versus concentration; 2) develop the least squares regression equation; 3) superimpose the least squares line ("best-fit line") on the scatter diagram and; 4) use the least squares line to relate fluorescence intensity to concentration values in mg/kg. **Note: In some cases (i.e. where laboratory values include concentrations greater than 3000 mg/kg or the need for low concentration values) linear regression may not be appropriate for the entire data set. For these data sets, the fluorescence and laboratory data will be regressed to develop a mathematical relationship between the two values. This procedure is the Lockheed Martin method for developing a site-specific relationship between fluorescence intensity and TPH laboratory results. Based on this procedure, a site-specific limit of detection also is determined.**

Revised 4/24/96

Industrial Compliance

10025 W. Technology Blvd., Suite 147 Dallas, TX 75220 214/352-9400 FAX 214/352-3200

November 3, 1995

IC Project No. 44102069

Mr. Steve Omo
Permits Ground Water Team - MC 130
Industrial and Hazardous Waste Division
Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, Texas 78711-3087

Via Facsimile
(512) 239-6383

Re: Southern Pacific Transportation Company (SPTCo)
4910 Liberty Road Facility, Houston
Post-Closure Care Permit No. HW-50343-000
ISWR No. 31547; EPA ID No. TXD00820266
Extent of Contamination Work Plan Implementation

Dear Mr. Omo:

On October 24, 1995, Southern Pacific Transportation Company indicated a tentative start date of November 7, 1995, for the initiation of field work under the EOC investigation and committed to a minimum of two days prior notification should the tentative start date change. SPTCo has elected to combine cone penetrometer (CPT) with Rapid Optical Screening Technology (ROST) to investigate subsurface soil stratigraphy and provide initial analytical screening of potential constituent concentrations within the soil.

On behalf of SPTCo, Industrial Compliance (IC) is providing notice that the tentative start date has been revised to Tuesday, November 14, 1995. This revised start date is based on CPT rig and ROST equipment availability, and allows adequate time to complete site preparation for rig access in coordination with the City of Houston Transportation Department and the City of Houston Parks and Recreation Department. Within five days of the start date of field investigations, SPTCo will submit an updated schedule for completion of the EOC investigation to the TNRCC as requested.

In accordance with Provision XIII.B of the Compliance Plan, notice of our intended schedule will be provided by copy of this letter to TNRCC Region 12 - Houston Office to afford regional personnel the opportunity to observe these events and collect samples. We will be pleased to cooperate with TNRCC staff in these efforts.

/u/ehanfo/hwpw/eoc/cpt-note-1.ltr

If you have any questions, please feel free to contact either Mr. Curt Jones at (913) 696-1300 or the undersigned at (214) 352-9400.

Sincerely,

INDUSTRIAL COMPLIANCE

Elaine J. Hanford
Project Manager

cc: TNRCC Region 12 - Houston
C. Jones - IC
A. Molnar - SP EAG

Industrial Compliance

6200 Rothway, Suite 190 Houston, TX 77040
713/460-4230 FAX 713/460-4227

November 13, 1995

IC Project No. 44102069

Ms. Cindy Garrigan - MC 127
Industrial and Hazardous Waste Division
Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, Texas 78711-3087

Via Facsimile
(512) 239-2346

Re: Southern Pacific Transportation Company (SPTCo)
4910 Liberty Road Facility, Houston
Post-Closure Care Permit No. HW-50343-000
ISWR No. 31547; EPA ID No. TXD00820266
RCRA Facility Investigation Work Plan Implementation

Dear Ms. Garrigan:

As we discussed on November 8, 1995, Southern Pacific Transportation Company (SPTCo) has elected to combine cone penetrometer (CPT) with Rapid Optical Screening Technology (ROST) to investigate subsurface soil stratigraphy and provide initial analytical screening of potential constituent concentrations within the soil. Further, this letter confirms our current schedule for conducting field investigation under the RFI beginning on November 16, 1995, with an expected completion on or about November 22, 1995. This start date has allowed for CPT rig and ROST equipment availability, and adequate time to complete the CPT/ROST work offsite under the Extent of Contamination Work Plan being coordinated with Mr. Steve Omo of TNRCC Permits Section. In accordance with Provision XIII.B of the Compliance Plan and Provision VIII. G of the Permit, notice of our schedule was provided by letter on November 3, 1995, to TNRCC Region 12 - Houston Office to afford regional personnel the opportunity to observe these events and collect samples. We will be pleased to cooperate with TNRCC staff in these efforts.

If you have any questions, please page me at (800) 759-7243, pin 837-9673 or leave a message for me at my office at (214) 352-9400.

Sincerely,

INDUSTRIAL COMPLIANCE

Elaine J. Hanford
Project Manager

cc: C. Jones - IC
A. Molnar - SP EAG

APPENDIX B

AIC WATER WELL SEARCH

AIC
Agency Information Consultants, Inc.
Information for a Changing World

RECEIVED
SEP 15 1995

September 13, 1995

Bill Goldsby
Industrial Compliance
6200 Rothway, Ste 190
Houston, Texas 77040

Re: AIC Job #02-0045405
Water and Monitor
Well Search
Liberty & Cashmere
Houston, Texas

Dear Mr. Goldsby:

At your request, Agency Information Consultants, Inc. (AIC) has reviewed records and maps on file at the Texas Water Development Board (TWDB) and the Texas Natural Resource Conservation Commission (TNRCC) and has plotted all water wells of record located within the requested Area of Review (AOR) on the enclosed map. AIC does not guarantee the accuracy of the information as provided by the original sources, nor can we guarantee that no plotting errors have occurred. The purpose of these maps is to give the user a "working approximation" of the positions of reported well locations. AIC performs water well research using the following protocol:

1. Transfer all "located" and "plotted" water wells found within the Area of Review (AOR) from TWDB county highway maps onto the enclosed map.

2. Transfer all "located" water wells found within the AOR from TWDB USGS 7.5 minute topographic maps onto the enclosed map.

3. Copy "located" schedules/logs for wells found within the AOR from TWDB files.

4. Examine all "plotted" well files for "partially plotted" well locations found within the AOR, and obtain copies of drillers' logs at the TNRCC.

5. Examine all "unnumbered" well logs and drillers' maps, filed by county, to determine wells located within the AOR. Obtain copies of drillers' logs for wells located within the AOR, from the TNRCC.

6. Examine the "DIM" file for monitor wells within the AOR. Obtain copies of the well logs from the TNRCC.

The following is a brief explanation of terms as used in this letter:

Located water well - Well whose location has been field checked by a TWDB or USGS staff member, spotted on a USGS 7.5' topographical and/or county highway map, and filed at the TWDB.

P.O. Box 2181 Austin, Texas 78768-2181 Tel (512) 478-8991 Fax (512) 478-5215

Plotted water well - Well whose appoximate location is based on information submitted on drillers' logs and spotted on county highway maps by TWDB staff members. NOTE: The TWDB stopped this procedure in June 1986.

Partially numbered - Any well with records processed from June 1986 through June 1991. Well locations are based on maps submitted with driller's logs. Each well is assigned a State ID Number by the TNRCC, establishing the location to within a 2.5 minute topographic quad.

Unnumbered well - Any well with records processed since June 1991. Well logs and drillers maps are filed by county at the TNRCC.

Monitor well - Monitor wells are filed in the DIM (De-watering, Injection, and Monitor) well file. These well logs are filed by county and are kept at the TNRCC.

** Additionally, an unplotted water well file exists that consists of wells predating 1967. These wells are considered "unlocatable" due to inadequate site maps and addresses. Due to the large number of wells found in this file and the lack of adequate location maps, AIC does not examine these files unless a request has been made.

SUMMARY

Our research has identified 28 wells within the area of review. There are 7 located water wells, 3 plotted water wells, 1 partially numbered water well, no unnumbered water wells, and 17 monitor wells. The following is a listing of the wells found. The final digits of each well number correspond to well numbers on the enclosed map.

LOCATED WATER WELLS

65-14-406
65-14-735 *
65-14-738 *
65-14-742 *
65-14-745 *
65-14-746 *
65-14-759 *

* - Note: The above Located Wells with an asterisk are all located in same area according to TWDB maps. They are all located on the enclosed map at the postion marked 735.

PLOTTED WATER WELLS

65-14-4F
65-14-7J (2 wells)

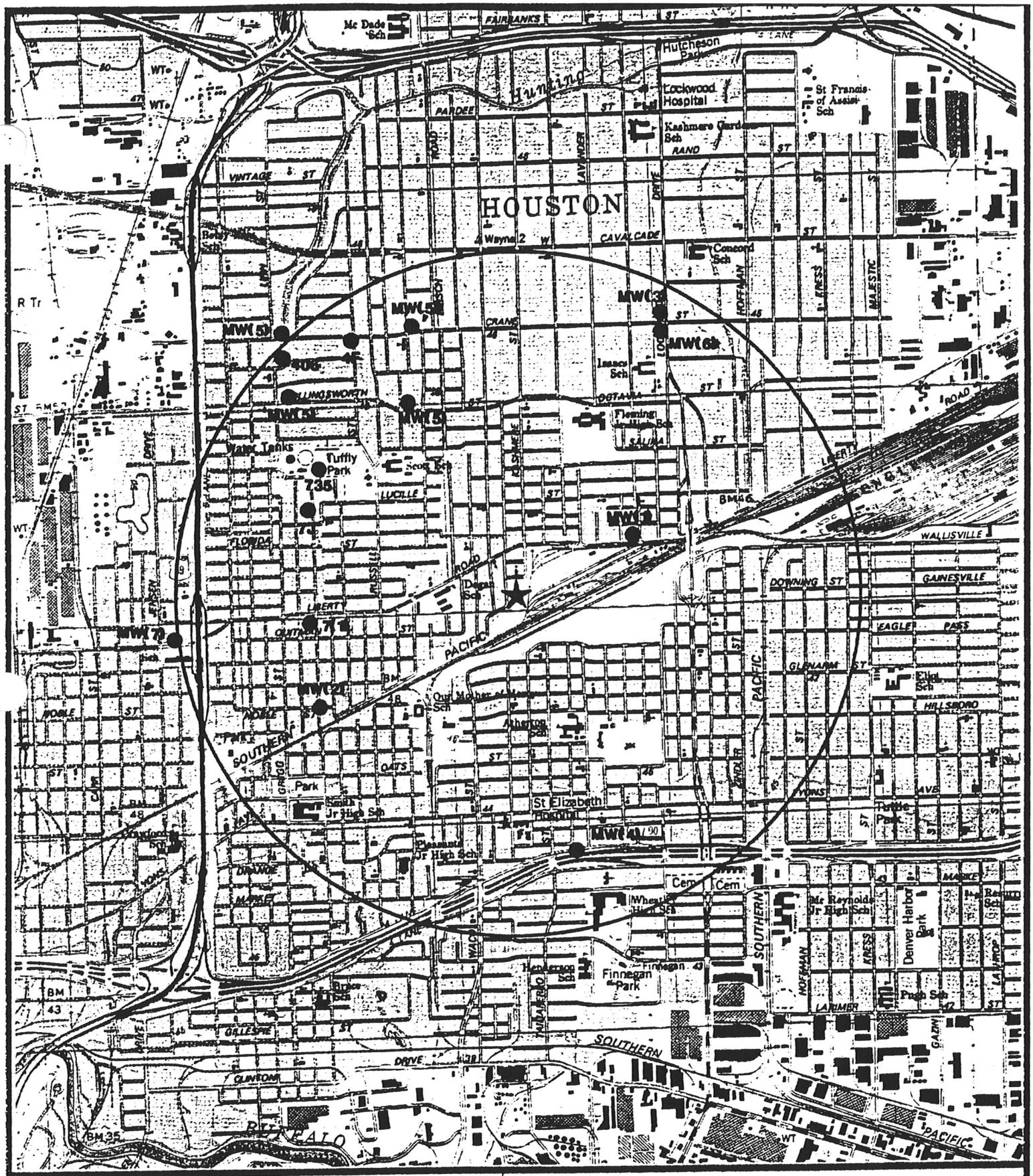
PARTIALLY NUMBERED WATER WELLS
65-14-7(1)

UNNUMBERED WATER WELLS
None Found

MONITOR WELLS
MW(1) (2 wells)
MW(2)
MW(3) (4 wells)
MW(4) (4 wells)
MW(5) (4 wells)
MW(6)
MW(7)

Thank you for using AIC for this research project. If you have any questions regarding this project or any future projects please call me at 512-478-8991.

Diane Barnes
Production Manager



Industrial Compliance Topographic Map Prepared by Agency Information Consultants, Inc.	Site: Liberty Road & Kashmere Houston, Texas
AIC #02-0045405 1 Mile Water & Monitor Well Search	Settegast (1982), TX 7.5' USGS Quad, Scale 1:24000

April 1966

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

-D-

MASTER CARD (T. BROWN)

Record by R.B.A. (5-10-61) Source of data FILES Date 2-20-68 Map 1:24000 Settegast 1955

State Texas [48] County (or town) Harris [LJ]

Latitude: 29 47 45 N/S Longitude: 095 20 10 Sequential number: 1

Lat-long accuracy: 1 T. ____ S, R ____ W, Sec ____, ____, ____, ____

Local well number: LJ-65-14-406 Other number: B & M NORTHEAST #3

Local use: ____ Owner or name: CITY OF HOUSTON

Owner or name: CITY OF HOUSTON Address: ____

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist ____ M

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Mnd, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other ____ P

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (O) Obs, (Φ) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed W

DATA AVAILABLE: Well data 1 Freq. W/L meas.: 1944 -- Annual A Field aquifer char. ____

Hyd. lab. data: ____

Qual. water data; type: ____

Freq. sampling: 3-22-48 A Pumpage inventory: yes / no, period: ____

Aperture cards: ____ yes

Log data: E-LOG 0-2510 D-LOG E D

WELL-DESCRIPTION CARD — WELL DRILLED TO 2510' & PLUGGED BACK TO 1993

SAME AS ON MASTER CARD Depth well: 1993 ft 1973 Meas. rept Driller accuracy 3

Depth cased: (first perf.) 1143 ft 1143 Casing type: S ; Diam. 24-12¾ in 24

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (Φ) open end, (P) perf., screen, sd. pt., (S) shored, (T) open hole, (W) other ____ G

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other ____ H

Date Drilled: 5-15-44 944 Pump intake setting: ____ ft

Driller: LAYNE-TEXAS CO. (name), HOUSTON, TEX. (address)

Lift (type): (A) air, (B) bucket, cent, (C) cent, jet, (J) multiple, (cent.), (L) multiple, (turb.), (M) none, piston, rot, submerg, (R) turb, (S) other T Deep Shallow D

Power (type): diesel, elec, gas, gasoline, hand, gas, wind; H.P. ____ 5 Trans. or meter no. ____

Descrip. MP ____ ft above below LSD. Alt. MP ____

Alt. LSD: 50 50 Accuracy: (source) Topo 5' 3

Water Level 111.68 ft above below MP, Ft above below LSD Accuracy: ____

Date meas: 6-21-44 644 Yield: 2525 gpm 2525 Method determined ____

Drawdown: 68 ft 68 Accuracy: USGS tape WD Pumping period 96 hrs ____

QUALITY OF WATER DATA: Iron ppm ____ Sulfate ppm ____ Chloride ppm ____ Hard. ppm ____

Sp. Conduct ____ K x 10^6 ____ Temp. ____ °F ____ Date sampled ____

Taste, color, etc. ____

PL 179.18 / 111.68 / 67.50

Well No. LJ-65-14-406

Well No. LJ-65-14-406

Latitude-longitude 29 47 45 N 095 20 10
d m s d m s

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19)

Physiographic Province: COASTAL PLAINS 03 (20–21) Section:

F (22) Drainage Basin: 51R (23–25) Subbasin: (26)

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (O) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat (27)

MAJOR AQUIFER: system, series T (28–29) aquifer, formation, group E (30–31)

Lithology: (32–33) Origin: (34) Aquifer Thickness: ft

(35–37) Length of well open to: 267 ft 267 (38–40) Depth to top of: ft (41–43)

MINOR AQUIFER: system, series (44–45) aquifer, formation, group (46–47)

Lithology: (48–49) Origin: (50) Aquifer Thickness: ft

(51–53) Length of well open to: ft (54–56) Depth to top of: ft (57–59)

Intervals Screened: 1,142'11" - 1969'6"

Depth to consolidated rock: ft (60–63) Source of data: (64)

Depth to basement: ft (65–68) Source of data: (69)

Surficial material: (70–71) Infiltration characteristics: (72)

Coefficient Trans: ✓ gpd/ft (73–75) Coefficient Storage: (76–78)

Coefficient Perm: ✓ gpd/ft^2; Spec cap: ✓ gpm/ft; Number of geologic cards: (79)

CASING:

558' of 24"

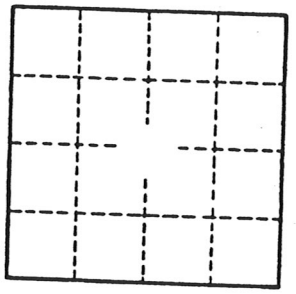
1,554 of 12 3/4"

12 3/4" from 439 to 1993

SURFACE CASING CEMENTED.
HOLE APPARENTLY 24" TO 1995'6" & GRAVEL PACKED.
TOP OF GRAVEL @ 455'

12 SCREENS @

1142'11" - 1146'11"
1149'5" - 1167'6"
1190'11" - 1209'10"
1220'3" - 1238'7"
1241' - 1259'10"
1300'6" - 1319'9"
1340'1" - 1354'7"
1379'10" - 1388'11"
1391'4" - 1409'6"
1514'5" - 1533'3"
1535'9" - 1553'6"
1574'11" - 1583'1"
1779'9" - 1799'
1801'6" - 1818'
1848'6" - 1863'5"
1865'10" - 1878'
1950'5" - 1969'6"



Well No. LJ-65-14-406

GPO 857-700

(11-74)

Water Resources Division
Austin, Texas

020978

Latitude ° ' "	Longitude ° ' "	Seq. No.
294745	095201	001

County code 201 County HARRIS

Well # LJ-65-14-406

Project number 7-4648-01000

Date 2-8-77 Time ____ Temp°C 28.5

Owner City of Houston

Address NORTHEAST #3

Date drld 5-15-44 WBF code 121 EVGL

Sample interval: (top) 1142 (bottom) 1969

Water level ____ Appr Clear Use PS

Collector Butler Yield — GPM

Smpld aftr pmpg ____ Depth 1993

Pt of coll top on discharge

Field: Cond ____ pH ____ HCO_3 ____ DO ____

Indicate types of analyses

Coliform Phenols Minors

Nutrients MBAS BOD TOC DOC

Std chem schedule ____

Other ____

Herbicide ____ Insecticide ____

Remarks:

Type 2 (1) Station identification number 294745095201001 (2–16)

Y M D (17–22) Begin

Time of measurement (29–32)

	Parameter code	Value	Exp.	Rmk
Depth	72008	1993	04	
Yield (GPM)	00059			
Sample interval	72015	1142	04	
Sample interval BOTTOM	72016	1969	04	
Water level	72019			

	Parameter code	Value	Exp.	Rmk	
Sampled after pumping	72004				
DO (mg/l)	00300				
DO % Sat.	00301				
Temp °C	00010	2850	02		28.5
pH	00400	7900	01		7.9
Specific conductance	00095	6630	03		663
HCO_3	00440	3170	03		317
CO_3	00445	0000	01		0
Chloride (Cl)	00940	5700	02		57
Sulfate (SO_4)	00945	2800	01		2.8
Color	00080				
Coliform, membrane filter	31501				
Coliform, fecal	31625				
Strep-tococci	31673				
BOD	00310				

(1-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
Water Resources Division
Austin, Texas

017564

Latitude ° ' " 29 47 45 | Longitude ° ' " 095 20 10 | Seq. No. 01

County code 201 County Harris

Well # CJ-65-17-406

Project number 4648-01000

Date 2-4-76 Time — Temp°C 29.0

Owner City of Houston

Address South East #3

Date drld — WBF code 121 EVGL

Sample interval: (top) 1142 (bottom) 1969

Water level — Appr Clear Use PS

Collector Moffat Yield — GPM

Smpld aftr pmpg Unknown Depth —

Pt of coll tap on discharge

Field: Cond ____ pH ____ HCO_3 ____ DO ____

Indicate types of analyses

Coliform | Phenols | Minors

Nutrients | MBAS | BOD | TOC | DOC

Std chem schedule I

Other

Herbicide ____ Insecticide ____

Remarks:

Type 2 | Station identification number 29 47 45 095 20 10 01

1 2 9 16

Y M D: 76 02 04 — Begin 17 22

Time of measurement: 29 32

	Parameter code	Value	Exp.	Rmk
Depth	72008			
Yield (GPM)	00059			
Sample interval	72015	1142	02	
Sample interval BOTTOM	72016	1969	02	

	Parameter code	Value	Exp.	Rmk	
Sampled after pumping	72004				
DO (mg/l)	00300				
DO % Sat.	00301				
Temp °C	00010	2900	02		29.0
pH	00400	8100	01		8.1
Specific conductance	00095	6950	03		695
HCO_3	00440	3200	03		320
CO_3	00445	0000	01		0
Chloride (Cl)	00940	6300	02		63
Sulfate (SO_4)	00945	5200	01		5.2
Color	00080				
Coliform, membrane filter	31501				
Coliform, fecal	31616				
Strep-tococci	31679				
BOD	00310				

Austin, Texas

025136

Latitude ° ' "	Longitude ° ' "	Seq. No.
29 47 45	~~0952~~ 0 10	01

County code 201 ~~LJ~~ County Harris

Well # LJ-65-14-406

Project number 5-4648-01000

Date 2-3-75 Time _____ Temp °C 29.5

Owner City of Houston

Address Northeast # 3

Date drld 5-15-44 WBF code 121EVCL

Sample interval: (top) 1142 (bottom) 1969

Water level _____ Appr _____ Use PS

Collector Naftel Yield _____ GPM

Smpld aftr pmpg on arr. Depth 1993

Pt of coll tap on pipe

Field: Cond _____ pH _____ HCO_3 _____ DO _____

Indicate types of analyses

Coliform Phenols Minors

Nutrients MBAS BOD TOC DOC

Chem schedule I + SO_4

Other _____

Herbicide _____ Insecticide _____

Remarks:

Type 2 (1)

Station identification number 29 47 45 09 52 01 00 1 (2–16)

Y	M	D
75	02	03

17 Begin 22

Time of measurement _____ (29–32)

	Parameter code	Value	Exp.	Rmk
Depth	72008	1993	04	
Yield (GPM)	00059			
Sample interval TOP	72015	1142	04	
Sample interval BOTTOM	72016	1969	04	
Water level	72019			

	Parameter code	Value	Exp.	Rmk	
Sampled after pumping	72004				
DO (mg/l)	00300				
DO % Sat.	00301				
Temp °C	00010	2950	02		29..
pH	00400	7700	01		7.7
Specific conductance	00095	7210	03		72
HCO_3	00440	3290	03		32
CO_3	00445	0000	01		0
Chloride (Cl)	00940	7800	02		78
Sulfate (SO_4)	00945	4000	01		4..
Color	00080				
Coliform, membrane filter	31501				
Coliform, fecal	31616				
Strep-tococci	31679				
BOD	00310				

Water ... Austin, Texas

Latitude ° ' "	Longitude ° ' "	Seq. No.
294745	0952010	01

County code 101 County Harris

Well # LJ-65-14-406

Project number T-4648-01000

Date 9-9-76 Time — Temp°C 20.0

Owner City of Houston

Address Northeast # 3

Date drld — WBF code 121 Evgl

Sample interval: (top) 1142 (bottom) 1969

Water level — Appr Clear Use PS

Collector King & Bezant Yield — GPM

Smpld aftr pmpg on arrival Depth —

Pt of coll tap on discharge

Field: Cond — pH — HCO_3 — DO —

Indicate types of analyses

Coliform Phenols Minors

Nutrients MBAS BOD TOC DOC

chem schedule I

Other

Herbicide Insecticide

Remarks:

Type 2 (1) Station identification number 294745095201001 (2–16)

Y M D 76 09 09 (17–22) Begin

Time of measurement (29–32)

	Parameter code	Value	Exp.	Rmk
Depth	72008			
Yield (GPM)	00059			
Sample interval TOP	72015	1142	04	
Sample interval BOTTOM	72016	1969	04	
Water level	72019			

	Parameter code	Value	Exp.	Rmk	
Sampled after pumping	72004				
DO (mg/l)	00300				
DO % Sat.	00301				
Temp °C	00010	2000	02		20.
pH	00400	7800	01		7.8
Specific conductance	00095	6580	03		658
HCO_3	00440	3190	03		319
CO_3	00445	0000	01		0
Chloride (Cl)	00940	5700	02		57
Sulfate (SO_4)	00945	2800	01		2.8
Color	00080				
Coliform, membrane filter	31501				
Coliform, fecal	31616				
Strep-tococci	31679				
BOD	00310				

April 1966

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

MASTER CARD

Record by: RS SONENSHEIN Source of data: DRILLER'S LOG Date: 2-11-80 Map: SETTEGAST, TX 1967 1:24,000

State: TEXAS [48] County (or town): HARRIS [LJ]

Latitude: 29 47 28 N Longitude: 095 20 01 Sequential number: 2

Lat-long accuracy: 1 T ____ N, R ____ E, Sec ____

Local well number: LJ-65-14-735 Other number: NORTHEAST NO. 2

Local use: ____ Owner or name: HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT

Owner or name: HGCSD Address: 1730 NASA RD 1

Ownership: (C) Count., (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist [5]

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Med, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other [4]

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (O) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed. [O]

DATA AVAILABLE: Well data [Y] Freq. W/L meas.: MONTHLY [M] Field aquifer char. [1]

Hyd. lab. data: ____

Qual. water data; type: partial [P]

Freq. sampling: ORIGINAL [O] Pumpage inventory: yes (no) period: ____

Aperture cards: ____ yes

Log data: DRILLER'S log [D]

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 1596 ft [1596] Meas. rept accuracy [3]

Depth cased: (first perf.) 1567 ft [1567] Casing type: steel; Diam. 4½-24 in [9]

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., (S) screen, (T) sd. pt., (W) shored, (X) open hole, (Z) other [5]

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other [H]

Date Drilled: FEB 1980 [80] Pump intake setting: NONE ft

Driller: O'DAY DRLG CO. name, PEARLAND, TX address

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other [N] Deep / Shallow

Power (type): diesel, elec, gas, gasoline, hand, nat gas, LP gas, wind; H.P. ____ Trans. or meter no. ____

Descrip. MP: top of casing +2.0 ft above / below LSD, Alt. MP ____

Alt. LSD: 49 [49] Accuracy (source): 5' TOPO [3]

Water Level 39.55 ft above / below MP; Ft above / below LSD [398] Accuracy: steel tape [A]

Date meas: 4-24-80 [80] Yield: 75 gpm [15] Method determined [I]

Drawdown: ____ ft Accuracy: ____ Pumping period ____ hrs

QUALITY OF WATER DATA: Iron ____ ppm S. [illegible] 8.8 ppm [9] Chloride ____ ppm HCO3 Hard. 390 ppm [7]

Sp. Conduct 980 k x 10^6 [4] Temp. 77.5 °F [78] Date sampled 2-8-80 [280]

Taste, color, etc. ____

Well No.

Well No. [illegible]

Latitude-longitude N S d m s d m s

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19)

Physiographic Province: COASTAL PLAIN (20–21) 03 Section: WEST GULF

(22) F Drainage Basin: [illegible] (23–25) 511R Subbasin: [illegible] (26)

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (Φ) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat [illegible] (27) F

MAJOR AQUIFER: [illegible] system, [illegible] series (28–29) TF EVANGELINE aquifer, formation, group (30–31) E

Lithology: [illegible] (32–33) 5 Origin: [illegible] (34) 3 Aquifer Thickness: 42 ft

(35–37) 42 Length of well open to: 10 ft (38–40) 10 Depth to top of: 1540 ft (41–43) A54

MINOR AQUIFER: [illegible] system, [illegible] series (44–45) [illegible] aquifer, formation, group (46–47) [illegible]

Lithology: [illegible] (48–49) [illegible] Origin: [illegible] (50) [illegible] Aquifer Thickness: [illegible] ft

(51–53) [illegible] Length of well open to: [illegible] ft (54–56) [illegible] Depth to top of: [illegible] ft (57–59) [illegible]

Intervals Screened: 1567-1577 SS WW [illegible] NO. 10 GAUGE 2½" OD

Depth to consolidated rock: [illegible] ft (60–63) [illegible] Source of data: [illegible] (64) [illegible]

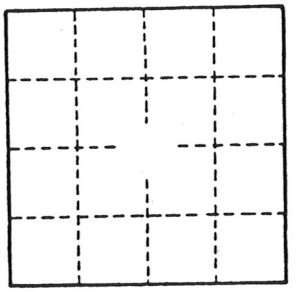
Depth to basement: [illegible] ft (65–68) [illegible] Source of data: [illegible] (69) [illegible]

Surficial material: [illegible] (70–71) [illegible] Infiltration characteristics: [illegible] (72) [illegible]

Coefficient Trans: 21 gpd/ft (73–75) 200 Coefficient Storage: [illegible] (76–78) [illegible]

Coefficient Perm: [illegible] gpd/ft^2; Spec cap: [illegible] gpm/ft; Number of geologic cards: [illegible] (79)

sample for water quality obtained by jetting with air



Well No.

GPO 857-700

April 1966

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

MASTER CARD

Record by RS SONENSHEIN Source of data DRILLER LOGS Date 2-13-80 Map SETTEGAST, TX 1967 1:24,000

State TEXAS 48 County (or town) HARRIS LJ

Latitude: 29 47 28 N Longitude: 095 20 01 Sequential number: 3

Lat-long accuracy: 1 T ____ N S, R ____ E W, Sec ____

Local well number: LJ-65-14-738 Other number: B & M NORTHEAST No. 4

Local use: Owner or name: HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT

Owner or name: HGCSD Address: 1730 NASA RD 1

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist — S

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Med, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other — U

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (O) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed. — O

DATA AVAILABLE: Well data 2 Freq. W/L meas.: MONTHLY M Field aquifer char. T

Hyd. lab. data:

Qual. water data; type: partial P

Freq. sampling: ORIGINAL O Pumpage inventory: yes (no) period:

Aperture cards: yes

Log data: DRILLER'S D

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 487 ft 487 Meas. rept ____ accuracy 3

Depth cased: (first perf.) 472 ft 472 Casing type: steel; Diam. 4½-2½ in 4

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., screen, (S) sd. pt., (T) shored, (W) open hole, (Z) other — S

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other — H

Date Drilled: FEB 1980 980 Pump intake setting: NONE ft

Driller: O'DAY DRLG CO name, PEARLAND, TX address

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other — N Deep ____ Shallow ____

Power (type): diesel, elec, gas, gasoline, hand, gas, wind; nat LP H.P. — Trans. or meter no. —

Descrip. MP Top of casing +2.0 ft above below LSD, Alt. MP ____

Alt. LSD: 49 49 Accuracy: (source) 5' TOPO 3

Water Level 264.69 ft above below MP; Ft above (below) LSD 265 Accuracy: steel tape A

Date meas: 3-18-80 380 Yield: 7.5 gpm 8 Method determined 1

Drawdown: ____ ft Accuracy: ____ Pumping period ____ hrs

QUALITY OF WATER DATA: Iron ____ ppm pH 8.7 9 Chloride ____ ppm Hard. HCO3 200 ppm 5

Sp. Conduct 500 K x 10^6 3 Temp. 73.5 °F 73 Date sampled 2-15-80 280

Taste, color, etc.

Well No.

Latitude-longitude N S
d m s d m s

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19) Physiographic Province: COASTAL PLAIN [0 3] (20–21) Section: WEST GULF

[F] (22) Drainage Basin: [5 1 R] (23–25) Subbasin: [ ] (26)

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (O) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat [F] (27)

MAJOR AQUIFER: system, series [Q] (28–29) Chicot aquifer, formation, group [C] (30–31)

Lithology: [S] (32–33) Origin: [3] (34) Aquifer Thickness: 66 ft

[6 6] (35–37) Length of well open to: 10 ft [1 0] (38–40) Depth to top of: 476 ft [4 7 6] (41–43)

MINOR AQUIFER: system, series [ ] (44–45) aquifer, formation, group [ ] (46–47)

Lithology: [ ] (48–49) Origin: [ ] (50) Aquifer Thickness: ft

[ ] (51–53) Length of well open to: ft [ ] (54–56) Depth to top of: ft [ ] (57–59)

Intervals Screened: 472-482 SSWW No 10 ga 2½" OD

Depth to consolidated rock: ft [ ] (60–63) Source of data: [ ] (64)

Depth to basement: ft [ ] (65–68) Source of data: [ ] (69)

Surficial material: [ ] (70–71) Infiltration characteristics: [ ] (72)

Coefficient Trans: 157 gpd/ft [1 6 1] (73–75) Coefficient Storage: [ ] (76–78)

Coefficient Perm: gpd/ft^2; Spec cap: gpm/ft; Number of geologic cards: [ ] (79)

sample for water quality obtained by jetting with air

Well No.

GPO 857-700

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

MASTER CARD

Record by: RS SONENSHEIN Source of data: DRILLER & OBS Date: 2-21-80 Map: SETTEGAST, TX 1967 1:24,000

State: TEXAS [4 8] County (or town): HARRIS [L J]

Latitude: 2 9 4 7 2 8 N (deg, min, sec) Longitude: 0 9 5 2 0 0 1 (degrees, min, sec) Sequential number: [4]

Lat-long accuracy: [1] T ___ N S, R ___ E W, Sec ___, ___ ¼, ___ ¼, ___ ¼ ___ B & M

Local well number: L J - 6 5 - 1 4 - 7 4 2 Other number: NORTHEAST NO. 3

Local use: ___ Owner or name: HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT

Owner or name: HGCSD Address: 1730 NASA RD 1

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist ___ [S]

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Med, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other ___ [U]

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (Ø) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed. [Ø]

DATA AVAILABLE: Well data [2] Freq. W/L meas.: MONTHLY [M] Field aquifer char. [T]

Hyd. lab. data: ___

Qual. water data; type: partial [P]

Freq. sampling: ORIGINAL [Ø] Pumpage inventory: yes (no) period: ___

Aperture cards: ___ yes

Log data: DRILLER'S log [D]

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 1035 ft [1 0 3 5] Meas. rept ___ accuracy [3]

Depth cased: (first perf.) 1020 ft [1 0 2 0] Casing type: STEEL; Diam. 4½-2½ in [4]

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (Ø) open end, (P) perf., (S) screen, (T) sd. pt., (W) shored, (X) open hole, (Z) other [S]

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other [H]

Date Drilled: Feb 1980 [9 8 0] Pump intake setting: NONE ft

Driller: O'DAY DRLG Co (name), PEARLAND, TX (address)

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other [N] Deep Shallow

Power (type): diesel, elec, nat gas, gasoline, hand, LP gas, wind; H.P. — [ ] Trans. or meter no. —

Descrip. MP: top of csng +2.0 ft above/below LSD, Alt. MP ___

Alt. LSD: 49 [4 9] Accuracy: (source) 5' TOPO [3]

Water Level: 326.10 ft above/below MP; Ft above/below LSD [3 2 6] Accuracy: steel tape [A]

Date meas: 4-24-80 [4 8 0] Yield: 8.5 gpm [9] Method determined [1]

Drawdown: ___ ft Accuracy: ___ Pumping period ___ hrs

QUALITY OF WATER DATA: Iron ___ ppm Sulfate pH 8.7 ppm [9] Chloride ___ ppm Hard. HCO_3 200 ppm

Sp. Conduct 500 K x 10^6 [3] Temp. 76 °F [7 6] Date sampled 2-23-80 [2 8 0]

Taste, color, etc.

Well No.

Latitude-longitude N/S d m s d m s

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19) Physiographic Province: COASTAL PLAIN [03] (20–21) Section: WEST GULF

[F] (22) Drainage Basin: [51R] (23–25) Subbasin: [ ] (26)

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (0) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat [F] (27)

MAJOR AQUIFER: ____ system, ____ series [TF] (28–29) EVANGELINE aquifer, formation, group [E] (30–31)

Lithology: ____ [S] (32–33) Origin: ____ [3] (34) Aquifer Thickness: 39 ft

[39] (35–37) Length of well open to: 10 ft [1010] (38–40) Depth to top of: 1010 ft [A01] (41–43)

MINOR AQUIFER: ____ system, ____ series [ ] (44–45) ____ aquifer, formation, group [ ] (46–47)

Lithology: ____ [ ] (48–49) Origin: ____ [ ] (50) Aquifer Thickness: ____ ft

[ ] (51–53) Length of well open to: ____ ft [ ] (54–56) Depth to top of: ____ ft [ ] (57–59)

Intervals Screened: 1020 - 1030 SSWW NO. 10 ga 2½" OD

Depth to consolidated rock: ____ ft [ ] (60–63) Source of data: ____ [ ] (64)

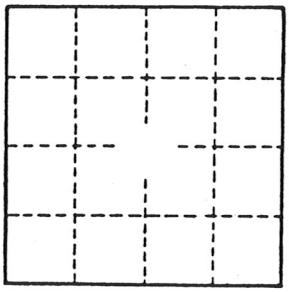
Depth to basement: ____ ft [ ] (65–68) Source of data: ____ [ ] (69)

Surficial material: ____ [ ] (70–71) Infiltration characteristics: ____ [ ] (72)

Coefficient Trans: 326 gpd/ft [321] (73–75) Coefficient Storage: ____ [ ] (76–78)

Coefficient Perm: ____ gpd/ft^2; Spec cap: ____ gpm/ft; Number of geologic cards: [ ] (79)

Sample for water quality obtained by jetting with air



Well No.

GPO 857-700

April 1980

Well No. L-65-14-745

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

MASTER CARD

Record by: RS SONENSTEIN Source of data: DRILLER'S LOG Date: 2-26-80 Map: 1:24,000 SCARSDALE, TEX 1967

State: TEXAS [48] County (or town): HARRIS [LJ]

Latitude: 29 47 28 N Longitude: 095 20 01 Sequential number: 5

Lat-long accuracy: [1] T ____ S, R ____ W, Sec ____, ¼ ____, ¼ ____, ¼ ____

Local well number: LJ-65-14-745 Other number: B&M NORTHEAST NO. 5

Local use: ____ Owner or name: HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT

Owner or name: HGCSD Address: 1730 NASA RD 1

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist ____ [S]

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Med, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other ____ [U]

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (Ø) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed. [Ø]

DATA AVAILABLE: Well data [2] Freq. W/L meas.: MONTHLY [M] Field aquifer char. [1]

Hyd. lab. data: ____

Qual. water data; type: partial [P]

Freq. sampling: ORIGINAL [Ø] Pumpage inventory: yes (no) period: ____

Aperture cards: ____ yes

Log data: DRILLER'S log [D]

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 298 ft [298] Meas. rept ____ [3]

Depth cased: (first perf.) 283 ft [283] Casing type: steel; Diam. 4½-2½ in accuracy [4]

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (Ø) open end, (P) perf., screen, (S) sd. pt., (T) shored, (W) open hole, (Z) other ____ [S]

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) jetted, (J) air rot., (P) percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other ____ [H]

Date Drilled: Feb 1980 [980] Pump intake setting: NONE ft

Driller: D'DAY DRLG Co (name), PEARLAND, TX (address)

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other [N] Deep ____ Shallow ____

Power (type): diesel, elec, gas (nat), gasoline, hand, gas (LP), wind; H.P. ____ Trans. or meter no. ____

Descrip. MP: top of csng +2.0 ft above/below LSD, Alt. MP ____

Alt. LSD: 49 [49] Accuracy (source): 5' TOPO [3]

Water Level 163.40 ft above/below MP; Ft above/below LSD [163] Accuracy: steel tape [A]

Date meas: 4-24-80 [480] Yield: 9 gpm [9] Method determined [1]

Drawdown: ____ ft Accuracy: ____ Pumping period ____ hrs

QUALITY OF WATER DATA: Iron ____ ppm pH 8.4 [8] Chloride ____ ppm HCO3 Hard. 240 ppm [6]

Sp. Conduct 500 K x 10^6 [3] Temp. 71 °F [71] Date sampled 2-27-80 [280]

Taste, color, etc. ____

Well No.

Latitude-longitude N S

d m s d m s

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19) Physiographic Province: COASTAL PLAIN [0 3] (20–21) Section: WEST GULF

[F] (22) Drainage Basin: [5 1 R] (23–25) Subbasin: [ ] (26)

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (O) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat [F] (27)

MAJOR AQUIFER: ____ system, ____ series [Q] (28–29) Chicot aquifer, formation, group [C] (30–31)

Lithology: ____ [S] (32–33) Origin: ____ [3] (34) Aquifer Thickness: 37 ft

[3 7] (35–37) Length of well open to: 10 ft [1 0] (38–40) Depth to top of: 277 ft [2 7 7] (41–43)

MINOR AQUIFER: ____ system, ____ series [ ] (44–45) ____ aquifer, formation, group [ ] (46–47)

Lithology: ____ [ ] (48–49) Origin: ____ [ ] (50) Aquifer Thickness: ____ ft

[ ] (51–53) Length of well open to: ____ ft [ ] (54–56) Depth to top of: ____ ft [ ] (57–59)

Intervals Screened: 283 - 293 SSWW No. 10 ga 2½" OD

Depth to consolidated rock: ____ ft [ ] (60–63) Source of data: ____ [ ] (64)

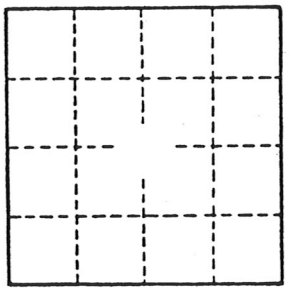
Depth to basement: ____ ft [ ] (65–68) Source of data: ____ [ ] (69)

Surficial material: ____ [ ] (70–71) Infiltration characteristics: ____ [ ] (72)

Coefficient Trans: 53 gpd/ft [5 0 0] (73–75) Coefficient Storage: ____ [ ] (76–78)

Coefficient Perm: ____ gpd/ft²; Spec cap: ____ gpm/ft; Number of geologic cards: [ ] (79)

sample for water quality obtained by jetting with air



Well No.

GPO 857-700

Layne-Western Company, Inc. A Marley Company

P.O. Box 79009 · Houston, Texas 77079 · 713/466-5001

L O G - WELL #5 NORTHEAST PLANT SITE

0	3	Top Soil
3	60	Clay
60	80	Sand
80	100	Clay
100	140	Sand
140	170	Clay
170	175	Sand
175	182	Clay
182	247	Sand
247	286	Clay
286	302	Sand

Layne

EXHIBIT C

SUBSIDENCE MONITOR/PIEZOMETERS WELL SYSTEM CONSTRUCTION SITE

NORTHEAST

The construction site is located adjacent to the easterly boundary of the City of Houston Northeast Well Field Plant Yard; said Plant Yard being a tract of land located in the J. S. Collins Survey, Abstract 15, bounded on the north side by Brill Street, on the east side by Tuffly Park, and on the west side by Linn Street.

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

MASTER CARD

1:24,000

Record by: SONENSHEIN — Source of data: OBS & DRILLER — Date: 4-28-80 — Map: SETTEGAST, TX 1967

State: TEXAS [4 8] — County (or town): HARRIS [L J]

Latitude: 29 47 28 N (deg, min, sec) — Longitude: 095 20 01 (degrees, min, sec) — Sequential number: 6

Lat-long accuracy: [ ] T ___ N S, R ___ E W, Sec ___, ___ ¼, ___ ¼, ___ ¼ ___ B & M

Local well number: LJ-65-14-746 — Other number: NORTHEAST NO. 1 EXTENSION

Local use: — Owner or name: HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT

Owner or name: HGCSD — Address: 1730 NASA RD 1

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist — [S]

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Med, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other — [U]

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (O) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed. — [Ø]

DATA AVAILABLE: Well data [2] — Freq. W/L meas.: MONTHLY [M] — Field aquifer char. [T]

Hyd. lab. data:

Qual. water data; type: partial

Freq. sampling: ORIGINAL [Ø] — Pumpage inventory: yes (no) period:

Aperture cards: yes

Log data: DRILLERS, CALIPER, INDUCTION & MICRO ELECTRIC, SONIC, GAMMA, NEUTRON DENSITY [Y S]

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD — Depth well: 2170 ft [2170] — Meas. rept accuracy [4]

Depth cased: (first perf.) 2099 ft [2099] — Casing type: steel; Diam. 5½ in [5]

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., (S) screen, (T) sd. pt., (W) shored, (X) open hole, (Z) other — [S]

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other — [H]

Date Drilled: APR 1980 [980] — Pump intake setting: NONE ft

Driller: LAYNE-TEXAS Co. (name), HOUSTON, TX (address)

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other — [N] — Deep Shallow [—]

Power (type): diesel, elec, nat gas, gasoline, hand, LP gas, wind; H.P. — [ ] — Trans. or meter no. —

Descrip. MP: Plug in 5" CSNG + 2.0 ft above/below LSD, Alt. MP

Alt. LSD: 49 [49] — Accuracy: (source) 5' TOPO [3]

Water Level: 394.43 ft above/below MP; Ft above/below LSD [394] — Accuracy: steel tape [A]

Date meas: 5-27-80 [580] — Yield: 18.5 gpm [19] — Method determined [1]

Drawdown: ___ ft — Accuracy: — Pumping period ___ hrs

QUALITY OF WATER DATA: Iron ___ ppm — Sulfate 9.0 ppm [9] — Chloride ___ ppm — HCO3 Hard. ___ ppm

Sp. Conduct ___ K x 10^6 — Temp. 79 °F [79] — Date sampled 4-25-80 [480]

Taste, color, etc.

Well No.

Latitude-longitude N S
d m s d m s

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19) Physiographic Province: 03 (20–21) Section:

F (22) Drainage Basin: 51R (23–25) Subbasin: (26)

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, swamp, (L) (Ø) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat F (27)

MAJOR AQUIFER: system, series TF (28–29) EVANGELINE aquifer, formation, group E (30–31)

Lithology: S (32–33) Origin: 3 (34) Aquifer Thickness: 61 ft

Length of well open to: 61 (35–37) ft Depth to top of: 2095 (38–40) ft 209 (41–43)

MINOR AQUIFER: system, series (44–45) aquifer, formation, group (46–47)

Lithology: (48–49) Origin: (50) Aquifer Thickness: ft

Length of well open to: (51–53) ft Depth to top of: (54–56) ft (57–59)

Intervals Screened: 2099-2119 5SWW NO.12 GAUGE 5½" OD

Depth to consolidated rock: ft (60–63) Source of data: (64)

Depth to basement: ft (65–68) Source of data: (69)

Surficial material: (70–71) Infiltration characteristics: (72)

Coefficient Trans: 74 gpd/ft 740 (73–75) Coefficient Storage: (76–78)

Coefficient Perm: gpd/ft²; Spec cap: gpm/ft; Number of geologic cards: (79)

sample for water quality obtained by jetting with air

initial hole drilled to 2250 - filled in bottom hole with cement plug to 2170

5½" csng to 2170 with slip joint from 2141 to 2149.5 ft

Well No.

GPO 857-700

Send original copy by certified mail to the Texas Department of Water Resources P. O. Box 13087 Austin, Texas 78711

State of Texas
WATER WELL REPORT

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

For TDWR use only
Well No. 65-14-7J
Located on map YES
Received: TH

1) OWNER Harris-Galveston Coastal Subsidence District (Name) Address P. O. Box 58847 (Street or RFD) Houston (City) Texas (State) 77058 (Zip)

2) LOCATION OF WELL: County Harris 5 miles in N.E. (N.E., S.W., etc.) direction from Houston (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. _____ Block No. _____ Township _____
Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____

☒ See attached map.

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☒ Test Well ☐ Other _____

5) DRILLING METHOD (Check):
☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other _____

6) WELL LOG:
#5
Date drilled 3-10-80

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
7-7/8	Surface	299

7) BOREHOLE COMPLETION:
☐ Open Hole ☒ Straight Wall ☐ Underreamed
☐ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from _____ ft. to _____ ft

From (ft.)	To (ft.)	Description and color of formation material
		See Attached

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
4½	N	Steel	+2	279	.23
2½	N	Steel	269	284	
2½	N	SST Screen	284	294	
2½	N	Steel	294	299	

CEMENTING DATA
Cemented from 0 ft. to 279 ft
Method used Pressure
Cemented by O'Day Drilling (Company or Individual)

9) WATER LEVEL:
Static level _____ ft. below land surface Date _____
Artesian flow _____ gpm. Date _____

10) PACKERS: Type Lead Depth 269

11) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

(Use reverse side if necessary)

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☒ Yes ☐ No

12) WELL TESTS:
☐ Type Test: ☐ Pump ☐ Bailer ☒ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME James O'Connor (Type or Print) Water Well Drillers Registration No. 999

ADDRESS 5931 Brittmoore (Street or RFD) Houston, (City) Texas (State) 77041 (Zip)

(Signed) James O'Connor (Water Well Driller) LAYNE-WESTERN COMPANY, INC. (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TDWR-0392 (Rev. 1-12-79) DEPARTMENT OF WATER RESOURCES COPY

WRD Exp. (6-)
April 1966

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

MASTER CARD (T. BROWN) (7-1941)

Record by N.A.R. & WFG — Source of data FILES — Date 2-20-68 — Map Settegast 1955 1:24000

State Texas [48] — County (or town) Harris [LJ]

Latitude: 29 47 28 N (deg, min, sec) — Longitude: 095 20 01 (degrees, min, sec) — Sequential number: 1

Lat-long accuracy: 1 — T. ___ S, R ___ W, Sec ___, ___ ¼, ___ ¼, ___ ¼ ___ B & M

Local well number: LJ-65-14-759 — Other number: WELL # 2-1355 in 559-c

Local use: — Owner or name: CITY OF HOUSTON

Owner or name: CITY OF HOUSTON — Address: NORTHEAST PLANT

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist — M

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Med, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other abd. 1964 — U

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (O) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed — U

DATA AVAILABLE: Well data 1 — Freq. W/L meas.: Semiannual 1938-1967; 1972 [S] — Field aquifer char.

Hyd. lab. data:

Qual. water data; type:

Freq. sampling: 8-17-38-'63 [I] — Pumpage inventory: yes no, period: yes

Aperture cards:

Log data: E-LOG U-28 — E

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD — Depth well: 1291 ft [1291] — Meas. rept. Driller accuracy [3]

Depth cased (first perf.): 461 ft [461] — Casing type: STEEL; Diam 21½"-12¾" in [21]

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., (S) screen, (T) sd. pt., (W) shored, (X) open hole, (Z) other — G

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other — H

Date Drilled: 1938 [938] — Pump intake setting: ___ ft

Driller: LAYNE-TEXAS CO. (name), HOUSTON, TEX. (address)

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other — N — Deep Shallow

Power (type): diesel, elec, nat gas, gasoline, hand, LP gas, wind; H.P. FORMERLY 150 HP T-E — Trans. or meter no.

Descrip. MP ___ ft above below LSD. Alt. MP

Alt. LSD: 49' [49] — Accuracy (source): 5' TOPO — 3

Water Level ___ ft above below MP; Ft above below LSD — Accuracy:

Date meas: Jan. 1942 — Yield: 2010 gpm — Method determined

Drawdown: ___ ft — Accuracy: — Pumping period ___ hrs

QUALITY OF WATER DATA: Iron ___ ppm — Sulfate ___ ppm — Chloride ___ ppm — Hard. ___ ppm

Sp. Conduct ___ K x 10^6 — Temp. ___ °F — Date sampled

Taste, color, etc.

Well No. LJ-65-14-759

Latitude-longitude 29 (d), 47 (m), 28 (s) N S095 (d), 20 (m), 01 (s)

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19) Physiographic Province: COASTAL PLAIN 03 (20–21) Section: _____

F (22) Drainage Basin: _____ 51R (23–25) Subbasin: _____ (26)

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (O) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat _____ (27)

MAJOR AQUIFER: _____ system, _____ series T (28–29) _____ aquifer, formation, group E (30–31)

Lithology: _____ (32–33) Origin: _____ (34) Aquifer Thickness: _____ ft

(35–37) Length of well open to: 404 ft 404 (38–40) Depth to top of: _____ ft (41–43)

MINOR AQUIFER: _____ system, _____ series Q (44–45) _____ aquifer, formation, group CL (46–47)

Lithology: _____ (48–49) Origin: _____ (50) Aquifer Thickness: _____ ft

(51–53) Length of well open to: _____ ft (54–56) Depth to top of: _____ ft (57–59)

Intervals Screened: 461-534 (73), 629-884 (255), 1015-1036 (21), 1114-1135 (21), 1245-1279 (34)

Depth to consolidated rock: _____ ft (60–63) Source of data: _____ (64)

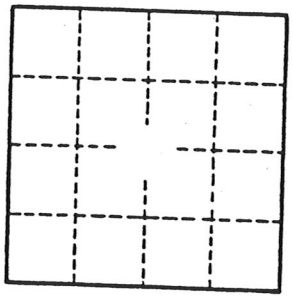
Depth to basement: _____ ft (65–68) Source of data: _____ (69)

Surficial material: _____ (70–71) Infiltration characteristics: _____ (72)

Coefficient Trans: ✓ _____ gpd/ft (73–75) Coefficient Storage: _____ (76–78)

Coefficient Perm: ✓ _____ gpd/ft^2; Spec cap: ✓ _____ gpm/ft; Number of geologic cards: _____ (79)

375 ft. of 21½" csg.
and 916 ft. 12¾ inch
Gravel wall



Well No. LJ-65-14-759

GPO 857-700

DUP

Send original copy by certified mail to the Texas Department of Water Resources P. O. Box 13087 Austin, Texas 78711

State of Texas
WATER WELL REPORT

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

For TDWR use only
Well No. 105-14-7J
Located on map YES
Received: TH

1) OWNER Harris-Galveston Coastal Subsidence District (Name) Address P. O. Box 58847 (Street or RFD) Houston (City) Texas (State) 77058 (Zip)

2) LOCATION OF WELL: County Harris 5 miles in N.E. (N.E., S.W., etc.) direction from Houston (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. _____ Block No. _____ Township _____
Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____
☒ See attached map.

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☒ Test Well ☐ Other _____

5) DRILLING METHOD (Check):
☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other _____

6) WELL LOG:
#4
Date drilled 2-29-80

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
7-7/8	Surface	487

7) BOREHOLE COMPLETION:
☐ Open Hole ☒ Straight Wall ☐ Underreamed
☐ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from _____ ft. to _____ ft.

From (ft.) To (ft.) Description and color of formation material

See Attached

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
4½	N	Steel	+2	467	.237
2½	N	Steel	457	472	
2½	N	SST Screen	472	482	
2½	N	Steel	482	487	

CEMENTING DATA
Cemented from 0 ft. to 467 ft.
Method used Pressure
Cemented by Halliburton (Company or Individual)

9) WATER LEVEL:
Static level _____ ft. below land surface Date _____
Artesian flow _____ gpm. Date _____

10) PACKERS: Type Lead Depth 457

(Use reverse side if necessary)

11) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☒ Yes ☐ No

12) WELL TESTS:
☐ Type Test: ☐ Pump ☐ Bailer ☒ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME James O'Connor (Type or Print) Water Well Drillers Registration No. 999

ADDRESS 5931 Brittmoore (Street or RFD) Houston (City) Texas (State) 77041 (Zip)

(Signed) James O'Connor (Water Well Driller) LAYNE-WESTERN COMPANY, INC. (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TDWR-0392 (Rev. 1-12-79)

DEPARTMENT OF WATER RESOURCES COPY

Please use black ink.
File WHITE COPY with:
TNRCC
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

State of Texas
PLUGGING REPORT

(This form must be completed and filed with the TNRCC within 30 days following the date the well is plugged as required by current statutory law.)

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER Williams Brothers Const. (Name) ADDRESS P.O. Box 66428 (Street or RFD) Houston (City) TX (State) 77266 (Zip)

2) ADDRESS OF WELL: County Harris Beltway 8 Hwy 90 (Street, RFD or other) Houston (City) TX (State) (Zip) GRID # _____

3) OWNER'S WELL NO: N/A

4) WELL TYPE (Check): X Water ☐ Monitor ☐ Injection ☐ De-watering

5) 65-14-7

Driller, Pump Installer, or Landowner performing the plugging operations must locate and identify the location of the well within a specific grid on a full scale-gridded County map available from the TNRCC/Installers Certification Program. The location of the well should be denoted within the grid by placing a corresponding dot in the grid to the right. The legal description section below is optional.

☐ LEGAL DESCRIPTION:

Section No. _____ Block No. _____ Township _____

Abstract No. _____ Survey Name _____

Distance and direction from two intersecting section lines or survey lines: _____

N ↑

B. HISTORICAL DATA ON WELL TO BE PLUGGED (if available)

6) Driller Almeda Water Well License No. 843,2703,2843 City Manvel

7) Drilled 6-5 19 92 8) Diameter of hole 5 inches; MAY 23 1995 9) Total depth of well 280 feet.

C. CURRENT PLUGGING DATA

10) Date well plugged 12-30 ,19 93

11) Sketch of well: Using space at right, show method of plugging the well including all casing and cemented intervals.

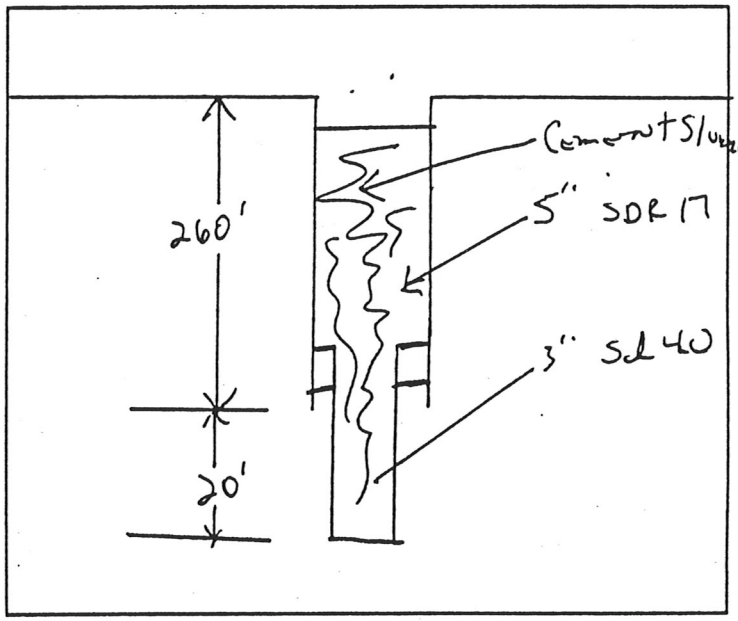
12) Name of Driller/Pump Installer actually performing the plugging operations
Dale Felder

License number 2440WI

13) Casing and cementing data relative to the plugging operations:

DIAMETER (inches)	CASING LEFT IN WELL	
	FROM (feet)	TO (feet)
5	-1	260
3	260	280

CEMENT PLUG(S) PLACED IN WELL		SACK(S) OF CEMENT USED
FROM (feet)	TO (feet)	
-1	280	35



D. VALIDATION OF INFORMATION INCLUDED IN FORM

I hereby certify that this well was plugged by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 13 will result in the report(s) being returned for completion and resubmittal.

Company or Individual's Name (type or print) Dale Felder - Felder Water Well & Pump Service

Address: Street or RFD 200 Henderson City Angleton State TX Zip 77515

Signature: Dale Felder

Licensed Driller/Pump Installer	Date	Owner of Well	Date
12-30-93		Williams Brothers Const.	12-30-93

Trainee/Apprentice _____ Date _____

White - TNRCC Yellow - Well Owner Pink - Licensed Well Driller/Pump Installer

TNRCC-0055 (Rev. 01-12-95)

DUP

Send original copy by certified mail to the Texas Department of Water Resources P. O. Box 13087 Austin, Texas 78711

State of Texas
WATER WELL REPORT

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

For TDWR use only
Well No. 65-14-7U
Located on map YES
Received: TH

1) OWNER Harris-Galveston Coastal Subsidence District (Name) Address P. O. Box 58847 (Street or RFD) Houston (City) Texas (State) 77041 (Zip)

2) LOCATION OF WELL: County Harris 5 miles in N.E. (N.E., S.W., etc.) direction from Houston (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. _____ Block No. _____ Township _____
Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____
☒ See attached map.

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☒ Test Well ☐ Other _____

5) DRILLING METHOD (Check):
☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other _____

6) WELL LOG:
#3
Date drilled 2-15-80

DIAMETER OF HOLE		
Dia. (in.)	From (ft.)	To (ft.)
7-7/8	Surface	1033

7) BOREHOLE COMPLETION:
☐ Open Hole ☒ Straight Wall ☐ Underreamed
☐ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from _____ ft. to _____ ft.

From (ft.)	To (ft.)	Description and color of formation material
		See Attached

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
4½	N	Steel	+2	1013	.237
2½	N	Steel	1003	1018	
2½	N	SST Screen	1018	1028	
2½	N	Steel	1028	1033	

CEMENTING DATA
Cemented from 0 ft. to 1013 ft.
Method used Pressure
Cemented by Halliburton (Company or Individual)

(Use reverse side if necessary)

9) WATER LEVEL:
Static level _____ ft. below land surface Date _____
Artesian flow _____ gpm. Date _____

10) PACKERS: Type Lead Depth 1003

11) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☒ Yes ☐ No

12) WELL TESTS:
☐ Type Test: ☐ Pump ☐ Bailer ☒ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME James O'Connor (Type or Print) Water Well Drillers Registration No. 222

ADDRESS 5931 Brittmoore (Street or RFD) Houston (City) Texas (State) 77041 (Zip)

(Signed) James O'Connor (Water Well Driller) LAYNE-WESTERN COMPANY, INC. (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TDWR-0392 (Rev. 1-12-79)

DEPARTMENT OF WATER RESOURCES COPY

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

1) OWNER SP ENVIRONMENTAL SYSTEMS INC (Name) ADDRESS 9719 LINCOLN VILLAGE DR #310 (Street or RFD) SACRAMENTO (City) CA (State) 95827 (Zip)

LOCATION OF WELL:
County HARRIS , _____ miles in _____ (NE, SW, etc.) direction from HOUSTON (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:
Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines 4910 LIBERTY Rd, HOUSTON TX

☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):
☐ Driven ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☒ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other _____

6) WELL LOG: MW 1
Date Drilling: Started 11-2 19 90 Completed 11-2 19 90

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
11.75	Surface	26

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from 8 ft. to 25 ft.

From (ft.)	To (ft.)	Description and color of formation material
0	1	CRUSHED LIMESTONE
1	8	CLAY PLASTIC GRAY
8	14	CLAY VERY PLASTIC GRAY W/TAN MOTTLES
14	15	SANDY CLAY GRAY WET
15	22	CLAYEY SAND VERY FINE GRAY
22	26	CLAY GRAY W/TAN MOTTLES

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
2	N	PVC WELL TEC SUPPLY	0	10	BLANK
V	V	V	10	25	.010

(Use reverse side if necessary)

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 0 ft. to 5 ft. No. of Sacks Used 4
_____ ft. to _____ ft. No. of Sacks Used _____
Method used MANUAL
Cemented by DRILLER

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other NA
Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS: NA
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

11) WATER LEVEL: NA
Static level _____ ft. below land surface Date _____
Artesian flow _____ gpm. Date _____

15) WATER QUALITY:
Did the drilling penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? FRESH Depth of strata 15
Was a chemical analysis made? ☐ Yes ☒ No

12) PACKERS: Type Depth
NA

RECEIVED
DEC 10 1990
TEXAS WATER COMMISSION

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME MASTER MONITORING SERVICES INC (Type or print) WELL DRILLER'S LICENSE NO. 3044

ADDRESS P.O. Box 19109 #152 (Street or RFD) HOUSTON (City) TX (State) 77224-9109 (Zip)

(Signed) _____ (Licensed Well Driller)

(Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. 65-14-5 Located on map _____

WWD-012 (Rev. 09/21/88)

TEXAS WATER COMMISSION COPY

Original copy by certified mail to: Texas Water Commission, P.O. Box 13087, Austin, Texas 78711 — Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

1) OWNER SP Environmental Systems Inc (Name) ADDRESS 9719 Lincoln Village Dr #310 (Street or RFD) Sacramento (City) CA (State) 95827 (Zip)

LOCATION OF WELL:
County Harris , _____ miles in _____ (NE, SW, etc.) direction from Houston (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:
Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines 4910 Liberty Rd, Houston TX
☑ SEE ATTACHED MAP

3) TYPE OF WORK (Check):
☑ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☑ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check): ☐ Driven
☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☑ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other _____

6) WELL LOG: MW 2
Date Drilling: Started 11-2 1990 Completed 11-2 1990

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
11.75	Surface	26

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☑ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from 8 ft. to 26 ft.

From (ft.)	To (ft.)	Description and color of formation material
0	8	Clay Very Plastic Dark Grey w/ tan Mottles
8	12	Clay Grey
12	16	Clay Grey w/ Red Mottles
16	22	Sandy Clay Lt Grey
22	26	Clay Grey

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	PVC Well Tech Sch 40	0	10	Blank
V	V	V	10	25	010

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 0 ft. to 5 ft. No. of Sacks Used 4
_____ ft. to _____ ft. No. of Sacks Used _____
Method used Manual
Cemented by Drillco

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

10) SURFACE COMPLETION
☑ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

14) WELL TESTS: NA
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

11) WATER LEVEL: NA
Static level _____ ft. below land surface Date _____
Artesian flow _____ gpm. Date _____

15) WATER QUALITY:
Did the drilling penetrate any strata which contained undesirable constituents?
☐ Yes ☑ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Fresh Depth of strata 16
Was a chemical analysis made? ☐ Yes ☑ No

12) PACKERS: Type Depth
NA

RECEIVED
DEC 19 1990
TEXAS WATER COMMISSION

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Master Monitoring Services Inc (Type or print) WELL DRILLER'S LICENSE NO. 3044M

ADDRESS P.O. Box 19109 #152 (Street or RFD) Houston (City) TX (State) 77224-9109 (Zip)

Signed _____ (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. 65-14-5 Located on map _____

WWD-012 (Rev. 09/21/88)

TEXAS WATER COMMISSION COPY

MW(2)

...ed mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

...WNER: *Confidentiality ...otice on Reverse Side*

State of Texas WELL REPORT

MW 16

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

OWNER Circle K Corp. (Name) ADDRESS 3920 Lockwood#84721 Houston, Tx. (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL: County Harris . 0 miles in (NE, SW, etc.) direction from Houston (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:

Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name D.I.M.

Distance and direction from two intersecting section or survey lines _____

☑ SEE ATTACHED MAP

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):
☐ Driven ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) WELL LOG:
Date Drilling: Started 2-03-94 19__ Completed 2-03-94 19__

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
11	Surface	25

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☑ Gravel Packed ☐ Other _____
If Gravel Packed give interval ... from 15 ft. to 25 ft.

From (ft.) To (ft.) Description and color of formation material

0-4 Clay, black
4-14 Clay, greenish gray
14-18 Clay, lt gry brwn mottle
18-21 Silty clay, rdbrwn
21-24 Clay, rdbrwn
24-25 Silty sand, rdbrwn

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
4	N	Sch. 40 PVC	0	15	-
4	N	Sch. 40 PVC	15	25	0.01

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 0 ft. to 11 ft. No. of Sacks Used 6.5
____ ft. to ____ ft. No. of Sacks Used ____
Method used Tremmie
Cemented by Eddie Kenebrew

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:
Static level 19 ft. below land surface Date 2-03-94
Artesian flow _____ gpm. Date _____

12) PACKERS: Type Depth
Bentonite 11 to 13

13) TYPE PUMP: N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS: N/A
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☒ Yes ☐ No

RECEIVED
MAY 03 1994
TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Best Drilling Services, Inc. (Type or print) WELL DRILLER'S LICENSE NO. 3022M

ADDRESS P.O. Box 845 (Street or RFD) Friendswood (City) Texas (State) 77546 (Zip)

Signed Eddie Kenebrew (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TNRCC use only: Well no. _____ Located on map _____

TNRCC-0199 (Rev. 05-18-90)

TNRCC COPY

mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

WNER: Confidentiality
otice on Reverse Side

State of Texas WELL REPORT

MW 15

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

1) OWNER Circle K Corp. (Name) ADDRESS 3920 Lockwood#84721 Houston, Tx. (Street or RFD) (City) (State) (Zip)

LOCATION OF WELL County Harris , 0 miles in (NE, SW, etc.) direction from Houston (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:

Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____

Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP D.I.M.

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):
☐ Driven ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) WELL LOG:

Date Drilling: Started 2-02-94 19__ Completed 2-02-94 19__

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
11	Surface	25

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from 15 ft. to 25 ft.

From (ft.)	To (ft.)	Description and color of formation material
0	8	Clay, grey
8	13	Clay, greenish gray
13	18	Clay, lt gry brwn mottle
18	22	Sand, Silty sand, rdbrwn
22	25	Clay, brown

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
4	N	Sch. 40 PVC	0	15	-
4	N	Sch. 40 PVC	15	25	0.01

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 0 ft. to 11 ft. No. of Sacks Used 6.5
_____ ft. to _____ ft. No. of Sacks Used _____
Method Used Tremmie
Cemented by Eddie Kenebrew

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:
Static level 18 ft. below land surface Date 2-03-94
Artesian flow _____ gpm. Date _____

12) PACKERS:

Type	Depth
Bentonite	11 to 13

13) TYPE PUMP: N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS: N/A
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☒ Yes ☐ No

RECEIVED
MAY 03 1994
TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Best Drilling Services, Inc. (Type or print) WELL DRILLER'S LICENSE NO. 3022M

ADDRESS P.O. Box 845 (Street or RFD) Friendswood (City) Texas (State) 77546 (Zip)

Eddie Kenebrew (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TNRCC use only: Well no. _____ Located on map _____

NRCC-0199 (Rev. 05-18-90)

TNRCC COPY

ertified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

OWNER: Confidentially
e Notice on Reverse Side

State of Texas WELL REPORT

MW 14

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

1) OWNER Circle K Corp. (Name) ADDRESS 3920 Lockwood#84721 Houston, Tx. (Street or RFD) (City) (State) (Zip)

LOCATION OF WELL: County Harris . 0 miles in (NE, SW, etc.) direction from Houston (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:

Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name D.I.M.

Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):
☐ Driven ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) WELL LOG:
Date Drilling: Started 2-02-94 19__ Completed 2-02-94 19__

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
11	Surface	25

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from 15 ft. to 25 ft.

From (ft.)	To (ft.)	Description and color of formation material
0	3	Clay, black
3	12	Clay, greenish gray
12	18	Clay, lt gry brwn streaks
18	21.5	Sand, lt brwn
21.5	25	Clay, lt gry

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
4	N	Sch. 40 PVC	0	15	-
4	N	Sch. 40 PVC	15	25	0.01

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 0 ft. to 11 ft. No. of Sacks Used 6.5
____ ft. to ____ ft. No. of Sacks Used ____
Method used Tremmie
Cemented by Eddie Kenebrew

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:
Static level 19 ft. below land surface Date 2-03-94
Artesian flow _____ gpm. Date _____

12) PACKERS:

Type	Depth
Bentonite	11 to 13

13) TYPE PUMP: N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS: N/A
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☒ Yes ☐ No

RECEIVED
MAY 03 1994
TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Best Drilling Services, Inc. (Type or print) WELL DRILLER'S LICENSE NO. 3022M

ADDRESS P.O. Box 845 (Street or RFD) Friendswood (City) Texas (State) 77546 (Zip)

Eddi Kenebrew (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TNRCC use only: Well no. _____ Located on map _____

RCC-0199 (Rev. 05-18-90)

TNRCC COPY

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas WELL REPORT

MW 13

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

OWNER Circle K Corp. (Name) ADDRESS 3920 Lockwood#84721 Houston, Tx. (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL County Harris . 0 miles in (NE, SW, etc.) direction from Houston (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:

Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name D.I.M.

Distance and direction from two intersecting section or survey lines _____

☑ SEE ATTACHED MAP

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):
☐ Driven ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) WELL LOG:
Date Drilling: Started 2-02-94 19__ Completed 2-02-94 19__

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
11	Surface	25

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☑ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from 15 ft. to 25 ft.

From (ft.)	To (ft.)	Description and color of formation material
0	7	Sand, lt brwn to lt gry
7	18	Clay, greenish gray to lt gry
18	24	Clayey silt, lt gry
24	25	Clay, lt gry brwn streaks

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
4	N	Sch. 40 PVC	0	15	-
4	N	Sch. 40 PVC	15	25	0.01

RECEIVED
MAY 03 1994
TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 0 ft. to 11 ft. No. of Sacks Used 6.5
____ ft. to ____ ft. No. of Sacks Used ____
Method used Tremmie
Cemented by Eddie Kenebrew

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:
Static level 19 ft. below land surface Date 2-02-94
Artesian flow _____ gpm. Date _____

12) PACKERS: Type Depth
Bentonite 11 to 13

13) TYPE PUMP: N/A
☐ Turbine ☐ Jet ☐ Submersible ☒ Cylinder
☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS: N/A
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☒ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Best Drilling Services, Inc. (Type or print) WELL DRILLER'S LICENSE NO. 3022M

ADDRESS P.O. Box 845 (Street or RFD) Friendswood (City) Texas (State) 77546 (Zip)

(Signed) Eddie Kenebrew (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TNRCC use only: Well no. _____ Located on map _____

TNRCC-0199 (Rev. 05-18-90)

TNRCC COPY

Send original copy by certified mail to: **Texas Water Commission, P.O. Box 13087, Austin, TX 78711-3087** — *Please use black ink.*

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas WELL REPORT

Texas Water Well Drillers Board
P.O. Box 13087
Austin, TX 78711-3087
512-371-6299

1) **OWNER** City Of Houston (Name) **ADDRESS** 4300 Staples (Street or RFD) Houston (City) Tx. (State) 77018 (Zip)

LOCATION OF WELL:
County Harris . _____ miles in _____ (NE, SW, etc.) direction from _____ (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ **LEGAL DESCRIPTION:**
Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____
☒ **SEE ATTACHED MAP** D.I.M.

3) **TYPE OF WORK (Check):**
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) **PROPOSED USE (Check):**
☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) **DRILLING METHOD (Check):** ☐ Driven
☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) **WELL LOG:**
Date Drilling: Started 3-10-94 19__ Completed 3-10-94 19__

DIAMETER OF HOLE		
Dia. (in.)	From (ft.)	To (ft.)
10	Surface	11

7) **BOREHOLE COMPLETION:**
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from 11 ft. to 1 ft.
Bentonite Seal 0 - 1

From (ft.)	To (ft.)	Description and color of formation material
0	9.5 ft.	Pea gravel
9.5 ft.	11 ft.	Tan Clay

(Use reverse side if necessary)

8) **CASING, BLANK PIPE, AND WELL SCREEN DATA:**

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
4	N	PVC Screen	11	1	.010
4	N	PVC Riser	1	+2	

9) **CEMENTING DATA** [Rule 287.44(1)]
Cemented from _____ ft. to _____ ft. No. of Sacks Used _____
_____ ft. to _____ ft. No. of Sacks Used _____
Method used N/A
Cemented by _____

10) **SURFACE COMPLETION**
☒ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

11) **WATER LEVEL:**
Static level DRY ft. below land surface Date 3-10-94
Artesian flow _____ gpm. Date _____

12) **PACKERS:** Type Depth

13) **TYPE PUMP:**
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) **WELL TESTS:**
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) **WATER QUALITY:**
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☒ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Jones Environmental Drilling (Type or print) **WELL DRILLER'S LICENSE NO.** 3150 M

ADDRESS P.O. Box 270773 (Street or RFD) Corpus Christi (City) Tx. (State) 78427-0773 (Zip)

(Signed) _____ (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. _____ Located on map _____

TWC-0199 (Rev. 05-18-90)

TEXAS WATER COMMISSION COPY

Send original copy by certified mail to: Texas Water Commission, P.O. Box 13087, Austin, Texas 78711

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

for Service Station Construction

State of Texas
WELL REPORT Texaco #135

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

OWNER Star Enterprise (Name) ADDRESS 5440 East Freeway Houston, Tx. 77020 (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL:
County Harris , _____ miles in _____ (NE, SW, etc.) direction from _____ (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:
Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP Well # 1 of 4 And #3 OF 4

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):
☐ Driven ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☒ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other _____

6) WELL LOG:
Date Drilling: Started 4/16/ 19 91 Completed 4/16 19 91

DIAMETER OF HOLE		
Dia. (in.)	From (ft.)	To (ft.)
6	Surface	13

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from 13' ft. to 2' ft.

From (ft.)	To (ft.)	Description and color of formation material
0	.5	CONCRETE
.5	13	CLAY (SOME GRAVEL)
		NOTE: THIS LOG IS FOR WELL #1 AND WELL #3 AT THIS TIME, BOTH WERE SAME COMPLETION AND ENCOUNTERED SAME STRATA DURING DRILLING
		MW #1 IS SOUTH WEST
		MW #3 IS NORTH EAST (OUR WELL)

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
4	N	SCH 40 PVC	13'	3'	.020
4	N	SCH 40 PVC	3'	0	RISER
4	N	END CAP			
4	N	LOCKING CAP			
		BOLT DOWN MH.			

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 1 ft. to 0 ft. No. of Sacks Used 3
_____ ft. to _____ ft. No. of Sacks Used _____
Method used Hand
Cemented by DRILLCO

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☒ Approved Alternative Procedure Used [Rule 287.71] SVC STA.

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

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14) WELL TESTS: NA
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

11) WATER LEVEL:
Static level Dry ft. below land surface Date 4/16/91
Artesian flow _____ gpm. Date _____

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ~~Dry~~ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☒ No

12) PACKERS:

Type	Depth
13' - 2' 10-20 SILICA SAND	
2' - 1' BENTONITE 1'-0 CONCRETE	

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Service Station Drillco, Inc. (Type or print) WELL DRILLER'S LICENSE NO. 2959M

ADDRESS 4412 Bluemel Road (Street or RFD) San Antonio (City) Texas (State) 78240 (Zip)

Signed _____ (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. 65-14-8 Located on map _____

WD-012 (Rev. 05-18-90)

TEXAS WATER COMMISSION COPY

...copy by certified mail to: Texas Water Commission, P.O. Box 13087, Austin, Texas 78711

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas WELL REPORT

for Service Station Construction — Texaco #135

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

OWNER Star Enterprise. (Name) ADDRESS 5440 East Freeway (Street or RFD) Houston, Tx. (City) 77020 (State) (Zip)

2) LOCATION OF WELL:
County Harris . _____ miles in _____ (NE, SW, etc.) direction from _____ (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:
Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP Well # 2 of 4

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):
☐ Driven ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☒ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other _____

6) WELL LOG:
Date Drilling: Started 4/16 19 91 Completed 4/16 19 91

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
6"	ft. Surface	12'

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval ... from 12' ft. to 2' ft.

From (ft.)	To (ft.)	Description and color of formation material
0	5	Concrete
5	12'	Pea Gravel

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
4	N	SCH 40 PVC	12'	2'	.020
4	N	SCH 40 PVC	2'	0	RISER
4	N	Bottom Cap			
4	N	Locking Cap			
		Bolt Down MH			

(Use reverse side if necessary)

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 1 ft. to 0 ft. No. of Sacks Used 6
_____ ft. to _____ ft. No. of Sacks Used _____
Method used Hand
Cemented by Drillco

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____

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14) WELL TESTS: NA
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☒ Approved Alternative Procedure Used [Rule 287.71] SVC STA.

11) WATER LEVEL:
Static level 10' 6" ft. below land surface Date 4/16/91
Artesian flow _____ gpm. Date _____

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☒ No

12) PACKERS:

Type	Depth
12'-2' Pea Gravel	
2'-1' Bentonite	1'-0 Concrete

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Service Station Drillco, Inc. (Type or print) WELL DRILLER'S LICENSE NO. 2959M

ADDRESS 4412 Bluemel Road (Street or RFD) San Antonio (City) Texas (State) 78240 (Zip)

(Signed) _____ (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. 65-14-8 Located on map _____

WD-012 (Rev. 05-18-90)

TEXAS WATER COMMISSION COPY

...d copy by certified mail to: Texas Water Commission, P.O. Box 13087, Austin, Texas 78711 — *Please use black ink.*

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas WELL REPORT

for Service Station Construction Texaco #135

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

1) OWNER Star Enterprise (Name) ADDRESS 5440 East Freeway (Street or RFD) Houston, Tx. (City) 77020 (State) (Zip)

2) LOCATION OF WELL: County Harris _____ miles in _____ (NE, SW, etc.) direction from _____ (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:
Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____
☒ SEE ATTACHED MAP Well # 4 of 4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check): ☐ Driven ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☒ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other _____

6) WELL LOG:
Date Drilling: Started 4/16 19 91 Completed 4/16 19 91

DIAMETER OF HOLE		
Dia. (in.)	From (ft.)	To (ft.)
6	Surface	74"
	B.H.	

7) BOREHOLE COMPLETION: ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from 6' 2" ft. to 1' ft.

From (ft.)	To (ft.)	Description and color of formation material
0	6"	CONCRETE
6"	6' 2"	PEA GRAVEL
		VERY HIGH WATER IN THIS HOLE
		BACKFILL - HAD TO SET SCREEN
		HIGH TO MONITOR THIS PROPERLY

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
4	N	SCH 40 PVC	6' 2"	1'	.020
4	N	SCH 40 PVC	1'	0	RISER
4	N	BOTTOM CAP			
4	N	LOCKING CAP			

(Use reverse side if necessary)

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 0.5 ft. to 0 ft. No. of Sacks Used 3
_____ ft. to _____ ft. No. of Sacks Used _____
Method used Hand
Cemented by Drillco

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☒ Approved Alternative Procedure Used [Rule 287.71] SDC STD.

11) WATER LEVEL:
Static level 1' 2" ft. below land surface Date 4/16/91
Artesian flow _____ gpm. Date _____

12) PACKERS: Type / Depth
6' 2" - 1' PEA GRAVEL 1' - .5' BENTONITE
.5' - 0 CONCRETE

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

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14) WELL TESTS: NA
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☒ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? SURFACE Depth of strata 1'
Was a chemical analysis made? ☐ Yes ☒ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Service Station Drillco, Inc. (Type or print) WELL DRILLER'S LICENSE NO. 2959M

ADDRESS 4412 Bluemel Road (Street or RFD) San Antonio (City) Texas (State) 78240 (Zip)

Signed _____ (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. 65-14-8 Located on map _____

WWD-012 (Rev. 05-18-90)

TEXAS WATER COMMISSION COPY

Send original copy by certified mail to: Texas Water Commission, P.O. Box 13087, Austin, Texas 78711

MW-1

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

1) OWNER Kemron Environmental Serv. (Name) ADDRESS 109 Starlite Park Marietta, Ohio 45750 (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL:
County Harris . _____ miles in _____ (NE, SW, etc.) direction from Houston (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:
Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply
☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):
☒ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored
☐ Air Rotary ☐ Cable Tool ☐ Other _____ ☐ Driven

6) WELL LOG:
Date Drilling:
Started 1-29 1990
Completed 1-29 1990

DIAMETER OF HOLE		
Dia. (in.)	From (ft.)	To (ft.)
	Surface	
6	0	18

From (ft.)	To (ft.)	Description and color of formation material
0	4"	Concrete
4"	4'	Blk Sa Cl
4'	8'	Tan Gr Cl
8'	10'	Red Gr Cl
10'	11'	Red Sa CL
11'	14'	Sa Wet Cl
14'	17'	Red Cl
17'	18'	Gr Cl

D.I.M.

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TEXAS WATER COMMISSION

(Use reverse side if necessary)

7) BOREHOLE COMPLETION:
☐ Open Hole ☒ Straight Wall ☐ Underreamed
☐ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from _____ ft. to _____ ft.

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2"	N	P.V.C.	18'	8'	.010
2"	N	Riser	8'	.5'	

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 6 ft. to .1 ft. No. of Sacks Used 1
_____ ft. to _____ ft. No. of Sacks Used _____
Method used Pressure Grouted
Cemented by E.L. Van Antwerp

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☒ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:
Static level 6' 2 1/4" ft. below land surface Date 1-29-90
Artesian flow _____ gpm. Date _____

12) PACKERS:

Type	Depth
Bentonite	8'-6'

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☒ Other Bailer
Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☒ Estimated
Yield: 1/5 gpm with 8 ft. drawdown after 1 hrs.

15) WATER QUALITY:
Did the drilling penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Van & Sons Drilling Service, Inc (Type or print) WELL DRILLER'S LICENSE NO. 3003M

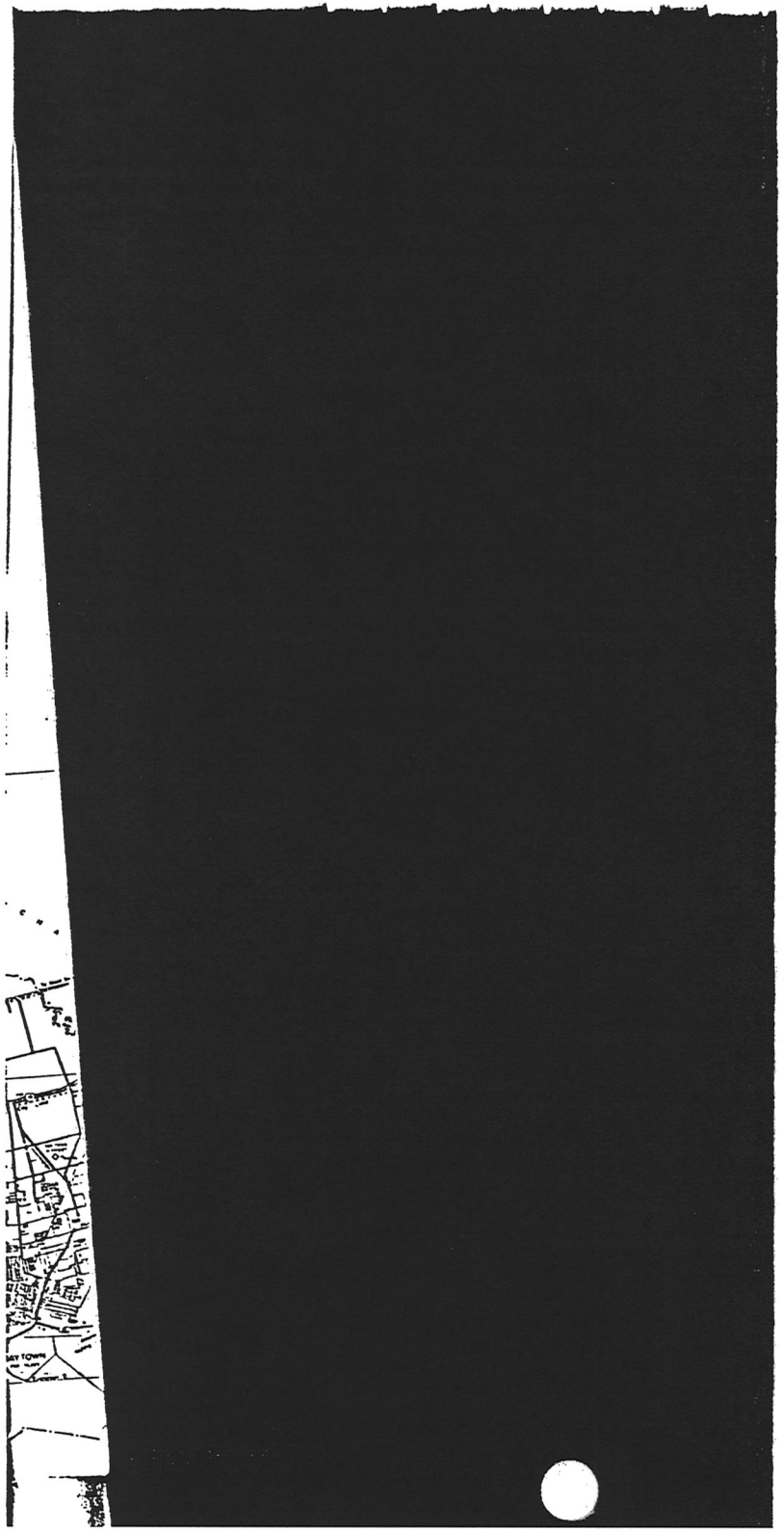
ADDRESS 319 John Alber Road (Street or RFD) Houston (City) Texas (State) 77076 (Zip)

(Signed) E L Van Antwerp (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, analysis, and other pertinent information, if available.

For TWC use only: Well No. 65-14-4 on map _____

WWD-012 (Rev. 09/21/88)



d mail to: Texas Water Commission, P.O. Box 13087, Austin, Texas 78711

MW-3

Confidentiality
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State of Texas
WELL REPORT

Please use black ink.

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

Kemron Environmental Serv. (Name) ADDRESS 109 Starlite Park Marietta, Ohio 45750 (Street or RFD) (City) (State) (Zip)

ON OF WELL: Harris . _____ miles in _____ (NE, SW, etc.) direction from Houston (Town)

ust complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official ... or Half-Scale Texas County General Highway Map and attach the map to this form.

LEGAL DESCRIPTION:
Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____
☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):
☒ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☐ Driven ☐ Air Rotary ☐ Cable Tool ☐ Other _____

6) WELL LOG:
Date Drilling: Started 1-29 1990 Completed 1-29 1990

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
	Surface	
6	0	18

From (ft.)	To (ft.)	Description and color of formation material
0	4"	Concrete
4"	5'	Blk Cl
5'	7'	Tan Gr Cl
7'	10'	Red Gr Cl
10'	12'	Sa Wet
12'	14'	Red Cl
14'	16'	Gr Cl
16'	18'	Gr Cl

(Use reverse side if necessary)

D.I.M.
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TEXAS WATER COMMISSION

7) BOREHOLE COMPLETION:
☐ Open Hole ☒ Straight Wall ☐ Underreamed
☐ Gravel Packed ☐ Other _____
If Gravel Packed give interval ... from _____ ft. to _____ ft.

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
2"	N	P.V.C.	18'	8'	.010
2"	N	Riser	8'	.5'	

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 6 ft. to 1 ft. No. of Sacks Used 1
_____ ft. to _____ ft. No. of Sacks Used _____
Method used Pressure Grouted
Cemented by E.L. Van Antwerp

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☒ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:
Static level 7'6" ft. below land surface Date 1-29-90
Artesian flow _____ gpm. Date _____

12) PACKERS:

Type	Depth
Bentonite	8'-6'

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☒ Other Bailer
Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:
Type Test: ☐ Pump ☐ Baller ☐ Jetted ☒ Estimated
Yield: ½ gpm with 8 ft. drawdown after 1 hrs.

15) WATER QUALITY:
Did the drilling penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Van & Sons Drilling Service, Inc (Type or print) WELL DRILLER'S LICENSE NO. 3003M

ADDRESS 319 John Alber Road (Street or RFD) Houston (City) Texas (State) 77076 (Zip)

(Signed) E.L. Van Antwerp (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent info

Mail to: Texas Water Commission, P.O. Box 13087, Austin, Texas 78711

Please use black ink.

Confidentiality
Reverse Side

State of Texas
WELL REPORT

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

emron Environmental Serv. (Name) ADDRESS 109 Starlite Park Marietta, Ohio 45750 (Street or RFD) (City) (State) (Zip)

N OF WELL:
Harris ____ . ____ miles in ____ (NE, SW, etc.) direction from Houston (Town)

complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Half-Scale Texas County General Highway Map and attach the map to this form.

AL DESCRIPTION:
ction No. ____ Block No. ____ Township ____ Abstract No. ____ Survey Name ____
istance and direction from two intersecting section or survey lines ____
SEE ATTACHED MAP

TYPE OF WORK (Check):
☑ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☑ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):
☒ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other ____ ☐ Driven

6) WELL LOG:
Date Drilling: Started 1-29 1990 Completed ____ 19__

DIAMETER OF HOLE		
Dia. (in.)	From (ft.)	To (ft.)
	Surface	
6	0	18

From (ft.)	To (ft.)	Description and color of formation material
0	4"	Concrete
4"	3'	Blk Sa Cl
3'	7'	Tan Gr Cl
7'	9'	Red Gr Cl
9'	11'	Red Sa Cl
11'	13'	Sa Wet @ 12'
13'	16'	Red Cl
16'	18'	Gr Cl

(Use reverse side if necessary)

D.H.

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7) BOREHOLE COMPLETION:
☐ Open Hole ☒ Straight Wall ☐ Underreamed
☐ Gravel Packed ☐ Other ____
If Gravel Packed give interval . . . from ____ ft. to ____ ft.

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2"	N	P.V.C.	18'	8'	.010
2"	N	Riser	8'	5'	

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 6 ft. to 1 ft. No. of Sacks Used 1
____ ft. to ____ ft. No. of Sacks Used ____
Method used Pressure Grouted
Cemented by E.L. Van Antwerp

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☒ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:
Static level 5' 7½" ft. below land surface Date 1-29-90
Artesian flow ____ gpm. Date ____

12) PACKERS:

Type	Depth
Bentonite	8'-6'

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☒ Other Bailer
Depth to pump bowls, cylinder, jet, etc., ____ ft.

14) WELL TESTS:
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☒ Estimated
Yield: ⅓ gpm with 8 ft. drawdown after 1 hrs.

15) WATER QUALITY:
Did the drilling penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Van & Sons Drilling Service, In (Type or print) WELL DRILLER'S LICENSE NO. 3003M

ADDRESS 319 John Alber Road (Street or RFD) Houston (City) Texas 77076 (State) (Zip)

(Signed) E C Van Antwerp (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chr[illegible]nalysis, and other pertinent information, if available.

For TWC use only: Well No. 65-19-5 L[illegible] map ____

WWD-012 (Rev. 09/21/88)

TEXAS WATER COMMISSION COPY

...d mail to: Texas Water Commission, P.O. Box 13087, Austin, Texas 78711

MW-4

...Confidentiality
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Please use black ink.

State of Texas
WELL REPORT

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

Kemron Environmental Serv. (Name) ADDRESS 109 Starlite Park Marietta, Ohio 45750 (Street or RFD) (City) (State) (Zip)

...ON OF WELL: Harris, _____ miles in _____ (NE, SW, etc.) direction from Houston (Town)

...must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official ...er- or Half-Scale Texas County General Highway Map and attach the map to this form.

LEGAL DESCRIPTION:
Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____
☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check): ☒ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other _____

6) WELL LOG:
Date Drilling: 1-29
Started _____ 1990
Completed 1-29 1990

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
	Surface	
6	0	19

7) BOREHOLE COMPLETION: ☐ Open Hole ☒ Straight Wall ☐ Underreamed ☐ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from _____ ft. to _____ ft.

From (ft.)	To (ft.)	Description and color of formation material
0	4"	Concrete
4"	4'	Blk Sa Cl
4'	9'	Tan Cl
9'	10'	Red Sa Cl
10'	12'	Red Gr Cl
12'	14'	Sa Wet @ 11'
14'	16'	Red Cl
16'	19'	Gr Cl

(Use reverse side if necessary)

D.I.M.

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JUL 6 1990
TEXAS WATER COMMISSION

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2"	N	P.V.C.	19'	9'	.010
2"	N	Riser	9'	.5'	

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 6 ft. to .1 ft. No. of Sacks Used 1
_____ ft. to _____ ft. No. of Sacks Used _____
Method used Pressure Grouted
Cemented by E.L. Van Antwerp

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☒ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:
Static level 7' 3½" ft. below land surface Date 1-29-90
Artesian flow _____ gpm. Date _____

12) PACKERS:

Type	Depth
Bentonite	8'-6'

13) TYPE PUMP: ☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☒ Other Bailer
Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☒ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:
Did the drilling penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Van & Sons Drilling Service, Inc. (Type or print) WELL DRILLER'S LICENSE NO. 3003M

ADDRESS 319 John Alber Road (Street or RFD) Houston (City) Texas (State) 77076 (Zip)

(Signed) E.L. Van Antwerp (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, che... ...alysis, and other pertinent information, if available.

For TWC use only ...

...WD-012 (Rev. ...

Send original copy by certified mail to: **Texas Water Commission, P.O. Box 13087, Austin, Texas 78711**

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas WELL REPORT

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

1) **OWNER** Circle K,Corp/HLA (Name) **ADDRESS** 9800 Richmond Ave #150 Hou Tex 77042 (Street or RFD) (City) (State) (Zip)

2) **LOCATION OF WELL:**
County Harris, ____ miles in ____ direction from ____
At 3290 Lockwood Dr. in Houston, Texas. (NE, SW, etc.) (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ **LEGAL DESCRIPTION:**
Section No. ____ Block No. ____ Township ____ Abstract No. ____ Survey Name ____
Distance and direction from two intersecting section or survey lines ____
SEE ATTACHED MAP

3) **TYPE OF WORK (Check):**
☐ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) **PROPOSED USE (Check):** D.I.M.
☐ Domestic ☐ Industrial ☐ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) **DRILLING METHOD (Check):**
☐ Driven ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other ____

6) **WELL LOG:**
Date Drilling: Started 10/17 1989 Completed 10/20 1989

DIAMETER OF HOLE		
Dia. (in.)	From (ft.)	To (ft.)
8"	Surface	31'

7) **BOREHOLE COMPLETION:**
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☐ Gravel Packed ☐ Other ____
If Gravel Packed give interval . . . from 3.5 ft. to 31 ft.

From (ft.)	To (ft.)	Description and color of formation material
0	2.5	Gr.-Brn. Sandy Lean Clay (CL)
2.5	5	Gr. Sandy Lean Clay (CL)
5	14.5	Lt. gr. & Ylw.-Brn. Sandy clay (CL)
14.5	18	Rd.-brn. lt. gr. fat clay (CH)
18	19	Rd.-brn. lt. gr. very fine (ML)
19	31	Reddish Brwon Clay & sand (CH)
CCI Installed 8 wells at this site. MW-5 through MW-12. MW- 7 was used for details in this report.		

(Use reverse side if necessary)

8) **CASING, BLANK PIPE, AND WELL SCREEN DATA:**

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2"	N	Sch 40 PVC Pipe	0	4	--
2"	N	Sch 40 PVC Screen	4	31	.020

9) **CEMENTING DATA** [Rule 287.44(1)]
Cemented from 0 ft. to 2 ft. No. of Sacks Used 1
Bent. pellets 2 ft. to 3.5 ft. No. of Sacks Used 1
Method used Gravity
Cemented by CCI

10) **SURFACE COMPLETION**
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

11) **WATER LEVEL:**
Static level 19' ft. below land surface Date DOD
Artesian flow ____ gpm. Date ____

12) **PACKERS:** Type ____ Depth ____
N/A

13) **TYPE PUMP:**
☐ Turbine ☐ Jet N/A ☐ Submersible ☐ Cylinder
☐ Other ____
Depth to pump bowls, cylinder, jet, etc., ____

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14) **WELL TESTS:** N/A
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

15) **WATER QUALITY:**
Did the drilling penetrate any strata which contained undesirable constituents?
☐ Yes ☐ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Custom Coring, Inc. (Type or print) WELL DRILLER'S LICENSE NO. 2769 DM

ADDRESS 2032 Karbach (Street or RFD) Houston, (City) Texas (State) 77092 (Zip)

(Signed) Scott Wolf (Licensed Well Driller) Scott Wolf By MT

(Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. 65-14-3 L ____ n map ____

WWD-012 (Rev. 09/21/88)

TEXAS WATER COMMISSION COPY

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas WELL REPORT

MW(7)

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

1) OWNER CDI MANAGEMENT SERVICES AS AGENT FOR FDIC (Name) ADDRESS 2819 QUITMAN, (Street or RFD) HOUSTON, (City) TX (State) (Zip)

LOCATION OF WELL:
County HARRIS , _____ miles in _____ (NE, SW, etc.) direction from _____ (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION: 2819 QUITMAN

Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____

Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP (FOUR SIMILAR WELLS)

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):
☐ Driven ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☒ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other _____

6) WELL LOG:
Date Drilling: Started 3-22 19 90 Completed 3-23 19 90

DIAMETER OF HOLE	Dia. (in.)	From (ft.)	To (ft.)
	6	Surface	34

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from 33 ft. to 23 ft.

From (ft.)	To (ft.)	Description and color of formation material
0	.5	ASPHALT & OYSTER SHELL BACKFILL D.I.M.
.5	4	BLACK W/LIGHT GREEN MOTTLED CLAY
4	10	LIGHT GREEN CLAY W/FOSSILS
10	14	YELLOW TO LIGHT BROWN SANDY CLAY
14	16	TAN CLAYEY SAND
16	27	YELLOW TO LIGHT BROWN SANDY CLAY

(Use reverse side if necessary) OVER

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
4	N	SLOTTED PVC	33	23	.010
4	N	PVC	23	SURFACE	SCH40

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 2 ft. to SURFACE No. of Sacks Used 2
_____ ft. to _____ ft. No. of Sacks Used _____
Method used HAND
Cemented by CECIL IRBY

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

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13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

11) WATER LEVEL:
Static level 6 ft. below land surface Date 3-23-90
Artesian flow _____ gpm. Date _____

15) WATER QUALITY:
Did the drilling penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? BRACKISH Depth of strata 30'
Was a chemical analysis made? ☐ Yes ☒ No

12) PACKERS: Type Depth

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME CTT ENVIRONMENTAL SERVICES (Type or print) WELL DRILLER'S LICENSE NO. 2953M

ADDRESS 14626 MORALES RD. (Street or RFD) HOUSTON, (City) TX (State) 77032 (Zip)

(Signed) Cecil Irby (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. 6.5-14-7 Located on map _____

WWD-012 (Rev. 09/21/88)

TEXAS WATER COMMISSION COPY

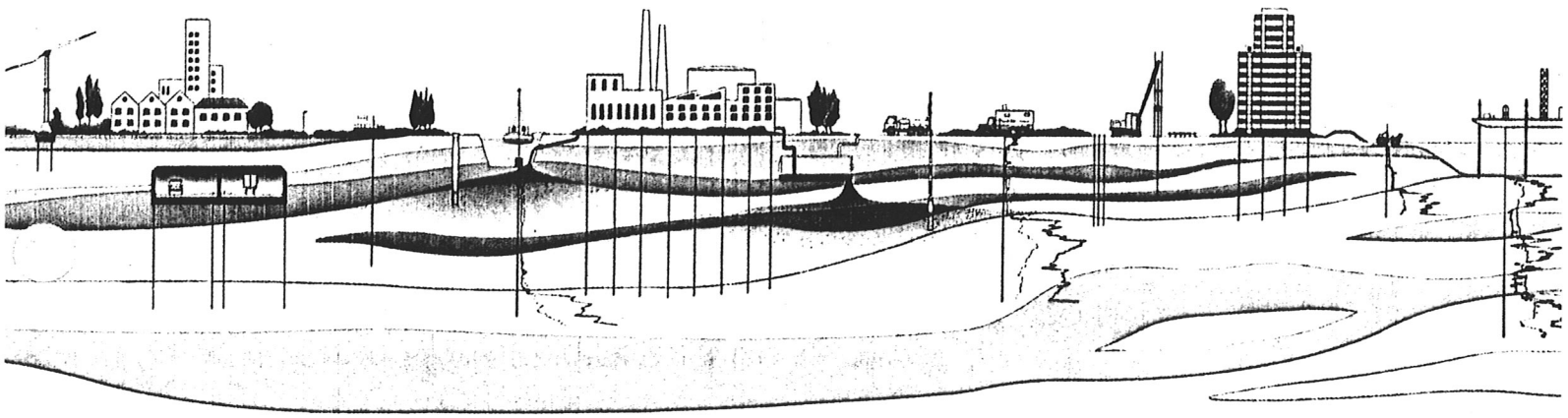
APPENDIX C

FUGRO/LORAL - REPORT OF CONE PENETROMETER TESTING AND RELATED SERVICES - WOOD PRESERVING WORKS, HOUSTON, TEXAS

FUGRO GEOSCIENCES, INC.

CONE PENETRATION TESTING AND RELATED SERVICES WOOD PRESERVING WORKS HOUSTON, TEXAS

Submitted To:
Terranext
Dallas, Texas



CONE PENETROMETER TESTING
AND RELATED SERVICES
WOOD PRESERVING WORKS
HOUSTON, TEXAS
REPORT NO.:0301-5133

******

Report To:
TERRANEXT.
Dallas, Texas

*****

Sumitted By:

FUGRO GEOSCIENCES, INC.
Houston, Texas

****

December-1995

FUGRO GEOSCIENCES, INC.

6105 Rookin
Houston, TX 77074
Phone : 713-778-5580
Fax : 713-778-5501

December 21, 1995
Report Number 0301-5133

Terranext
10025 West Technology Blvd.
Suite 147
Dallas, Texas 75220

Attention: Ms. Elaine J. Hanford

SUMMARY REPORT
CONE PENETRATION TESTING
AND RELATED SERVICES
WOOD PRESERVING WORKS
HOUSTON, TEXAS

Dear Ms. Hanford:

Please find enclosed the final results of the Cone Penetration Tests (CPT) performed at the above referenced site. Also, included is a brief summary of the CPT field work performed and explanation of the CPT, CPT data and its interpretation.

The data/sample collection portion of the project was divided into two phases. The first phase consisted of performing CPT soundings coupled with the Rapid Optical Screening Tool (ROST™). The second phase consisted of collecting direct push groundwater samples at and around the site.

During the first phase, which took place from November 14, through November 19, 1995, 46 CPT/ROST™ soundings were performed. These forty-six CPT/ROST™ soundings generated a total of 2,177 linear feet of testing. The CPT utilized for this phase of the project was Fugro's Supercone. The Supercone measures and records tip resistance, sleeve friction, induced and static pore pressures and electric conductivity of soil. In addition to these parameters, the inclination of the Supercone as it was advanced was monitored. CPT data is presented in Appendix B. The soil stratigraphy presented on the CPT logs, was identified by Campanella and Robertson's Simplified Soil Behavior Chart. Due to the empirical nature of the soil behavior chart, the soil identification should be verified locally. The ROST™ unit (System No. 4), recorded the laser induced fluorescence (LIF) of aromatic hydrocarbons in the soil. The combined CPT/ROST™ data is presented in Appendix C.

During the second phase of the project, which was performed from December 4 through December 7, 1995, thirty-one direct push groundwater samples were collected. Fugro's bailing style groundwater sampler was utilized for this phase of the project.

Terranext
Ms. Hanford
Report Number 0301-5133

Fugro Geosciences appreciates the opportunity to be of service to Terranext. Please contact us at (713) 778-5580 if you have any questions or require any additional information. We look forward to working with you again in the future.

Very truly yours,
FUGRO GEOSCIENCES, INC.

K. Van De Vusse

Kevin Van De Vusse
CPT Manager

KVDV/rsp

Enclosures
Diskette

APPENDIX A

DESCRIPTION OF CPT

CONE PENETROMETER TESTING AND DIRECT PUSH SAMPLING

INTRODUCTION

Knowing the drawbacks of drilling, many geotechnical and environmental professionals are looking for new assessment and exploration methodologies. The most often utilized and accepted of these new methodologies is **Cone Penetrometer Testing (CPT).** For the last 25 years Fugro has been the leader in CPT throughout the United States. The following is a description of CPT and Fugro's equipment and capabilities.

FUGRO GEOSCIENCES, INC.

Fugro is an international company that currently utilizes in excess of 130 rigs throughout the world. In the 1960's, Fugro developed the first commercial electrical cone penetrometer by incorporating strain gauge technology to the mechanical Dutch Cone. Since that time, Fugro has continued to lead the world in cone penetrometer testing and the development and advancement of CPT testing and sampling methods.

Fugro Geosciences, Inc., is an independent division of Fugro, USA, that is exclusively a subcontracting CPT service company. We currently own and operate nine (9) CPT rigs and 28 drill rigs. Our CPT rigs are stationed throughout the United States. We have offices in Los Angeles, California, Baton Rouge, Louisiana, Atlanta, Georgia and our headquarters in Houston, Texas. Our office in Houston has complete machine, welding and maintenance facilities.

CONE PENETROMETER TESTING AND DIRECT PUSH SAMPLING

Cone penetrometer testing and direct push sampling are methods in which instruments and sampling tools are "pushed" directly into the earth for the purpose of collecting subsurface information and samples. Since the tools are pushed, not drilled, no drilling by products are generated. This greatly reduces crew exposure and cuts cost by eliminating the need to dispose of drill cuttings and fluids.

The CPT Rig

Primary to performing CPT testing is the CPT rig. The type of rigs employed by Fugro are truck and ATV mounted, self-contained, climate controlled units ranging in weight from 15 to 35 tons. These rigs are designed and built specifically for the purpose of performing CPT testing and direct push sampling. The weight of the rigs provides the reaction force necessary to advance the tools into the earth without the need for time consuming earth anchoring . The hydraulic system, which is used to push the various tools into the earth, is completely self contained on the CPT rig. This hydraulic system is equipped with high speed rams, up to 1 meter/4 seconds, for the rapid insertion and retrieval of the push rods and instruments. A flow control valve is used to regulate the speed (2 cm/sec.) of the hydraulic rams when pushing the cone penetrometers. Also included in the hydraulic system is a 12,000 watt hydraulic generator. This generator provides the electrical current to power the computer and air conditioning systems as will as excitation voltages for the various stress and strain gauges.

To correctly perform any cone penetrometer test, the pushing stage must be stabilized. To achieve this, the CPT unit must be elevated off the ground so that it is no longer in contact with the surface. Without this elevated stabilization, the unit is pushed off the ground by the downward thrusting force, and then it falls back to its tires. When this situation occurs, the computer interprets the rods as being pushed into the ground when in reality the unit is rising around the rods. The consequence of this occurrence is inaccurate depths at which different subsurface layers occur. To avoid this, the CPT unit and pushing stage must be vertically stabilized.

Fugro's Cone Penetrometers

Fugro Geosciences offers a complete line of cone penetrometers. All of the cones are designed to the specifications outlined in ASTM D-3441, "Standard Tests Method for Deep, Quasi-Static, Cone and Friction-Cone Penetration Tests of Soil". All of our cone penetrometers consist of a 60 degree conical point and a cylindrical friction sleeve located immediately behind the point. Inside the cones are various types and styles of gauge assemblies. Adhered to these gauge assemblies are stress and strain gauges which are situated in a Whetstone Bridge formation. These cones include:

Standard Cone - Tip Resistance and Sleeve Friction

Piezocone - Tip Resistance, Sleeve Friction and Pore Pressure

Conductivity Cone - Tip Resistance, Sleeve Friction, Pore Pressure and LIF.

Laser Induced Fluorescence Cone - Tip Resistance, Sleeve Friction, Pore Pressure, and Electrical Conductivity.

Super Cone - Tip Resistance, Sleeve Friction, Pore Pressure, and Electrical Conductivity

Super Cone With LIF - Tip Resistance, Sleeve Friction, Pore Pressure, Electrical Conductivity, and LIF.

Prior to advancing the cone penetrometer, an electrical baseline is established. Once the baseline has been established the cone is advanced into the earth at a constant rate of 2 centimeters per second. As the cone is advanced, the rig's on-board signal conditioner sends as excitation voltage to the strain gauges located inside the cone. The strain gauges offer resistance to this excitation voltage and send a return signal to the signal conditioner. This return signal is plotted real-time in its analog form on a strip chart recorder located in the rig. The signal conditioner also converts the analog signal to a digital signal that is recorded and stored by the rig's computer for later manipulation. As the cone is advanced, the encountered soils offer resistance to pushing. This resistance actually compresses the cone penetrometer which in turn compresses the adhered strain gauges. As the strain gauges are compressed, they more or less resist the excitation voltage. The signal conditioner relays these changes in voltage to the rig's strip chart recorder and on-board computer.

Recorded measurements vary with the type and style of cone penetrometer being utilized. In general, the resistance to advancing the tip into the soil and the drag, or friction encountered by the sleeve are recorded. When utilizing a piezocone, the tip and sleeve resistance are measured as will as the induced pore pressure as the cone is being advanced. When the pushing is stopped the time rate of pore pressure dissipation is recorded. Estimated permeability values can be determined from the time rate of dissipation curves as well as hydrostatic pressures within the aquifer. When using the conductivity cone, tip, sleeve and the soil's electric conductivity are recorded. Various combinations of these cones and various locations of some of the sensors can be utilized.

Upon completion of cone penetrometer testing, the recorded measurements are correlated to soil behavior type, soil characteristics, groundwater flow characteristics, and potential contamination locations. A plot of the recorded measurement and soil conditions is generated with the rig's on-board Laser Jet printer. Plotting parameters can be adjusted to meet the needs of individual projects and lithologic formations.

Fugro's Direct Push Samplers

Fugro offers a complete line of Direct Push Groundwater, Soil and Soil Gas Samplers. All of these samplers are pushed into the earth in a similar fashion to the cone penetrometers. Therefore, they offer many of the same benefits, no drilling by-products, reduced health and safety concerns, rapid installation and retrieval, and cost effectiveness. Following is a description of our various samplers.

Fugro's Hydro-Trap

The Hydro-Trap is a surface activated, inert gas controlled, stainless steel groundwater sampler. The hydro-trap consists of a stainless steel body that acts as a sample chamber. Housed inside of this body is a telescopic screen assembly which consist of a conical point, a one (1) foot wire wrap stainless steel screen and a check valve assembly. Immediately above the Hydro-Trap body is an ultrasonic sensor that measures the in-flow of groundwater into the sample chamber.

Sampling with the Hydro-trap is conducted by pushing the sampler to a predetermined sampling depth with the screen assembly in the closed and sealed position (retracted in the sample chamber). When the sampling depth has been achieved, the sample chamber is pressurized and the sample chamber and rod string are back-pulled (retrieved) one foot. The pressure in the sampler holds the screen assembly at depth while this back-pulling is performed, exposing the screen. Once the screen has been exposed, the gas pressure is vented to a pressure below that of the hydrostatic pressure at that depth. The hydrostatic pressure then forces groundwater through the screen, past the check valve and into the sample chamber. When the sample chamber is full, the gas pressure is again raised above the hydrostatic level, closing the check valve and securing the sample. At this point, the entire sampler is retrieved to the surface. At the surface the screen assembly is removed and a decanting mechanism is inserted in the bottom of the sample chamber. The groundwater sample is then decanted directly into the sample vials provided by the laboratory.

The filling and retrieval process are monitored by the rig operator to ensure that a sufficient volume of sample has been collected. Laboratory results from samples collected with the Hydro-trap are generally slightly higher than those of similar samples collected form monitoring wells. This is due to the fact that the sample is collected in a controlled, back-pressure environment that virtually eliminated any volatilization.

Bailer Style Samplers

Fugro's bailing style samplers, are similar to the Hydro-Trap in that they utilize a telescopic screen assembly that is housed in the sample collection area during pushing. Bailing style samplers come in a variety of diameters and screen lengths. The primary differance between the samplers and the Hydro-Trap is that bailing style samplers are not monitored in any way and instead of "trapping" a sample, groundwater is allowed to naturally flow into the sampler and it is then bailed to the surface with a small diameter bailer.

Advantages of the bailing style sampler are that an unlimited volume of sample can be retrieved. Also if the sampling depth is in a slow recharge zone, the samplers can be disconnected from the CPT rig, left in the ground, and sampled at a later time. Laboratory results of samples collected with bailing style samplers are usually very similar to those of samples collected from monitoring wells. This is due to the fact that bailing style samplers can be purged and developed in a similar fashion to wells. In addition, they are sampled in the same manner as a well is sampled.

Fugro's Direct Push Soil Sampler

Fugro's direct push soil samplers are designed to be pushed to a specific depth for the purpose of collecting a soil sample. The sampler can be lined with either a split spoon or a three ring assembly which are made of Teflon, brass of stainless steel. The soil sampler consist of a two foot sample chamber, locking tip, ball chuck mechanism and an overshot system. Sampling with the soil sampler is performed by locking the tip at the bottom of the sampler with the ball chuck mechanism. The sampler is then pushed to the required sampling depth. When the sampling depth has been achieved, the operator collapses the ball chuck mechanism by pulling on the overshot system. By collapsing the ball chuck mechanism, the tip is released from its locked position. The operator will then pull the tip and ball chuck system to the top of the sampler, the sample is collected by pushing the entire sampler an additional two feet into undisturbed soil. Once the sample has been collected, the entire sampler is retrieved to the surface.

Fugro's Soil Gas Samplers

Fugro utilizes two type of soil gas samplers. The first is for collecting depth discreet soil gas samples and the second is for collecting continuous soil gas samples as the sampler is being advanced. The depth discreet sampler consists of a sampling tube connected to a telescopic sampling tip. The sampler is pushed in the closed position with the telescopic tip sealed inside the sampler, to the required depth. When the sampling depth has been achieved, the rod string is pulled back to expose the telescopic sampling tip. At this time, a vacuum is applied to the sampling tube in order to retrieve the soil gas sample to the surface. At the surface, the sample can be collected in tedlar bags or directly into an analysis unit. The sampler can then be retrieved to the surface for decontamination and reused, or pushed to the next sampling depth and reopened to collect another sample.

The continuous sampling style soil gas sampler consist of a sample tube connected to an exposed screen. The sampler is pushed to specific sampling depth to collect samples for laboratory analysis or a field analysis the unit can be connected directly to the sample tube for continuous analysis as the sampler is advanced into the soil.

Push-In Piezometers and Small Diameter Wells

Fugro's CPT rigs can install push-in well points ranging in diameter from 3/4 to 2 inch. This is accomplished by utilizing sacrificial points connected to PVC or stainless steel well material. The wells are installed with steel casing that is housed either inside or outside the well material, depending on the diameter of the well. The steel casing bears on the sacrificial tip as the well is being pushed into the ground. The well material does not carry any of the load and therefore is not damaged during the pushing process. When the final depth of the well is achieved, the casing is retrieved to the surface leaving the sacrificial point and well material in the ground. The well can then be finished at the surface in a similar fashion to a drill rig installed well.

Decontamination

Fugro field professionals fully understand the need for complete and thorough decontamination at environmental sites. Therefore, all field personnel are trained in decontamination procedures and QA/QC protocol. In addition to mobilizing our CPT rigs to environmental sites, we also mobilize a complete decontamination unit, containing the necessary tools and equipment. The standard decontamination unit includes a high pressure, high temperature steam cleaner, deionized, organic free water, plastic sprayers and brushes, containers for decontaminated fluids and the necessary tools to construct a decontamination containment area to collect contaminated waste fluids. Additional equipment can be mobilized if site specific decontamination protocols require tools that we do not carry on a standard basis.

Our standard decontamination procedures meet or exceed the requirements outlined by the Environmental Protection Agency's Standard Operating Procedures for work on Superfund sites. This generally includes, but is not limited to , a high pressure, high temperature steam cleaning, scrubbing of all sampling tools with an industrial grade detergent (Alconox or Liquinox), deionized, organic free water rinse and spraying with pesticide grade isopropyl alcohol.

The entire inside of the CPT work cabin can be washed and steam cleaned. The rigs are properly maintained and hydraulic and lubricating fluid leaks are immediately repaired upon discovery. As a precautionary measure, thick plastic sheeting is generally laid out under the rig prior to beginning any sampling.

In addition to the above mentioned decontamination equipment, Fugro can utilize a rod washing system, if requested. This system is placed between the rig and the ground, the CPT rods are then pushed through it as they are being advanced into the subsurface. As the rods are being retrieved, they are steam cleaned with the rod washing system. The contaminated fluids are collected and containerized in a 55 gallon drum.

Grouting

As with decontamination, Fugro understands the importance of grouting all holes from the total depth to the surface. In addition to the CPT and decontamination units, a grouting system is mobilized to the site. Once all of the rods and instruments are retrieved to the surface, either ground rods or tremmie pipe is inserted into the hole and grout is pumped from the bottom of the hole to the surface.

Fugro Personnel

All of Fugro Geosciences employees are properly trained in the uses and applications of our technology. In addition to training in CPT methods and applications. All of our employees are OSHA 40 Hour Hazardous Waste Operations and Emergency Response trained and are on a current medical monitoring program. Resumes of key employees are included in Appendix B.

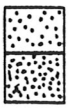
APPENDIX B

CONE PENETRATION TEST RESULTS

Key To Soil Classification and Symbols

SOIL TYPE
(Shown in Symbol Column)

Fill

Sand

Sandy

Silt

Silty

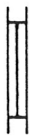
Clay

Clayey

Predominant Type Shown Heavy

SAMPLE TYPE
(Shown in Samples Column)

Undisturbed


Rock Core

Split Spoon

No Recovery

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (Major portion Retained on No. 200 Sieve)
Includes (1) clean gravels and sand described as fine, medium or course, depending on distribution of grain sizes (2) silty or clayey gravels and sands and (3) fine grained low plasticity soils (PI < 10) such as sandy silts. Condition is rated according to relative density, as determined by lab tests or estimated from resistance to sampler penetration.

Descriptive Term	Penetration Resistance*	Relative Density
Loose	0 - 10	0 to 40%
Medium Dense	10 - 30	40 to 70%
Dense	30 - 50	70 to 90%
Very Dense	Over 50	90 to 100%

* Blows/Foot, 140# Hammer, 30" Drop

FINE GRAINED SOILS (Major Portion Passing No. 200 Sieve)
Includes (1) inorganic and organic silts and clays, (2) sandy, gravelly or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests for soils with PI $\geq$ 10.

Descriptive Term	Cohesive Shear Strength Tons/Square Foot
Very Soft	Less Than 0.125
Soft	0.125 to 0.25
Firm	0.25 to 0.50
Stiff	0.50 to 1.00
Very Stiff	1.00 to 2.00
Hard	2.00 and Higher

Note: Slickensided and fissured clay may have lower unconfined compressive strengths than shown above because of planes of weakness or shrinkage cracks; consistency ratings of such soils are based on hand penetrometer readings.

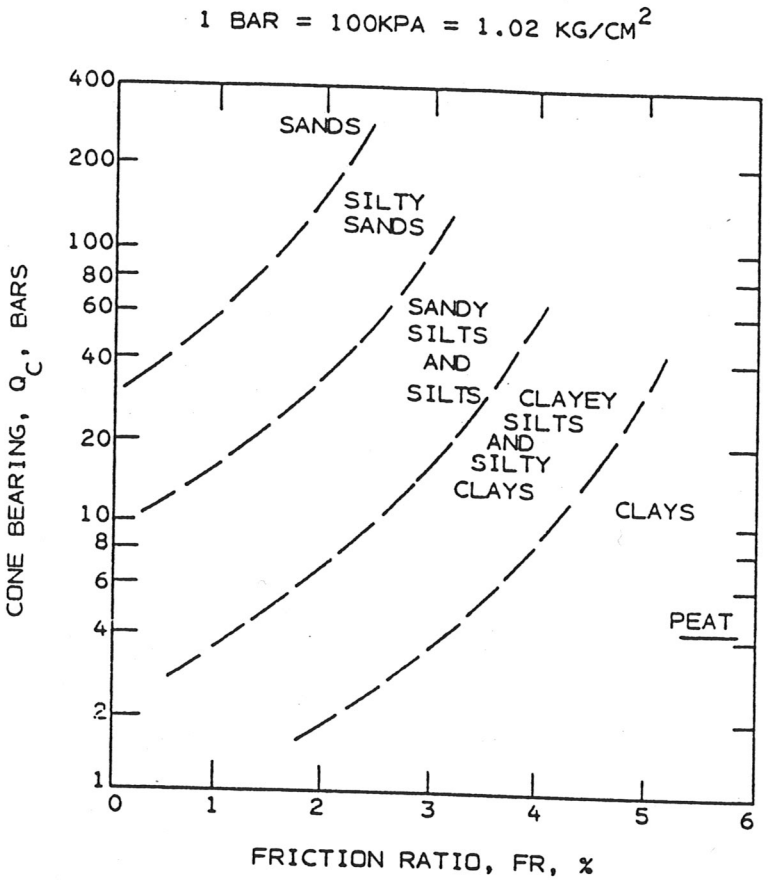
TERMS CHARACTERIZING SOIL STRUCTURE

Parting: paper thin in size
Seam: 1/8" to 3" thick
Layer: greater than 3"
Fissured: containing shrinkage cracks, frequently filled with fine sand or silt, usually more or less vertical
Sensitive: pertaining to cohesive soils that are subject to appreciable loss of strength when remolded
Interbedded: composed of alternate layers of different soil types
Laminated: composed of thin layers of varying color and texture
Calcareous: containing appreciable quantities of calcium carbonate
Well Graded: having wide range in grain sizes and substantial amounts of all intermediate particle sizes
Poorly Graded: predominantly of one grain size, or having a range of sizes with some intermediate size missing

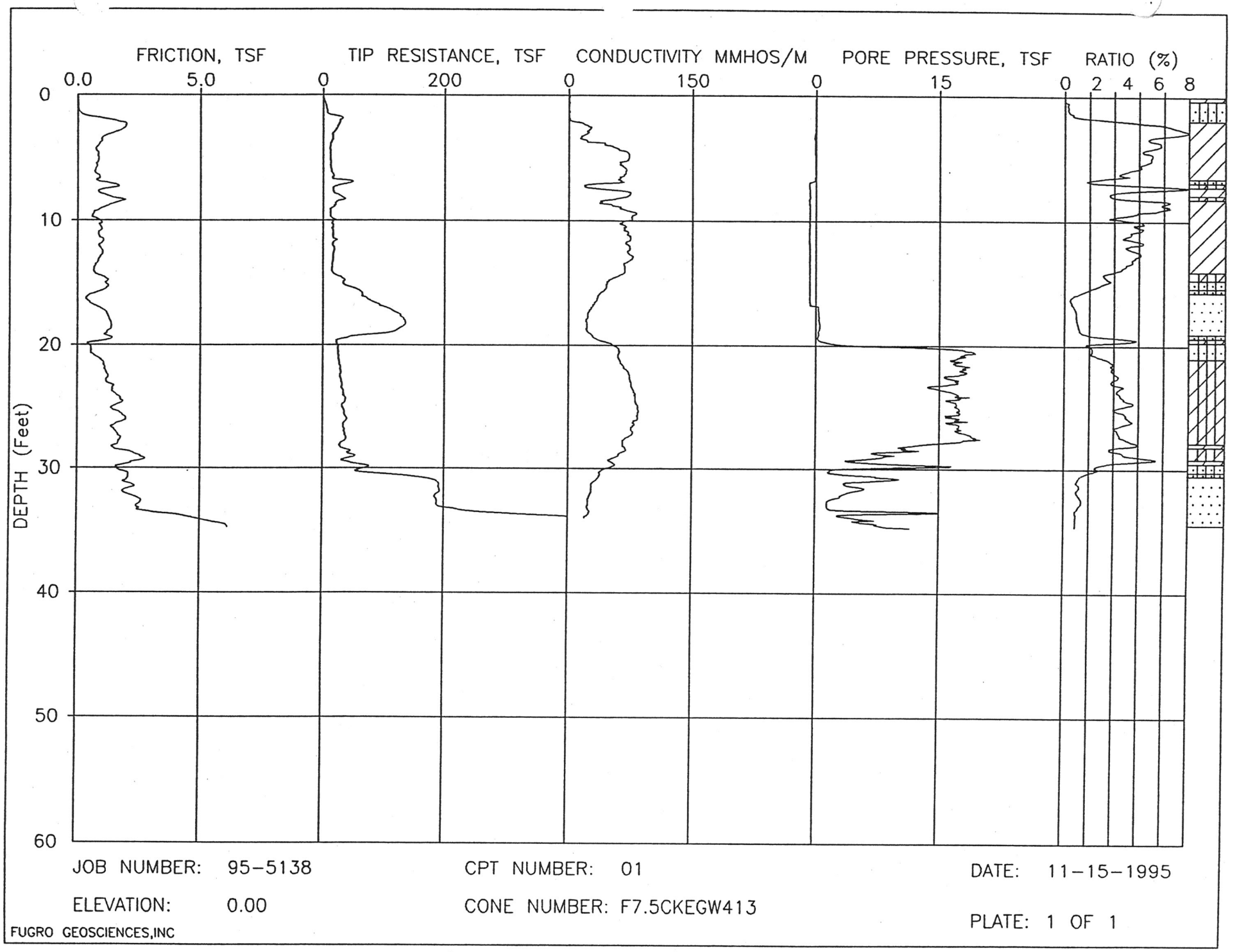
Flocculated: pertaining to cohesive soils that exhibit a loose knit or flakey structure
Slickensided: having inclined planes of weakness that are slick and glossy in appearance.

Degree of Slickensided Development

Slightly Slickensided: slickensides present at intervals of 1' to 2', soil does not easily break along these plates
Moderately Slickensided: slickensides spaced at intervals of 1' to 2', soil breaks easily along these planes
Extremely Slickensided: continuous and interconnected slickensides spaced at intervals of 4" to 12', soil breaks along the slickensides into pieces 3" to 6" in size
Intensely Slickensided: slickensides spaced at intervals of less than 4", continuous in all directions; soil breaks down along planes into nodules 1/4" to 2" in size.



CAMPANELLA AND ROBERTSON CLASSIFICATION CHART



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CPT NUMBER: 01

DATE: 11-15-1995

ELEVATION: 0.00

CONE NUMBER: F7.5CKEGW413

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC

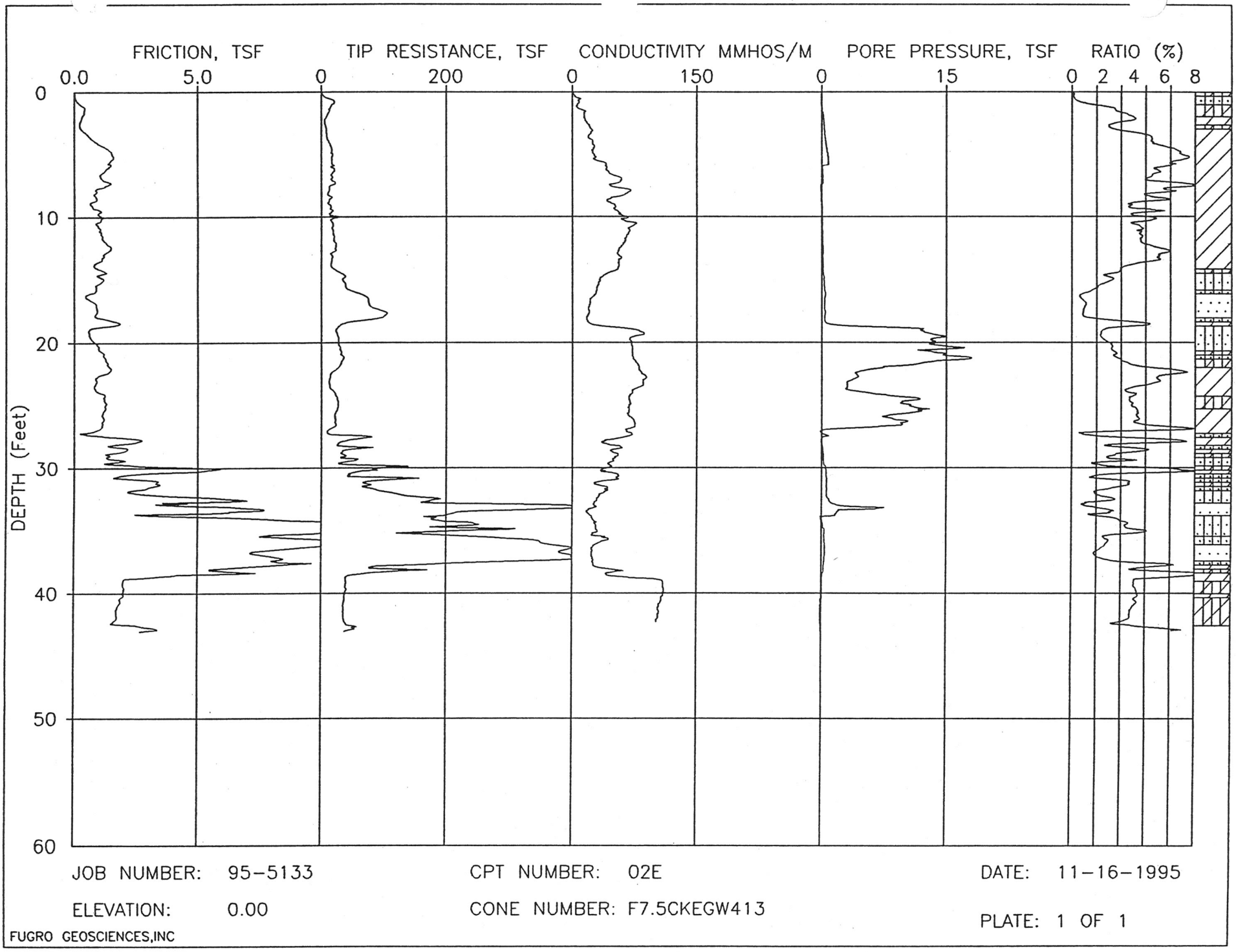

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PLATE: 1 OF 1

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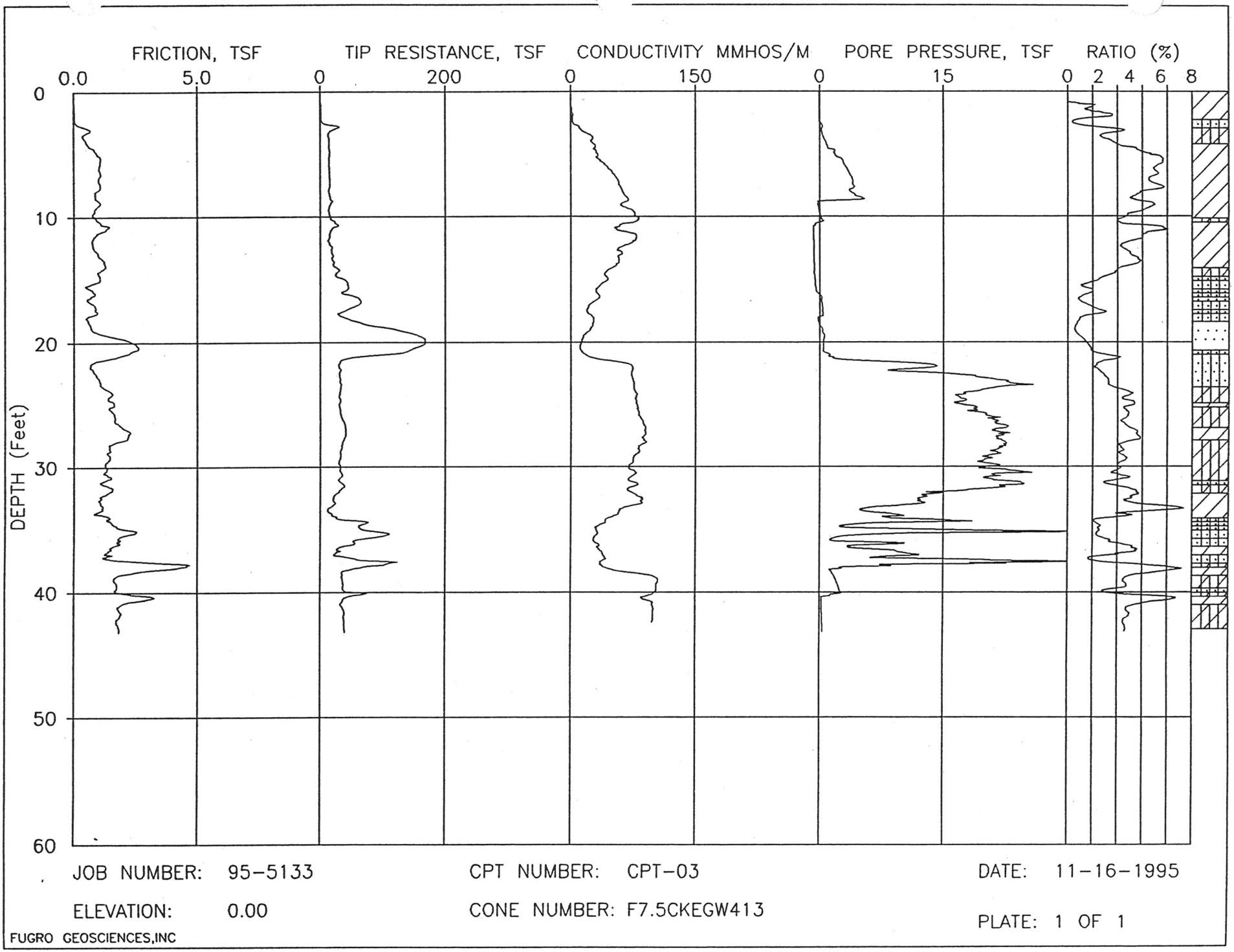
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RATIO (%)
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DEPTH (Feet)
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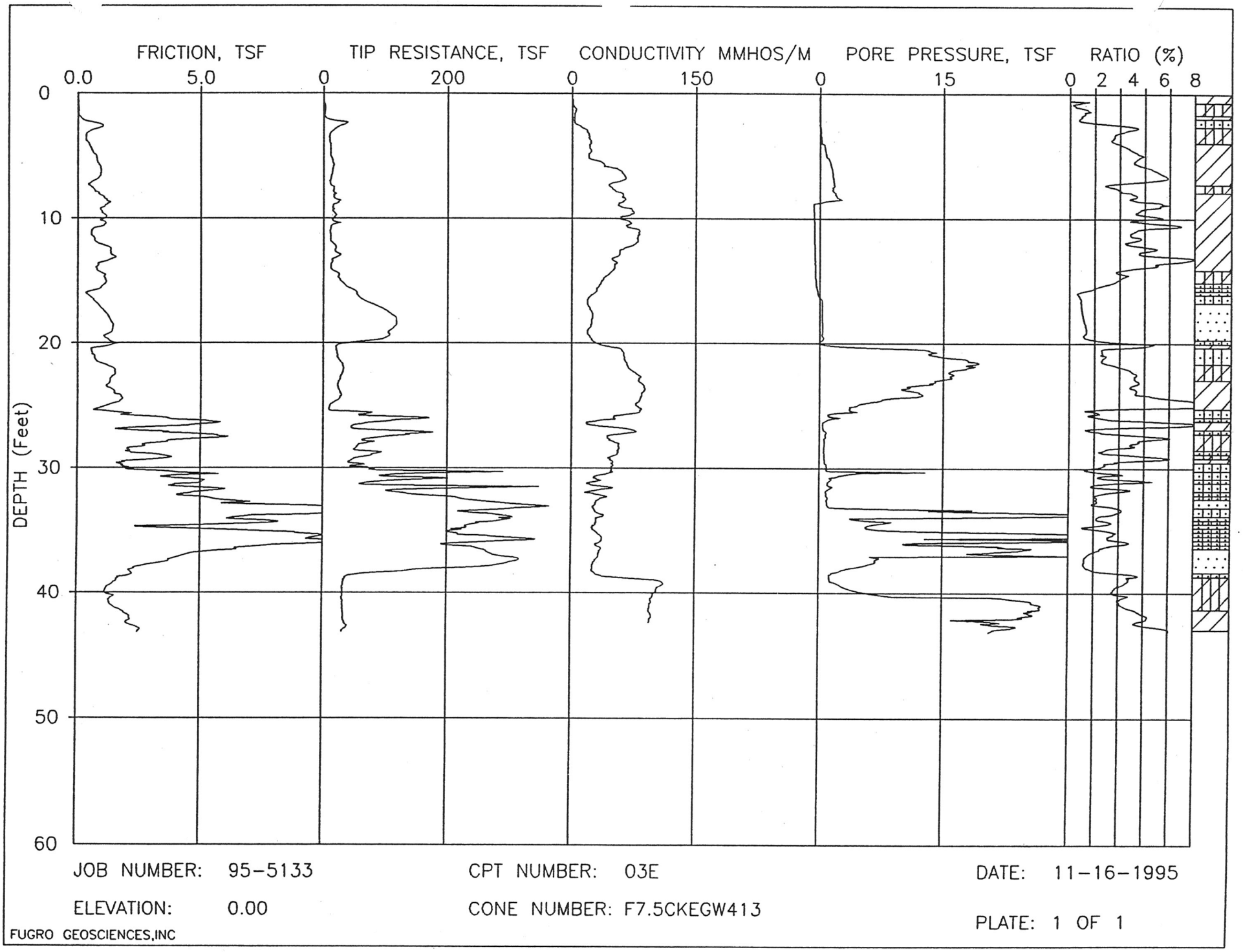
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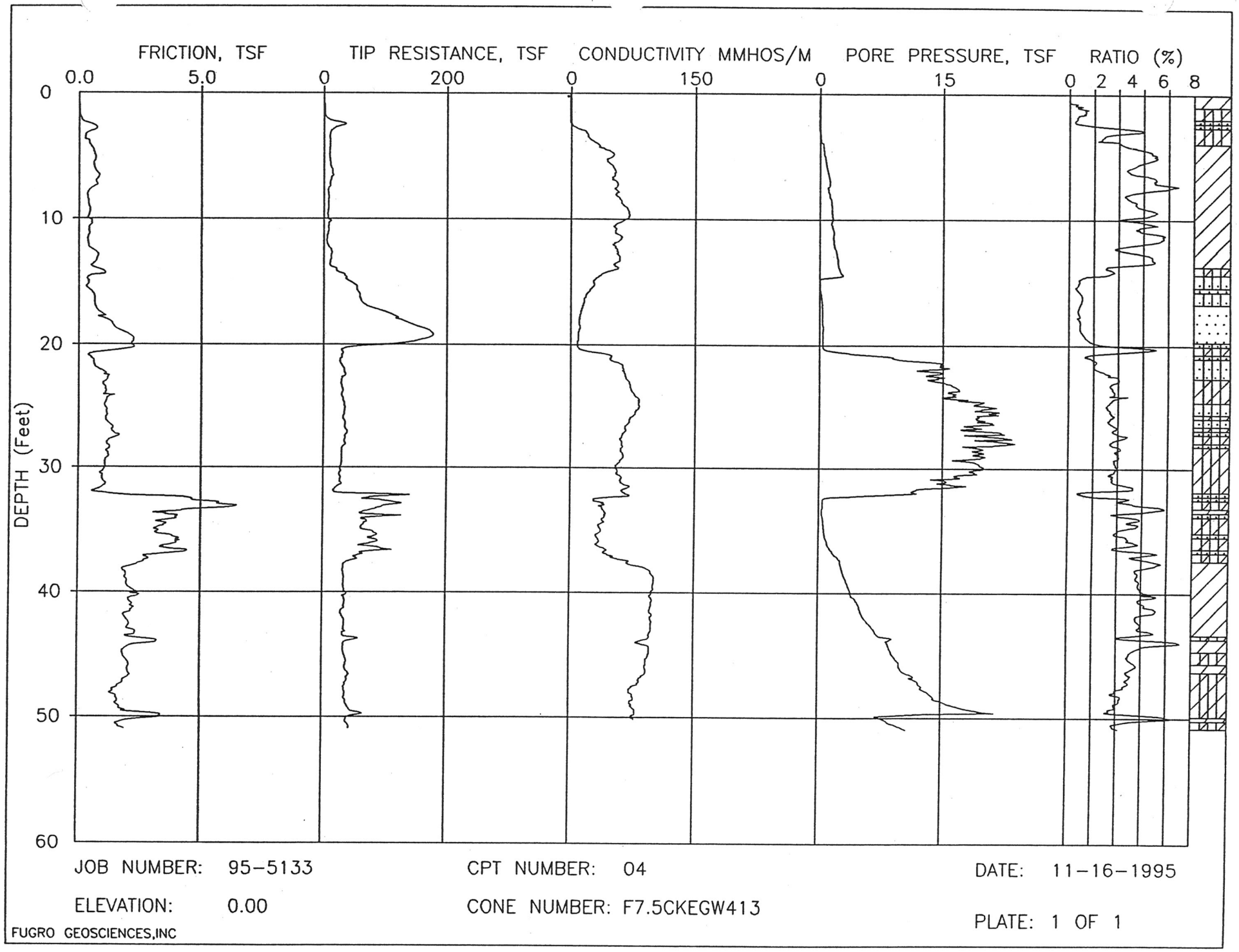
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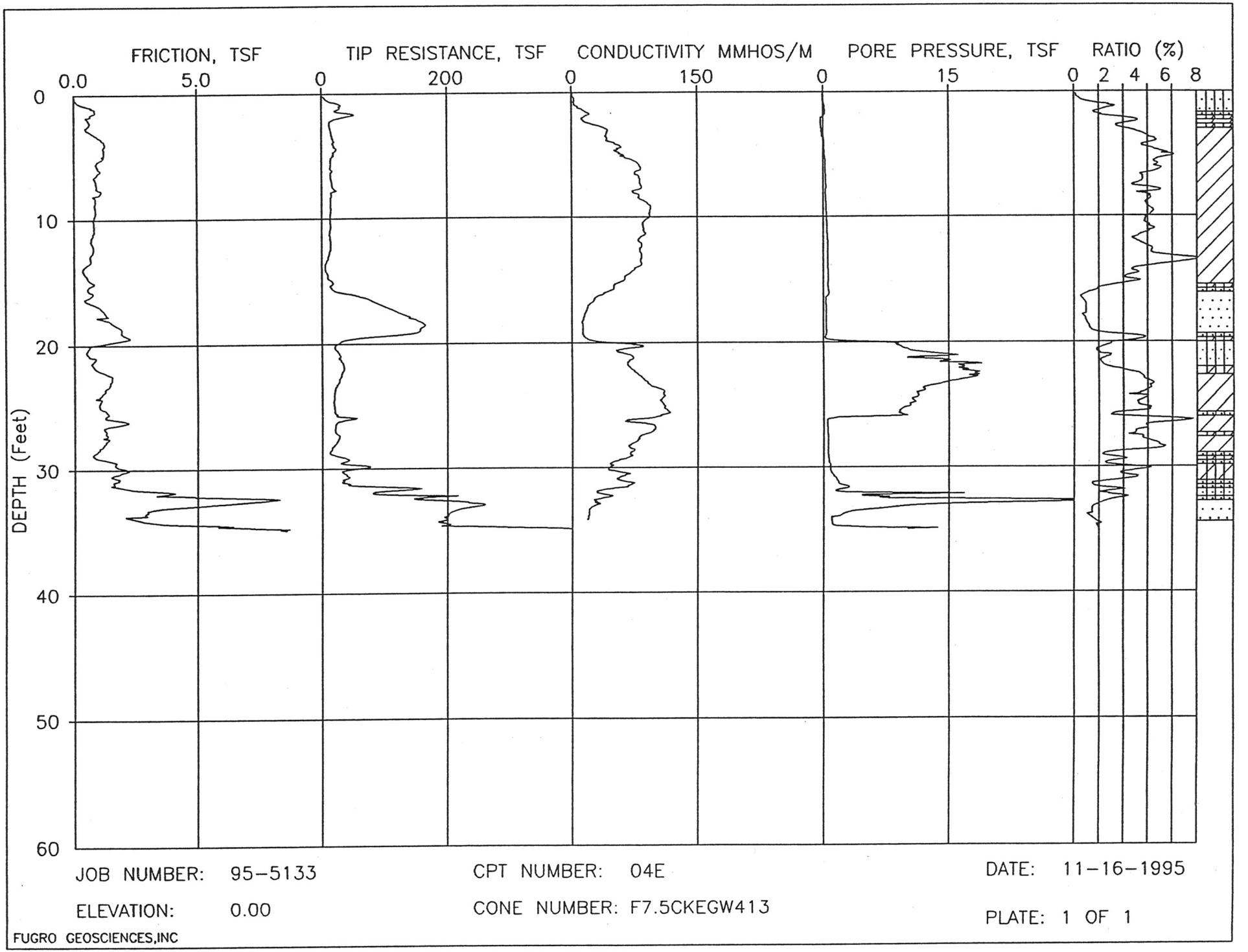
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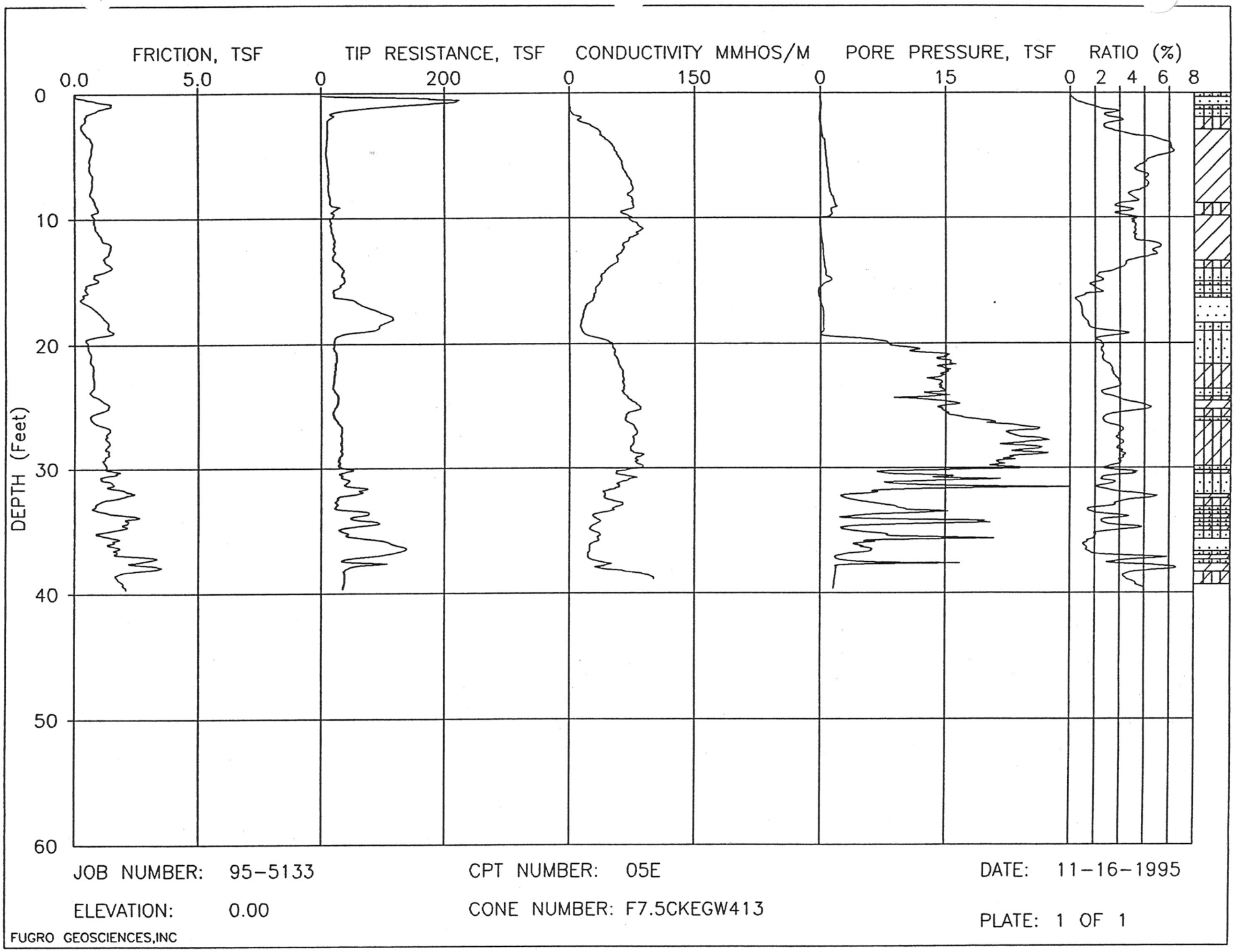
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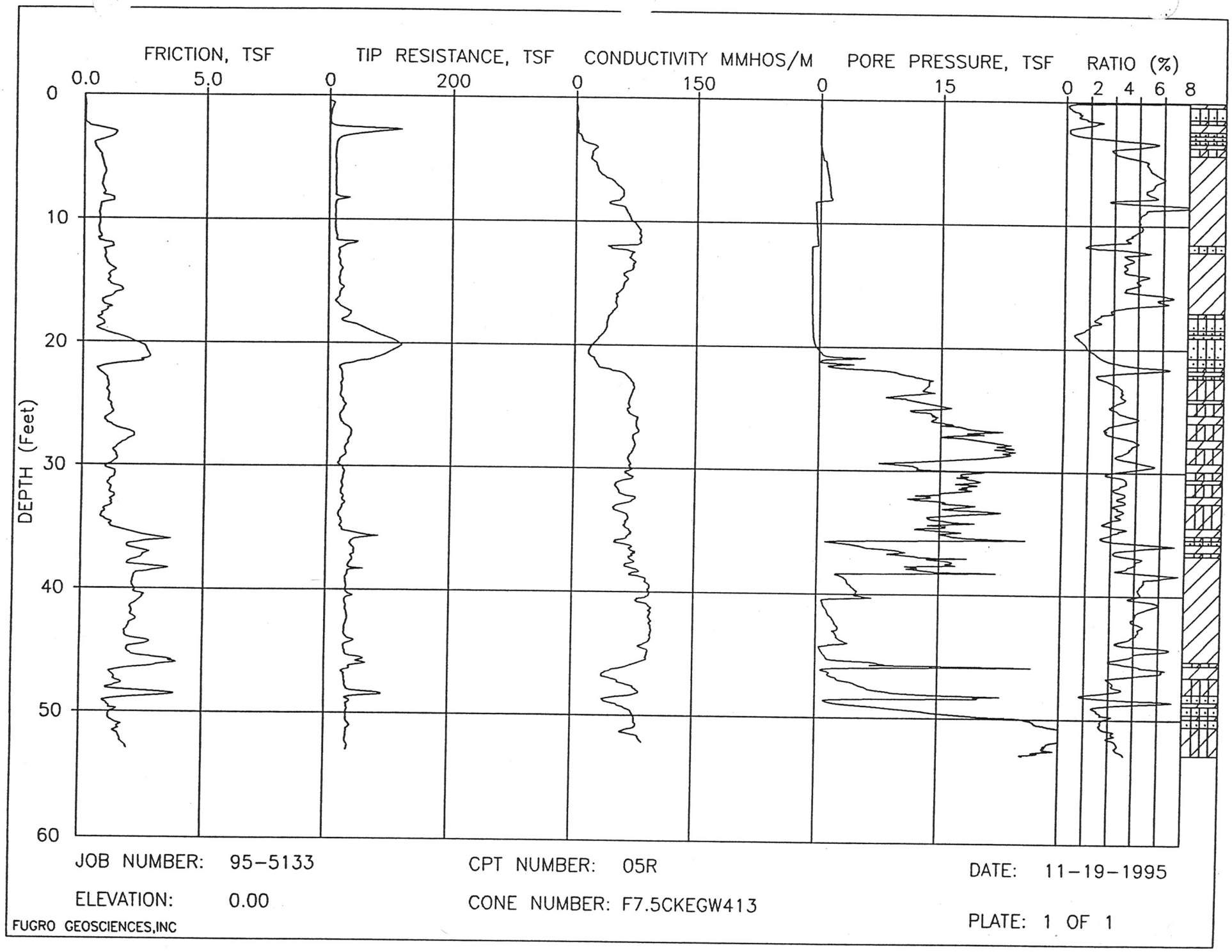
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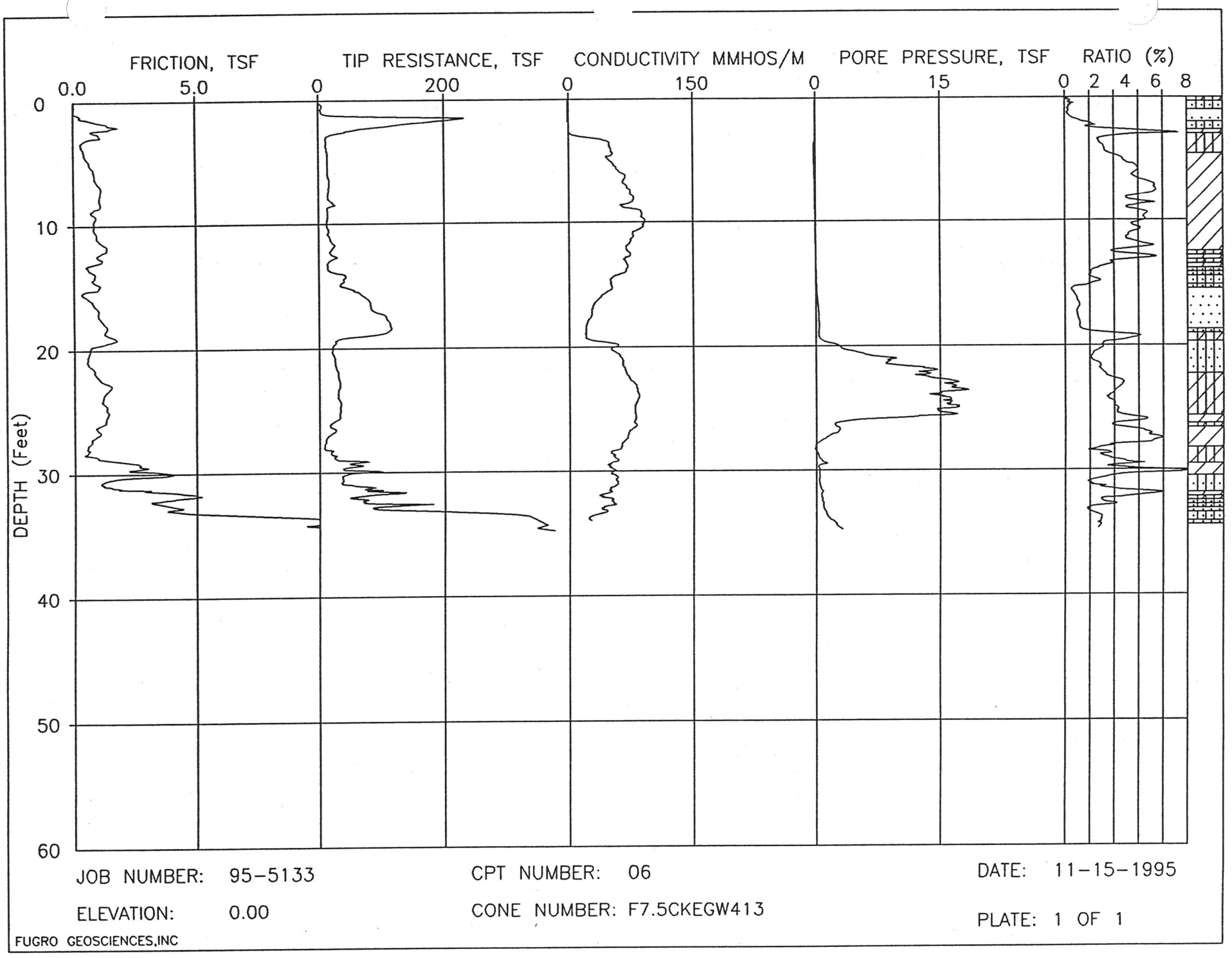
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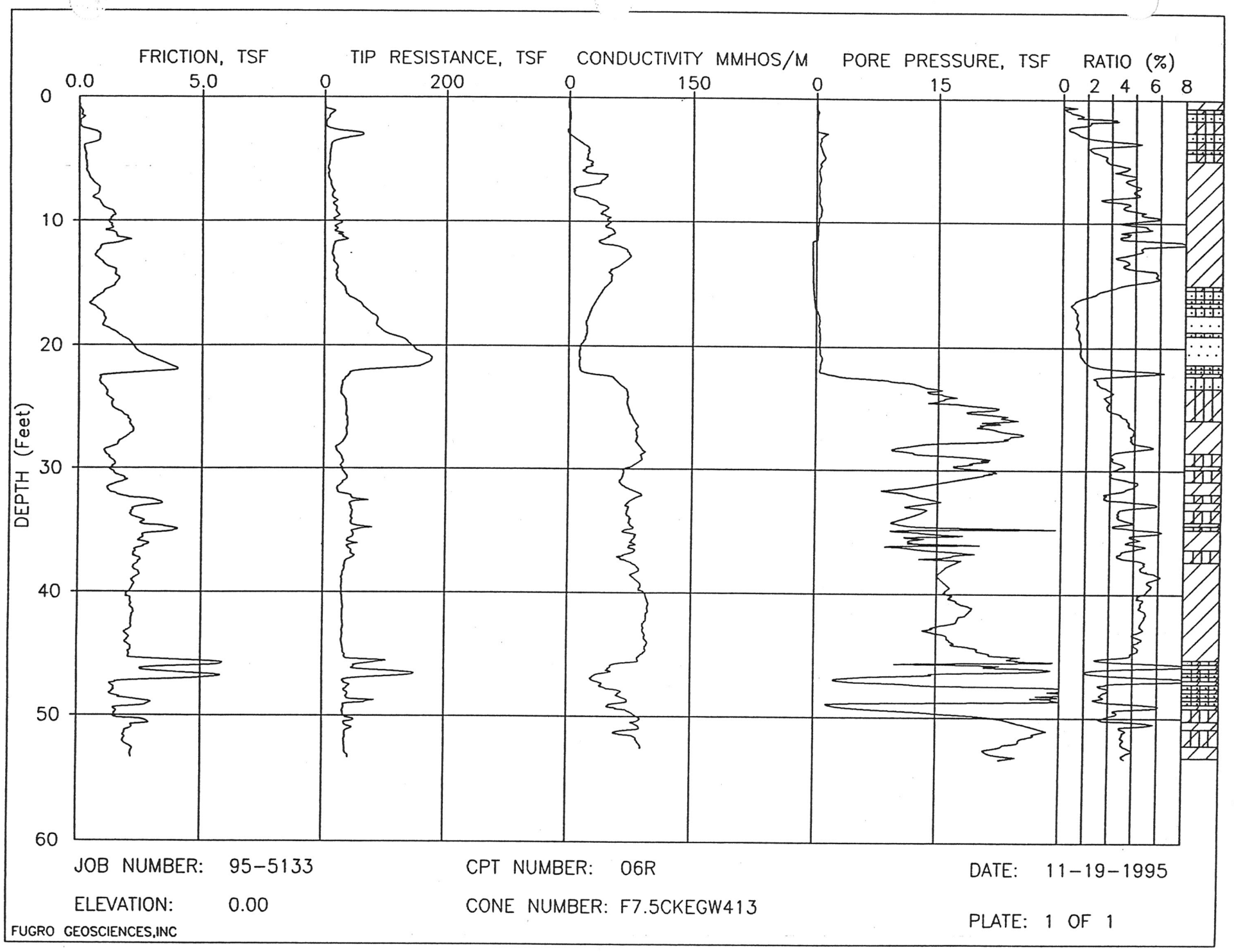
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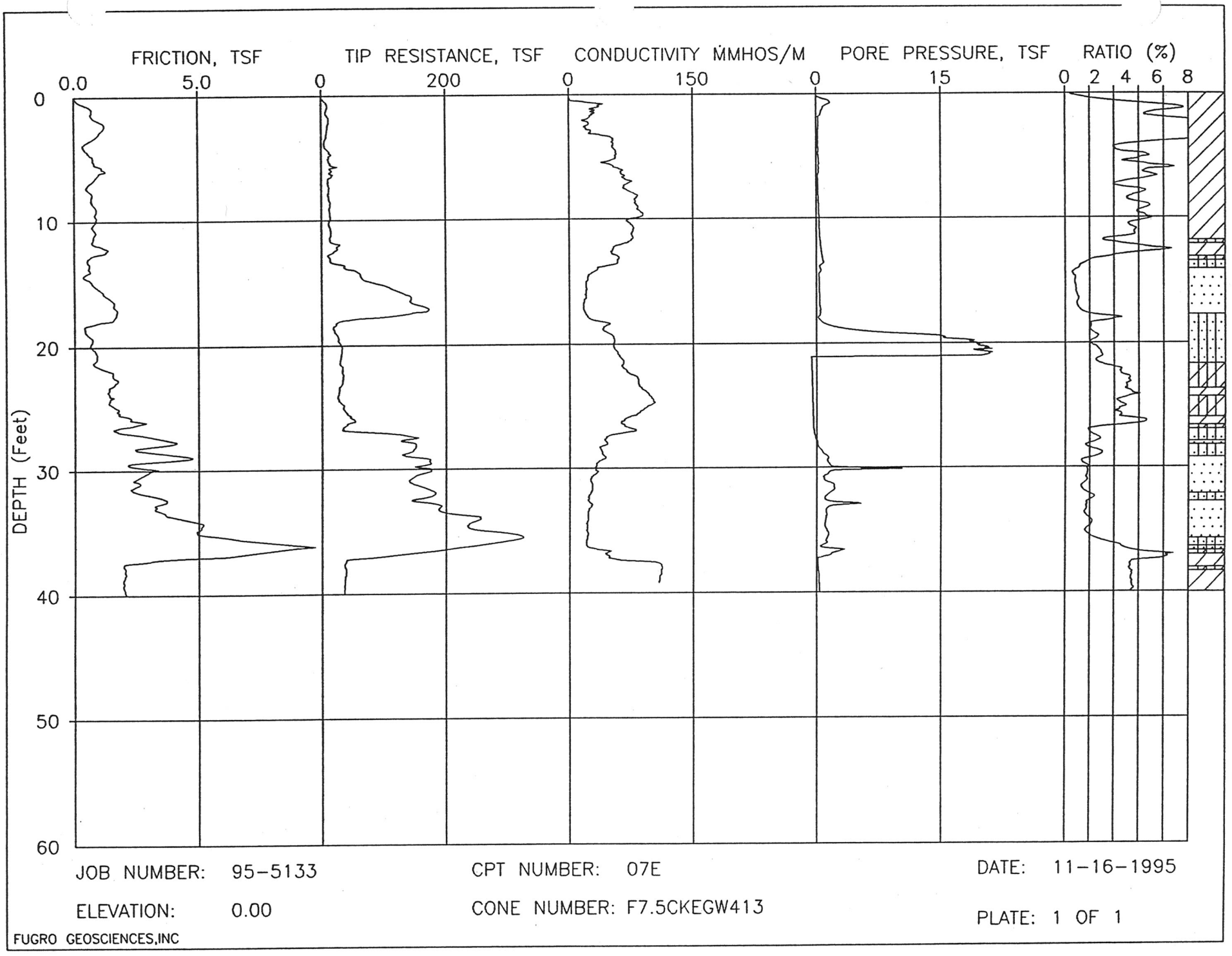

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PLATE: 1 OF 1

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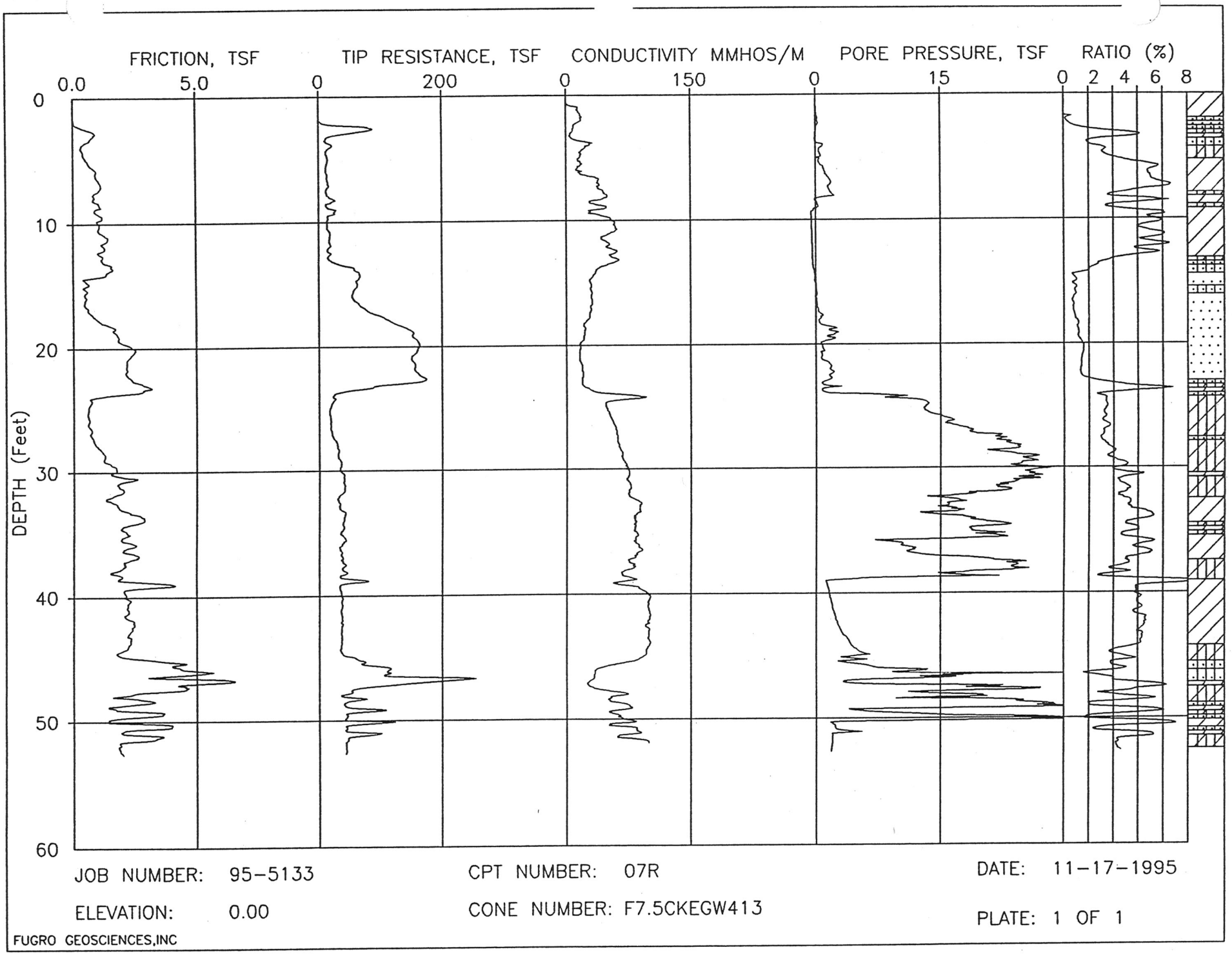
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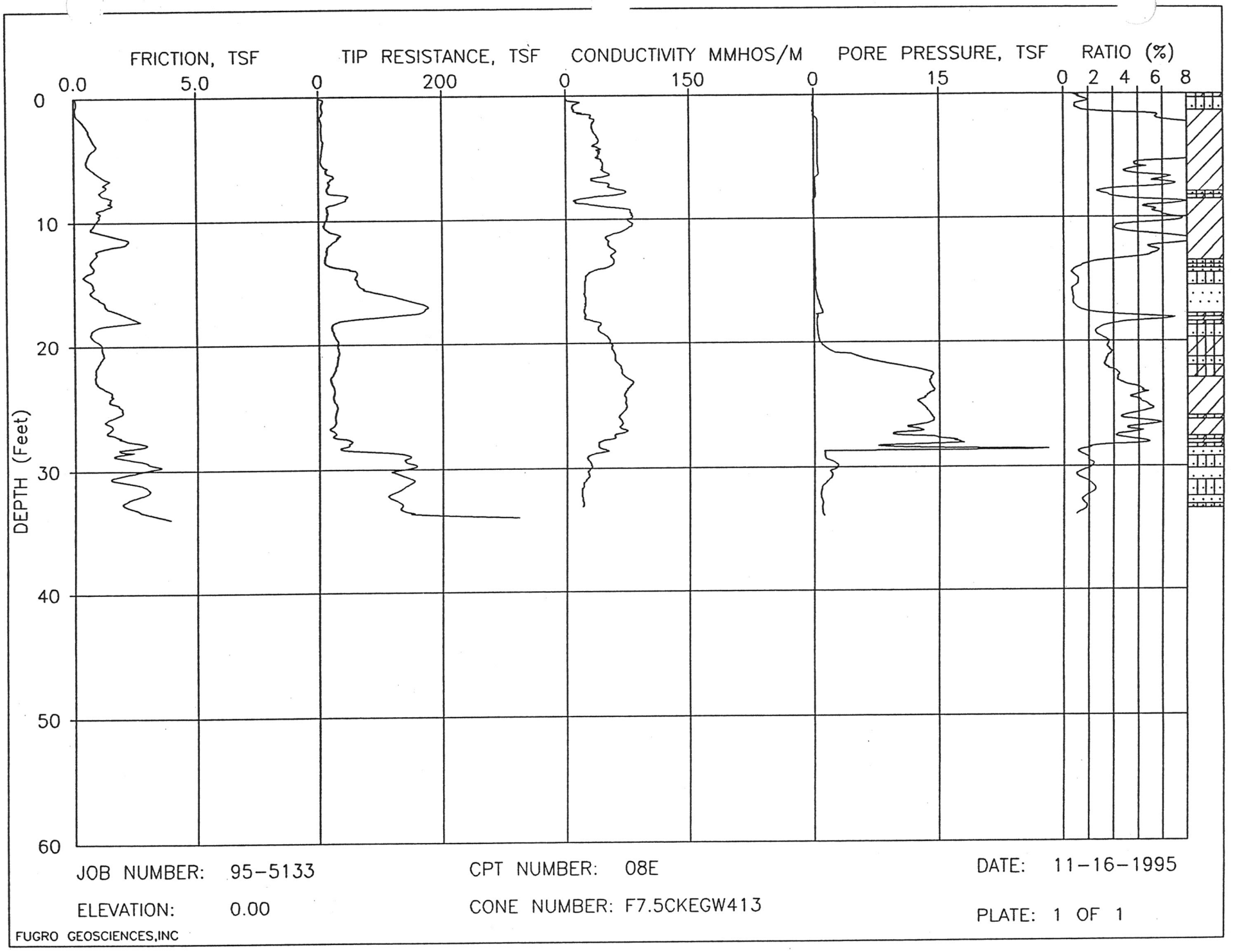
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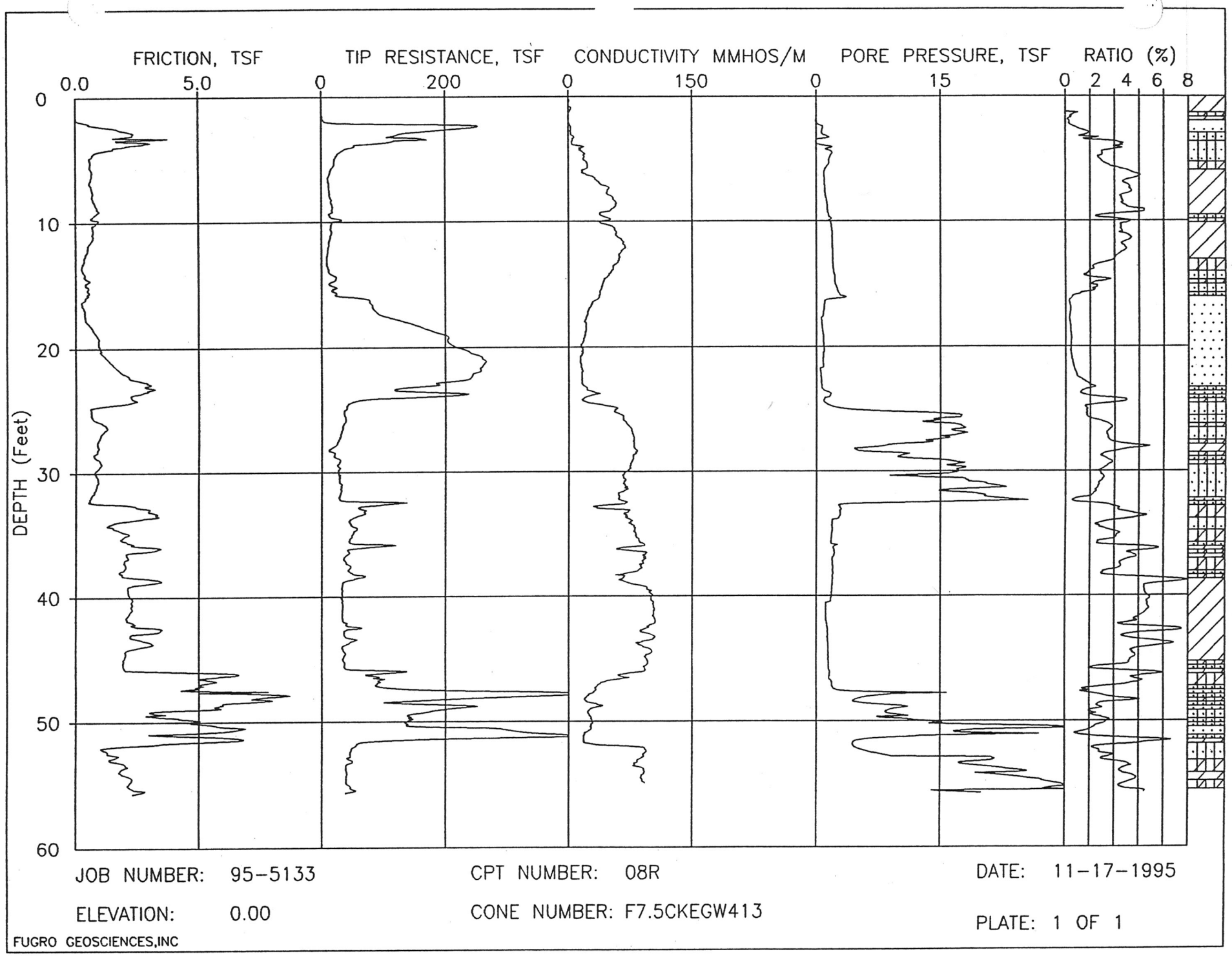

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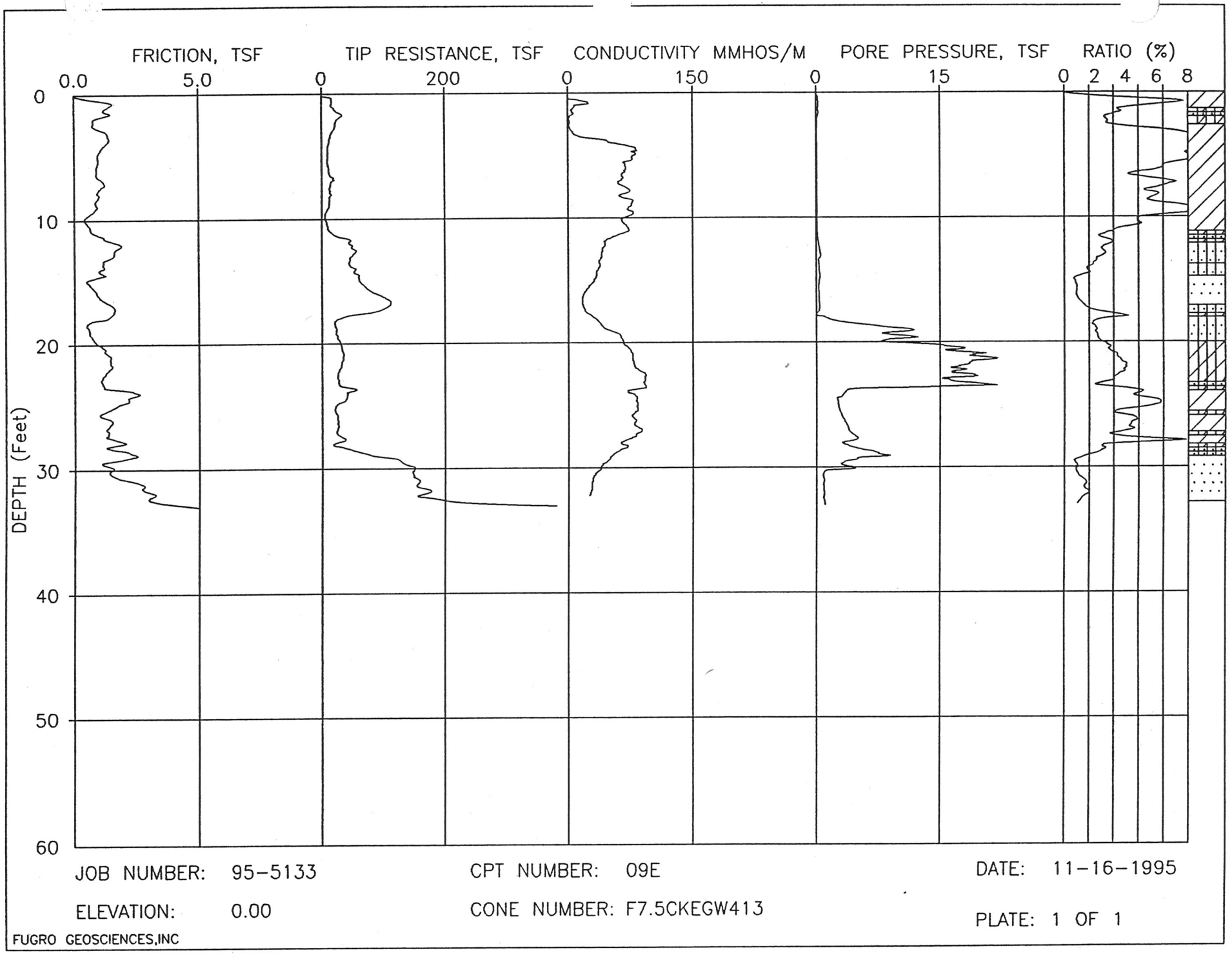

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PLATE: 1 OF 1

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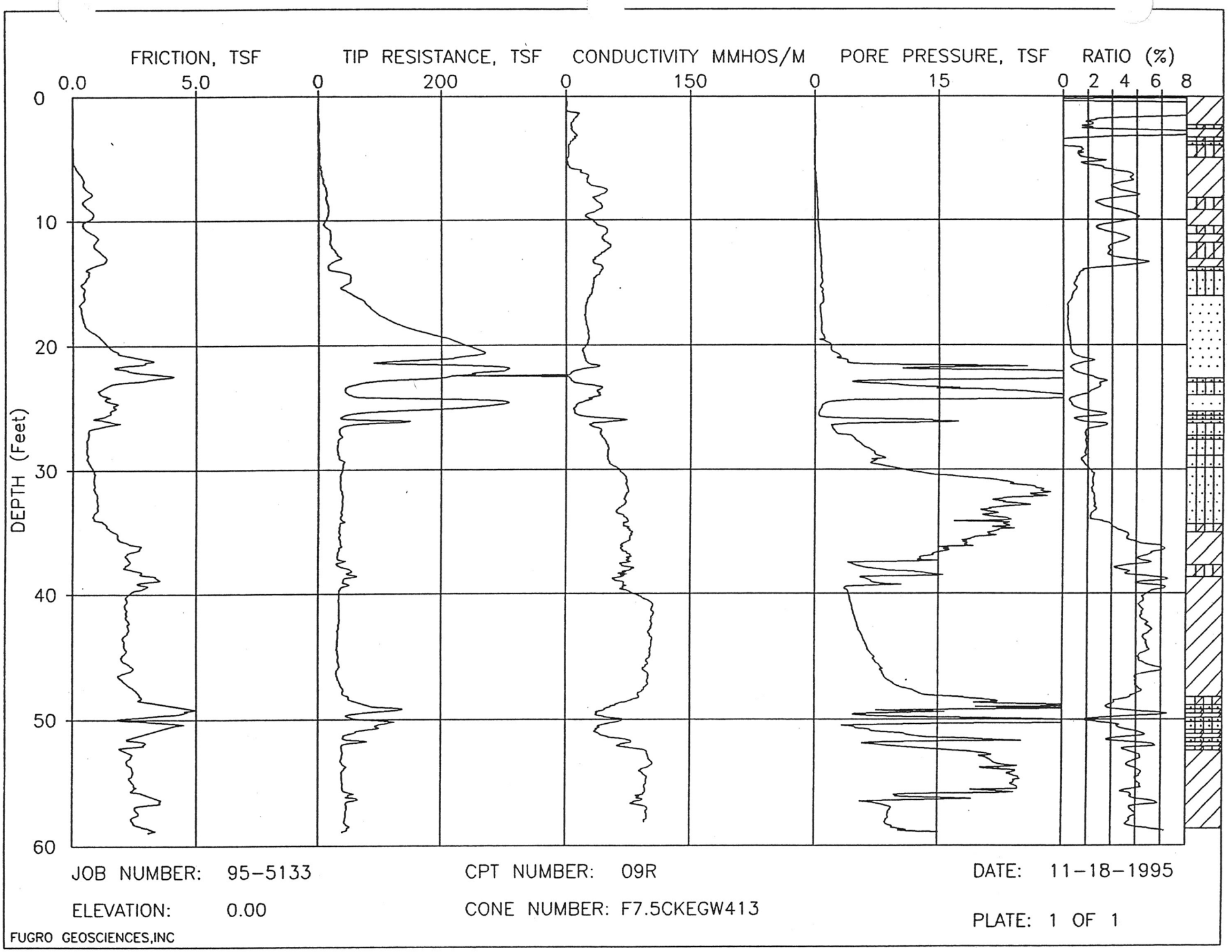

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CPT NUMBER: 09R

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ELEVATION: 0.00

CONE NUMBER: F7.5CKEGW413

PLATE: 1 OF 1

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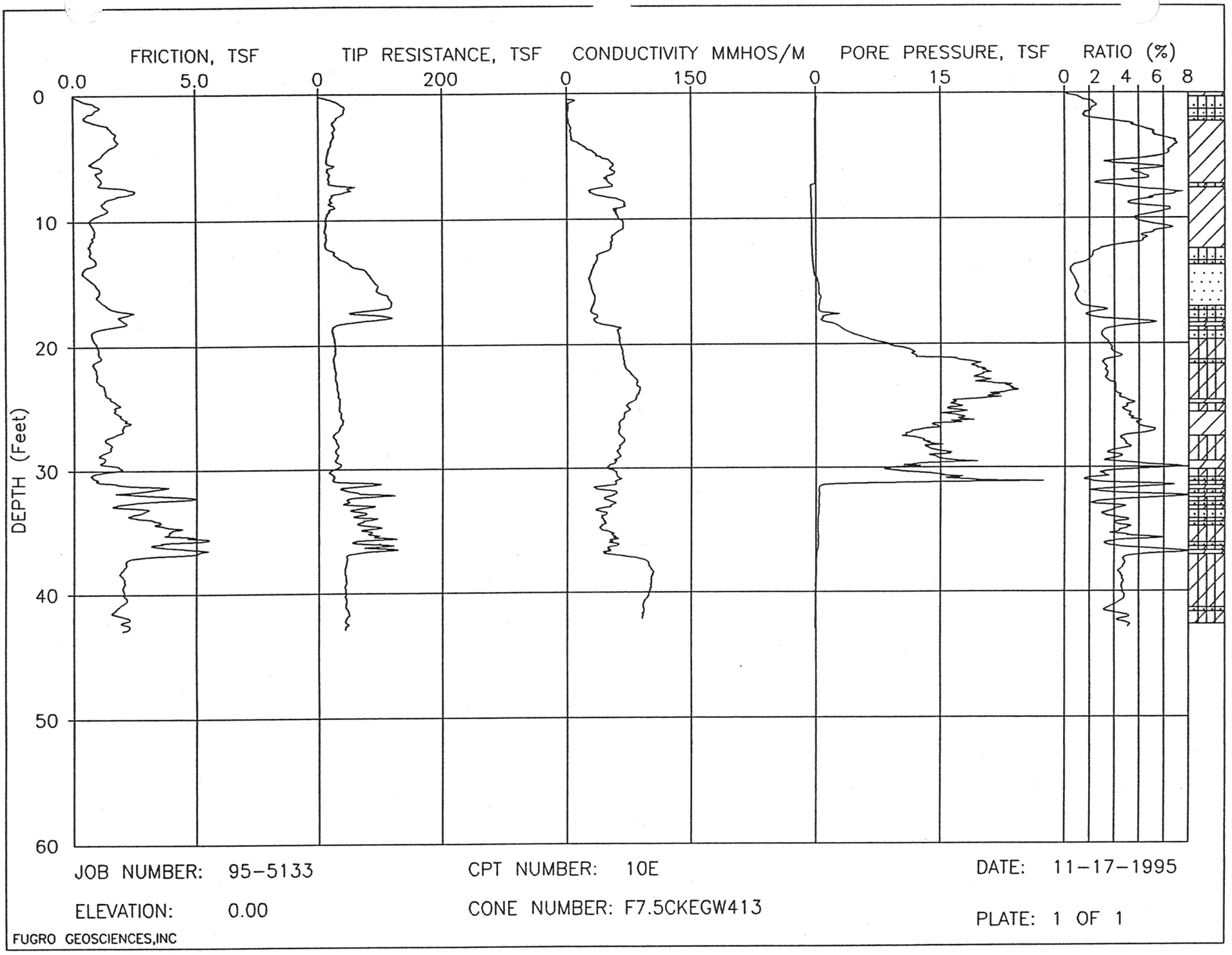

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PLATE: 1 OF 1

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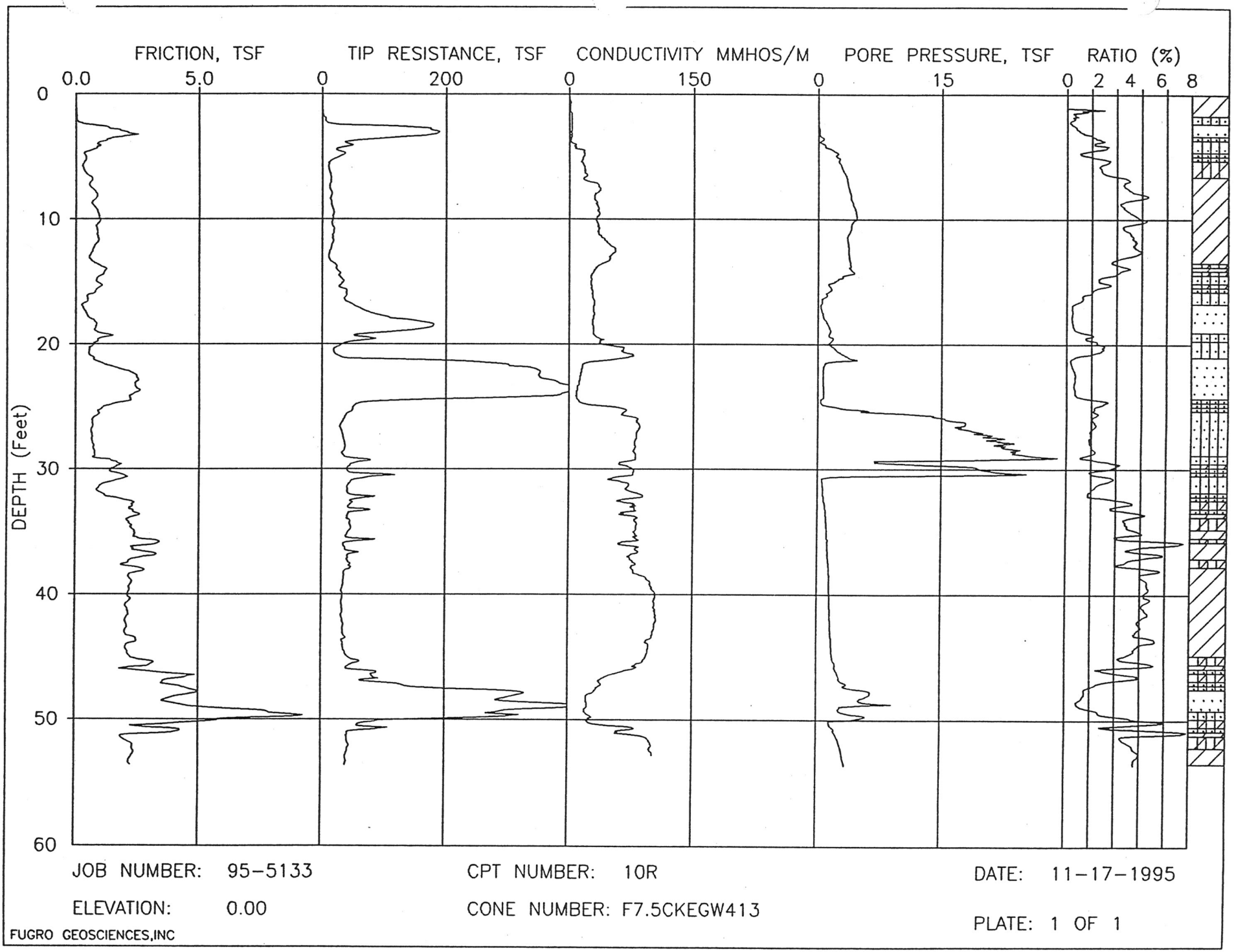
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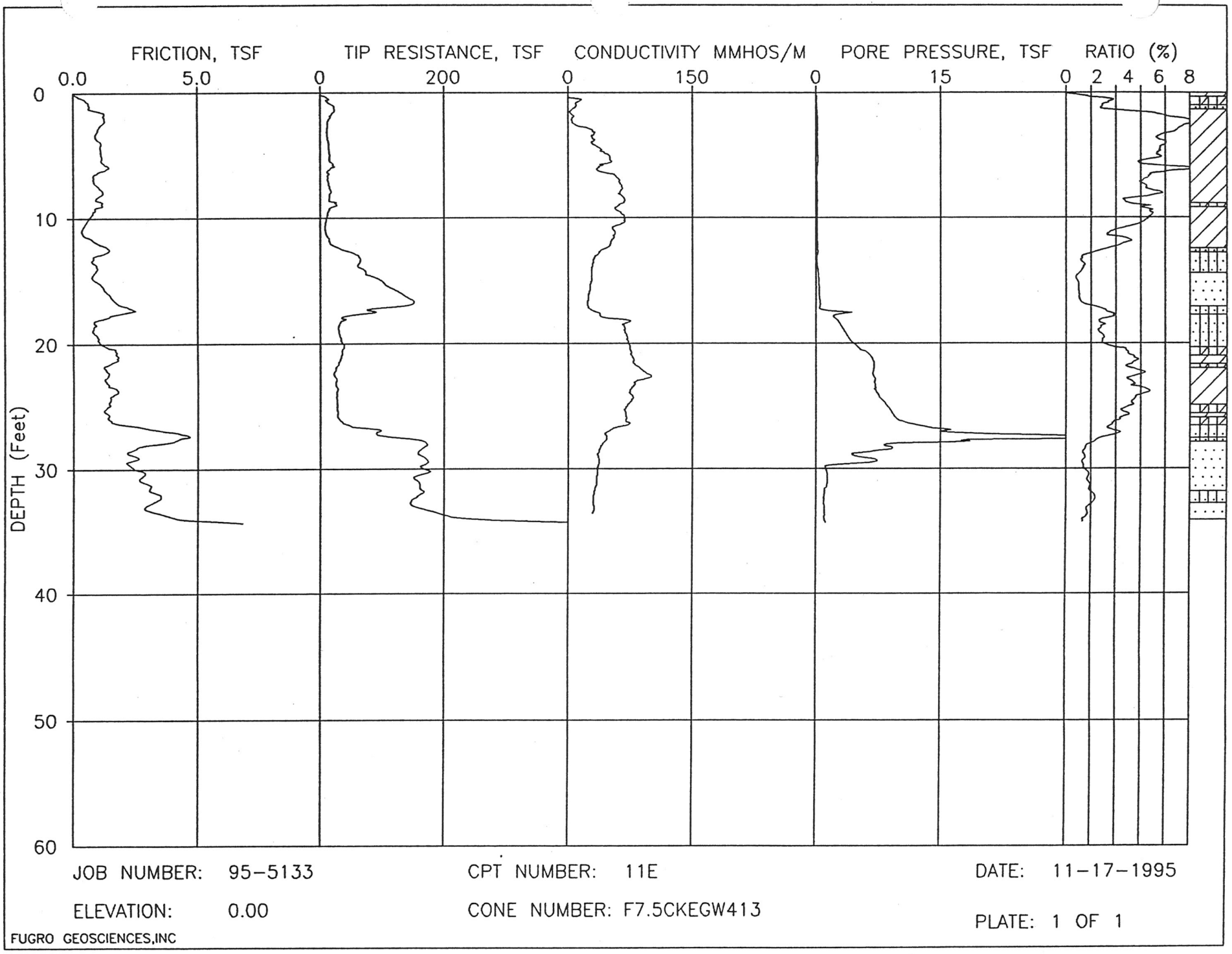

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PLATE: 1 OF 1

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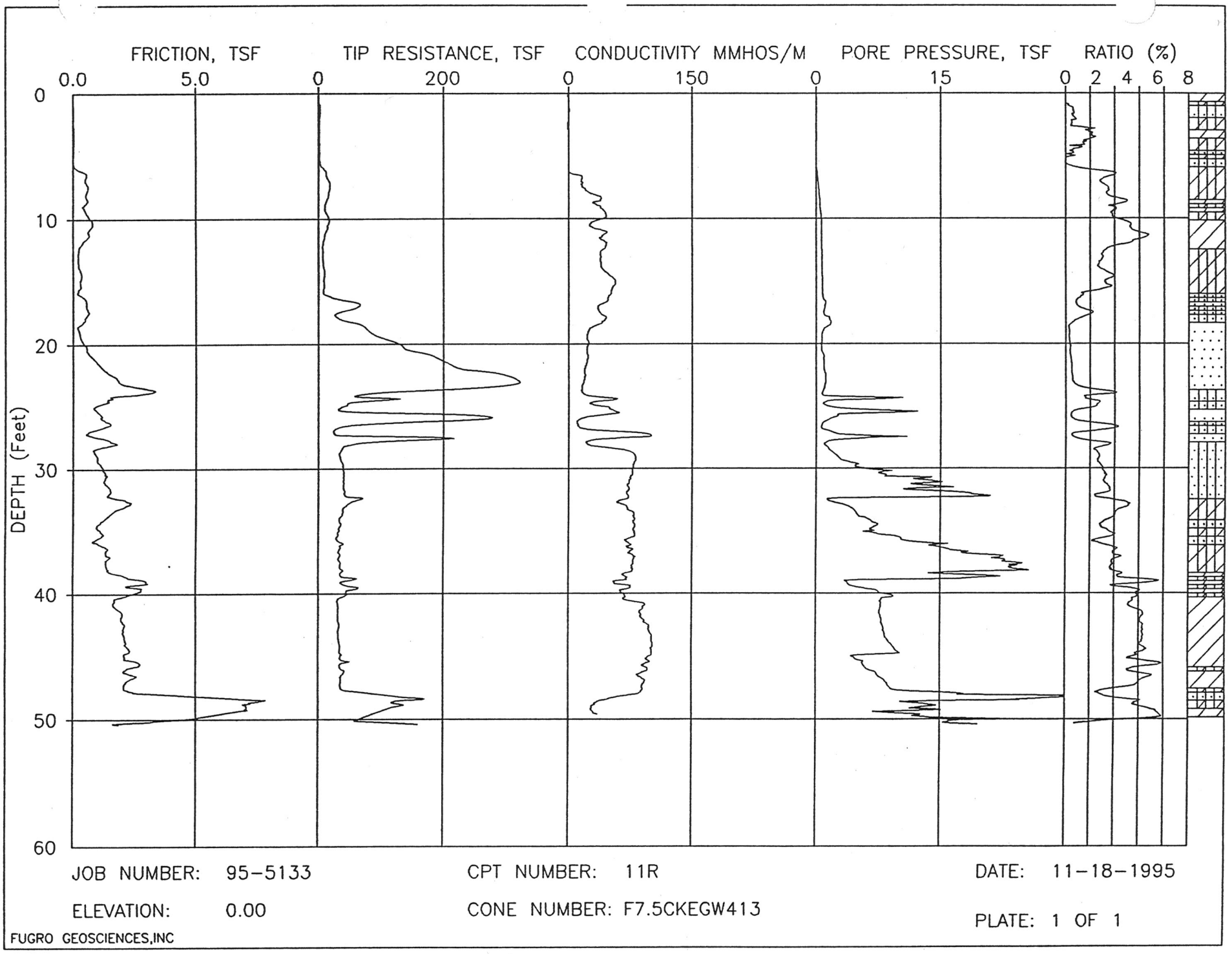
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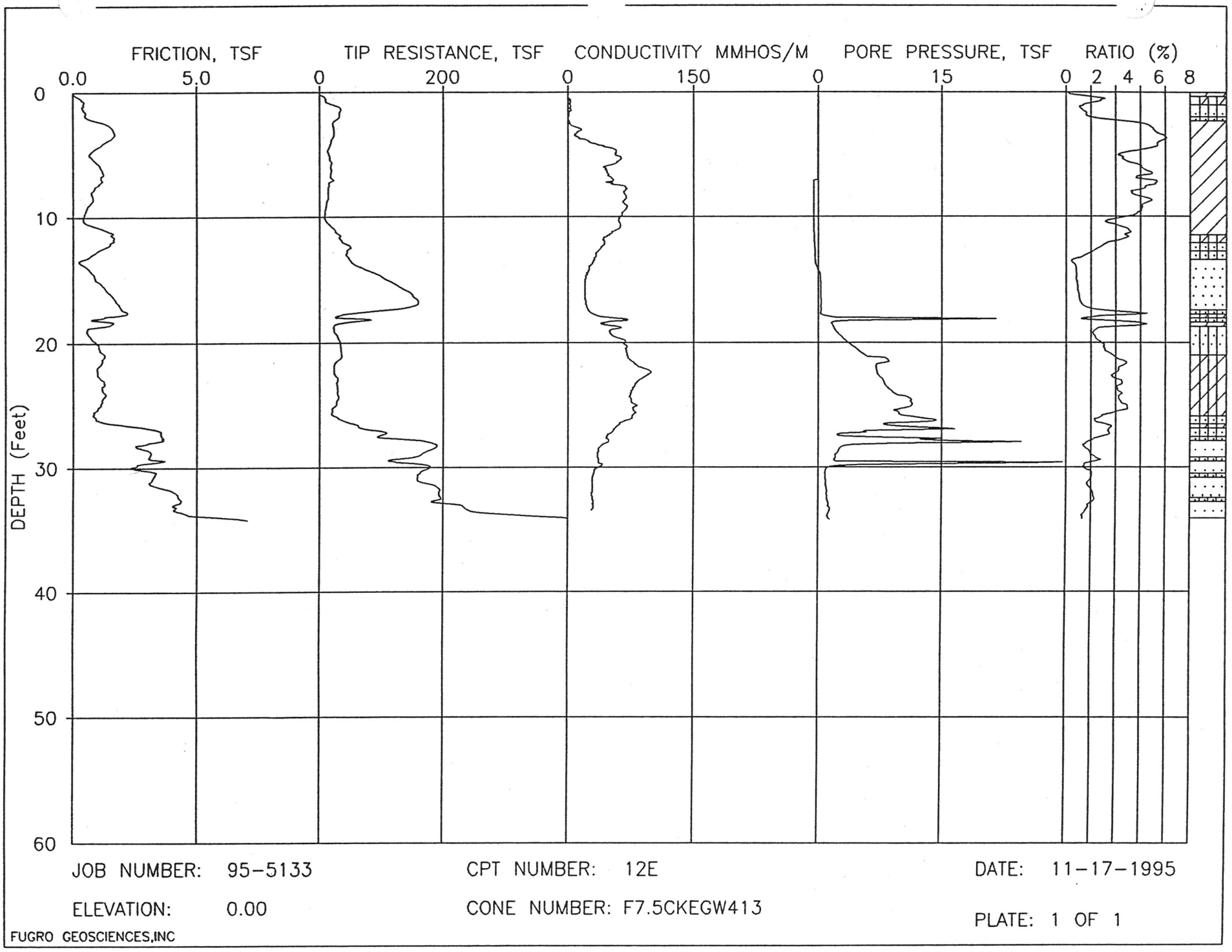
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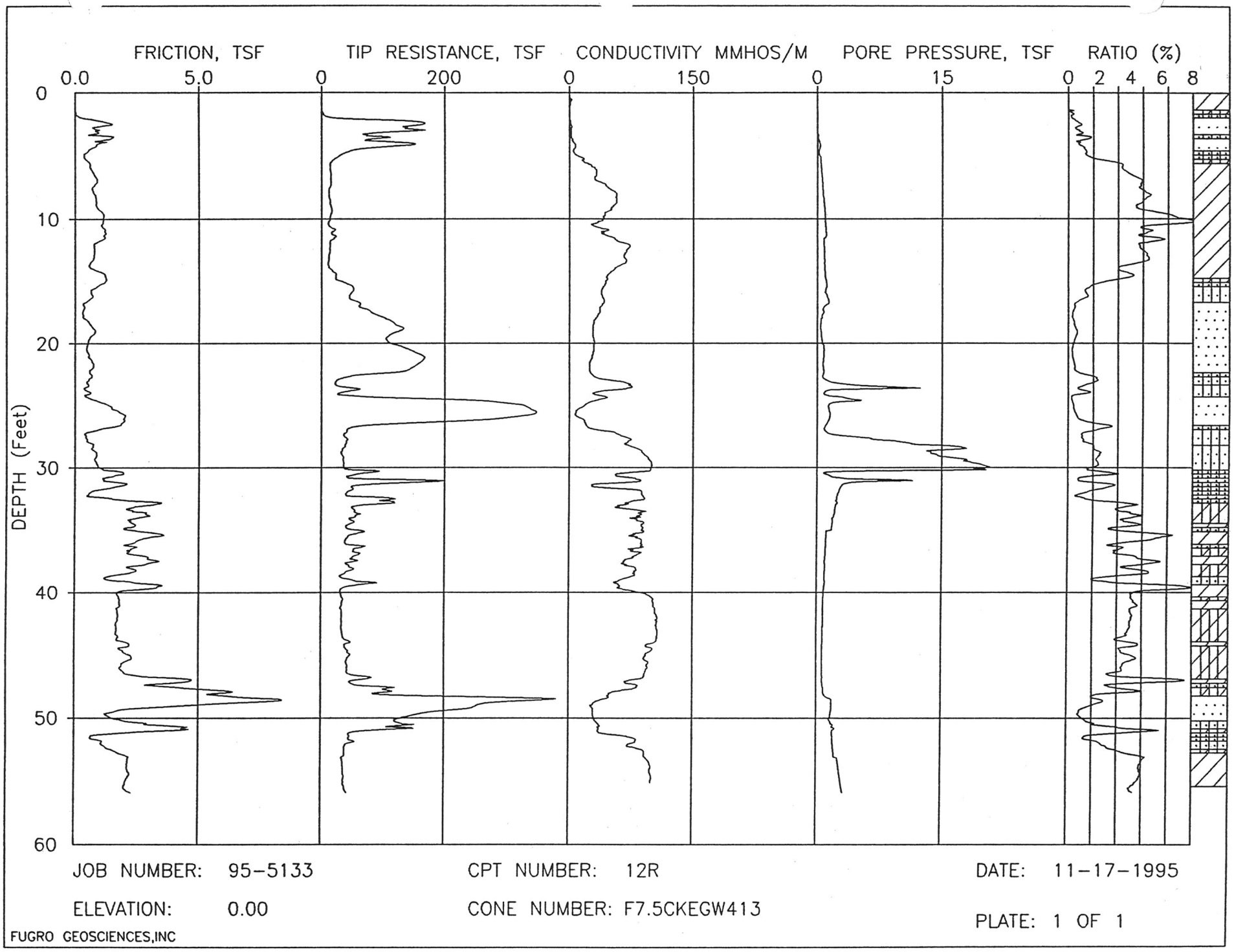
PLATE: 1 OF 1
FUGRO GEOSCIENCES,INC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PORE PRESSURE, TSF
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RATIO (%)
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8
DEPTH (Feet)
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20
30
40
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PLATE: 1 OF 1
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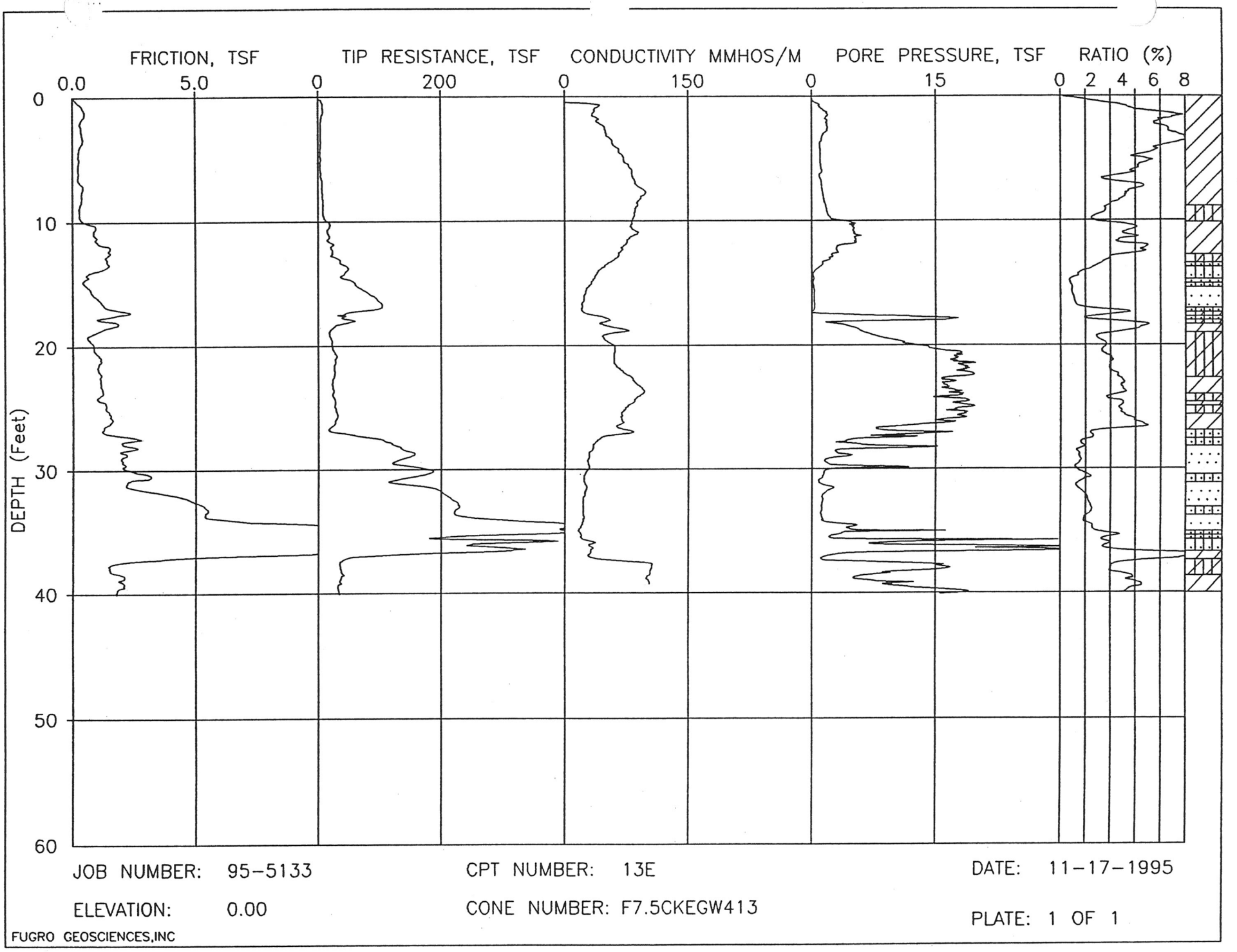
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RATIO (%)
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DEPTH (Feet)
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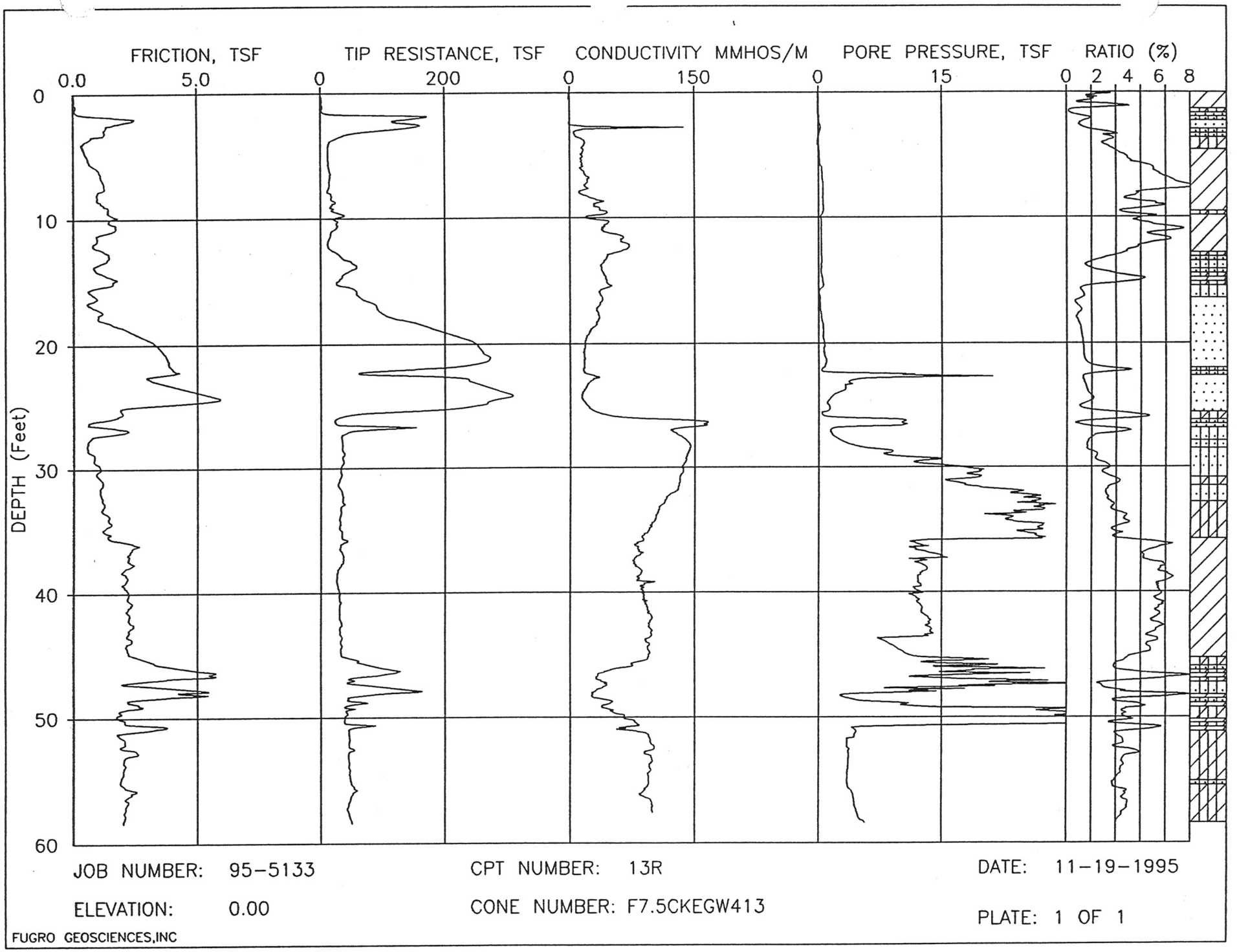
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RATIO (%)
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DEPTH (Feet)
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CPT NUMBER: 13R
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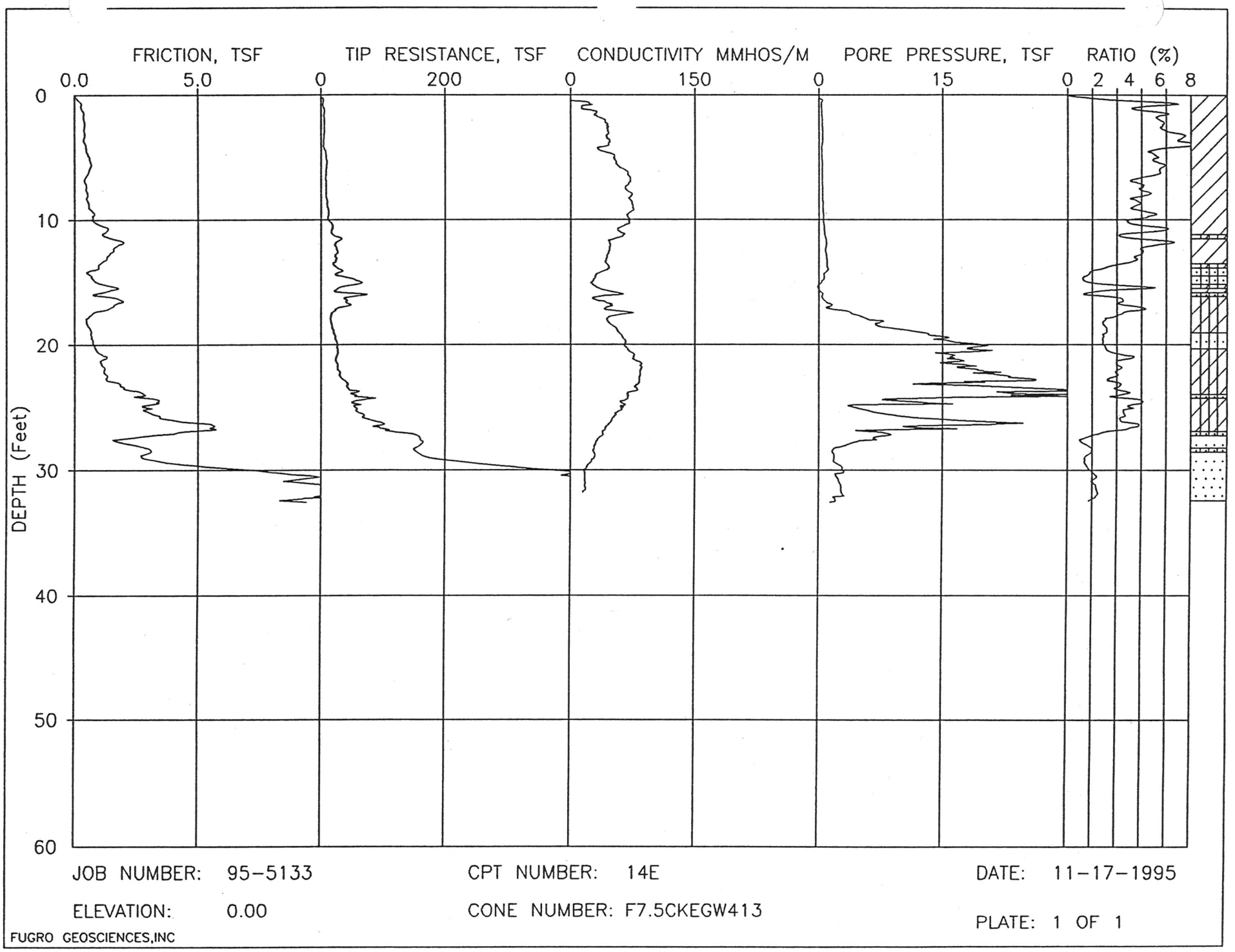
CONE NUMBER: F7.5CKEGW413
PLATE: 1 OF 1
FUGRO GEOSCIENCES,INC



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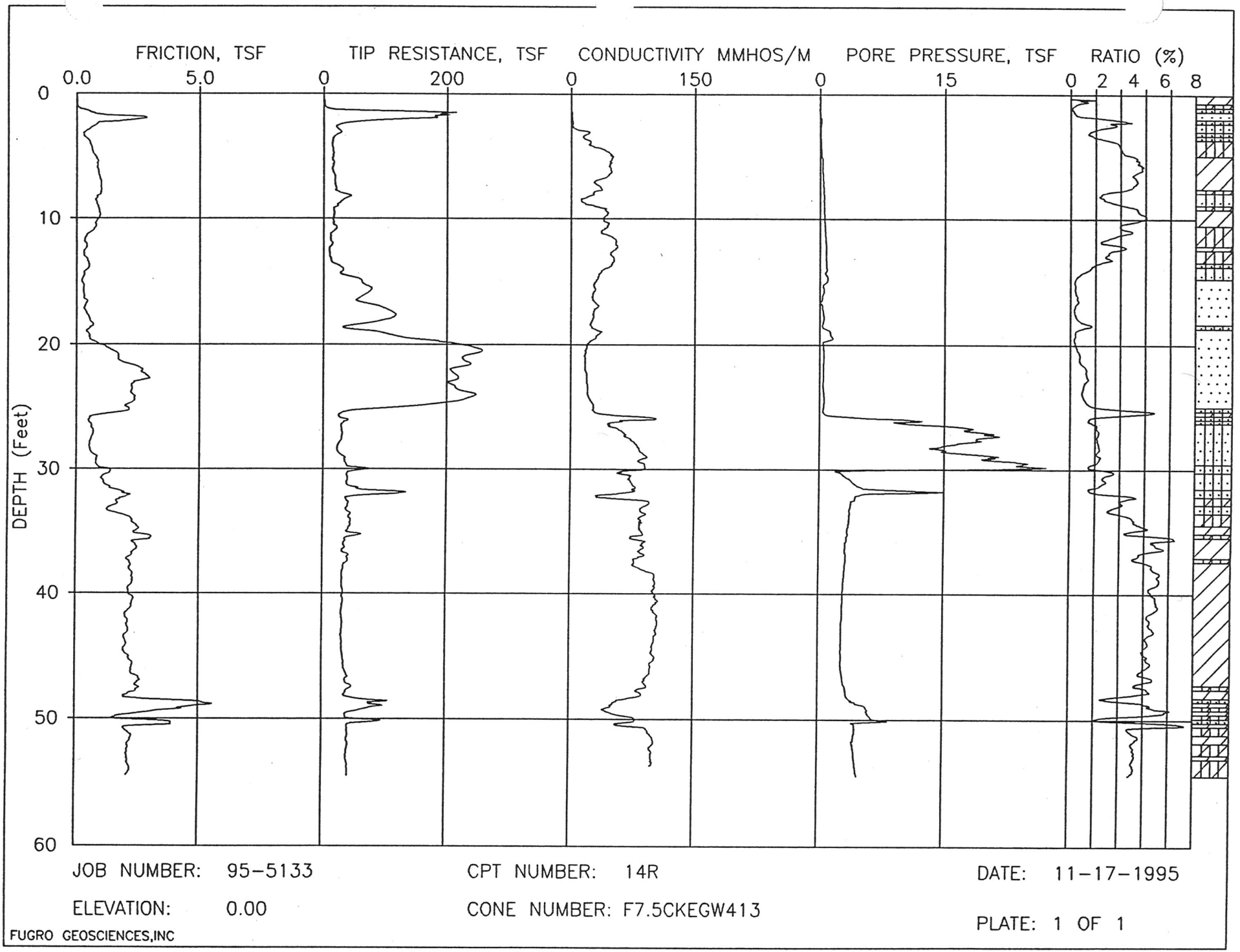

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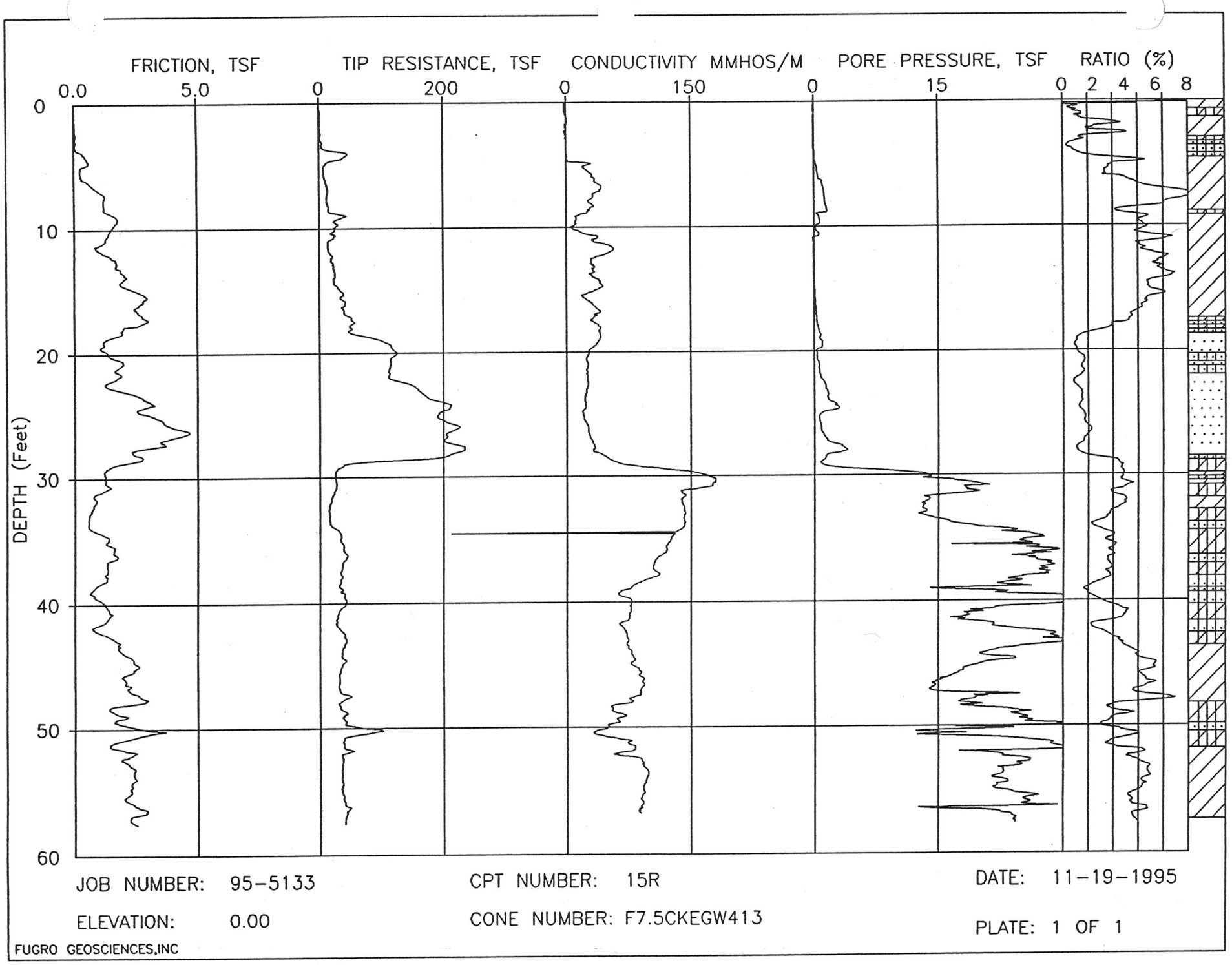
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RATIO (%)
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DEPTH (Feet)
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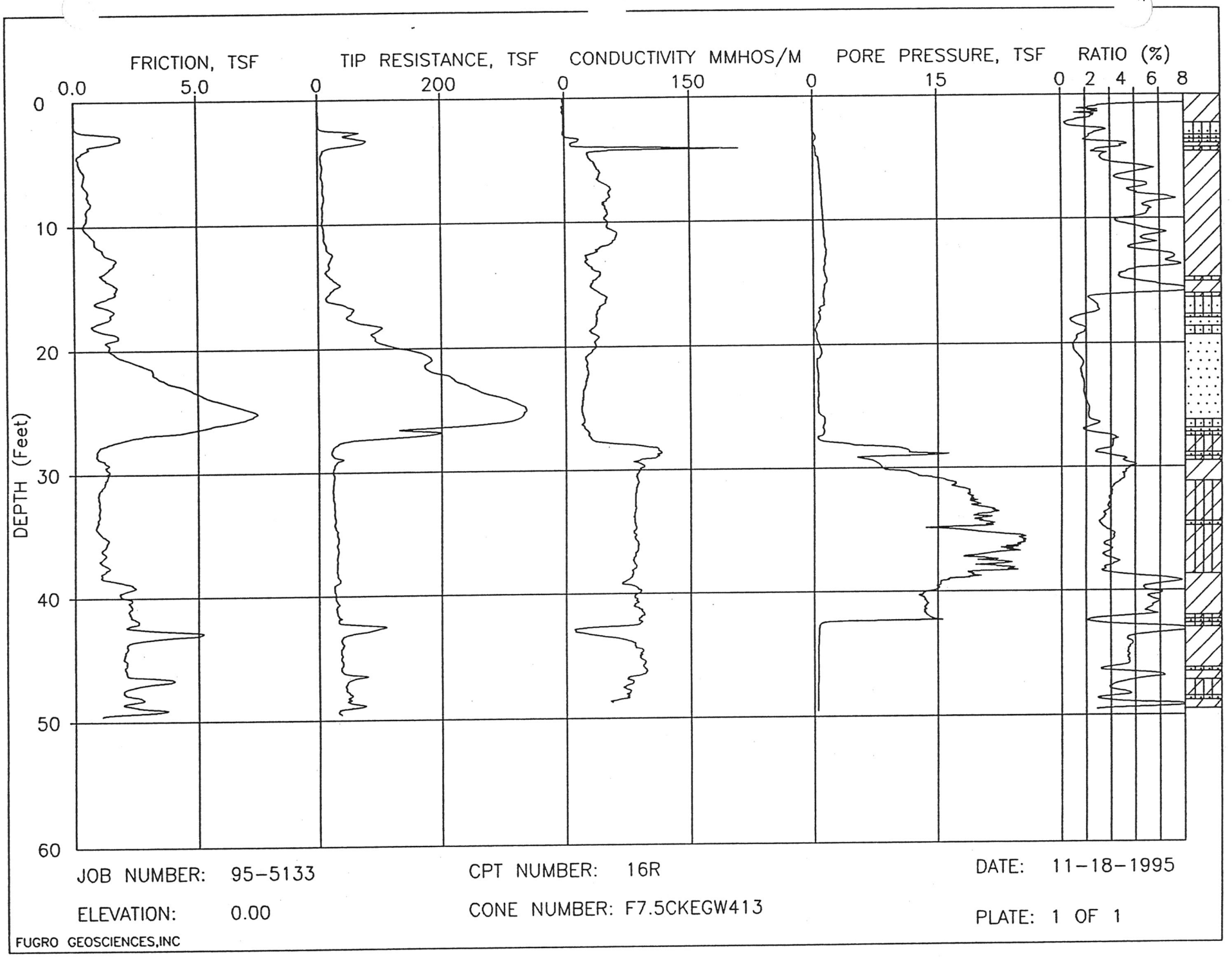
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RATIO (%)
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6
8
DEPTH (Feet)
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PLATE: 1 OF 1
FUGRO GEOSCIENCES,INC

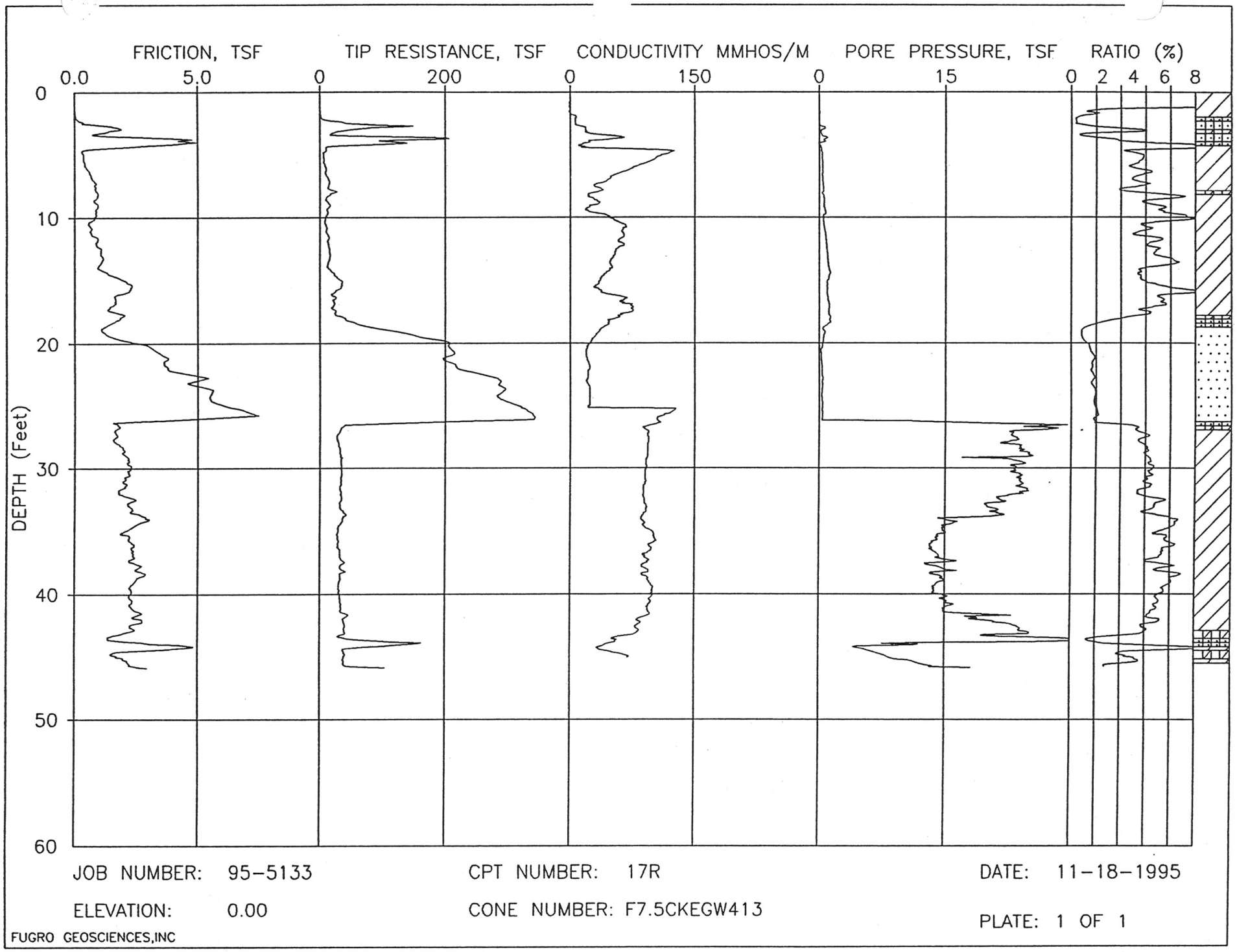

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PLATE: 1 OF 1

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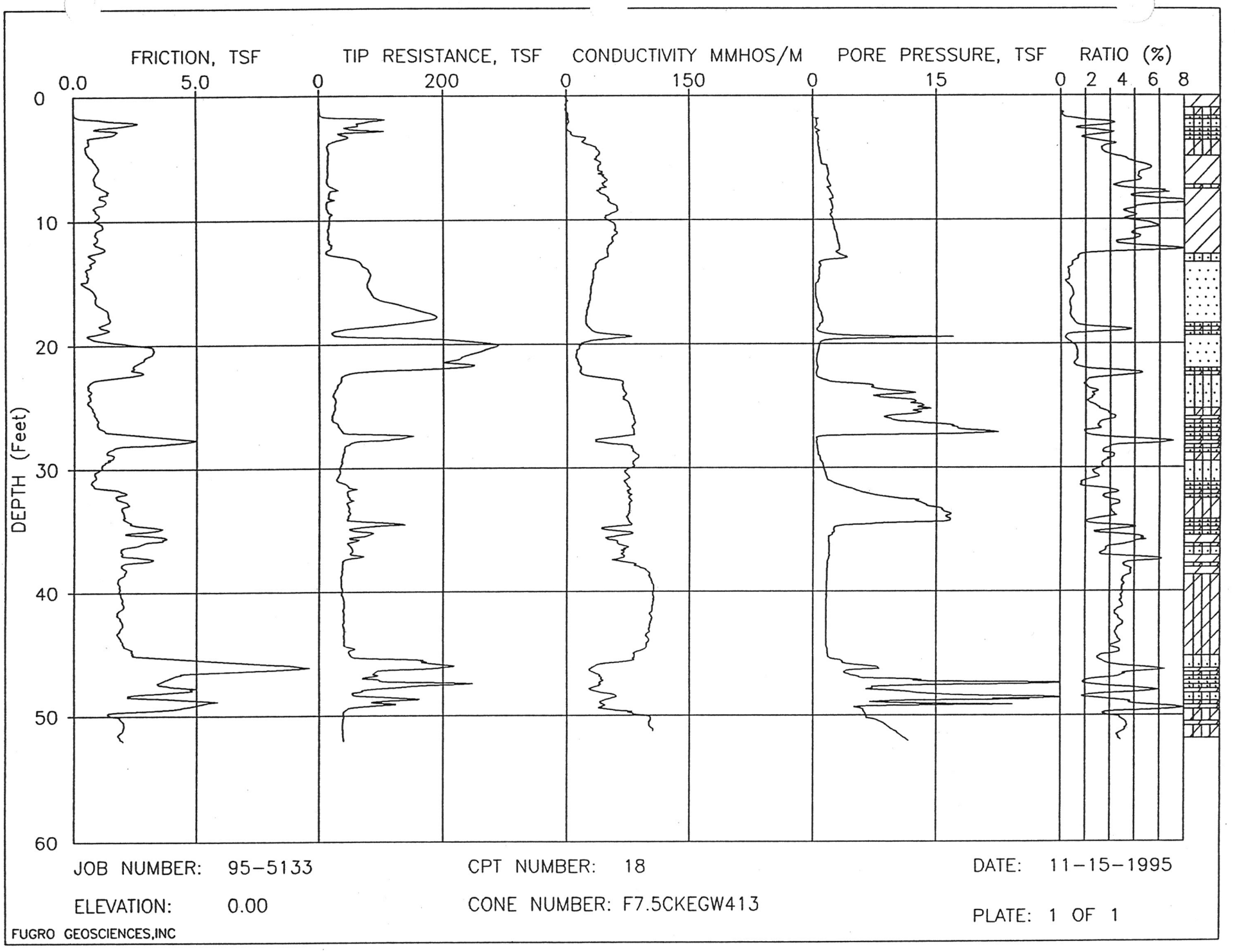
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RATIO (%)
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DEPTH (Feet)
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JOB NUMBER: 95-5133
CPT NUMBER: 18
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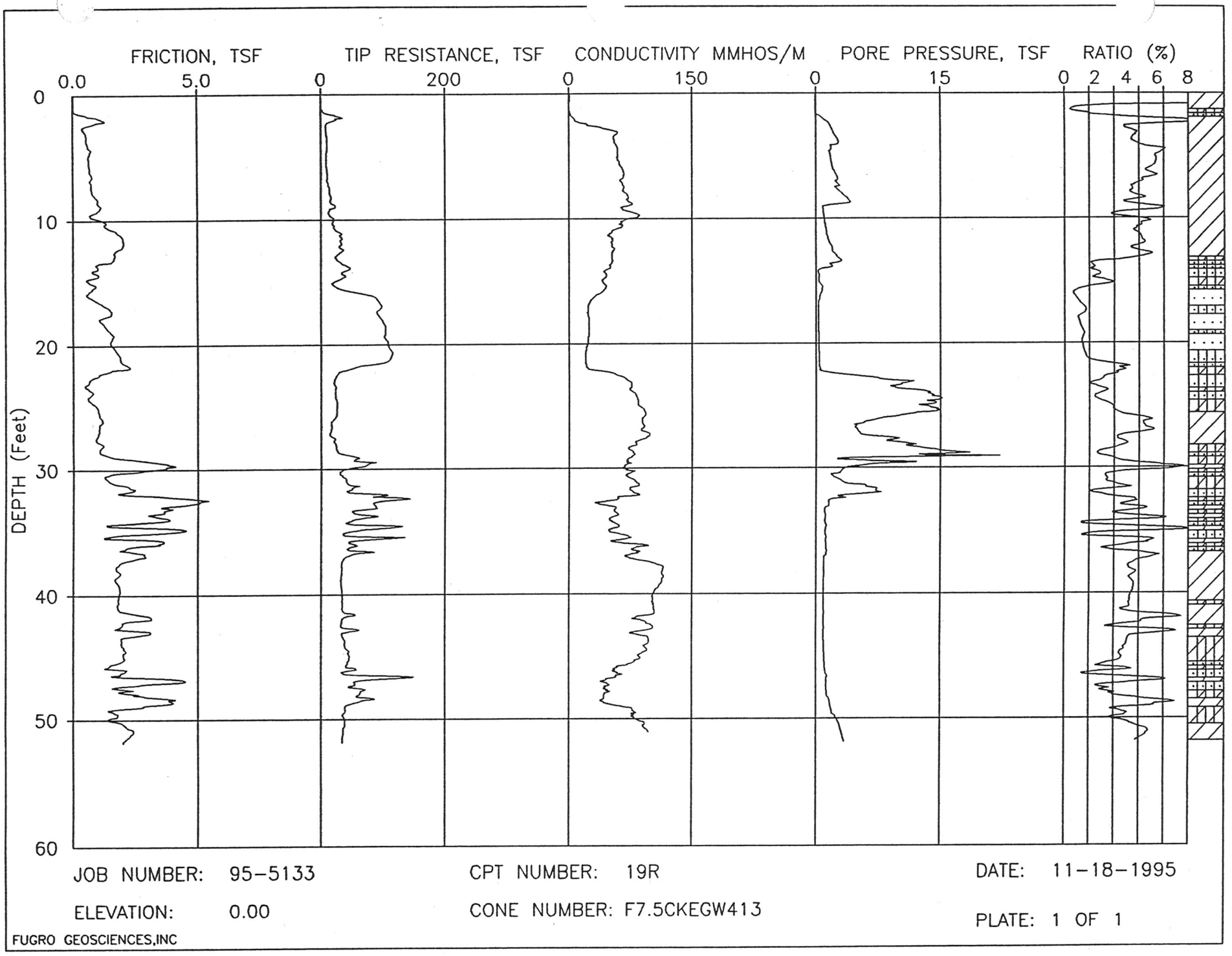
CONE NUMBER: F7.5CKEGW413
PLATE: 1 OF 1
FUGRO GEOSCIENCES,INC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RATIO (%)
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DEPTH (Feet)
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JOB NUMBER: 95-5133
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PLATE: 1 OF 1
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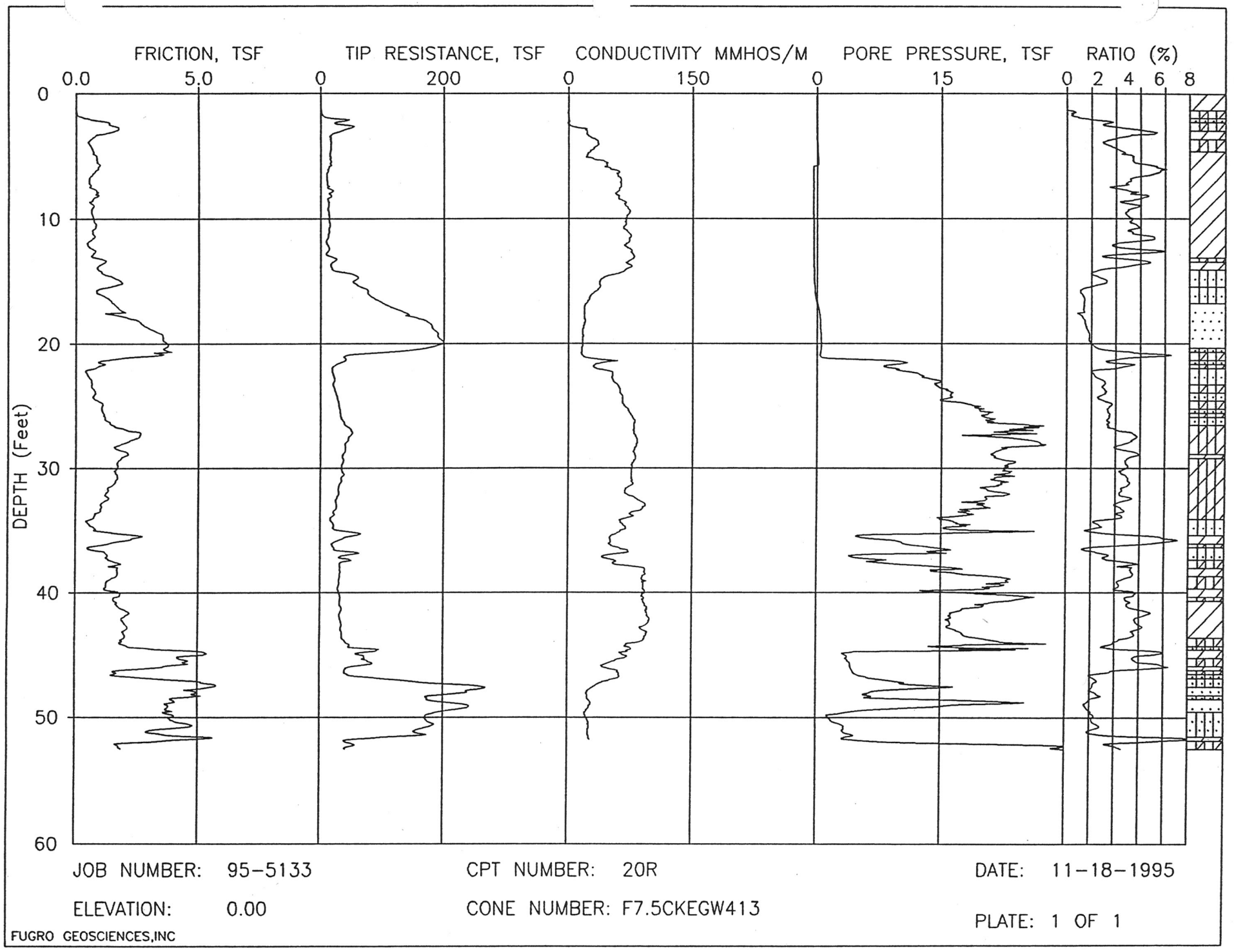
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RATIO (%)
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DEPTH (Feet)
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PLATE: 1 OF 1
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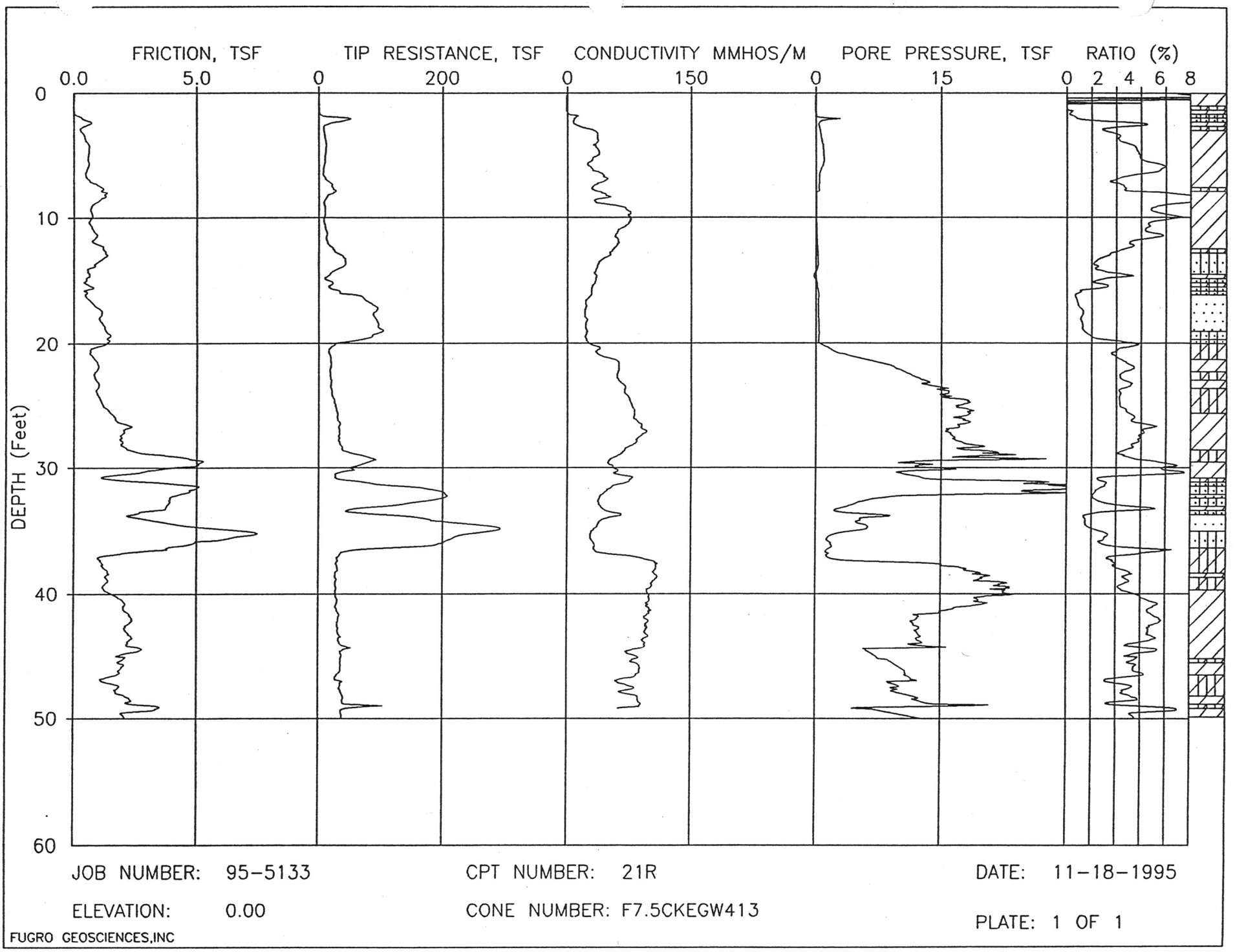
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RATIO (%)
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6
8
DEPTH (Feet)
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PLATE: 1 OF 1
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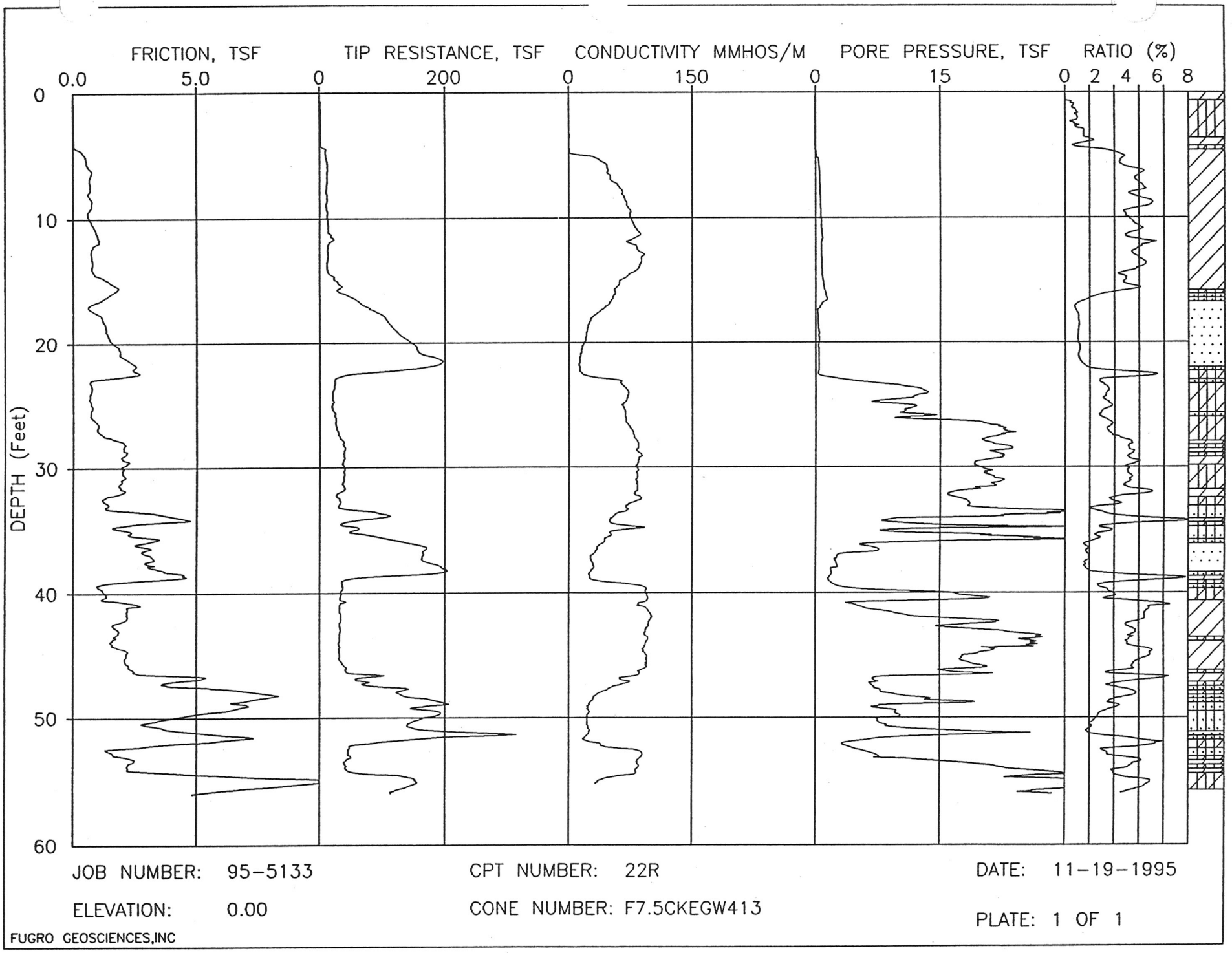

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CPT NUMBER: 22R

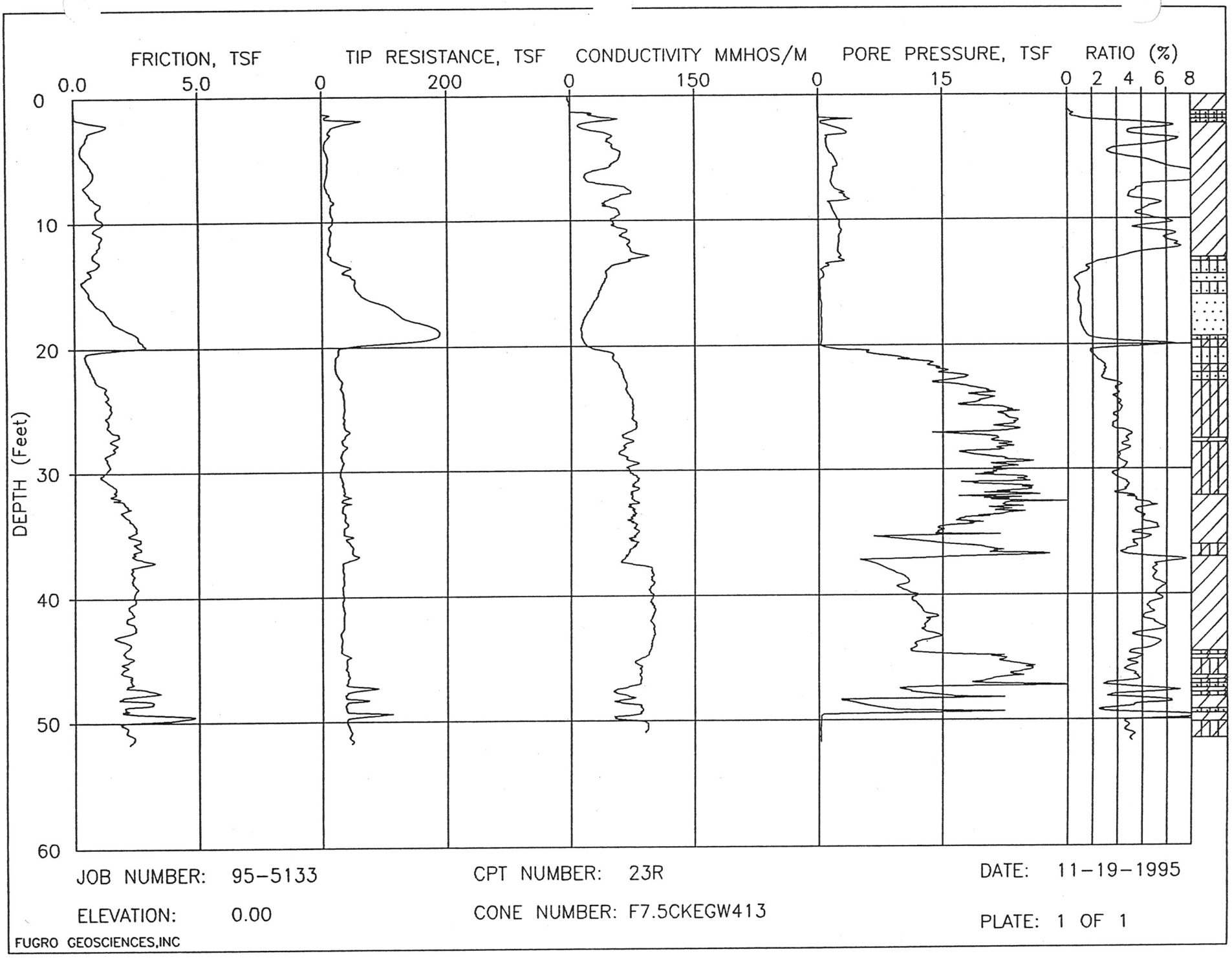
DATE: 11-19-1995

ELEVATION: 0.00

CONE NUMBER: F7.5CKEGW413

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC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RATIO (%)
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6
8
DEPTH (Feet)
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40
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JOB NUMBER: 95-5133
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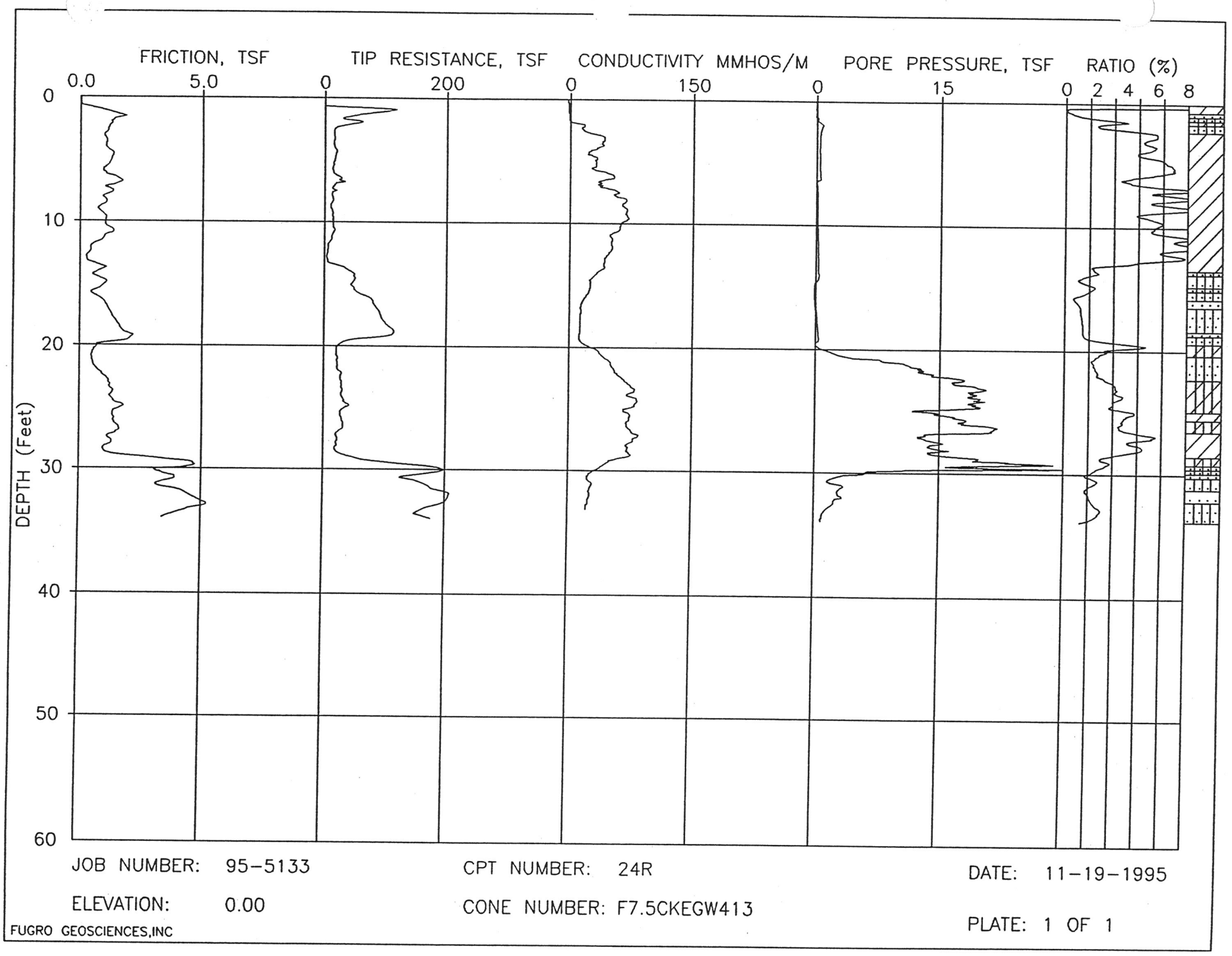
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RATIO (%)
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DEPTH (Feet)
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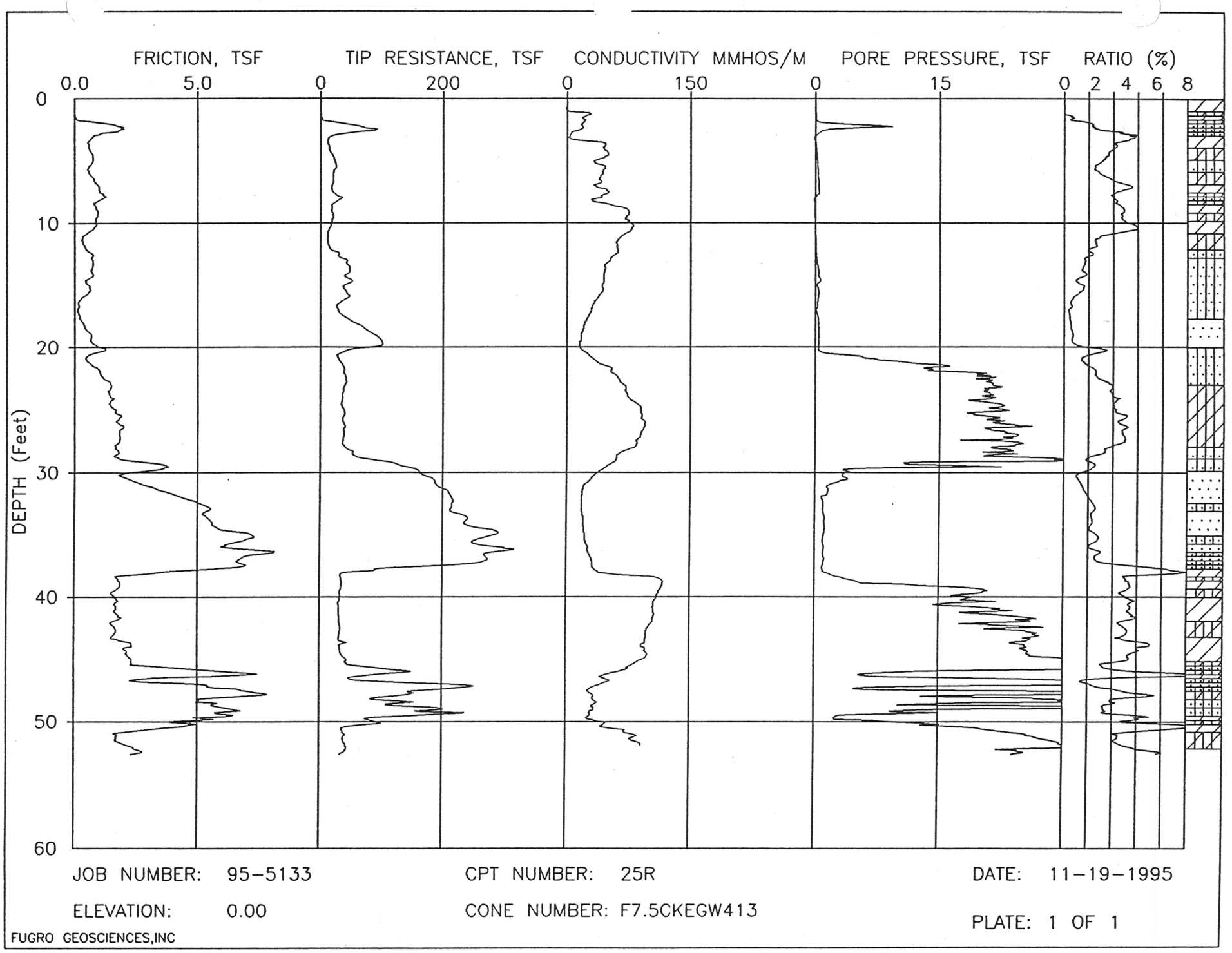
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RATIO (%)
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DEPTH (Feet)
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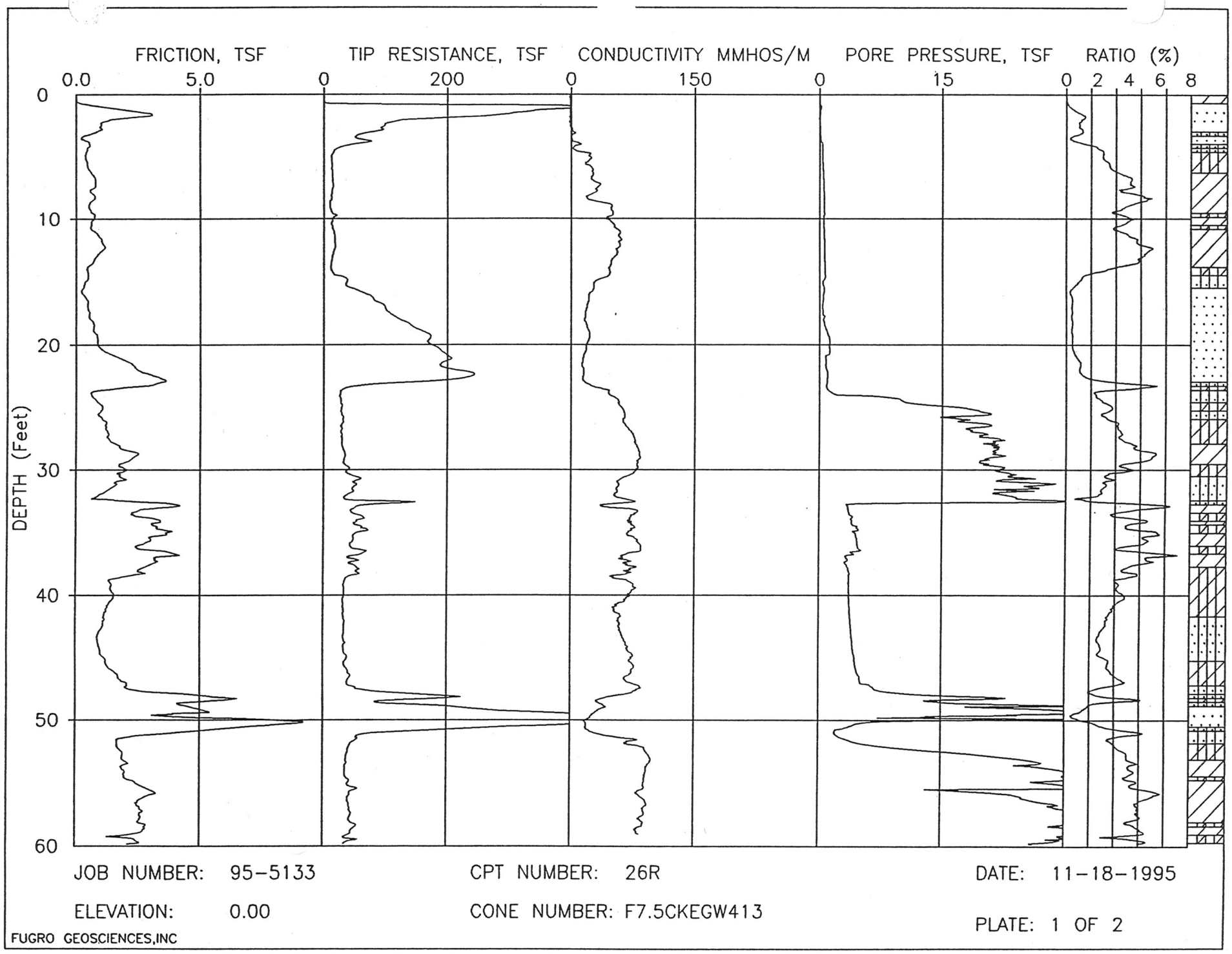
PLATE: 1 OF 1
FUGRO GEOSCIENCES,INC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RATIO (%)
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DEPTH (Feet)
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PLATE: 1 OF 2
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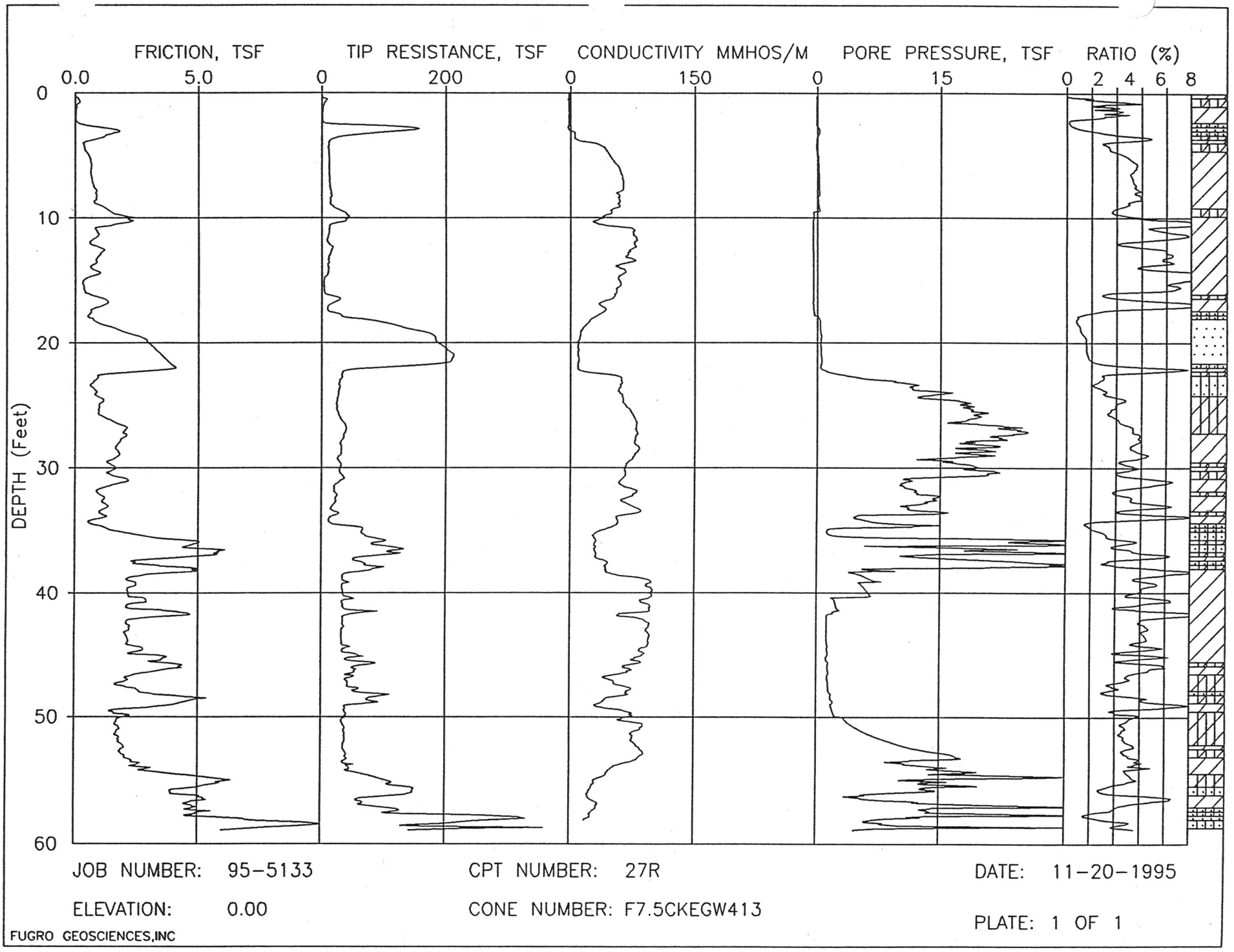
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RATIO (%)
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DEPTH (Feet)
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PLATE: 1 OF 1
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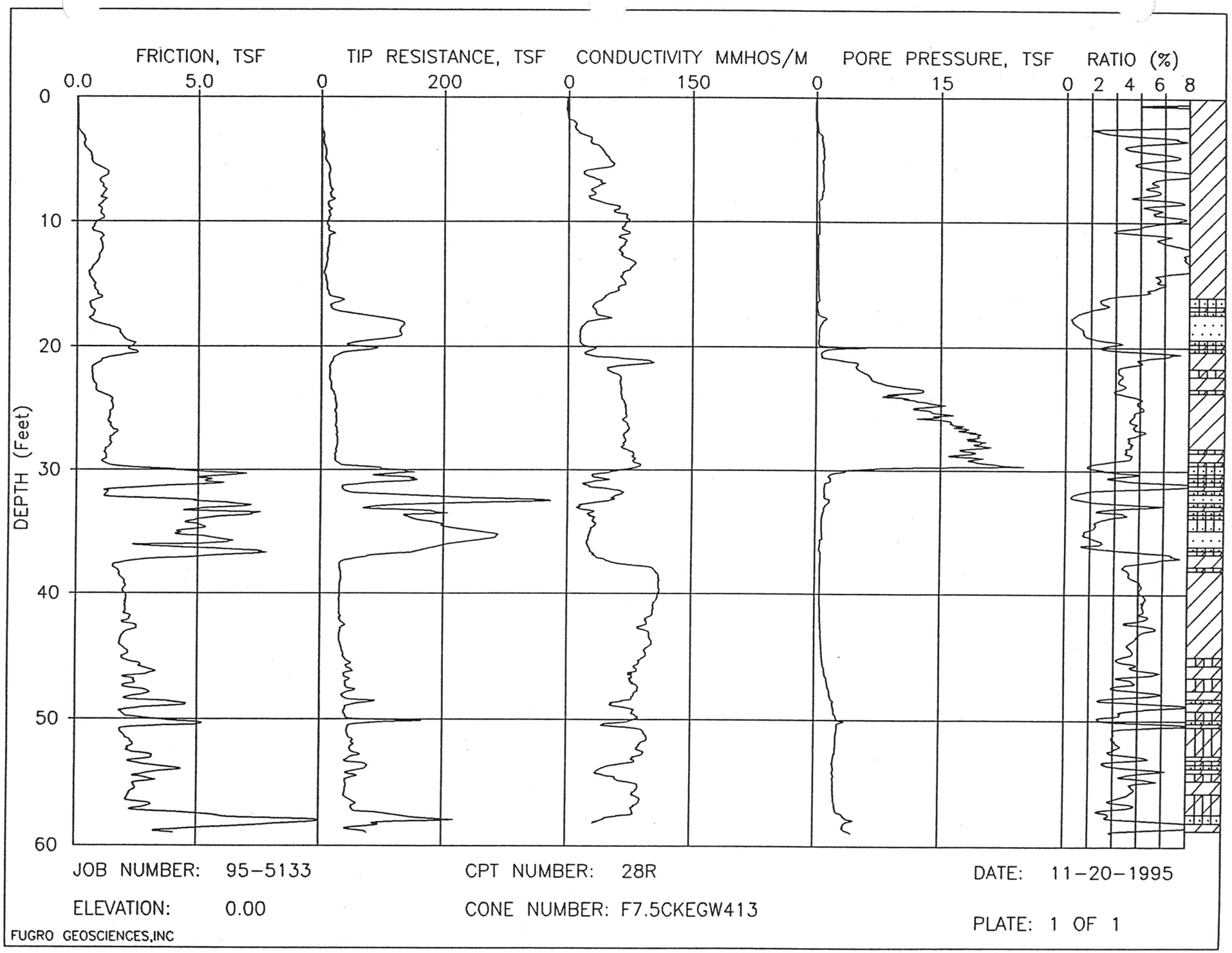
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RATIO (%)
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DEPTH (Feet)
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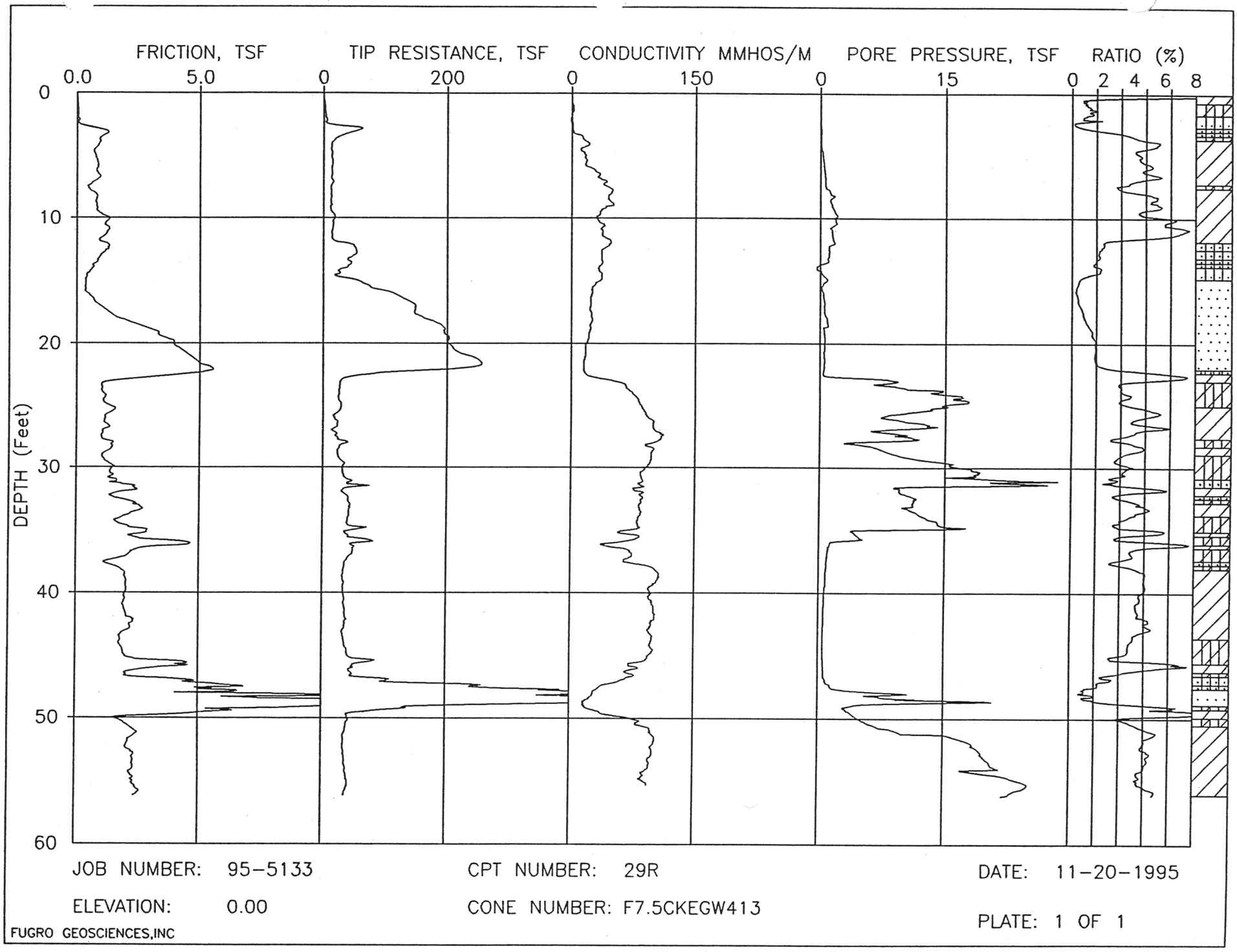
CONE NUMBER: F7.5CKEGW413
PLATE: 1 OF 1
FUGRO GEOSCIENCES,INC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PORE PRESSURE, TSF
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RATIO (%)
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DEPTH (Feet)
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JOB NUMBER: 95-5133
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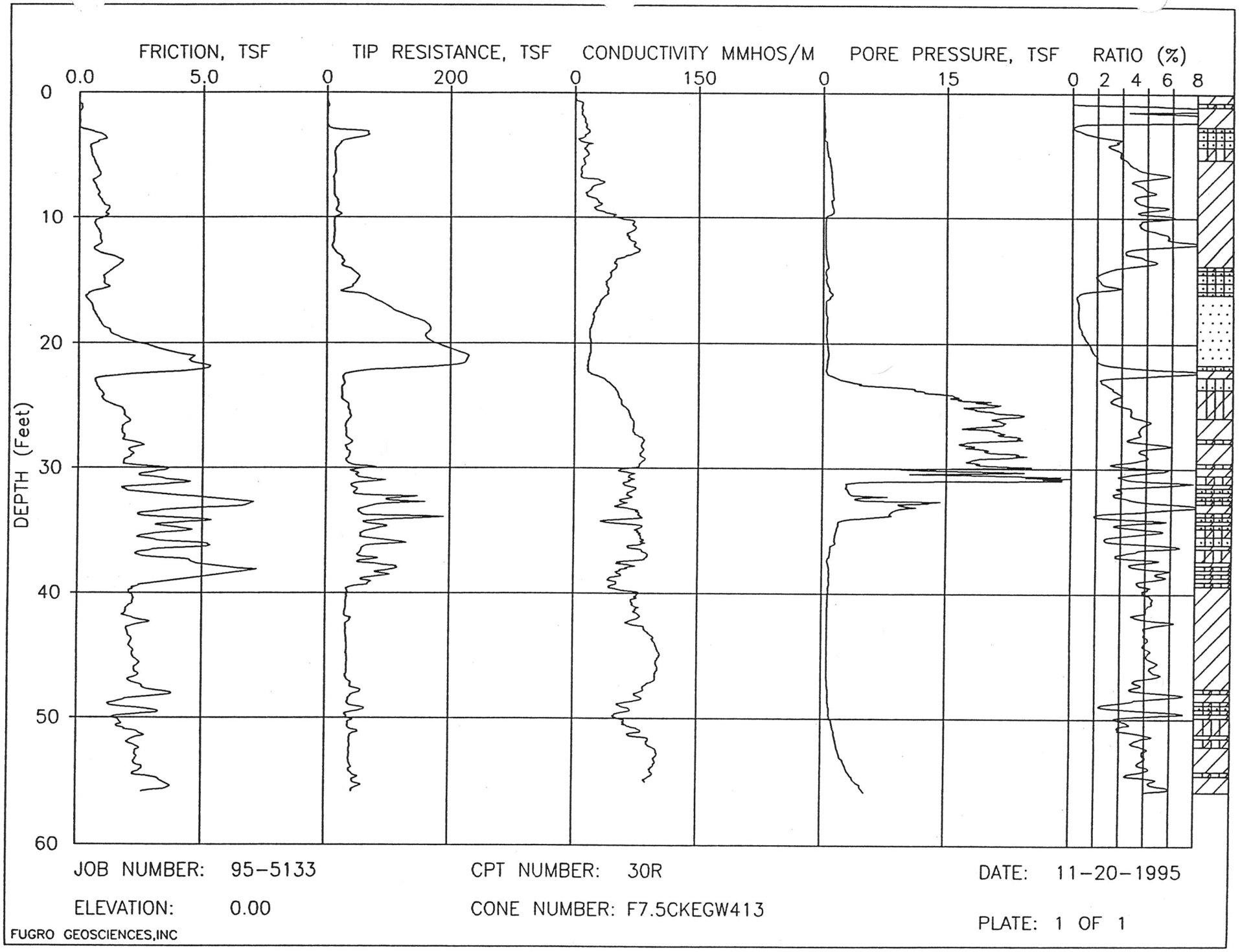
ELEVATION: 0.00
CONE NUMBER: F7.5CKEGW413
PLATE: 1 OF 1
FUGRO GEOSCIENCES,INC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RATIO (%)
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DEPTH (Feet)
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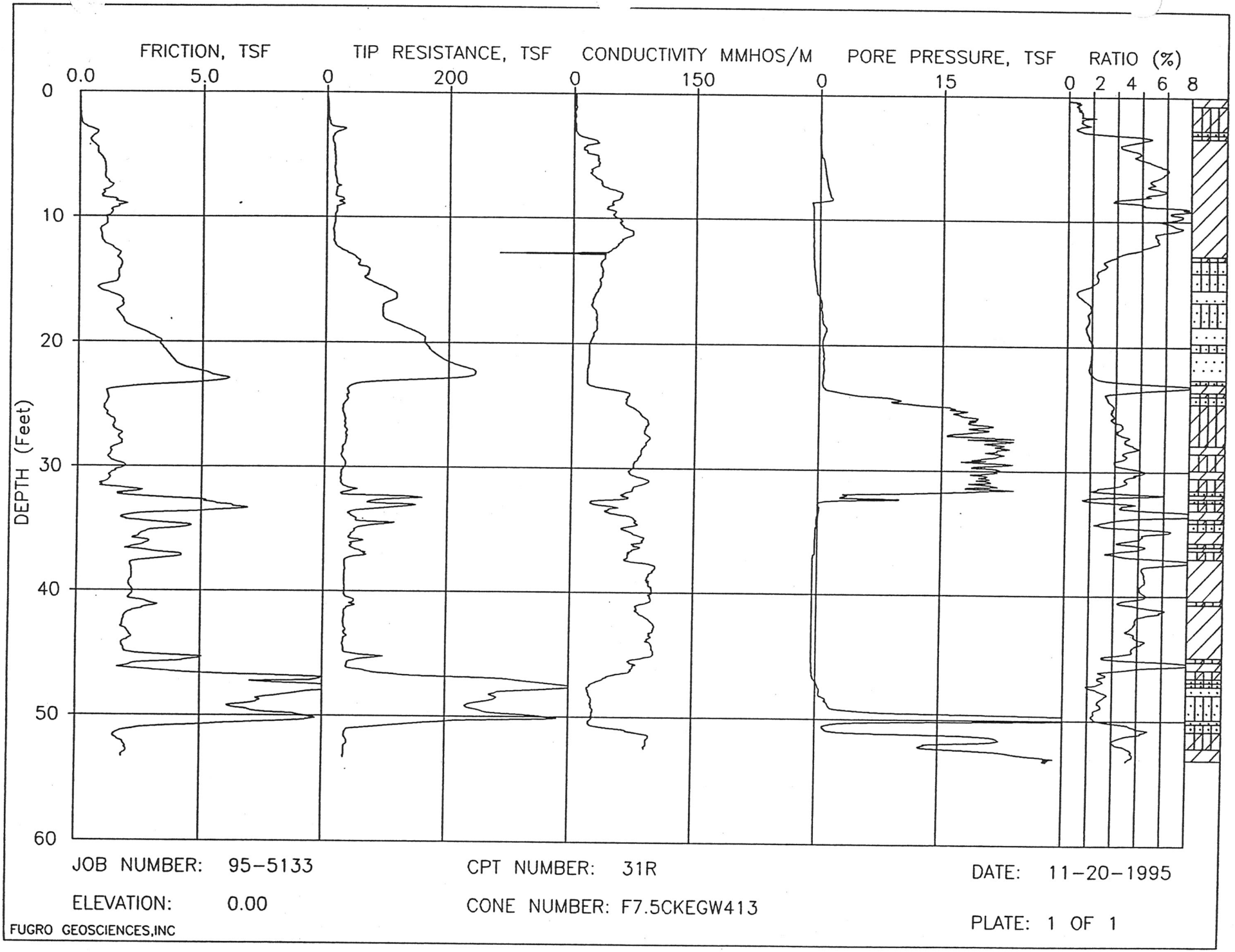
CONE NUMBER: F7.5CKEGW413
PLATE: 1 OF 1
FUGRO GEOSCIENCES,INC



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CPT NUMBER: 31R

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CONE NUMBER: F7.5CKEGW413

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC

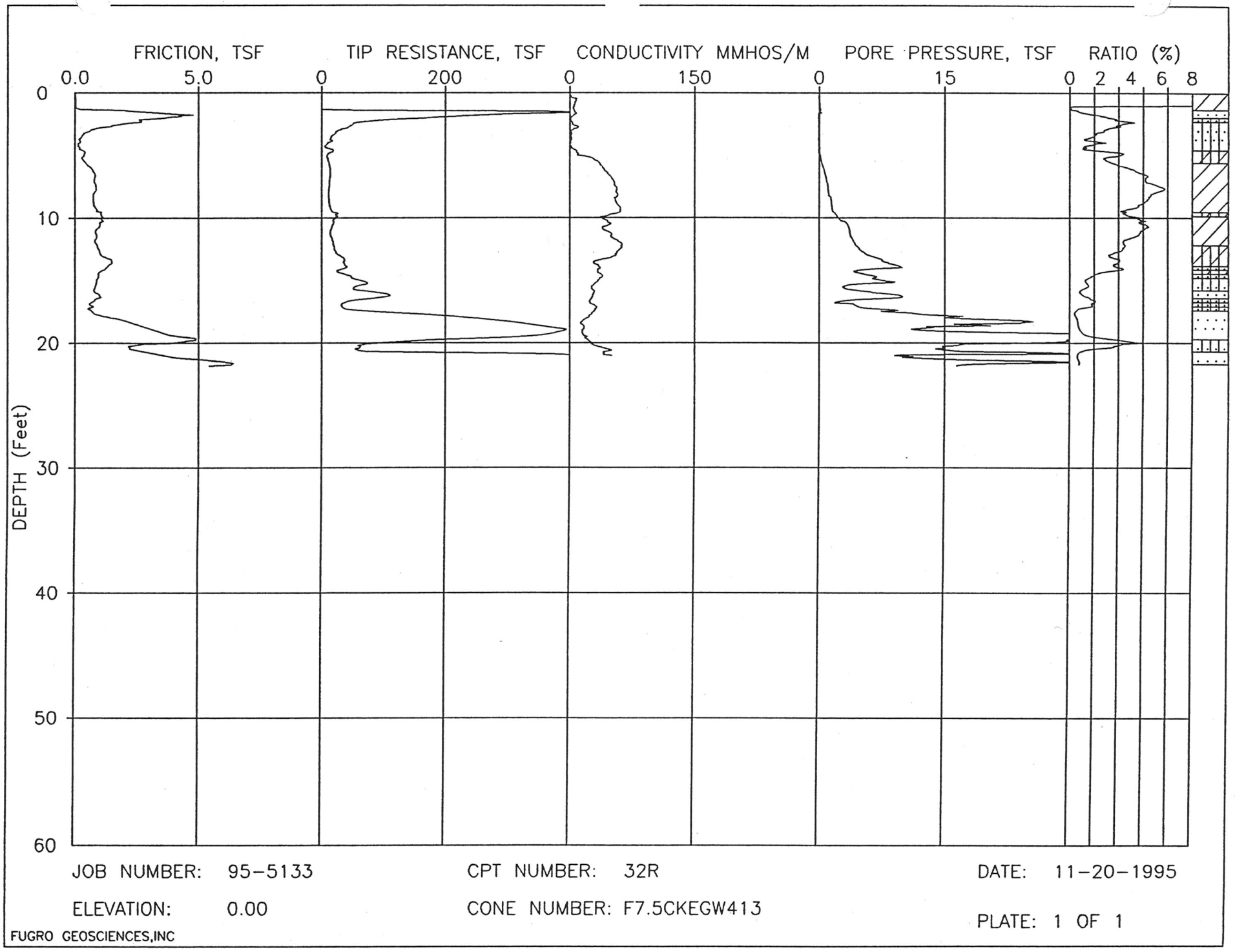

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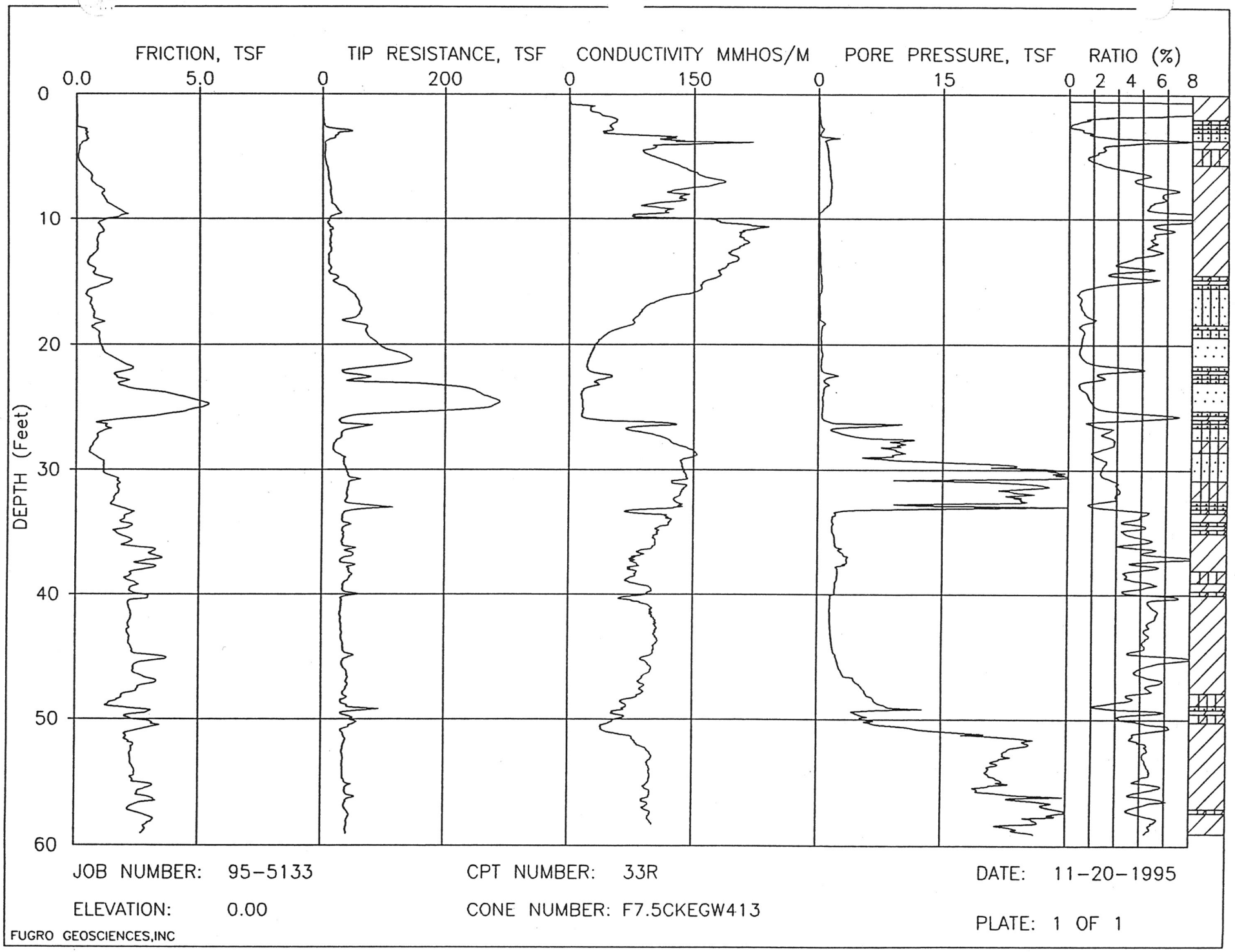
PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 95-5133

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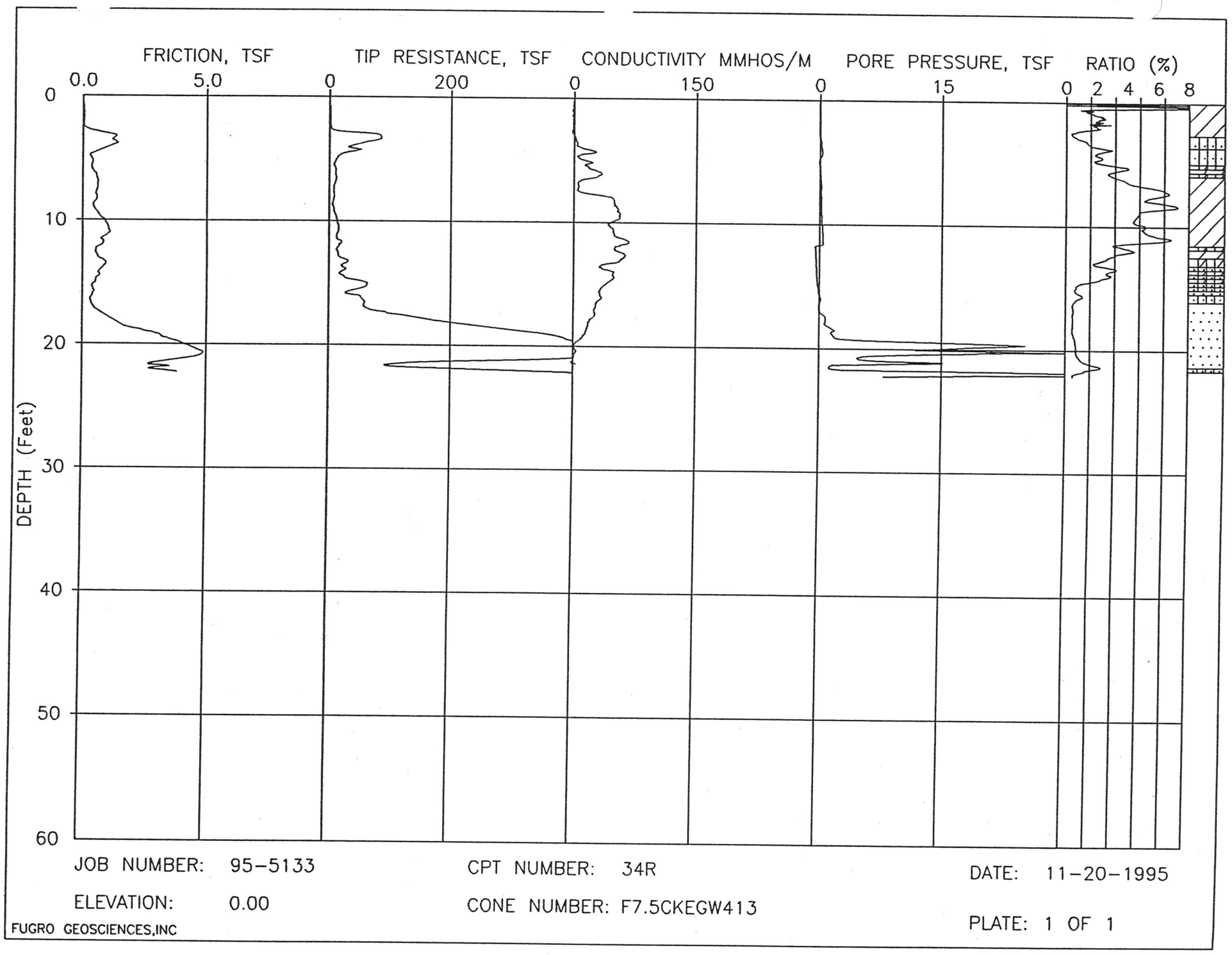
CONE NUMBER: F7.5CKEGW413

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



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CPT NUMBER: 34R

DATE: 11-20-1995

ELEVATION: 0.00

CONE NUMBER: F7.5CKEGW413

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC

APPENDIX C
RAPID OPTICAL SCREENING TOOL (ROST™) SUMMARY REPORT

FUGRO GEOSCIENCES, INC.

WOOD PRESERVING WORKS
HOUSTON, TEXAS

RAPID OPTICAL
SCREENING TOOL
AND
CONE PENETROMETER TEST
SUMMARY REPORT

DECEMBER 1995

(Project No. HA25)

LORAL

Fugro Geosciences, Inc.
6105 Rookin
Houston, Texas 77074
Phone (713) 778-5580

3333 Pilot Knob Road
Eagan, Minnesota 55121
Phone (612) 456-4163
Fax (612) 456-2029

FUGRO GEOSCIENCES, INC.

WOOD PRESERVING WORKS
HOUSTON, TEXAS

RAPID OPTICAL SCREENING TOOL AND CONE PENETROMETER TEST SUMMARY REPORT

Table of Contents

Narrative — Page

1.0 Introduction 1

2.0 Description of Technology 1

3.0 Results 4

4.0 Methods and Procedures 5
- 4.1 Equipment Decontamination 5
- 4.2 Health and Safety 5
- 4.3 Hole Abandonment 5

Table

Table 1 ROST Data Summary

Attachment

Attachment 1 ROST Data Interpretation

Appendices

Appendix A Integrated ROST/CPT Data Logs

FUGRO GEOSCIENCES, INC.

WOOD PRESERVING WORKS
HOUSTON, TEXAS

RAPID OPTICAL SCREENING TOOL AND CONE PENETROMETER TEST SUMMARY REPORT

1.0 INTRODUCTION

On November 14 to 19, 1995, Loral provided Fugro Geosciences, Inc. (Fugro) of Houston, Texas with subsurface characterization services at the Wood Preserving Works located in Houston, Texas. Loral was contracted by Fugro to use the Rapid Optical Screening Tool (**ROST**)[1] to evaluate subsurface areas located at the above referenced site for the presence of aromatic petroleum hydrocarbons (PHCs).

The ROST unit (System No. 4), a laser-induced fluorescence (LIF) tool, was delivered through standard Cone Penetrometer Test (CPT) methods from a 20 ton truck-mounted CPT rig. CPT services for the project were provided by Fugro.

During the six day project 46 ROST/CPT test locations were selected. A total of approximately 2,188 linear feet of ROST/CPT testing was completed. The ROST/CPT data is summarized in Table 1.

2.0 DESCRIPTION OF TECHNOLOGY

The cone penetrometer test is a proven method for rapidly evaluating the physical characteristics of unconsolidated subsurface materials. It is based on the resistance to penetration of an electronically-instrumented cone which is continuously advanced into the

---

[1] Rapid Optical Screening Tool is a registered Trademark of Loral Corporation and is hereafter referred to as ROST.

subsurface. In accordance with ASTM Standard D3441, the cone is typically advanced at a rate of two centimeters per second with the driving force provided by hydraulic rams that can usually generate twenty tons of force. For specialized applications, CPT delivery systems capable of producing more or less force are available.

The CPT cone used at this site had an apex angle of 60 degrees with a base area of 15 square centimeters (cm^2), and friction sleeve with a surface area of 200 cm^2. The standard geotechnical sensors within the cone measure tip resistance and sleeve friction in tons per square foot (TSF). The combined data from the tip resistance and sleeve friction form the basis of the soil classification (e.g., sand, silt, clay, etc.).

ROST greatly expands the utility of CPT by simultaneously providing information concerning the distribution of PHCs, specifically aromatic petroleum hydrocarbons, with the geotechnical characterization. The ROST employs laser-induced fluorescence spectroscopy for in-situ analysis of PHCs in saturated as well as unsaturated subsurface conditions. Pulsed laser light used for excitation travels via fiber optic cable to a specialized sub-unit attached to the standard CPT cone. The light is directed through a sapphire window in the side of the sub-unit and onto the surface of the soil. Aromatic petroleum hydrocarbons present within the soil absorb the excitation light and emit the absorbed energy as fluorescence. A portion of this fluorescence is returned by a collection fiber to the surface and is analyzed by the ROST unit for both spectral (wavelength) and temporal (time-resolved) information.

The ROST laser pulses excitation light at 50 pulses per second, and then averages the information to a single data point with a digital oscilloscope. The wavelength of the pulsed excitation light is tunable and can be set to wavelengths of 266 nanometers (nm) or to wavelengths between 280 and 300 nm. The wavelength of the excitation light used for each test during this project is listed on the individual Integrated ROST/CPT Data Logs in Appendix A.

The fluorescence intensity of a reference solution placed on the sapphire window is measured immediately prior to conducting each test. This reference solution measurement serves two main purposes. First, as a quality control check, the solution is used to ensure that

the performance of the system is within specifications. Second, it allows for normalization of the data from different test locations for variation in laser power, operating conditions, and monitored emission wavelength. The reference solution used for this project was the standard M1 reference, which is a proprietary PHC containing solution developed by Loral. M1 provides consistent fluorescence response across the portion of the spectrum analyzed by ROST and therefore, allows the fluorescence data collected to be consistently normalized to intensities recorded as a percentage of M1.

During ROST testing, the fluorescence emission is monitored at an operator selected wavelength, which is recorded on the individual Integrated ROST/CPT Data Logs. The fluorescence versus depth (FVD) log, found on the left side of the integrated data logs, is developed from the gathered emission and provides the basis for determining the distribution of PHCs as a function of depth below ground surface. The intensity of the fluorescence (in percent) is displayed as a continuous graph over the entire depth of the ROST/CPT hole.

The fluorescence intensity value is a sum of two components, background signal and fluorescence response. The background signal is composed of several components including fluorescence from the sapphire window, laser scatter, and electrical noise. The background can be measured directly by the signal returned from uncontaminated soil, or in the case of an FVD, a histogram of the signal in the background region can be plotted. In the later case, the arithmetic mean of the noise in this region represents the background. Once the background has been established it is subtracted from the fluorescence signal. The standard deviation of the noise in the background is used to establish a confidence interval, for the project a confidence interval of 99% was used. Readings above the confidence interval are statistically significant. The readings above the confidence interval are referred to as being above the limit of detection (LOD). The noise is still in the measurements, and the LOD is used to judge the point at which PHCs are reliably detected.

In addition to the FVD information, ROST can be used to qualitatively differentiate PHC product types according to variations in their wavelength-time matrices (WTMs). The WTMs, recorded during short pauses (approximately two minutes) in the CPT test, are a

series of averaged fluorescence intensity versus time profiles over a range of fluorescence wavelengths, typically 300 to 500 nm, in 10 nm intervals. Because the WTMs can be used to distinguish the spectroscopic signatures of PHC product types, they are especially useful for defining separate plumes when multiple sources of contamination are present. General data interpretation information for both FVDs and WTMs are found in Attachment 1.

3.0 RESULTS

The data collected by ROST indicates the presence of PHCs within subsurface areas of the site. The presence of PHCs is indicated by elevated fluorescence responses on the Integrated ROST/CPT Data Logs which are attached in Appendix A. Based on analysis of the in-situ FVD data, fluorescence intensities greater than the LOD indicate the presence of PHCs. All of the forty-six test locations showed elevated fluorescence response. Only eight of the forty-six test locations (CPT08R, CPT10R, CPT14R, CPT16R, CPT26R, CPT32R, CPT30R, and CPT34R) had maximum fluorescence intensities of greater than one hundred percent.

The types of PHC products encountered can be qualitatively identified from the spectroscopic signatures on the WTM plots which are also found in the integrated logs in Appendix A. Seven of the ninety-five WTMs (WCPT01EA, WCPT04RA, WCPT07RC, WCPT17RB, WCPT09RD, WCPT21RA, and WCPT23RB) indicate background. Of the remaining eighty-eight WTMs, six (WCPT08EB, WCPT04EC, WCPT03EC, WCPT14EA, WCPT19RB, and WCPT33RC) indicate a lower molecular weight PHC than the other WTMs. Differences in WTMs may be due to increased weathering of the PHCs or variations in soil oxygen content. Data interpretation information for both the FVDs and WTMs is found in Attachment 1.

The CPT data indicate that soil lithology encountered consists of multiple layers of unconsolidated sands, silts, and clays. The interbedded nature of the layers can be seen on the coded soil logs which are part of the Integrated ROST/CPT Data Log.

4.0 METHODS AND PROCEDURES

Loral incorporates standard operating procedures, performs services in accordance with applicable health and safety standards, and follows site specific protocols to address decontamination and hole abandonment procedures. The following section summarizes our methods and procedures.

4.1 Equipment Decontamination

Decontamination of all down hole equipment consisted of drawing the CPT rods through a rubber "O" ring wiper assembly and steam cleaning chamber which are located beneath the CPT vehicle. Due to the location of the "O" ring and steam cleaning assemblies, all equipment was thoroughly decontaminated before it entered the operations area of the CPT vehicle.

4.2 Health and Safety

All work was performed in accordance with Loral (ROST Program) health and safety policy as well as with the site specific health and safety plan. In accordance with Level D personal protection, all Loral personnel wore steel-toed shoes, hard hats, and safety glasses while on site.

4.3 Hole Abandonment

All test hole abandonment procedures were conducted by Fugro.

WAVELENGTH-TIME MATRIX (WTM) INTERPRETATION

Wavelength-Time Matrices (WTMs) are three dimensional representations that relate fluorescence intensity to emission wavelength and to fluorescence decay time following the pulsed excitation. Many common fuel products exhibit characteristic WTM signatures which can be used for qualitative analyses and identification purposes. WTMs obtained during a ROST/CPT test can be compared with WTMs of common petroleum products or with WTMs generated from specific materials recovered from the site.

The wavelength at which the maximum fluorescence intensity occurs (*Peak Signal)* on the WTM is a general indicator of petroleum hydrocarbon (PHC) composition. The fluorescence intensity distribution of aromatic hydrocarbons shifts to longer wavelengths with increasing molecular weight. Lighter PHC products, such as those composed predominantly of lower molecular weight compounds, reach peak fluorescence intensity at relatively shorter wavelengths. In contrast, heavier products composed of larger molecular weight compounds exhibit most of their fluorescence at longer wavelengths.

The Peak Signal recorded at the highest intensity point indicates the maximum relative strength of the fluorescence signal. The fluorescence intensity on a WTM is represented by contour lines or by color coded contour intervals referenced to the amplitude of the peak signal.

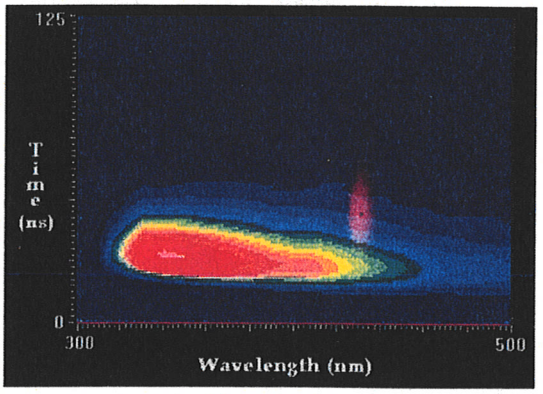
The fluorescence decay time, represented along the vertical axis of the WTM, further aids in defining the PHC type. The WTM signature of *Gasoline* tends to be elongated along the wavelength axis, but with short to moderate extension along the time axis. The *Jet Fuel* (*JP-4*) WTM has a characteristic compact triangular shape and a long fluorescence decay time. *Diesel Fuel* WTMs are less symmetric than those from gasoline or jet fuel, and tend to have a broad fin pattern along the time axis. *Heavy PHC products such as Coal Tar* have an elliptical shape like gasoline but are shifted to much longer wavelengths.

The shape of the WTM is independent of concentration for a particular petroleum product, but is sensitive to the PHC material composition and to soil oxygen content. The amplitude of the WTM, which is indicated by the peak signal, is proportional to the concentration. The amplitude may be affected by soil matrix and oxygen content.

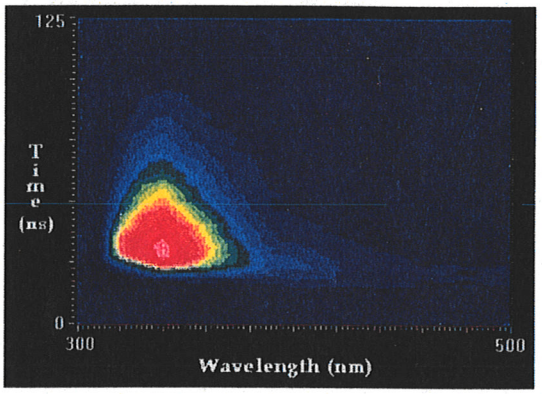
The four WTM plots of common petroleum products presented here are intended to be used only as a guide for qualitative comparison. Should more precise characterization of WTMs be required, additional spectroscopic evaluation of site specific samples can be conducted by Loral.

WTM Signatures of Common Petroleum Products

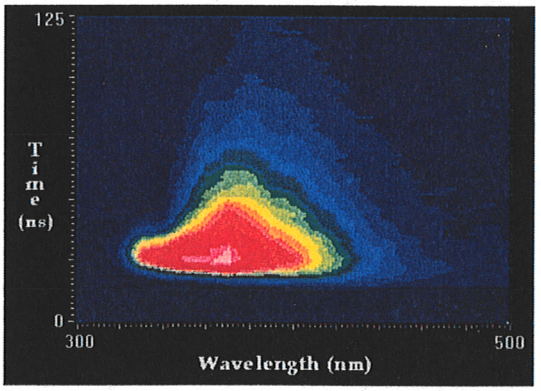
Gasoline **Peak Signal 0.183 @ 340nm**



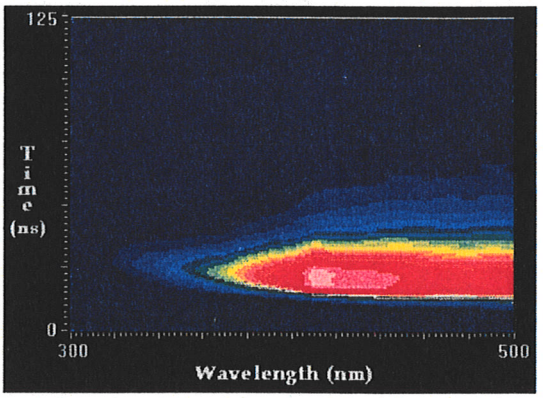
Jet Fuel (JP-4) **Peak Signal 0.176 @ 340nm**



Diesel Fuel **Peak Signal 0.182 @ 370nm**



Coal Tar **Peak Signal 0.127 @ 410nm**



LORAL

TABLE 1

ROST DATA SUMMARY

TABLE 1

ROST DATA SUMMARY

FUGRO GEOSCIENCES, INC.

WOOD PRESERVING WORKS
HOUSTON, TEXAS

ROST Location Identification	Date	Maximum Relative Fluorescence	Depth of Max. Relative Fluorescence (ft.)	Number of WTMs Collected	Total Depth (ft.)	Comments
CPT01E	11/14/95	3.1	0.4	2	35.0	WTMs collected at 14.6 and 32.7 ft. Fluorescence above the LOD noted from the surface to approx. 12.5, 17.5 to 19.5 and 31.9 to the bottom of the hole at 32.7 ft.
CPT06E	11/14/95	2.4	0.03	0	35.2	No WTMs collected. Fluorescence above the LOD noted from the surface to approx. 6.5, 7.5 to 9.5, 16 to 19.5, and 30 to 32 ft.
CPT18R	11/14/95	24.7	27.8	3	52.4	WTMs collected at 3.0, 21.7, and 26.7 ft. Fluorescence above the LOD noted from the surface to approx. 13, 17 to 19, 20.5 to 23.5, 26 to 42, and 46.5 ft.
CPT04R	11/15/95	4.5	2.3	1	51.3	WTM collected at 22.4 ft. Fluorescence above the LOD noted from the surface to approx. 9, 17 to 21, 22 to 23, and 36.5 ft.
CPT03R	11/15/95	2.4	0.7	2	43.6	WTMs collected at 2.1 and 38.0 ft. Fluorescence above the LOD noted from approx. 0.5 to 12, 17.5 to 22, and 37.5 to 41 ft.
CPT05E	11/15/95	6.6	1.5	2	40.1	WTMs collected at 0.9 and 9.4 ft. Fluorescence above the LOD noted from the surface to approx. 20 ft.
CPT07E	11/15/95	5.9	0.1	1	40.6	WTM collected at 15.4 ft. Fluorescence above the LOD noted from the surface to approx. 10.5 and 14.5 to 19.5 ft.
CPT08E	11/15/95	15.4	8.9	3	34.4	WTMs collected at 1.3, 5.1, and 13.6 ft. Fluorescence above the LOD noted from the surface to approx. 21 ft.
CPT04E	11/15/95	9.0	19.4	3	35.4	WTMs collected at 1.2, 19.2, and 33.2 ft. Fluorescence above the LOD noted from the surface to approx. 21, 27 to 31, and 33 to the bottom of the hole at 33.6 ft.
CPT02E	11/15/95	1.6	31.6	1	43.7	WTM collected at 31.1 ft. Fluorescence above the LOD noted from the surface to approx. 1.5 and 30.5 to 32.5 ft.
CPT03E	11/15/95	10.0	34.0	4	43.5	WTMs collected at 1.6, 28.6, 34.0, and 42.1 ft. Fluorescence above the LOD noted from approx. 1 to 20.5, 26.5 to 28, 28.5 to 29.5, and 31 to the bottom of the hole at 42.1 ft.
CPT09E	11/15/95	11.5	29.2	3	33.4	WTMs collected at 2.5, 26.5, and 28.9 ft. Fluorescence above the LOD noted from the surface to approx. 19 and 26 to the bottom of the hole at 31.7 ft.
			TOTALS	25	488.6	

TABLE 1
(CONTINUED)

ROST DATA SUMMARY

FUGRO GEOSCIENCES, INC.

WOOD PRESERVING WORKS
HOUSTON, TEXAS

ROST Location Identification	Date	Maximum Relative Fluorescence	Depth of Max. Relative Fluorescence (ft.)	Number of WTMs Collected	Total Depth (ft.)	Comments
CPT12E	11/16/95	1.3	0.1	1	34.6	WTM collected at 4.1 ft. Fluorescence above the LOD noted from the surface to approx. 4.5 and 14 to 16.5 ft.
CPT11E	11/16/95	2.8	0.2	0	34.8	No WTMs collected. Fluorescence above the LOD noted from the surface to approx. 1.5, 2 to 4, 6.5 to 7, and 16 to 18.5 ft.
CPT10E	11/16/95	2.2	0.1	1	43.2	WTM collected at 7.4 ft. Fluorescence above the LOD noted from the surface to approx. 1, at 3.5, from 5.5 to 6.5, and 7 to 10 ft.
CPT14E	11/16/95	4.4	30.5	1	33.0	WTM collected at 30.5 ft. Fluorescence above the LOD noted from the surface to approx. 2.5 and 30 to the bottom of the hole at 31.0 ft.
CPT13E	11/16/95	3.9	0.1	1	40.4	WTM collected at 1.1 ft. Fluorescence above the LOD noted from the surface to approx. 8 ft.
CPT07R	11/16/95	79.5	39.4	5	53.3	WTMs collected at 1.6, 3.4, 18.6, 29.1, and 36.9 ft. Fluorescence above the LOD noted from the surface to approx. 16.5, 28 to 49, and at 50 ft.
CPT08R	11/16/95	133	20.9	4	56.2	WTMs collected at 3.9, 7.2, 19.8, and 39.1 ft. Fluorescence above the LOD noted from approx. 1 to 37, 38.5 to 52.5, and at 54 ft.
CPT10R	11/16/95	120	24.2	3	54.0	WTMs collected at 4.9, 24.7, and 48.3 ft. Fluorescence above the LOD noted from approx. 1 to 52 ft.
CPT12R	11/16/95	63.5	33.4	3	56.3	WTMs collected at 2.6, 22.3, and 33.4 ft. Fluorescence above the LOD noted from approx. 1.5 to 45.5, at 47.5, 48.5, and from 50 to the bottom of the hole at 55.3 ft.
CPT14R	11/16/95	110	28.8	2	56.6	WTMs collected at 4.0 and 27.7 ft. Fluorescence above the LOD noted from approx. 0.5 to the bottom of the hole at 55.0 ft.
CPT20R	11/17/95	5.3	1.9	1	52.8	WTM collected at 36.6 ft. Fluorescence above the LOD noted from approx. 1 to 7, 16.5 to 21.5, and 36.5 to 38.5 ft.
CPT19R	11/17/95	10.5	35.5	3	52.4	WTMs collected at 2.4, 20.3, and 35.5 ft. Fluorescence above the LOD noted from approx. 1 to 4, 9.5, 18.5 to 23.5, and 35 to 46 ft.
			TOTAL	25	567.6	

TABLE 1
(CONTINUED)

ROST DATA SUMMARY

FUGRO GEOSCIENCES, INC.

WOOD PRESERVING WORKS
HOUSTON, TEXAS

ROST Location Identification	Date	Maximum Relative Fluorescence	Depth of Max. Relative Fluorescence (ft.)	Number of WTMs Collected	Total Depth (ft.)	Comments
CPT16R	11/17/95	279	9.9	3	49.9	WTMs collected at 2.4, 6.2, and 28.3 ft. Fluorescence above the LOD noted from approx. 0.5 to 43 and 47 to 48.5 ft.
CPT17R	11/17/95	21.0	3.8	2	50.2	WTMs collected at 2.4 and 18.4 ft. Fluorescence above the LOD noted from approx. 0.5 to 30.5, 33.5 to 37, 38.5 to 40, and 49.5 to the bottom of the hole at 50.2 ft.
CPT11R	11/17/95	86.5	12.3	2	50.8	WTMs collected at 7.0 and 29.9 ft. Fluorescence above the LOD noted from the surface to the bottom of the hole at 49.6 ft.
CPT09R	11/17/95	57.4	2.0	4	59.5	WTMs collected at 2.3, 25.8, 54.9, and 58.8 ft. Fluorescence above the LOD noted from the surface to the bottom of the hole at 58.8 ft.
CPT26R	11/17/95	287	19.5	2	60.2	WTMs collected at 5.1 and 45.6 ft. Fluorescence above the LOD noted from the surface to approx. 35, at 35.4, and 38 to the bottom of the hole at 58.8 ft.
CPT21R	11/17/95	20.4	1.2	1	50.7	WTM collected at 25.2 ft. Fluorescence above the LOD noted from the surface to approx. 24, 30 to 31.5, 33 to 34, and 36 to 37.5 ft.
CPT22R	11/18/95	14.9	16.1	3	56.4	WTMs collected at 2.7, 15.3, and 36.5 ft. Fluorescence above the LOD noted from the surface to approx. 26, 36 to 38.5, and 50 to 55.5 ft.
CPT23R	11/18/95	23.2	0.8	2	52.1	WTMs collected at 3.1 and 25.9 ft. Fluorescence above the LOD noted from the surface to approx. 22.5 and at 49 ft.
CPT25R	11/18/95	37.6	0.9	2	53.1	WTMs collected at 4.1 and 30.2 ft. Fluorescence above the LOD noted from approx. 1 to 26.5, 27.5 to 32, and 38.5 to 49 ft.
CPT24R	11/18/95	12.4	1.2	1	34.3	WTM collected at 4.8 ft. Fluorescence above the LOD noted from the surface to approx. 12.5 and 13 to 20.5 ft.
CPT06R	11/18/95	6.1	32.4	1	53.6	WTM collected at 32.6 ft. Fluorescence above the LOD noted from the surface to approx. 11, 15.5 to 24.5, and 31.5 to 34 ft.
CPT05R	11/18/95	2.5	0.5	0	53.4	No WTMs collected. Fluorescence above the LOD noted from the surface to approx. 15.5 and 21 to 21.5 ft.
			TOTAL	23	624.2	

TABLE 1
(CONTINUED)

ROST DATA SUMMARY

FUGRO GEOSCIENCES, INC.

WOOD PRESERVING WORKS
HOUSTON, TEXAS

ROST Location Identification	Date	Maximum Relative Fluorescence	Depth of Max. Relative Fluorescence (ft.)	Number of WTMs Collected	Total Depth (ft.)	Comments
CPT15R	11/18/95	77.8	40.6	3	57.9	WTMs collected at 3.8, 28.9, and 39.3 ft. Fluorescence above the LOD noted from the surface to approx. 30 and 36 to 55.5 ft.
CPT13R	11/18/95	49.6	39.7	3	59.7	WTMs collected at 4.6, 26.1, and 39.9 ft. Fluorescence above the LOD noted from approx. 0.5 to 22, 26.5 to 50, and 52 to 56 ft.
CPT27R	11/19/95	7.6	2.5	1	59.4	WTM collected at 15.7 ft. Fluorescence above the LOD noted from the surface to approx. 24.5 and at 50.5 ft.
CPT28R	11/19/95	11.5	33.9	2	59.3	WTMs collected at 14.3 and 33.9 ft. Fluorescence above the LOD noted from approx. 0.5 to 26, 31 to 32, 33 to 35, 36 to 38, and 48 ft.
CPT31R	11/19/95	27.0	35.5	1	53.7	WTM collected at 35.4 ft. Fluorescence above the LOD noted from the surface to approx. 26.5, 30, 32, 34.5 to 45.5, and 47.5 to 49.5 ft.
CPT29R	11/19/95	74.1	28.5	3	56.6	WTMs collected at 5.8, 16.6, and 29.0 ft. Fluorescence above the LOD noted from approx. 0.5 to 52 ft.
CPT33R	11/19/95	53.5	36.2	3	59.5	WTMs collected at 6.8, 26.5, and 50.3 ft. Fluorescence above the LOD noted from approx. 0.5 to 13.5, 15.5 to 17, 21.5 to 42, and 46.5 to 57 ft.
CPT32R	11/19/95	439	19.8	2	22.1	WTMs collected at 6.0 and 18.5 ft. Fluorescence above the LOD noted from the surface to the bottom of the hole at 19.9 ft.
CPT30R	11/19/95	169	49.7	2	56.3	WTMs collected at 7.0 and 45.4 ft. Fluorescence above the LOD noted from the surface to approx. 25, 31 to 40.5, and 45 to 52.5 ft.
CPT34R	11/19/95	322	20.2	2	22.6	WTMs collected at 7.7 and 17.9 ft. Fluorescence above the LOD noted from approx. 0.5 to the bottom of the hole at 20.5 ft.
			TOTAL	22	507.1	

ATTACHMENT 1

ROST DATA INTERPRETATION

ROST DATA INTERPRETATION

Fluorescence Verses Depth Data

The FVD and CPT data obtained are presented on the Integrated ROST/CPT Data Logs in Appendix A. The FVD data is exhibited as a continuous graph of fluorescence intensity and is presented as a function of depth over the entire length of the ROST/CPT test hole. Depth is recorded along the vertical axis in meters or feet below ground surface (bgs), while the relative fluorescence is recorded along the horizontal axis. Increases in fluorescence intensity are indicated by peaks extending across the horizontal axis of the FVD log. Fluorescence intensities above the background signal indicate the presence of PHC containing substances.

As seen on the integrated logs, coded stratigraphic soil logs allow the stratigraphic position of any relative fluorescence data to be readily determined. The coded logs correspond to the general lithologic soil legend found at the bottom of each log which is based on soil classifications defined by P.K. Robertson and R.G. Campanella.

Wavelength-Time Matrix Data

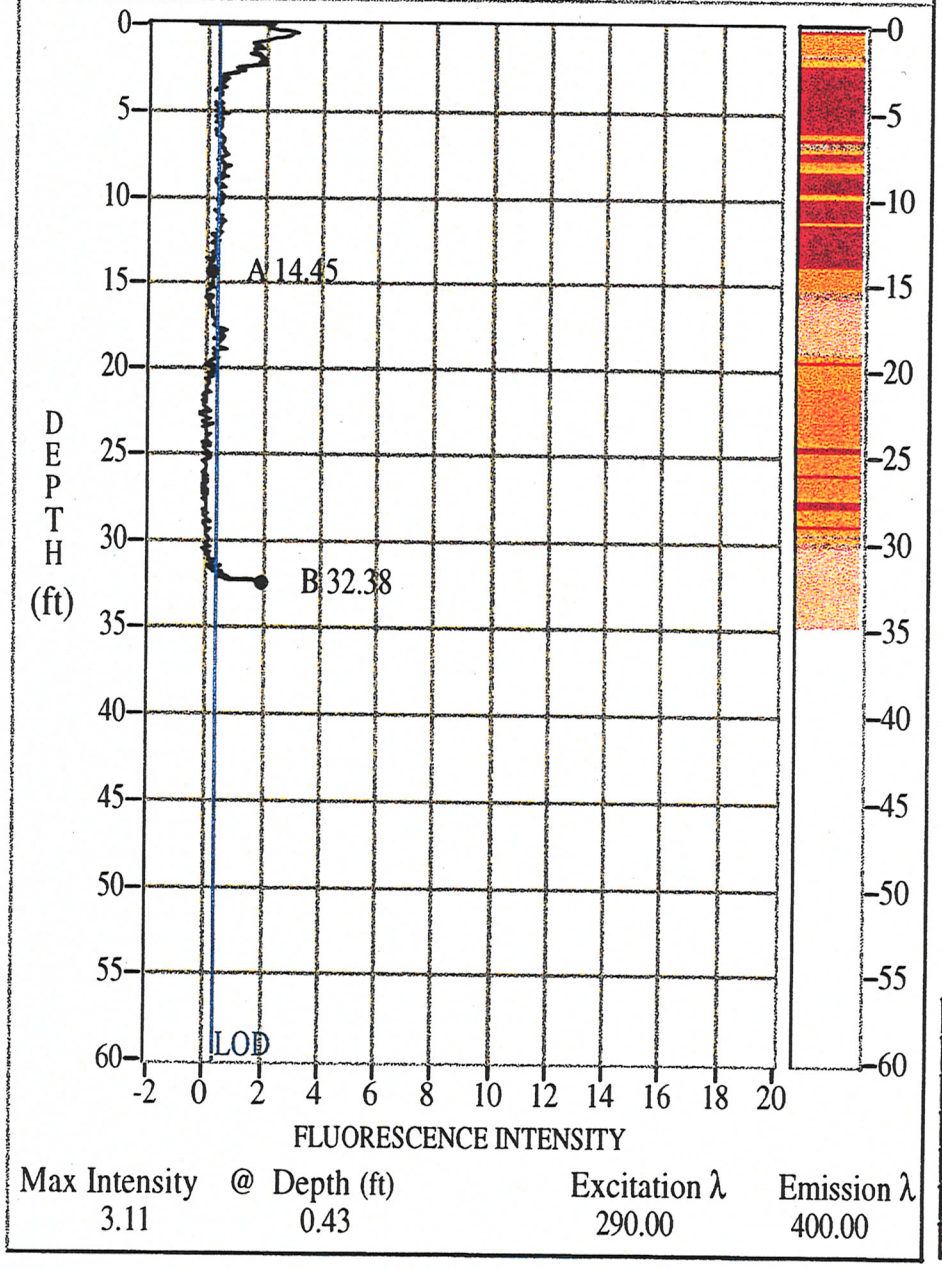
The WTM plots are also included in Appendix A as part of the Integrated ROST/CPT Data Logs. As many common fuel products exhibit characteristic spectroscopic signatures, qualitative comparisons to site specific WTMs can be made. The WTMs obtained during ROST/CPT testing can be compared to the WTMs of common petroleum products or with WTMs generated from specific material samples recovered from the site. The attached WTM interpretation sheet can be used as guide for making qualitative comparisons. Note that signature patterns on WTMs obtained from zones where only background fluorescence was encountered do not exhibit any distinguishable pattern. Zones of weak fluorescence tend to exhibit slightly erratic signatures and also have indistinguishable patterns.

APPENDIX A

INTEGRATED ROST/CPT DATA LOGS

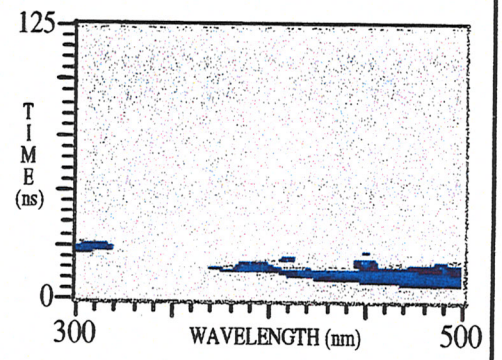
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT01E



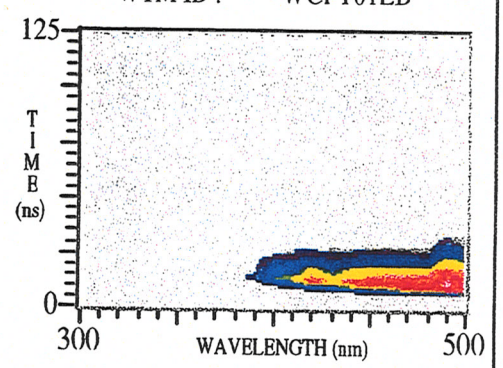
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
3.11	0.43	290.00	400.00

A WTM ID : WCPT01EA

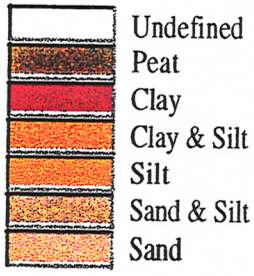


Peak Signal	0.002337 @ 500.00
FVD Signal	0.001022 @ 400.00

B WTM ID : WCPT01EB



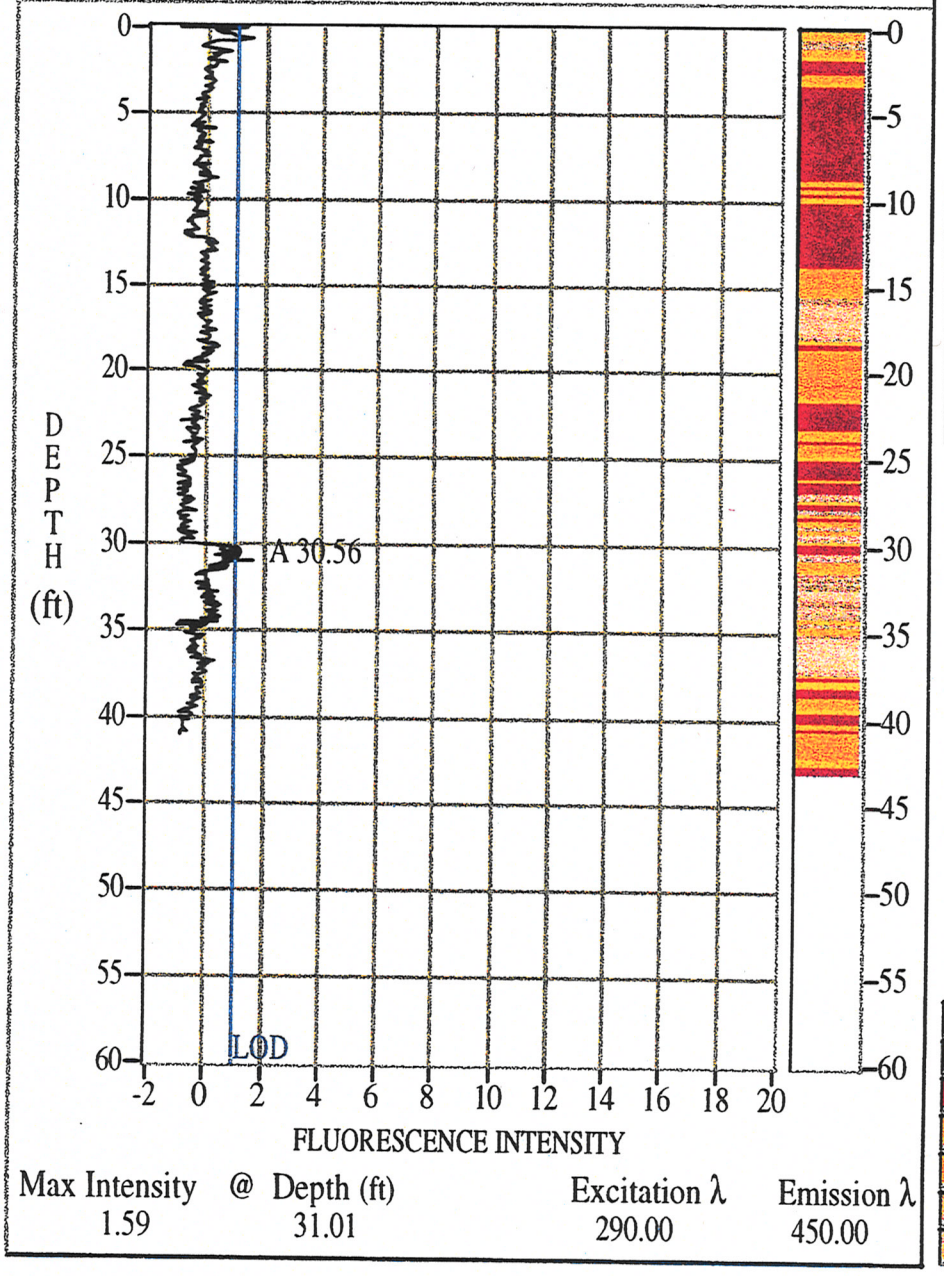
Peak Signal	0.068749 @ 490.00
FVD Signal	0.022096 @ 400.00



Date: 11/14/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
Checked By: BJT	LORAL ENVIRONMENTAL SYSTEMS
Background Corrected	
Page 1 of 1	

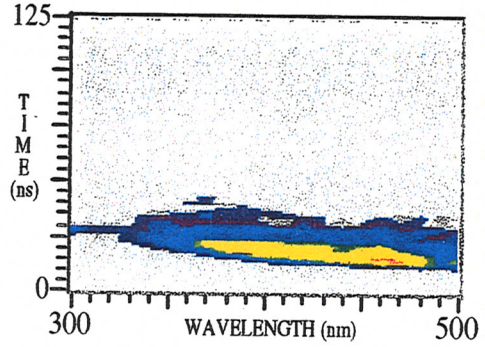
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT02E



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
1.59	31.01	290.00	450.00

A WTM ID : WCPT02EA



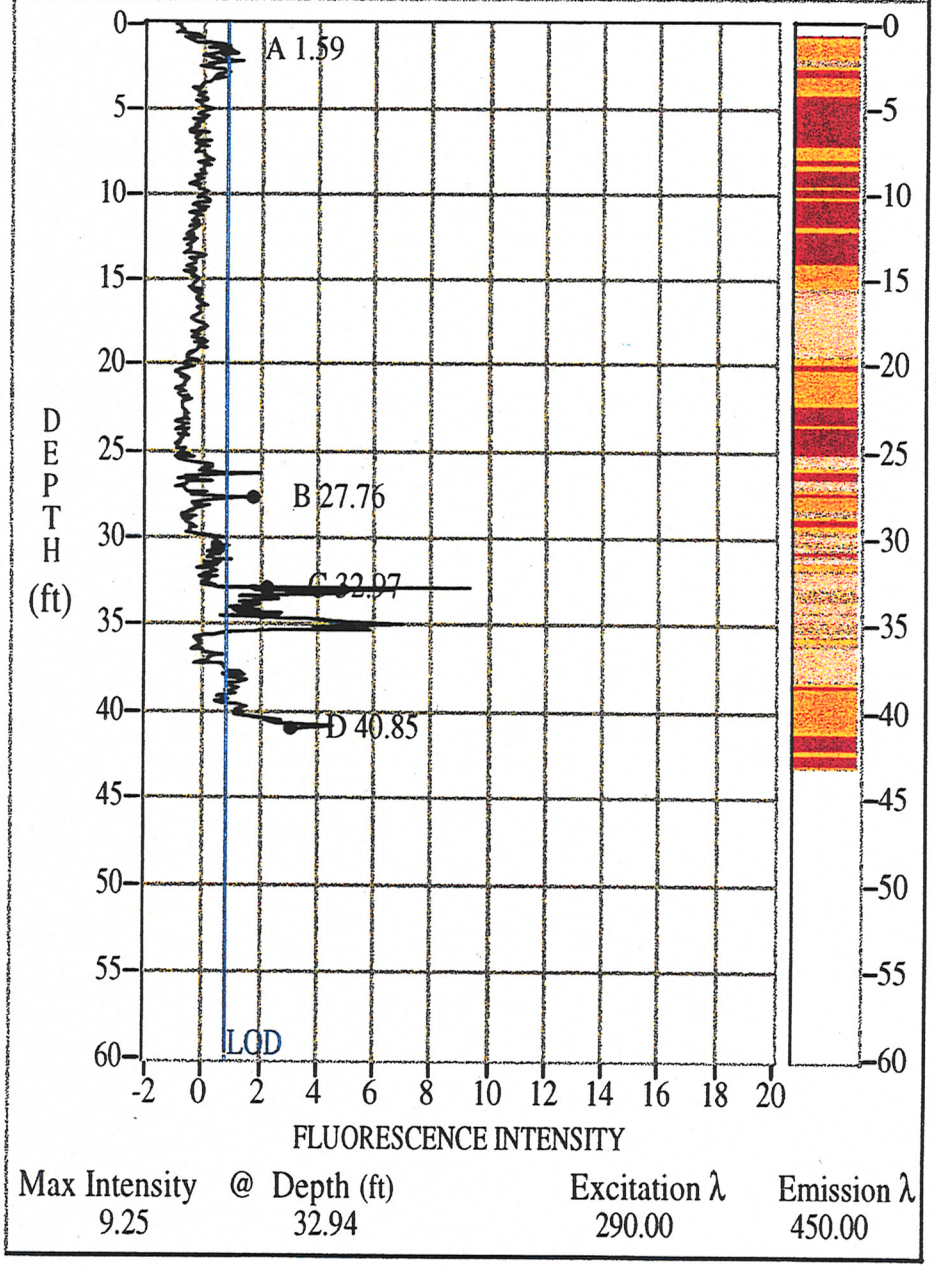
Peak Signal	0.006101 @ 460.00
FVD Signal	0.005566 @ 450.00

Undefined
Peat
Clay
Clay & Silt
Silt
Sand & Silt
Sand

Date: 11/15/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
Checked By: BJT	LORAL ENVIRONMENTAL SYSTEMS
Background Corrected	
Page 1 of 1	

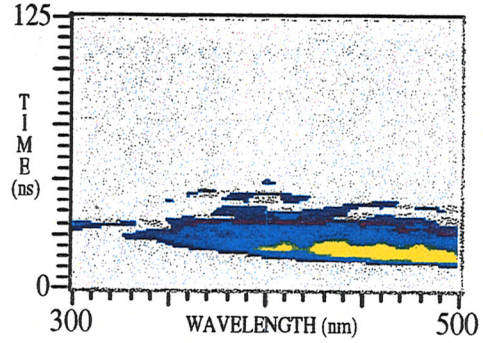
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT03E



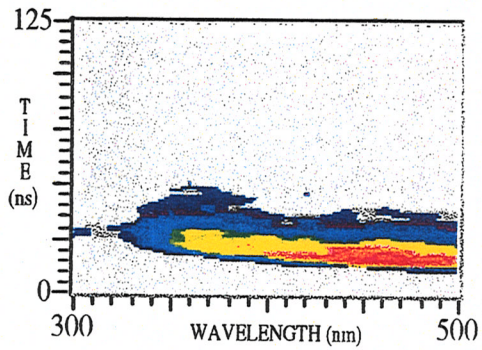
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
9.25	32.94	290.00	450.00

A WTM ID : WCPT03EA



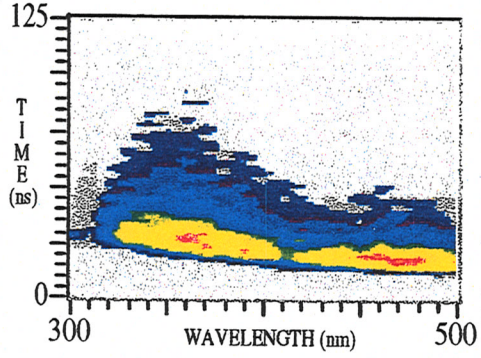
Peak Signal	0.005373 @ 460.00
FVD Signal	0.005197 @ 450.00

B WTM ID : WCPT03EB



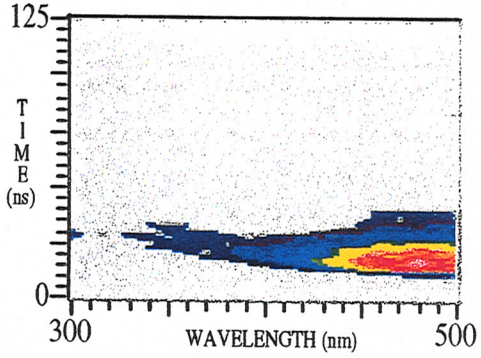
Peak Signal	0.008980 @ 460.00
FVD Signal	0.007972 @ 450.00

C WTM ID : WCPT03EC



Peak Signal	0.007222 @ 460.00
FVD Signal	0.006013 @ 450.00

D WTM ID : WCPT03ED



Peak Signal	0.019397 @ 480.00
FVD Signal	0.013244 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

Date: 11/15/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
Checked By: BJT	LORAL ENVIRONMENTAL SYSTEMS
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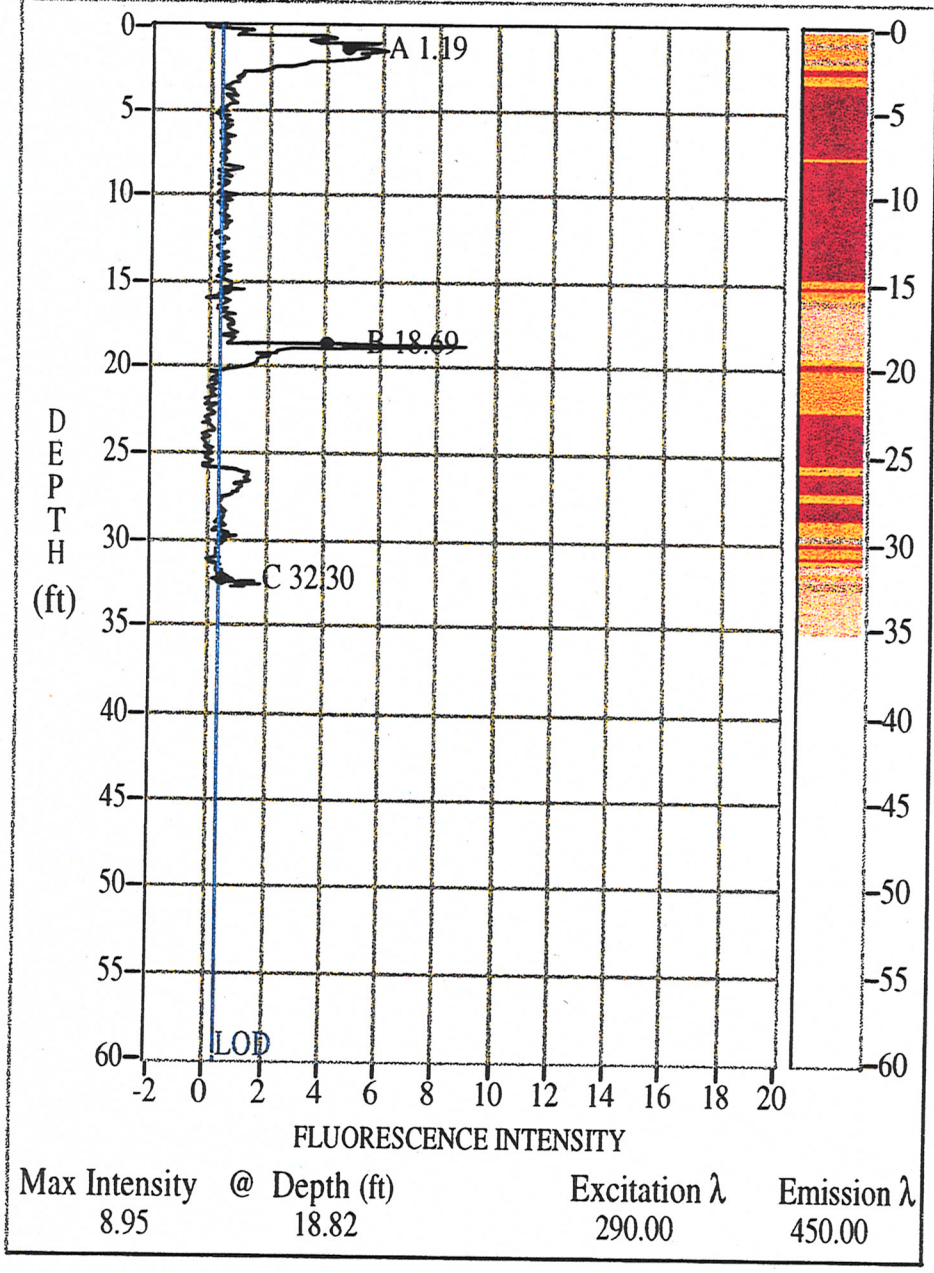
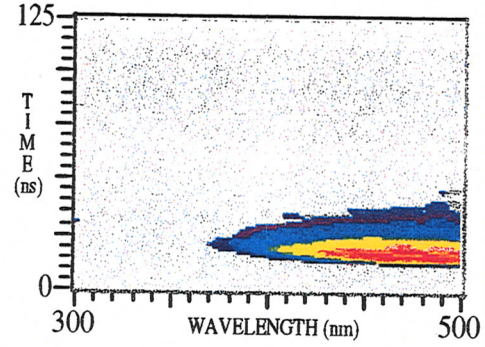
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT04E



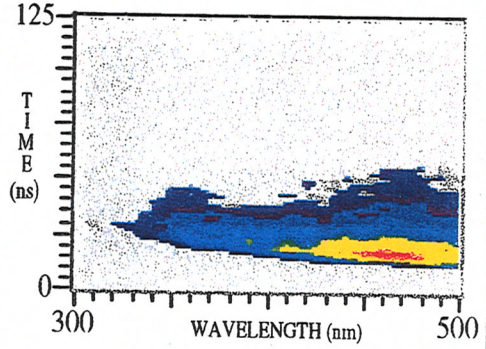
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
8.95	18.82	290.00	450.00

A WTM ID : WCPT04EA



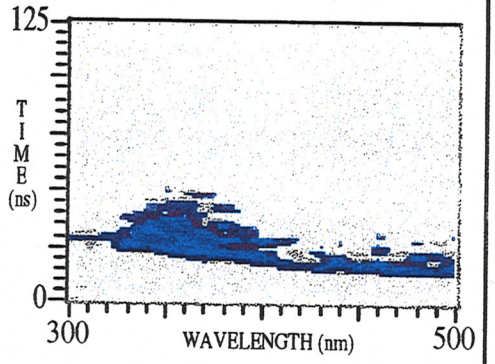
Peak Signal	0.025835 @ 470.00
FVD Signal	0.024843 @ 450.00

B WTM ID : WCPT04EB



Peak Signal	0.013853 @ 460.00
FVD Signal	0.012189 @ 450.00

C WTM ID : WCPT04EC



Peak Signal	0.002081 @ 360.00
FVD Signal	0.001586 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

Date: 11/15/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
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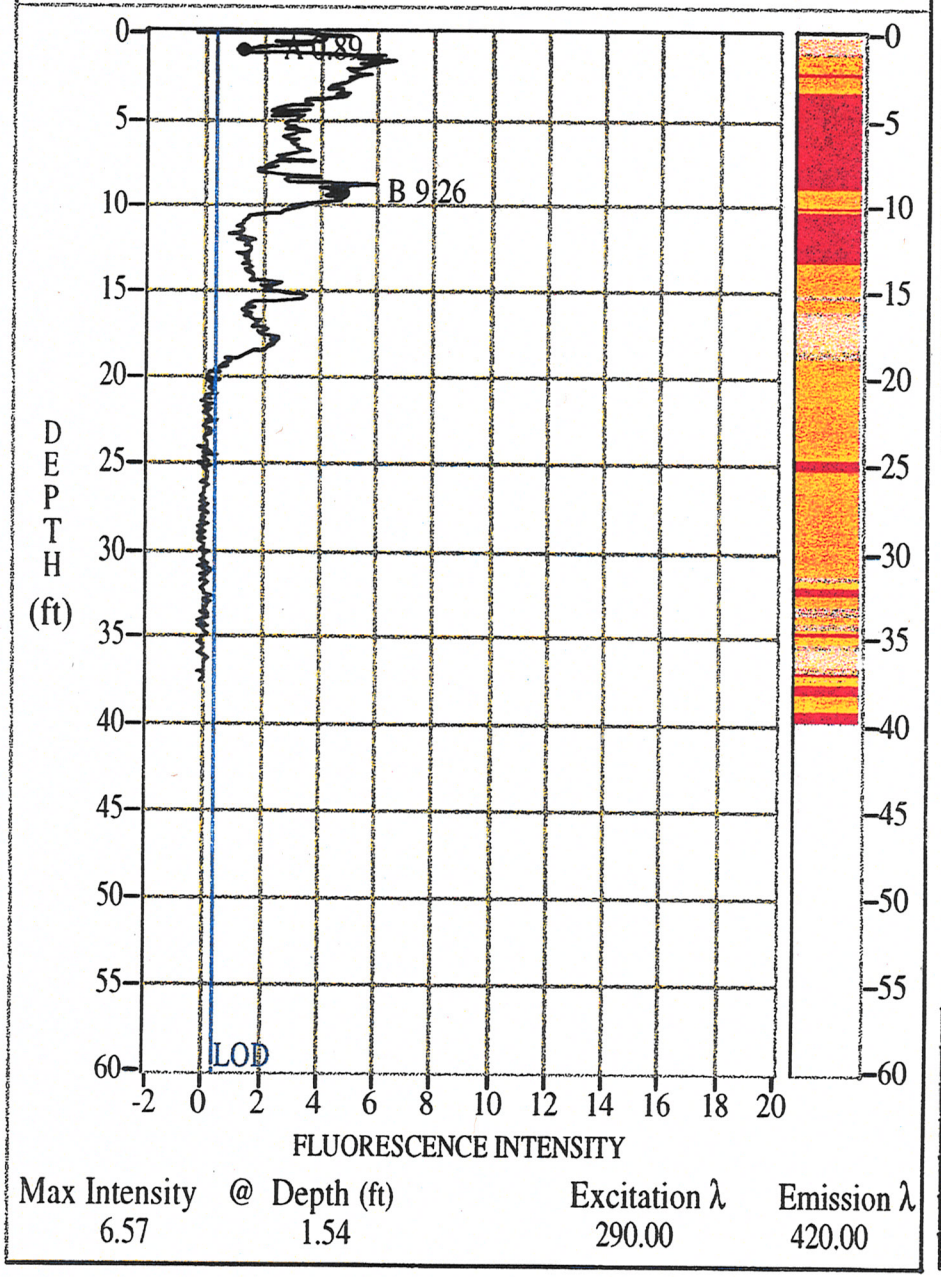
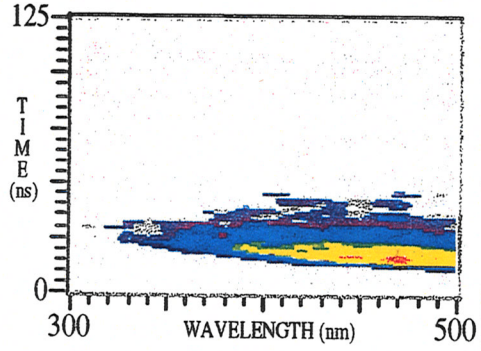
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT05E



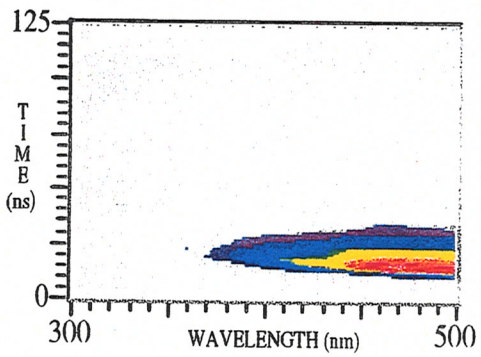
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
6.57	1.54	290.00	420.00

A WTM ID : WCPT05EA



Peak Signal	0.007393 @ 470.00
FVD Signal	0.004407 @ 420.00

B WTM ID : WCPT05EB



Peak Signal	0.056327 @ 470.00
FVD Signal	0.024438 @ 420.00

Date: 11/15/95	Wood Preserving Works
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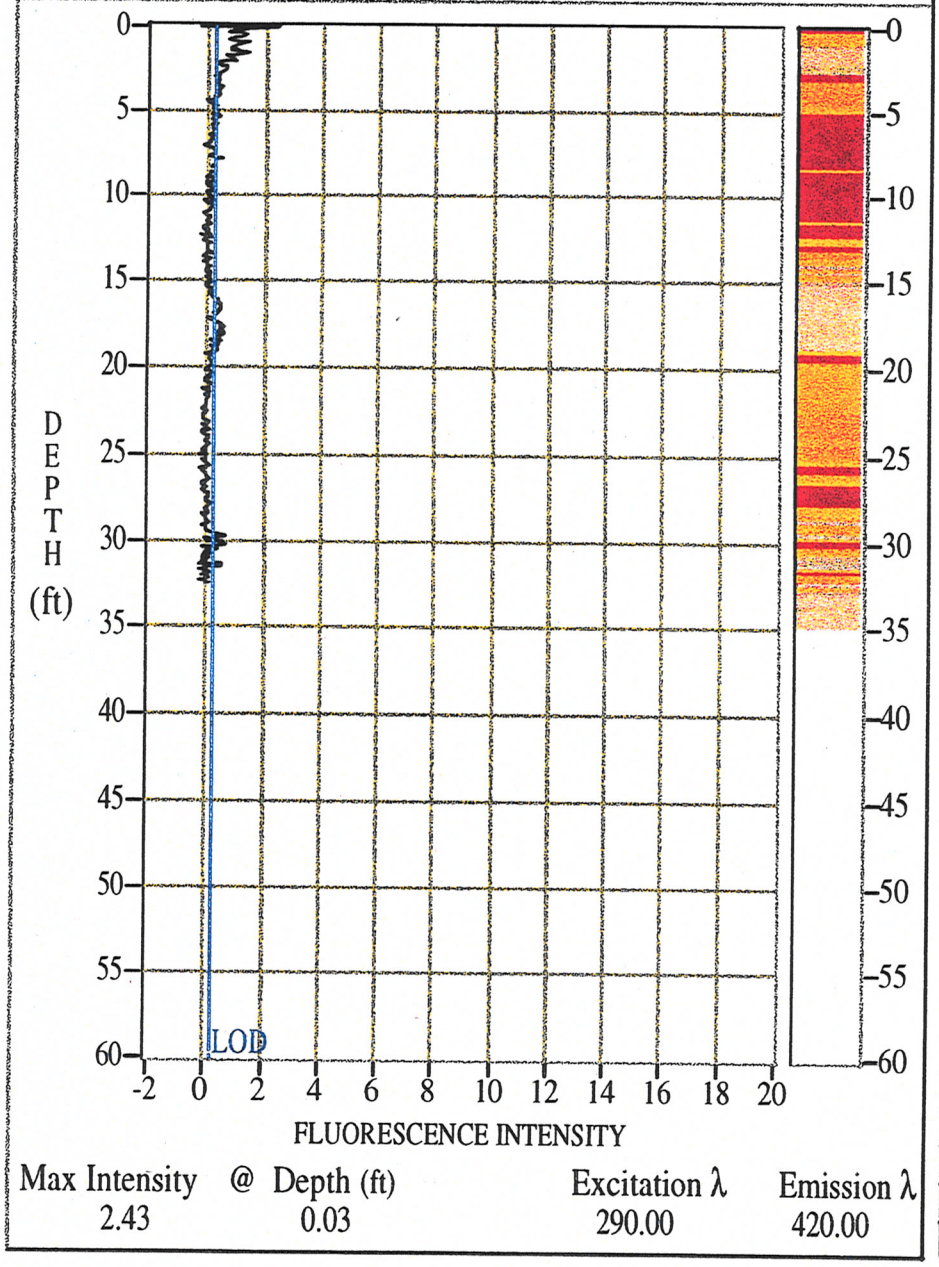
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT06E



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
2.43	0.03	290.00	420.00

Date: 11/14/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
Checked By: BJT	LORAL ENVIRONMENTAL SYSTEMS
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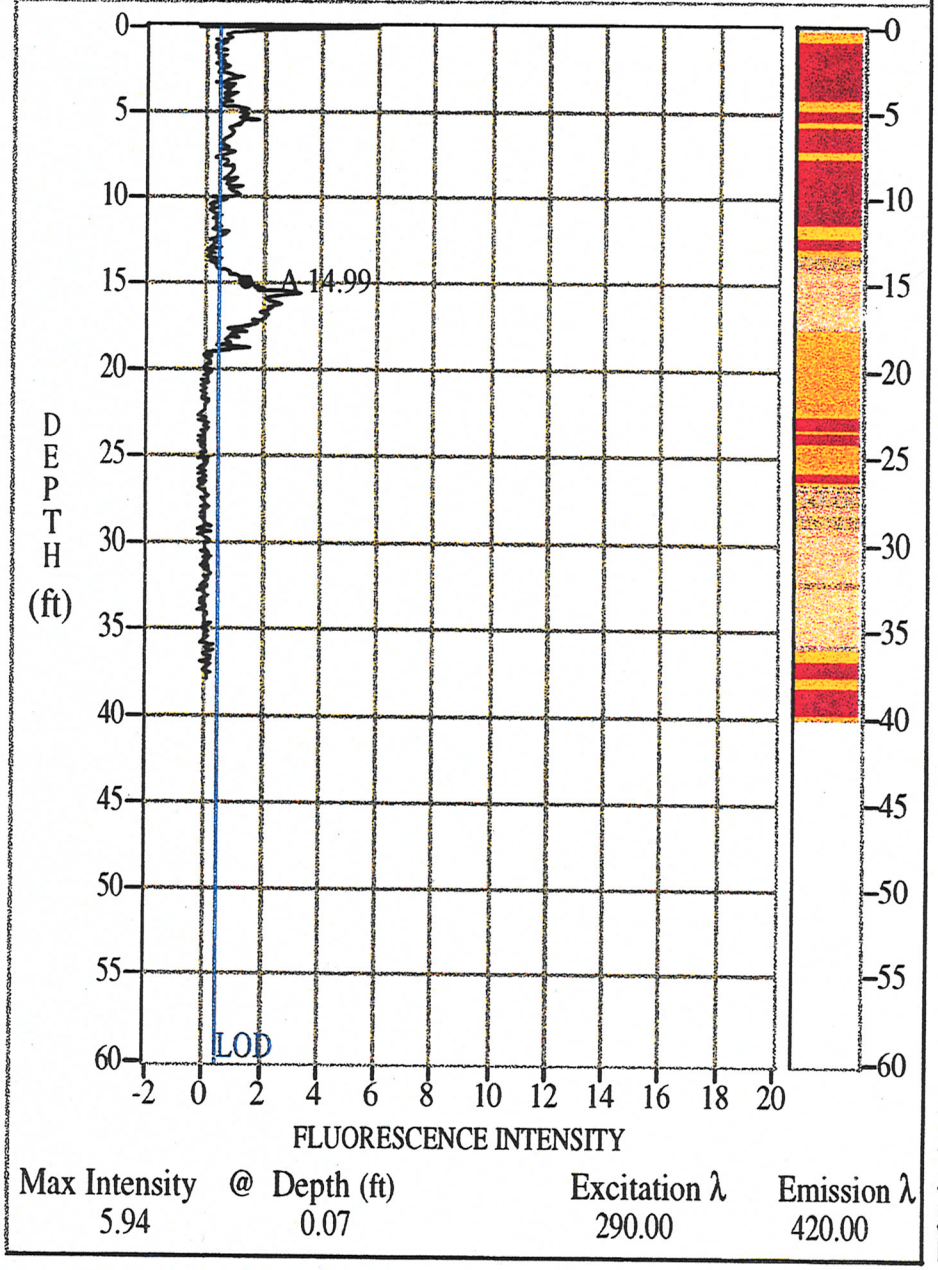
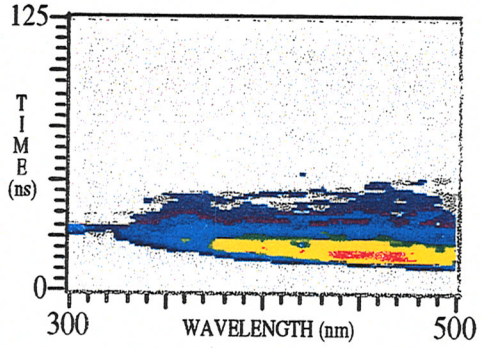
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT07E



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
5.94	0.07	290.00	420.00

A WTM ID : WCPT07EA



Peak Signal	0.006823 @ 440.00
FVD Signal	0.005909 @ 420.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

Date: 11/15/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
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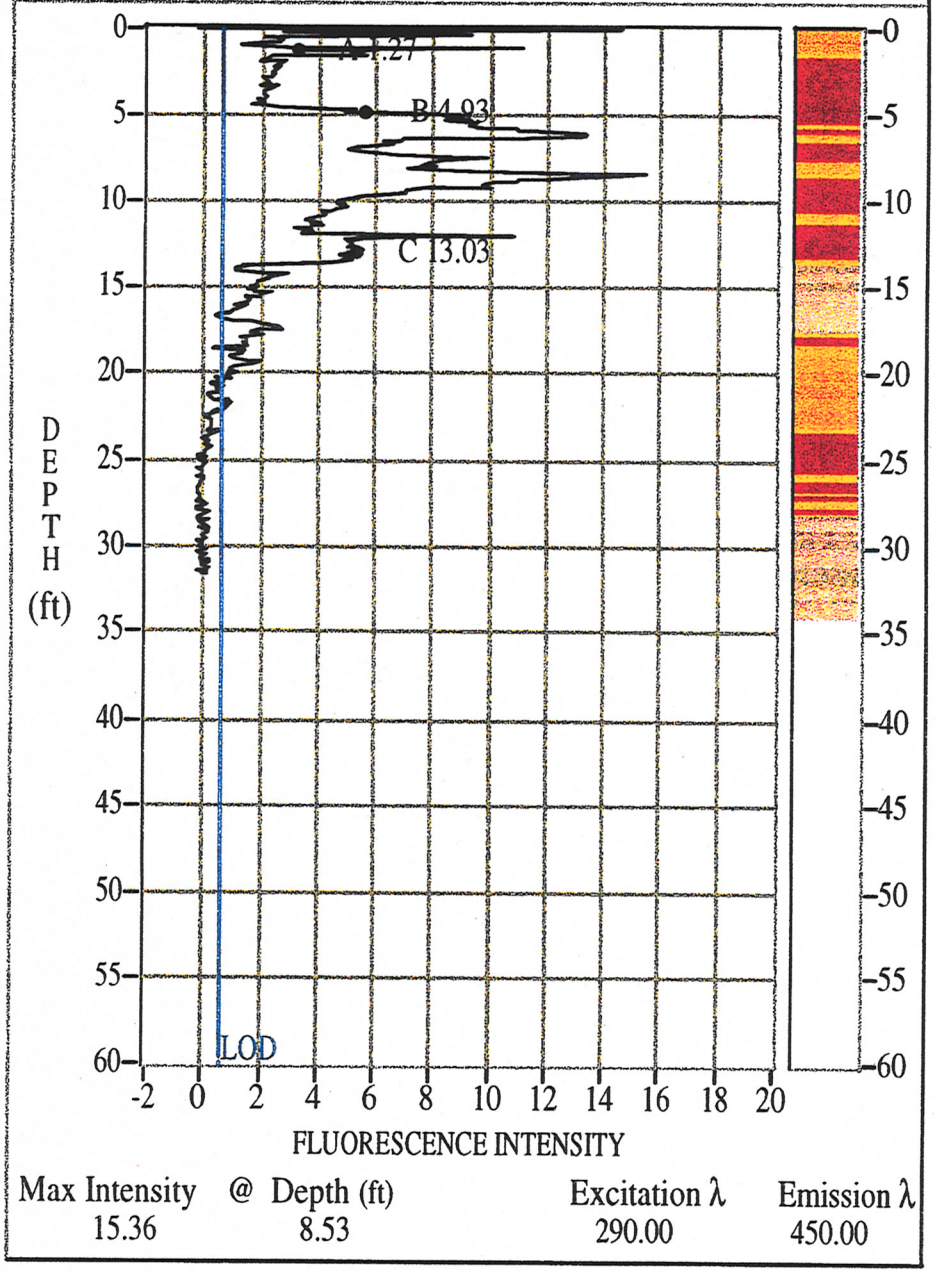
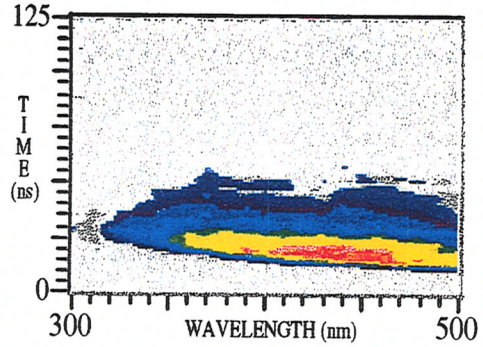
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT08E



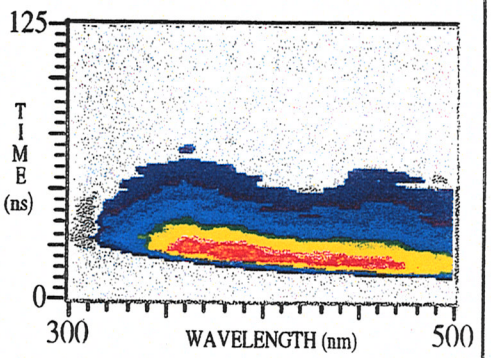
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
15.36	8.53	290.00	450.00

A WTM ID : WCPT08EA



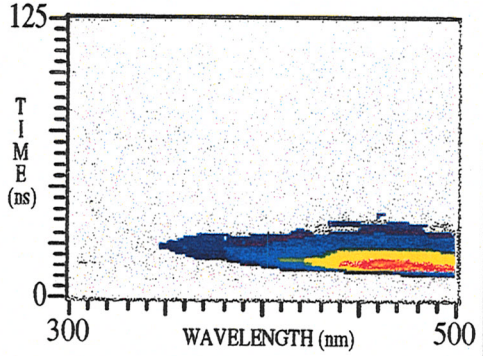
Peak Signal	0.015140 @ 450.00
FVD Signal	0.015140 @ 450.00

B WTM ID : WCPT08EB



Peak Signal	0.022869 @ 390.00
FVD Signal	0.020359 @ 450.00

C WTM ID : WCPT08EC



Peak Signal	0.023374 @ 470.00
FVD Signal	0.018894 @ 450.00

Date: 11/15/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
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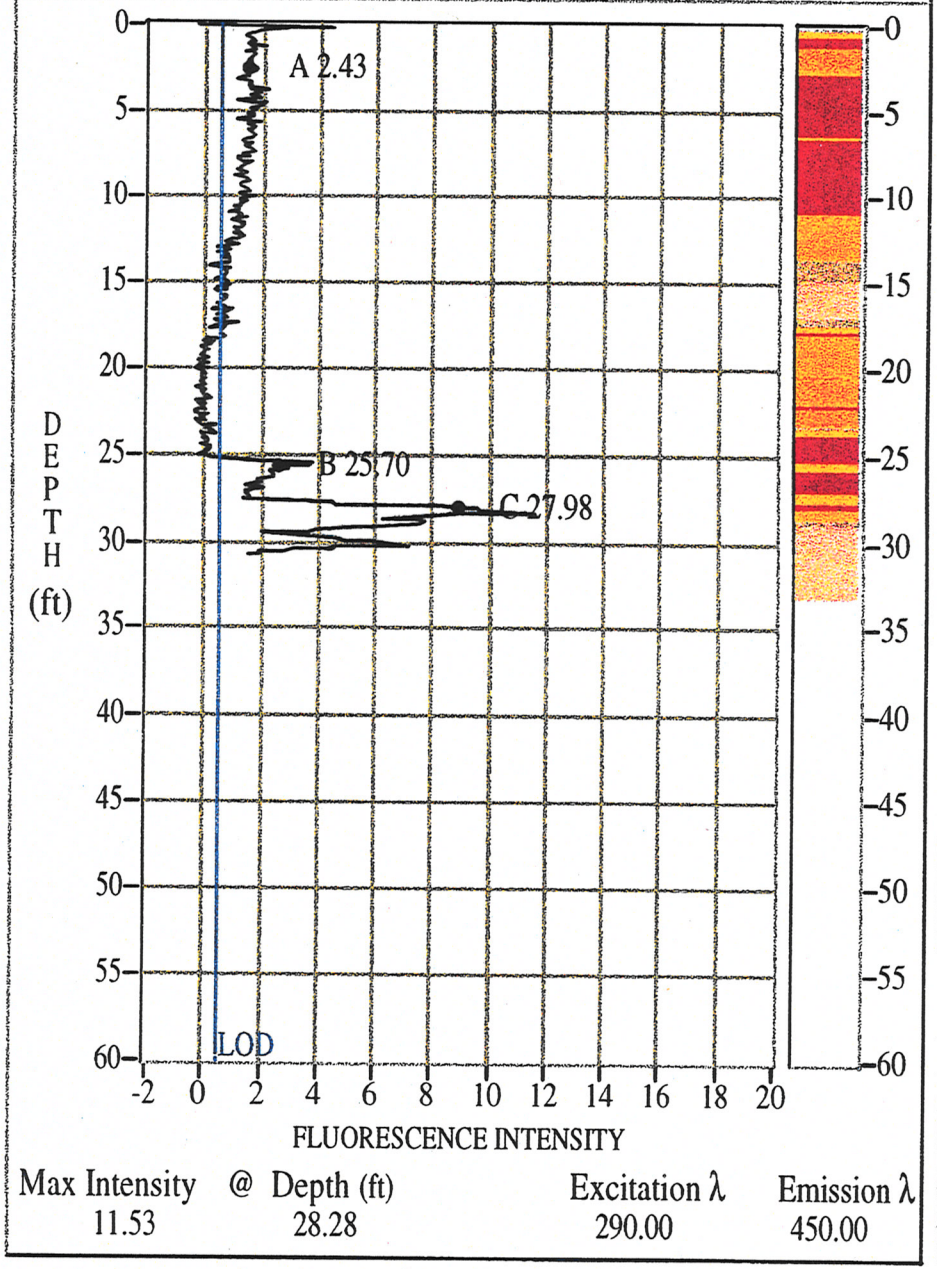
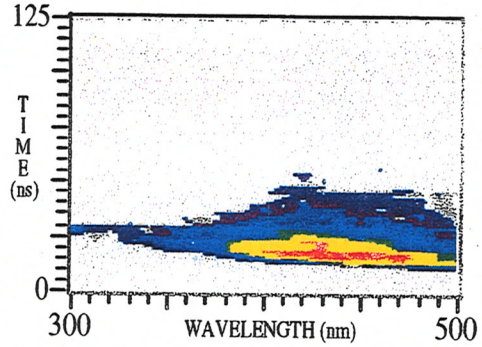
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT09E



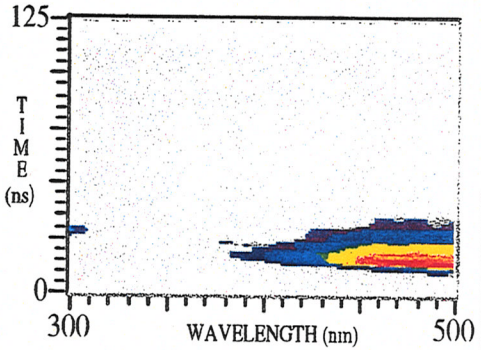
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
11.53	28.28	290.00	450.00

A WTM ID : WCPT09EA



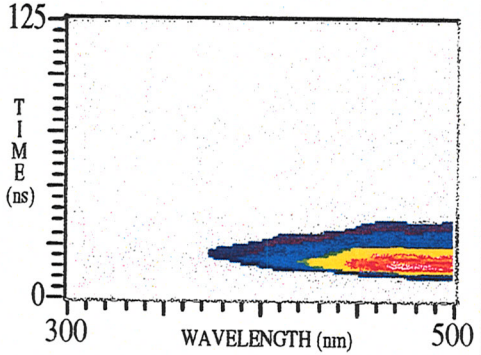
Peak Signal	0.007712 @ 430.00
FVD Signal	0.006722 @ 450.00

B WTM ID : WCPT09EB



Peak Signal	0.017130 @ 480.00
FVD Signal	0.012688 @ 450.00

C WTM ID : WCPT09EC



Peak Signal	0.057518 @ 470.00
FVD Signal	0.043257 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

Date: 11/15/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
Checked By: BJT	LORAL ENVIRONMENTAL SYSTEMS
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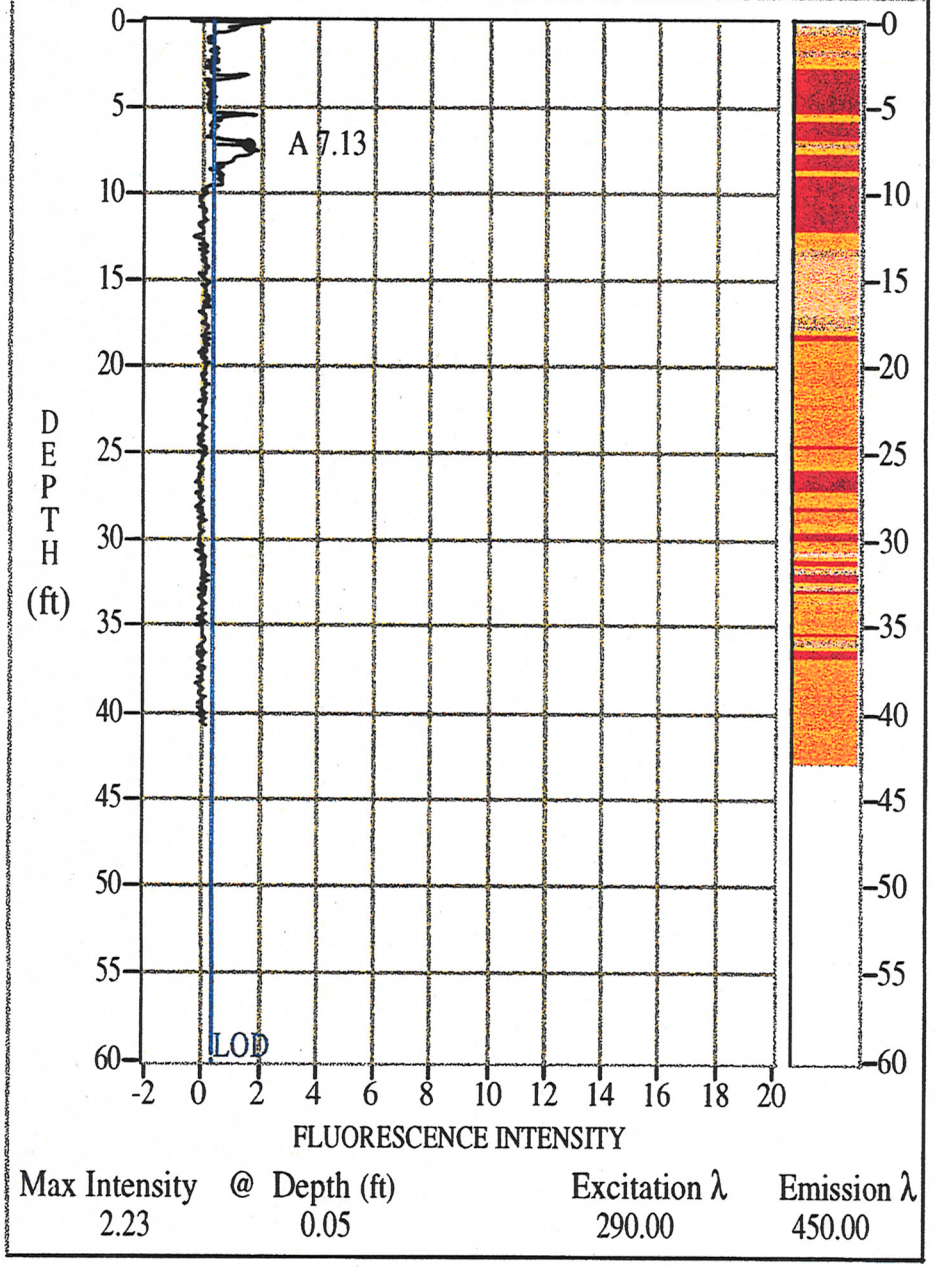
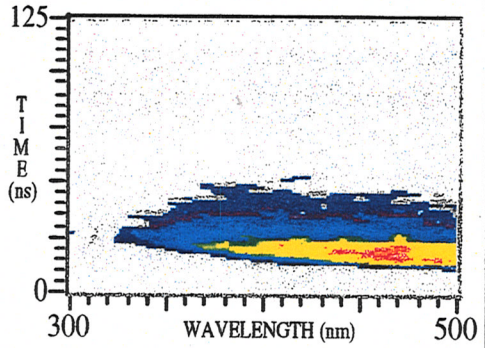
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT10E



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
2.23	0.05	290.00	450.00

A WTM ID : WCPT10EA



Peak Signal	0.007324 @ 470.00
FVD Signal	0.005904 @ 450.00

Undefined
Peat
Clay
Clay & Silt
Silt
Sand & Silt
Sand

Date: 11/16/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
Checked By: BJT	LORAL ENVIRONMENTAL SYSTEMS
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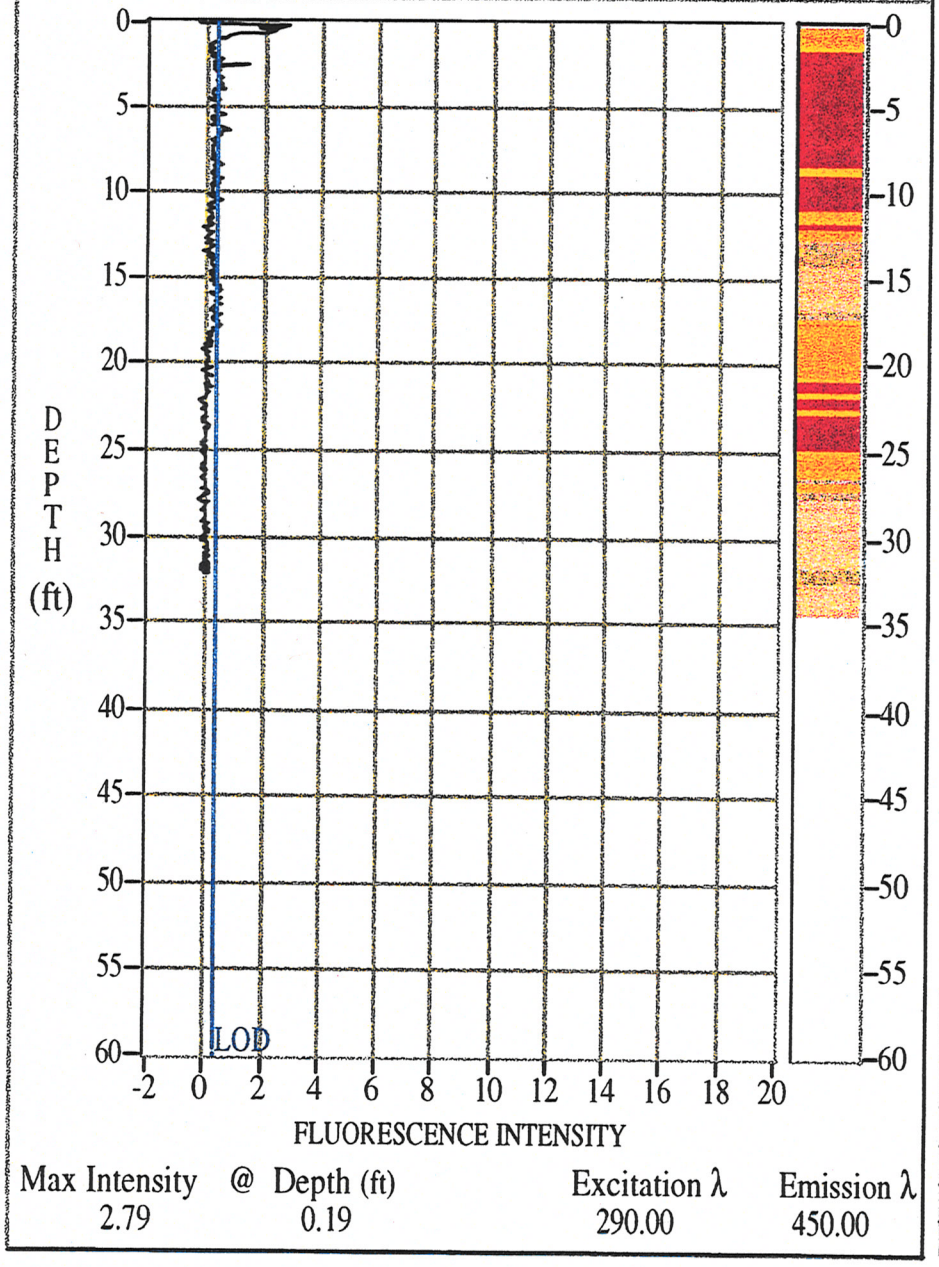
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT11E



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
2.79	0.19	290.00	450.00

Date: 11/16/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
Checked By: BJT	LORAL ENVIRONMENTAL SYSTEMS
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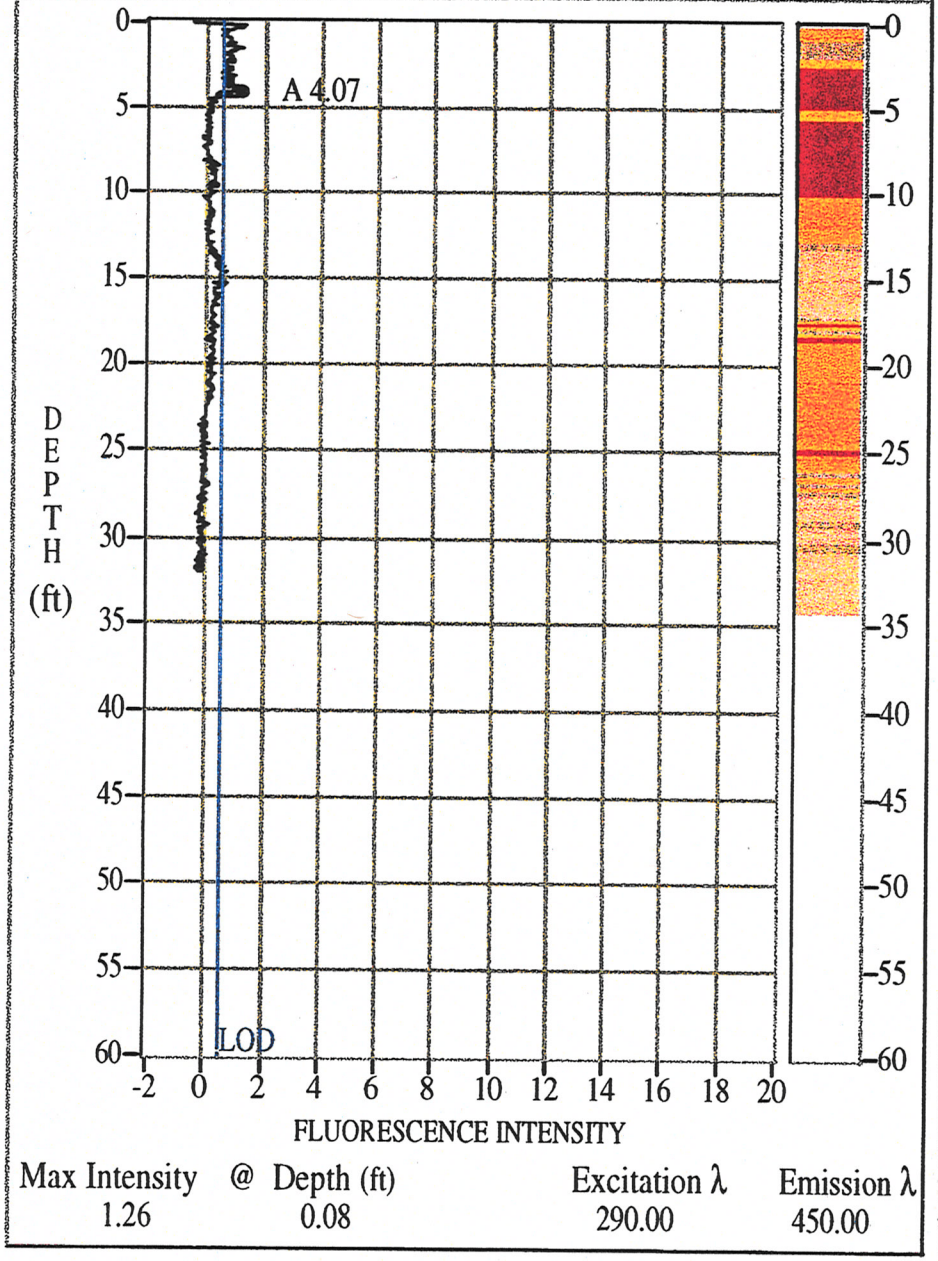
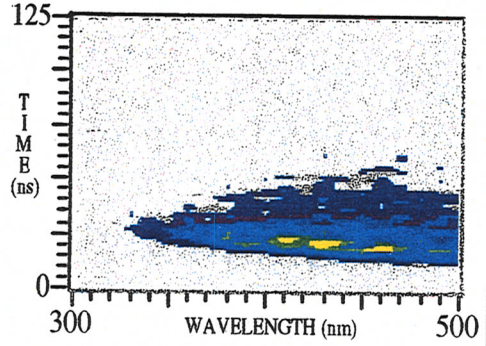
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT12E



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
1.26	0.08	290.00	450.00

A WTM ID : WCPT12EA



Peak Signal	0.004663 @ 430.00
FVD Signal	0.003615 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

Date: 11/16/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
Checked By: BJT	LORAL ENVIRONMENTAL SYSTEMS
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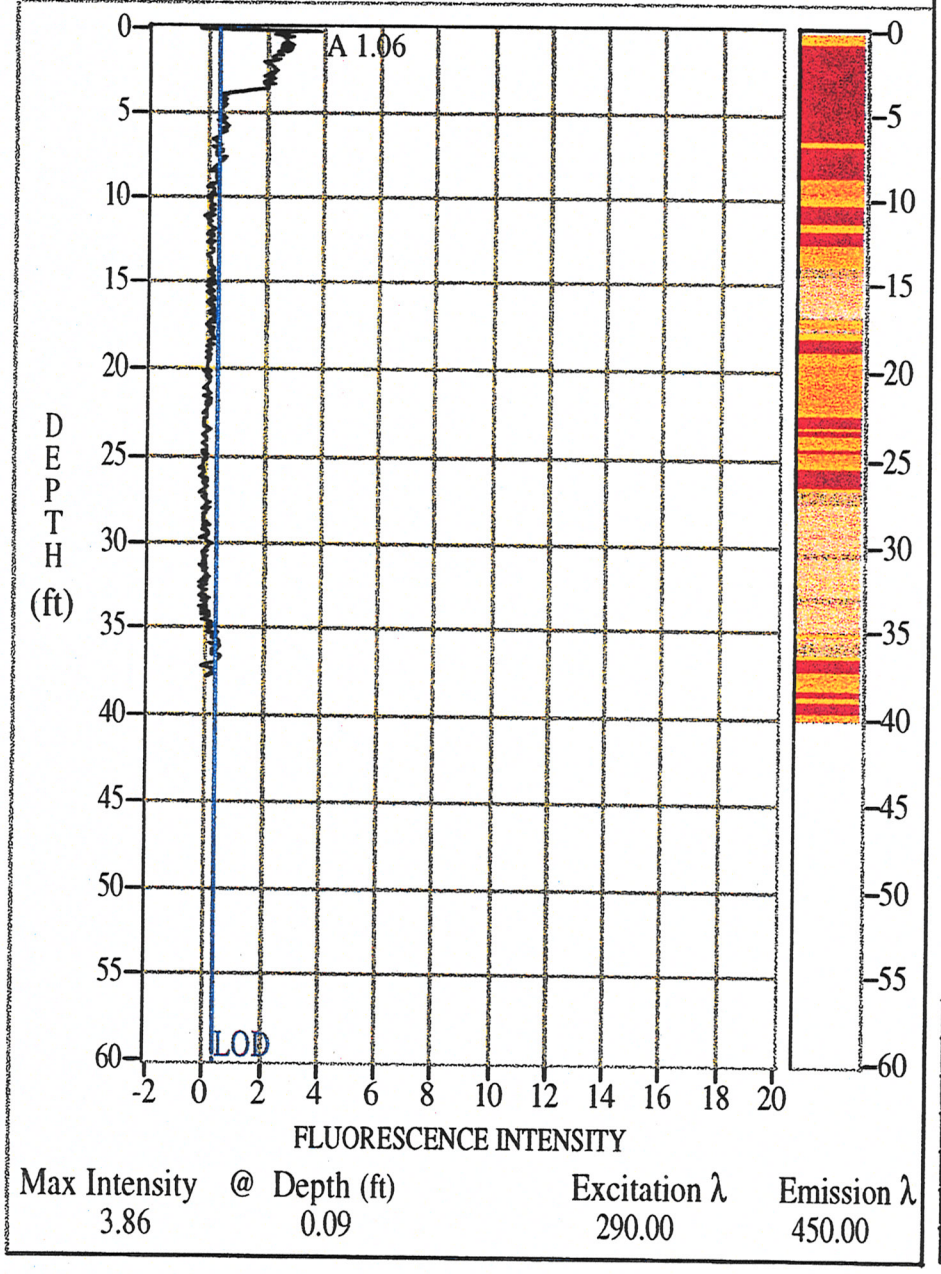
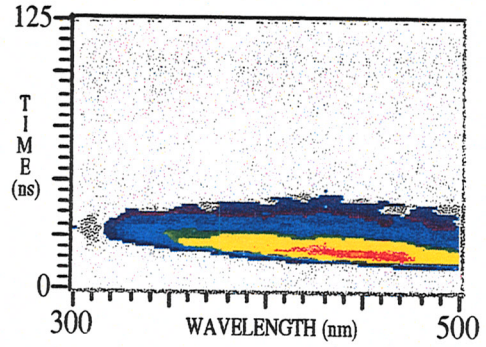
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT13E



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
3.86	0.09	290.00	450.00

A WTM ID : WCPT13EA



Peak Signal	0.013760 @ 450.00
FVD Signal	0.013760 @ 450.00

Undefined
Peat
Clay
Clay & Silt
Silt
Sand & Silt
Sand

Date: 11/16/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
Checked By: BJT	LORAL ENVIRONMENTAL SYSTEMS
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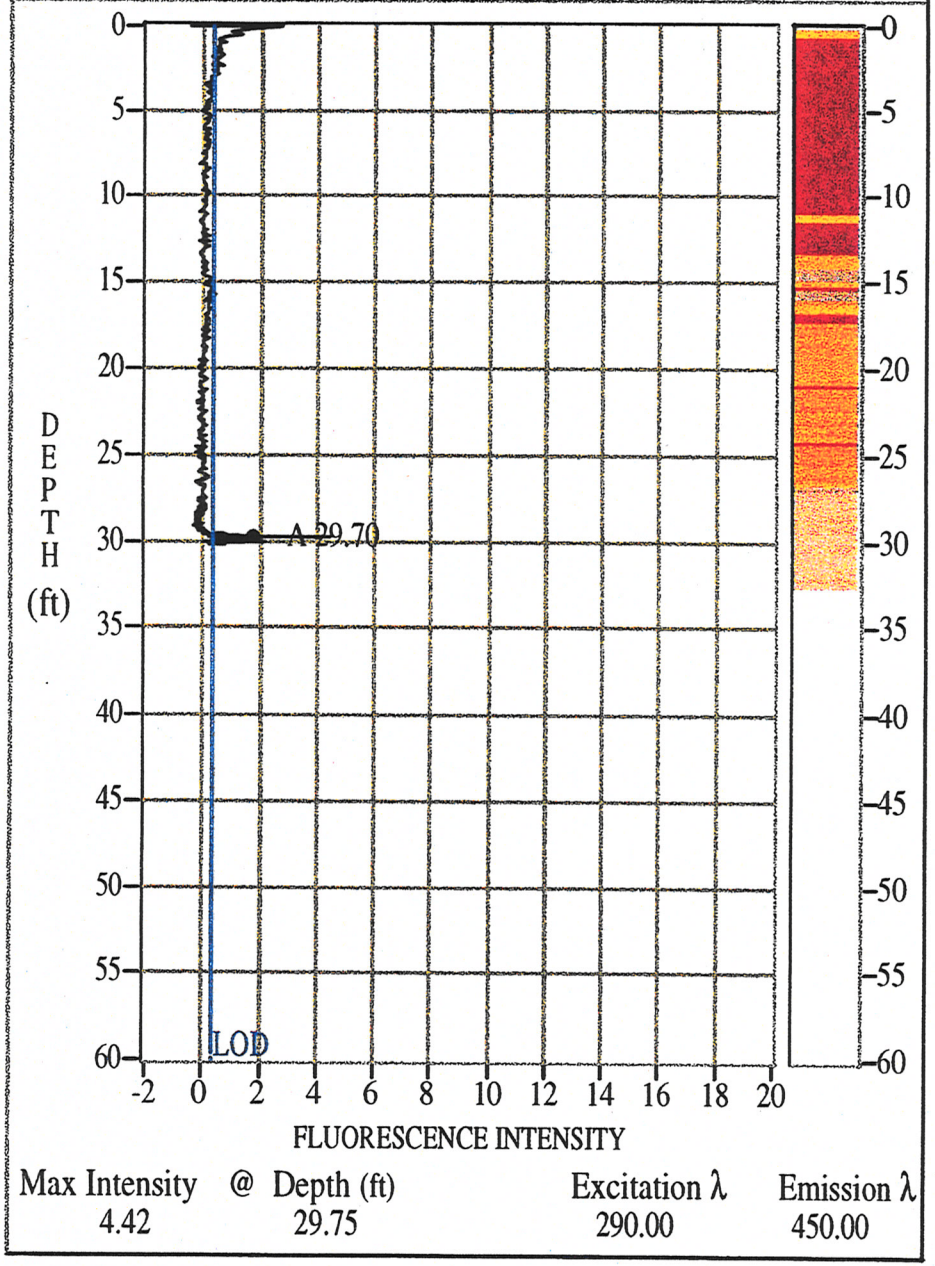
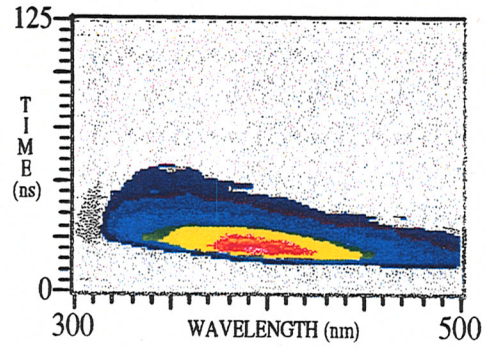
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT14E



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
4.42	29.75	290.00	450.00

A WTM ID : WCPT14EA



Peak Signal	0.056108 @ 390.00
FVD Signal	0.021542 @ 450.00

Undefined
Peat
Clay
Clay & Silt
Silt
Sand & Silt
Sand

Date: 11/16/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
Checked By: BJT	LORAL ENVIRONMENTAL SYSTEMS
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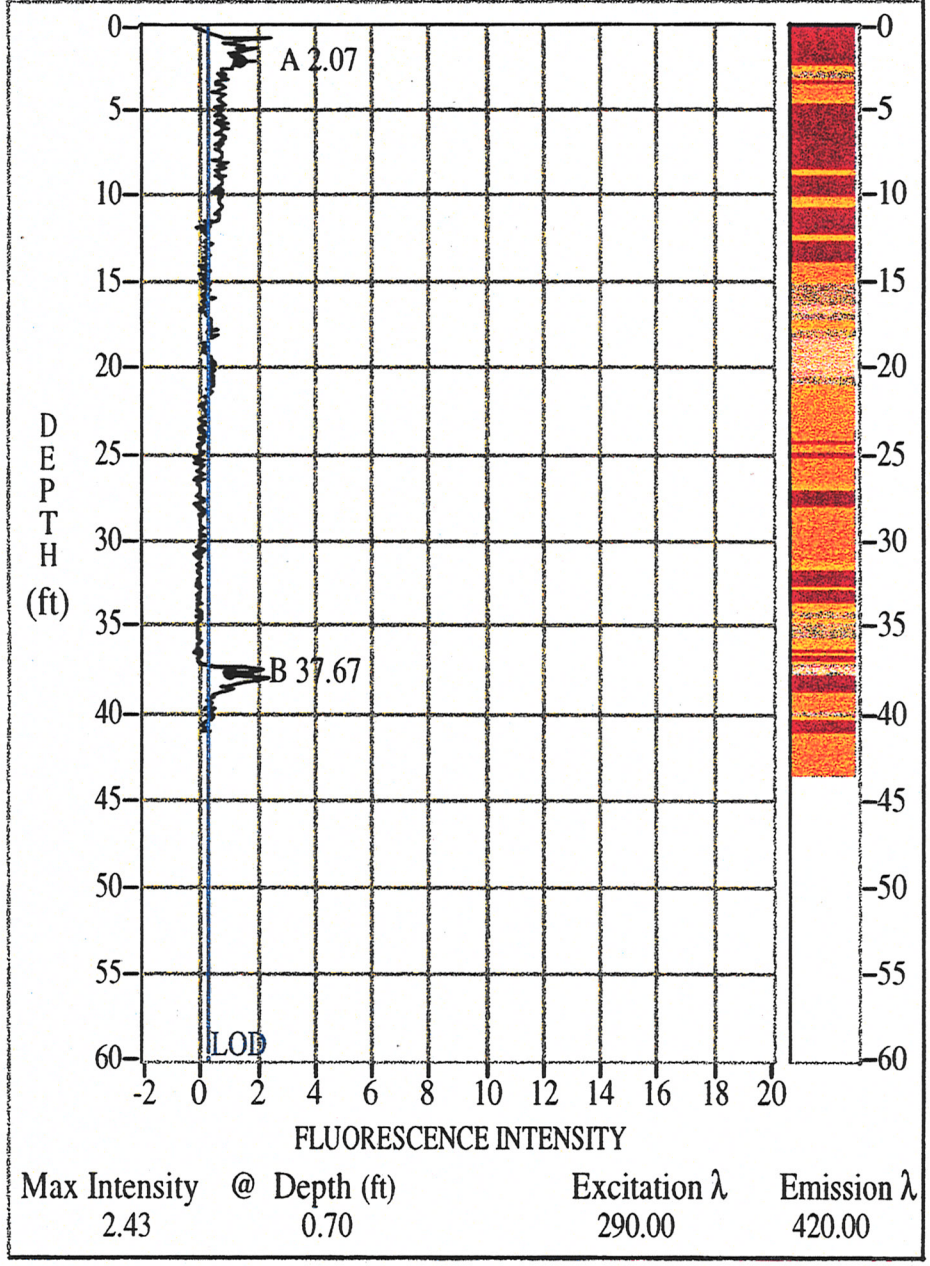
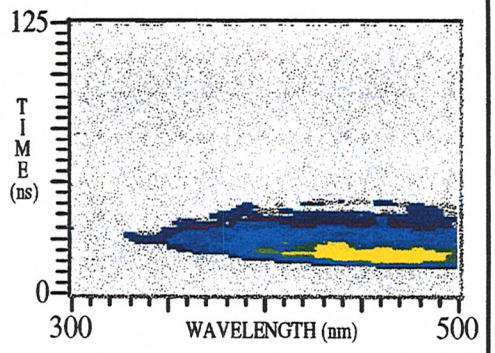
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT03R



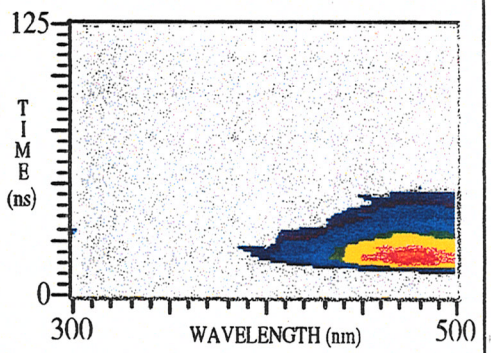
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
2.43	0.70	290.00	420.00

A WTM ID : WCPT03RA

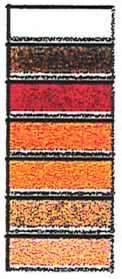


Peak Signal	0.010397 @ 470.00
FVD Signal	0.007944 @ 420.00

B WTM ID : WCPT03RB



Peak Signal	0.021143 @ 480.00
FVD Signal	0.006403 @ 420.00



- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

Date: 11/15/95	Wood Preserving Works
Proj. No.: HA25	Fugro Geosciences, Inc.
Checked By: BJT	LORAL ENVIRONMENTAL SYSTEMS
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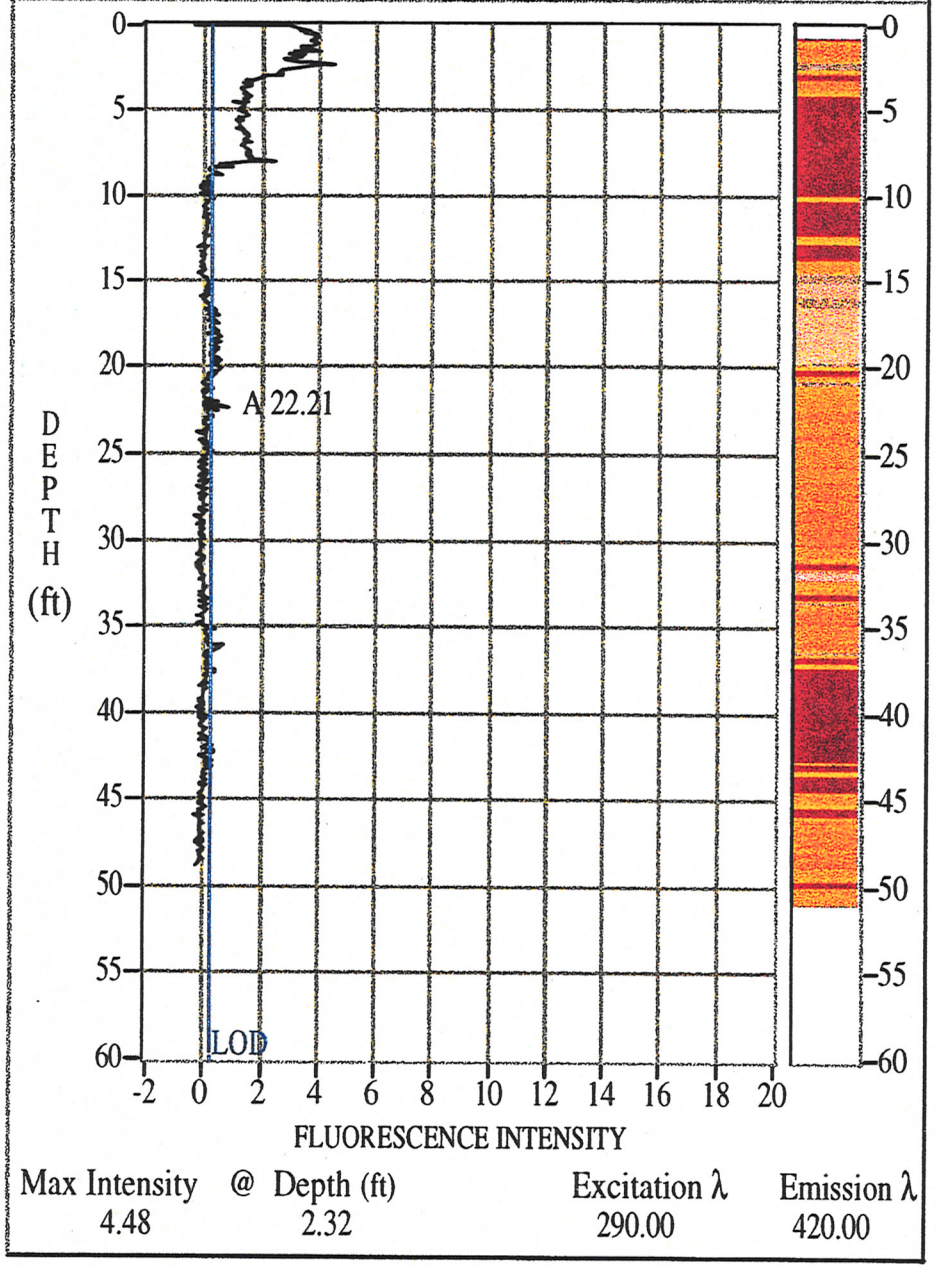
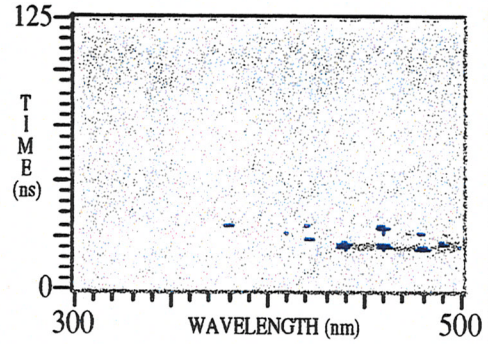
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT04R

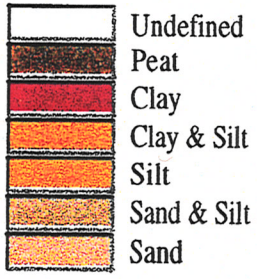


Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
4.48	2.32	290.00	420.00

A WTM ID : WCPT04RA



Peak Signal	0.001043 @ 460.00
FVD Signal	0.000600 @ 420.00



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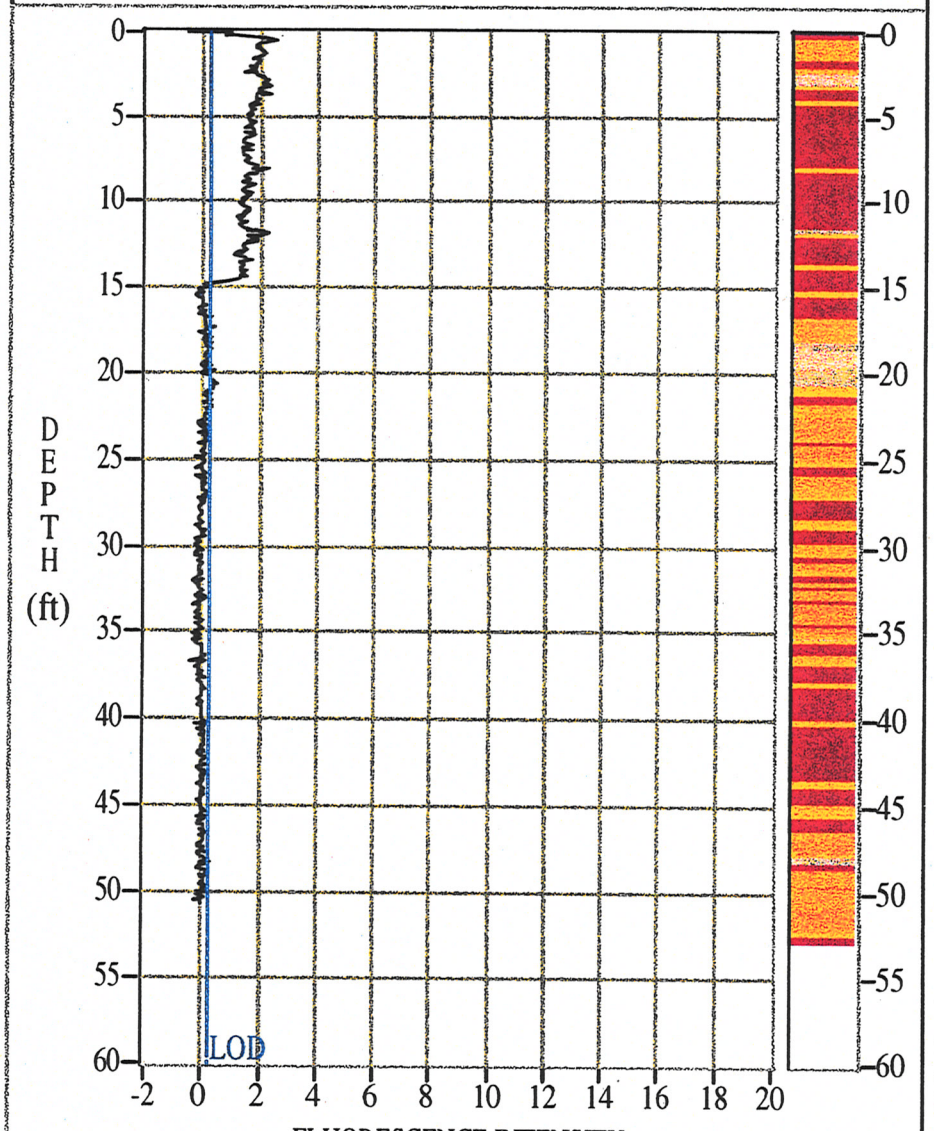
FVD ID : CPT05R



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
2.52	0.47	290.00	450.00

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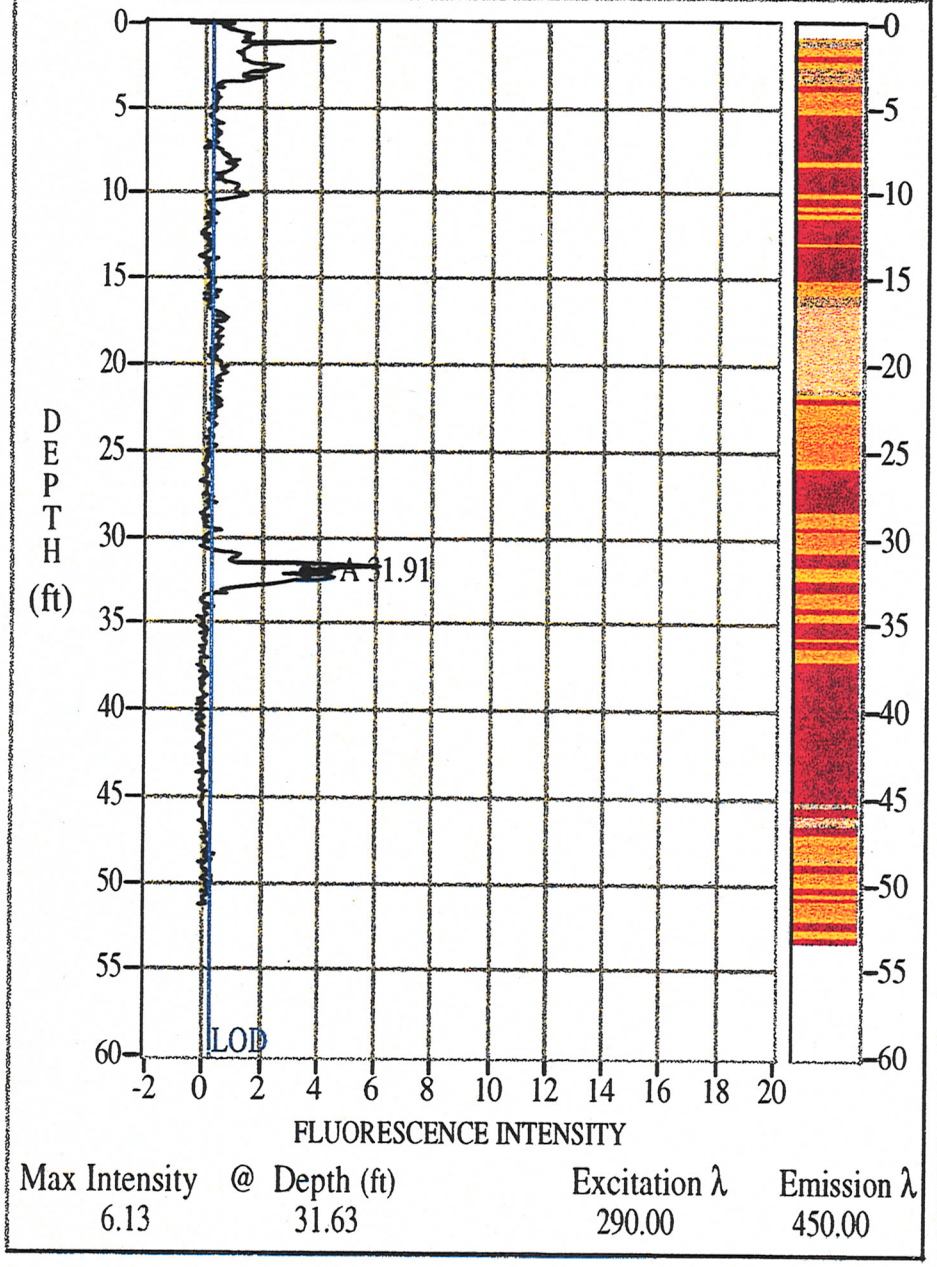
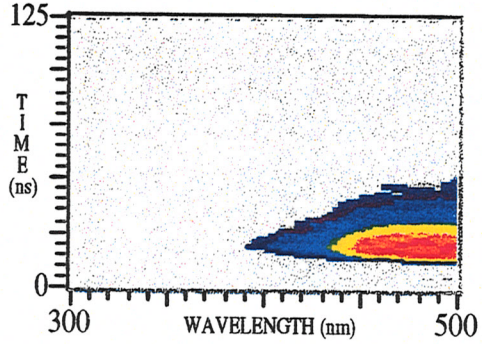
FVD ID : CPT06R



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
6.13	31.63	290.00	450.00

A WTM ID : WCPT06RA



Peak Signal	0.026976 @ 480.00
FVD Signal	0.021143 @ 450.00

Undefined
Peat
Clay
Clay & Silt
Silt
Sand & Silt
Sand

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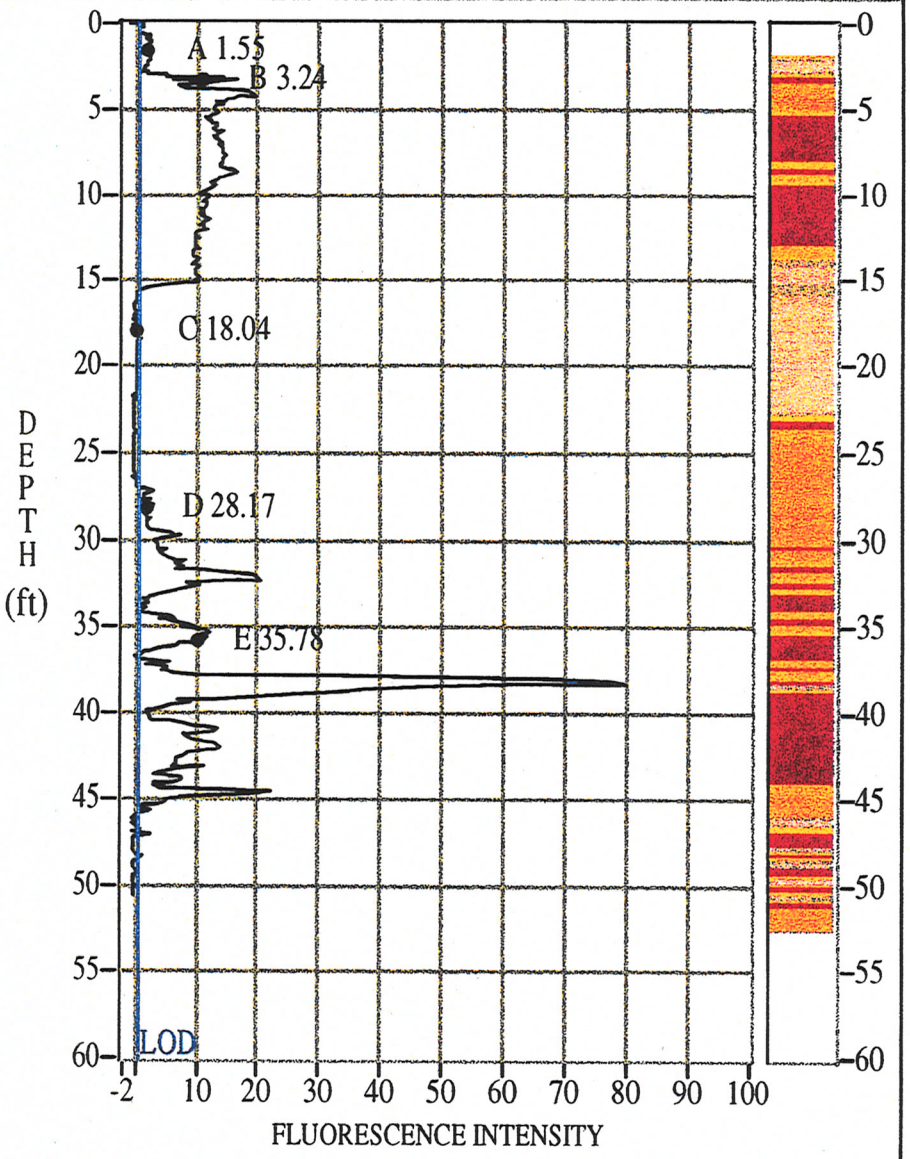
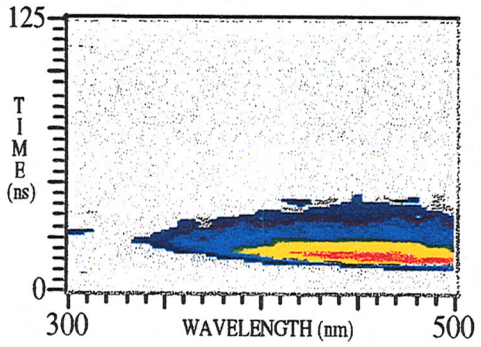
FVD ID : CPT07R



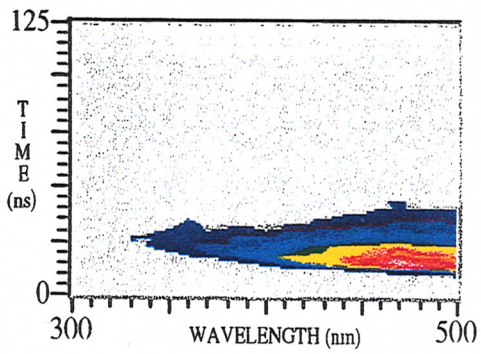
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
79.45	38.16	290.00	450.00

A WTM ID : WCPT07RA



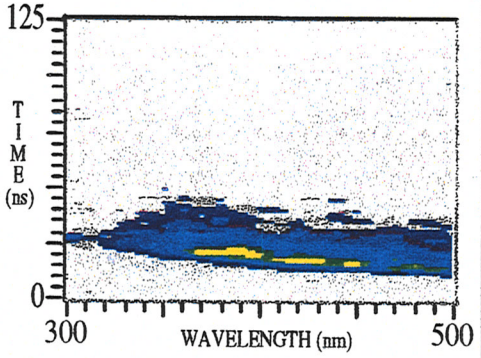
Peak Signal	0.015186 @ 460.00
FVD Signal	0.013898 @ 450.00

B WTM ID : WCPT07RB



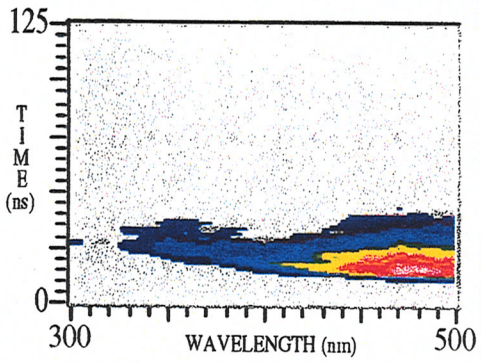
Peak Signal	0.049028 @ 470.00
FVD Signal	0.040112 @ 450.00

C WTM ID : WCPT07RC

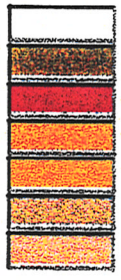


Peak Signal	0.004490 @ 370.00
FVD Signal	0.004049 @ 450.00

D WTM ID : WCPT07RD



Peak Signal	0.019795 @ 480.00
FVD Signal	0.016724 @ 450.00



- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

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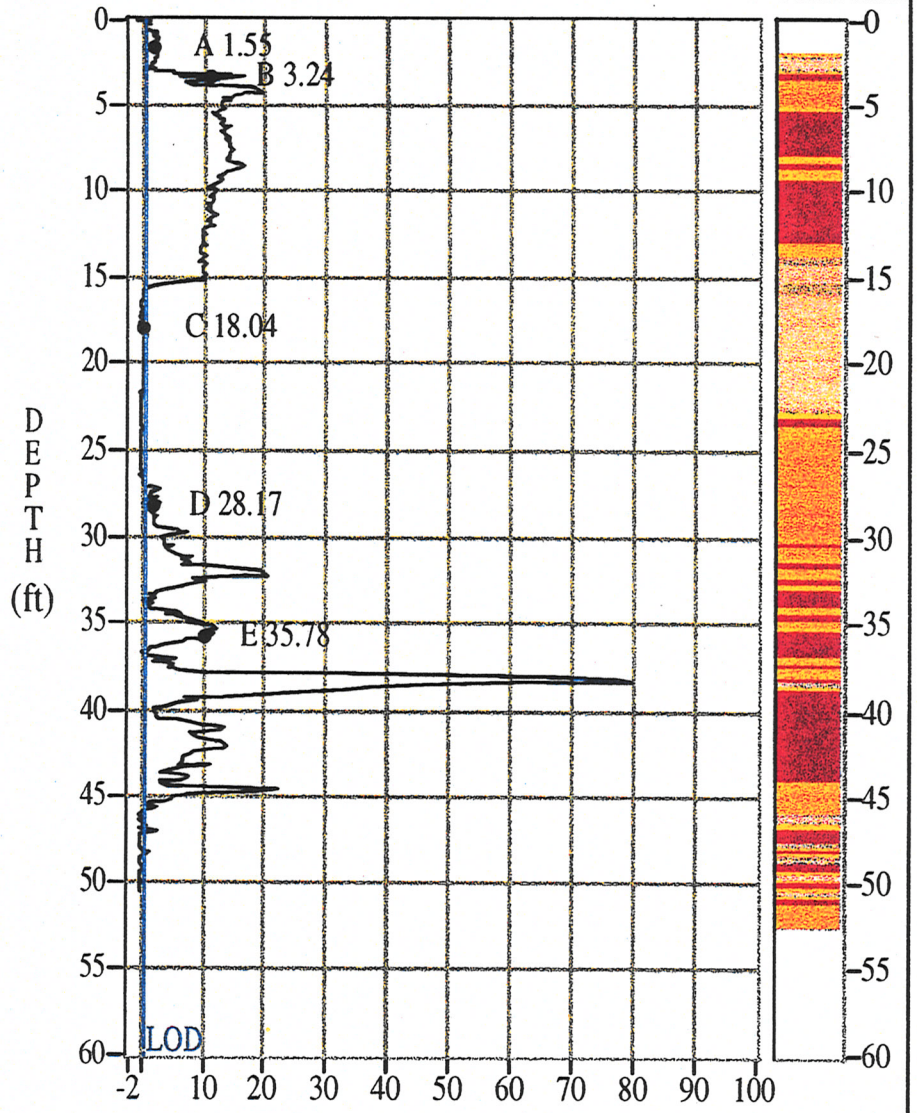
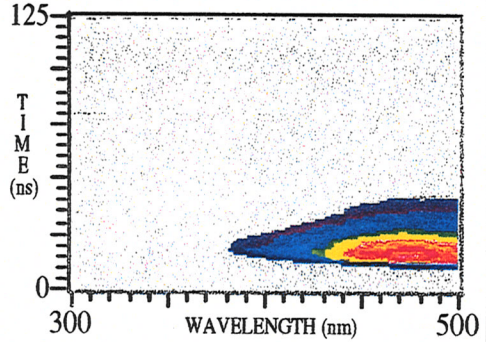
FVD ID : CPT07R



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
79.45	38.16	290.00	450.00

E WTM ID : WCPT07RE



Peak Signal	0.071744 @ 470.00
FVD Signal	0.064013 @ 450.00

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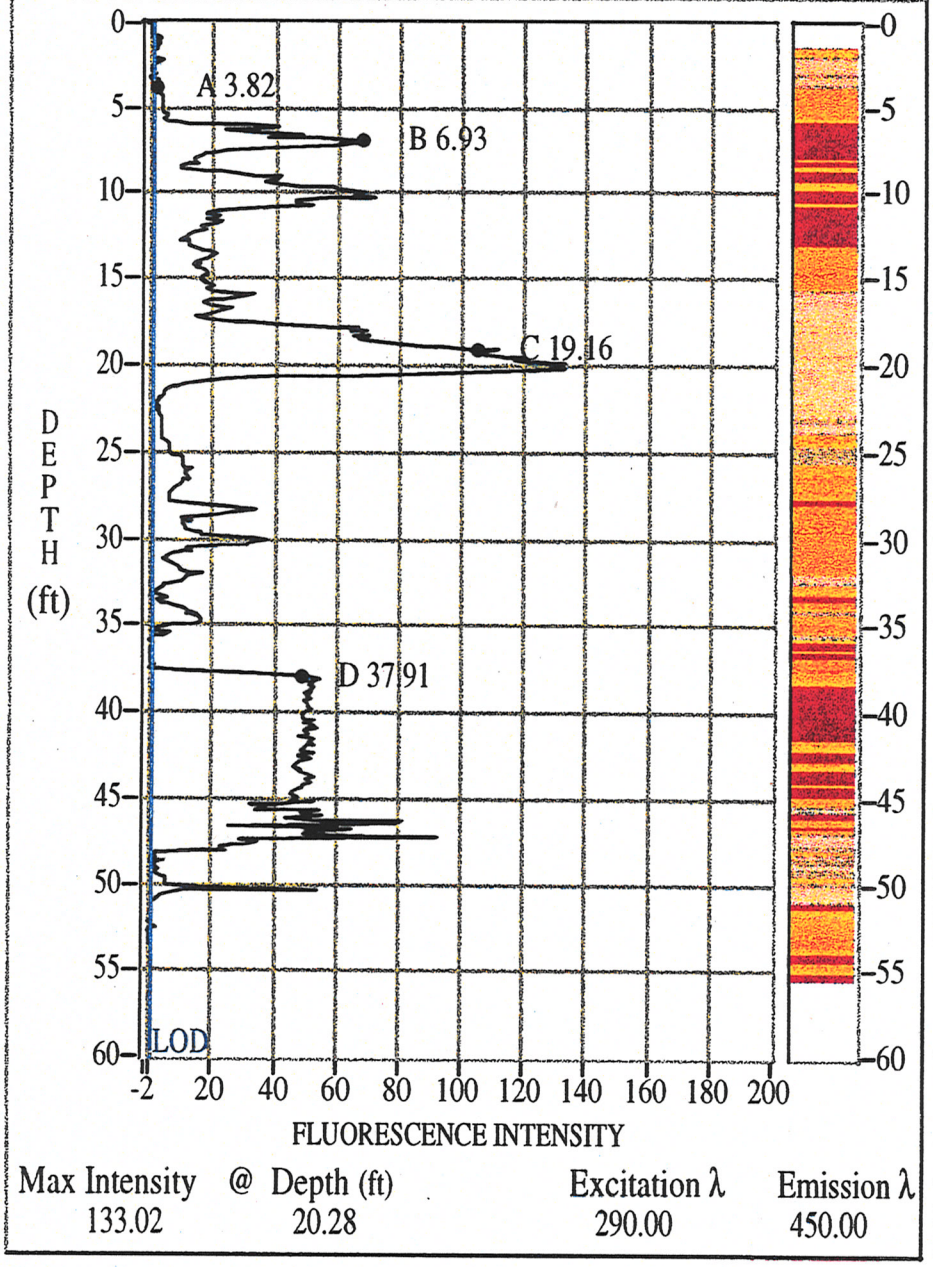
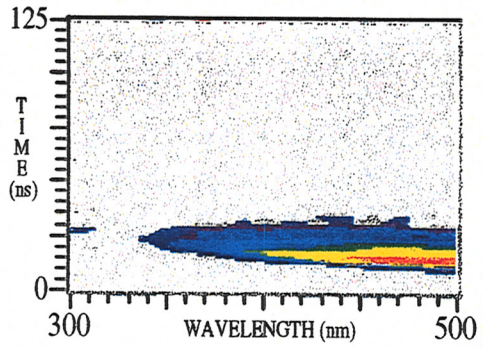
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT08R



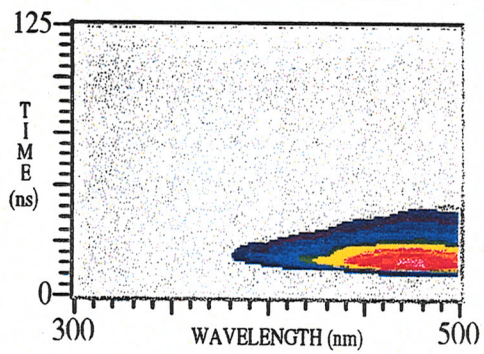
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
133.02	20.28	290.00	450.00

A WTM ID : WCPT08RA



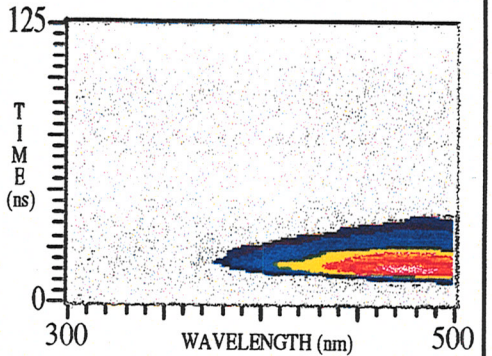
Peak Signal	0.022459 @ 500.00
FVD Signal	0.018051 @ 450.00

B WTM ID : WCPT08RB



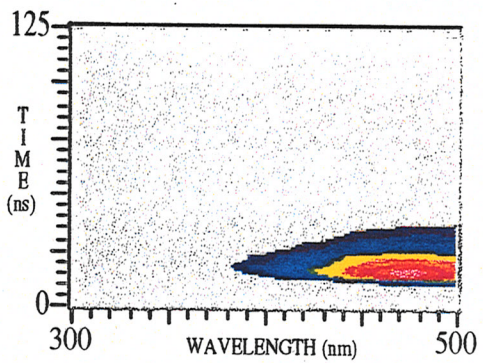
Peak Signal	0.562359 @ 480.00
FVD Signal	0.459792 @ 450.00

C WTM ID : WCPT08RC

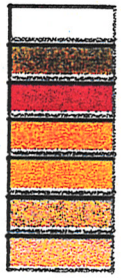


Peak Signal	0.858413 @ 470.00
FVD Signal	0.768086 @ 450.00

D WTM ID : WCPT08RD



Peak Signal	0.423554 @ 470.00
FVD Signal	0.354008 @ 450.00



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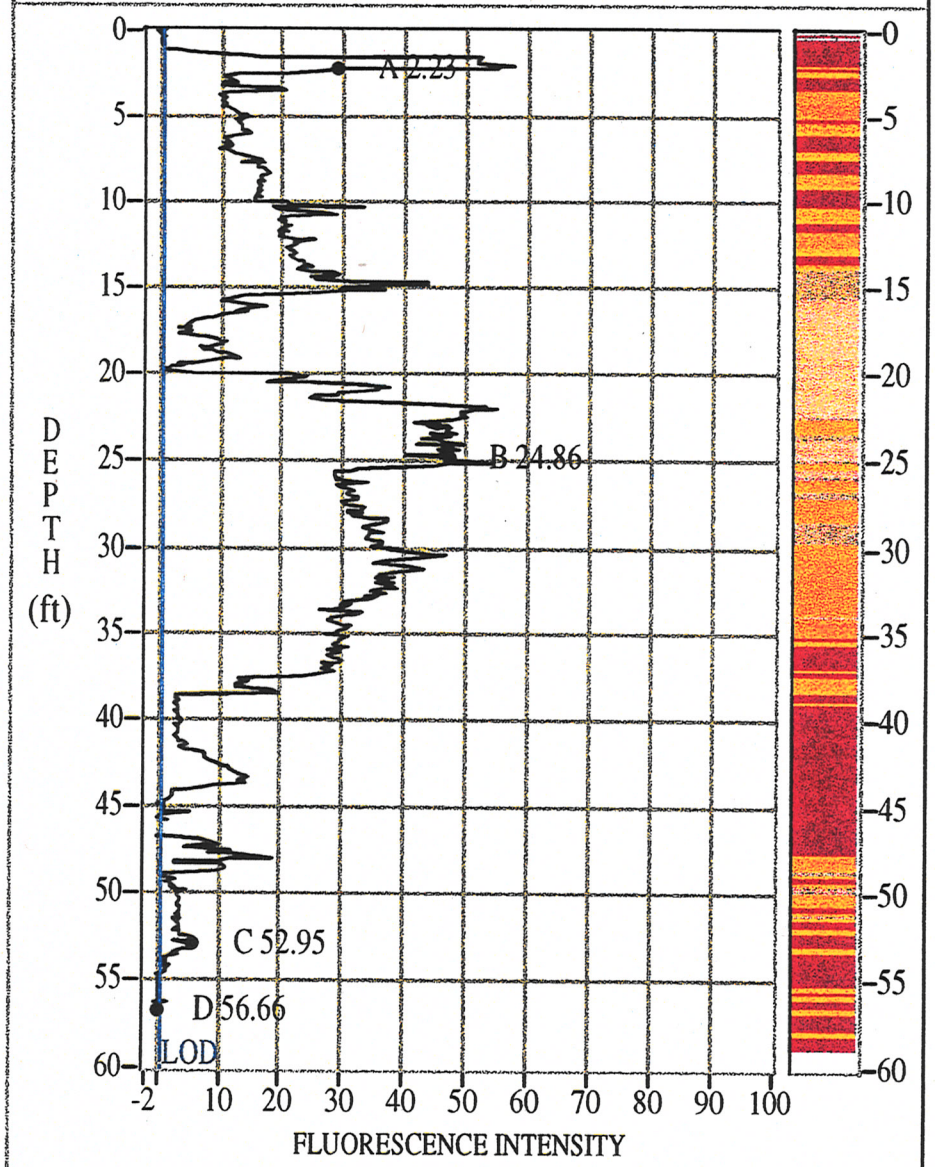
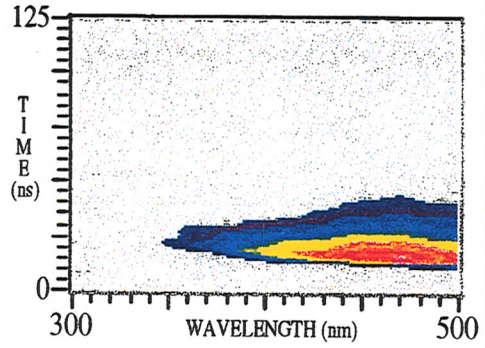
FVD ID : CPT09R



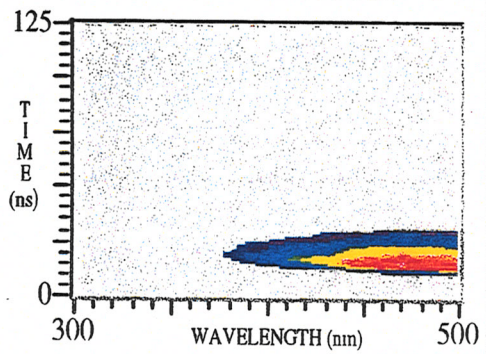
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
57.36	1.96	290.00	450.00

A WTM ID : WCPT09RA



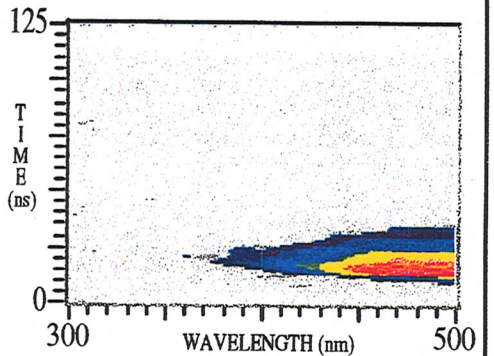
Peak Signal	0.184682 @ 470.00
FVD Signal	0.177043 @ 450.00

B WTM ID : WCPT09RB



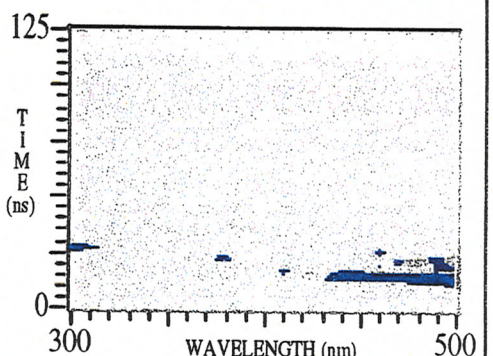
Peak Signal	0.456893 @ 470.00
FVD Signal	0.375534 @ 450.00

C WTM ID : WCPT09RC



Peak Signal	0.055579 @ 480.00
FVD Signal	0.043989 @ 450.00

D WTM ID : WCPT09RD



Peak Signal	0.002225 @ 500.00
FVD Signal	0.001615 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

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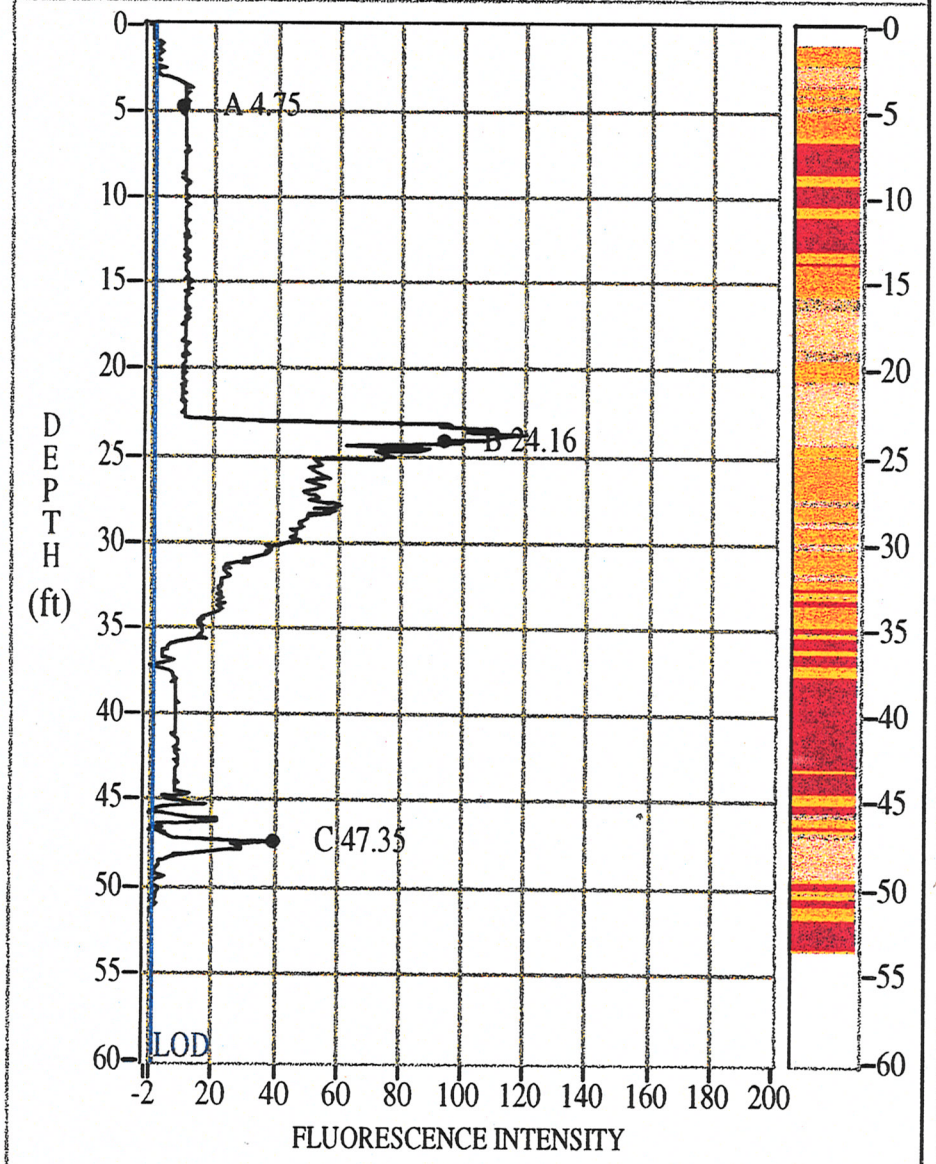
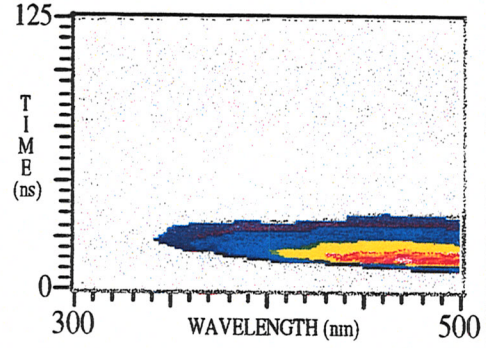
FVD ID : CPT10R



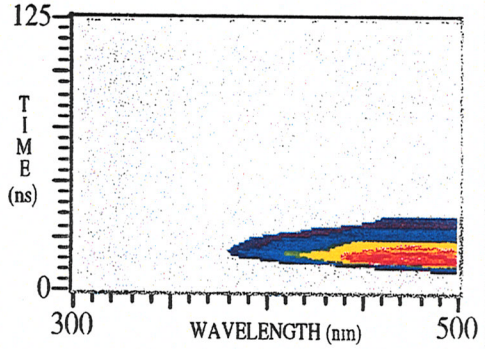
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
119.67	23.74	290.00	450.00

A WTM ID : WCPT10RA



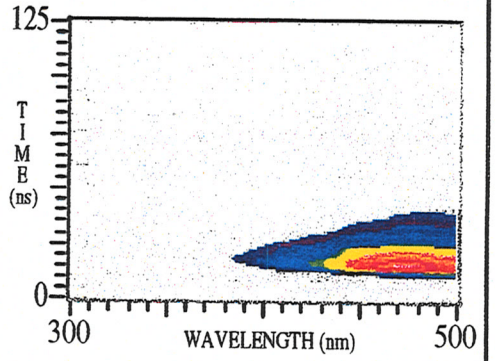
Peak Signal	0.088540 @ 470.00
FVD Signal	0.072278 @ 450.00

B WTM ID : WCPT10RB



Peak Signal	0.815101 @ 480.00
FVD Signal	0.696886 @ 450.00

C WTM ID : WCPT10RC



Peak Signal	0.316813 @ 470.00
FVD Signal	0.265842 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

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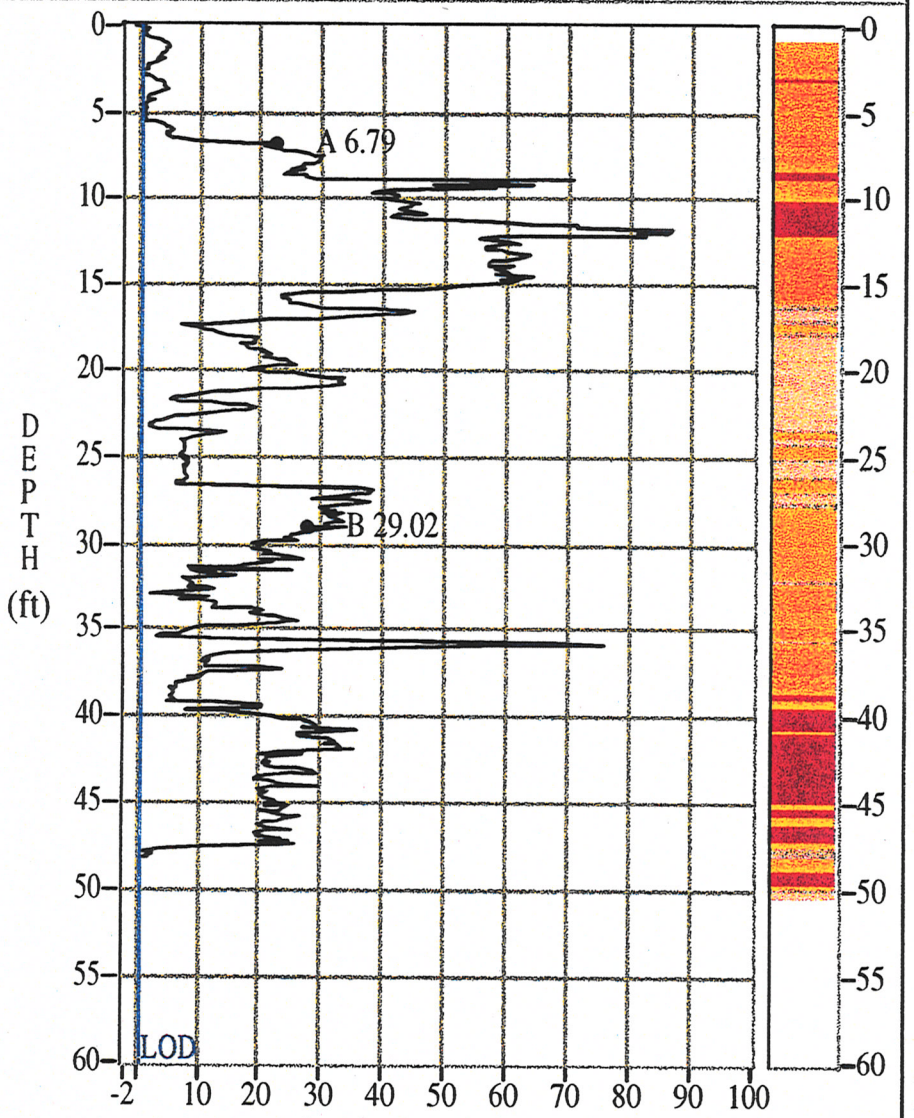
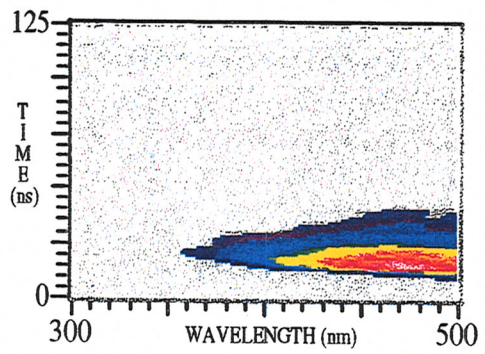
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT11R



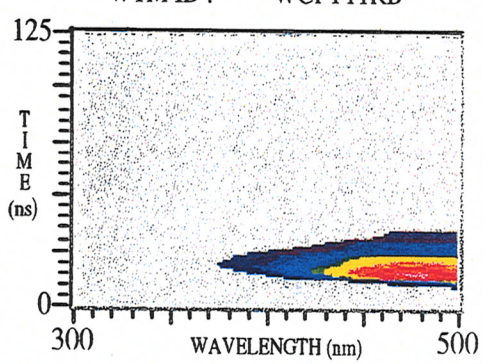
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
86.52	11.88	290.00	450.00

A WTM ID : WCPT11RA

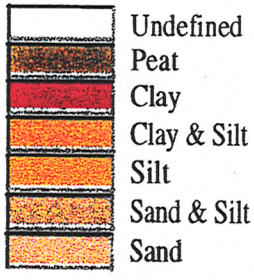


Peak Signal	0.114867 @ 470.00
FVD Signal	0.105604 @ 450.00

B WTM ID : WCPT11RB



Peak Signal	0.280746 @ 470.00
FVD Signal	0.216875 @ 450.00



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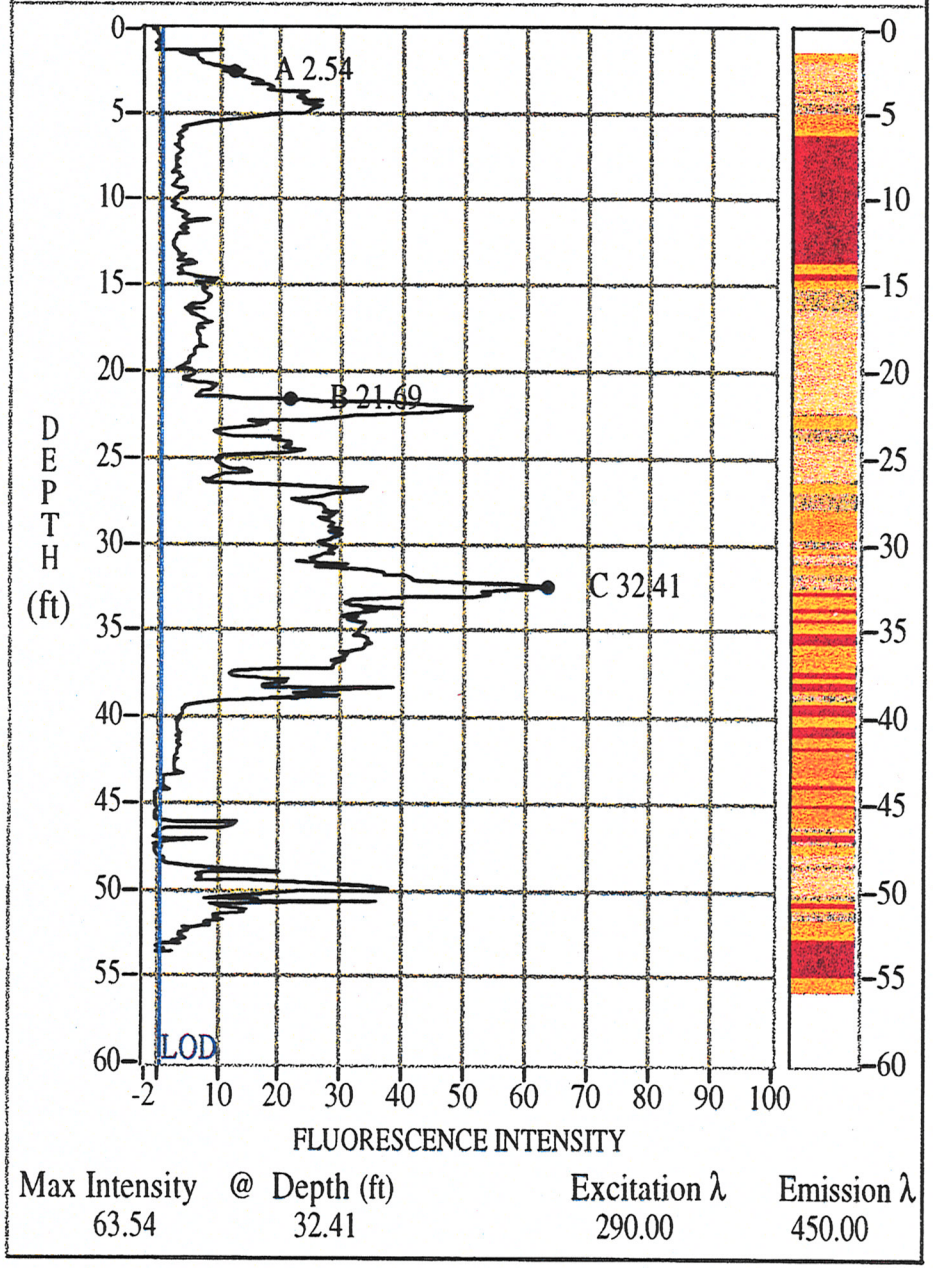
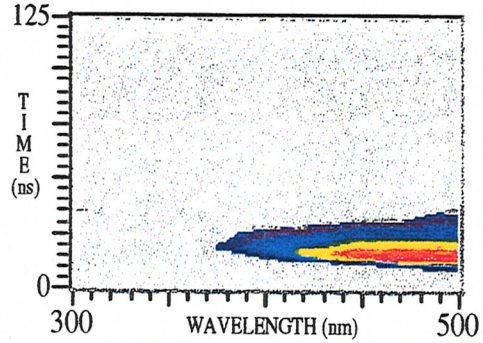
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT12R



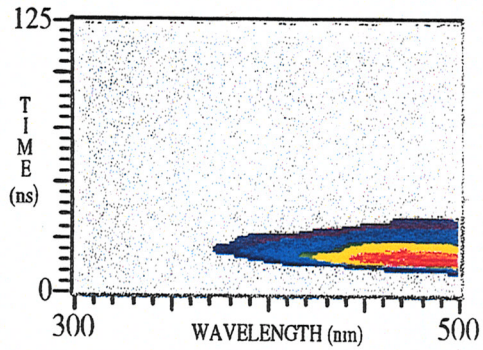
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
63.54	32.41	290.00	450.00

A WTM ID : WCPT12RA



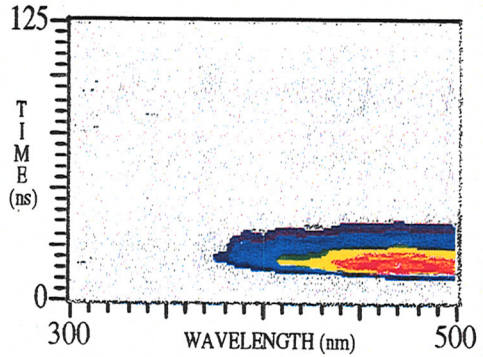
Peak Signal	0.120342 @ 480.00
FVD Signal	0.099717 @ 450.00

B WTM ID : WCPT12RB



Peak Signal	0.220194 @ 470.00
FVD Signal	0.168329 @ 450.00

C WTM ID : WCPT12RC



Peak Signal	0.405042 @ 470.00
FVD Signal	0.365329 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

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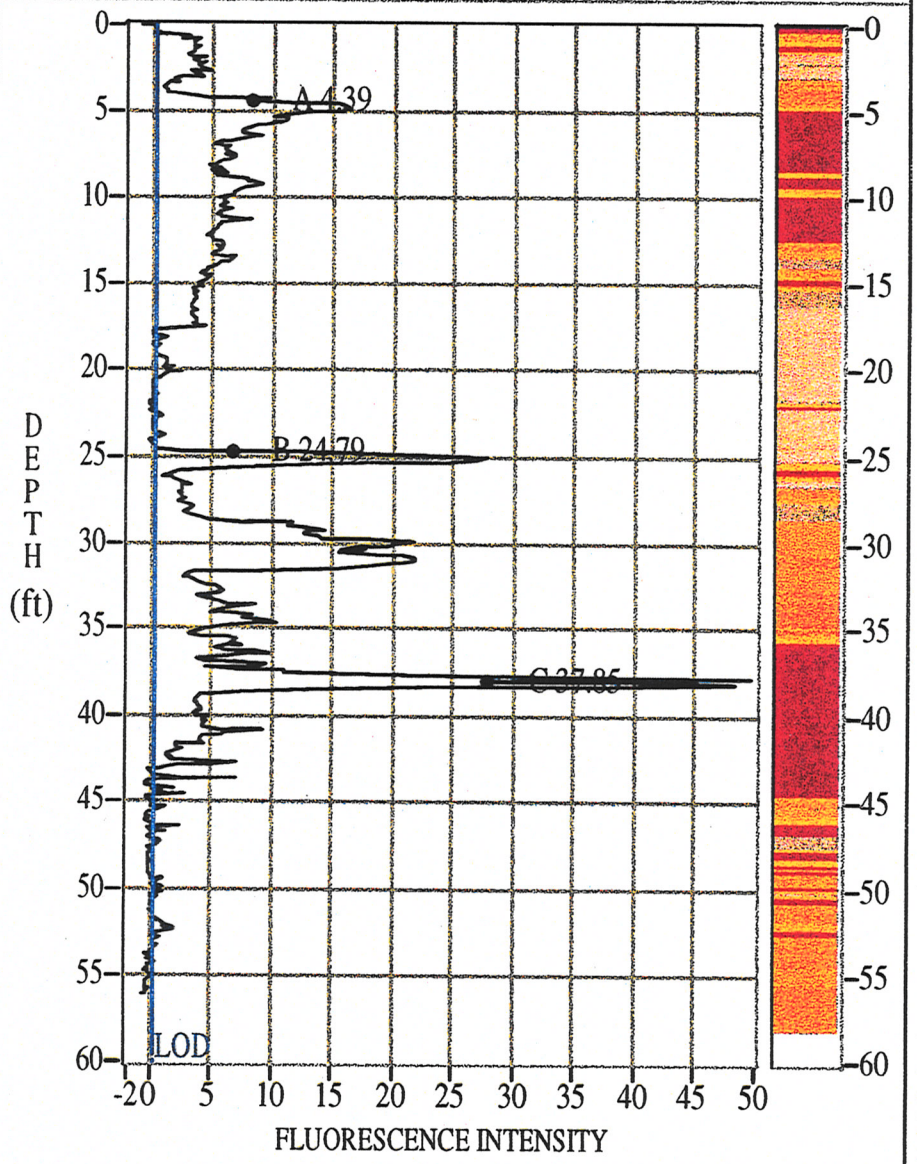
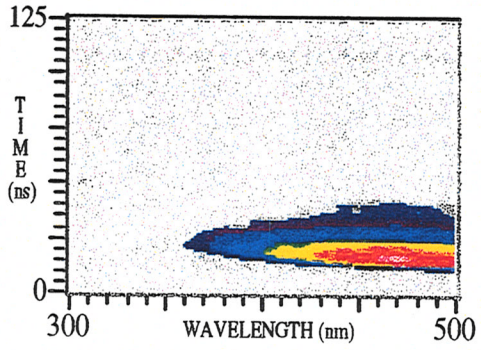
FVD ID : CPT13R



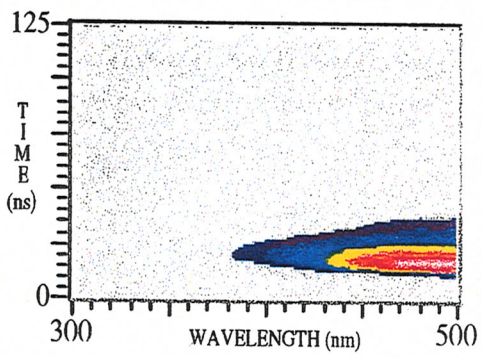
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
49.58	37.68	290.00	450.00

A WTM ID : WCPT13RA



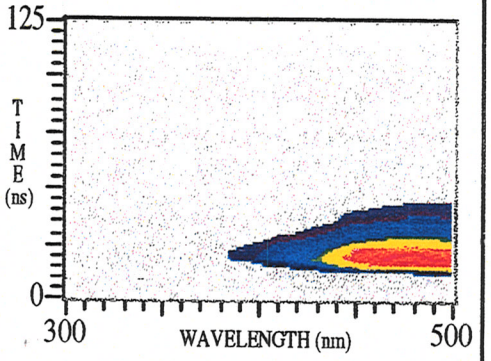
Peak Signal	0.077687 @ 470.00
FVD Signal	0.068263 @ 450.00

B WTM ID : WCPT13RB



Peak Signal	0.087403 @ 490.00
FVD Signal	0.065218 @ 450.00

C WTM ID : WCPT13RC



Peak Signal	0.161893 @ 480.00
FVD Signal	0.125928 @ 450.00

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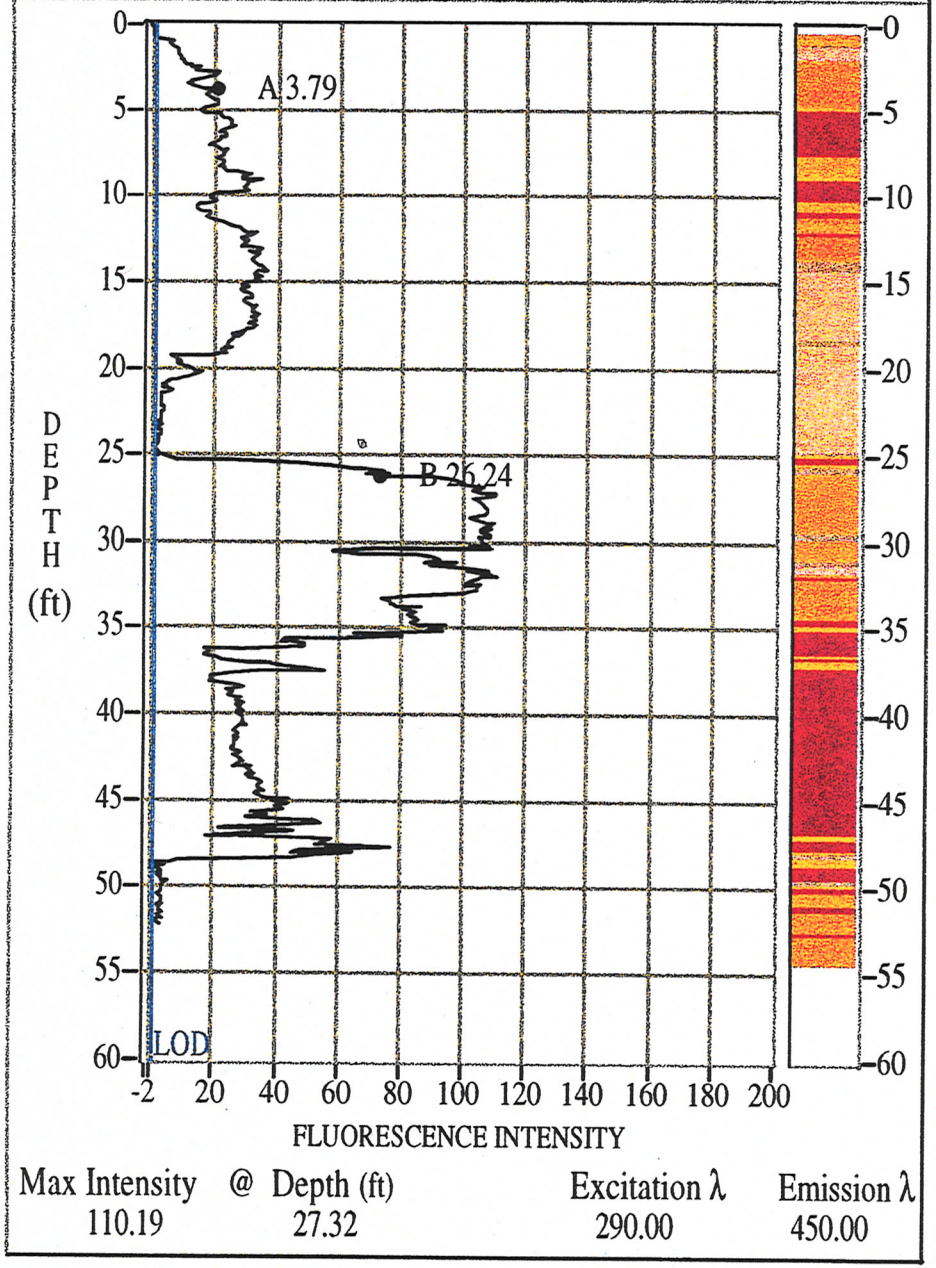
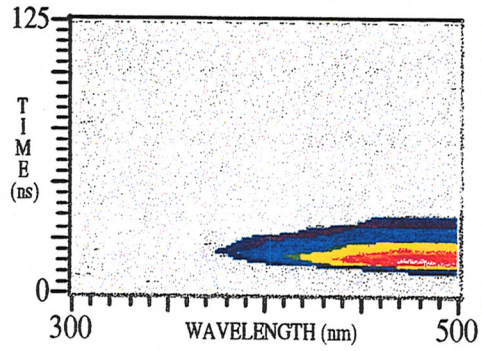
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT14R



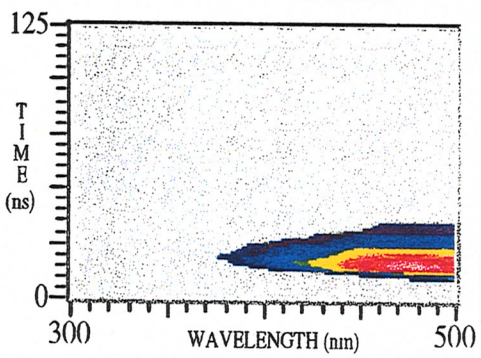
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
110.19	27.32	290.00	450.00

A WTM ID : WCPT14RA



Peak Signal	0.211465 @ 470.00
FVD Signal	0.163060 @ 450.00

B WTM ID : WCPT14RB



Peak Signal	0.766567 @ 480.00
FVD Signal	0.643999 @ 450.00

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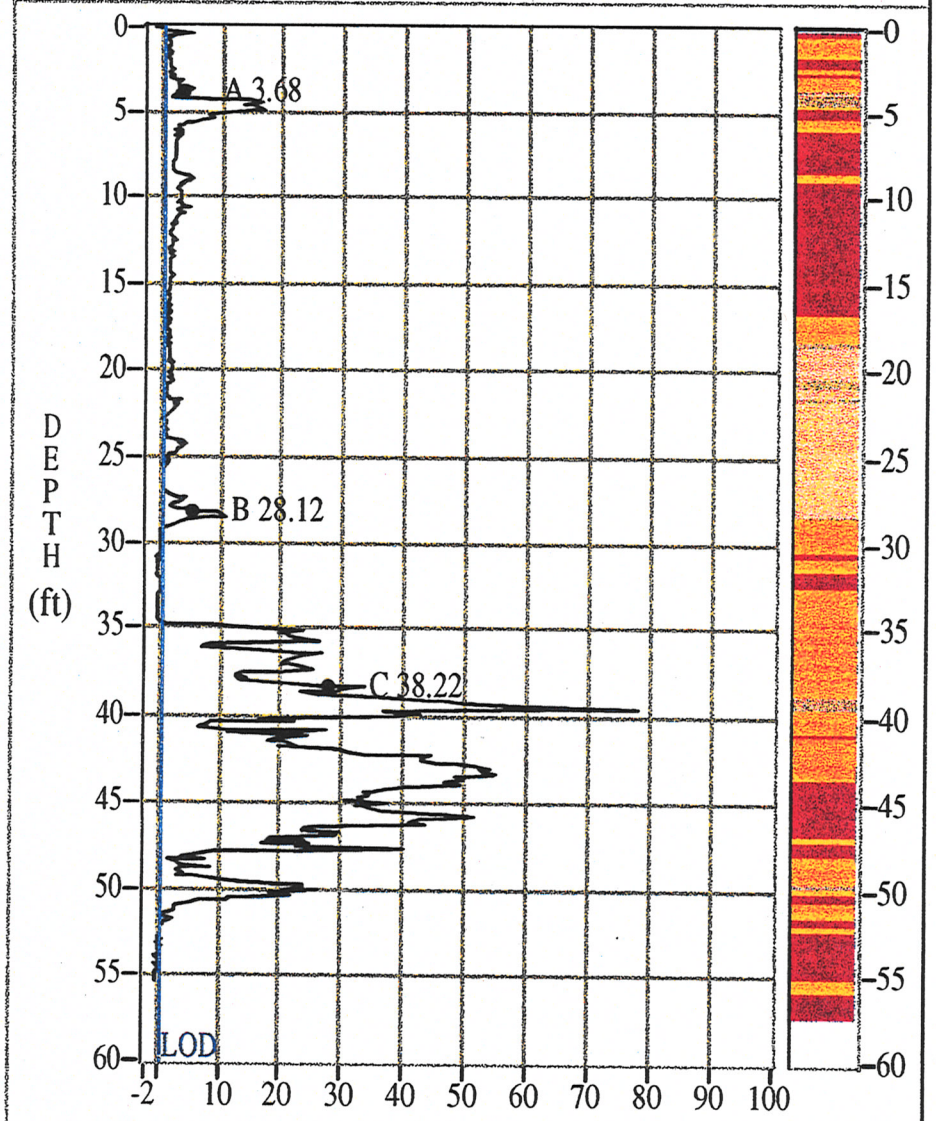
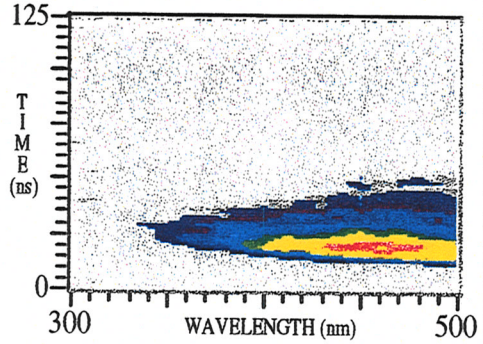
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT15R



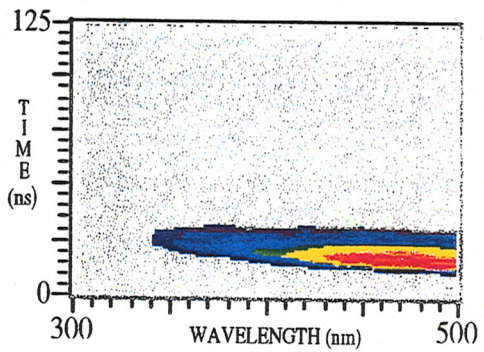
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
77.84	39.40	290.00	450.00

A WTM ID : WCPT15RA



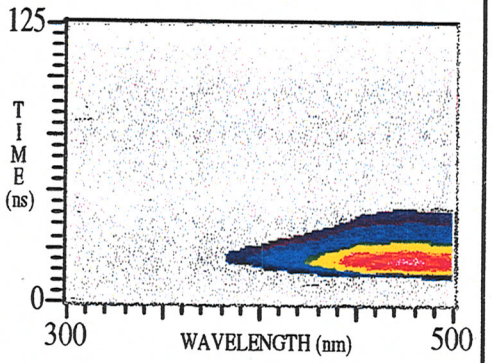
Peak Signal	0.013741 @ 450.00
FVD Signal	0.013741 @ 450.00

B WTM ID : WCPT15RB



Peak Signal	0.063190 @ 470.00
FVD Signal	0.057389 @ 450.00

C WTM ID : WCPT15RC



Peak Signal	0.209059 @ 480.00
FVD Signal	0.175032 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

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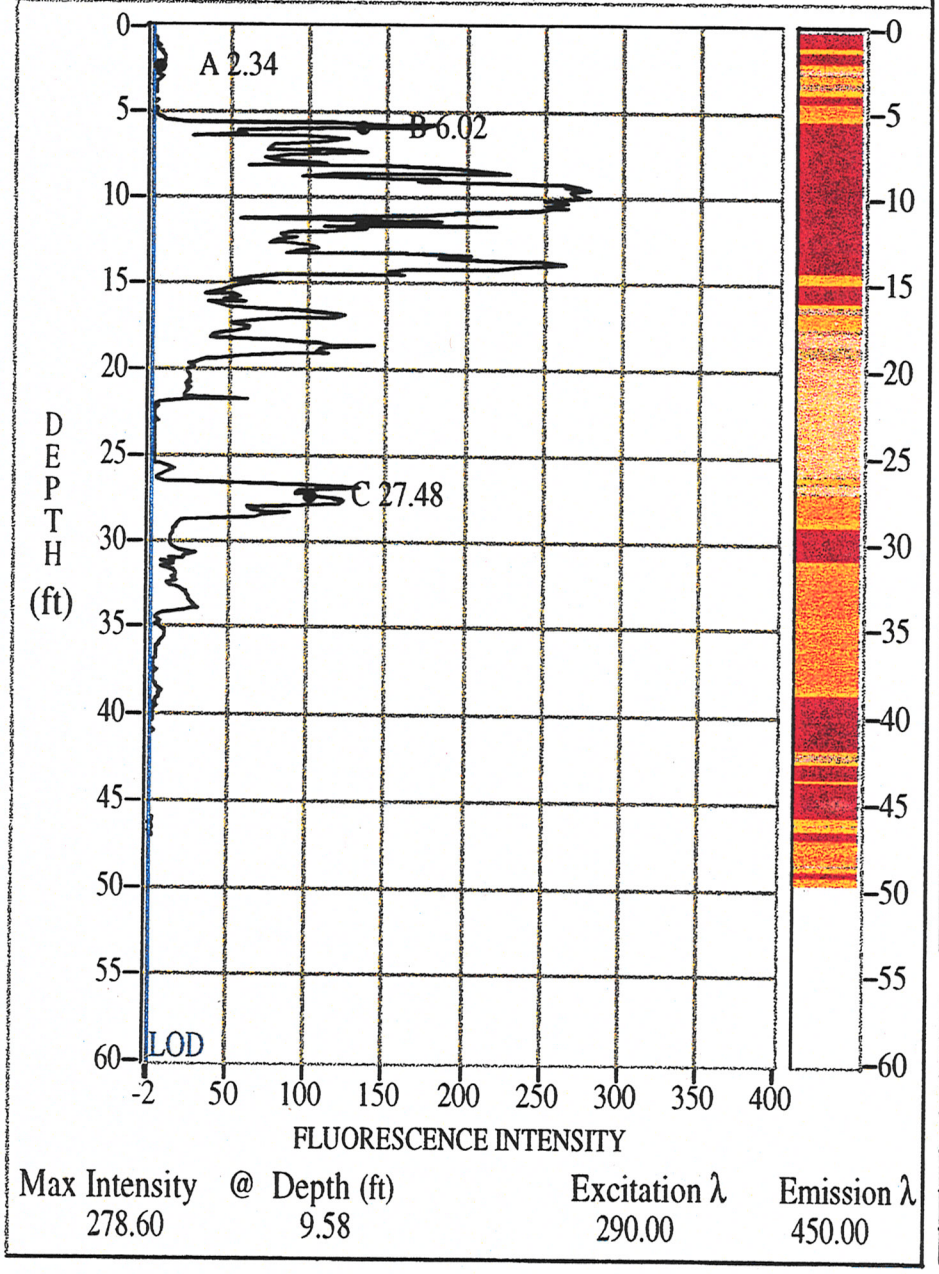
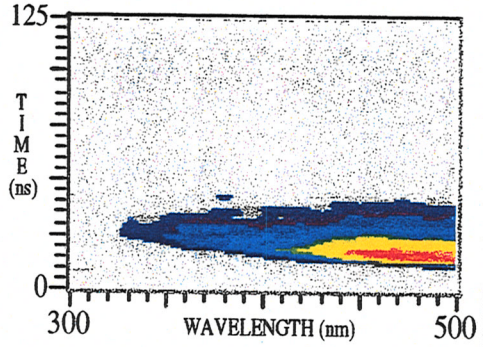
FVD ID : CPT16R



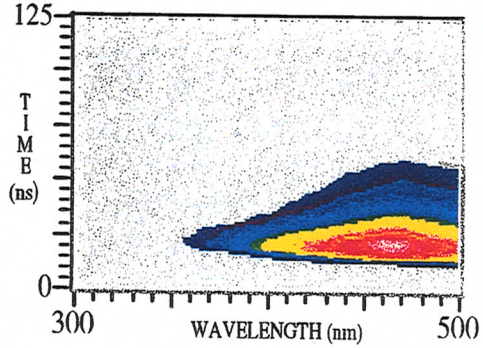
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
278.60	9.58	290.00	450.00

A WTM ID : WCPT16RA



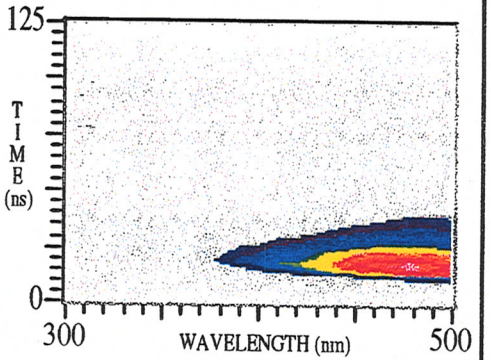
Peak Signal	0.021154 @ 480.00
FVD Signal	0.020029 @ 450.00

B WTM ID : WCPT16RB



Peak Signal	0.527441 @ 460.00
FVD Signal	0.480009 @ 450.00

C WTM ID : WCPT16RC



Peak Signal	0.835134 @ 480.00
FVD Signal	0.708927 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

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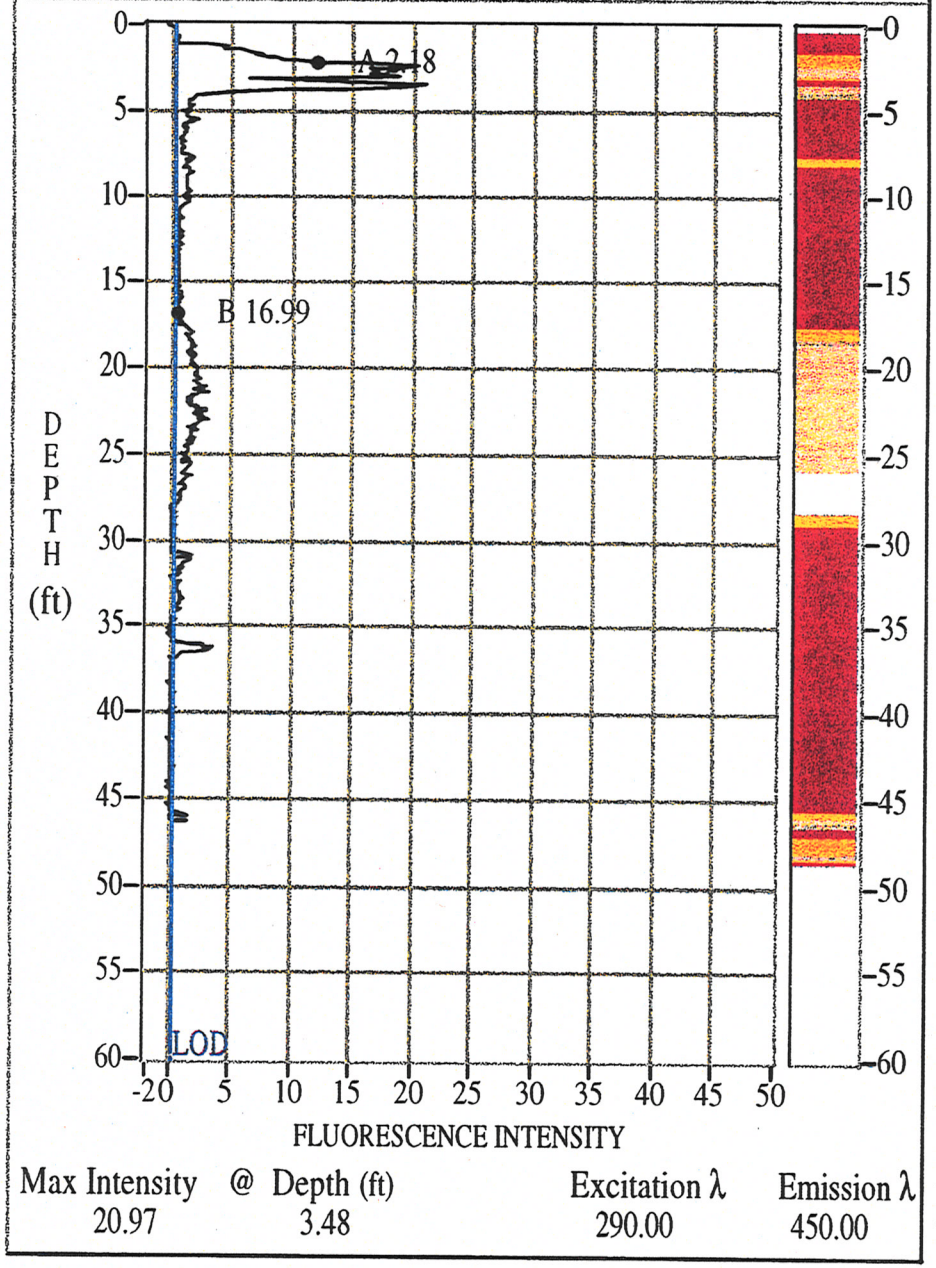
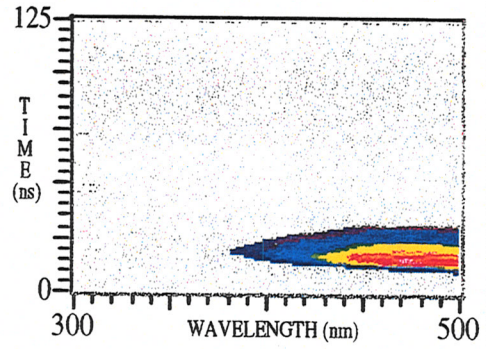
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT17R



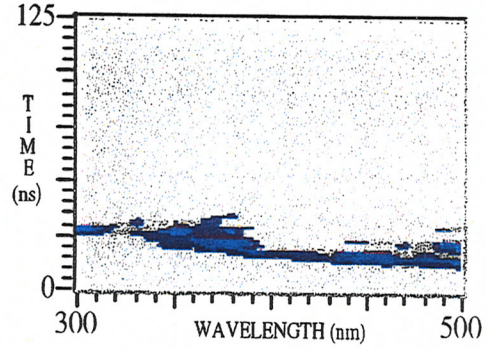
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
20.97	3.48	290.00	450.00

A WTM ID : WCPT17RA



Peak Signal	0.128112 @ 470.00
FVD Signal	0.103696 @ 450.00

B WTM ID : WCPT17RB



Peak Signal	0.002913 @ 300.00
FVD Signal	0.002052 @ 450.00

Undefined
Peat
Clay
Clay & Silt
Silt
Sand & Silt
Sand

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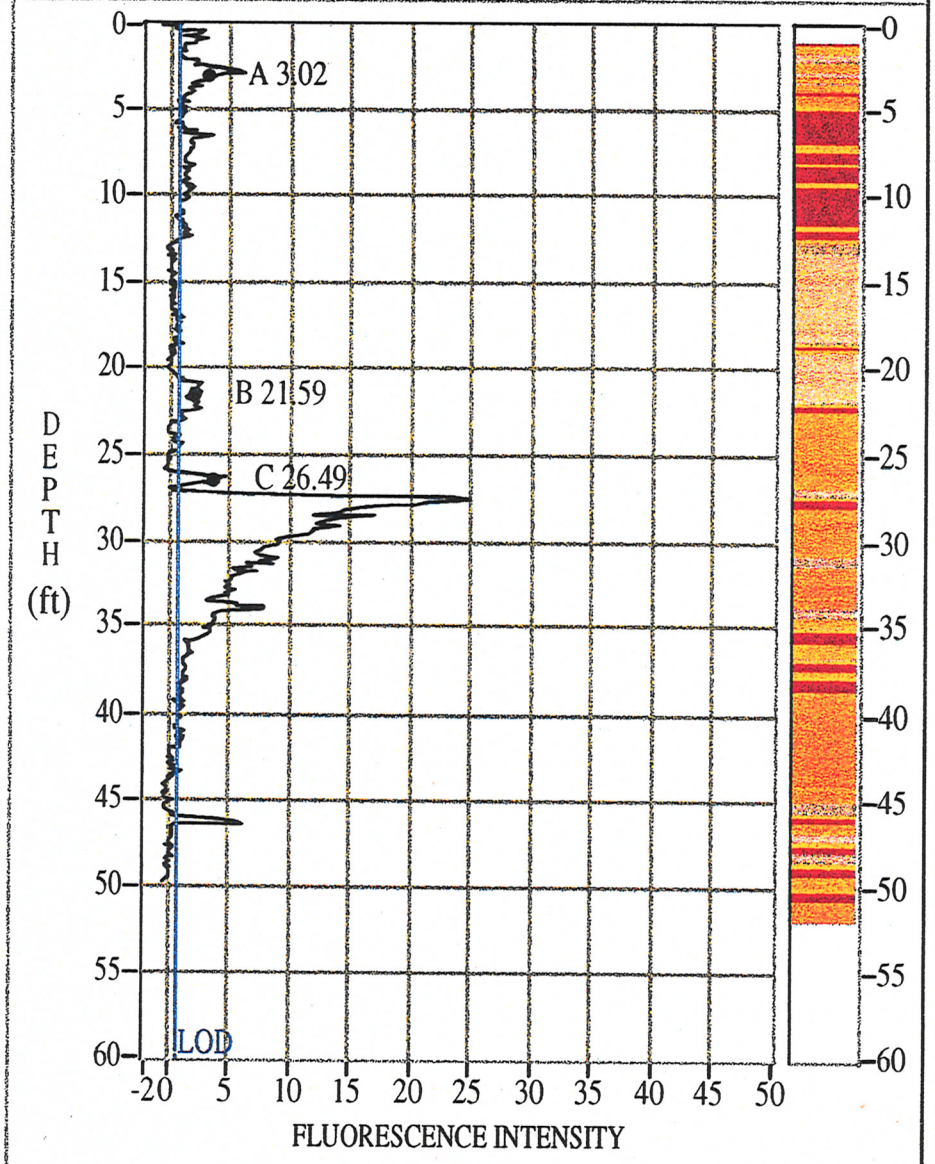
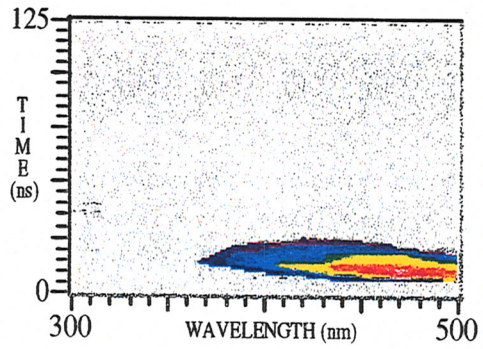
FVD ID : CPT18R



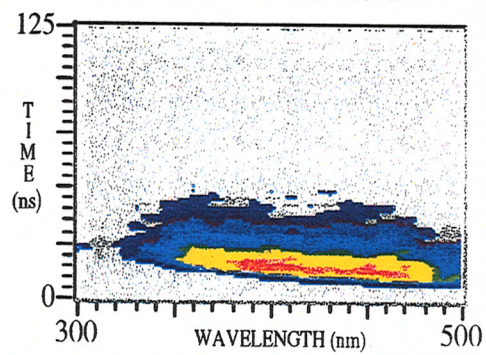
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
24.66	27.59	290.00	420.00

A WTM ID : WCPT18RA



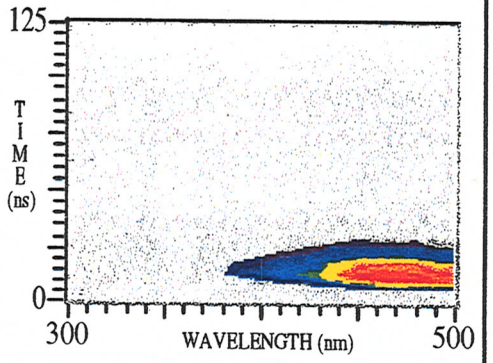
Peak Signal	0.057720 @ 470.00
FVD Signal	0.026076 @ 420.00

B WTM ID : WCPT18RB

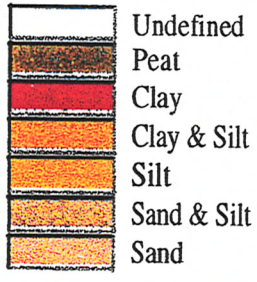


Peak Signal	0.007656 @ 410.00
FVD Signal	0.006941 @ 420.00

C WTM ID : WCPT18RC



Peak Signal	0.071517 @ 470.00
FVD Signal	0.025424 @ 420.00



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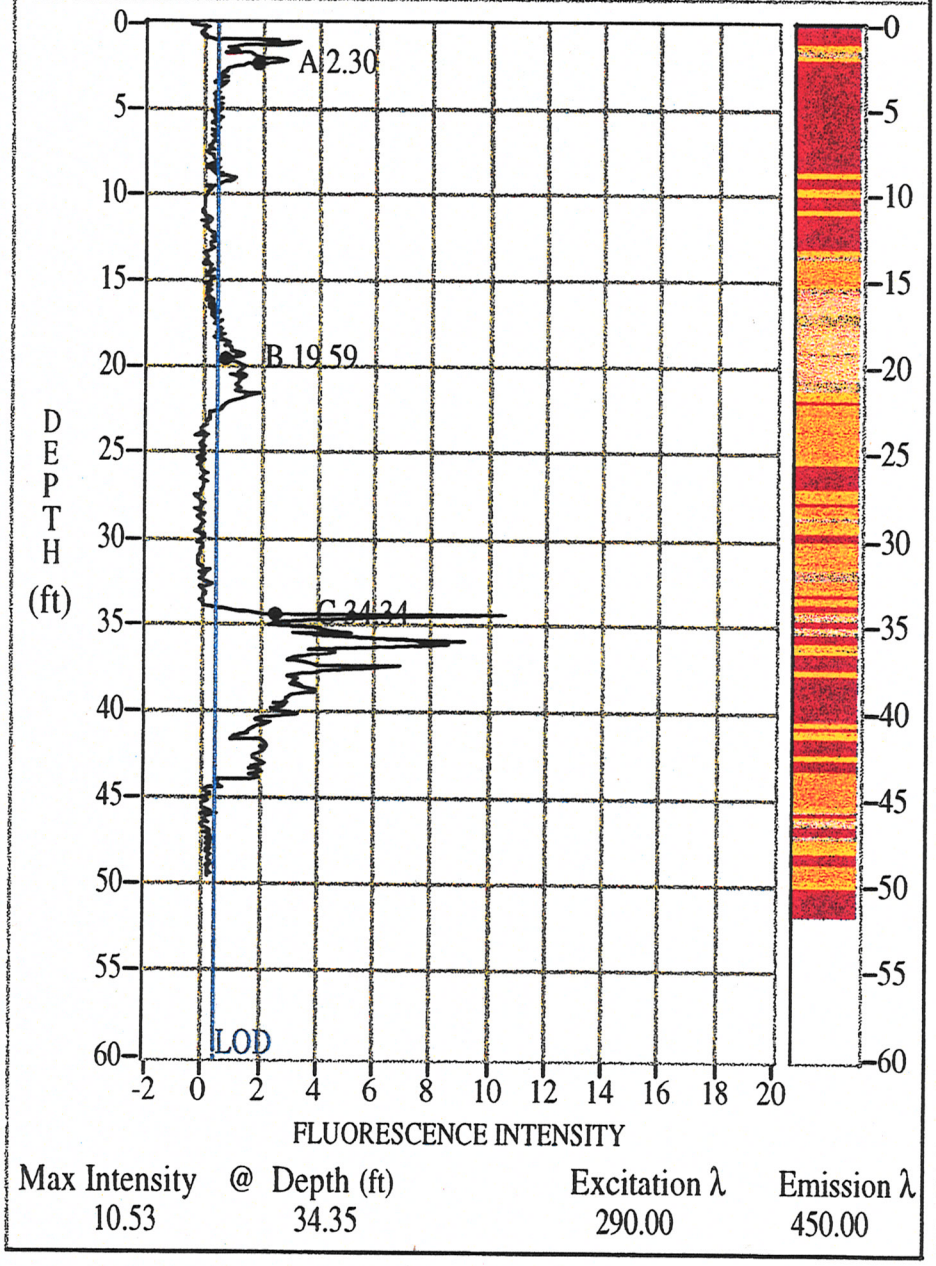
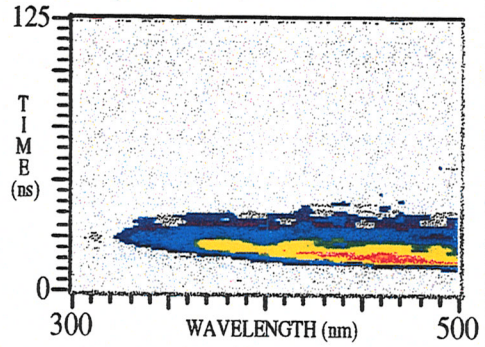
FVD ID : CPT19R



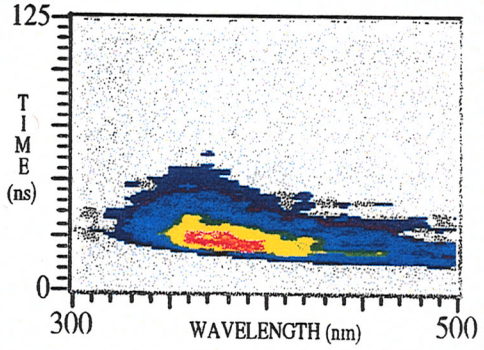
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
10.53	34.35	290.00	450.00

A WTM ID : WCPT19RA



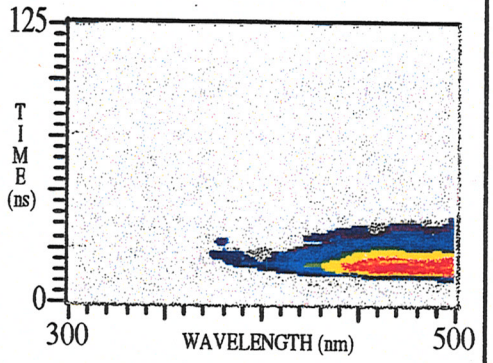
Peak Signal	0.007039 @ 460.00
FVD Signal	0.007038 @ 450.00

B WTM ID : WCPT19RB



Peak Signal	0.007959 @ 390.00
FVD Signal	0.003348 @ 450.00

C WTM ID : WCPT19RC



Peak Signal	0.016561 @ 470.00
FVD Signal	0.014495 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

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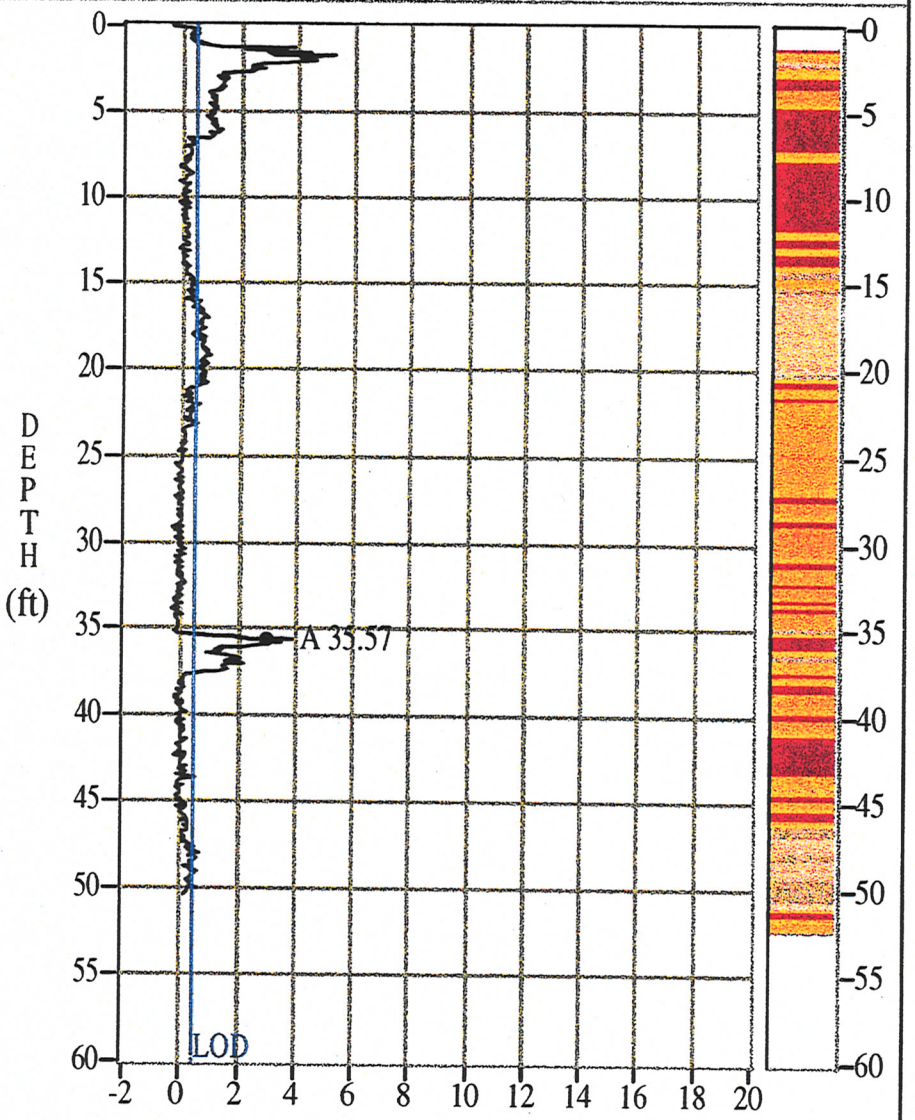
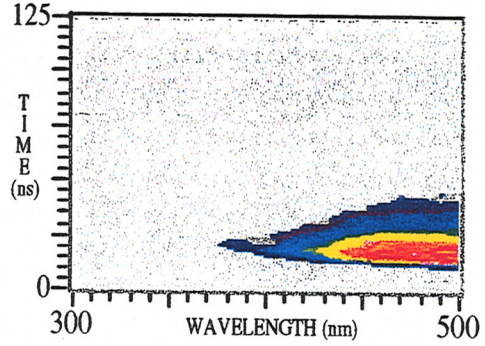
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT20R



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
5.28	1.80	290.00	450.00

A WTM ID : WCPT20RA



Peak Signal	0.027332 @ 480.00
FVD Signal	0.023331 @ 450.00

Undefined
Peat
Clay
Clay & Silt
Silt
Sand & Silt
Sand

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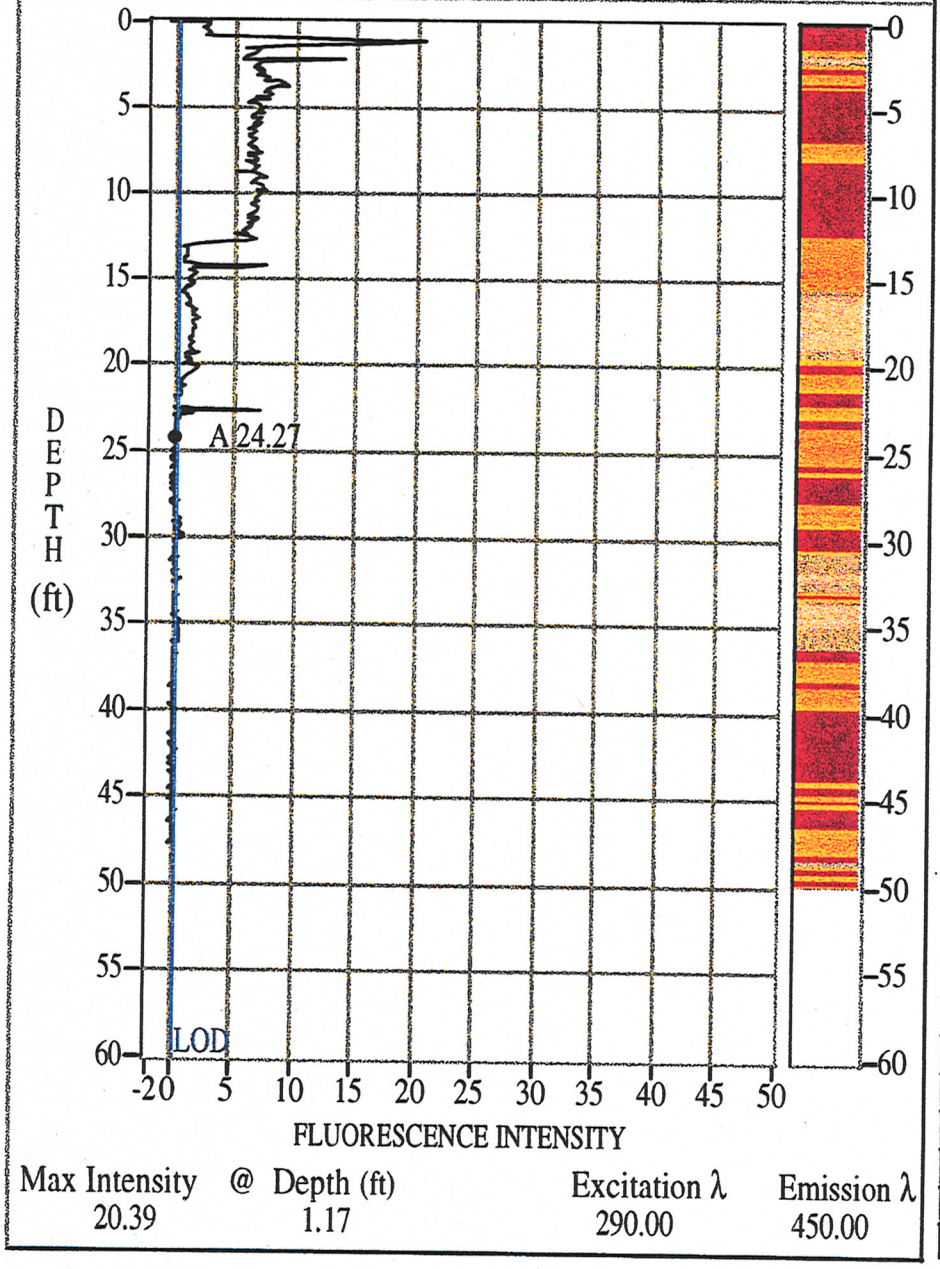
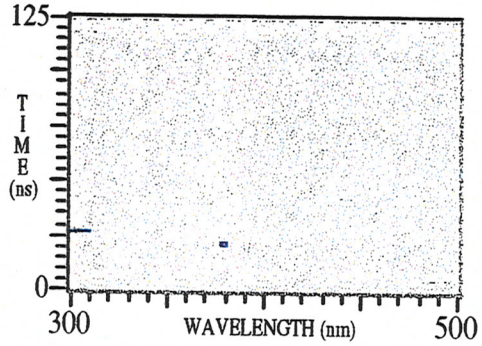
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT21R



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
20.39	1.17	290.00	450.00

A WTM ID : WCPT21RA



Peak Signal	0.000959 @ 300.00
FVD Signal	0.000078 @ 450.00

Undefined
Peat
Clay
Clay & Silt
Silt
Sand & Silt
Sand

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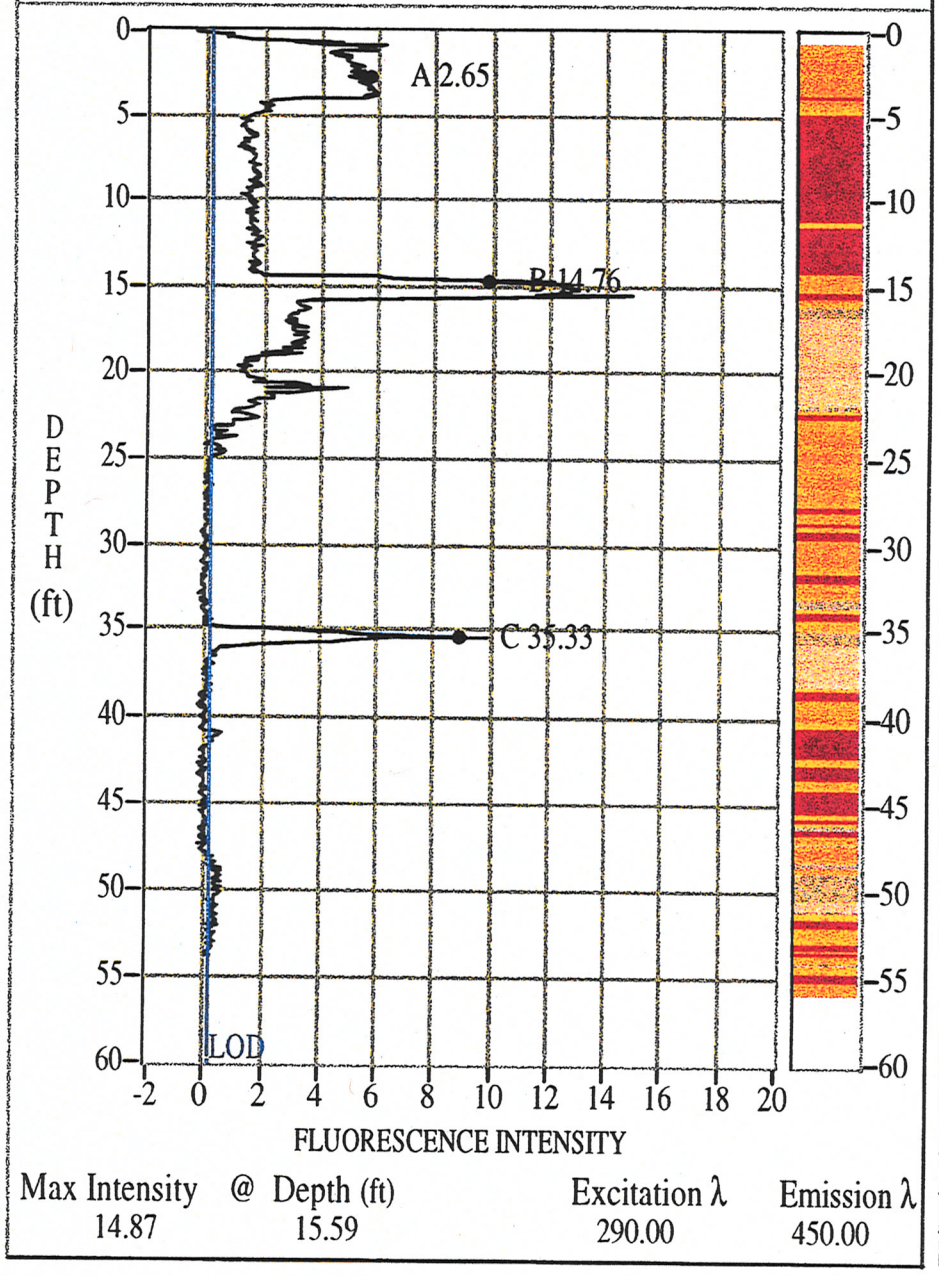
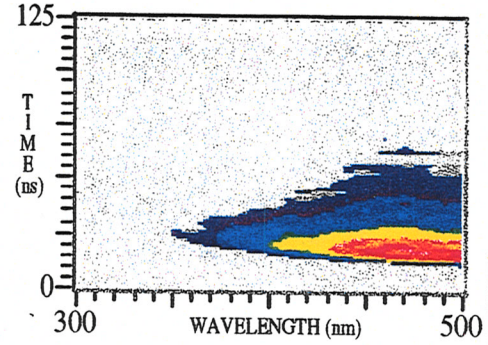
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT22R



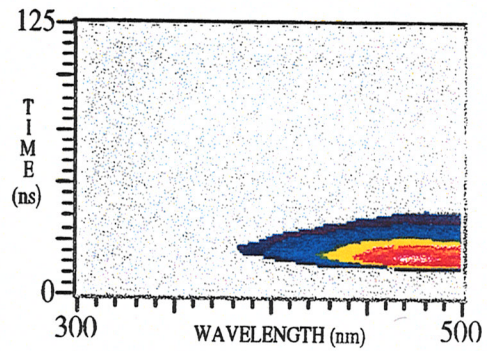
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
14.87	15.59	290.00	450.00

A WTM ID : WCPT22RA



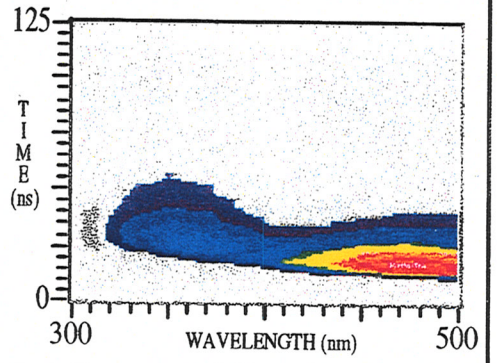
Peak Signal	0.027584 @ 470.00
FVD Signal	0.024999 @ 450.00

B WTM ID : WCPT22RB

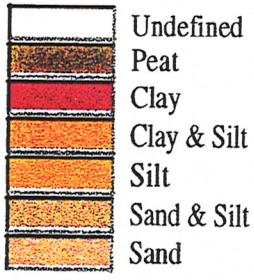


Peak Signal	0.107282 @ 470.00
FVD Signal	0.081689 @ 450.00

C WTM ID : WCPT22RC



Peak Signal	0.129740 @ 470.00
FVD Signal	0.114111 @ 450.00



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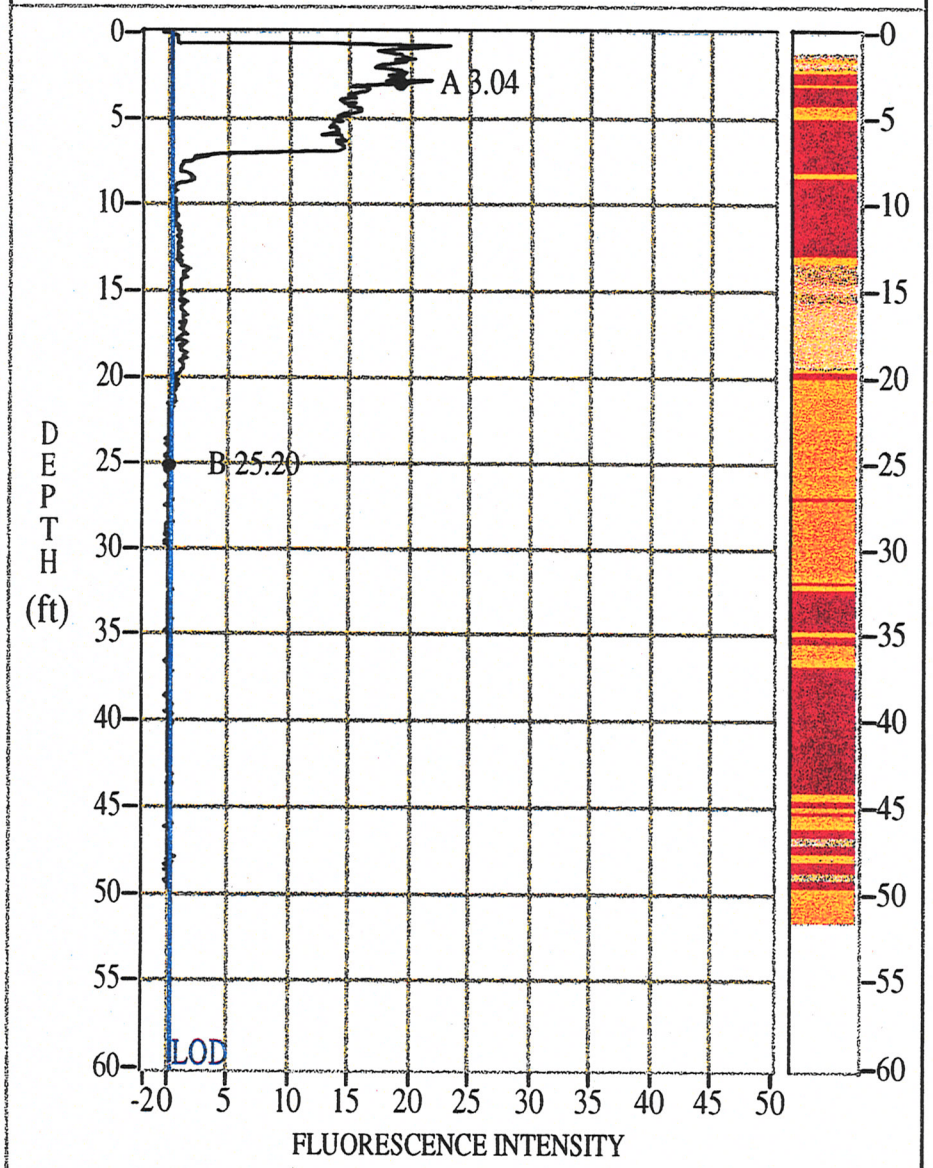
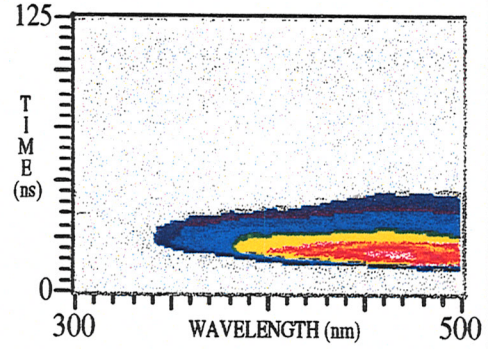
FVD ID : CPT23R



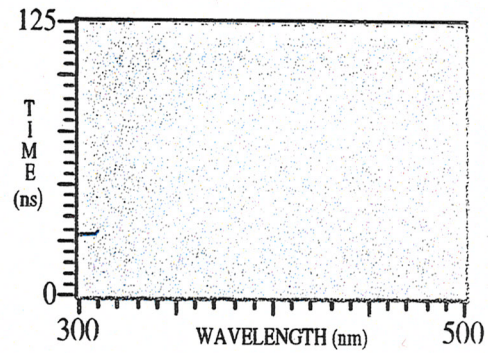
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
23.16	0.79	290.00	450.00

A WTM ID : WCPT23RA

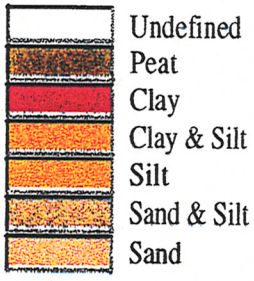


Peak Signal	0.097045 @ 470.00
FVD Signal	0.090152 @ 450.00

B WTM ID : WCPT23RB



Peak Signal	0.000770 @ 300.00
FVD Signal	0.000144 @ 450.00



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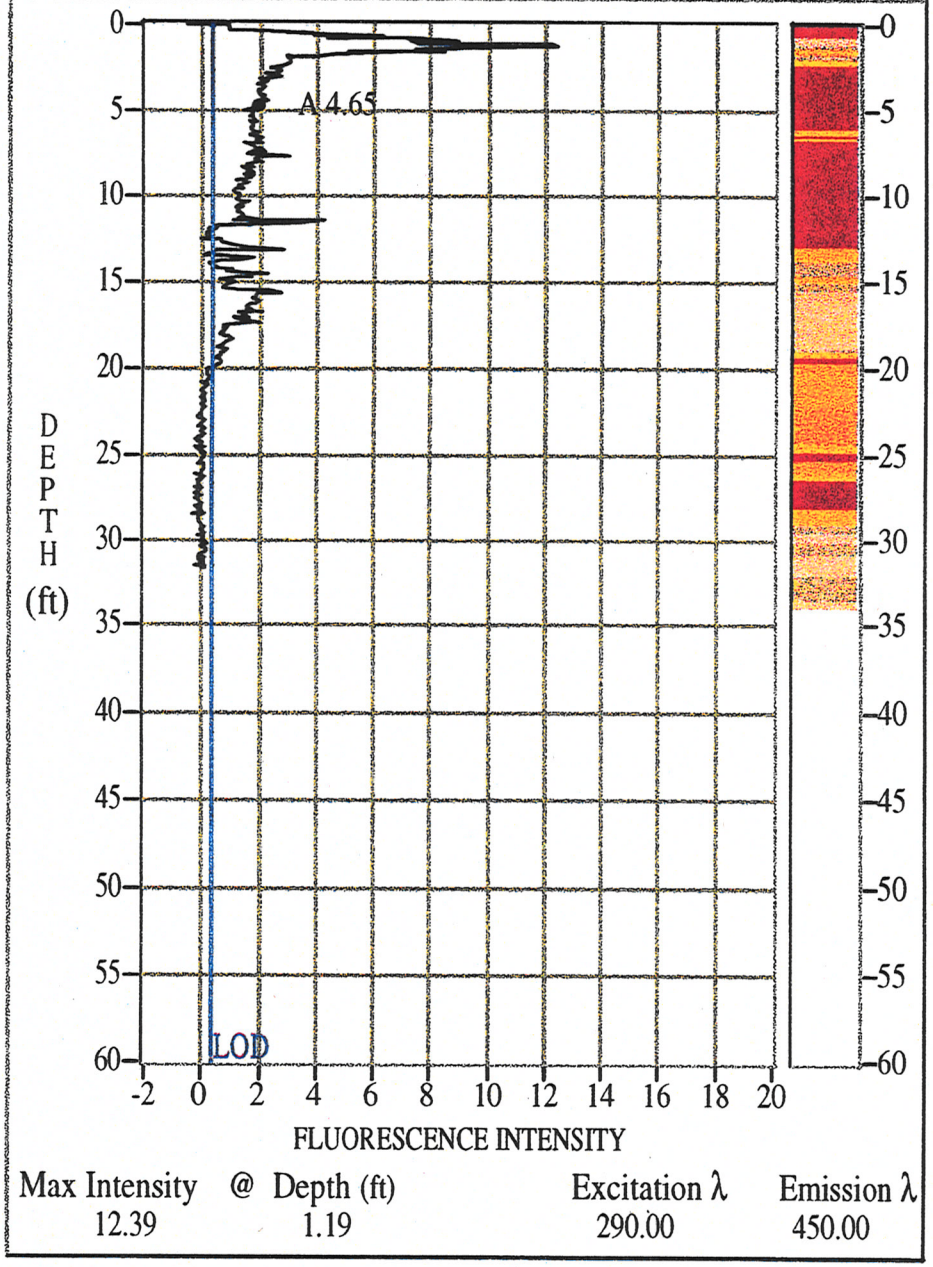
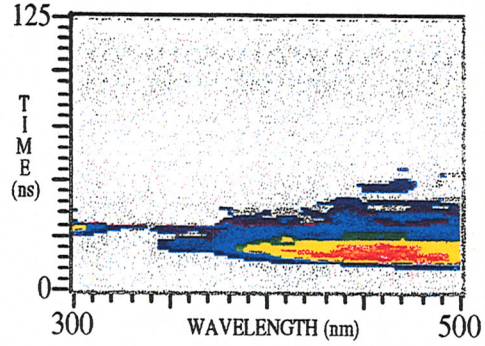
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT24R



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
12.39	1.19	290.00	450.00

A WTM ID : WCPT24RA



Peak Signal	0.009514 @ 460.00
FVD Signal	0.007672 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

Date: 11/18/95	Wood Preserving Works
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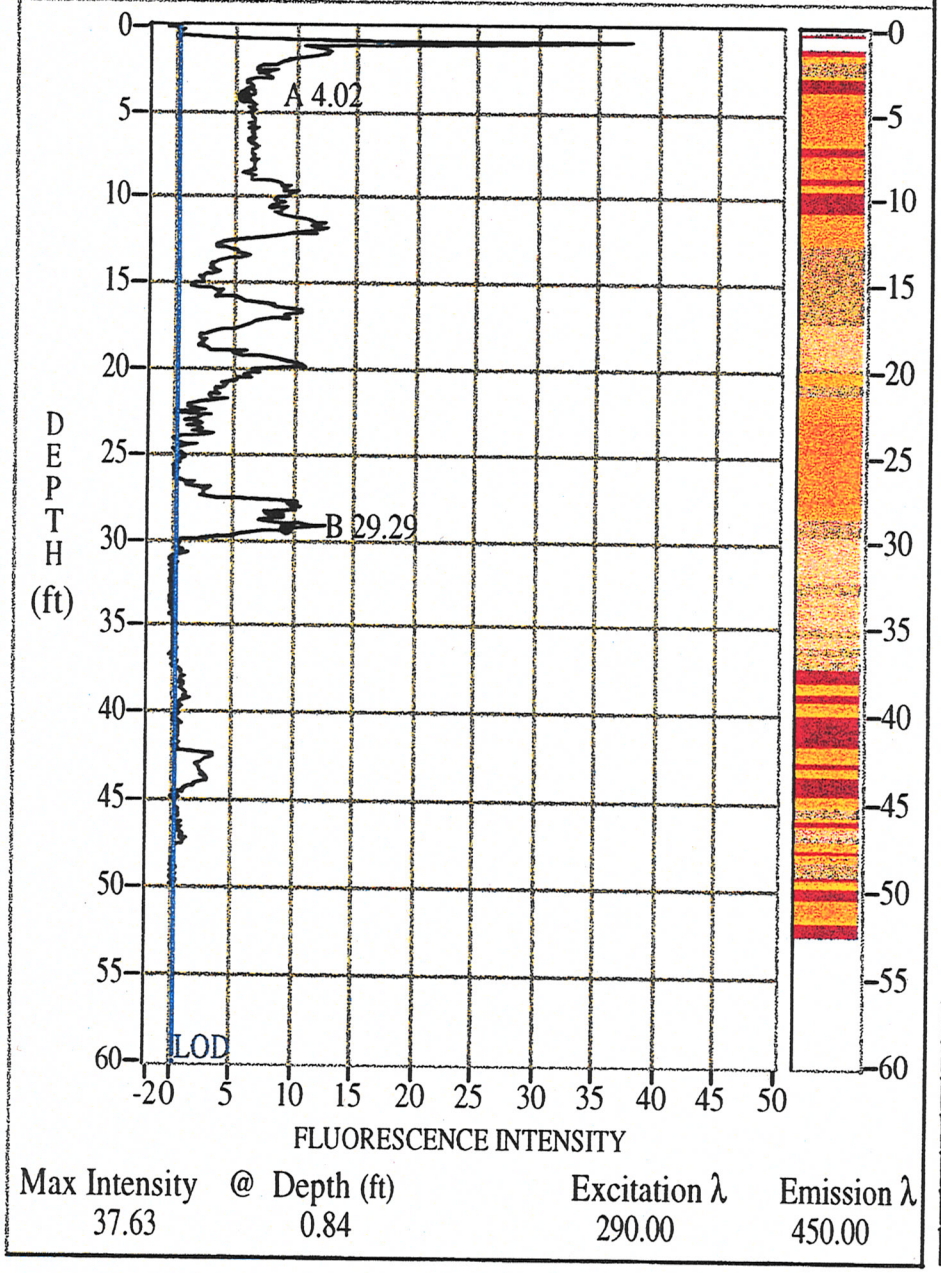
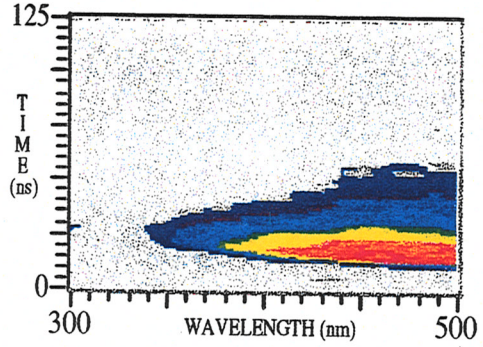
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT25R



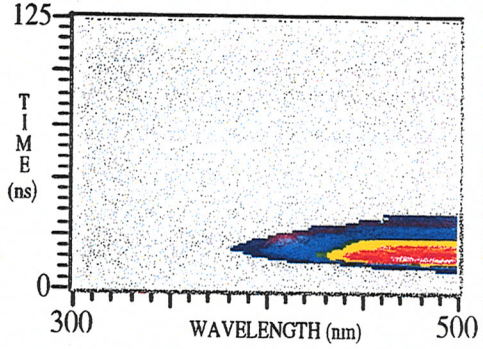
Max Intensity 37.63 @ Depth (ft) 0.84 Excitation λ 290.00 Emission λ 450.00

A WTM ID : WCPT25RA



Peak Signal 0.026332 @ 460.00
FVD Signal 0.024951 @ 450.00

B WTM ID : WCPT25RB



Peak Signal 0.088347 @ 470.00
FVD Signal 0.070235 @ 450.00

Undefined
Peat
Clay
Clay & Silt
Silt
Sand & Silt
Sand

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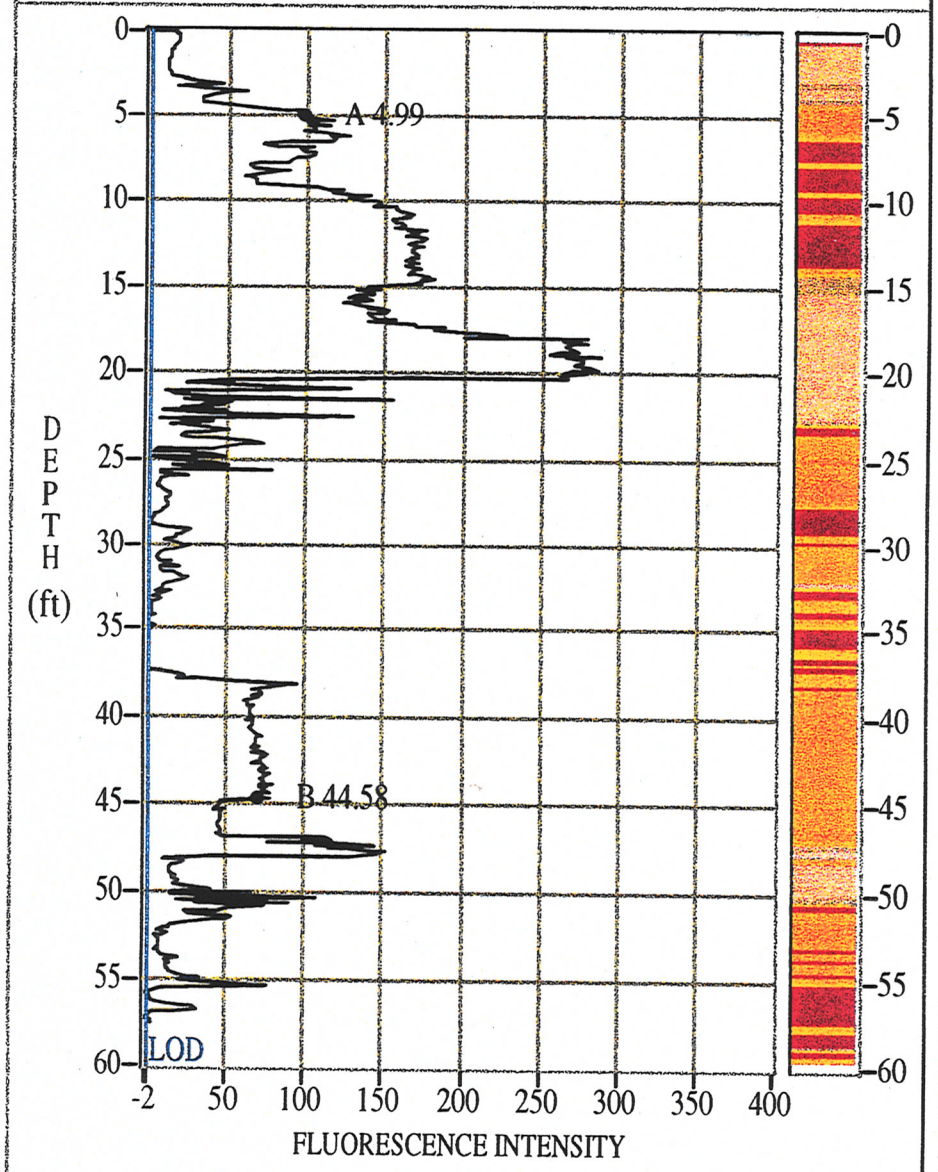
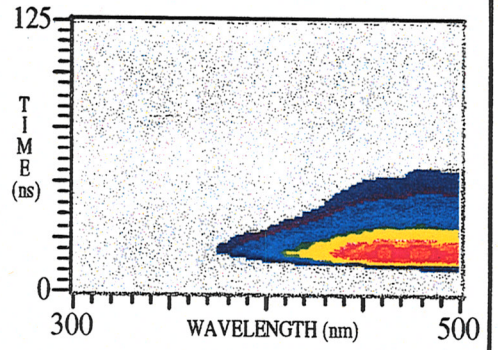
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT26R



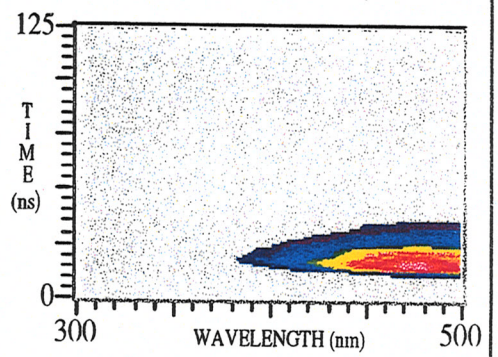
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
286.77	19.05	290.00	450.00

A WTM ID : WCPT26RA

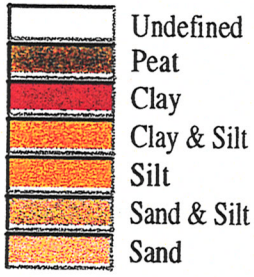


Peak Signal	0.401367 @ 480.00
FVD Signal	0.348574 @ 450.00

B WTM ID : WCPT26RB



Peak Signal	0.563926 @ 480.00
FVD Signal	0.474089 @ 450.00



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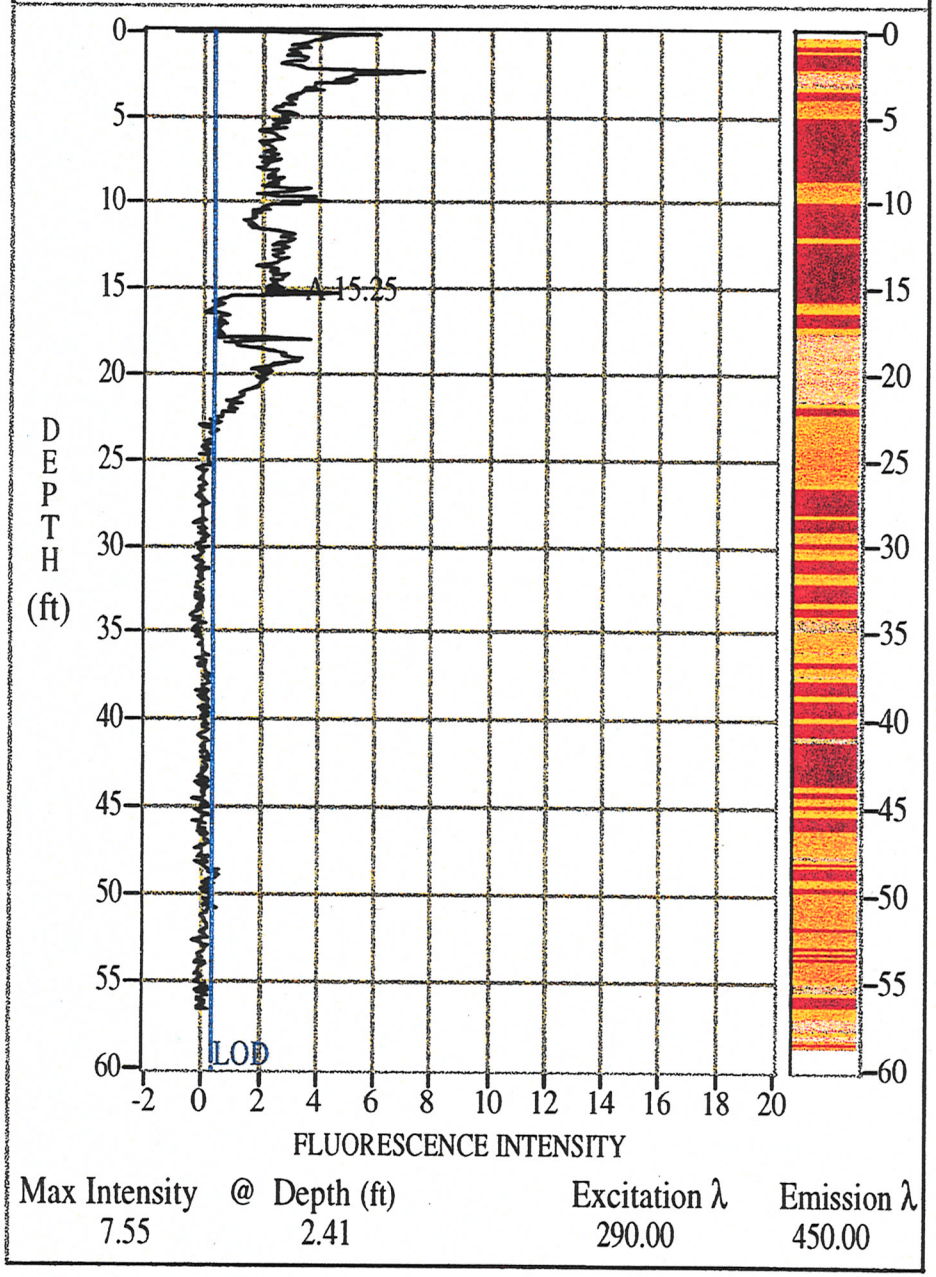
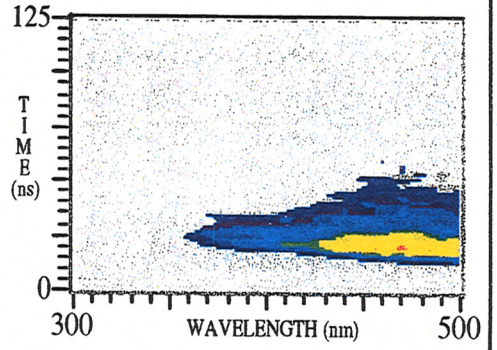
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT27R



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
7.55	2.41	290.00	450.00

A WTM ID : WCPT27RA



Peak Signal	0.011778 @ 470.00
FVD Signal	0.010012 @ 450.00

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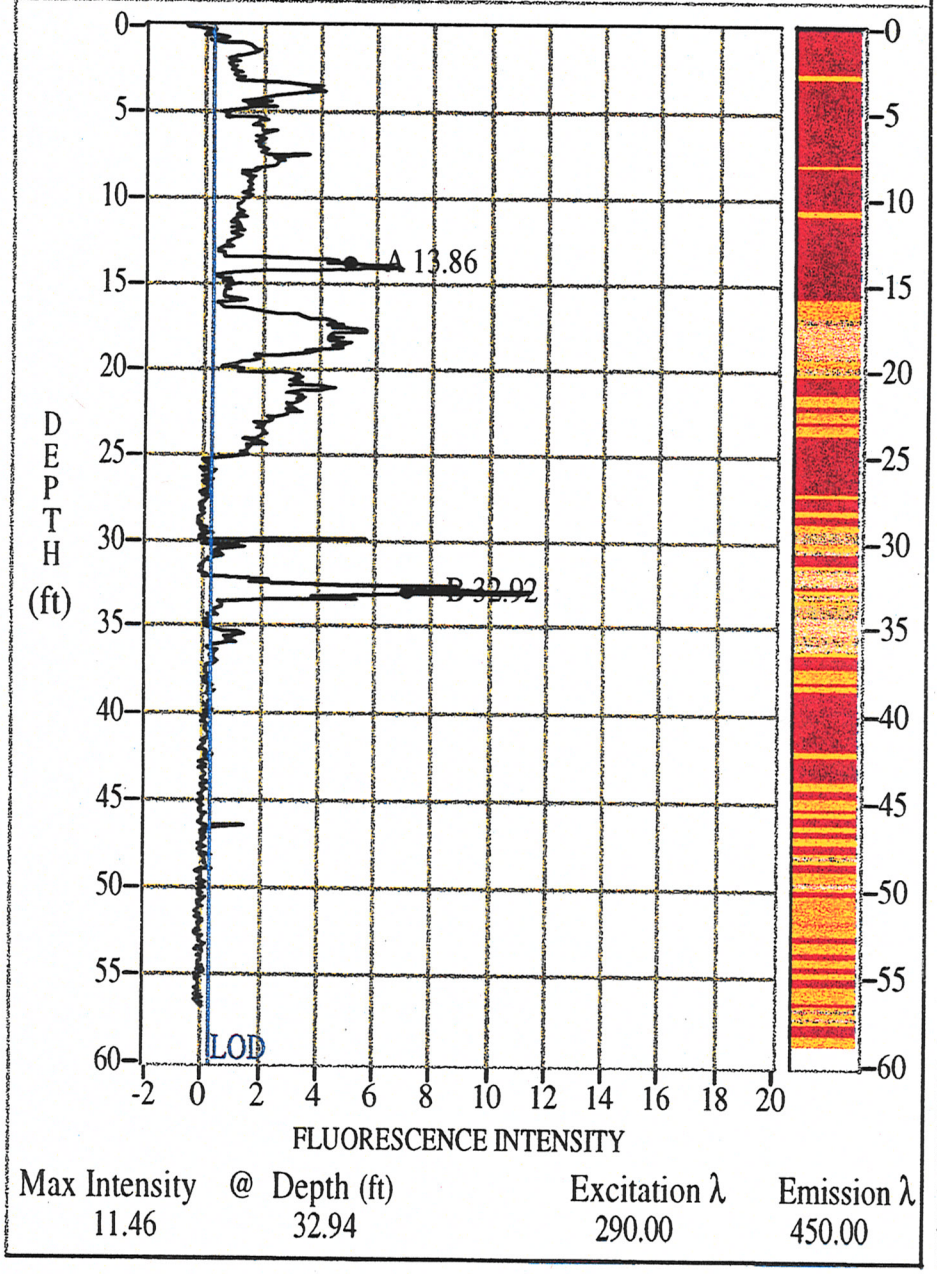
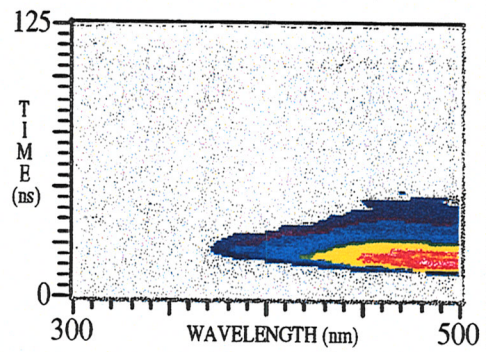
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT28R



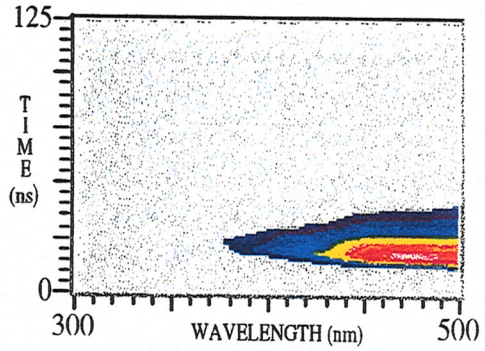
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
11.46	32.94	290.00	450.00

A WTM ID : WCPT28RA

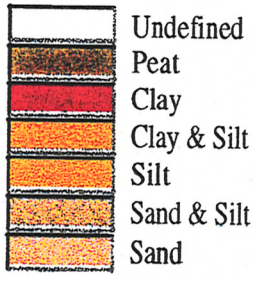


Peak Signal	0.038137 @ 480.00
FVD Signal	0.025150 @ 450.00

B WTM ID : WCPT28RB



Peak Signal	0.088288 @ 470.00
FVD Signal	0.074118 @ 450.00



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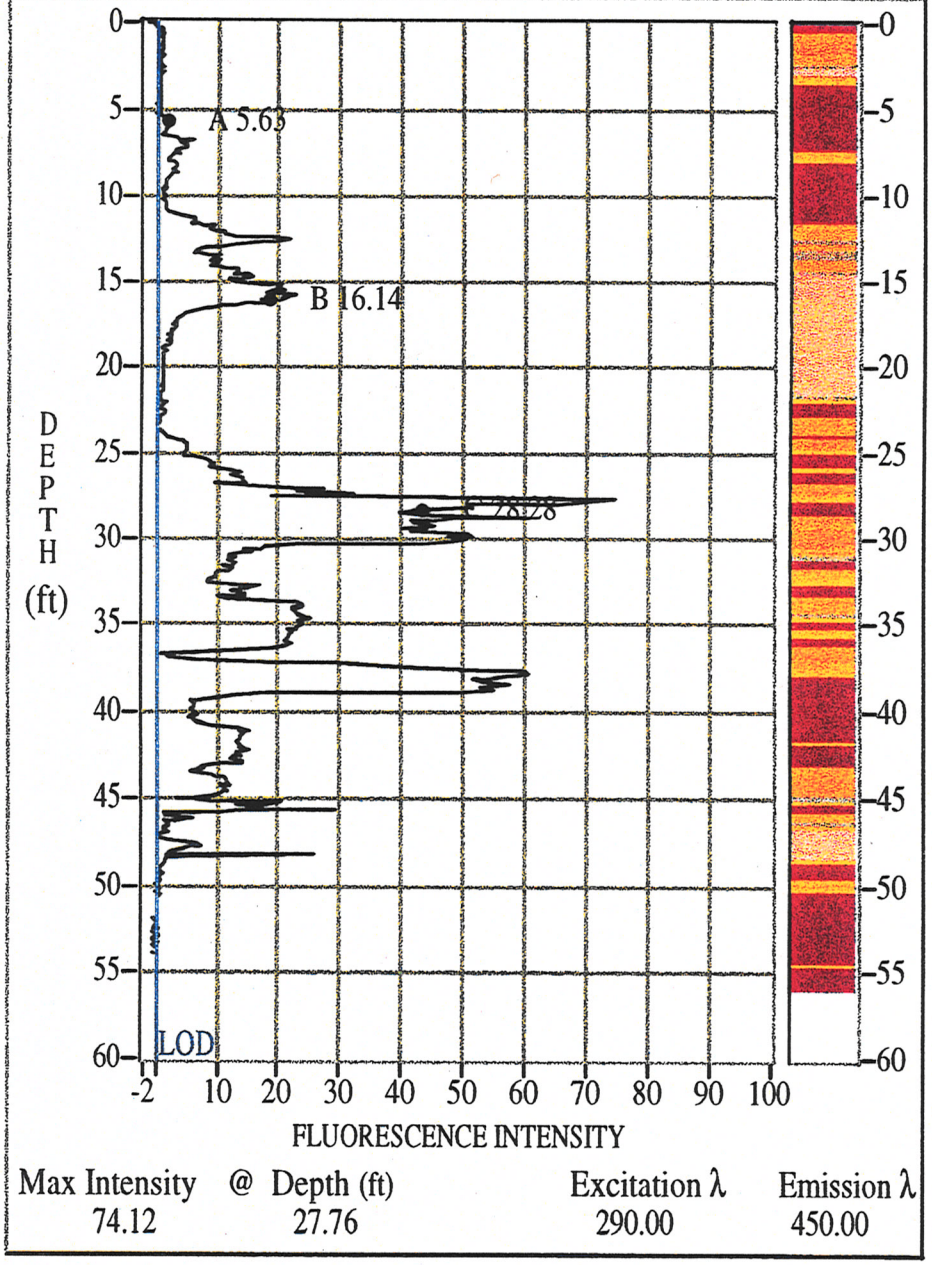
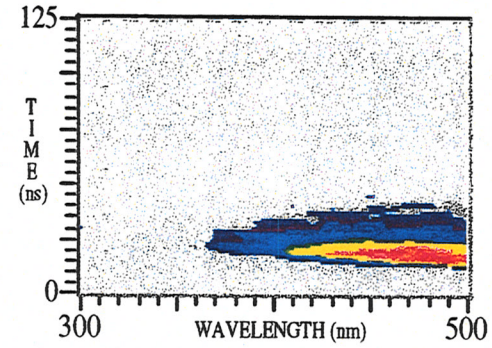
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT29R



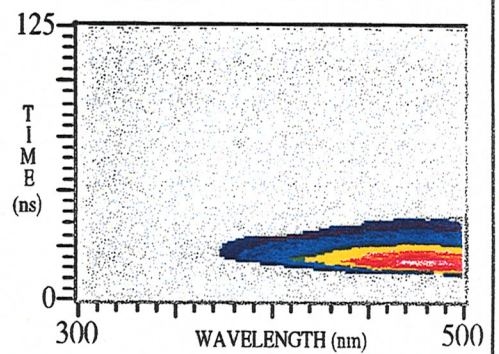
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
74.12	27.76	290.00	450.00

A WTM ID : WCPT29RA



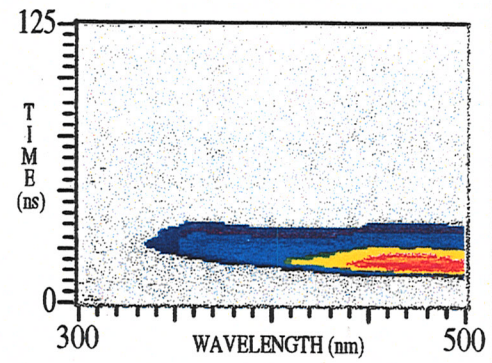
Peak Signal	0.016943 @ 480.00
FVD Signal	0.013322 @ 450.00

B WTM ID : WCPT29RB

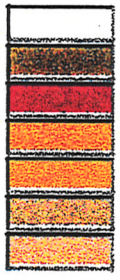


Peak Signal	0.139443 @ 480.00
FVD Signal	0.110889 @ 450.00

C WTM ID : WCPT29RC



Peak Signal	0.261854 @ 480.00
FVD Signal	0.236952 @ 450.00



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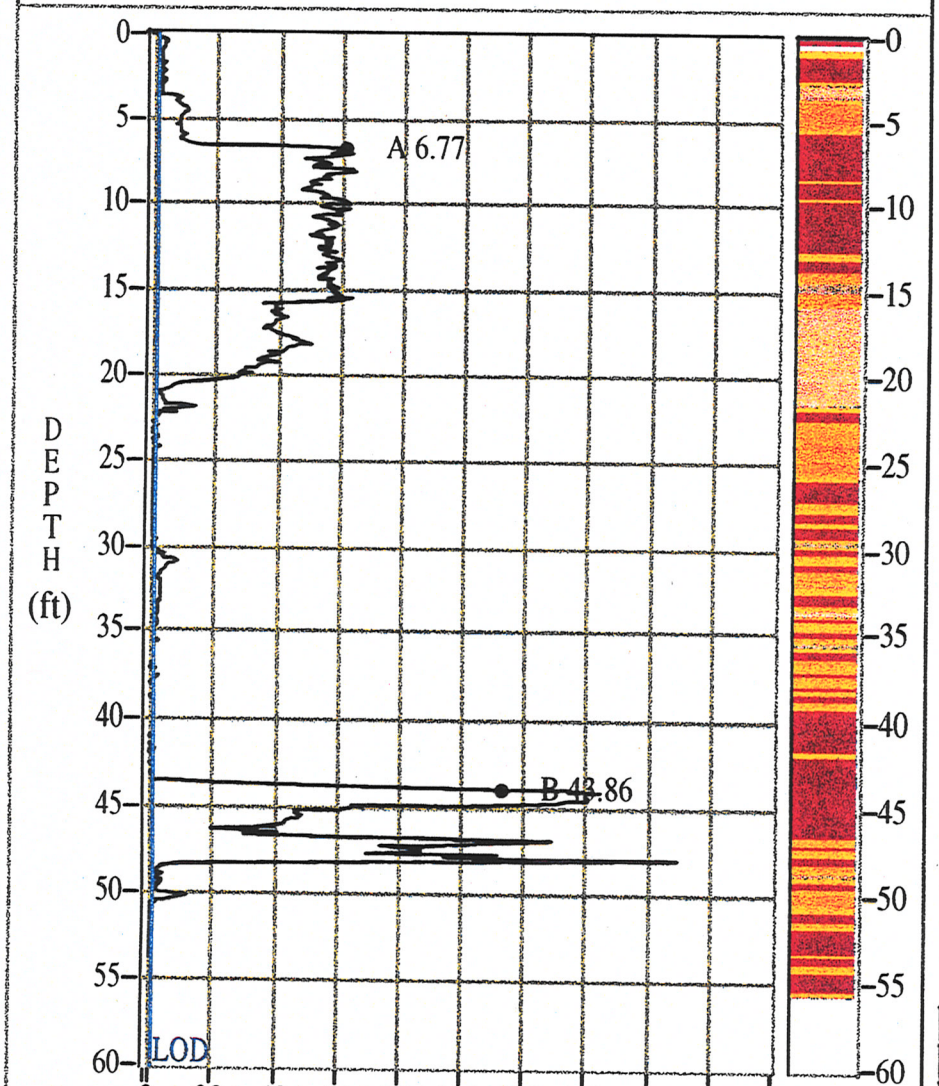
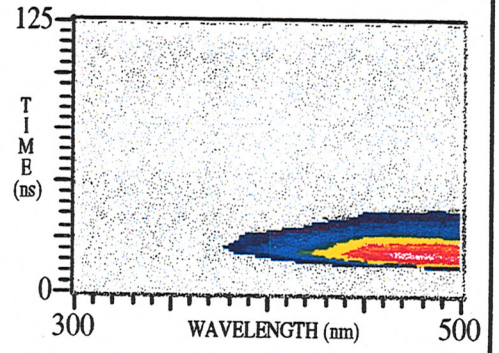
FVD ID : CPT30R



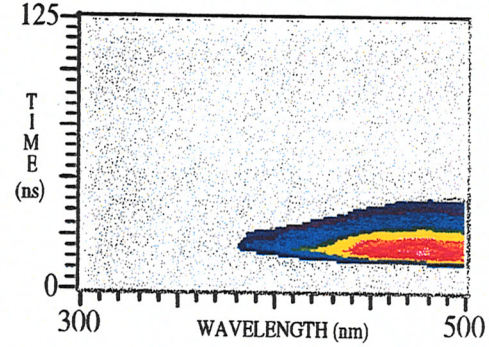
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
168.88	47.96	290.00	450.00

A WTM ID : WCPT30RA



Peak Signal	0.393793 @ 470.00
FVD Signal	0.328659 @ 450.00

B WTM ID : WCPT30RB



Peak Signal	0.752179 @ 480.00
FVD Signal	0.648203 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

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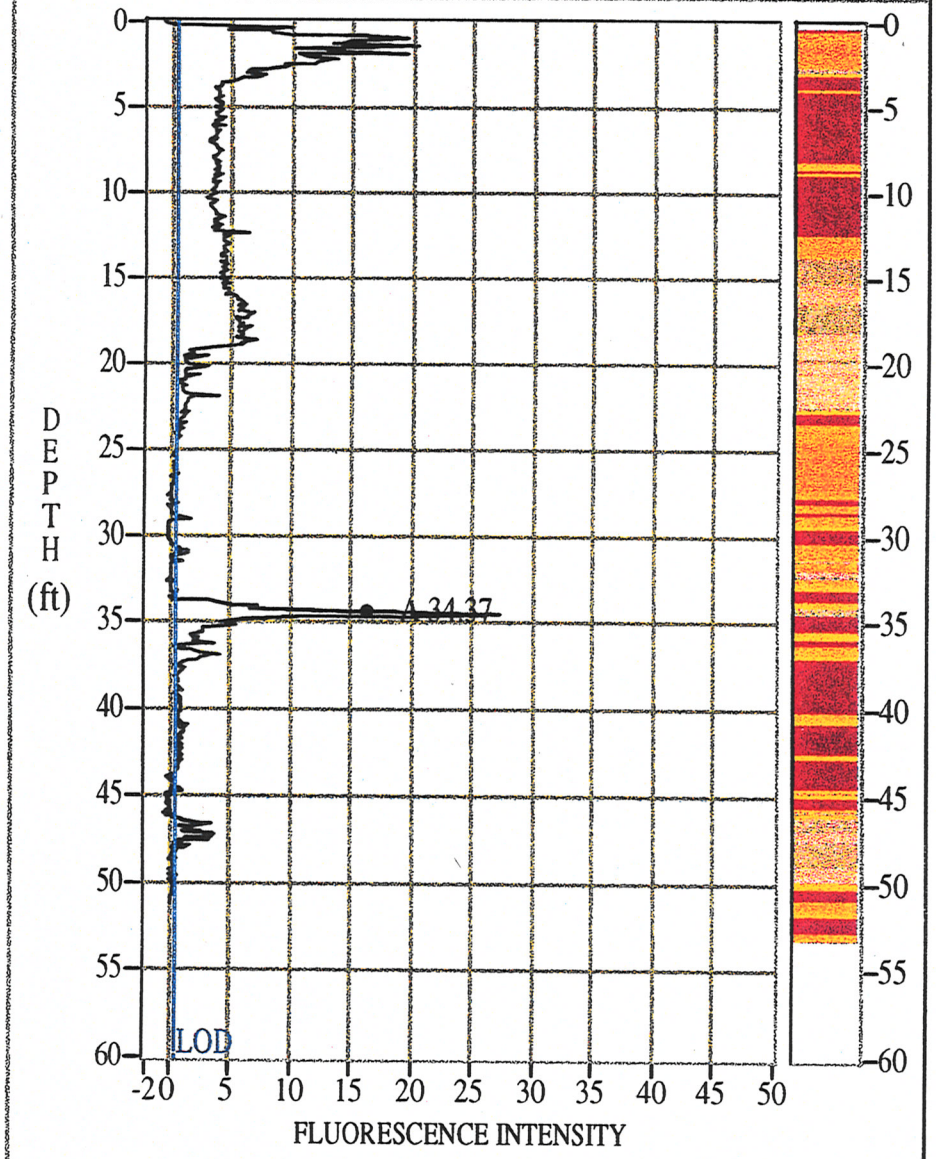
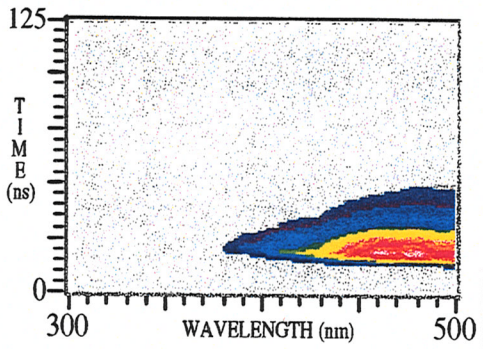
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT31R



Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
27.01	34.46	290.00	450.00

A WTM ID : WCPT31RA



Peak Signal	0.197635 @ 480.00
FVD Signal	0.164897 @ 450.00

- Undefined
- Peat
- Clay
- Clay & Silt
- Silt
- Sand & Silt
- Sand

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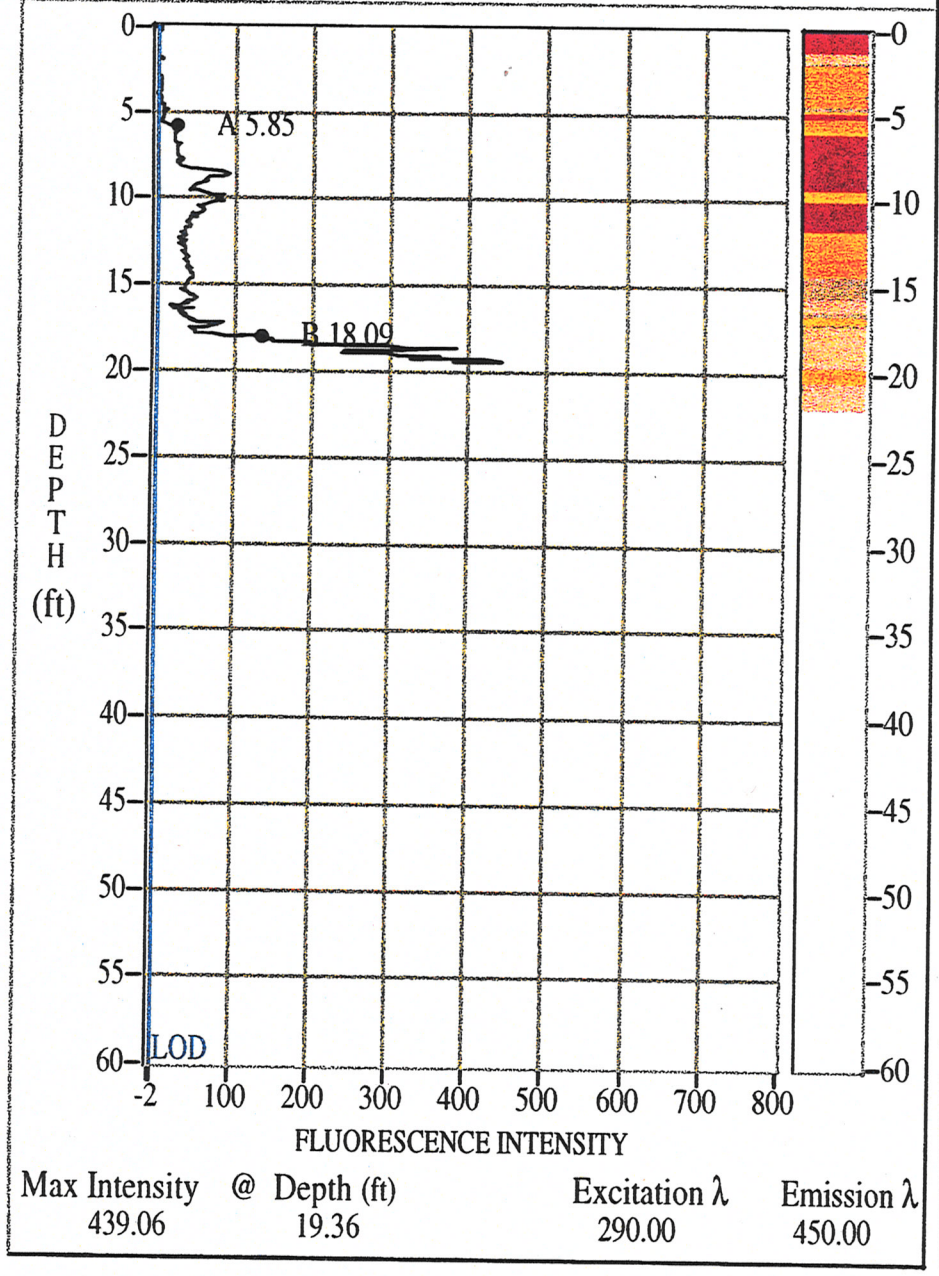
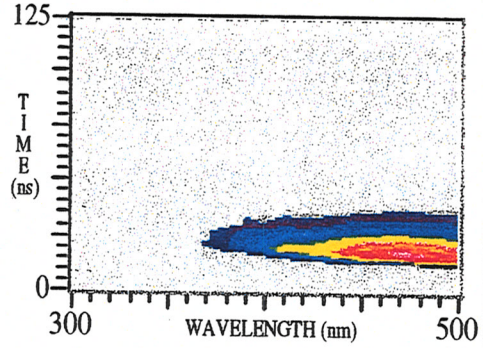
INTEGRATED ROST/CPT DATA LOG

FVD ID : CPT32R



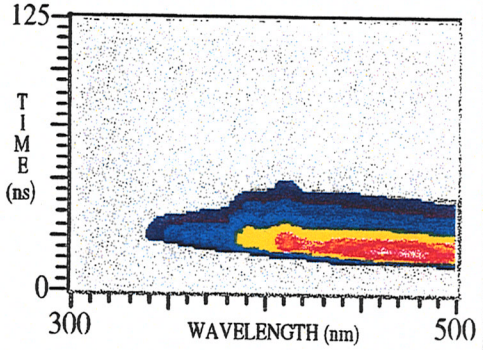
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
439.06	19.36	290.00	450.00

A WTM ID : WCPT32RA

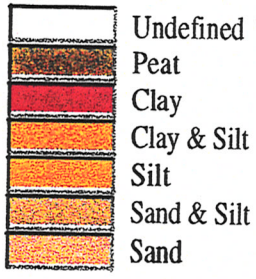


Peak Signal	0.129056 @ 470.00
FVD Signal	0.113026 @ 450.00

B WTM ID : WCPT32RB



Peak Signal	0.481148 @ 480.00
FVD Signal	0.444428 @ 450.00



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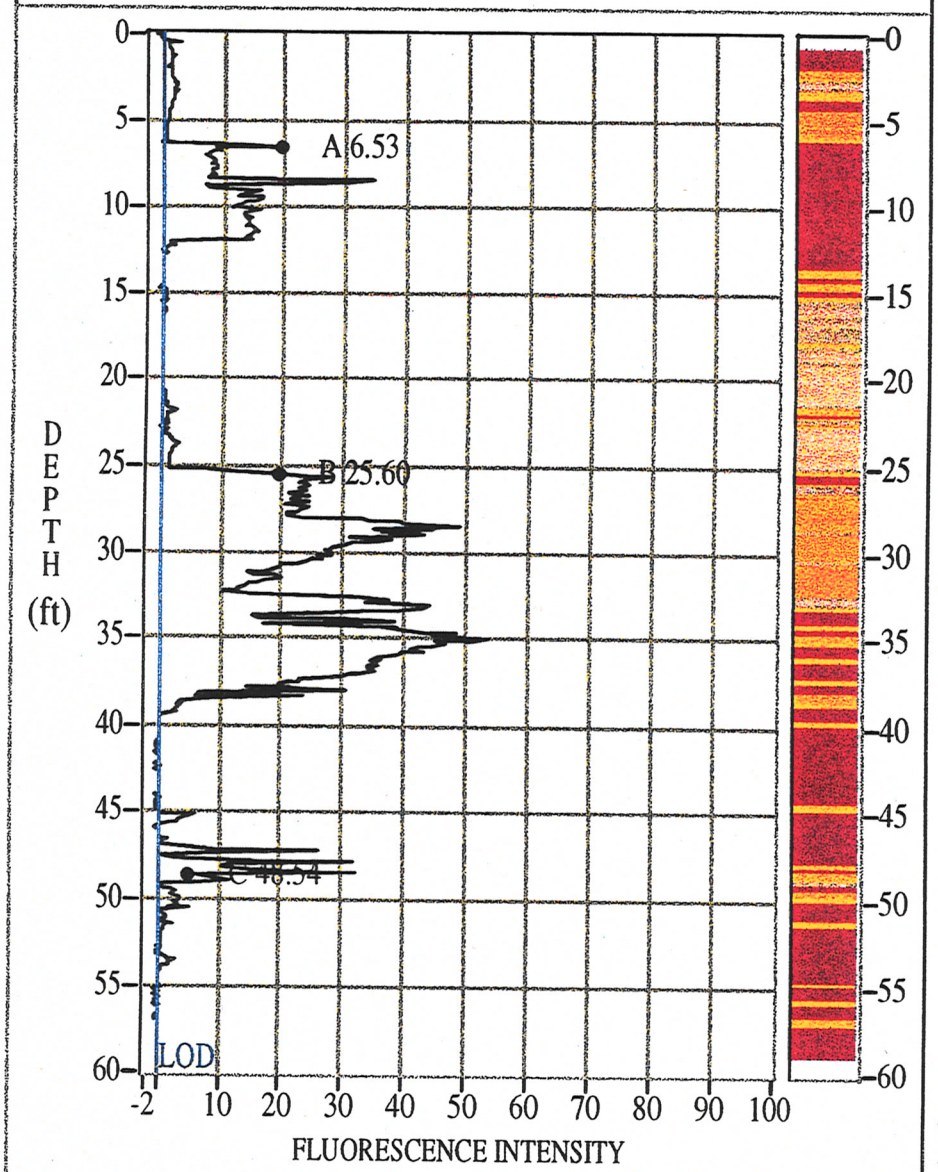
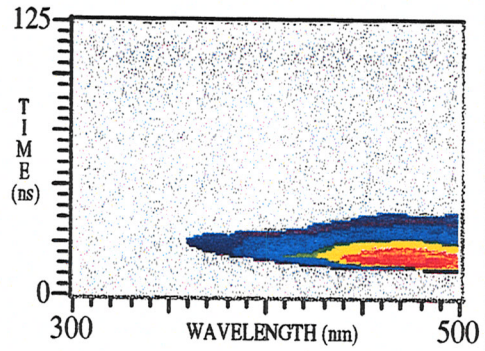
FVD ID : CPT33R



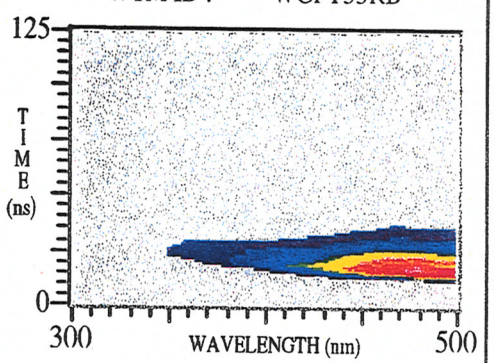
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
53.48	34.91	290.00	450.00

A WTM ID : WCPT33RA



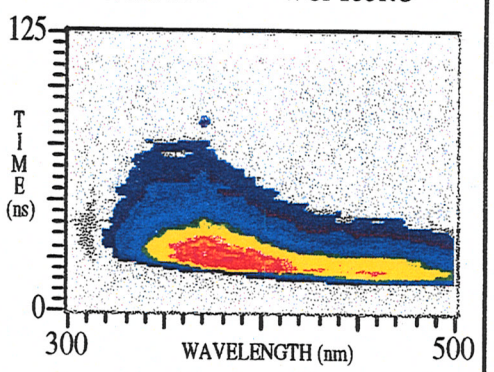
Peak Signal	0.061956 @ 470.00
FVD Signal	0.055650 @ 450.00

B WTM ID : WCPT33RB

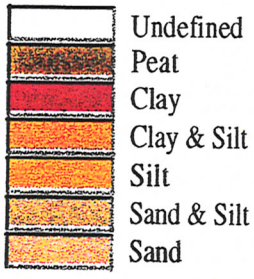


Peak Signal	0.164204 @ 480.00
FVD Signal	0.127941 @ 450.00

C WTM ID : WCPT33RC



Peak Signal	0.027297 @ 370.00
FVD Signal	0.017839 @ 450.00



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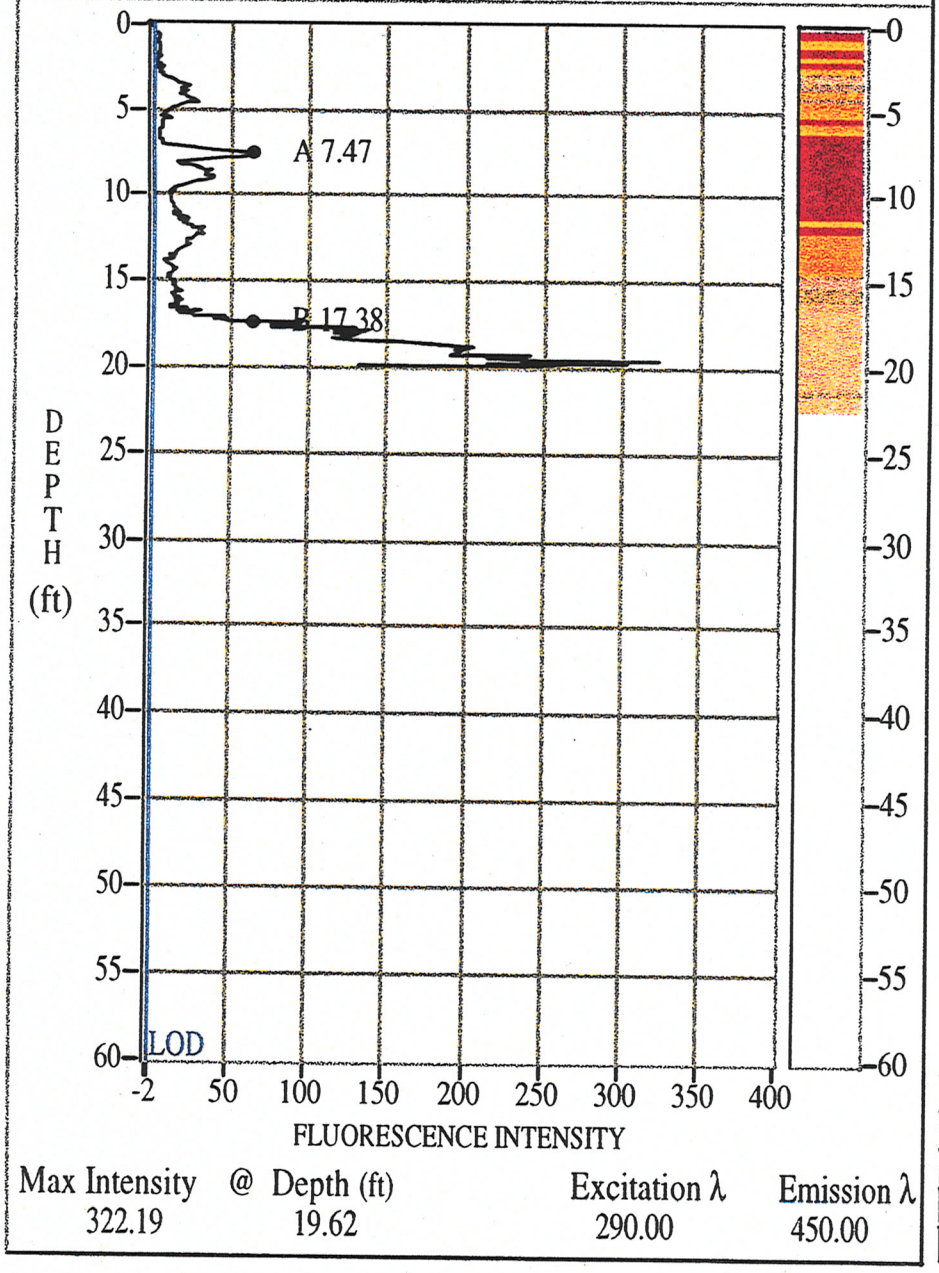
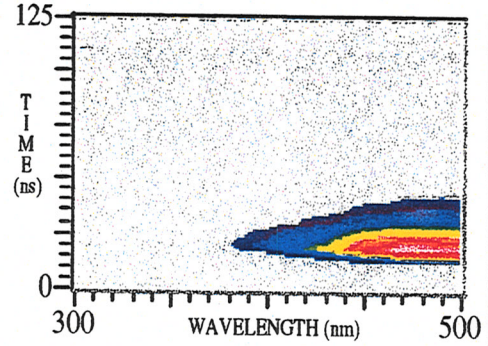
FVD ID : CPT34R



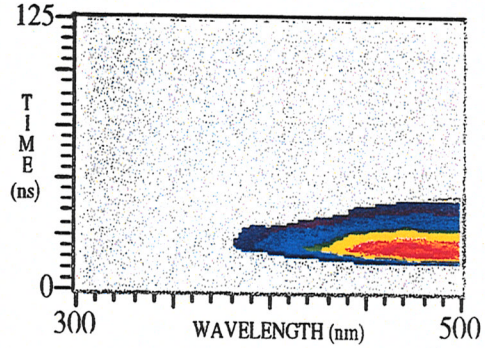
Max Intensity	@ Depth (ft)	Excitation λ	Emission λ
322.19	19.62	290.00	450.00

A WTM ID : WCPT34RA

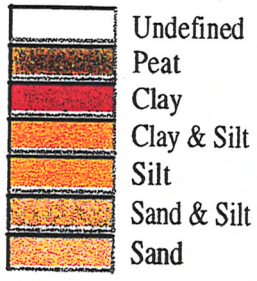


Peak Signal	0.298664 @ 470.00
FVD Signal	0.239659 @ 450.00

B WTM ID : WCPT34RB



Peak Signal	0.309948 @ 470.00
FVD Signal	0.259021 @ 450.00



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APPENDIX D
ASTM D-3441

Designation: D 3441 – 86

Standard Test Method for Deep, Quasi-Static, Cone and Friction-Cone Penetration Tests of Soil[1]

This standard is issued under the fixed designation D 3441; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of end bearing and side friction, the components of penetration resistance which are developed during the steady slow penetration of a pointed rod into soil. This method is sometimes referred to as the "Dutch Cone Test," or "Cone Penetration Test" and is often abbreviated as the "CPT."

1.2 This test method includes the use of both cone and friction-cone penetrometers, of both the mechanical and electric types. It does not include data interpretation. It also includes the penetrometer aspects of piezocone soundings, but does not include the details of piezometer construction, location, measurement, or data interpretation.

NOTE 1—The European Standard for the CPT uses a tip of right cylindrical shape as shown in Fig. 3, as their reference test against which other CPTs may be compared.

1.3 Mechanical penetrometers of the type described in this method operate incrementally, using a telescoping trometer tip, resulting in no movement of the push rods ..g the measurement of the resistance components. Design constraints for mechanical penetrometers preclude a complete separation of the end-bearing and side-friction components. Electric penetrometers are advanced continuously and permit separate measurement of both components. Differences in shape and method of advance between cone penetrometer tips may result in significant differences in one or both resistance components.

1.4 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Definitions

2.1 *cone*—the cone-shaped point of the penetrometer tip, upon which the end-bearing resistance develops.

2.2 *cone penetrometer*—an instrument in the form of a cylindrical rod with a conical point designed for penetrating soil and soft rock and for measuring the end-bearing component of penetration resistance.

2.3 *cone resistance or end-bearing resistance, q_c*—the resistance to penetration developed by the cone, equal to the vertical force applied to the cone divided by its horizontally projected area.

2.4 *cone sounding*—the entire series of penetration tests performed at one location when using a cone penetrometer.

2.5 *electric penetrometer*—a penetrometer that uses electric-force transducers built into a nontelescoping penetrometer tip for measuring, within the tip, the component(s) of penetration resistance.

2.6 *friction-cone penetrometer*—a cone penetrometer with the additional capability of measuring the local side friction component of penetration resistance.

2.7 *friction-cone sounding*—the entire series of penetration tests performed at one location when using a friction-cone penetrometer.

2.8 *friction ratio, R_f*—the ratio of friction resistance to cone resistance, f_s/q_c, expressed in percent.

2.9 *friction resistance, f_s*—the resistance to penetration developed by the friction sleeve, equal to the vertical force applied to the sleeve divided by its surface area. This resistance consists of the sum of friction and adhesion.

2.10 *friction sleeve*—a section of the penetrometer tip upon which the local side-friction resistance develops.

2.11 *inner rods*—rods that slide inside the push rods to extend the tip of a mechanical penetrometer.

2.12 *mechanical penetrometer*—a penetrometer that uses a set of inner rods to operate a telescoping penetrometer tip and to transmit the component(s) of penetration resistance to the surface for measurement.

2.13 *penetrometer tip*—the end section of the penetrometer, which comprises the active elements that sense the soil resistance, the cone, and in the case of the friction-cone penetrometer, the friction sleeve.

2.13.1 *Discussion*—The addition of a piezometer to the electric penetrometer tip permits the measurement of pore water pressure during and after stopping tip penetration. A penetrometer including a piezometer is known as a piezocone penetrometer, or just piezocone.

2.14 *piezocone sounding*—the entire series of penetration tests performed at one location when using a piezocone penetrometer.

2.15 *push rods*—the thick-walled tubes, or other suitable rods, used for advancing the penetrometer tip to the required test depth.

3. Significance and Use

3.1 This test method supplies data on the engineering properties of soil intended to help with the design and construction of earthworks and the foundations for structures.

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[1] This test method is under the jurisdiction of ASTM Committee D-18 on Soil ..ock and is the direct responsibility of Subcommittee D18.02 on Sampling ..elated Field Testing for Soil Investigations.

Current edition approved Oct. 31, 1986. Published December 1986. Originally published as D 3441 – 75 T. Last previous edition D 3441 – 79.

3.2 This test method tests the soil in place and does not obtain soil samples. The interpretation of the results from this method requires knowledge of the types of soil penetrated. Engineers usually obtain this soil information from parallel borings and soil sampling methods, but prior information or experience may preclude the need for borings.

3.3 Engineers often correlate the results of tests by this test method with laboratory or other types of field tests, or directly with performance. The accuracy of such correlations will vary with the type of soil involved. Engineers usually rely on local experience to judge this accuracy.

3.4 Most engineers with offshore experience have also found this test method suitable for offshore use.

4. Apparatus

4.1 *General:*

4.1.1 *Cone*—The cone shall have a 60° (±5°) point angle and a base diameter of 1.406 ± 0.016 in. (35.7 ± 0.4 mm), resulting in a projected area of 1.55 in.^{2} (10 cm^2). The point of the cone shall have a radius less than ⅛ in. (3 mm).

NOTE 2—Cone tips with larger end areas may be used to increase measurement sensitivity in weak soils. Experience with electrical tips with end area between 0.78 in.^{2} (5 cm^2) and 3.10 in.^{2} (20 cm^2) has shown that they produce data similar to the 1.55 in.^{2} (10 cm^2) standard provided they maintain the same tip geometry. Cone tip sizes in this range may be used for special circumstances provided the cone tip and friction sleeve (if any) area is noted.

4.1.2 *Friction Sleeve*, having the same outside diameter +0.024 to −0.000 in. (+0.5 to −0.0 mm) as the base diameter of the cone (see 4.1.1). No other part of the penetrometer tip shall project outside the sleeve diameter. The surface area of the sleeve shall be 23.2 in.^{2} (150 cm^2) ±2 %.

4.1.3 *Steel*—The cone and friction sleeve shall be made from steel of a type and hardness suitable to resist wear due to abrasion by soil. The friction sleeve shall have and maintain with use a roughness of 20 μin. (0.5 μm) AA, ±50 %.

4.1.4 *Push Rods*—Made of suitable steel, these rods must have a section adequate to sustain, without buckling, the thrust required to advance the penetrometer tip. They must have an outside diameter not greater than the diameter of the base of the cone for a length of at least 1.3 ft (0.4 m) above the base, or, in the case of the friction-cone penetrometer, at least 1.0 ft (0.3 m) above the top of the friction sleeve. Each push rod must have the same constant inside diameter. They must screw or attach together to bear against each other and form a rigid-jointed string of rods with a continuous, straight axis.

4.1.5 *Inner Rods*—Mechanical penetrometers require a separate set of steel, or other metal alloy, inner rods within the steel push rods. The inner rods must have a constant outside diameter with a roughness, excluding waviness, less than 10 μin. (0.25 μm) AA. They must have the same length as the push rods (±0.004 in. or ±0.1 mm) and a cross section adequate to transmit the cone resistance without buckling or other damage. Clearance between inner rods and push rods shall be between 0.020 and 0.040 in. (0.5 and 1.0 mm). See 6.8.1.

4.1.6 *Measurement Accuracy*—Maintain the thrust-measuring instrumentation to obtain thrust measurements within ±5 % of the correct values.

NOTE 3—Special, and preferably redundant, instrumentation may be required in the offshore environment to assure this accuracy and the proper operation of all the remote systems involved.

4.2 *Mechanical Penetrometers:*

4.2.1 The sliding mechanism necessary in a mechanical penetrometer tip must allow a downward movement of the cone in relation to the push rods of at least 1.2 in. (30.5 mm).

NOTE 4—At certain combinations of depth and tip resistance(s), the elastic compression of the inner rods may exceed the downward stroke that the thrust machine can apply to the inner rods relative to the push rods. In this case, the tip will not extend and the thrust readings will rise elastically to the end of the machine stroke and then jump abruptly when the thrust machine makes contact with the push rods.

4.2.2 Mechanical penetrometer tip design shall include protection against soil entering the sliding mechanism and affecting the resistance component(s) (see 4.2.3 and Note 5).

4.2.3 *Cone Penetrometer*—Figure 1 shows the design and action of one mechanical cone penetrometer tip. A mantle of reduced diameter is attached above the cone to minimize possible soil contamination of the sliding mechanism.

NOTE 5—An unknown amount of side friction may develop along this mantle and be included in the cone resistance.

4.2.4 *Friction-Cone Penetrometer*—Figure 2 shows the design and action of one telescoping mechanical friction cone penetrometer tip. The lower part of the tip, including a mantle to which the cone attaches, advances first until the flange engages the friction sleeve and then both advance.

NOTE 6—The shoulder at the lower end of the friction sleeve encounters end-bearing resistance. In sands as much as two thirds of the sleeve resistance may consist of bearing on this shoulder. Ignore this effect in soft to medium clays.

4.2.5 *Measuring Equipment*—Measure the penetration resistance(s) at the surface by a suitable device such as hydraulic or electric load cell or proving ring.

4.3 *Electric Penetrometers:*

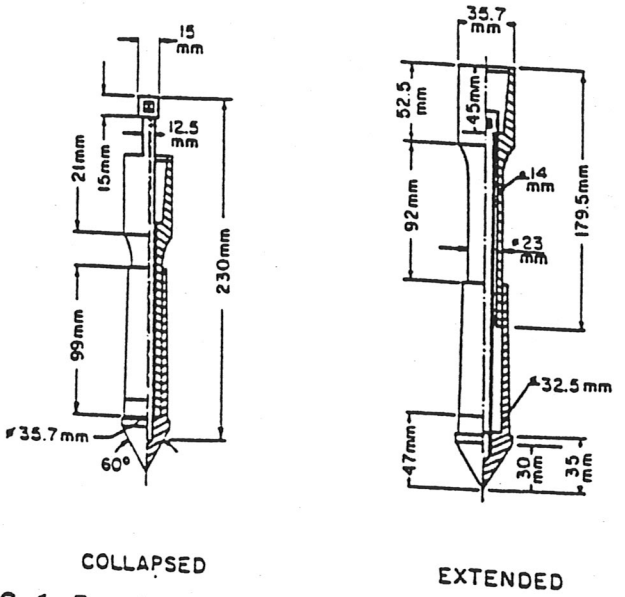


FIG. 1 Example of a Mechanical Cone Penetrometer Tip (Dutch Mantle Cone)

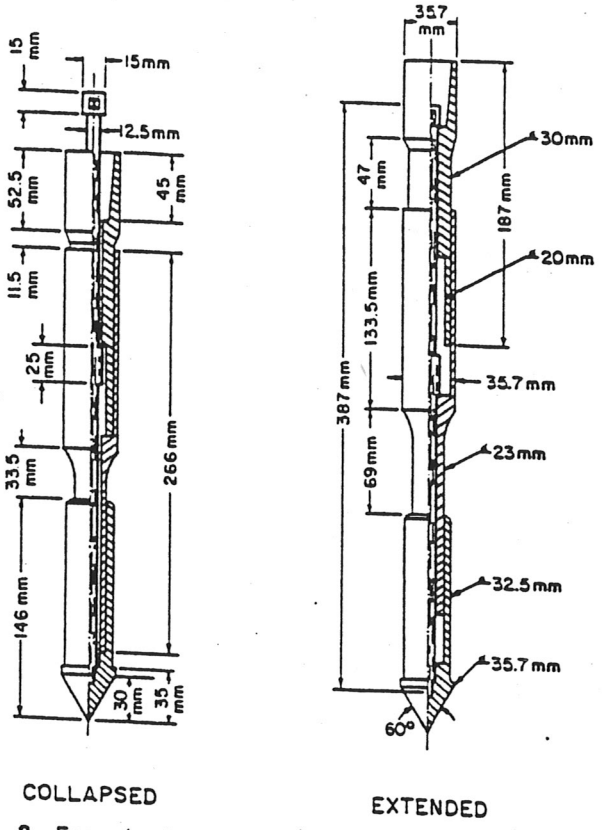


FIG. 2 Example of a Mechanical Friction-Cone Penetrometer Tip (Begemann Friction-Cone)

4.3.1 *Cone Penetrometer*—Figure 3 shows one design for an electric-cone penetrometer tip. The cone resistance is measured by means of a force transducer attached to the cone. An electric cable or other suitable system transmits the transducer signals to a data recording system. Electric-cone penetrometers shall permit continuous advance and recording over each push rod-length interval.

4.3.2 *Friction-Cone Penetrometer*—The bottom of the friction sleeve shall not be more than 0.4 in. (10 mm) above the base of the cone. The same requirements as 4.3.1 apply. Figure 4 shows one design for an electric friction-cone penetrometer tip.

4.3.3 *Other Penetrometers*—Electric penetrometers may include other transducer measurements as well as, or instead of, the friction sleeve measurement. Common ones are inclinometers to assist with the alignment control of the tip (see 6.3) and piezometers to provide additional data on soil stratigraphy and behavior.

4.4 *Thrust Machine*—This machine shall provide a continuous stroke, preferably over a distance greater than one push rod length. The machine must advance the penetrometer tip at a constant rate while the magnitude of the thrust required fluctuates (see 5.1.2).

NOTE 7—Deep penetration soundings usually require a thrust capability of at least 5 tons (45 kN). Most modern machines use hydraulic pistons with 10 to 20-ton (90 to 180-kN) thrust capability.

4.5 *Reaction Equipment*—The proper performance of the static-thrust machine requires a stable, static reaction.

NOTE 8—The type of reaction provided may affect the penetrometer resistance(s) measured, particularly in the surface or near-surface layers.

5. Procedure

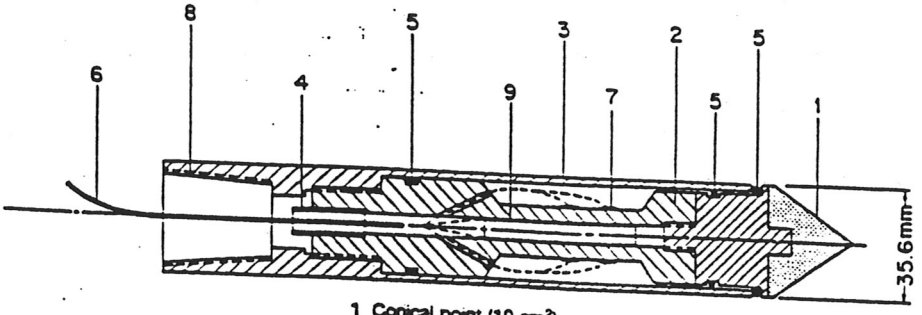
5.1 *General:*

5.1.1 Set up the thrust machine for a thrust direction as near vertical as practical.

5.1.2 *Rate of Penetration*—Maintain a rate of depth penetration of 2 to 4 ft/min (10 to 20 mm/s) ±25 % when obtaining resistance data. Other rates of penetration may be used between tests.

NOTE 9—The rate of 2 ft/min (10 mm/s) provides the time the operator needs to read properly the resistance values when using the mechanical friction-cone penetrometer. The rate of 4 ft/min (20 mm/s) is suitable for the single resistance reading required when using the mechanical cone penetrometer and provides for the efficient operation of electric penetrometers. The European standard requires 4 ft/min (20 mm/s).

NOTE 10—Rates of penetration either slower or faster than the standard rate may be used for special circumstances, such as pore pressure measurements. This is permissible provided the rate actually used and the reason for the deviation is noted on the test record.



1 Conical point (10 cm²)
2 Load cell
3 Protective mantle
4 Waterproof bushing
5 O-rings
6 Cable
7 Strain gages
8 Connection with rods
9 Inclinometer

FIG. 3 Electric-Cone Penetrometer Tip

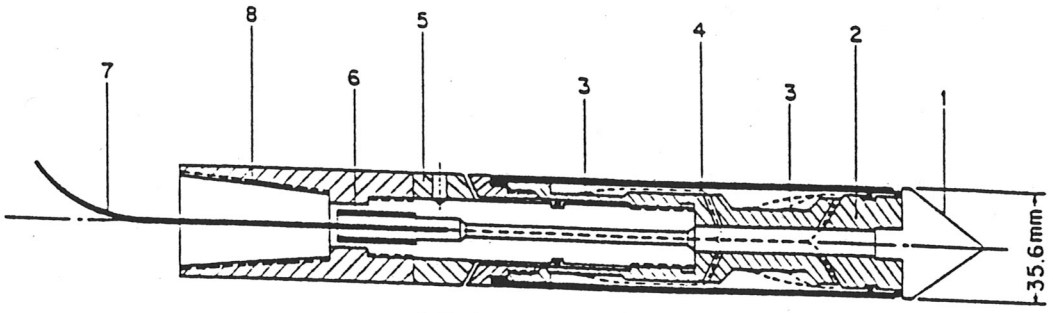


FIG. 4 Electric Friction-Cone Penetrometer Tip

NOTE 11—Pore pressures generated ahead of and around the penetrating cone or friction cone penetrometer tip can have an important effect on the q_c and f_s values measured. Piezocone tips with simultaneous pore pressure measurement capability have proven useful to help evaluate such effects and to provide additional data about the stratigraphy and engineering properties of the soils penetrated.

5.2 *Mechanical Penetrometers:*

5.2.1 *Cone Penetrometer*—(*1*) Advance penetrometer tip to the required test depth by applying sufficient thrust on the push rods; and (*2*) Apply sufficient thrust on the inner rods to extend the penetrometer tip (see Fig. 1). Obtain the cone resistance at a specific point (see 5.2.3) during the downward movement of the inner rods relative to the stationary push rods. Repeat step *(1)*. Apply sufficient thrust on the push rods to collapse the extended tip and advance it to a new test depth. By continually repeating this two-step cycle, obtain cone resistance data at increments of depth. This increment shall not ordinarily exceed 8 in. (203 mm).

5.2.2 *Friction-Cone Penetrometer*—Use this penetrometer as described in 5.2.1 but obtain two resistances during the step *(2)* extension of the tip (see Figs. 2 and 5). First obtain the cone resistance during the initial phase of the extension. When the lower part of the tip engages and pulls down the friction sleeve, obtain a second measurement of the total resistance of the cone plus the sleeve. Subtraction gives the sleeve resistance.

NOTE 12—Because of soil layering, the cone resistance may change during the additional downward movement of the tip required to obtain the friction measurement.

NOTE 13—The soil friction along the sleeve puts an additional overburden load on the soil above the cone and may increase cone resistance above that measured during the initial phase of the tip extension by an unknown, but probably small amount. Ignore this effect.

5.2.3 *Recording Data*—To obtain reproducible cone-resistance test data, or cone and friction-resistance test data when using a friction-cone tip, record only those thrust readings that occur at a well-defined point during the downward movement of the top of the inner rods in relation to the top of the push rods. Because of the elastic compression of inner rods (see Note 4), this point ordinarily should be at not less than 1.0 in. (25 mm) apparent relative movement of the inner rods. When using the friction-cone penetrometer, this point shall be just before the cone engages the friction sleeve.

NOTE 14—Figure 5 shows one example of how the thrust in the hydraulic load cell can vary during the extension of the friction-cone tip. Note the jump in gage pressure when the cone engages the sleeve.

5.2.3.1 Obtain the cone plus friction-resistance reading as soon as possible after the jump so as to minimize the error described in Fig. 5. Unless using continuous recording as in Fig. 5, the operator should not record a cone plus friction resistance if he suspects the cone resistance is changing abruptly or erratically.

5.3 *Electric Penetrometers:*

5.3.1 If using continuous electric cable, prethread it through the push rods.

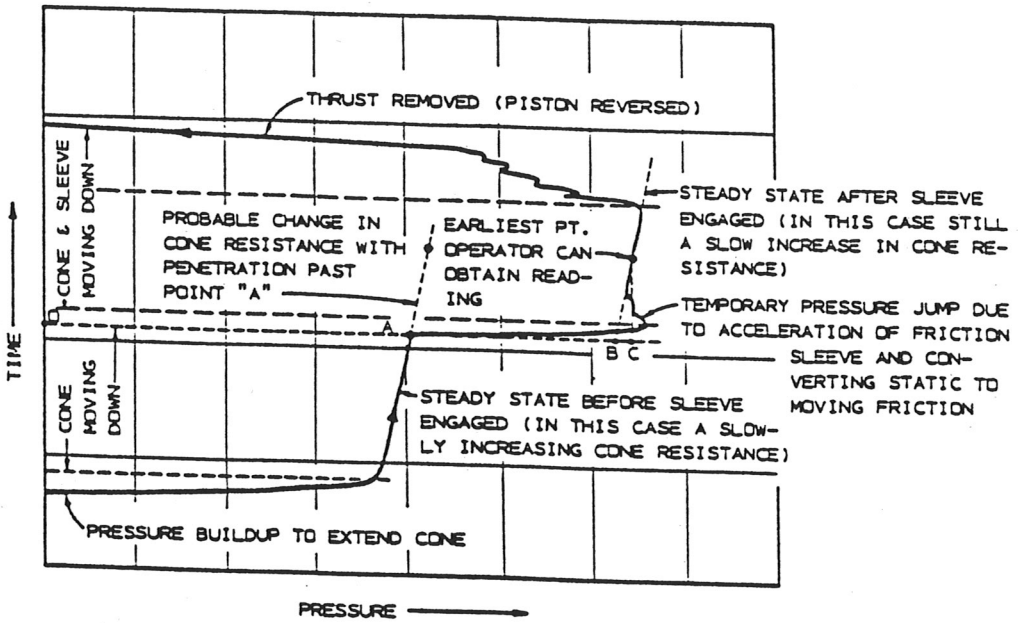
5.3.2 Record the initial reading(s) with the penetrometer tip hanging freely in air or in water, out of direct sunlight and after an initial, short penetration, test hole so that the tip temperature is at soil temperature.

5.3.3 Record the cone resistance, or cone resistance and friction resistance, continuously with depth or note them at intervals of depth not exceeding 8 in. (203 mm).

5.3.4 At the end of a sounding, obtain a final set of readings as in 5.3.2 and check them against the initial set. Discard the sounding, and repair or replace the tip if this check is not satisfactory for the accuracy desired for the resistance component(s).

6. Special Techniques and Precautions

6.1 *Reduction of Friction Along Push Rods*—The purpose of this friction reduction is to increase the penetrometer depth capability, and not to reduce any differences between resistance components determined by mechanical and electric tips as noted in 1.3. To accomplish the friction reduction, introduce a special rod with an enlarged diameter or special projections, called a "friction reducer," into the string of push rods or between the push rods and the tip. Another allowable method to reduce friction is to use push rods with a diameter less than that of the tip. In accordance with 4.1.4, any such projections or changes in diameter must begin no closer than 1.0 ft (0.3 m) from the base of the cone or the top



NOTE—"o-a" represents the correct cone resistance reading just before the pressure jump associated with engaging the friction sleeve during the continuing downward extension of the tip. "a-b" is the correct friction resistance if the friction sleeve could be engaged instantaneously and the cone plus friction resistance read instantaneously. However, the operator cannot read a pressure gage dial until it steadies, such as at point "c." By this forced wait, the operator has introduced a friction resistance error of "b-c." The operator must read the gage as soon as possible after the jump to minimize this error. Erratic or abrupt changes in cone resistance may make this error unacceptable.

FIG. 5 Annotated Chart Record of the Pressure Changes in the Hydraulic Load Cell Measuring Thrust on Top of the Inner Rods During an Example Extension of the Mechanical Friction-Cone Penetrometer Tip

of the friction sleeve when using cones with the standard 4.1.1 diameter. For other cones (see Note 2) use no closer n 8 diameters.

NOTE 15—Non-mechanical techniques to reduce friction, such as the use of drilling mud above the tip, are also allowable.

6.2 *Prevention of Rod Bending Above Surface*—Use a tubular rod guide, at the base of the thrust machine, of sufficient length to prevent significant bending of the push rods between the machine and the ground surface.

NOTE 16—Special situations, such as when working through water, will require a special system of casing support to restrict adequately the buckling of the push rods.

6.3 *Drift of Tip*—For penetration depths exceeding about 40 ft (12 m), the tip will probably drift away from a vertical alignment. Occasionally, serious drifting occurs, even at less depth. Reduce drifting by using push rods that are initially straight and by making sure that the initial cone penetration into soil does not involve unwanted, initial lateral thrust. Passing through or alongside an obstruction such as boulders, soil concretions, thin rock layers, or inclined dense layers may deflect the tip and induce drifting. Note any indications of encountering such obstructions and be alert for possible subsequent improper tip operation as a sign of serious drifting.

NOTE 17—Electric penetrometer tips may also incorporate an inclinometer to monitor drift and provide a warning when it becomes excessive.

6.4 *Wear of Tip*—Penetration into abrasive soils eventu-ly wears down or scours the penetrometer tip. Discard tips, or parts thereof, whose wear changes their geometry or surface roughness so they no longer meet the requirements of 4.1. Permit minor scratches.

6.5 *Distance Between Cone and Friction Sleeve*—The friction resistance of the sleeve applies to the soil at some distance above the soil in which the cone resistance was obtained at the same time. When comparing these resistances for the soil at a specified depth, for example when computing friction ratios or when plotting these data on graphs, take proper account of the vertical distance between the base of the cone and the midheight of the friction sleeve.

6.6 *Interruptions*—The engineer may have to interrupt the normal advance of a static penetration test for purposes such as removing the penetrometer and drilling through layers or obstructions too strong to penetrate statically. If the penetrometer is designed to be driven dynamically without damage to its subsequent static performance (those illustrated herein in Figs. 1 to 4 are not so designed), the engineer may drive past such layers or obstructions. Delays of over 10 min due to personnel or equipment problems shall be considered an interruption. Continuing the static penetration test after an interruption is permitted provided this additional testing remains in conformance with this standard. Obtain further resistance component data only after the tip passes through the engineer's estimate of the disturbed zone resulting from the nature and depth of the interruption. As an alternative, readings may be continued without first making the additional tip penetration and the disturbed zone evaluated from these data. Then disregard data within the disturbed zone.

NOTE 18—Interruption of the piezocone sounding after a push allows the engineer to examine the dissipation of positive or negative excess pore water pressure.

6.7 *Below or Adjacent to Borings*—A cone or friction-cone sounding shall not be performed any closer than 25 boring diameters from an existing, unbackfilled, uncased boring hole. When performed at the bottom of a boring, the engineer should estimate the depth below the boring of the disturbed zone and disregard penetration test data in this zone. The depth may vary from one to five diameters. Where the engineer does not have sufficient experience with this variable a depth of at least three boring diameters should be used.

6.8 *Mechanical Penetrometers:*

6.8.1 *Inner Rod Friction*—Soil particles and corrosion can increase the friction between inner rods and push rods, possibly resulting in significant errors in the measurement of the resistance component(s). Clean and lubricate the inner rods.

6.8.2 *Weight of Inner Rods*—For improved accuracy at low values of cone resistance, correct the thrust data to include the accumulated weight of the inner rods from the tip to the topmost rod.

6.8.3 *Jamming*—Soil particles between sliding surfaces or bending of the tip may jam the mechanism during the many extensions and collapses of the telescoping mechanical tip. Stop the sounding as soon as uncorrectable jamming occurs.

6.9 *Electric Penetrometers:*

6.9.1 *Water Seal*—Provide adequate waterproofing for the electric transducer. Make periodic checks to assure that no water has passed the seals.

NOTE 19—Some electric tip sleeve designs are not compensated for hydrostatic end area effects and require a calibration correction. Determining the net end area of the cone under hydrostatic pressure also requires a hydrostatic calibration measurement. The tip manufacturer can usually supply these calibration correction constants. Their importance increases as the soil being tested becomes weaker.

7. Report

7.1 *Graph of Cone Resistance, q_c*—Every report of a cone or friction-cone sounding shall include a graph of the variation of cone resistance (in units of tons or kPa) with depth (in feet or metres). Successive cone-resistance test values from the mechanical cone and friction-cone penetrometers, usually determined at equal increments of depth and plotted at the depth corresponding to the depth of the measurement, may be connected with straight lines as an approximation for a continuous graph.

7.2 *Friction-Cone Penetrometer:*

7.2.1 *Graph of Friction Resistance, f_s*—In addition to the graph of cone resistance (7.1) the report may include an adjacent or superposed graph of friction resistance or friction ratio, or both, with depth. Use the same depth scale as in 7.1 (see 6.5).

7.2.2 *Graph of Friction Ratio, R_f*—If the report includes soil descriptions estimated from the friction-cone penetrometer data, include a graph of the variation of friction ratio with depth. Place this graph adjacent to the graph for cone resistance, using the same depth scale (see 6.5).

7.3 *Piezocone Penetrometer*—In addition to the 7.1 and 7.2 report requirements, a piezocone sounding shall include a parallel graph, to the same depth scale, of measured pore water pressure during the penetration versus depth. Excess pore water pressure versus time plots may also be constructed at those depths where the piezocone sounding is interrupted (see Note 1).

7.4 *General*—The operator shall record his name, the name and location of the job, date of sounding, sounding number, location coordinates, and soil and water surface elevations (if available). The report shall also include a note as to the type of penetrometer tip used, the type of thrust machine, tip and thrust calibration information, or both, any zero-drift noted, the method used to provide the reaction force, if a friction reducer was used, the method of tip advancement, the method of recording, the condition of the rods and tip after withdrawal, and any special difficulties or other observations concerning the performance of the equipment.

7.5 *Deviations from Standard*—The report shall state that the test procedures were in accordance with this Test Method D 3441. Describe completely any deviations from this test method.

8. Precision and Bias

8.1 Because of the many variables involved and the lack of a superior standard, engineers have no direct data to determine the bias of this method. Judging from its observed reproducibility in approximately uniform soil deposits, plus the q_c and f_s measurement effects of special equipment and operator care, persons familiar with this method estimate its precision as follows:

8.1.1 *Mechanical Tips*—Standard deviation of 10 % in q_c and 20 % in f_s.

8.1.2 *Electric Tips*—Standard deviation of 5 % in q_c and 10 % in f_s.

NOTE 20—These data may not match similar data from mechanical tips (see 1.3).

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, PA 19103.

APPENDIX D

LABORATORY DATA SHEETS AND CHAIN-OF-CUSTODY DOCUMENTATION

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP01UTZ
SAMPLE NO: H417428

LIMS CLIENT: 0717 0007
PACE PROJECT: H37162
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 05-DEC-95 1310
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 25 *	ug/L
		Benzene	< 25	ug/L
		Chlorobenzene	< 25	ug/L
		Ethylbenzene	100	ug/L
		Methylene chloride	< 25	ug/L
		Toluene	< 25	ug/L
		Xylenes	1,300	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	65	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	120	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	12	ug/L
		Dibenzofuran	50	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	68	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	2,200	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	50	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L
5	I590	Solids, Dissolved at 180C	698	mg/L

COMMENTS: Continued on next page.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
SAMPLE ID: HP01UTZ
SAMPLE NO: H417428

LN	TEST CODE	DETERMINATION	RESULT	UNITS

COMMENTS: * The reporting limits were elevated due to the dilution required because of the high concentration of target analytes.

RECEIVED JAN 0 8 1996

ANALYTICAL SERVICES, INC.

January 05, 1996
Report No.: 00047685
Section A Page 1

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP01STZ
SAMPLE NO: H417426

LIMS CLIENT: 0717 0007
PACE PROJECT: H37162
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 05-DEC-95 1220
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	100	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	15	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L
5	I590	Solids, Dissolved at 180C	346	mg/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: EB01
SAMPLE NO: H417427

LIMS CLIENT: 0717 0007
PACE PROJECT: H37162
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 05-DEC-95 1255
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	12	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

LIMS CLIENT: 0717 0007
PACE PROJECT: H37162
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

SAMPLE ID: TRIP BLANK
SAMPLE NO: H417429

DATE SAMPLED: 05-DEC-95
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP07STZ
SAMPLE NO: H417430

LIMS CLIENT: 0717 0007
PACE PROJECT: H37162
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 05-DEC-95 1430
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	18	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

LIMS CLIENT: 0717 0007
PACE PROJECT: H37162
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

SAMPLE ID: HP07UTZ
SAMPLE NO: H417431

DATE SAMPLED: 05-DEC-95 1530
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	7	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	60	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	89	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	17	ug/L
		Dibenzofuran	28	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	53	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	700	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	12	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

SUPPLEMENTAL INFORMATION

LN	TEST CODE	LCSR BLNK BATCH	DUP/MS MS/MSD BATCH	SAMPLE PREPARATION LR-METHOD	SAMPLE PREPARATION DATE/TIME	SAMPLE PREPARATION ANALYST	SAMPLE ANALYSIS LR-METHOD	SAMPLE ANALYSIS DATE/TIME	SAMPLE ANALYSIS ANALYST	SAMPLE ANALYSIS INSTRUI
SAMPLE ID: HP01STZ									SAMPLE NO: H417426	
1	OVTCW2	58128	58128	NA			19-8260A	08-DEC-95 1454	MH	GCMSQ
5	I590	58215	58215	NA			02-160.1	11-DEC-95 1800	RDR	008WAT
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1659	CAH	GCMSS
SAMPLE ID: EB01									SAMPLE NO: H417427	
1	OVTCW2	58128	58128	NA			19-8260A	08-DEC-95 1522	MH	GCMSQ
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1744	CAH	GCMSS
SAMPLE ID: HP01UTZ									SAMPLE NO: H417428	
1	OVTCW2	58185	58128	NA			19-8260A	12-DEC-95 0030	MH	GCMSQ
5	I590	58215	58215	NA			02-160.1	11-DEC-95 1800	RDR	008WAT
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	14-DEC-95 1940	CAH	GCMSS
SAMPLE ID: TRIP BLANK									SAMPLE NO: H417429	
1	OVTCW2	58128	58128	NA			19-8260A	08-DEC-95 1618	MH	GCMSQ
SAMPLE ID: HP07STZ									SAMPLE NO: H417430	
1	OVTCW2	58128	58128	NA			19-8260A	08-DEC-95 1647	MH	GCMSQ
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	13-DEC-95 2200	EAY	GCMSZ
SAMPLE ID: HP07UTZ									SAMPLE NO: H417431	
1	OVTCW2	58128	58128	NA			19-8260A	08-DEC-95 1715	MH	GCMSQ
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	12-DEC-95 2117	ASP	GCMST

LR Method Literature Reference

02 EPA-Methods for Chemical Analysis of Water & Wastes, 1984.
19 EPA-Test Methods for Evaluating Solid Waste, 3rd ed, Nov. 1986 and updates

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: HP01STZ				SAMPLE NO: H417426	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	104	-	
		Toluene-d8	92	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	60	-	
		2-Fluorobiphenyl	55	-	
		2-Fluorophenol	43	-	
		Nitrobenzene-d5	71	-	
		Phenol-d5	32	-	
		p-Terphenyl-d14	65	-	
SAMPLE ID: EB01				SAMPLE NO: H417427	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	103	-	
		Toluene-d8	96	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	50	-	
		2-Fluorobiphenyl	48	-	
		2-Fluorophenol	30	-	
		Nitrobenzene-d5	66	-	
		Phenol-d5	20	-	
		p-Terphenyl-d14	76	-	
SAMPLE ID: HP01UTZ				SAMPLE NO: H417428	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	93	-	
		Dibromofluoromethane	86	-	
		Toluene-d8	92	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	65	-	
		2-Fluorobiphenyl	66	-	
		2-Fluorophenol	46	-	
		Nitrobenzene-d5	78	-	
		Phenol-d5	14	-	
		p-Terphenyl-d14	69	-	
SAMPLE ID: TRIP BLANK				SAMPLE NO: H417429	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	104	-	

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: TRIP BLANK				SAMPLE NO: H417429	
		Toluene-d8	96	-	
SAMPLE ID: HP07STZ				SAMPLE NO: H417430	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	96	-	
		Toluene-d8	96	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	85	-	
		2-Fluorobiphenyl	73	-	
		2-Fluorophenol	38	-	
		Nitrobenzene-d5	69	-	
		Phenol-d5	28	-	
		p-Terphenyl-d14	86	-	
SAMPLE ID: HP07UTZ				SAMPLE NO: H417431	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	100	-	
		Toluene-d8	93	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	20	-	
		2-Fluorobiphenyl	67	-	
		2-Fluorophenol	46	-	
		Nitrobenzene-d5	99	-	
		Phenol-d5	24	-	
		p-Terphenyl-d14	55	-	

LABORATORY CONTROL SAMPLE RECOVERY

TEST CODE	DETERMINATION	LCS % RECOVERY	ACCEPTANCE LIMITS
BATCH NO: 58072			SAMPLE NO: H360442
OSVTCW	TCL - Semi-volatile Extractables in Water		
	1,2,4-Trichlorobenzene	71	-
	1,4-Dichlorobenzene	71	-
	2,4-Dinitrotoluene	78	-
	2-Chlorophenol	66	-
	4-Nitrophenol	90	-
	Acenaphthene	71	-
	Pentachlorophenol	78	-
	Phenol	66	-
	Pyrene	70	-
	n-Nitrosodi-n-propylamine	70	-
	p-Chloro-m-cresol	71	-
BATCH NO: 58128			SAMPLE NO: H360532
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	92	-
	Benzene	92	-
	Chlorobenzene	100	-
	Toluene	91	-
	Trichloroethene	87	-
BATCH NO: 58185			SAMPLE NO: H360629
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	68	-
	Benzene	123	-
	Chlorobenzene	121	-
	Toluene	114	-
	Trichloroethene	119	-
BATCH NO: 58215			SAMPLE NO: H360676
I590	Solids, Dissolved at 180C	99.2	-

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58072		SAMPLE NO:	H360443
OSVTCW	TCL - Semi-volatile Extractables in Water		
	1,2-Diphenylhydrazine	< 10	ug/L
	2,4-Dimethylphenol	< 10	ug/L
	2,4-Dinitrotoluene	< 10	ug/L
	2,6-Dinitrotoluene	< 10	ug/L
	2-Chloronaphthalene	< 10	ug/L
	2-Methylnaphthalene	< 10	ug/L
	4,6-Dinitro-o-cresol	< 50	ug/L
	4-Nitrophenol	< 50	ug/L
	Acenaphthene	< 10	ug/L
	Acenaphthylene	< 10	ug/L
	Anthracene	< 10	ug/L
	Benzo(a)anthracene	< 10	ug/L
	Benzo(a)pyrene	< 10	ug/L
	Chrysene	< 10	ug/L
	Di-n-butylphthalate	< 10	ug/L
	Dibenzofuran	< 10	ug/L
	Fluoranthene	< 10	ug/L
	Fluorene	< 10	ug/L
	N-Nitrosodiphenylamine	< 10	ug/L
	Naphthalene	< 10	ug/L
	Nitrobenzene	< 10	ug/L
	Pentachlorophenol	< 50	ug/L
	Phenanthrene	< 10	ug/L
	Phenol	< 10	ug/L
	Pyrene	< 10	ug/L
	bis(2-Chloroethoxy)methane	< 10	ug/L
	bis(2-Chloroethyl)ether	< 10	ug/L
BATCH NO: 58128		SAMPLE NO:	H360533
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L
BATCH NO: 58185		SAMPLE NO:	H360630
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L
BATCH NO: 58215		SAMPLE NO:	H360677
I590	Solids, Dissolved at 180C	< 5	mg/L

DUPLICATE AND MATRIX SPIKE DATA

TEST CODE	DETERMINATION	ORIGINAL RESULT	DUPLICATE RESULT	UNITS	RANGE / RPD	MS RESULT	MS % RCVRY
BATCH NO: 58215						SAMPLE NO: H416519	
I590	Solids, Dissolved at 180C	2,508	2,682	mg/L	6.7		
BATCH NO: 58215						SAMPLE NO: H417673	
I590	Solids, Dissolved at 180C	703	816	mg/L	14.9		

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE DATA

TEST CODE	DETERMINATION	MS RESULT	MSD RESULT	UNITS	RPD	MS PCT RCVRY	MSD PC RCVR
BATCH NO: 57727						SAMPLE NO: H359899	
OSVTCW	TCL - Semi-volatile Extractables in Water						
	1,2,4-Trichlorobenzene	74.4	70.3	ug/L	5.67	74	70
	1,4-Dichlorobenzene	74.9	70.3	ug/L	6.34	75	70
	2,4-Dinitrotoluene	85.6	78.9	ug/L	8.14	86	79
	2-Chlorophenol	139.5	132.1	ug/L	5.45	70	66
	4-Nitrophenol	215.1	198.9	ug/L	7.83	108	99
	Acenaphthene	76.4	73.4	ug/L	4.00	76	73
	N-Nitroso-di-n-propylamine	73.9	71.1	ug/L	3.86	74	71
	Pentachlorophenol	172.8	162.3	ug/L	6.27	86	81
	Phenol	148.2	139.7	ug/L	5.90	74	70
	Pyrene	81.2	75.0	ug/L	7.94	81	75
	p-Chloro-m-cresol	148.8	146.5	ug/L	1.56	74	73
BATCH NO: 58128						SAMPLE NO: H417429	
OVTCW2	8260A TCL Volatiles in Water						
	1,1-Dichloroethene	53.0	65.0	ug/L	20.3*	106	130
	Benzene	49.6	59.3	ug/L	18.3	99	119
	Chlorobenzene	57.6	61.8	ug/L	7.50	115	124
	Toluene	48.8	55.5	ug/L	12.4	98	111
	Trichloroethene	48.4	56.5	ug/L	15.2	97	113

* The RPD was out of range due to matrix interference.

Industrial Compliance

A Subsidiary of SP Environmental Systems, Inc.

303/277-1400

PROJECT NAME: HWPW

SITE LOCATION: 4910 LIBERTY ROAD, HOUSTON, TX

PROJECT #: 44102069

I.C. CHAIN OF CUSTODY RECORD

1..02

C.O.C. #

SHIP TO: PACE LABS

SAMPLERS NAME & SIGNATURE: William R Goldsby / William R Goldsby

I.C. CONTACT & PHONE: B. GOLDSBY (713) 460-4230; E. HANFORD (214) 352-9400

LAB. CONTACT & PHONE: ELESSA SOMMERS

SAMPLE #	DATE	TIME	COMP.	GRAB	SAMPLE LOCATION	# OF CONTAINERS	ANALYSIS METHOD: BTEX (8260)	ANALYSIS METHOD: PAH (8270)	PRESERVATIVES YES	PRESERVATIVES NO	CUSTODY SEALS YES	CUSTODY SEALS NO	*REMARKS:
HP01STZ	12/5/95	12:20		X	CPT07E	4	X	X	VOAS	LITERS		X	H417426
EB01		12:55		X	CPT08E	4	X	X	VOAS	LITERS		X	427
HP01UTZ		13:10		X	CPT07E	4	X	X	VOAS	LITERS		X	428
TRIP BLANK						2	X		VOAS			X	429
HP07STZ		14:30		X	CPT02E	4	X	X	VOAS	LITERS		X	430
HP07UTZ		15:30		X	CPT02E	4	X	X	VOAS	LITERS		X	431

Last Line — William R Goldsby

RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
William R Goldsby	12-5-95 16:12	R. [signature]			
R. [signature]	12-5-95 16:10				
	12-5-95	RECEIVED AT LAB. BY	METHOD OF SHIPMENT		

*REMARKS:

RECEIVED JAN 0 8 1996

pace ANALYTICAL SERVICES, INC.

January 03, 1996
Report No.: 00047650

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP04STZ
SAMPLE NO: H417417

LIMS CLIENT: 0717 0007
PACE PROJECT: H37161
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 04-DEC-95 1305
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	24	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	18	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	10	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	45	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	46	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP04UTZ
SAMPLE NO: H417418

LIMS CLIENT: 0717 0007
PACE PROJECT: H37161
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 04-DEC-95 1415
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	22	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	11	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	34	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	23	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	14	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	32	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	260	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP03STZ
SAMPLE NO: H417419

LIMS CLIENT: 0717 0007
PACE PROJECT: H37161
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 04-DEC-95 1545
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Naphthalene	< 10	ug/L
		Toluene	< 5	ug/L
		m-Xylene	< 5	ug/L
		o-Xylene	< 5	ug/L
		p-Xylene	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	27	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Nitrobenzene	< 50	ug/L
		Pentachlorophenol	< 10	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate		

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

LIMS CLIENT: 0717 0007
PACE PROJECT: H37161
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

SAMPLE ID: HP03UTZ
SAMPLE NO: H417420

DATE SAMPLED: 04-DEC-95 1635
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		m-Xylene	< 5	ug/L
		o-Xylene	< 5	ug/L
		p-Xylene	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	19	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
SAMPLE ID: HP03UTZ
SAMPLE NO: H417420

LN	TEST CODE	DETERMINATION	RESULT	UNITS
5	1590	Solids, Dissolved at 180C	906	mg/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP02STZ
SAMPLE NO: H417421

LIMS CLIENT: 0717 0007
PACE PROJECT: H37161
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 05-DEC-95 0830
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		m-Xylene	< 5	ug/L
		o-Xylene	< 5	ug/L
		p-Xylene	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	25	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: FB01
SAMPLE NO: H417422

LIMS CLIENT: 0717 0007
PACE PROJECT: H37161
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 05-DEC-95 0907
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	24	ug/L
		Naphthalene	< 10	ug/L
		Toluene	< 5	ug/L
		m-Xylene	< 5	ug/L
		o-Xylene	< 5	ug/L
		p-Xylene	< 5	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP02UTZ
SAMPLE NO: H417423

LIMS CLIENT: 0717 0007
PACE PROJECT: H37161
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 05-DEC-95 0935
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	15	ug/L
		Di-n-butylphthalate	< 10	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 50	ug/L
		Pentachlorophenol	< 10	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L
5	I590	Solids, Dissolved at 180C	695	mg/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP08UTZ
SAMPLE NO: H417424

LIMS CLIENT: 0717 0007
PACE PROJECT: H37161
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 05-DEC-95 1050
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 50 *	ug/L
		Benzene	< 50	ug/L
		Chlorobenzene	< 50	ug/L
		Ethylbenzene	240	ug/L
		Methylene chloride	< 50	ug/L
		Toluene	< 50	ug/L
		Xylenes	2,100	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	95	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	140	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	30	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	17	ug/L
		Dibenzofuran	53	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	50	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	1,100	ug/L
		Nitrobenzene	41	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	40	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

COMMENTS: Continued on next page.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
SAMPLE ID: HP08UTZ
SAMPLE NO: H417424

LN	TEST CODE	DETERMINATION	RESULT	UNITS

COMMENTS: * The reporting limits were elevated due to the dilution required because of the high concentration of target analytes.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: TRIP BLANK
SAMPLE NO: H417425

LIMS CLIENT: 0717 0007
PACE PROJECT: H37161
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: UnAvail
DATE RECEIVED: 05-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Naphthalene	< 10	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L

SUPPLEMENTAL INFORMATION

LN	TEST CODE	LCSR BLNK BATCH	DUP/MS MS/MSD BATCH	SAMPLE PREPARATION LR-METHOD	DATE/TIME	ANALYST	SAMPLE ANALYSIS LR-METHOD	DATE/TIME	ANALYST	INSTRUME
SAMPLE ID: HP04STZ									SAMPLE NO: H417417	
1	OVTCW2	58128	58128	NA			19-8260A	08-DEC-95 1230	MH	GCMSQ
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1153	CAH	GCMSS
SAMPLE ID: HP04UTZ									SAMPLE NO: H417418	
1	OVTCW2	58128	58128	NA			19-8260A	08-DEC-95 1302	MH	GCMSQ
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1238	CAH	GCMSS
SAMPLE ID: HP03STZ									SAMPLE NO: H417419	
1	OVTCW2	58018	58128	NA			19-8260A	07-DEC-95 1937	MH	GCMSQ
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1321	CAH	GCMSS
SAMPLE ID: HP03UTZ									SAMPLE NO: H417420	
1	OVTCW2	58018	58128	NA			19-8260A	07-DEC-95 2006	MH	GCMSQ
5	I590	58215	58215	NA			02-160.1	11-DEC-95 1800	RDR	008WAT
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	12-DEC-95 1800	ASP	GCMST
SAMPLE ID: HP02STZ									SAMPLE NO: H417421	
1	OVTCW2	58018	58128	NA			19-8260A	07-DEC-95 2034	MH	GCMSQ
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1448	CAH	GCMSS
SAMPLE ID: FB01									SAMPLE NO: H417422	
1	OVTCW2	58018	58128	NA			19-8260A	07-DEC-95 2102	MH	GCMSQ
SAMPLE ID: HP02UTZ									SAMPLE NO: H417423	
1	OVTCW2	58128	58128	NA			19-8260A	08-DEC-95 1330	MH	GCMSQ
5	I590	58215	58215	NA			02-160.1	11-DEC-95 1800	RDR	008WAT
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1533	ASP	GCMST
SAMPLE ID: HP08UTZ									SAMPLE NO: H417424	
1	OVTCW2	58185	58128	NA			19-8260A	11-DEC-95 2320	MH	GCMSQ
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1618	CAH	GCMSS
SAMPLE ID: TRIP BLANK									SAMPLE NO: H417425	
1	OVTCW2	58223	58128	NA			19-8260A	12-DEC-95 2355	JC	GCMSY

SUPPLEMENTAL INFORMATION

LN	TEST CODE	LCSR BLNK BATCH	DUP/MS MS/MSD BATCH	SAMPLE PREPARATION LR-METHOD	SAMPLE PREPARATION DATE/TIME	SAMPLE PREPARATION ANALYST	SAMPLE ANALYSIS LR-METHOD	SAMPLE ANALYSIS DATE/TIME	SAMPLE ANALYSIS ANALYST	INSTRUM

LR Method Literature Reference

02 EPA-Methods for Chemical Analysis of Water & Wastes, 1984.
19 EPA-Test Methods for Evaluating Solid Waste, 3rd ed, Nov. 1986 and updates

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: HP04STZ				SAMPLE NO: H417417	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	106	-	
		Toluene-d8	97	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	47	-	
		2-Fluorobiphenyl	44	-	
		2-Fluorophenol	26	-	
		Nitrobenzene-d5	50	-	
		Phenol-d5	24	-	
		p-Terphenyl-d14	51	-	
SAMPLE ID: HP04UTZ				SAMPLE NO: H417418	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	97	-	
		Toluene-d8	96	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	50	-	
		2-Fluorobiphenyl	41	-	
		2-Fluorophenol	22	-	
		Nitrobenzene-d5	50	-	
		Phenol-d5	17	-	
		p-Terphenyl-d14	61	-	
SAMPLE ID: HP03STZ				SAMPLE NO: H417419	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	96	-	
		Toluene-d8	98	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	65	-	
		2-Fluorobiphenyl	61	-	
		2-Fluorophenol	42	-	
		Nitrobenzene-d5	76	-	
		Phenol-d5	38	-	
		p-Terphenyl-d14	82	-	
SAMPLE ID: HP03UTZ				SAMPLE NO: H417420	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	94	-	

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: HP03UTZ				SAMPLE NO: H417420	
		Toluene-d8	94	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	35	-	
		2-Fluorobiphenyl	28	-	
		2-Fluorophenol	19	-	
		Nitrobenzene-d5	37	-	
		Phenol-d5	11	-	
		p-Terphenyl-d14	59	-	
SAMPLE ID: HP02STZ				SAMPLE NO: H417421	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	104	-	
		Dibromofluoromethane	95	-	
		Toluene-d8	95	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	71	-	
		2-Fluorobiphenyl	56	-	
		2-Fluorophenol	35	-	
		Nitrobenzene-d5	67	-	
		Phenol-d5	27	-	
		p-Terphenyl-d14	80	-	
SAMPLE ID: FB01				SAMPLE NO: H417422	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	89	-	
		Dibromofluoromethane	100	-	
		Toluene-d8	97	-	
SAMPLE ID: HP02UTZ				SAMPLE NO: H417423	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	94	-	
		Dibromofluoromethane	99	-	
		Toluene-d8	96	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	63	-	
		2-Fluorobiphenyl	52	-	
		2-Fluorophenol	33	-	
		Nitrobenzene-d5	64	-	
		Phenol-d5	25	-	
		p-Terphenyl-d14	71	-	

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: HP08UTZ				SAMPLE NO: H417424	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	89	-	
		Toluene-d8	94	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	61	-	
		2-Fluorobiphenyl	56	-	
		2-Fluorophenol	42	-	
		Nitrobenzene-d5	110	-	
		Phenol-d5	32	-	
		p-Terphenyl-d14	74	-	
SAMPLE ID: TRIP BLANK				SAMPLE NO: H417425	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	89	-	
		Toluene-d8	94	-	

LABORATORY CONTROL SAMPLE RECOVERY

TEST CODE	DETERMINATION	LCS % RECOVERY	ACCEPTANCE LIMITS
BATCH NO: 58018			SAMPLE NO: H360360
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	98	-
	Benzene	100	-
	Chlorobenzene	99	-
	Toluene	100	-
	Trichloroethene	100	-
BATCH NO: 58072			SAMPLE NO: H360442
OSVTCW	TCL - Semi-volatile Extractables in Water		
	1,2,4-Trichlorobenzene	71	-
	1,4-Dichlorobenzene	71	-
	2,4-Dinitrotoluene	78	-
	2-Chlorophenol	66	-
	4-Nitrophenol	90	-
	Acenaphthene	71	-
	Pentachlorophenol	78	-
	Phenol	66	-
	Pyrene	70	-
	n-Nitrosodi-n-propylamine	70	-
	p-Chloro-m-cresol	71	-
BATCH NO: 58128			SAMPLE NO: H360532
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	92	-
	Benzene	92	-
	Chlorobenzene	100	-
	Toluene	91	-
	Trichloroethene	87	-
BATCH NO: 58185			SAMPLE NO: H360629
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	68	-
	Benzene	123	-
	Chlorobenzene	121	-
	Toluene	114	-
	Trichloroethene	119	-
BATCH NO: 58215			SAMPLE NO: H360676
1590	Solids, Dissolved at 180C	99.2	-

LABORATORY CONTROL SAMPLE RECOVERY

TEST CODE	DETERMINATION	LCS % RECOVERY	ACCEPTANCE LIMITS
BATCH NO: 58223			SAMPLE NO: H360691
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	102	-
	Benzene	99	-
	Chlorobenzene	105	-
	Toluene	101	-
	Trichloroethene	106	-

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58018		SAMPLE NO:	H360361
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Naphthalene	< 10	ug/L
	Toluene	< 5	ug/L
	Xylenes(total)	< 5	ug/L
BATCH NO: 58072		SAMPLE NO:	H360443
OSVTCW	TCL - Semi-volatile Extractables in Water		
	1,2-Diphenylhydrazine	< 10	ug/L
	2,4-Dimethylphenol	< 10	ug/L
	2,4-Dinitrotoluene	< 10	ug/L
	2,6-Dinitrotoluene	< 10	ug/L
	2-Chloronaphthalene	< 10	ug/L
	2-Methylnaphthalene	< 10	ug/L
	4,6-Dinitro-o-cresol	< 50	ug/L
	4-Nitrophenol	< 50	ug/L
	Acenaphthene	< 10	ug/L
	Acenaphthylene	< 10	ug/L
	Anthracene	< 10	ug/L
	Benzo(a)anthracene	< 10	ug/L
	Benzo(a)pyrene	< 10	ug/L
	Chrysene	< 10	ug/L
	Di-n-butylphthalate	< 10	ug/L
	Dibenzofuran	< 10	ug/L
	Fluoranthene	< 10	ug/L
	Fluorene	< 10	ug/L
	N-Nitrosodiphenylamine	< 10	ug/L
	Naphthalene	< 10	ug/L
	Nitrobenzene	< 50	ug/L
	Pentachlorophenol	< 10	ug/L
	Phenanthrene	< 10	ug/L
	Phenol	< 10	ug/L
	Pyrene	< 10	ug/L
	bis(2-Chloroethoxy)methane	< 10	ug/L
	bis(2-Chloroethyl)ether	< 10	ug/L

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58128		SAMPLE NO:	H360533
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L
BATCH NO: 58185		SAMPLE NO:	H360630
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L
BATCH NO: 58215		SAMPLE NO:	H360677
I590	Solids, Dissolved at 180C	< 5	mg/L
BATCH NO: 58223		SAMPLE NO:	H360692
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dibromomethane	< 5	ug/L
	1,2-Dichloroethane	< 5	ug/L
	1,2-Dichloropropane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Naphthalene	< 10	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L

DUPLICATE AND MATRIX SPIKE DATA

TEST CODE	DETERMINATION	ORIGINAL RESULT	DUPLICATE RESULT	UNITS	RANGE / RPD	MS RESULT	MS % RCVRY
						SAMPLE NO:	H416519
BATCH NO:	58215						
I590	Solids, Dissolved at 180C	2,508	2,682	mg/L	6.7		
						SAMPLE NO:	H417673
BATCH NO:	58215						
I590	Solids, Dissolved at 180C	703	816	mg/L	14.9		

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE DATA

TEST CODE	DETERMINATION	MS RESULT	MSD RESULT	UNITS	RPD	MS PCT RCVRY	MSD PCT RCVRY
BATCH NO: 57727						SAMPLE NO: H359899	
OSVTCW	TCL - Semi-volatile Extractables in Water						
	1,2,4-Trichlorobenzene	74.4	70.3	ug/L	5.67	74	70
	1,4-Dichlorobenzene	74.9	70.3	ug/L	6.34	75	70
	2,4-Dinitrotoluene	85.6	78.9	ug/L	8.14	86	79
	2-Chlorophenol	139.5	132.1	ug/L	5.45	70	66
	4-Nitrophenol	215.1	198.9	ug/L	7.83	108	99
	Acenaphthene	76.4	73.4	ug/L	4.00	76	73
	N-Nitroso-di-n-propylamine	73.9	71.1	ug/L	3.86	74	71
	Pentachlorophenol	172.8	162.3	ug/L	6.27	86	81
	Phenol	148.2	139.7	ug/L	5.90	74	70
	Pyrene	81.2	75.0	ug/L	7.94	81	75
	p-Chloro-m-cresol	148.8	146.5	ug/L	1.56	74	73
BATCH NO: 58128						SAMPLE NO: H417429	
OVTCW2	8260A TCL Volatiles in Water						
	1,1-Dichloroethene	53.0	65.0	ug/L	20.3*	106	130
	Benzene	49.6	59.3	ug/L	18.3	99	119
	Chlorobenzene	57.6	61.8	ug/L	7.50	115	124
	Toluene	48.8	55.5	ug/L	12.4	98	111
	Trichloroethene	48.4	56.5	ug/L	15.2	97	113

* The RPD was out of range due to matrix interference.

Industrial Compliance

A Subsidiary of SP Environmental Systems, Inc.

303/277-1400

PROJECT NAME: HWPW

SITE LOCATION: Liberty Road Houston, Tx

PROJECT #: 44102069

I.C. CHAIN OF CUSTODY RECORD

H, 01

C.O.C. #

SHIP TO: Pace Lab

LAB. CONTACT & PHONE: Elessa 488-1810

SAMPLERS NAME & SIGNATURE: William R Golosby / William R Goldsby

I.C. CONTACT & PHONE: B. Golosby 713-460-4230, E. Hankford 214-352-9400

ANALYSIS METHOD: BTEX (8260), PAHs (8270)

SAMPLE #	DATE	TIME	COMP.	GRAB	SAMPLE LOCATION	# OF CONTAINERS	PRESERVATIVES YES	PRESERVATIVES NO	CUSTODY SEALS YES	CUSTODY SEALS NO	*REMARKS:
HP04STZ	12/4/95	13:05		X	CPT12E	4	VOAS LITER			X	H41742
HP04UTZ		14:15		X	CPT12E	4	VOAS LITER			X	-418
HP03STZ		15:45		X	CPT10E	3	VOAS LITER			X	COULD NOT COLLECT FULL LITER. -419
HP03UTZ		16:35		X	CPT10E	4	VOAS LITER			X	-420
HP02STZ	12/5/95	08:30		X	CPT13E	3	VOAS LITER			X	-421
FB01		09:07		X	CPT13E	2	VOAS			X	-422
HP02UTZ		09:35		X	CPT13E	4	VOAS LITER			X	-423
HP08UTZ		10:50		X	CPT08E	4	VOAS LITER			X	-424
	LAST LINE - William R. Goldsby										
TRIP BLANK	NA					2	VOAS			X	-425
	LAST LINE - William R Goldsby										

RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
William R Goldsby	12-5-95 10:12				
RELINQUISHED BY (Signature)	DATE & TIME 12-5-95 16:10	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
RELINQUISHED BY (Signature)	DATE & TIME 12-5-95	RECEIVED AT LAB. BY	METHOD OF SHIPMENT		

*REMARKS:
STANDARD TURN-AROUND TIME.

RECEIVED JAN 0 8 1996

January 03, 1996
Report No.: 00047814

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP10UTZ
SAMPLE NO: H417680

LIMS CLIENT: 0717 0007
PACE PROJECT: H37181
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 06-DEC-95 1145
DATE RECEIVED: 06-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	11	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	20	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP10STZ
SAMPLE NO: H417681

LIMS CLIENT: 0717 0007
PACE PROJECT: H37181
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 06-DEC-95 1250
DATE RECEIVED: 06-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 10	ug/L
		Naphthalene	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: TRIP BLANK
SAMPLE NO: H417682

LIMS CLIENT: 0717 0007
PACE PROJECT: H37181
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 06-DEC-95
DATE RECEIVED: 06-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Naphthalene	< 10	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L

SUPPLEMENTAL INFORMATION

LN	TEST CODE	LCSR BLNK BATCH	DUP/MS MS/MSD BATCH	SAMPLE PREPARATION LR-METHOD	SAMPLE PREPARATION DATE/TIME	SAMPLE PREPARATION ANALYST	SAMPLE ANALYSIS LR-METHOD	SAMPLE ANALYSIS DATE/TIME	SAMPLE ANALYSIS ANALYST	SAMPLE ANALYSIS INSTRUME
SAMPLE ID: HP10UTZ									SAMPLE NO: H417680	
1	OVTCW2	58361	58355	NA			19-8260A	15-DEC-95 0815	MH	GCMSQ
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 2112	ASP	GCMST
SAMPLE ID: HP10STZ									SAMPLE NO: H417681	
1	OVTCW2	58465	58355	NA			19-8260A	15-DEC-95 2351	MH	GCMSQ
SAMPLE ID: TRIP BLANK									SAMPLE NO: H417682	
1	OVTCW2	58361	58355	NA			19-8260A	15-DEC-95 0918	MH	GCMSQ

LR Method Literature Reference

19 EPA-Test Methods for Evaluating Solid Waste, 3rd ed, Nov. 1986 and updates

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: HP10UTZ				SAMPLE NO: H417680	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	95	-	
		Dibromofluoromethane	115	-	
		Toluene-d8	93	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	30	-	
		2-Fluorobiphenyl	45	-	
		2-Fluorophenol	24	-	
		Nitrobenzene-d5	72	-	
		Phenol-d5	16	-	
		p-Terphenyl-d14	66	-	
SAMPLE ID: HP10STZ				SAMPLE NO: H417681	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	101	-	
		Dibromofluoromethane	93	-	
		Toluene-d8	107	-	
SAMPLE ID: TRIP BLANK				SAMPLE NO: H417682	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	91	-	
		Dibromofluoromethane	117	-	
		Toluene-d8	92	-	

LABORATORY CONTROL SAMPLE RECOVERY

TEST CODE	DETERMINATION	LCS % RECOVERY	ACCEPTANCE LIMITS
BATCH NO: 58072			SAMPLE NO: H360442
OSVTCW	TCL - Semi-volatile Extractables in Water		
	1,2,4-Trichlorobenzene	71	-
	1,4-Dichlorobenzene	71	-
	2,4-Dinitrotoluene	78	-
	2-Chlorophenol	66	-
	4-Nitrophenol	90	-
	Acenaphthene	71	-
	Pentachlorophenol	78	-
	Phenol	66	-
	Pyrene	70	-
	n-Nitrosodi-n-propylamine	70	-
	p-Chloro-m-cresol	71	-
BATCH NO: 58361			SAMPLE NO: H360918
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	107	-
	Benzene	109	-
	Chlorobenzene	112	-
	Toluene	120	-
	Trichloroethene	112	-
BATCH NO: 58465			SAMPLE NO: H361086
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	106	-
	Benzene	102	-
	Chlorobenzene	124	-
	Toluene	101	-
	Trichloroethene	110	-

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58072		SAMPLE NO:	H360443
OSVTCW	TCL - Semi-volatile Extractables in Water		
	1,2-Diphenylhydrazine	< 10	ug/L
	2,4-Dimethylphenol	< 10	ug/L
	2,4-Dinitrotoluene	< 10	ug/L
	2,6-Dinitrotoluene	< 10	ug/L
	2-Chloronaphthalene	< 10	ug/L
	2-Methylnaphthalene	< 10	ug/L
	4,6-Dinitro-o-cresol	< 50	ug/L
	4-Nitrophenol	< 50	ug/L
	Acenaphthene	< 10	ug/L
	Acenaphthylene	< 10	ug/L
	Anthracene	< 10	ug/L
	Benzo(a)anthracene	< 10	ug/L
	Benzo(a)pyrene	< 10	ug/L
	Chrysene	< 10	ug/L
	Di-n-butylphthalate	< 10	ug/L
	Dibenzofuran	< 10	ug/L
	Fluoranthene	< 10	ug/L
	Fluorene	< 10	ug/L
	N-Nitrosodiphenylamine	< 10	ug/L
	Naphthalene	< 10	ug/L
	Nitrobenzene	< 10	ug/L
	Pentachlorophenol	< 50	ug/L
	Phenanthrene	< 10	ug/L
	Phenol	< 10	ug/L
	Pyrene	< 10	ug/L
	bis(2-Chloroethoxy)methane	< 10	ug/L
	bis(2-Chloroethyl)ether	< 10	ug/L
BATCH NO: 58361		SAMPLE NO:	H360919
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Naphthalene	< 10	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58465			SAMPLE NO: H361087
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Naphthalene	< 10	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE DATA

TEST CODE	DETERMINATION	MS RESULT	MSD RESULT	UNITS	RPD	MS PCT RCVRY	MSD PCT RCVRY
BATCH NO: 57727						SAMPLE NO: H359899	
OSVTCW	TCL - Semi-volatile Extractables in Water						
	1,2,4-Trichlorobenzene	74.4	70.3	ug/L	5.67	74	70
	1,4-Dichlorobenzene	74.9	70.3	ug/L	6.34	75	70
	2,4-Dinitrotoluene	85.6	78.9	ug/L	8.14	86	79
	2-Chlorophenol	139.5	132.1	ug/L	5.45	70	66
	4-Nitrophenol	215.1	198.9	ug/L	7.83	108	99
	Acenaphthene	76.4	73.4	ug/L	4.00	76	73
	N-Nitroso-di-n-propylamine	73.9	71.1	ug/L	3.86	74	71
	Pentachlorophenol	172.8	162.3	ug/L	6.27	86	81
	Phenol	148.2	139.7	ug/L	5.90	74	70
	Pyrene	81.2	75.0	ug/L	7.94	81	75
	p-Chloro-m-cresol	148.8	146.5	ug/L	1.56	74	73
BATCH NO: 58355						SAMPLE NO: H417778	
OVTCW2	8260A TCL Volatiles in Water						
	1,1-Dichloroethene	41.8	45.7	ug/L	8.70	84	91
	Benzene	47.1	49.7	ug/L	5.39	94	99
	Chlorobenzene	54.1	48.2	ug/L	11.5	108	96
	Toluene	50.0	53.8	ug/L	7.51	100	108
	Trichloroethene	48.4	48.6	ug/L	0.44	97	97

Industrial Compliance

A Subsidiary of SP Environmental Systems, Inc.

303/277-1400

PROJECT NAME: HWPW

SITE LOCA: 4910 Liberty Rd Houston, Tx

PROJECT #: 44102069

I.C. CHAIN OF CUSTODY RECORD

C.O.C. # 04

SHIP TO: Pace Lab

SAMPLERS NAME & SIGNATURE: William R Goldsby / William R Goldsby

I.C. CONTACT & PHONE: Bill Goldsby 713-460-4230, Elaine Hanford 214-352-9400

LAB. CONTACT & PHONE: #88-1810 Elessa Sommers

SAMPLE #	DATE	TIME	COMP	GRAB	SAMPLE LOCATION	# OF CONTAINERS	ANALYSIS METHOD: BTEX - 8260	ANALYSIS METHOD: PAH - 8270	PRESERVATIVES YES	PRESERVATIVES NO	CUSTODY SEALS YES	CUSTODY SEALS NO	*REMARKS:
HP10UTZ	12/6/95	11:45		X	CPT19R	4	X	X	VOAs	LITERS		X	Cnot enough for TPS) -6
HP10STZ		12:50		X	CPT19R	2	X	-w/ Naph.	VOAs			X	COULD ONLY COLLECT 1½ VOAs. -6
TRIP BLANK						2	X		VOAs			X	-6
					Last Line - William R Goldsby								

RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
William R Goldsby	12/6/95 16:10			12-6-95 16:10	
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED AT LAB. BY	METHOD OF SHIPMENT		

*REMARKS:

H417688-682

RECEIVED JAN 0 8 1996

pace ANALYTICAL SERVICES, INC.

January 03, 1996
Report No.: 00047908
Section A Page 1

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP05STZ
SAMPLE NO: H417672

LIMS CLIENT: 0717 0007
PACE PROJECT: H37180
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 06-DEC-95 0900
DATE RECEIVED: 06-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	17	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L
5	I590	Solids, Dissolved at 180C	660	mg/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

LIMS CLIENT: 0717 0007
PACE PROJECT: H37180
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

SAMPLE ID: HP05UTZ
SAMPLE NO: H417673

DATE SAMPLED: 06-DEC-95 0945
DATE RECEIVED: 06-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	62	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	108	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	19	ug/L
		Dibenzofuran	58	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	53	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L
5	I590	Solids, Dissolved at 180C	703	mg/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP06STZ
SAMPLE NO: H417674

LIMS CLIENT: 0717 0007
PACE PROJECT: H37180
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 06-DEC-95 1100
DATE RECEIVED: 06-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	34	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

LIMS CLIENT: 0717 0007
PACE PROJECT: H37180
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

SAMPLE ID: HP09UTZ
SAMPLE NO: H417675

DATE SAMPLED: 06-DEC-95 1300
DATE RECEIVED: 06-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Naphthalene	< 10	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: FB-02
SAMPLE NO: H417676

LIMS CLIENT: 0717 0007
PACE PROJECT: H37180
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 06-DEC-95 1345
DATE RECEIVED: 06-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 10	ug/L
		Naphthalene	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes		

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP06UTZ
SAMPLE NO: H417677

LIMS CLIENT: 0717 0007
PACE PROJECT: H37180
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 06-DEC-95 1145
DATE RECEIVED: 06-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	19	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP15STZ
SAMPLE NO: H417678

LIMS CLIENT: 0717 0007
PACE PROJECT: H37180
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 06-DEC-95 1410
DATE RECEIVED: 06-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	11	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP15UTZ
SAMPLE NO: H417679

LIMS CLIENT: 0717 0007
PACE PROJECT: H37180
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 06-DEC-95 1500
DATE RECEIVED: 06-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	17	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

SUPPLEMENTAL INFORMATION

LN	TEST CODE	LCSR BLNK BATCH	DUP/MS MS/MSD BATCH	SAMPLE PREPARATION LR-METHOD	SAMPLE PREPARATION DATE/TIME	SAMPLE PREPARATION ANALYST	SAMPLE ANALYSIS LR-METHOD	SAMPLE ANALYSIS DATE/TIME	SAMPLE ANALYSIS ANALYST	SAMPLE ANALYSIS INSTRUMENT
SAMPLE ID: HP05STZ								SAMPLE NO: H417672		
1	OVTCW2	58299	58128	NA			19-8260A	14-DEC-95 0142	MH	GCMSQ
5	I590	58215	58215	NA			02-160.1	11-DEC-95 1800	RDR	008WAT
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	13-DEC-95 2104	EAY	GCMSZ
SAMPLE ID: HP05UTZ								SAMPLE NO: H417673		
1	OVTCW2	58465	58355	NA			19-8260A	15-DEC-95 2240	MH	GCMSQ
5	I590	58215	58215	NA			02-160.1	11-DEC-95 1800	RDR	008WAT
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1441	ASP	GCMST
SAMPLE ID: HP06STZ								SAMPLE NO: H417674		
1	OVTCW2	58544	58355	NA			19-8260A	20-DEC-95 1513	JC	GCMSX
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1520	ASP	GCMST
SAMPLE ID: HP09UTZ								SAMPLE NO: H417675		
1	OVTCW2	58361	58355	NA			19-8260A	15-DEC-95 0557	MH	GCMSQ
SAMPLE ID: FB-02								SAMPLE NO: H417676		
1	OVTCW2	58361	58355	NA			19-8260A	15-DEC-95 0625	MH	GCMSQ
SAMPLE ID: HP06UTZ								SAMPLE NO: H417677		
1	OVTCW2	58465	58355	NA			19-8260A	15-DEC-95 2316	MH	GCMSQ
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1559	ASP	GCMST
SAMPLE ID: HP15STZ								SAMPLE NO: H417678		
1	OVTCW2	58361	58355	NA			19-8260A	15-DEC-95 0722	MH	GCMSQ
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1637	ASP	GCMST
SAMPLE ID: HP15UTZ								SAMPLE NO: H417679		
1	OVTCW2	58361	58355	NA			19-8260A	15-DEC-95 0747	MH	GCMSQ
3	OSVTCW	58072	57727	19-3510B	08-DEC-95 0900	RE	19-8270B	11-DEC-95 1717	ASP	GCMST

LR Method Literature Reference

02 EPA-Methods for Chemical Analysis of Water & Wastes, 1984.
19 EPA-Test Methods for Evaluating Solid Waste, 3rd ed, Nov. 1986 and updates

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: HP05STZ				SAMPLE NO: H417672	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	107	-	
		Dibromofluoromethane	100	-	
		Toluene-d8	94	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	52	-	
		2-Fluorobiphenyl	43	-	
		2-Fluorophenol	41	-	
		Nitrobenzene-d5	45	-	
		Phenol-d5	32	-	
		p-Terphenyl-d14	52	-	
SAMPLE ID: HP05UTZ				SAMPLE NO: H417673	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	100	-	
		Toluene-d8	96	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	58	-	
		2-Fluorobiphenyl	72	-	
		2-Fluorophenol	19	-	
		Nitrobenzene-d5	81	-	
		Phenol-d5	15	-	
		p-Terphenyl-d14	75	-	
SAMPLE ID: HP06STZ				SAMPLE NO: H417674	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	98	-	
		Dibromofluoromethane	105	-	
		Toluene-d8	101	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	65	-	
		2-Fluorobiphenyl	67	-	
		2-Fluorophenol	31	-	
		Nitrobenzene-d5	91	-	
		Phenol-d5	27	-	
		p-Terphenyl-d14	88	-	
SAMPLE ID: HP09UTZ				SAMPLE NO: H417675	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	110	-	
		Dibromofluoromethane	106	-	

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: HP09UTZ				SAMPLE NO: H417675	
		Toluene-d8	102	-	
SAMPLE ID: FB-02				SAMPLE NO: H417676	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	107	-	
		Toluene-d8	94	-	
SAMPLE ID: HP06UTZ				SAMPLE NO: H417677	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	110	-	
		Dibromofluoromethane	92	-	
		Toluene-d8	105	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	63	-	
		2-Fluorobiphenyl	69	-	
		2-Fluorophenol	36	-	
		Nitrobenzene-d5	82	-	
		Phenol-d5	35	-	
		p-Terphenyl-d14	73	-	
SAMPLE ID: HP15STZ				SAMPLE NO: H417678	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	102	-	
		Dibromofluoromethane	106	-	
		Toluene-d8	101	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	68	-	
		2-Fluorobiphenyl	76	-	
		2-Fluorophenol	45	-	
		Nitrobenzene-d5	91	-	
		Phenol-d5	54	-	
		p-Terphenyl-d14	91	-	
SAMPLE ID: HP15UTZ				SAMPLE NO: H417679	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	98	-	
		Dibromofluoromethane	107	-	
		Toluene-d8	93	-	

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: HP15UTZ				SAMPLE NO: H417679	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	67	-	
		2-Fluorobiphenyl	82	-	
		2-Fluorophenol	19	-	
		Nitrobenzene-d5	81	-	
		Phenol-d5	15	-	
		p-Terphenyl-d14	75	-	

LABORATORY CONTROL SAMPLE RECOVERY

TEST CODE	DETERMINATION	LCS % RECOVERY	ACCEPTANCE LIMITS
BATCH NO: 58072			SAMPLE NO: H360442
OSVTCW	TCL - Semi-volatile Extractables in Water		
	1,2,4-Trichlorobenzene	71	-
	1,4-Dichlorobenzene	71	-
	2,4-Dinitrotoluene	78	-
	2-Chlorophenol	66	-
	4-Nitrophenol	90	-
	Acenaphthene	71	-
	Pentachlorophenol	78	-
	Phenol	66	-
	Pyrene	70	-
	n-Nitrosodi-n-propylamine	70	-
	p-Chloro-m-cresol	71	-
BATCH NO: 58215			SAMPLE NO: H360676
I590	Solids, Dissolved at 180C	99.2	-
BATCH NO: 58299			SAMPLE NO: H360806
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	115	-
	Benzene	106	-
	Chlorobenzene	108	-
	Toluene	107	-
	Trichloroethene	102	-
BATCH NO: 58361			SAMPLE NO: H360918
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	107	-
	Benzene	109	-
	Chlorobenzene	112	-
	Toluene	120	-
	Trichloroethene	112	-
BATCH NO: 58465			SAMPLE NO: H361086
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	106	-
	Benzene	102	-
	Chlorobenzene	124	-
	Toluene	101	-
	Trichloroethene	110	-

LABORATORY CONTROL SAMPLE RECOVERY

TEST CODE	DETERMINATION	LCS % RECOVERY	ACCEPTANCE LIMITS
BATCH NO: 58544			SAMPLE NO: H361222
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	98	-
	Benzene	87	-
	Chlorobenzene	95	-
	Toluene	90	-
	Trichloroethene	92	-

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58072			SAMPLE NO: H360443
OSVTCW	TCL - Semi-volatile Extractables in Water		
	1,2-Diphenylhydrazine	< 10	ug/L
	2,4-Dimethylphenol	< 10	ug/L
	2,4-Dinitrotoluene	< 10	ug/L
	2,6-Dinitrotoluene	< 10	ug/L
	2-Chloronaphthalene	< 10	ug/L
	2-Methylnaphthalene	< 10	ug/L
	4,6-Dinitro-o-cresol	< 50	ug/L
	4-Nitrophenol	< 50	ug/L
	Acenaphthene	< 10	ug/L
	Acenaphthylene	< 10	ug/L
	Anthracene	< 10	ug/L
	Benzo(a)anthracene	< 10	ug/L
	Benzo(a)pyrene	< 10	ug/L
	Chrysene	< 10	ug/L
	Di-n-butylphthalate	< 10	ug/L
	Dibenzofuran	< 10	ug/L
	Fluoranthene	< 10	ug/L
	Fluorene	< 10	ug/L
	N-Nitrosodiphenylamine	< 10	ug/L
	Naphthalene	< 10	ug/L
	Nitrobenzene	< 10	ug/L
	Pentachlorophenol	< 50	ug/L
	Phenanthrene	< 10	ug/L
	Phenol	< 10	ug/L
	Pyrene	< 10	ug/L
	bis(2-Chloroethoxy)methane	< 10	ug/L
	bis(2-Chloroethyl)ether	< 10	ug/L
BATCH NO: 58215			SAMPLE NO: H360677
I590	Solids, Dissolved at 180C	< 5	mg/L
BATCH NO: 58299			SAMPLE NO: H360807
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58361		SAMPLE NO:	H360919
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Naphthalene	< 10	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L
BATCH NO: 58465		SAMPLE NO:	H361087
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Naphthalene	< 10	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L
BATCH NO: 58544		SAMPLE NO:	H361223
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L

DUPLICATE AND MATRIX SPIKE DATA

TEST CODE	DETERMINATION	ORIGINAL RESULT	DUPLICATE RESULT	UNITS	RANGE / RPD	MS RESULT	MS % RCVRY
BATCH NO: 58215						SAMPLE NO: H416519	
I590	Solids, Dissolved at 180C	2,508	2,682	mg/L	6.7		
BATCH NO: 58215						SAMPLE NO: H417673	
I590	Solids, Dissolved at 180C	703	816	mg/L	14.9		

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE DATA

TEST CODE	DETERMINATION	MS RESULT	MSD RESULT	UNITS	RPD	MS PCT RCVRY	MSD PCT RCVRY
BATCH NO: 57727						SAMPLE NO: H359899	
OSVTCW	TCL - Semi-volatile Extractables in Water						
	1,2,4-Trichlorobenzene	74.4	70.3	ug/L	5.67	74	70
	1,4-Dichlorobenzene	74.9	70.3	ug/L	6.34	75	70
	2,4-Dinitrotoluene	85.6	78.9	ug/L	8.14	86	79
	2-Chlorophenol	139.5	132.1	ug/L	5.45	70	66
	4-Nitrophenol	215.1	198.9	ug/L	7.83	108	99
	Acenaphthene	76.4	73.4	ug/L	4.00	76	73
	N-Nitroso-di-n-propylamine	73.9	71.1	ug/L	3.86	74	71
	Pentachlorophenol	172.8	162.3	ug/L	6.27	86	81
	Phenol	148.2	139.7	ug/L	5.90	74	70
	Pyrene	81.2	75.0	ug/L	7.94	81	75
	p-Chloro-m-cresol	148.8	146.5	ug/L	1.56	74	73
BATCH NO: 58128						SAMPLE NO: H417429	
OVTCW2	8260A TCL Volatiles in Water						
	1,1-Dichloroethene	53.0	65.0	ug/L	20.3*	106	130
	Benzene	49.6	59.3	ug/L	18.3	99	119
	Chlorobenzene	57.6	61.8	ug/L	7.50	115	124
	Toluene	48.8	55.5	ug/L	12.4	98	111
	Trichloroethene	48.4	56.5	ug/L	15.2	97	113
BATCH NO: 58355						SAMPLE NO: H417778	
OVTCW2	8260A TCL Volatiles in Water						
	1,1-Dichloroethene	41.8	45.7	ug/L	8.70	84	91
	Benzene	47.1	49.7	ug/L	5.39	94	99
	Chlorobenzene	54.1	48.2	ug/L	11.5	108	96
	Toluene	50.0	53.8	ug/L	7.51	100	108
	Trichloroethene	48.4	48.6	ug/L	0.44	97	97

* The RPD was out of range due to matrix interference.

Industrial Compliance

A Subsidiary of SP Environmental Systems, Inc.

303/277-1400

PROJECT NAME: HWPW

SITE LOCATION: ~~[illegible]~~ Houston TX

PROJECT #: 44102069

I.C. CHAIN OF CUSTODY RECORD

C.O.C. #

SHIP TO:

SAMPLERS NAME & SIGNATURE: Roger Lamb [signature]

I.C. CONTACT & PHONE:

LAB. CONTACT & PHONE:

SAMPLE #	DATE	TIME	COMP.	GRAB	SAMPLE LOCATION	# OF CONTAINERS	ANALYSIS METHOD: 8270 PAHs, phenols, naphthalene	BTEX - 8260	BTEX, Naphthalene 8260					PRESERVATIVES YES	PRESERVATIVES NO	CUSTODY SEALS YES	CUSTODY SEALS NO	*REMARKS:
HP05 ST2	12/6	0900		X	CPT06E	4	X	X						VOA	liters			Do not shake up enough for TDS samples in lab
HP05 UT2	12/6	0945		X	CPT06E	4	X	X						VOAs				enough for TDS
HP06 ST2	12/6	1100		X	CPT03E	3	X	X										only 1-1 liter could be collected
HP09 UT2	12/6	1300		X	CPT23R	2			X	naph.								
FB-02	12/6	1345		X	N/A	2		X										
HP06 UT2	12/6	1145		X	CPT03E	3	X	X										only 1-1 liter col
HP15 ST2	12/6	1410		X	CPT27E	3	X	X										only 1-1 liter colle
HP15 UT2	12/6	1500		X	CPT27E	4	X	X										enough for TDS.

RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
[signature]	1600 12/6	William R Goldsby	William R Goldsby	12/6/95 16:10	[signature]
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
			[signature]		
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED AT LAB. BY	METHOD OF SHIPMENT		
		K Jenkins			

*REMARKS:

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP12UTZ
SAMPLE NO: H417777

LIMS CLIENT: 0717 0007
PACE PROJECT: H37215
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 06-DEC-95 1630
DATE RECEIVED: 07-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	< 10	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L
5	I590	Solids, Dissolved at 180C	347	mg/L

RECEIVED JAN 0 8 1996

pace ANALYTICAL SERVICES, INC.

January 03, 1996
Report No.: 00047943

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP11UTZ
SAMPLE NO: H417776

LIMS CLIENT: 0717 0007
PACE PROJECT: H37215
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 06-DEC-95 1535
DATE RECEIVED: 07-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	80	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	1,100	ug/L
		Methylene chloride	< 5	ug/L
		Naphthalene	3,700	ug/L
		Toluene	10	ug/L
		Xylenes	900	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP14UTZ
SAMPLE NO: H417773

LIMS CLIENT: 0717 0007
PACE PROJECT: H37214
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 07-DEC-95 1105
DATE RECEIVED: 07-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	16	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	270	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	410	ug/L
		Xylenes	850	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 1,000 *	ug/L
		2,4-Dimethylphenol	< 1,000	ug/L
		2,4-Dinitrotoluene	< 1,000	ug/L
		2,6-Dinitrotoluene	< 1,000	ug/L
		2-Chloronaphthalene	< 1,000	ug/L
		2-Methylnaphthalene	< 1,000	ug/L
		4,6-Dinitro-o-cresol	< 5,000	ug/L
		4-Nitrophenol	< 5,000	ug/L
		Acenaphthene	< 1,000	ug/L
		Acenaphthylene	< 1,000	ug/L
		Anthracene	< 1,000	ug/L
		Benzo(a)anthracene	< 1,000	ug/L
		Benzo(a)pyrene	< 1,000	ug/L
		Chrysene	< 1,000	ug/L
		Di-n-butylphthalate	< 1,000	ug/L
		Dibenzofuran	< 1,000	ug/L
		Fluoranthene	< 1,000	ug/L
		Fluorene	< 1,000	ug/L
		N-Nitrosodiphenylamine	< 1,000	ug/L
		Naphthalene	12,000	ug/L
		Nitrobenzene	< 1,000	ug/L
		Pentachlorophenol	< 5,000	ug/L
		Phenanthrene	< 1,000	ug/L
		Phenol	< 1,000	ug/L
		Pyrene	< 1,000	ug/L
		bis(2-Chloroethoxy)methane	< 1,000	ug/L
		bis(2-Ethylhexyl)phthalate	< 1,000	ug/L

COMMENTS: Continued on next page.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
SAMPLE ID: HP14UTZ
SAMPLE NO: H417773

LN	TEST CODE	DETERMINATION	RESULT	UNITS

COMMENTS: * The reporting limits were elevated due to the dilution required by the high concentration of target analytes.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: EB02
SAMPLE NO: H417774

LIMS CLIENT: 0717 0007
PACE PROJECT: H37214
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 07-DEC-95 1245
DATE RECEIVED: 07-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	49	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	82	ug/L
		Xylenes	190	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	< 10	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: TRIP BLANK
SAMPLE NO: H417775

LIMS CLIENT: 0717 0007
PACE PROJECT: H37214
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 07-DEC-95
DATE RECEIVED: 07-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L

SUPPLEMENTAL INFORMATION

LN	TEST CODE	LCSR BLNK BATCH	DUP/MS MS/MSD BATCH	SAMPLE PREPARATION LR-METHOD	SAMPLE PREPARATION DATE/TIME	SAMPLE PREPARATION ANALYST	SAMPLE ANALYSIS LR-METHOD	SAMPLE ANALYSIS DATE/TIME	SAMPLE ANALYSIS ANALYST	SAMPLE ANALYSIS INSTRUMENT
SAMPLE ID: HP14UTZ									SAMPLE NO: H417773	
1	OVTCW2	58578	58355	NA			19-8260A	20-DEC-95 2334	JC	GCMSY
3	OSVTCW	58122	57894	19-3510B	11-DEC-95 0800	RE	19-8270B	13-DEC-95 1345	CAH	GCMSS
SAMPLE ID: EB02									SAMPLE NO: H417774	
1	OVTCW2	58562	58355	NA			19-8260A	19-DEC-95 1953	JC	GCMSY
3	OSVTCW	58122	57894	19-3510B	11-DEC-95 0800	RE	19-8270B	13-DEC-95 1429	CAH	GCMSS
SAMPLE ID: TRIP BLANK									SAMPLE NO: H417775	
1	OVTCW2	58355	58355	NA			19-8260A	15-DEC-95 0059	JC	GCMSY

LR Method Literature Reference

19 EPA-Test Methods for Evaluating Solid Waste, 3rd ed, Nov. 1986 and updates

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: HP14UTZ				SAMPLE NO: H417773	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	103	-	
		Dibromofluoromethane	106	-	
		Toluene-d8	101	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	*	-	
		2-Fluorobiphenyl	*	-	
		2-Fluorophenol	*	-	
		Nitrobenzene-d5	*	-	
		Phenol-d5	*	-	
		p-Terphenyl-d14	*	-	
		* The surrogates were not recovered due to the dilution required because of high analyte concentration.			
SAMPLE ID: EB02				SAMPLE NO: H417774	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	101	-	
		Dibromofluoromethane	101	-	
		Toluene-d8	100	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	68	-	
		2-Fluorobiphenyl	68	-	
		2-Fluorophenol	34	-	
		Nitrobenzene-d5	93	-	
		Phenol-d5	21	-	
		p-Terphenyl-d14	80	-	
SAMPLE ID: TRIP BLANK				SAMPLE NO: H417775	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	101	-	
		Toluene-d8	100	-	

LABORATORY CONTROL SAMPLE RECOVERY

TEST CODE	DETERMINATION	LCS % RECOVERY	ACCEPTANCE LIMITS
BATCH NO: 58122			SAMPLE NO: H360520
OSVTCW	TCL - Semi-volatile Extractables in Water		
	1,2,4-Trichlorobenzene	97	-
	1,4-Dichlorobenzene	89	-
	2,4-Dinitrotoluene	108	-
	2-Chlorophenol	84	-
	4-Nitrophenol	128	-
	Acenaphthene	98	-
	N-Nitrosodi-n-propylamine	90	-
	Pentachlorophenol	115	-
	Phenol	71	-
	Pyrene	98	-
	p-Chloro-m-cresol	96	-
BATCH NO: 58355			SAMPLE NO: H360906
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	98	-
	Benzene	104	-
	Chlorobenzene	110	-
	Toluene	107	-
	Trichloroethene	109	-
BATCH NO: 58562			SAMPLE NO: H361252
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	89	-
	Benzene	90	-
	Chlorobenzene	98	-
	Toluene	95	-
	Trichloroethene	97	-
BATCH NO: 58578			SAMPLE NO: H361284
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	102	-
	Benzene	104	-
	Chlorobenzene	113	-
	Toluene	108	-
	Trichloroethene	116	-

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58122		SAMPLE NO:	H360521
OSVTCW	TCL - Semi-volatile Extractables in Water		
	1,2-Diphenylhydrazine	< 10	ug/L
	2,4-Dimethylphenol	< 10	ug/L
	2,4-Dinitrotoluene	< 10	ug/L
	2,6-Dinitrotoluene	< 10	ug/L
	2-Chloronaphthalene	< 10	ug/L
	2-Methylnaphthalene	< 10	ug/L
	4,6-Dinitro-o-cresol	< 50	ug/L
	4-Nitrophenol	< 50	ug/L
	Acenaphthene	< 10	ug/L
	Acenaphthylene	< 10	ug/L
	Anthracene	< 10	ug/L
	Benzo(a)anthracene	< 10	ug/L
	Benzo(a)pyrene	< 10	ug/L
	Chrysene	< 10	ug/L
	Di-n-butylphthalate	< 10	ug/L
	Dibenzofuran	< 10	ug/L
	Fluoranthene	< 10	ug/L
	Fluorene	< 10	ug/L
	N-Nitrosodiphenylamine	< 10	ug/L
	Naphthalene	< 10	ug/L
	Nitrobenzene	< 10	ug/L
	Pentachlorophenol	< 50	ug/L
	Phenanthrene	< 10	ug/L
	Phenol	< 10	ug/L
	Pyrene	< 10	ug/L
	bis(2-Chloroethoxy)methane	< 10	ug/L
	bis(2-Ethylhexyl)phthalate	< 10	ug/L
BATCH NO: 58355		SAMPLE NO:	H360907
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Naphthalene	< 10	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58562		SAMPLE NO:	H361253
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L
BATCH NO: 58578		SAMPLE NO:	H361285
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dibromomethane	< 5	ug/L
	1,2-Dichloroethane	< 5	ug/L
	1,2-Dichloropropane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Naphthalene	< 10	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE DATA

TEST CODE	DETERMINATION	MS RESULT	MSD RESULT	UNITS	RPD	MS PCT RCVRY	MSD PCT RCVRY
BATCH NO: 57894						SAMPLE NO: H414886	
OSVPPW	Semi-volatile Extractables in Water						
	1,2,4-Trichlorobenzene	58.3	61.3	ug/L	5.02	58	61
	1,4-Dichlorobenzene	60.8	62.3	ug/L	2.44	61	62
	2,4-Dinitrotoluene	61.0	62.0	ug/L	1.63	61	62
	2-Chlorophenol	132	140	ug/L	5.88	66	70
	4-Nitrophenol	45.0	40.7	ug/L	10.0	22 *	20 *
	Acenaphthene	69.6	72.2	ug/L	3.67	70	72
	N-Nitrosodi-n-propylamine	58.4	63.3	ug/L	8.05	58	63
	Pentachlorophenol	137	132	ug/L	3.72	68	66
	Phenol	59.8	62.3	ug/L	4.10	30	31
	Pyrene	69.6	66.6	ug/L	4.41	70	67
	p-Chloro-m-cresol	110	115	ug/L	4.44	55	58
	* MS recovery below in house QA limits, but passes 8270 QA limits.						
BATCH NO: 58355						SAMPLE NO: H417778	
OVTCW2	8260A TCL Volatiles in Water						
	1,1-Dichloroethene	41.8	45.7	ug/L	8.70	84	91
	Benzene	47.1	49.7	ug/L	5.39	94	99
	Chlorobenzene	54.1	48.2	ug/L	11.5	108	96
	Toluene	50.0	53.8	ug/L	7.51	100	108
	Trichloroethene	48.4	48.6	ug/L	0.44	97	97

Industrial Compliance

A Subsidiary of SP Environmental Systems, Inc.

303/277-1400

PROJECT NAME: HWPW

SITE LOCA: 4910 LIBERTY RD HOUSTON, TX

PROJECT #: 4410765

I.C. CHAIN OF CUSTODY RECORD

HP06

C.O.C. #

SHIP TO: PACE LABS

LAB. CONTACT & PHONE: E. SOMMERS

SAMPLERS NAME & SIGNATURE: William R Goldsby / William R Goldsby

I.C. CONTACT & PHONE: R. GOLDSBY (713) 460-4230, E. HANFORD (214) 352-9400

SAMPLE #	DATE	TIME	COMP.	GRAB	SAMPLE LOCATION	# OF CONTAINERS	ANALYSIS METHOD: BTEX - 8260, PAH - 8270	PRESERVATIVES: YES	PRESERVATIVES: NO	CUSTODY SEALS: YES	CUSTODY SEALS: NO	*REMARKS:
HP14UTZ	12/7/95	11:05		X	CPT08R	4	X X	VOAs	1 liters		X	H417773
EB02	↓	12:45		↓	↓	4	X X	↓	↓		↓	774
TRIP BLANK	↓	NA		↓	NA	2	X	↓	↓		↓	775
					Last Line — William R Goldsby							

RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
William R Goldsby	12/7/95			12-7-95 15:00	
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED AT LAB. BY	METHOD OF SHIPMENT		
	12/7/95				

*REMARKS:

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

LIMS CLIENT: 0717 0007
PACE PROJECT: H37215
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

SAMPLE ID: HP16LTZ
SAMPLE NO: H417778

DATE SAMPLED: 07-DEC-95 0805
DATE RECEIVED: 07-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	< 10	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Naphthalene	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L
5	I590	Solids, Dissolved at 180C	743	mg/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: TRIP BLANK
SAMPLE NO: H417779

LIMS CLIENT: 0717 0007
PACE PROJECT: H37215
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 07-DEC-95
DATE RECEIVED: 07-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Naphthalene	< 10	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

LIMS CLIENT: 0717 0007
PACE PROJECT: H37215
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

SAMPLE ID: HP16UTZ
SAMPLE NO: H417780

DATE SAMPLED: 07-DEC-95 0905
DATE RECEIVED: 07-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Naphthalene	< 10	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 10	ug/L
		2,4-Dimethylphenol	< 10	ug/L
		2,4-Dinitrotoluene	< 10	ug/L
		2,6-Dinitrotoluene	< 10	ug/L
		2-Chloronaphthalene	< 10	ug/L
		2-Methylnaphthalene	< 10	ug/L
		4,6-Dinitro-o-cresol	< 50	ug/L
		4-Nitrophenol	< 50	ug/L
		Acenaphthene	< 10	ug/L
		Acenaphthylene	< 10	ug/L
		Anthracene	< 10	ug/L
		Benzo(a)anthracene	< 10	ug/L
		Benzo(a)pyrene	< 10	ug/L
		Chrysene	< 10	ug/L
		Di-n-butylphthalate	< 10	ug/L
		Dibenzofuran	< 10	ug/L
		Fluoranthene	< 10	ug/L
		Fluorene	< 10	ug/L
		N-Nitrosodiphenylamine	< 10	ug/L
		Nitrobenzene	< 10	ug/L
		Pentachlorophenol	< 50	ug/L
		Phenanthrene	< 10	ug/L
		Phenol	< 10	ug/L
		Pyrene	< 10	ug/L
		bis(2-Chloroethoxy)methane	< 10	ug/L
		bis(2-Ethylhexyl)phthalate	< 10	ug/L

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: HP13UTZ
SAMPLE NO: H417781

LIMS CLIENT: 0717 0007
PACE PROJECT: H37215
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 07-DEC-95 1005
DATE RECEIVED: 07-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	33	ug/L
		Methylene chloride	< 5	ug/L
		Toluene	< 5	ug/L
		Xylenes	30	ug/L
3	OSVTCW	TCL - Semi-volatile Extractables in Water		
		1,2-Diphenylhydrazine	< 50 *	ug/L
		2,4-Dimethylphenol	< 50	ug/L
		2,4-Dinitrotoluene	< 50	ug/L
		2,6-Dinitrotoluene	< 50	ug/L
		2-Chloronaphthalene	< 50	ug/L
		2-Methylnaphthalene	210	ug/L
		4,6-Dinitro-o-cresol	< 250	ug/L
		4-Nitrophenol	< 250	ug/L
		Acenaphthene	210	ug/L
		Acenaphthylene	< 50	ug/L
		Anthracene	< 50	ug/L
		Benzo(a)anthracene	< 50	ug/L
		Benzo(a)pyrene	< 50	ug/L
		Chrysene	< 50	ug/L
		Di-n-butylphthalate	< 50	ug/L
		Dibenzofuran	100	ug/L
		Fluoranthene	< 50	ug/L
		Fluorene	110	ug/L
		N-Nitrosodiphenylamine	< 50	ug/L
		Naphthalene	1200	ug/L
		Nitrobenzene	< 50	ug/L
		Pentachlorophenol	< 250	ug/L
		Phenanthrene	< 50	ug/L
		Phenol	< 50	ug/L
		Pyrene	< 50	ug/L
		bis(2-Chloroethoxy)methane	< 50	ug/L
		bis(2-Ethylhexyl)phthalate	< 50	ug/L
5	I590	Solids, Dissolved at 180C	603	mg/L

COMMENTS: Continued on next page.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
SAMPLE ID: HP13UTZ
SAMPLE NO: H417781

LN	TEST CODE	DETERMINATION	RESULT	UNITS

COMMENTS: * The reporting limits were elevated due to the dilution required by the high concentration of target analytes.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: FB03
SAMPLE NO: H417782

LIMS CLIENT: 0717 0007
PACE PROJECT: H37215
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 07-DEC-95 1115
DATE RECEIVED: 07-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCW2	8260A TCL Volatiles in Water		
		1,2-Dichloroethane	< 5	ug/L
		Benzene	< 5	ug/L
		Chlorobenzene	< 5	ug/L
		Ethylbenzene	< 5	ug/L
		Methylene chloride	< 5	ug/L
		Naphthalene	< 10	ug/L
		Toluene	< 5	ug/L
		Xylenes	< 5	ug/L

SUPPLEMENTAL INFORMATION

LN	TEST CODE	LCSR BLNK BATCH	DUP/MS MS/MSD BATCH	SAMPLE PREPARATION LR-METHOD	SAMPLE PREPARATION DATE/TIME	SAMPLE PREPARATION ANALYST	SAMPLE ANALYSIS LR-METHOD	SAMPLE ANALYSIS DATE/TIME	SAMPLE ANALYSIS ANALYST	SAMPLE ANALYSIS INSTRUMENT
SAMPLE ID: HP11UTZ									SAMPLE NO: H417776	
1	OVTCW2	58578	58355	NA			19-8260A	20-DEC-95 0142	JC	GCMSY
SAMPLE ID: HP12UTZ									SAMPLE NO: H417777	
1	OVTCW2	58355	58355	NA			19-8260A	15-DEC-95 0224	JC	GCMSY
5	I590	58082	58082	NA			02-160.1	08-DEC-95 1800	RDR	008WAT
3	OSVTCW	58122	57894	19-3510B	11-DEC-95 0800	RE	19-8270B	13-DEC-95 1513	CAH	GCMSS
SAMPLE ID: HP16LTZ									SAMPLE NO: H417778	
1	OVTCW2	58355	58355	NA			19-8260A	15-DEC-95 0306	JC	GCMSY
5	I590	58082	58082	NA			02-160.1	08-DEC-95 1800	RDR	008WAT
3	OSVTCW	58122	57894	19-3510B	11-DEC-95 0800	RE	19-8270B	13-DEC-95 1558	CAH	GCMSS
SAMPLE ID: TRIP BLANK									SAMPLE NO: H417779	
1	OVTCW2	58355	58355	NA			19-8260A	15-DEC-95 0349	JC	GCMSY
SAMPLE ID: HP16UTZ									SAMPLE NO: H417780	
1	OVTCW2	58355	58355	NA			19-8260A	15-DEC-95 0431	JC	GCMSY
3	OSVTCW	58122	57894	19-3510B	11-DEC-95 0800	RE	19-8270B	13-DEC-95 1642	CAH	GCMSS
SAMPLE ID: HP13UTZ									SAMPLE NO: H417781	
1	OVTCW2	58355	58355	NA			19-8260A	15-DEC-95 0513	JC	GCMSY
5	I590	58082	58082	NA			02-160.1	08-DEC-95 1800	RDR	008WAT
3	OSVTCW	58122	57894	19-3510B	11-DEC-95 0800	RE	19-8270B	13-DEC-95 1726	CAH	GCMSS
SAMPLE ID: FB03									SAMPLE NO: H417782	
1	OVTCW2	58617	58355	NA			19-8260A	21-DEC-95 1310	JC	GCMSY

LR Method Literature Reference

02 EPA-Methods for Chemical Analysis of Water & Wastes, 1984.
19 EPA-Test Methods for Evaluating Solid Waste, 3rd ed, Nov. 1986 and updates

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: HP11UTZ				SAMPLE NO: H417776	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	101	-	
		Dibromofluoromethane	110	-	
		Toluene-d8	101	-	
SAMPLE ID: HP12UTZ				SAMPLE NO: H417777	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	103	-	
		Dibromofluoromethane	102	-	
		Toluene-d8	101	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	70	-	
		2-Fluorobiphenyl	63	-	
		2-Fluorophenol	27	-	
		Nitrobenzene-d5	89	-	
		Phenol-d5	19	-	
		p-Terphenyl-d14	69	-	
SAMPLE ID: HP16LTZ				SAMPLE NO: H417778	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	102	-	
		Dibromofluoromethane	102	-	
		Toluene-d8	102	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	70	-	
		2-Fluorobiphenyl	67	-	
		2-Fluorophenol	31	-	
		Nitrobenzene-d5	91	-	
		Phenol-d5	20	-	
		p-Terphenyl-d14	73	-	
SAMPLE ID: TRIP BLANK				SAMPLE NO: H417779	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	101	-	
		Dibromofluoromethane	105	-	
		Toluene-d8	100	-	
SAMPLE ID: HP16UTZ				SAMPLE NO: H417780	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	99	-	
		Dibromofluoromethane	108	-	

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: HP16UTZ				SAMPLE NO: H417780	
		Toluene-d8	100	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	12*	-	
		2-Fluorobiphenyl	15*	-	
		2-Fluorophenol	10*	-	
		Nitrobenzene-d5	19*	-	
		Phenol-d5	8*	-	
		p-Terphenyl-d14	15*	-	
		* The surrogate recovery was out of range. However, there was insufficient sample for re-extraction and re-analysis.			
SAMPLE ID: HP13UTZ				SAMPLE NO: H417781	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	100	-	
		Dibromofluoromethane	112	-	
		Toluene-d8	100	-	
4	$BNAW	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	62	-	
		2-Fluorobiphenyl	65	-	
		2-Fluorophenol	30	-	
		Nitrobenzene-d5	90	-	
		Phenol-d5	18	-	
		p-Terphenyl-d14	70	-	
SAMPLE ID: FB03				SAMPLE NO: H417782	
2	$VOA2W	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	99	-	
		Dibromofluoromethane	102	-	
		Toluene-d8	100	-	

LABORATORY CONTROL SAMPLE RECOVERY

TEST CODE	DETERMINATION	LCS % RECOVERY	ACCEPTANCE LIMITS
BATCH NO: 58082			SAMPLE NO: H360459
I590	Solids, Dissolved at 180C	99.5	-
BATCH NO: 58122			SAMPLE NO: H360520
OSVTCW	TCL - Semi-volatile Extractables in Water		
	1,2,4-Trichlorobenzene	97	-
	1,4-Dichlorobenzene	89	-
	2,4-Dinitrotoluene	108	-
	2-Chlorophenol	84	-
	4-Nitrophenol	128	-
	Acenaphthene	98	-
	N-Nitrosodi-n-propylamine	90	-
	Pentachlorophenol	115	-
	Phenol	71	-
	Pyrene	98	-
	p-Chloro-m-cresol	96	-
BATCH NO: 58355			SAMPLE NO: H360906
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	98	-
	Benzene	104	-
	Chlorobenzene	110	-
	Toluene	107	-
	Trichloroethene	109	-
BATCH NO: 58578			SAMPLE NO: H361284
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	102	-
	Benzene	104	-
	Chlorobenzene	113	-
	Toluene	108	-
	Trichloroethene	116	-
BATCH NO: 58617			SAMPLE NO: H361356
OVTCW2	8260A TCL Volatiles in Water		
	1,1-Dichloroethene	100	-
	Benzene	108	-
	Chlorobenzene	117	-
	Toluene	113	-
	Trichloroethene	116	-

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58082		SAMPLE NO:	H360460
I590	Solids, Dissolved at 180C	< 5	mg/L
BATCH NO: 58122		SAMPLE NO:	H360521
OSVTCW	TCL - Semi-volatile Extractables in Water		
	1,2-Diphenylhydrazine	< 10	ug/L
	2,4-Dimethylphenol	< 10	ug/L
	2,4-Dinitrotoluene	< 10	ug/L
	2,6-Dinitrotoluene	< 10	ug/L
	2-Chloronaphthalene	< 10	ug/L
	2-Methylnaphthalene	< 10	ug/L
	4,6-Dinitro-o-cresol	< 50	ug/L
	4-Nitrophenol	< 50	ug/L
	Acenaphthene	< 10	ug/L
	Acenaphthylene	< 10	ug/L
	Anthracene	< 10	ug/L
	Benzo(a)anthracene	< 10	ug/L
	Benzo(a)pyrene	< 10	ug/L
	Chrysene	< 10	ug/L
	Di-n-butylphthalate	< 10	ug/L
	Dibenzofuran	< 10	ug/L
	Fluoranthene	< 10	ug/L
	Fluorene	< 10	ug/L
	N-Nitrosodiphenylamine	< 10	ug/L
	Naphthalene	< 10	ug/L
	Nitrobenzene	< 10	ug/L
	Pentachlorophenol	< 50	ug/L
	Phenanthrene	< 10	ug/L
	Phenol	< 10	ug/L
	Pyrene	< 10	ug/L
	bis(2-Chloroethoxy)methane	< 10	ug/L
	bis(2-Ethylhexyl)phthalate	< 10	ug/L
BATCH NO: 58355		SAMPLE NO:	H360907
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Naphthalene	< 10	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58578		SAMPLE NO: H361285	
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dibromomethane	< 5	ug/L
	1,2-Dichloroethane	< 5	ug/L
	1,2-Dichloropropane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Naphthalene	< 10	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L
BATCH NO: 58617		SAMPLE NO: H361357	
OVTCW2	8260A TCL Volatiles in Water		
	1,2-Dichloroethane	< 5	ug/L
	Benzene	< 5	ug/L
	Chlorobenzene	< 5	ug/L
	Ethylbenzene	< 5	ug/L
	Methylene chloride	< 5	ug/L
	Naphthalene	< 10	ug/L
	Toluene	< 5	ug/L
	Xylenes	< 5	ug/L

DUPLICATE AND MATRIX SPIKE DATA

TEST CODE	DETERMINATION	ORIGINAL RESULT	DUPLICATE RESULT	UNITS	RANGE / RPD	MS RESULT	MS % RCVRY
BATCH NO: 58082						SAMPLE NO: H417762	
I590	Solids, Dissolved at 180C	550	538	mg/L	2.2		

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE DATA

TEST CODE	DETERMINATION	MS RESULT	MSD RESULT	UNITS	RPD	MS PCT RCVRY	MSD PCT RCVRY
BATCH NO: 57894						SAMPLE NO: H414886	
OSVPPW	Semi-volatile Extractables in Water						
	1,2,4-Trichlorobenzene	58.3	61.3	ug/L	5.02	58	61
	1,4-Dichlorobenzene	60.8	62.3	ug/L	2.44	61	62
	2,4-Dinitrotoluene	61.0	62.0	ug/L	1.63	61	62
	2-Chlorophenol	132	140	ug/L	5.88	66	70
	4-Nitrophenol	45.0	40.7	ug/L	10.0	22 *	20 *
	Acenaphthene	69.6	72.2	ug/L	3.67	70	72
	N-Nitrosodi-n-propylamine	58.4	63.3	ug/L	8.05	58	63
	Pentachlorophenol	137	132	ug/L	3.72	68	66
	Phenol	59.8	62.3	ug/L	4.10	30	31
	Pyrene	69.6	66.6	ug/L	4.41	70	67
	p-Chloro-m-cresol	110	115	ug/L	4.44	55	58
	* MS recovery below in house QA limits, but passes 8270 QA limits.						
BATCH NO: 58355						SAMPLE NO: H417778	
OVTCW2	8260A TCL Volatiles in Water						
	1,1-Dichloroethene	41.8	45.7	ug/L	8.70	84	91
	Benzene	47.1	49.7	ug/L	5.39	94	99
	Chlorobenzene	54.1	48.2	ug/L	11.5	108	96
	Toluene	50.0	53.8	ug/L	7.51	100	108
	Trichloroethene	48.4	48.6	ug/L	0.44	97	97

Industrial Compliance

A Subsidiary of SP Environmental Systems, Inc.

303/277-1400

PROJECT NAME: HWPW

SITE LOCATION: 4910 Liberty Rd Houston, Tx

PROJECT #: 4#102065

I.C. CHAIN OF CUSTODY RECORD

1HP05

C.O.C. #

SHIP TO: Pace Labs

LAB. CONTACT & PHONE: E. Sommers 488-1840

SAMPLERS NAME & SIGNATURE: William R Goldsby / William R Goldsby

I.C. CONTACT & PHONE: Bill Garsby (713) 460-4230, E. Hanford (214) 352-9400

SAMPLE #	DATE	TIME	COMP.	GRAB	SAMPLE LOCATION	# OF CONTAINERS	ANALYSIS METHOD: BTEX-8260	PAH's-8270	BTEX-8260 + NAPTHALENE	TOTAL DISSOLVED SOLIDS	PRESERVATIVES YES	PRESERVATIVES NO	CUSTODY SEALS YES	CUSTODY SEALS NO	*REMARKS:
HP11UTZ	12/6/95	15:35		X	CPT16R	2		X			VOAs			X	COULD ONLY COLLECT (2) 40 mL VIALS
HP12UTZ	↓	16:30			CPT04R	5	X		X			LITERS			
HP16LTZ	12/7/95	08:05			CPT06R	5	X		X						
TRIP BLANK		NA			NA	2	X								
HP16UTZ		09:05			CPT06R	3	X								
HP13UTZ		10:05			CPT07R	5	X		X						
FB03	↓	11:15		↓	NA	2	X				↓	↓	↓	↓	
Last Line					William R Goldsby										
TRIP BLANK					NA	2	X								
Last Line					William R Goldsby										

RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
William R Goldsby	12/7/95			12-7-95 15:00	
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED AT LAB. BY	METHOD OF SHIPMENT		
	1017 RC				

*REMARKS:

Only 1 trip blank was received.

Elena Sommers

RECEIVED JAN 0 8 1996

pace ANALYTICAL SERVICES, INC.

January 03, 1996
Report No.: 00048102

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

LIMS CLIENT: 0717 0007
PACE PROJECT: H37359
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

SAMPLE ID: WPW-S-002-P
SAMPLE NO: H418502

DATE SAMPLED: 13-DEC-95 1230
DATE RECEIVED: 14-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCS2	8260A TCL Volatiles in Soil		
		1,2-Dichloroethane	< 5	ug/kg
		Benzene	< 5	ug/kg
		Chlorobenzene	< 5	ug/kg
		Ethylbenzene	< 5	ug/kg
		Methylene chloride	< 5	ug/kg
		Toluene	< 5	ug/kg
		Xylenes (total)	< 5	ug/kg
3	OSVTCS	TCL - Semi-volatile Extractables in Soil		
		1,2-Diphenylhydrazine	< 330	ug/kg
		2,4-Dimethylphenol	< 330	ug/kg
		2,4-Dinitrotoluene	< 330	ug/kg
		2,6-Dinitrotoluene	< 330	ug/kg
		2-Chloronaphthalene	< 330	ug/kg
		2-Methylnaphthalene	< 330	ug/kg
		4,6-Dinitro-o-cresol	< 1600	ug/kg
		4-Nitrophenol	< 1600	ug/kg
		Acenaphthene	< 330	ug/kg
		Acenaphthylene	< 330	ug/kg
		Anthracene	< 330	ug/kg
		Benzo(a)anthracene	< 330	ug/kg
		Benzo(a)pyrene	< 330	ug/kg
		Chrysene	< 330	ug/kg
		Di-n-butyl phthalate	< 330	ug/kg
		Dibenzofuran	< 330	ug/kg
		Fluoranthene	< 330	ug/kg
		Fluorene	< 330	ug/kg
		N-Nitrosodiphenylamine	< 330	ug/kg
		Naphthalene	< 330	ug/kg
		Nitrobenzene	< 330	ug/kg
		Pentachlorophenol	< 1600	ug/kg
		Phenanthrene	< 330	ug/kg
		Phenol	< 330	ug/kg
		Pyrene	< 330	ug/kg
		bis(2-Chloroethoxy)methane	< 330	ug/kg
		bis(2-Ethylhexyl)phthalate	< 330	ug/kg

COMMENTS: Continued on next page.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
SAMPLE ID: WPW-S-002-P
SAMPLE NO: H418502

LN	TEST CODE	DETERMINATION	RESULT	UNITS

COMMENTS: Results are reported on an "as received" basis and are not corrected for moisture.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

LIMS CLIENT: 0717 0007
PACE PROJECT: H37359
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

SAMPLE ID: WPW-S-003-P
SAMPLE NO: H418503

DATE SAMPLED: 13-DEC-95 1235
DATE RECEIVED: 14-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCS2	8260A TCL Volatiles in Soil		
		1,2-Dichloroethane	< 5	ug/kg
		Benzene	< 5	ug/kg
		Chlorobenzene	< 5	ug/kg
		Ethylbenzene	< 5	ug/kg
		Methylene chloride	< 5	ug/kg
		Toluene	< 5	ug/kg
		Xylenes (total)	< 5	ug/kg
3	OSVTCS	TCL - Semi-volatile Extractables in Soil		
		1,2-Diphenylhydrazine	< 330	ug/kg
		2,4-Dimethylphenol	< 330	ug/kg
		2,4-Dinitrotoluene	< 330	ug/kg
		2,6-Dinitrotoluene	< 330	ug/kg
		2-Chloronaphthalene	< 330	ug/kg
		2-Methylnaphthalene	< 330	ug/kg
		4,6-Dinitro-o-cresol	< 1600	ug/kg
		4-Nitrophenol	< 1600	ug/kg
		Acenaphthene	< 330	ug/kg
		Acenaphthylene	< 330	ug/kg
		Anthracene	< 330	ug/kg
		Benzo(a)anthracene	< 330	ug/kg
		Benzo(a)pyrene	< 330	ug/kg
		Chrysene	< 330	ug/kg
		Di-n-butyl phthalate	< 330	ug/kg
		Dibenzofuran	< 330	ug/kg
		Fluoranthene	< 330	ug/kg
		Fluorene	< 330	ug/kg
		N-Nitrosodiphenylamine	< 330	ug/kg
		Naphthalene	< 330	ug/kg
		Nitrobenzene	< 330	ug/kg
		Pentachlorophenol	< 1600	ug/kg
		Phenanthrene	< 330	ug/kg
		Phenol	< 330	ug/kg
		Pyrene	< 330	ug/kg
		bis(2-Chloroethoxy)methane	< 330	ug/kg
		bis(2-Ethylhexyl)phthalate	< 330	ug/kg

COMMENTS: Continued on next page.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
SAMPLE ID: WPW-S-003-P
SAMPLE NO: H418503

LN	TEST CODE	DETERMINATION	RESULT	UNITS

COMMENTS: Results are reported on an "as received" basis and are not corrected for moisture.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: WPW-S-004-P
SAMPLE NO: H418504

LIMS CLIENT: 0717 0007
PACE PROJECT: H37359
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 13-DEC-95 1240
DATE RECEIVED: 14-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCS2	8260A TCL Volatiles in Soil		
		1,2-Dichloroethane	< 5	ug/kg
		Benzene	< 5	ug/kg
		Chlorobenzene	< 5	ug/kg
		Ethylbenzene	< 5	ug/kg
		Methylene chloride	< 5	ug/kg
		Toluene	< 5	ug/kg
		Xylenes (total)	< 5	ug/kg
3	OSVTCS	TCL - Semi-volatile Extractables in Soil		
		1,2-Diphenylhydrazine	< 660 *	ug/kg
		2,4-Dimethylphenol	< 660	ug/kg
		2,4-Dinitrotoluene	< 660	ug/kg
		2,6-Dinitrotoluene	< 660	ug/kg
		2-Chloronaphthalene	< 660	ug/kg
		2-Methylnaphthalene	< 660	ug/kg
		4,6-Dinitro-o-cresol	< 3300	ug/kg
		4-Nitrophenol	< 3300	ug/kg
		Acenaphthene	< 660	ug/kg
		Acenaphthylene	< 660	ug/kg
		Anthracene	< 660	ug/kg
		Benzo(a)anthracene	1100	ug/kg
		Benzo(a)pyrene	360	ug/kg
		Chrysene	1400	ug/kg
		Di-n-butyl phthalate	< 660	ug/kg
		Dibenzofuran	< 660	ug/kg
		Fluoranthene	2600	ug/kg
		Fluorene	< 660	ug/kg
		N-Nitrosodiphenylamine	< 660	ug/kg
		Naphthalene	< 660	ug/kg
		Nitrobenzene	< 660	ug/kg
		Pentachlorophenol	< 3300	ug/kg
		Phenanthrene	< 660	ug/kg
		Phenol	< 660	ug/kg
		Pyrene	2800	ug/kg
		bis(2-Chloroethoxy)methane	< 660	ug/kg
		bis(2-Ethylhexyl)phthalate	< 660	ug/kg

COMMENTS: Continued on next page.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
SAMPLE ID: WPW-S-004-P
SAMPLE NO: H418504

LN	TEST CODE	DETERMINATION	RESULT	UNITS

COMMENTS: Results are reported on an "as received" basis and are not corrected for moisture.
* The reporting limits were elevated due to the dilution required by the high concentration of target analytes.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

SAMPLE ID: WPW-S-009-P
SAMPLE NO: H418505

LIMS CLIENT: 0717 0007
PACE PROJECT: H37359
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

DATE SAMPLED: 13-DEC-95 1310
DATE RECEIVED: 14-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCS2	8260A TCL Volatiles in Soil		
		1,2-Dichloroethane	< 5 **	ug/kg
		Benzene	< 5	ug/kg
		Chlorobenzene	< 5	ug/kg
		Ethylbenzene	< 5	ug/kg
		Methylene chloride	< 5	ug/kg
		Toluene	< 5	ug/kg
		Xylenes (total)	< 5	ug/kg
3	OSVTCS	TCL - Semi-volatile Extractables in Soil		
		1,2-Diphenylhydrazine	< 660 *	ug/kg
		2,4-Dimethylphenol	< 660	ug/kg
		2,4-Dinitrotoluene	< 660	ug/kg
		2,6-Dinitrotoluene	< 660	ug/kg
		2-Chloronaphthalene	< 660	ug/kg
		2-Methylnaphthalene	< 660	ug/kg
		4,6-Dinitro-o-cresol	< 3300	ug/kg
		4-Nitrophenol	< 3300	ug/kg
		Acenaphthene	< 660	ug/kg
		Acenaphthylene	< 660	ug/kg
		Anthracene	< 660	ug/kg
		Benzo(a)anthracene	< 660	ug/kg
		Benzo(a)pyrene	< 660	ug/kg
		Chrysene	< 660	ug/kg
		Di-n-butyl phthalate	< 660	ug/kg
		Dibenzofuran	< 660	ug/kg
		Fluoranthene	< 660	ug/kg
		Fluorene	< 660	ug/kg
		N-Nitrosodiphenylamine	< 660	ug/kg
		Naphthalene	< 660	ug/kg
		Nitrobenzene	< 660	ug/kg
		Pentachlorophenol	< 3300	ug/kg
		Phenanthrene	< 660	ug/kg
		Phenol	< 660	ug/kg
		Pyrene	< 660	ug/kg
		bis(2-Chloroethoxy)methane	< 660	ug/kg
		bis(2-Ethylhexyl)phthalate	< 660	ug/kg

COMMENTS: Continued on next page.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
SAMPLE ID: WPW-S-009-P
SAMPLE NO: H418505

LN	TEST CODE	DETERMINATION	RESULT	UNITS

COMMENTS: Results are reported on an "as received" basis and are not corrected for moisture.
* The reporting limits were elevated due to the dilution required by the high concentration of non-target analytes.
**The internal standard areas were out range due to matrix interferences, which was confirmed by re-analysis.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

LIMS CLIENT: 0717 0007
PACE PROJECT: H37359
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

SAMPLE ID: WPW-S-007-P
SAMPLE NO: H418506

DATE SAMPLED: 13-DEC-95 1340
DATE RECEIVED: 14-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	OVTCS2	8260A TCL Volatiles in Soil		
		1,2-Dichloroethane	< 5	ug/kg
		Benzene	< 5	ug/kg
		Chlorobenzene	< 5	ug/kg
		Ethylbenzene	< 5	ug/kg
		Methylene chloride	< 5	ug/kg
		Toluene	< 5	ug/kg
		Xylenes (total)	< 5	ug/kg
3	OSVTCS	TCL - Semi-volatile Extractables in Soil		
		1,2-Diphenylhydrazine	< 660 *	ug/kg
		2,4-Dimethylphenol	< 660	ug/kg
		2,4-Dinitrotoluene	< 660	ug/kg
		2,6-Dinitrotoluene	< 660	ug/kg
		2-Chloronaphthalene	< 660	ug/kg
		2-Methylnaphthalene	< 660	ug/kg
		4,6-Dinitro-o-cresol	< 3300	ug/kg
		4-Nitrophenol	< 3300	ug/kg
		Acenaphthene	< 660	ug/kg
		Acenaphthylene	< 660	ug/kg
		Anthracene	< 660	ug/kg
		Benzo(a)anthracene	< 660	ug/kg
		Benzo(a)pyrene	670	ug/kg
		Chrysene	6200	ug/kg
		Di-n-butyl phthalate	< 660	ug/kg
		Dibenzofuran	< 660	ug/kg
		Fluoranthene	22000	ug/kg
		Fluorene	< 660	ug/kg
		N-Nitrosodiphenylamine	< 660	ug/kg
		Naphthalene	1200	ug/kg
		Nitrobenzene	< 660	ug/kg
		Pentachlorophenol	< 3300	ug/kg
		Phenanthrene	19000	ug/kg
		Phenol	< 660	ug/kg
		Pyrene	15000	ug/kg
		bis(2-Chloroethoxy)methane	< 660	ug/kg
		bis(2-Ethylhexyl)phthalate	< 660	ug/kg

COMMENTS: Continued on next page.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
SAMPLE ID: WPW-S-007-P
SAMPLE NO: H418506

LN	TEST CODE	DETERMINATION	RESULT	UNITS

COMMENTS: Results are reported on an "as received" basis and are not corrected for moisture.
* The reporting limits were elevated due to the dilution required by the high concentration of target analytes.

LABORATORY ANALYSIS REPORT

CLIENT NAME: TERRANEXT
ADDRESS: 10025 W. TECHNOLOGY BLVD, STE 147
DALLAS, TX 75220-
ATTENTION: ELAINE HANFORD

LIMS CLIENT: 0717 0007
PACE PROJECT: H37359
PACE CLIENT: 621004
P.O. NO: DOC.AUDIT# 187764

SAMPLE ID: WPW-M-001-P
SAMPLE NO: H418507

DATE SAMPLED: 13-DEC-95 1410
DATE RECEIVED: 14-DEC-95
PROJECT MANAGER: Elessa Sommers

LN	TEST CODE	DETERMINATION	RESULT	UNITS
5	ANAS	Sodium, Total (Na)	370,000	mg/kg
6	AKS	Potassium, Total (K)	60	mg/kg
7	AFES	Iron, Total (Fe)	350	mg/kg
8	AMGS	Magnesium, Total (Mg)	20	mg/kg
9	AALS	Aluminum, Total (Al)	10	mg/kg
10	I730S	Sulfate (as SO4)	8,800	mg/kg
11	I130S	Chloride (Cl)	482,000	mg/kg
12	I023S	Alkalinity, Total (as CaCO3)	500 *	mg/kg

COMMENTS: Results are reported on an "as received" basis and are not corrected for moisture.
* The Alkalinity analysis was performed on a 40g/800mL leachate and required a high range titrant (0.1N) due to matrix interference with the low range titrant (0.02N).

SUPPLEMENTAL INFORMATION

LN	TEST CODE	LCSR BLNK BATCH	DUP/MS MS/MSD BATCH	SAMPLE PREPARATION LR-METHOD	SAMPLE PREPARATION DATE/TIME	SAMPLE PREPARATION ANALYST	SAMPLE ANALYSIS LR-METHOD	SAMPLE ANALYSIS DATE/TIME	SAMPLE ANALYSIS ANALYST	SAMPLE ANALYSIS INSTRUMENT
SAMPLE ID: WPW-S-002-P								SAMPLE NO: H418502		
1	OVTCS2	58746	57684	NA			19-8260A	27-DEC-95 1828	MH	GCMSY
3	OSVTCS	58527	58527	19-3550A	20-DEC-95 1200	RE	19-8270B	22-DEC-95 1655	CAH	GCMSS
SAMPLE ID: WPW-S-003-P								SAMPLE NO: H418503		
1	OVTCS2	58710	57684	NA			19-8260A	26-DEC-95 0743	MH	GCMSY
3	OSVTCS	58527	58527	19-3550A	20-DEC-95 1200	RE	19-8270B	22-DEC-95 1743	CAH	GCMSS
SAMPLE ID: WPW-S-004-P								SAMPLE NO: H418504		
1	OVTCS2	58746	57684	NA			19-8260A	27-DEC-95 2026	MH	GCMSY
3	OSVTCS	58527	58527	19-3550A	20-DEC-95 1200	RE	19-8270B	22-DEC-95 1830	CAH	GCMSS
SAMPLE ID: WPW-S-009-P								SAMPLE NO: H418505		
1	OVTCS2	58746	57684	NA			19-8260A	27-DEC-95 1620	MH	GCMSY
3	OSVTCS	58527	58527	19-3550A	20-DEC-95 1200	RE	19-8270B	22-DEC-95 1918	CAH	GCMSS
SAMPLE ID: WPW-S-007-P								SAMPLE NO: H418506		
1	OVTCS2	58746	57684	NA			19-8260A	27-DEC-95 2150	MH	GCMSY
3	OSVTCS	58527	58527	19-3550A	20-DEC-95 1200	RE	19-8270B	22-DEC-95 2005	CAH	GCMSS
SAMPLE ID: WPW-M-001-P								SAMPLE NO: H418507		
10	I730S	58551	58551	13-10.2			02-375.4	20-DEC-95 0745	LNP	301WAT
11	I130S	58568	58568	13-10.2			02-325.2	20-NOV-95 1140	LB	304WAT
12	I023S	58613	58613	13-10.2			03-403	20-DEC-95 0800	TAM	200WAT
5	ANAS	58522	58522	19-3050A	20-DEC-95 1300	SAO	19-7770	22-DEC-95 1448	JVR	300MET
6	AKS	58522	58522	19-3050A	20-DEC-95 1300	SAO	19-7610	22-DEC-95 1405	JVR	300MET
7	AFES	58522	58522	19-3050A	20-DEC-95 1300	SAO	19-6010A	22-DEC-95 1153	JVR	700MET
8	AMGS	58522	58522	19-3050A	20-DEC-95 1300	SAO	19-6010A	22-DEC-95 1153	JVR	700MET
9	AALS	58522	58522	19-3050A	20-DEC-95 1300	SAO	19-6010A	22-DEC-95 1153	JVR	700MET

LR Method Literature Reference

02 EPA-Methods for Chemical Analysis of Water & Wastes, 1984.
03 APHA-Standard Methods for the Examination of Water and Wastewater, 16th edition
13 Methods of Soils Analysis, Am Soc of Agronomy, 2nd ed, 1982
19 EPA-Test Methods for Evaluating Solid Waste, 3rd ed, Nov. 1986 and updates

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: WPW-S-002-P				SAMPLE NO: H418502	
2	$VOA2S	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	110	-	
		Dibromofluoromethane	111	-	
		Toluene-d8	98	-	
4	$BNAS	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	69	-	
		2-Fluorobiphenyl	67	-	
		2-Fluorophenol	58	-	
		Nitrobenzene-d5	78	-	
		Phenol-d5	57	-	
		p-Terphenyl-d14	83	-	
SAMPLE ID: WPW-S-003-P				SAMPLE NO: H418503	
2	$VOA2S	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	119	-	
		Dibromofluoromethane	119	-	
		Toluene-d8	90	-	
4	$BNAS	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	51	-	
		2-Fluorobiphenyl	49	-	
		2-Fluorophenol	42	-	
		Nitrobenzene-d5	57	-	
		Phenol-d5	42	-	
		p-Terphenyl-d14	61	-	
SAMPLE ID: WPW-S-004-P				SAMPLE NO: H418504	
2	$VOA2S	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	128 *	-	
		Dibromofluoromethane	118	-	
		Toluene-d8	93	-	
		* The surrogate was out of range due to matrix interference, which was confirmed by re-analysis.			
4	$BNAS	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	82	-	
		2-Fluorobiphenyl	85	-	
		2-Fluorophenol	67	-	
		Nitrobenzene-d5	99	-	
		Phenol-d5	67	-	
		p-Terphenyl-d14	100	-	

SURROGATE STANDARD RECOVERY

LN	TEST CODE	SURROGATE COMPOUND	PERCENT RECOVERY	ACCEPTANCE LIMITS	REF LN
SAMPLE ID: WPW-S-009-P				SAMPLE NO: H418505	
2	$VOA2S	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	98	-	
		Dibromofluoromethane	102	-	
		Toluene-d8	101	-	
4	$BNAS	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	77	-	
		2-Fluorobiphenyl	114	-	
		2-Fluorophenol	64	-	
		Nitrobenzene-d5	80	-	
		Phenol-d5	64	-	
		p-Terphenyl-d14	107	-	
SAMPLE ID: WPW-S-007-P				SAMPLE NO: H418506	
2	$VOA2S	GC/MS Volatiles Surrogates (8260)			1
		4-Bromofluorobenzene	116	-	
		Dibromofluoromethane	123 *	-	
		Toluene-d8	97	-	
		* The surrogate was out of range due to matrix interference, which was confirmed by re-analysis.			
4	$BNAS	GC/MS BNA Surrogates			3
		2,4,6-Tribromophenol	72	-	
		2-Fluorobiphenyl	108	-	
		2-Fluorophenol	61	-	
		Nitrobenzene-d5	77	-	
		Phenol-d5	60	-	
		p-Terphenyl-d14	106	-	

LABORATORY CONTROL SAMPLE RECOVERY

TEST CODE	DETERMINATION	LCS % RECOVERY	ACCEPTANCE LIMITS
BATCH NO: 58522			SAMPLE NO: H361182
AALS	Aluminum, Total (Al)	81.7	-
AFES	Iron, Total (Fe)	60.6	-
AKS	Potassium, Total (K)	87.0	-
AMGS	Magnesium, Total (Mg)	90.3	-
ANAS	Sodium, Total (Na)	91.6	-
BATCH NO: 58527			SAMPLE NO: H361190
OSVTCS	TCL - Semi-volatile Extractables in Soil		
	1,2,4-Trichlorobenzene	76	-
	1,4-Dichlorobenzene	73	-
	2,4-Dinitrotoluene	81	-
	2-Chlorophenol	67	-
	4-Chloro-3-methylphenol	71	-
	4-Nitrophenol	88	-
	Acenaphthene	78	-
	N-Nitrosodi-n-propylamine	71	-
	Pentachlorophenol	83	-
	Phenol	61	-
	Pyrene	86	-
BATCH NO: 58551			SAMPLE NO: H361236
I730S	Sulfate (as SO4)	105.5	-
BATCH NO: 58568			SAMPLE NO: H361264
I130S	Chloride (Cl)	96	-
BATCH NO: 58613			SAMPLE NO: H361348
I023S	Alkalinity, Total (as CaCO3)	100.5	-
BATCH NO: 58710			SAMPLE NO: H361520
OVTCS2	8260A TCL Volatiles in Soil		
	1,1-Dichloroethene	96	-
	Benzene	100	-
	Chlorobenzene	89	-
	Toluene	98	-
	Trichloroethene	90	-

LABORATORY CONTROL SAMPLE RECOVERY

TEST CODE	DETERMINATION	LCS % RECOVERY	ACCEPTANCE LIMITS
BATCH NO: 58746			SAMPLE NO: H361582
OVTCS2	8260A TCL Volatiles in Soil		
	1,1-Dichloroethene	95	-
	Benzene	100	-
	Chlorobenzene	88	-
	Toluene	98	-
	Trichloroethene	90	-

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58522			SAMPLE NO: H361183
AALS	Aluminum, Total (Al)	< 10	mg/kg
AFES	Iron, Total (Fe)	< 2	mg/kg
AKS	Potassium, Total (K)	< 10	mg/kg
AMGS	Magnesium, Total (Mg)	< 10	mg/kg
ANAS	Sodium, Total (Na)	< 100	mg/kg
BATCH NO: 58527			SAMPLE NO: H361191
OSVTCS	TCL - Semi-volatile Extractables in Soil		
	1,2,4-Trichlorobenzene	< 330	ug/kg
	1,2-Dichlorobenzene	< 330	ug/kg
	1,2-Diphenylhydrazine	< 330	ug/kg
	1,3-Dichlorobenzene	< 330	ug/kg
	1,4-Dichlorobenzene	< 330	ug/kg
	2,4,5-Trichlorophenol	< 330	ug/kg
	2,4,6-Trichlorophenol	< 330	ug/kg
	2,4-Dichlorophenol	< 330	ug/kg
	2,4-Dimethylphenol	< 330	ug/kg
	2,4-Dinitrophenol	< 1,600	ug/kg
	2,4-Dinitrotoluene	< 330	ug/kg
	2,6-Dinitrotoluene	< 330	ug/kg
	2-Chloronaphthalene	< 330	ug/kg
	2-Chlorophenol	< 330	ug/kg
	2-Methylnaphthalene	< 330	ug/kg
	2-Methylphenol	< 330	ug/kg
	2-Nitroaniline	< 1,600	ug/kg
	2-Nitrophenol	< 330	ug/kg
	3,3'-Dichlorobenzidine	< 660	ug/kg
	3-Nitroaniline	< 1,600	ug/kg
	4,6-Dinitro-o-cresol	< 1,600	ug/kg
	4-Bromophenylphenylether	< 330	ug/kg
	4-Chloro-3-methylphenol	< 330	ug/kg
	4-Chloroaniline	< 330	ug/kg
	4-Chlorophenylphenylether	< 330	ug/kg
	4-Methylphenol	< 330	ug/kg
	4-Nitronaniline	< 1,600	ug/kg
	4-Nitrophenol	< 1,600	ug/kg
	Acenaphthene	< 330	ug/kg
	Acenaphthylene	< 330	ug/kg
	Anthracene	< 330	ug/kg
	Benzo(a)anthracene	< 330	ug/kg
	Benzo(a)pyrene	< 330	ug/kg
	Benzo(b)fluoranthene	< 330	ug/kg
	Benzo(g,h,i)perylene	< 330	ug/kg
	Benzo(k)fluoranthene	< 330	ug/kg

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
	Benzoic acid	< 1,600	ug/kg
	Benzyl alcohol	< 330	ug/kg
	Butylbenzylphthalate	< 330	ug/kg
	Chrysene	< 330	ug/kg
	Di-n-butyl phthalate	< 330	ug/kg
	Di-n-butylphthalate	< 330	ug/kg
	Di-n-octylphthalate	< 330	ug/kg
	Dibenzo(a,h)anthracene	< 330	ug/kg
	Dibenzofuran	< 330	ug/kg
	Diethylphthalate	< 330	ug/kg
	Dimethylphthalate	< 330	ug/kg
	Fluoranthene	< 330	ug/kg
	Fluorene	< 330	ug/kg
	Hexachlorobenzene	< 330	ug/kg
	Hexachlorobutadiene	< 330	ug/kg
	Hexachlorocyclopentadiene	< 330	ug/kg
	Hexachloroethane	< 330	ug/kg
	Indeno(1,2,3-cd)pyrene	< 330	ug/kg
	Isophorone	< 330	ug/kg
	N-Nitrosodi-n-propylamine	< 330	ug/kg
	N-Nitrosodiphenylamine	< 330	ug/kg
	Naphthalene	< 330	ug/kg
	Nitrobenzene	< 330	ug/kg
	Pentachlorophenol	< 1,600	ug/kg
	Phenanthrene	< 330	ug/kg
	Phenol	< 330	ug/kg
	Pyrene	< 330	ug/kg
	bis(2-Chloroethoxy)methane	< 330	ug/kg
	bis(2-Chloroethyl)ether	< 330	ug/kg
	bis(2-Chloroisopropyl)ether	< 330	ug/kg
	bis(2-Ethylhexyl)phthalate	< 330	ug/kg
BATCH NO: 58551			SAMPLE NO: H361237
I730S	Sulfate (as SO4)	< 40	mg/kg
BATCH NO: 58568			SAMPLE NO: H361265
I130S	Chloride (Cl)	< 60	mg/kg
BATCH NO: 58613			SAMPLE NO: H361349
I023S	Alkalinity, Total (as CaCO3)	< 60	mg/kg

METHOD BLANK DATA

TEST CODE	DETERMINATION	RESULT	UNIT
BATCH NO: 58710			SAMPLE NO: H361521
OVTCS2	8260A TCL Volatiles in Soil		
	1,2-Dichloroethane	< 5	ug/kg
	Benzene	< 5	ug/kg
	Chlorobenzene	< 5	ug/kg
	Ethylbenzene	< 5	ug/kg
	Methylene chloride	< 5	ug/kg
	Toluene	< 5	ug/kg
	Xylenes (total)	< 5	ug/kg
BATCH NO: 58746			SAMPLE NO: H361583
OVTCS2	8260A TCL Volatiles in Soil		
	1,2-Dichloroethane	< 5	ug/kg
	Benzene	< 5	ug/kg
	Chlorobenzene	< 5	ug/kg
	Ethylbenzene	< 5	ug/kg
	Methylene chloride	< 5	ug/kg
	Toluene	< 5	ug/kg
	Xylenes (total)	< 5	ug/kg

DUPLICATE AND MATRIX SPIKE DATA

TEST CODE	DETERMINATION	ORIGINAL RESULT	DUPLICATE RESULT	UNITS	RANGE / RPD	MS RESULT	MS % RCVRY
BATCH NO: 58522						SAMPLE NO: H418507	
ANAS	Sodium, Total (Na)	370,000	370,000	mg/kg	0.0	370,000 *	---
	* The concentration of the analyte prevented accurate determination of the matrix spike recovery.						
AKS	Potassium, Total (K)	60	60	mg/kg	0.0	3000 *	150.0
	* Recovery of the matrix spike indicates the presence of a matrix interference. This should be considered in evaluating the data.						
AFES	Iron, Total (Fe)	350	342	mg/kg	2.3	404	110.2
AMGS	Magnesium, Total (Mg)	20	20	mg/kg	0.0	1,650	83.2
AALS	Aluminum, Total (Al)	10	10	mg/kg	0.0	190	90.0
BATCH NO: 58551						SAMPLE NO: H418507	
I730S	Sulfate (as SO4)	8,800	8,400	mg/kg	4.7	17,000	82.0
BATCH NO: 58568						SAMPLE NO: H418507	
I130S	Chloride (Cl)	482,000	482,000	mg/kg	0.0	944,000	92.4

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE DATA

TEST CODE	DETERMINATION	MS RESULT	MSD RESULT	UNITS	RPD	MS PCT RCVRY	MSD PCT RCVRY
BATCH NO: 57684						SAMPLE NO: H416387	
OVTCS	TCL - Volatiles in Soil						
	1,1-Dichloroethene	43.47	41.78	ug/kg	3.96	108.6	104.4
	Benzene	38.46	37.45	ug/kg	2.66	96.15	93.63
	Chlorobenzene	39.62	37.25	ug/kg	6.17	99.05	93.13
	Toluene	40.16	38.09	ug/kg	5.29	100.4	95.23
	Trichloroethene	39.34	38.64	ug/kg	1.80	98.35	96.60
BATCH NO: 57684						SAMPLE NO: H416388	
OVTCS	TCL - Volatiles in Soil						
	1,1-Dichloroethene	41.8	43.1	ug/kg	2.97	104	108
	Benzene	38.0	39.0	ug/kg	2.42	95	97
	Chlorobenzene	37.3	38.4	ug/kg	2.96	93	96
	Toluene	40.1	40.4	ug/kg	0.75	100	101
	Trichloroethene	38.0	39.2	ug/kg	3.03	95	98
BATCH NO: 58527						SAMPLE NO: H418537	
OSVTCS	TCL - Semi-volatile Extractables in Soil						
	1,2,4-Trichlorobenzene	2010	2240	ug/kg	10.8	61	68
	1,4-Dichlorobenzene	1970	2170	ug/kg	9.66	60	66
	2,4-Dinitrotoluene	2590	2740	ug/kg	5.63	79	83
	2-Chlorophenol	3780	4190	ug/kg	10.3	57	63
	4-Chloro-3-methylphenol	4220	4500	ug/kg	6.42	64	68
	4-Nitrophenol	5800	6290	ug/kg	8.18	88	95
	Acenaphthene	2290	2480	ug/kg	7.97	69	75
	N-Nitrosodi-n-propylamine	2020	2200	ug/kg	8.53	61	67
	Pentachlorophenol	5340	5690	ug/kg	6.35	81	86
	Phenol	3540	3800	ug/kg	7.08	54	58
	Pyrene	2410	2550	ug/kg	5.64	73	77
BATCH NO: 58568						SAMPLE NO: H418507	
I130S	Chloride (Cl)	944,000	946,000	mg/kg	0.2	92.4	92.8

Industrial Compliance

A Subsidiary of SP Environmental Systems, Inc.

303/277-1400

PROJECT NAME: Houston Wood Preserving Works

SITE LOCATION: 4910 Liberty Rd Houston, Tx

PROJECT #: 44102069

I.C. CHAIN OF CUSTODY RECORD

12/13/95 #1

C.O.C. #

SHIP TO: Pace Lab

SAMPLERS NAME & SIGNATURE: William R Goldsby / William R Goldsby

I.C. CONTACT & PHONE: B. Goldsby (713) 460-4230

LAB. CONTACT & PHONE: E. Sommers 488-1810

SAMPLE #	DATE	TIME	COMP.	GRAB	SAMPLE LOCATION	# OF CONTAINERS	ANALYSIS METHOD 8240	8270 (8260)	CATION-ANION BALANCE					PRESERVATIVES YES	PRESERVATIVES NO	CUSTODY SEALS YES	CUSTODY SEALS NO	*REMARKS:
WPW-S-002-P	12/13/95	12:30		X	NDD	2	X	X							X		X	
WPW-S-003-P	↓	12:35		↓	↓	↓	X	X							↓		↓	
WPW-S-004-P	↓	12:40		↓	↓	↓	X	X							↓		↓	
WPW-S-009-P	↓	13:10		↓	Diesel Ast	↓	X	X							↓		↓	Rocky Material
WPW-S-007-P	↓	13:40		↓	CPT 12R	↓	X	X							↓		↓	"
WPW-M-001-P	↓	14.10		↓	Water Treatment Plant	↓			X						↓		↓	

William R Goldsby — Last Line

RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
William R Goldsby	12-13-95 16:40	[signature] 12/13/95 1640			[signature]
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
			[signature]	12-14-95 10:35	
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED AT LAB. BY	METHOD OF SHIPMENT		
	12-14-95 1605	[signature]			

*REMARKS: H418502-507

Industrial Compliance

A Subsidiary of SP Environmental Systems, Inc.

303/277-1400

PROJECT NAME: Houston Wood Preserving Works

SITE LOCA: 4910 Liberty Rd Houston, Tx

PROJECT #: 44102069

I.C. CHAIN OF CUSTODY RECORD

12/13/95 #1

C.O.C. #

SHIP TO: Pace Lab

SAMPLERS NAME & SIGNATURE: William R Goldsby / William R Goldsby

I.C. CONTACT & PHONE: B. Goldsby (713)460-4230

LAB. CONTACT & PHONE: E. Somers 488-1810

SAMPLE #	DATE	TIME	COMP.	GRAB	SAMPLE LOCATION	# OF CONTAINERS	ANALYSIS METHOD 8240 (8260)	8270	CATION-ANION BALANCE	PRESERVATIVES YES	PRESERVATIVES NO	CUSTODY SEALS YES	CUSTODY SEALS NO	*REMARKS:
WPW-S-002-P	12/13/95	12:30		X	NDD	2	X	X			X		X	
WPW-S-003-P	↓	12:35		↓	↓	↓					↓		↓	
WPW-S-004-P		12:40			↓									
WPW-S-009-P		13:10			DIESEL AST									ROCKY MATERIAL
WPW-S-007-P		13:40			CPT 12R									"
WPW-M-001-P	↓	14.10		↓	WATER TREATMENT PLANT			X						
					William R Goldsby — Last Line									

RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
William R Goldsby	12-13-95 16:40	White Oak 12/13/95 1640			
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
				12-14-95 10:35	
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED AT LAB. BY	METHOD OF SHIPMENT		
	12-14-95 1605				

*REMARKS:

H418502-507

Industrial Compliance

A Subsidiary of SP Environmental Systems, Inc.

303/277-1400

PROJECT NAME: Houston Wood Preserving Works

SITE LOCATION: 4910 Liberty Rd Houston, Tx

PROJECT #: 44102069

I.C. CHAIN OF CUSTODY RECORD

12/13/95 #1

C.O.C. #

SHIP TO: Pace Lab

SAMPLERS NAME & SIGNATURE: William R Golosby / William R Goldsby

I.C. CONTACT & PHONE: B. Golosby (713)460-4230

LAB. CONTACT & PHONE: E. Somers 488-1810

SAMPLE #	DATE	TIME	COMP.	GRAB	SAMPLE LOCATION	# OF CONTAINERS	ANALYSIS METHOD 8240 (8260)	8270	CATION-ANION BALANCE	PRESERVATIVES YES	PRESERVATIVES NO	CUSTODY SEALS YES	CUSTODY SEALS NO	*REMARKS:
WPW-S-002-P	12/13/95	12:30		X	NDD	2	X	X			X		X	
WPW-S-003-P	↓	12:35		↓	↓	↓	X	X			↓		↓	
WPW-S-004-P		12:40					X	X						
WPW-S-009-P		13:10			Diesel AST		X	X						Rocky Material
WPW-S-007-P		13:40			CPT 12R		X							"
WPW-M-001-P	↓	14.10		↓	Water Treatment Plant			X						
					William R Goldsby — Last Line									

RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
William R Goldsby	12-13-95 16:40	White 12/13/95 1644			R.
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
			R.	12-14-95 10:35	
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED AT LAB. BY	METHOD OF SHIPMENT		
	12-14-95 1605				

*REMARKS:

H418502-507

Industrial Compliance

A Subsidiary of SP Environmental Systems, Inc.

303/277-1400

PROJECT NAME: Houston Wood Preserving Works

SITE LOCAT: 4910 Liberty Rd Houston, Tx

PROJECT #: 44102069

I.C. CHAIN OF CUSTODY RECORD

12/13/95 #1

C.O.C. #

SHIP TO: Pace Lab

SAMPLERS NAME & SIGNATURE: William R Golosby / William R Golosby

I.C. CONTACT & PHONE: B. Golosby (713)460-4230

LAB. CONTACT & PHONE: E. Summers 488-1810

SAMPLE #	DATE	TIME	COMP.	GRAB	SAMPLE LOCATION	# OF CONTAINERS	ANALYSIS METHOD 8240 (8260)	8270	CATION-ANION BALANCE	PRESERVATIVES YES	PRESERVATIVES NO	CUSTODY SEALS YES	CUSTODY SEALS NO	*REMARKS:
WPW-S-002-P	12/13/95	12:30		X	NDD	2	X	X			X		X	
WPW-S-003-P	↓	12:35		↓	↓	↓	↓	↓	↓		↓		↓	
WPW-S-004-P		12:40												
WPW-S-009-P		13:10			Diesel AST									Rocky Material
WPW-S-007-P		13:40			CPT 12R									"
WPW-M-001-P	↓	14.10		↓	Water Treatment Plant			X						
					William R Golosby — Last Line									

RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
William R Golosby	12-13-95 16:40	[signature] 12/13/95 1640			[signature]
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED BY	RELEASED BY	DATE & TIME	RECEIVED BY
		[signature]	[signature]	12-14-95 10:35	
RELINQUISHED BY (Signature)	DATE & TIME	RECEIVED AT LAB. BY	METHOD OF SHIPMENT		
	12-14-95 1605	[signature]			

*REMARKS:

H418502-507

APPENDIX E

BORINGS LOGS - POINT OF COMPLIANCE WELLS

IC INDUSTRIAL COMPLIANCE

LOG OF BORING No.: MW-10A

SHEET NUMBER 1 OF 2

CLIENT:	SPTCo
OJECT NAME:	Houston Wood Preserving Works
PROJECT NUMBER:	44102069
PROJECT LOCATION:	4910 Liberty Road Houston, TX
BORING LOCATION:	
START DATE:	09/13/94
FINISH DATE:	09/13/94
START TIME:	
FINISH TIME:	
DRILLING CONTRACTOR:	PSI
DRILLING METHOD:	6.25" - Hollow Stem Auger
SAMPLING METHOD:	Shelby Tube and Split Spoon
SURFACE ELEVATION:	47.2'
TOC ELEVATION:	49.90'
WATER LEVEL:	7.1'
WATER ELEVATION:	42.80'
DATE:	09/19/94

Location Diagram

SAMPLER TYPE	SAMPLE DEPTH	OVM (PPM)	RECOVERY (FT)	DEPTH IN FEET	SOIL GRAPH	CI	SOIL DESCRIPTION AND DRILLING CONDITIONS	NOTES:
				1	FILL		Fill - crushed concrete 0-0.5'	
ST			0.9	2			clay dark brown and gray	
ST			0.9	3				
				4	CL		Silty clay - dark gray, stiff, moist, laminated rootlets	PP 1.75
ST			1.2	5			4-6' medium gray and dark yellow orange calcareous nodules	PP 2.0 - 2.25 PP 3.0
				6				
ST			1.5	7				
				8				
ST			1.1	9			very calcareous with small iron nodules	PP 2.5
				10				
ST			1.6	11				
				12			very sandy, light gray and dark yellow orange, moist to wet stiff to hard	PP 1.25 - 4.5+
ST			1.5	13				
				14				
ST			1.0	15	SM		Sand - light greenish gray, some clay, wet	
				16				
ST			2.0	17			wet, creosote odor	
				18				
ST			1.8	19	CL		Silty Clay, slight creosote odor light gray / iron stained;	PP 3.0
				20				

Geologist: Shiman
Checked By:

LEGEND:

CI - Completion Interval
OVM - Organic Vapor Meter
PP - Pocket Penetrometer
TOC - Top Of Casing

IC INDUSTRIAL COMPLIANCE

LOG OF BORING No.: MW-10A

SHEET NUMBER 2 OF 2

CLIENT: SPTCo

PROJECT NAME: Houston Wood Preserving Works

PROJECT NUMBER: 44102069

PROJECT LOCATION: 4910 Liberty Road Houston, TX

BORING LOCATION:

START DATE: 09/13/94 FINISH DATE: 09/13/94

START TIME: FINISH TIME:

DRILLING CONTRACTOR: PSI

DRILLING METHOD: 6.25" - Hollow Stem Auger

SAMPLING METHOD: Shelby Tube and Split Spoon

SURFACE ELEVATION: 47.2'

TOC ELEVATION: 49.90'

WATER LEVEL: 7.1'

WATER ELEVATION: 42.80'

DATE: 09/19/94

Location Diagram

SAMPLER TYPE	SAMPLE DEPTH	OVM (PPM)	RECOVERY (FT)	DEPTH IN FEET	SOIL GRAPH	CI	SOIL DESCRIPTION AND DRILLING CONDITIONS
ST			2.0	21	CL		very stiff, moist, no creosote odor to very mild creosote odor, some very fine grained sand
				22			
				23			
				24	///		Total Depth of Boring: 23 ft Well Screened Interval: 11.0 - 20.5 ft Well Total Depth: 23 ft
				25			
				26			
				27			
				28			
				29			
				30			
				31			
				32			
				33			
				34			
				35			
				36			
				37			
				38			
				39			
				40			

NOTES:

Geologist: Shiman

Checked By:

LEGEND:

CI - Completion Interval
OVM - Organic Vapor Meter
PP - Pocket Penetrometer
TOC - Top Of Casing

IC INDUSTRIAL COMPLIANCE

LOG OF BORING No.: MW-10B

SHEET NUMBER 1 OF 3

CLIENT:	SPTCo
PROJECT NAME:	Houston Wood Preserving Works
PROJECT NUMBER:	44102069
PROJECT LOCATION:	4910 Liberty Road Houston, TX
BORING LOCATION:	
START DATE: 09/12/94	FINISH DATE: 09/14/94
START TIME:	FINISH TIME:

DRILLING CONTRACTOR:	PSI
DRILLING METHOD:	6.25" Hollow Stem Auger Ream 0-19' with 16" Auger Bit
SAMPLING METHOD:	Shelby Tube and Split Spoon
SURFACE ELEVATION:	47.3'
TOC ELEVATION:	49.97'
WATER LEVEL:	7.0'
WATER ELEVATION:	42.97'
DATE:	09/19/94

Location Diagram

SAMPLER TYPE	SAMPLE DEPTH	OVM (PPM)	RECOVERY (FT)	DEPTH IN FEET	SOIL GRAPH	CI	SOIL DESCRIPTION AND DRILLING CONDITIONS	NOTES:
				1	FILL		Fill - crushed concrete 0-0.9'; clay; dark gray with black discoloration, calcareous nodules, dark to medium gray	Borehole diameter 16" from 0 to 19 ft
ST			0.6	2				
ST			0.7	3				
				4				
ST			1.5	5			With fine-grained gravel, woody fragments, moist to wet	poor sample
				6				
ST			2.0	7	CL		Silty Clay - medium light gray, soft, wet, with large wood fragments	PP 0.5
				8				
ST			1.5	9			light olive gray, stiff to very stiff, moist, with dark yellow orange iron staining	PP 1.75 - 2.75
				10				
ST			0.3	11			soft boggy / woody fragments with sandy clay	very poor recovery
				12				
ST			1.7	13			Silty Sandy Clay - light greenish gray and dark yellow orange mottled; stiff, moist to wet	PP 1.25 - 2.0
				14				
ST			0.9	15	SP		Sand - light greenish gray, some clay, wet, with woody fragments	
				16				
SS			1.5	17			light gray, very fine-grained, trace silt, wet, creosote odor	
				18				
SS			1.2	19	CL		Sandy Clay - light gray, moist to wet	PP 1.5
				20				Set 12" surface casing 0-20'

Geologist: Shiman

Checked By:

LEGEND:

CI - Completion Interval
OVM - Organic Vapor Meter
PP - Pocket Penetrometer
TOC - Top Of Casing

IC INDUSTRIAL COMPLIANCE

LOG OF BORING No.: MW-10B

SHEET NUMBER 2 OF 3

Location Diagram

CLIENT: SPTCo
PROJECT NAME: Houston Wood Preserving Works
PROJECT NUMBER: 44102069
PROJECT LOCATION: 4910 Liberty Road Houston, TX
BORING LOCATION:
START DATE: 09/12/94 FINISH DATE: 09/14/94
START TIME: FINISH TIME:

DRILLING CONTRACTOR: PSI
DRILLING METHOD: 6.25" Hollow Stem Auger
Ream 0-19' with 16" Auger Bit
SAMPLING METHOD: Shelby Tube and Split Spoon
SURFACE ELEVATION: 47.3'
TOC ELEVATION: 49.97'
WATER LEVEL: 7.0'
WATER ELEVATION: 42.97'
DATE: 09/19/94

SAMPLER TYPE	SAMPLE DEPTH	OVM (PPM)	RECOVERY (FT)	DEPTH IN FEET	SOIL GRAPH	CI	SOIL DESCRIPTION AND DRILLING CONDITIONS	NOTES:
ST			1.5	21			with dark yellow orange iron staining; very stiff, moist, no creosote odor	PP 3.25 - 3.75
				22				
ST			1.8	23			some silt, very mild creosote odor light gray and orange brown mottled clay	PP 3.0 - 3.75
				24			silty, sandy, hard, moist	PP > 4.5
SS			2.0	25				
				26				
SS			1.7	27				PP 4.0
				28				
SS			1.9	29			color is light gray and light brown	
				30	SM		mottled, become silty sand @ 29', wet 6" layer silty clay (30-30.5)	
SS			1.0	31				
				32			Silty Sand - brown, wet, very fine-grained;	
SS			1.7	33	SP		sand, light brown, vfg very dense, saturated, 10-20% silt, mild creosote odor, light brown and gray	PID 2.5 ppm MAX
				34				
SS			0.7	35				PID 2.9 ppm MAX
				36				
SS			0.5	37				
				38				
SS			2.0	39			Clay - moderate reddish-brown with light greenish	strata break @ 38.5'
				40	CH		gray markings, hard, moist, with light brown silty sand (40.5'-41.4').	

Geologist: Shiman
Checked By:

LEGEND:

CI - Completion Interval
OVM - Organic Vapor Meter
PP - Pocket Penetrometer
TOC - Top Of Casing

IC INDUSTRIAL COMPLIANCE

LOG OF BORING No.: MW-10B

SHEET NUMBER 3 OF 3

CLIENT:	SPTCo
PROJECT NAME:	Houston Wood Preserving Works
PROJECT NUMBER:	44102069
PROJECT LOCATION:	4910 Liberty Road Houston, TX
BORING LOCATION:	
START DATE:	09/12/94
FINISH DATE:	09/14/94
START TIME:	
FINISH TIME:	
DRILLING CONTRACTOR:	PSI
DRILLING METHOD:	6.25" Hollow Stem Auger Ream 0-19' with 16" Auger Bit
SAMPLING METHOD:	Shelby Tube and Split Spoon
SURFACE ELEVATION:	47.3'
TOC ELEVATION:	49.97'
WATER LEVEL:	7.0'
WATER ELEVATION:	42.97'
DATE:	09/19/94

Location Diagram

SAMPLER TYPE	SAMPLE DEPTH	OVM (PPM)	RECOVERY (FT)	DEPTH IN FEET	SOIL GRAPH	CI	SOIL DESCRIPTION AND DRILLING CONDITIONS
SS			1.8	41	SM		
				42			wet, with very mild creosote odor
SS			2.0	43	CH		Clay - moderate reddish brown with light greenish gray marks; hard, moist
				44			
SS			2.0	45			
				46			
				47	///		Total Depth of boring: 46' Well screen (completion) interval: 27.1' - 41.6' Total Depth of Well: 44'
				48			
				49			
				50			
				51			
				52			
				53			
				54			
				55			
				56			
				57			
				58			
				59			
				60			

NOTES:

Set 12" surface casing 0-20'

Geologist: Shiman

Checked By:

LEGEND:

CI - Completion Interval
OVM - Organic Vapor Meter
PP - Pocket Penetrometer
TOC - Top Of Casing

IC INDUSTRIAL COMPLIANCE

LOG OF BORING No.: MW-11A

SHEET NUMBER 1 OF 2

CLIENT: SPTCo

PROJECT NAME: Houston Wood Preserving Works

PROJECT NUMBER: 44102069

PROJECT LOCATION: 4910 Liberty Road Houston, TX

BORING LOCATION:

START DATE: 09/15/94 FINISH DATE: 09/15/94

START TIME: FINISH TIME:

DRILLING CONTRACTOR: PSI

DRILLING METHOD: 6.25" Hollow Stem Auger

SAMPLING METHOD: Shelby Tube and Split Spoon

SURFACE ELEVATION: 47.5'

TOC ELEVATION: 50.00'

WATER LEVEL: 7.4'

WATER ELEVATION: 42.06'

DATE: 09/19/94

Location Diagram

SAMPLER TYPE	SAMPLE DEPTH	OVM (PPM)	RECOVERY (FT)	DEPTH IN FEET	SOIL GRAPH	CI	SOIL DESCRIPTION AND DRILLING CONDITIONS	NOTES:
				1	FILL		Fill - crushed concrete brown/gray silty clay	
ST			0.9	2				
ST			1.3	3				
				4	CL		Silty Clay - blackish gray	
ST			1.4	5			medium light gray and dark yellow orange, stiff, moist, rootlets	PP 2.0
				6				
ST			1.2	7			medium light gray with iron staining, some sand, Fe nodules, creosote odor	PP 1.75 - 2.0
				8				
ST			1.3	9			calcareous deposit @ 8 ft, creosote odor	PP 2.25
				10				
ST			1.7	11			grayish yellow green with Fe staining, with dark gray vertical silt pocket, wet, creosote odor	PP 1.0
				12				
ST			1.6	13			calcareous deposits, iron black staining, very stiff, very mild creosote odor	PP 2.25 - 3.0
				14				
ST			1.3	15	SC-SM		Clayey to Silty Sand - greenish gray with dark yellow orange markings, wet, no odor	
				16				
SS			2.0	17	SM		Silty Sand - very fine-grained, medium dense, wet, no creosote odor	No creosote odor @ bottom of sand
				18				
ST			1.8	19	CL		Silty Clay - light gray with light olive brown markings, stiff, moist to wet	PP 1.25 - 1.5
				20				

Geologist: Shiman

Checked By:

LEGEND:

CI - Completion Interval
OVM - Organic Vapor Meter
PP - Pocket Penetrometer
TOC - Top Of Casing

IC INDUSTRIAL COMPLIANCE

LOG OF BORING No.: MW-11A

SHEET NUMBER 2 OF 2

CLIENT:	SPTCo
PROJECT NAME:	Houston Wood Preserving Works
PROJECT NUMBER:	44102069
PROJECT LOCATION:	4910 Liberty Road Houston, TX
BORING LOCATION:	
START DATE:	09/15/94
FINISH DATE:	09/15/94
START TIME:	
FINISH TIME:	
DRILLING CONTRACTOR:	PSI
DRILLING METHOD:	6.25" Hollow Stem Auger
SAMPLING METHOD:	Shelby Tube and Split Spoon
SURFACE ELEVATION:	47.5'
TOC ELEVATION:	50.00'
WATER LEVEL:	7.4'
WATER ELEVATION:	42.06'
DATE:	09/19/94

Location Diagram

SAMPLER TYPE	SAMPLE DEPTH	OVM (PPM)	RECOVERY (FT)	DEPTH IN FEET	SOIL GRAPH	CI	SOIL DESCRIPTION AND DRILLING CONDITIONS	NOTES:
ST			1.7	21	CL		light gray, with dark yellow orange markings, very stiff, moist	PP 3.75
				22				
				23	///		Total Depth of boring: 22'	
							Well screen (completion) interval: 10.0' - 19.3'	
				24			Total Depth of Well: 21.5'	
				25				
				26				
				27				
				28				
				29				
				30				
				31				
				32				
				33				
				34				
				35				
				36				
				37				
				38				
				39				
				40				

Geologist: Shiman

Checked By:

LEGEND:

CI - Completion Interval
OVM - Organic Vapor Meter
PP - Pocket Penetrometer
TOC - Top Of Casing

IC INDUSTRIAL COMPLIANCE

LOG OF BORING No.: MW-11B

SHEET NUMBER 1 OF 2

CLIENT:	SPTCo
PROJECT NAME:	Houston Wood Preserving Works
PROJECT NUMBER:	44102069
PROJECT LOCATION:	4910 Liberty Road Houston, TX
BORING LOCATION:	
START DATE:	09/16/94
FINISH DATE:	09/19/94
START TIME:	
FINISH TIME:	
DRILLING CONTRACTOR:	PSI
DRILLING METHOD:	Hollow Stem Auger
SAMPLING METHOD:	Shelby Tube and Split Spoon
SURFACE ELEVATION:	47.6'
TOC ELEVATION:	50.19'
WATER LEVEL:	7.55'
WATER ELEVATION:	42.64'
DATE:	09/20/94

Location Diagram

SAMPLER TYPE	SAMPLE DEPTH	OVM (PPM)	RECOVERY (FT)	DEPTH IN FEET	SOIL GRAPH	CI	SOIL DESCRIPTION AND DRILLING CONDITIONS	NOTES:
							12" isolation casing set 0' to 20'	
				21				
				22				
SS			2.0	23	CL		Silty Clay - light gray, very stiff, moist, some vfg sand, tr, Fe stain, no creosote odor	PP 3.25 - 4.25
				24				
SS			2.0	25			light gray and light brown mottled, trace calcareous deposits, trace sand	PP 4.5+
				26				
SS			2.0	27			light gray and orange-brown mottled, hard, becomes sandier	PP > 4.5
				28			Sandy Clay - with wet sand pockets, green, gray staining, very slight creosote odor.	
SS			2.0	29				
				30				
SS			0.2	31			mild creosote odor	very poor recovery hit calcareous hard zone
				32				
SS			2.0	33	SP		Sand - moderate yellowish brown, vfg, wet, ~10% silt, with creosote product in calcareous deposits with yellowish gray color, no visible product,	
				34				
SS			1.2	35				
				36			slight creosote odor	
SS			0.5	37			slight creosote odor	
				38				
SS			1.4	39	CL		Silty Sandy Clay - moderate reddish brown and light greenish gray, hard, moist, slight creosote odor. Becomes high plastic clay below 40'	break @ 38.3' PP 4.5+ PP 4.5+
				40				

Geologist: Shiman

Checked By:

LEGEND:

CI - Completion Interval
OVM - Organic Vapor Meter
PP - Pocket Penetrometer
TOC - Top Of Casing

IC INDUSTRIAL COMPLIANCE

LOG OF BORING No.: MW-11B

SHEET NUMBER 2 OF 2

CLIENT:	SPTCo
PROJECT NAME:	Houston Wood Preserving Works
PROJECT NUMBER:	44102069
PROJECT LOCATION:	4910 Liberty Road Houston, TX
BORING LOCATION:	
START DATE:	09/16/94
FINISH DATE:	09/19/94
START TIME:	
FINISH TIME:	
DRILLING CONTRACTOR:	PSI
DRILLING METHOD:	Hollow Stem Auger
SAMPLING METHOD:	Shelby Tube and Split Spoon
SURFACE ELEVATION:	47.6'
TOC ELEVATION:	50.19'
WATER LEVEL:	7.55'
WATER ELEVATION:	42.64'
DATE:	09/20/94

Location Diagram

SAMPLER TYPE	SAMPLE DEPTH	OVM (PPM)	RECOVERY (FT)	DEPTH IN FEET	SOIL GRAPH	CI	SOIL DESCRIPTION AND DRILLING CONDITIONS
SS			2.0	41	CN		
				42			slickenside fracture planes
SS			2.0	43			questionable creosote odor
				44			
				45	///		Total Depth of boring: 44'
							Well screen (completion) Interval: 27.5' - 41.2'
				46			Total Depth of Well: 43.5'
				47			
				48			
				49			
				50			
				51			
				52			
				53			
				54			
				55			
				56			
				57			
				58			
				59			
				60			

NOTES:

Geologist: Shiman

Checked By:

LEGEND:

CI - Completion Interval
OVM - Organic Vapor Meter
PP - Pocket Penetrometer
TOC - Top Of Casing

APPENDIX F

CHEMICAL PROPERTIES OF CREOSOTE

1.0 Chemical Properties of Creosote

At least 75 percent of coal tar creosote mixtures are composed of polynuclear aromatic hydrocarbons (PAHs). PAHs are neutral, nonpolar organic compounds consisting of two or more fused benzene rings in linear, angular, or cluster arrangements. Due to the potentially acute and chronic toxicity primarily associated with the lower molecular weight PAHs, EPA has designated sixteen PAHs as being environmentally important and representative of PAHs as a class of compounds. These are the same PAH compounds which are included in EPAs Priority Pollutant List. These sixteen PAHs are listed in Table F-1 along with selected physical/chemical characteristics. As can be seen from this table, PAHs generally exhibit both low volatility and low aqueous solubility as compared to volatile aromatics such as benzene, toluene and xylene (BTEX compounds). Both of these properties decrease with increasing ring number (i.e., increasing molecular weight). It is these characteristics which strongly influence the removal of PAHs from soil material via bioremediation. While many other PAH isomers exist, those listed in Table F-1 are usually given focused attention by both state and federal regulatory agencies.

2.0 Environmental Fate and Transport

The environmental fate and transport of a chemical is dictated largely by a compound's physicochemical properties, including the following parameters:

* Soil/water distribution coefficient (K_d)
* Organic carbon/water partition coefficient (K_{oc})
* Octanol/water partition coefficient (K_{ow})
* Water solubility
* Vapor pressure
* Henry's law constant - air/water partition coefficient (H)
* Bioconcentration and bioaccumulation factors
* Media-specific half-life

Sorption - Normally, the value of K_d for a single compound will vary with the composition of the soils. Because organic matter in soil has been so strongly correlated with the adsorption of nonpolar, low water-soluble organics, K_d has been normalized for the soil organic matter content - K_{oc} [1]. The transport and partitioning of a chemical in a soil matrix is largely dictated by a chemical's soil/water distribution coefficient (K_d) and water solubility. The K_d is a measure of relative sorption potential and characterizes the tendency of an

organic chemical to be adsorbed to soil. A high K_d suggests a relatively low potential for leaching into ground water over a period of time. Chemicals with K_d values in excess of 2000 are ranked as immobile; less than 2000 but greater than 500 have low mobility.

The Gas Research Institute [2] cites the following equation that expresses the equilibrium relationship between an organic chemical concentration in the solid phase (Cs) to the respective aqueous phase concentration (Cw) for a soil - water system:

$$Cs = Cw * Kp$$

Here, a linear relationship is expressed with Kp defined as the overall partitioning coefficient that represents the sorption of the organic compounds on naturally occurring organic soil matter and NAPLs. The work of Boyd and Sun [3] suggests that Kp can be expressed as:

$$Kp = f_{NOC} * K_{OC} + f_{NAPL} * K_{NAPL}$$

where:

f_{NOC}	=	fraction of native organic carbon in a soil;
K_{OC}	=	equilibrium partition coefficient of an organic chemical between native organic carbon and water;
f_{NAPL}	=	fraction of NAPL in soil matrix; and
K_{NAPL}	=	equilibrium partition coefficient of an organic chemical between NAPL and water.

While the issue of PAH sorption with a NAPL-free soil is somewhat straightforward, the presence of NAPLs in a soil matrix serves to complicate the situation. As reported by the Gas Research Institute [2] and the Electric Power Research Institute (EPRI) [4], the parameter K_{NAPL} is believed to be somewhat analogous to K_{OC} and indicates the tendency of PAH compounds to partition more to the NAPL phase and less to the aqueous phase with increasing molecular weight. Work by EPRI to determine K_{NAPL} values for BTEX and PAH compounds in coal tar suggests that the partitioning of these compounds between NAPL and water follows Raoult's Law. On this basis, K_{NAPL} values should increase with increasing PAH molecular weight, thus suggesting a conservative decrease in the extent of PAH dissolution from NAPL into water.

Based on this discussion and referring to Table F-1 for the different PAHs, it is expected that sorption processes have an increasing effect of controlling the rate and extent of biodegradation as their molecular weight increases. Thus, the 2-, 3-, and 4-ring PAHs will be bioaccessible and biodegrade at a greater rate and to a greater extent than the 5- and 6-ring PAHs. This hypothesis is based on the fact that the aqueous solubilities decrease, and that the K_{ow} values increase, with the increasing molecular weight of the PAH.

Volatilization - The Henry's constant (and vapor pressure) of a chemical may also affect the transport and partitioning of a chemical in soil. Henry's constant characterizes the tendency of an organic chemical to volatilize from water. A low Henry's constant suggests a relatively low potential for volatilization from ground water and soil. Henry's constants (in atm-m^3/mole) lower than 10^{-7} are considered nonvolatile; less than 10^{-7} but greater than 10^{-5} are considered only slightly volatile.

PAH volatilization can occur from water to air and also from soil to air (sublimination). This migration can occur in two steps. In the first step, the organic compound is transferred from the macropore fluid into the soil gas, a process that is believed to be quite rapid. Next, the chemical diffuses through the soil gas to the interface of the soil and atmosphere and crosses a boundary layer into the atmosphere. This transport phenomena from the soil gas to the atmosphere depends upon the degree of saturation in the soil, the rate of gas exchange between the soil and atmosphere, and the rapidity with which organic compounds are mixed and dispersed in the atmosphere. While it is difficult to generalize about the relative rate of this transport process, it is expected that once PAHs are present in macropore fluid, then volatilization competes with biodegradation [5].

The PAHs considered herein can be grouped as follows:

* Low-molecular weight compounds: naphthalene, anthracene, fluorene, and phenanthrene

* Medium-molecular weight compounds: fluoranthene and pyrene

* High-molecular-weight compounds: benzo[a]anthracene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[a]pyrene and chrysene

As can be seen from Table F-1, the low-molecular-weight PAHs have K_{oc} values in the range of 1,000 to 10,000, indicating a low potential to migrate in soils (ATSDR, 1989). The medium-molecular-weight PAHs have K_{oc} values in the range of 10,000 and the high-molecular-weight PAHs have K_{oc} values in the range of 100,000 to 1 million, indicating that these compounds are relatively immobile in soils. Also summarized in Table F-1 are typical water solubilities. The water solubilities of the PAHs are low compared with benzene for example. The water solubilities of the PAHs also decrease substantially as their molecular weight increases. These low water solubilities of the residual PAHs also indicate that these constituents will tend to partition into (adsorb to) soils.

Also summarized in Table F-1 are Henry's constants for the PAHs of interest. As can be seen, the potential for volatilization of the low molecular weight PAHs from soil is very low compared benzene; however, it may be substantial compared to the other PAH fate and transport characteristics. Volatilization is not considered to be significant for the higher-molecular-weight PAHs. Microbial metabolism is the major fate process for the degradation

of PAHs in soils. This pathway is influenced by both the physicochemical properties of the PAHs and environmental factors (e.g. soil depth, moisture content, and temperature), and the characteristics of the soils microbial population. Hydrolysis, photolysis, and oxidation are not considered significant fate processes for the degradation of PAHs in soil.

3.0 Intrinsic Biodegradation/Natural Attenuation

Many of the compounds in creosote are reported to be aerobically biodegradable [6]. PAHs are known to degrade through a series of bacterial oxidations that subsequently transform the parent compound to various biotransformation products and, ultimately, to carbon dioxide [7,8,9,10,11,12]. A former manufactured gas plant waste site in New York was evaluated with regard to natural attenuation of PAHs [13]. Parent-compound concentrations of PAHs within an aquifer plume were observed to decrease with time subsequent to source removal of coal tar. Biotransformation-potential studies indicated that indigenous microorganisms in soils from the site were capable of degrading naphthalene and phenanthrene.

Studies being conducted under the Coal Tar Organics in Groundwater Program at the Waterloo Center for Groundwater Research have focussed on investigating the natural attenuation of creosote and selected creosote compounds under controlled conditions. The natural attenuation of several PAHs found in creosote has been demonstrated [14].

Soils contaminated with pentachlorophenol (PCP) and creosote were treated without bioaugmentation at field scale in two 1-acre land treatment units at Libby, Montana. The concentration of indicator compounds of treatment performance, i.e., PCP, pyrene, total carcinogenic polycyclic aromatic hydrocarbons (TCPAHs) were monitored in the soil by taking both composited and discrete soils samples. A statistically significant decrease in PCP, pyrene, and TCPAH concentration occurred at field scale, and first-order degradation rate kinetics, from discrete and composited soil samples, satisfactorily represented the chemical loss for these compounds. Detoxification occurred in the soil; and toxicity reduction corresponded with PCP, pyrene, and TCPAH disappearance. No increase in toxicity in the lower treated soil layers of the treatment units was observed with time, while the upper, more recently applied soil layers were highly contaminated and toxic. This indicated that vertical migration of soluble contaminants had little effect on microbial activity in lower lifts of treated soil [15].

The different PAH compounds will behave differently with respect to the three environmental fate mechanisms. Depending on their tendencies to be influenced by sorption processes within the soil matrix, which is dictated by their physical/chemical characteristics, PAHs existing as soluble compounds in solution will volatilize and/or be biodegraded. On this basis, Table F-1 ranks the three environmental fate mechanisms of volatilization, sorption, and biodegradation as the primary, secondary, or tertiary mechanism responsible for the measured reductions of PAHs that may occur.

These Table F-1 rankings are based on the results of extensive work performed by the Gas Research Institute and other referenced work cited herein. Based on such data, it is generally observed that the tendency to remain sorbed onto or within soil materials increases with increasing molecular weight (i.e., increasing ring number). This tendency for higher molecular weight PAHs not to desorb into solution to be directly bioaccessible explains the somewhat proportional decrease in the observed rate and extent of PAH biodegradation with increasing molecular weight. Once in solution, the 2- and 3-ring PAHs could also potentially volatilize, but this mechanism is considered minor compared to sorption and biodegradation processes. It is to be noted that the fate mechanism rankings given in Table F-1 are based on generally observed trends and that there are cited cases where sorption processes are so dominant that biodegradation of even the 2- and 3-ring PAHs does not occur under active treatment.

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TABLE F-1
CHARACTERISTICS OF PAHs AND SUMMARY OF THEIR EXPECTED FATE

POLYNUCLEAR AROMATIC HYDROCARBON	MAXIMUM AQUEOUS SOLUBILITY[A] (mg/L)	HENRY'S LAW CONSTANT[A] (atm-m^3/mole)	LOG OCTANOL/WATER PARTITION COEFFICIENT[A] (LOG K_{ow})	RANKING OF EXPECTED FATE MECHANISMS[B]		
				V	SOR	B
2-Ring						
Naphthalene	3.00E +01	4.83E -04	3.37	T	S	P
3-Ring						
Acenaphthene	3.42 +00	2.41E -04	3.92	T	S	P
Acenaphthylene	3.93 +00	1.14E -04	4.07	T	S	P
Anthracene	1.29 +00	8.60E -05	4.45	T	S	P
Fluorene	1.90 +00	1.17E -04	4.18	T	S	P
Phenanthrene at 21°C	8.16 -01	3.93E -05	4.46	T	S	P
4-Ring						
Benzo(a)anthracene at 24°C	1.00E -02	1.16E -06[C]	5.61	NE	S	P
Chrysene	6.00E -03	1.05E -06	5.61	NE	S	P
Fluoranthene	2.65E -01	6.50E -06	5.33	NE	S	P
Pyrene at 26°C	1.60E -01	5.10E -06	5.18	NE	S	P
5-Ring						
Benzo(a)pyrene	3.80E -03	4.90E -07	5.98	NE	P	S
Benzo(b)fluoranthene	1.40E -02[C]	1.19E -05[C]	6.57	NE	P	S
Benzo(c)fluoranthene	4.30E -03[C]	3.94E -05[C]	6.84	NE	P	S
Dibenzo(a,h)anthracene	5.00E -04	7.30E -08	5.97	NE	P	S
6-Ring						
Benzo(g,h,i)perylene	2.60E -04	5.34E -08[C]	7.23	NE	P	S
Indeno(1,2,3-cd)pyrene	5.30E -04[C]	6.95E -08	7.66	NE	P	S

A Data taken from U.S. EPA.[47] All data at 25°C unless otherwise noted.

B In terms of expected fate mechanism: V = volatilization, SOR = sorption processes, B = biodegradation.
In terms of competitive ranking: P = primary, S = secondary, T = tertiary, and NE - fate mechanism not expected.

C Data taken from U.S. EPA.[48]