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October 6, 2004  
Report Number: 0303-1090

Envirologic Resources, Inc.  
15 82<sup>nd</sup> Drive  
Suite 120  
Gladstone, Oregon 97027

Attn.: Mr. Tom Calabrese

**DATA REPORT  
CONE PENETRATION AND  
RAPID OPTICAL SCREENING TOOL TESTING  
PORT OF ASTORIA, OREGON**

Dear Mr. Calabrese:

Fugro Geosciences (Fugro) is pleased to present this data report for Cone Penetration (CPT) and Rapid Optical Screening Tool (ROST™) testing at the above-referenced site. CPT/ROST™ provided continuous characterization of stratigraphy and petroleum hydrocarbon distribution at the testing locations. A description of the CPT and ROST™ technologies and a discussion of general ROST™ data interpretation follows. CPT and ROST™ logs and electronic data CD are included as attachments.

#### **Cone Penetration Testing**

CPT was performed simultaneously with each ROST™ sounding and yielded real-time stratigraphic data. CPT is a proven method for rapidly evaluating the physical characteristics of unconsolidated soils. It is based on the resistance to penetration of an electronically-instrumented cone which is continuously advanced into the subsurface. In accordance with ASTM Standard D5778-95, the cone was advanced at a rate of two centimeters per second with the driving force provided by hydraulic rams.

The CPT cone used at this site had an apex angle of 60 degrees with a base area of 15 square centimeters ( $\text{cm}^2$ ), and friction sleeve with a surface area of 200  $\text{cm}^2$ . 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.).

Soil stratigraphy was identified using Campanella and Robertson's Simplified Soil Behavior Chart. Please note that because of the empirical nature of the soil behavior chart, the soil identification should be verified locally.



## ROST™ Testing

Fugro Geosciences' ROST™ Laser-Induced Fluorescence system was used for this investigation to screen soils for petroleum hydrocarbon materials containing aromatic hydrocarbon constituents. The system consists of a tunable laser mounted in the CPT truck that is connected to a down-hole sensor. The down-hole sensor consists of a small diameter sapphire window mounted flush with the side of the cone penetrometer probe.

The laser and associated equipment transmit 50 pulses of light per second to the sensor through a fiber optic cable. 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. An excitation wavelength of 290 nm was used for each test during this project.

The laser light passes through the sapphire window and is absorbed by aromatic hydrocarbon molecules in contact with the window, as the probe is advanced. This addition of energy (photons) to the aromatic hydrocarbons causes them to fluoresce. A portion of the fluorescence emitted from any encountered aromatic constituents is returned through the sapphire window and conveyed by a second fiber optic cable to a detection system within the CPT rig. The emission data resulting from the pulsed laser light is averaged into one reading per one second interval (approximately one reading per 2 cm vertical interval) and is recorded continuously. ROST™ may be operated in single or multi-wavelength mode, depending on project objectives. For this project, ROST™ was operated in multi-wavelength mode (MWL).

**Multi-Wavelength Mode (MWL).** In MWL mode, several characteristics of the emitted fluorescence are measured and recorded simultaneously at four (4) specific wavelengths (340, 390, 440, and 490 nm). These four wavelengths represent the spectrum of fluorescence typically produced by aromatic hydrocarbons ranging from light fuels through heavy contaminants such as coal tar and creosote. The recorded data is then presented as a color graph of fluorescence intensity (the combined fluorescence of all four monitored wavelengths) versus depth (FVD).

On the FVD graph, each of the four monitored wavelengths is assigned a color. These colors are combined based on the proportional fluorescence intensity of each of the individual wavelengths. The combined color is then used on the FVD graph. Changes in color on the FVD graph typically represent changes in product type. Similarly, like colors on the FVD graph typically represent the same product, regardless of the total fluorescence intensity. Changes in the total fluorescence intensity typically indicate changes in contaminant concentration, with higher fluorescence intensities representing proportionally higher concentrations when compared to lower fluorescence intensities.

In addition to the FVD graph, depth specific waveforms are presented at four (4) selected depths throughout the sounding. These waveform graphs are presented to the right of the FVD graph on each plot. In the waveform graphs, the fluorescence intensity and duration of fluorescence of each of the monitored wavelengths is represented by an individual peak, starting at 340 nm and increasing in 50 nm wavelengths as you move to the right. The intensity of each wavelength is represented by the height of the peaks, and the duration of fluorescence is represented by the width of each peak. For general interpretation purposes, lighter aromatic hydrocarbon molecules will emit fluorescence at the shorter wavelengths, and heavier, longer chained hydrocarbons will emit fluorescence at the longer wavelengths. The presented waveforms can be compared to waveforms typical of common hydrocarbon products to determine the likely product type that has been encountered. Please note that the waveforms are available at every two centimeter interval throughout the entire sounding. Additional waveforms can be generated at any time during or after testing is complete.

**Reference Solution.** The fluorescence intensity of a reference solution placed on the sapphire window was measured immediately prior to conducting each test. This reference solution measurement serves two 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. 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.

#### LIMITATIONS OF ENVIRONMENTAL SUBSURFACE WORK

Fugro Geosciences' report is based upon our observations made during field work, the information provided to Fugro and the results of the ROST/CPT survey. Given the inherent limitation of environmental subsurface work, Fugro cannot guarantee that the site is free of hazardous or potentially hazardous materials or conditions or that latent or undiscovered conditions will not become evident in the future. Fugro's report was prepared in accordance with our proposal and the General Conditions agreed to between Fugro and Client and no warranties, representations, or certifications are made.

Fugro Geosciences, Inc. appreciates the opportunity to be of service to your organization. Please do not hesitate to contact us if we can be of further assistance. We look forward to working with you in the future.

Sincerely,  
**FUGRO GEOSCIENCES, INC.**



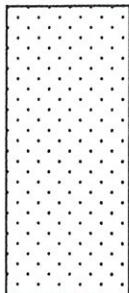
Recep Yilmaz  
President

RY/jm

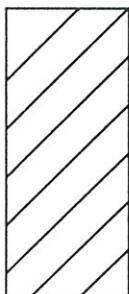
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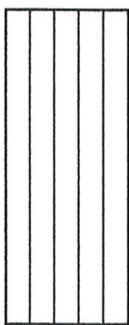
## KEY TO SOIL BEHAVIOR TYPE



SAND AND SANDY SOIL

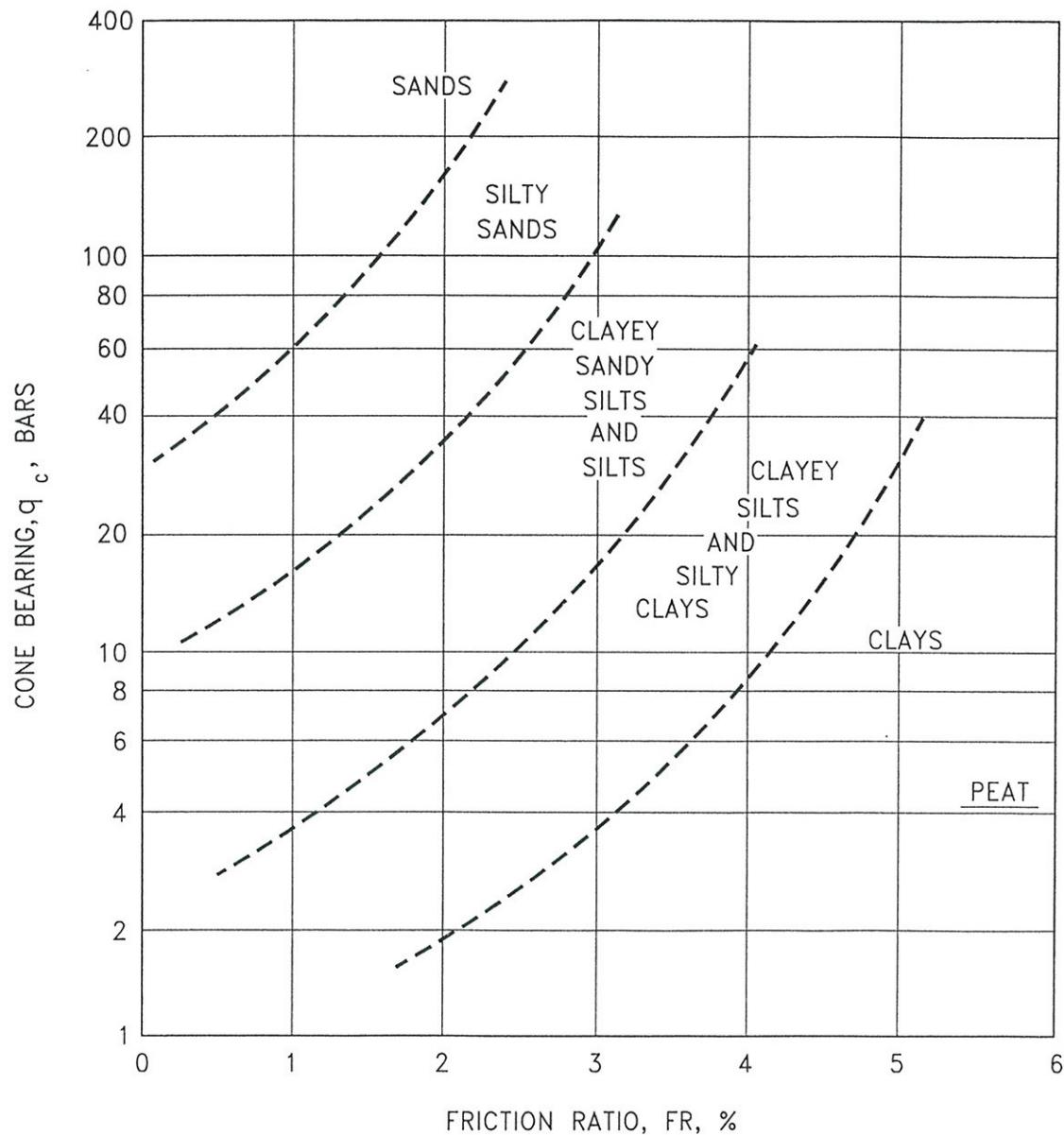


CLAY AND CLAYEY SOIL



SILT AND SILTY SOIL

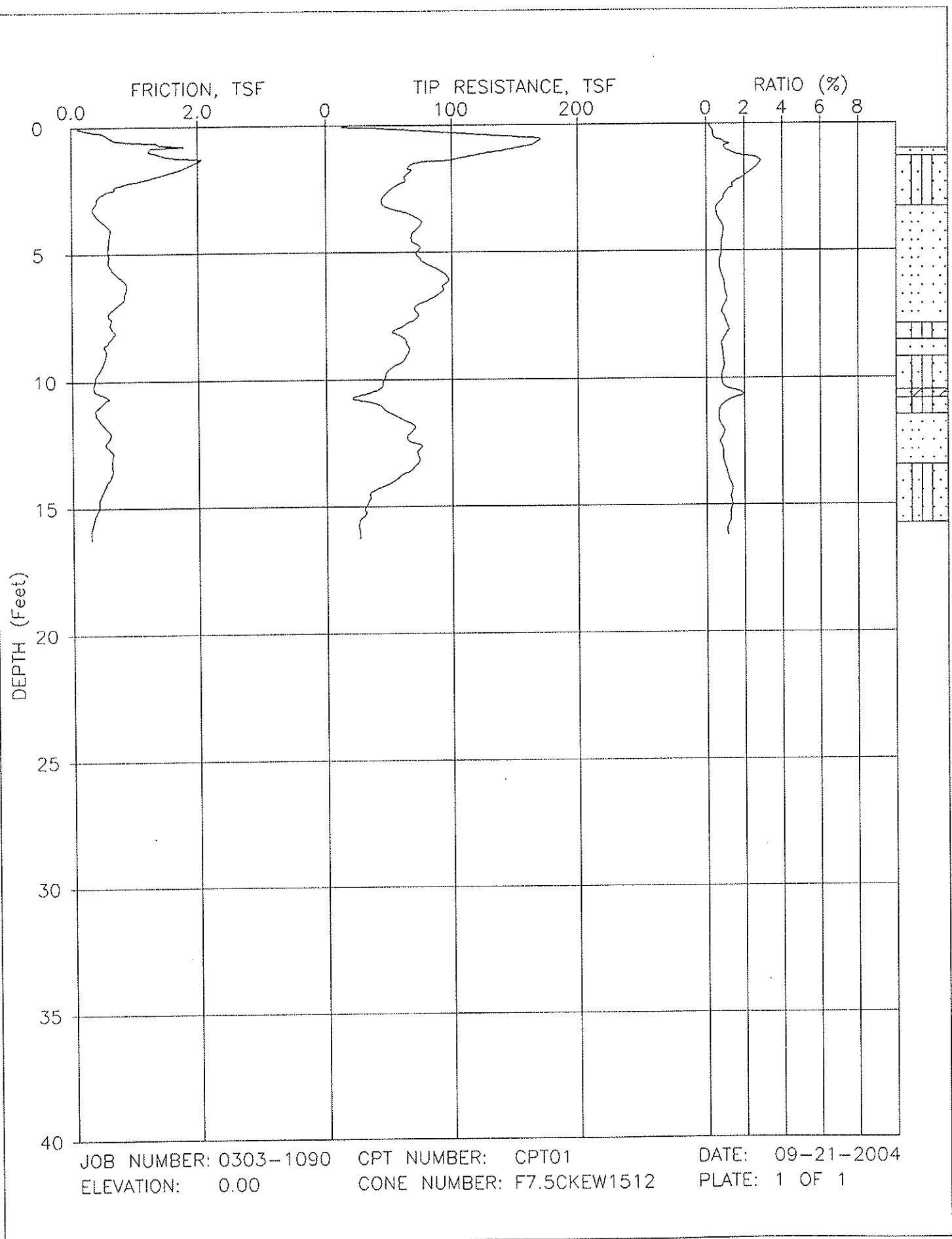
1 BAR=100 kPA=1.02 KG/CM<sup>2</sup>

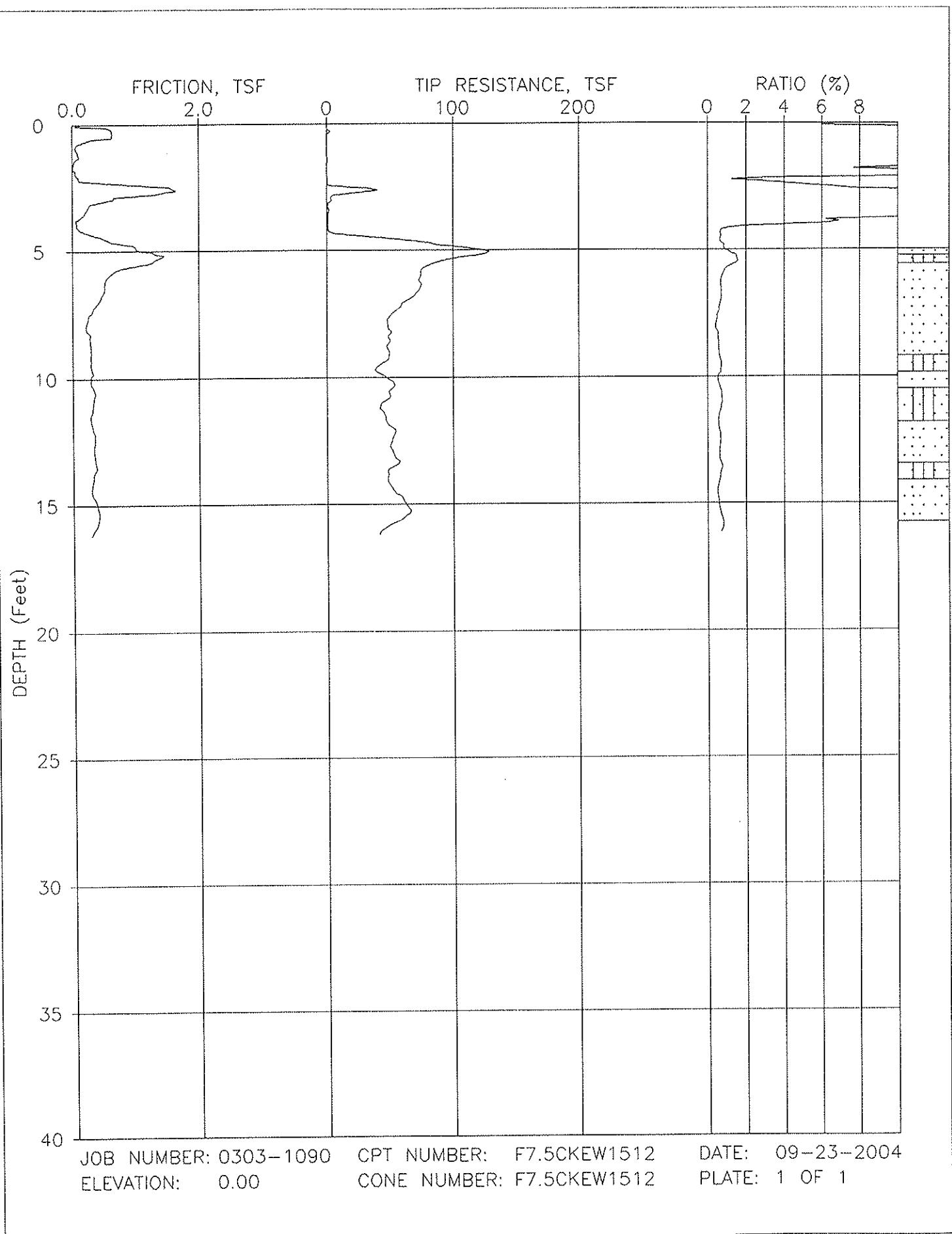


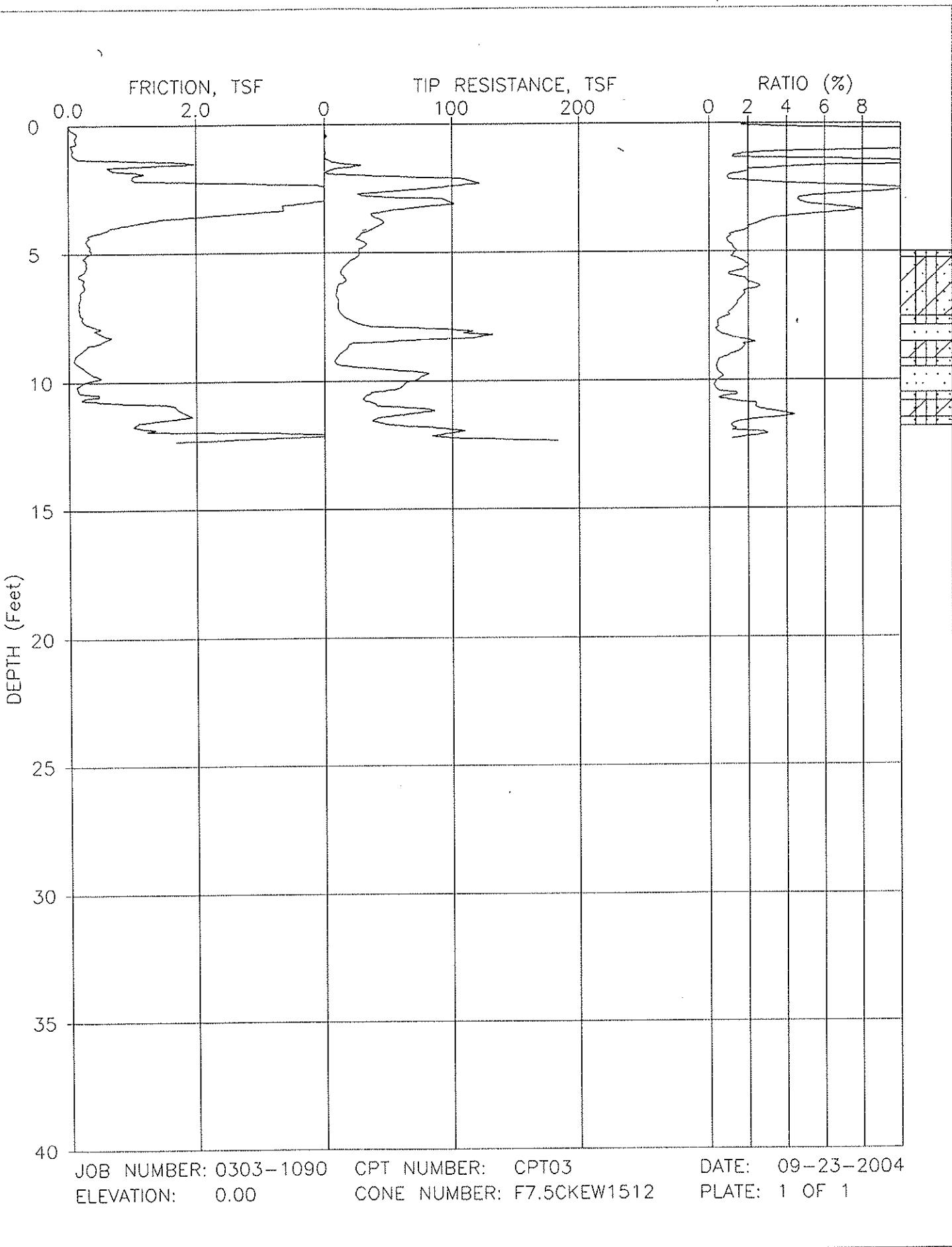
MODIFIED CAMPANELLA AND ROBERTSON SOIL BEHAVIOR CHART (1983)

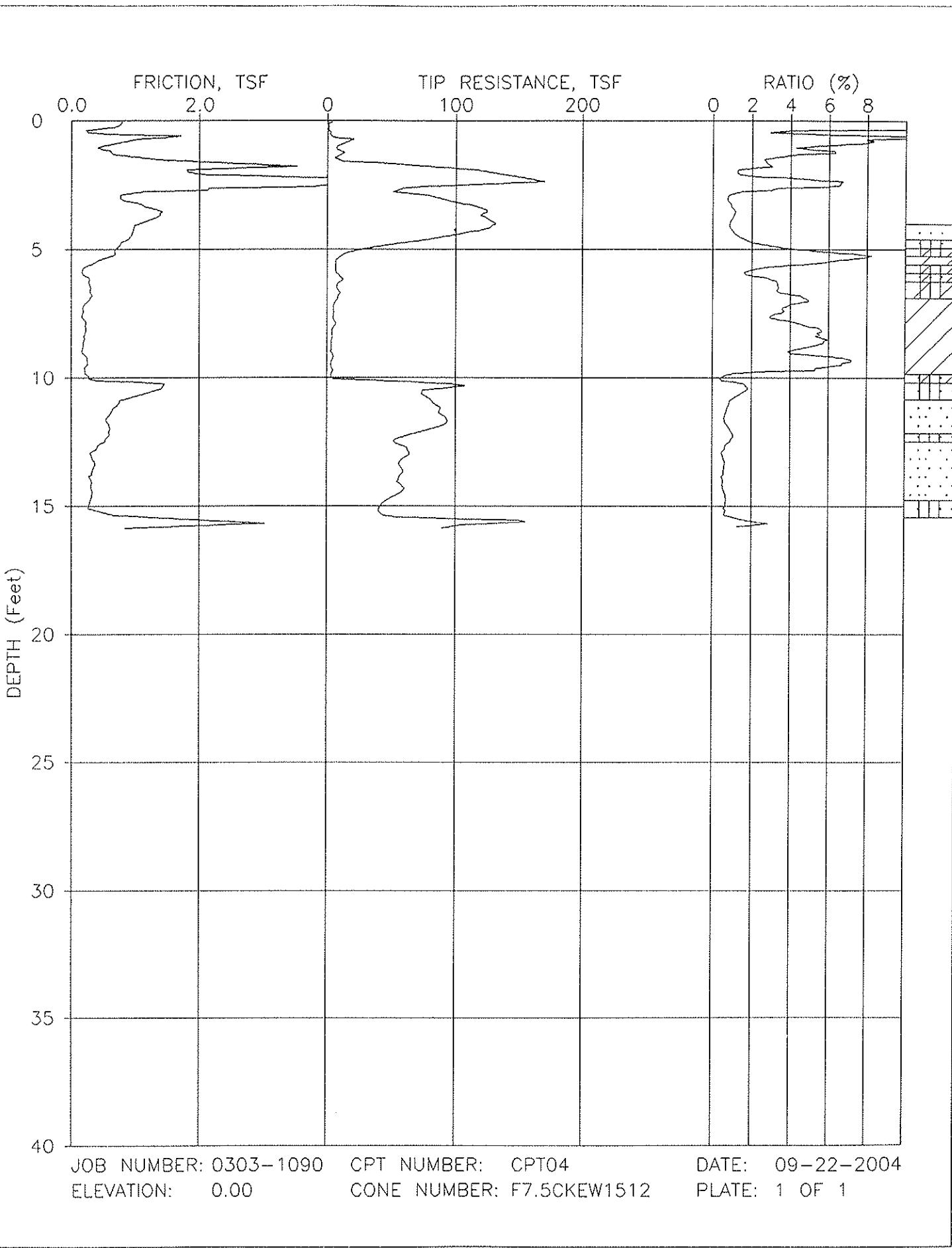


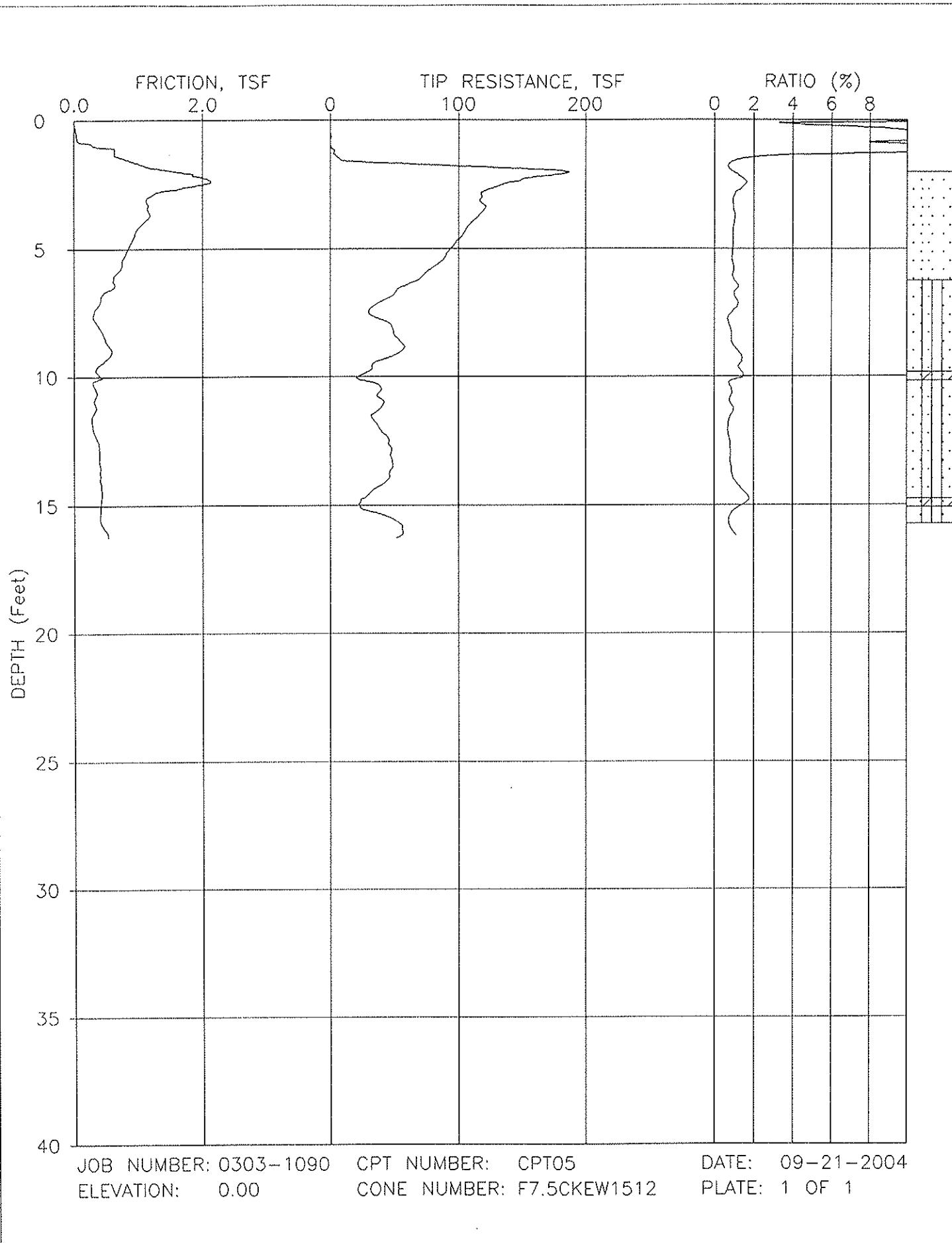
**CPT LOGS**

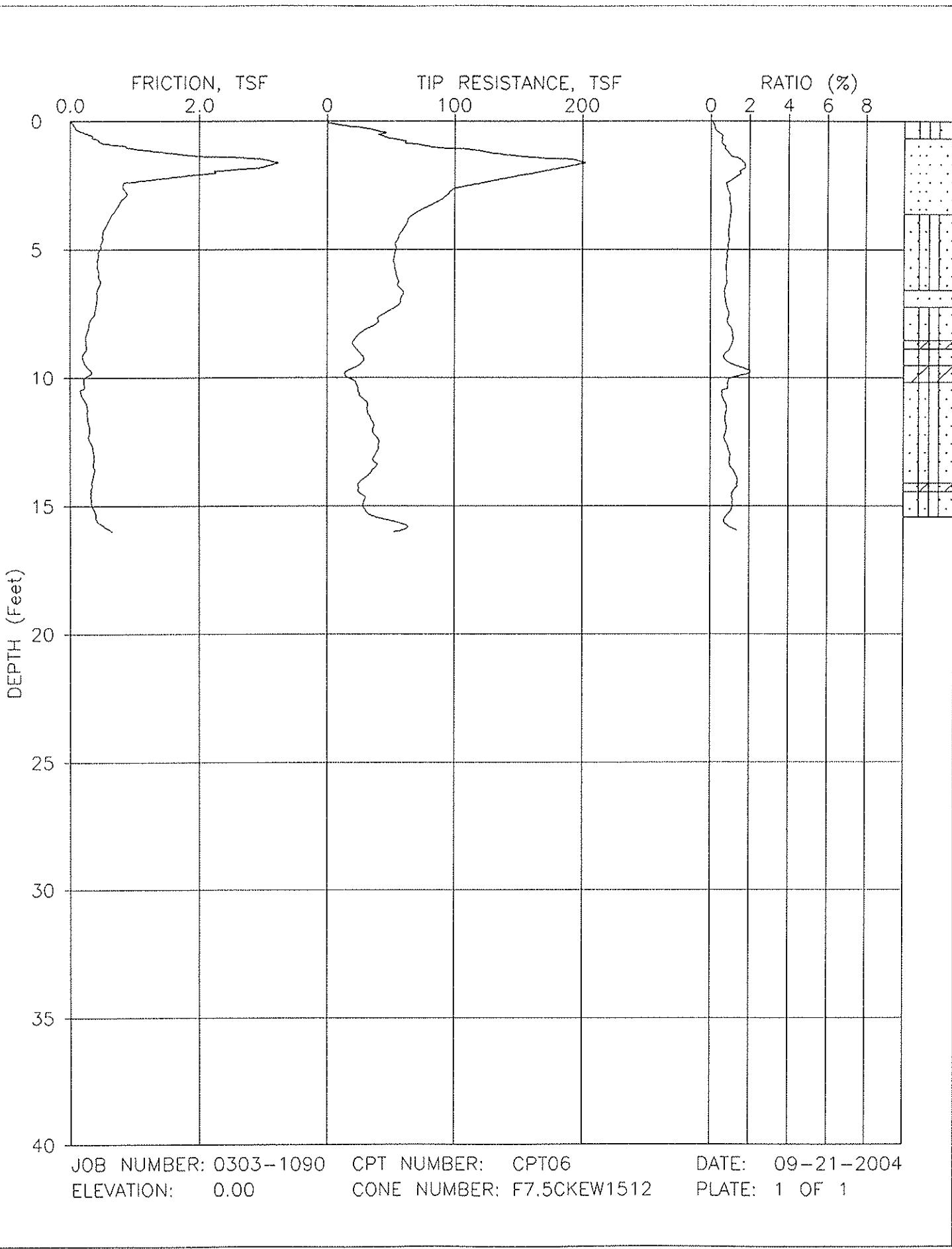


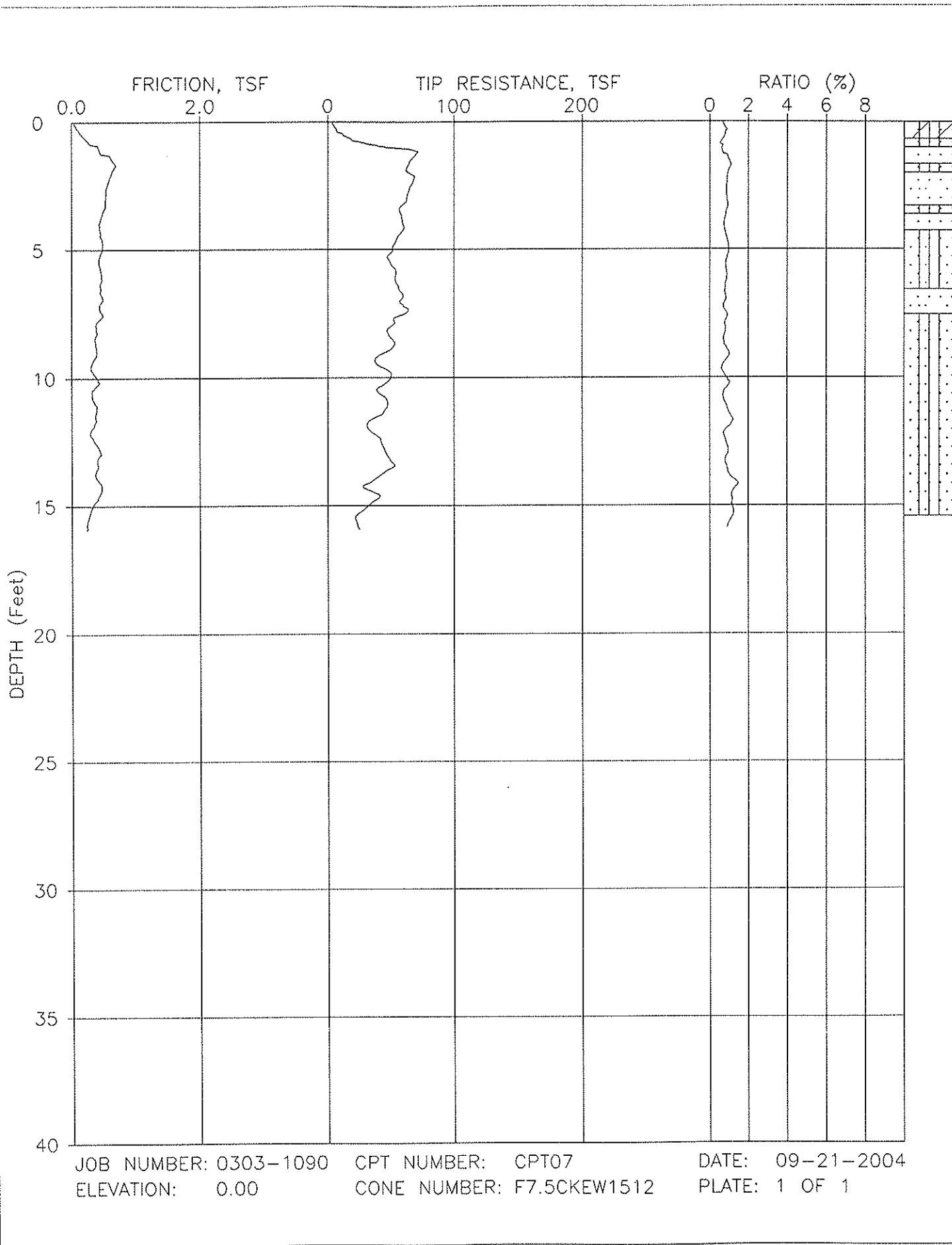


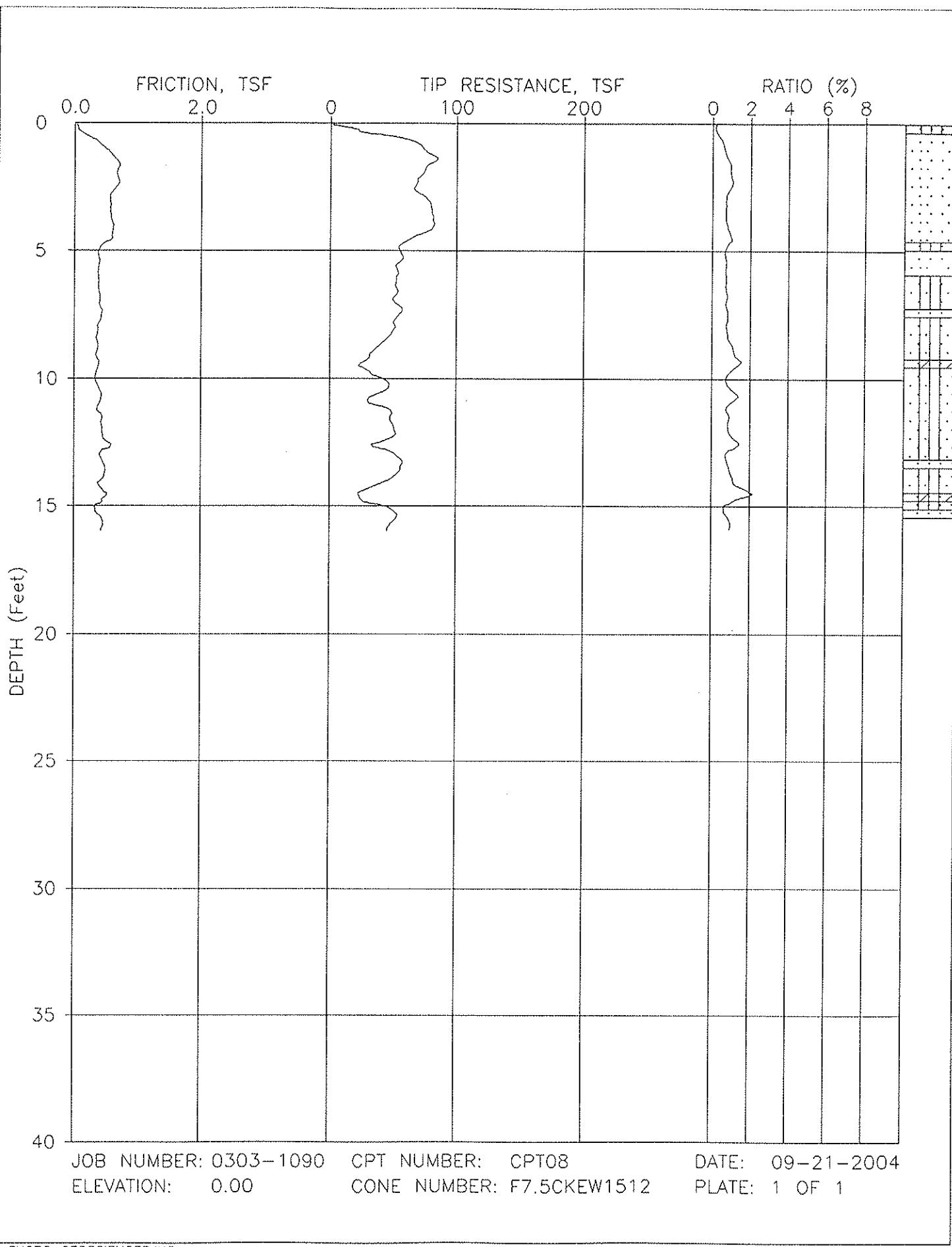


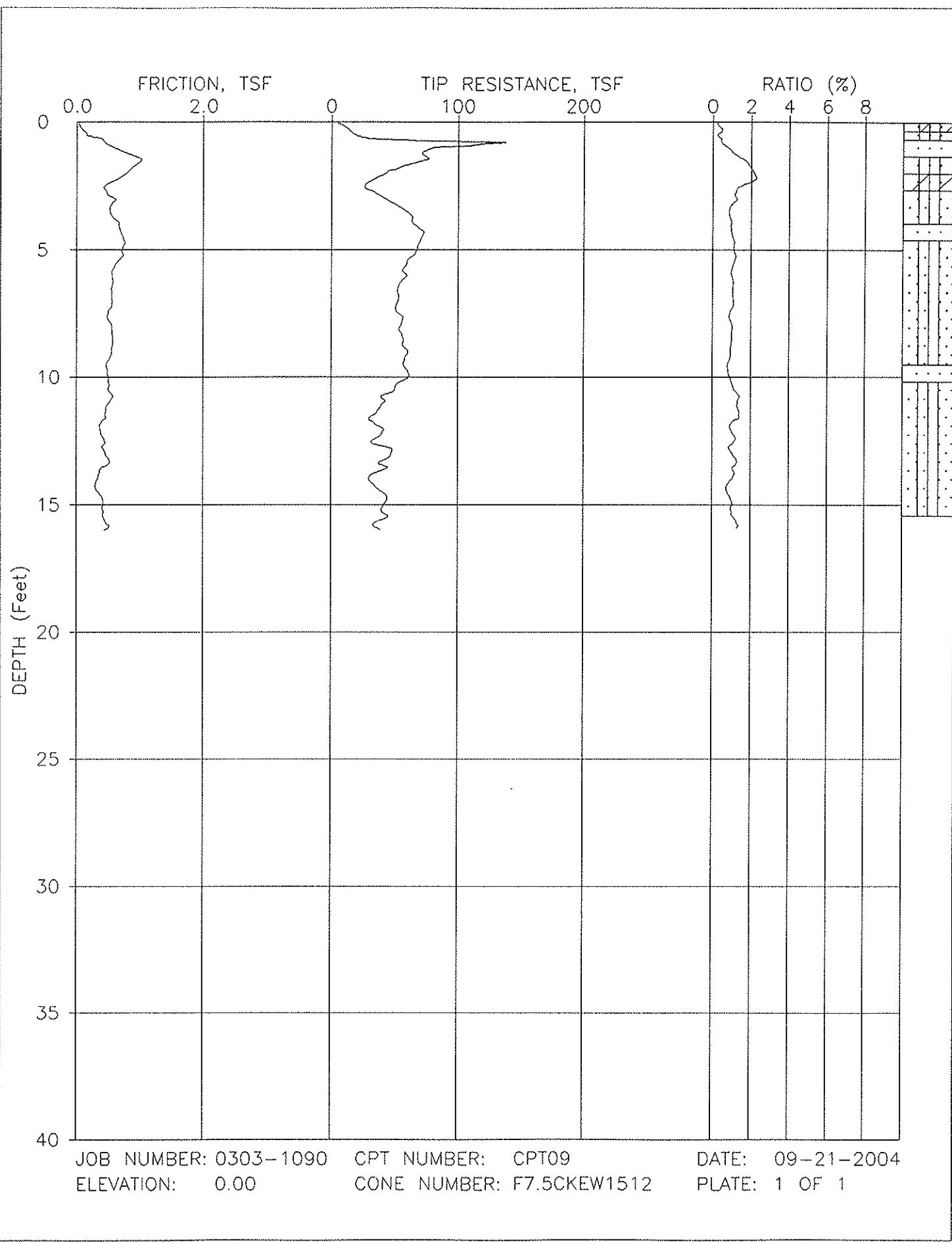


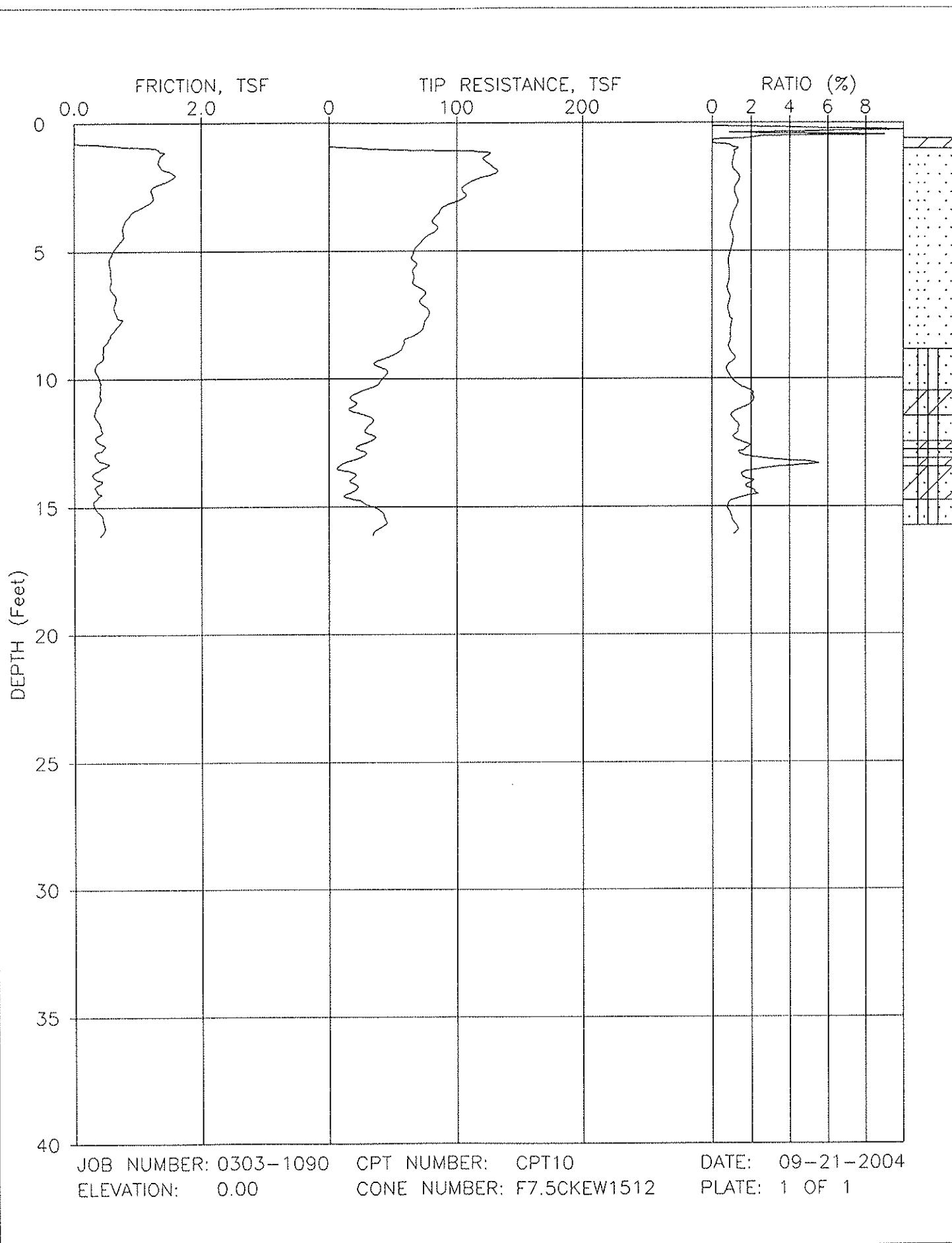


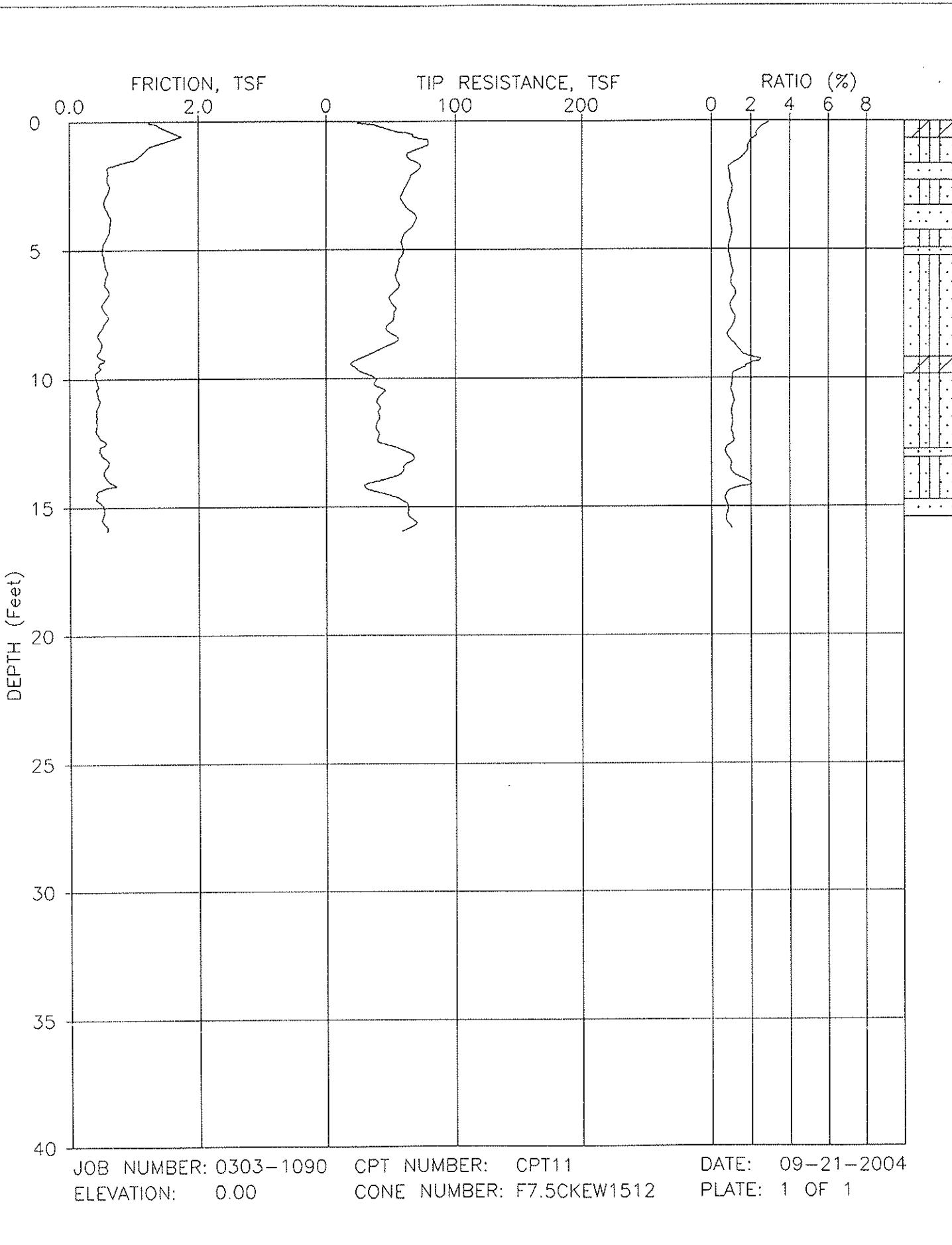


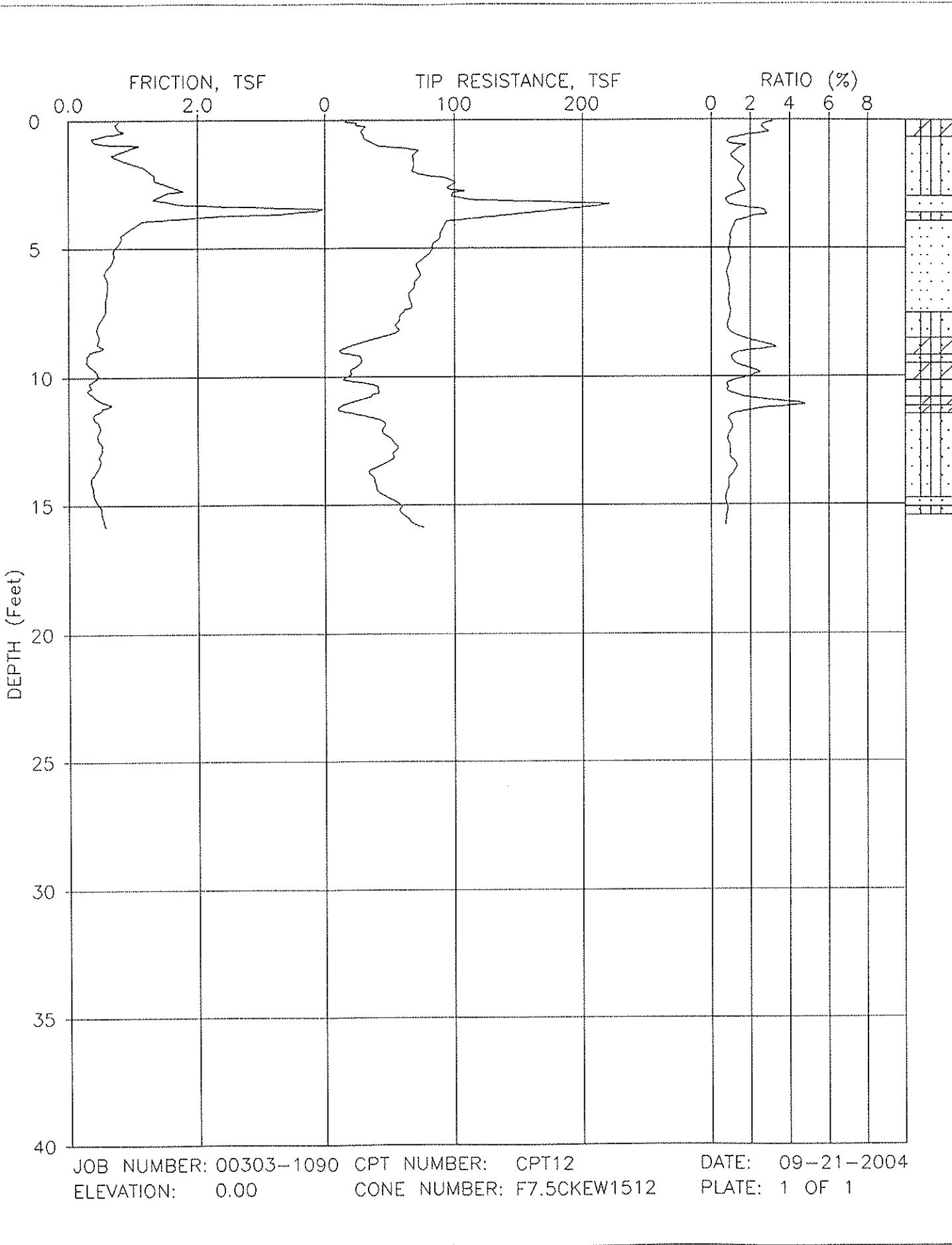


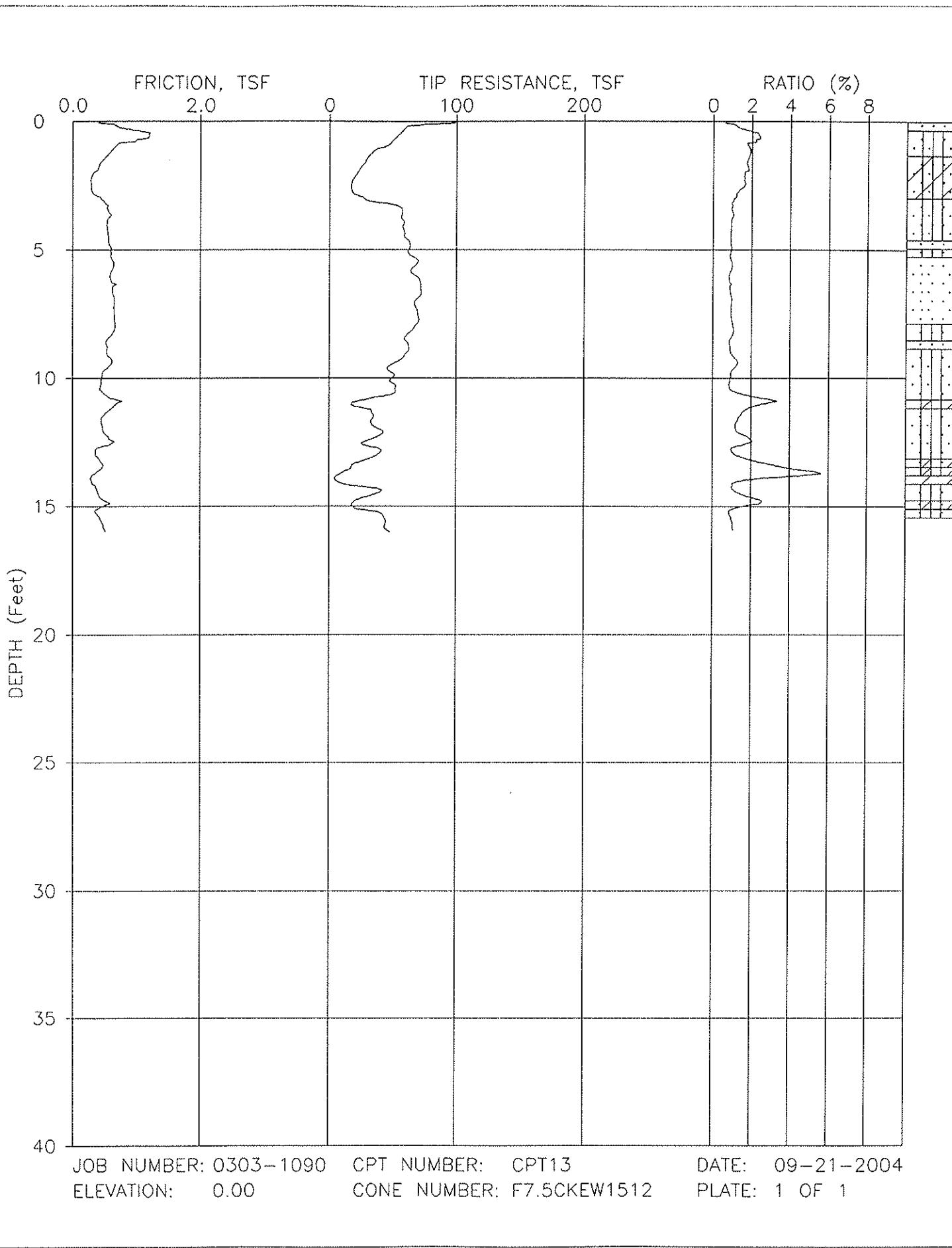


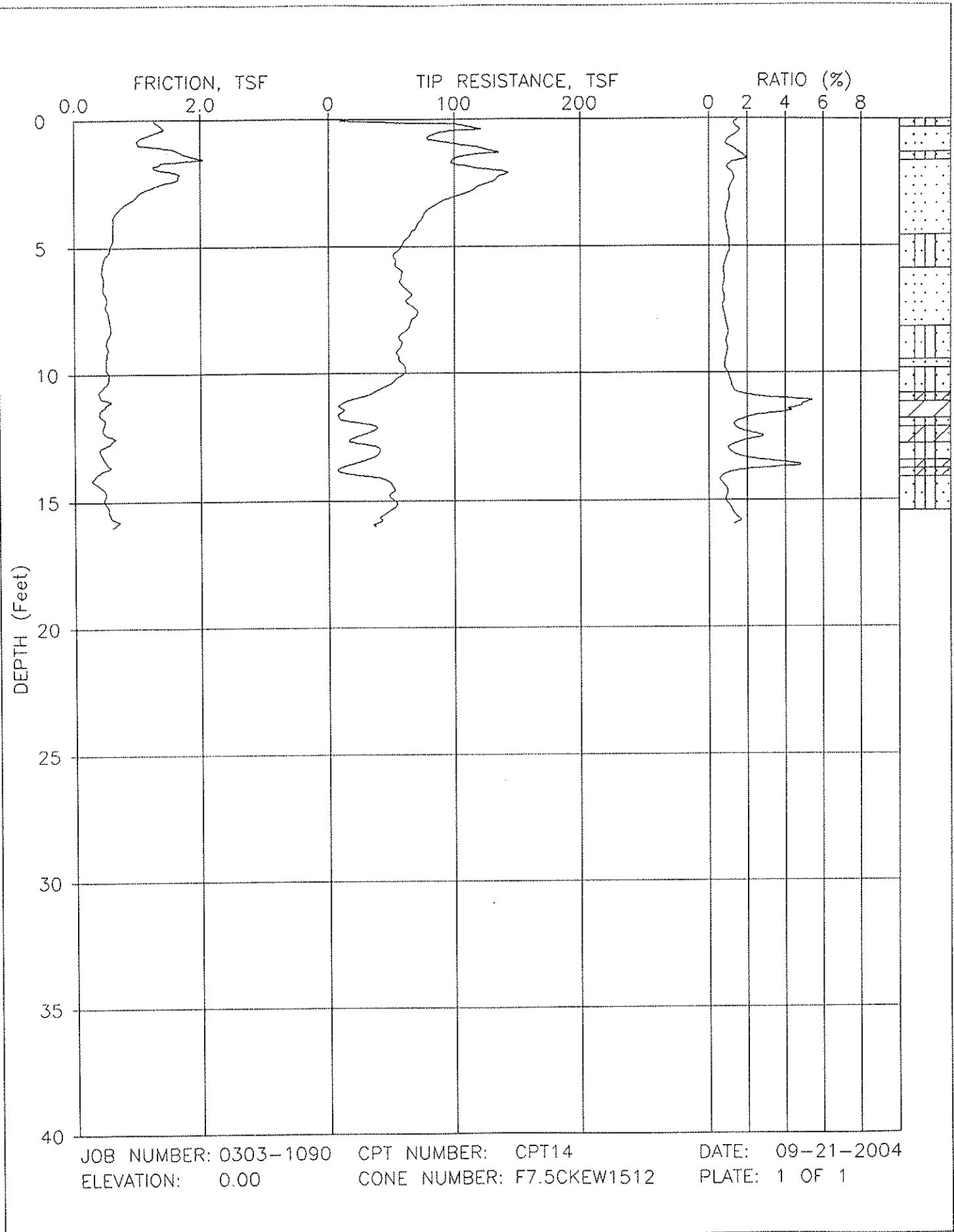


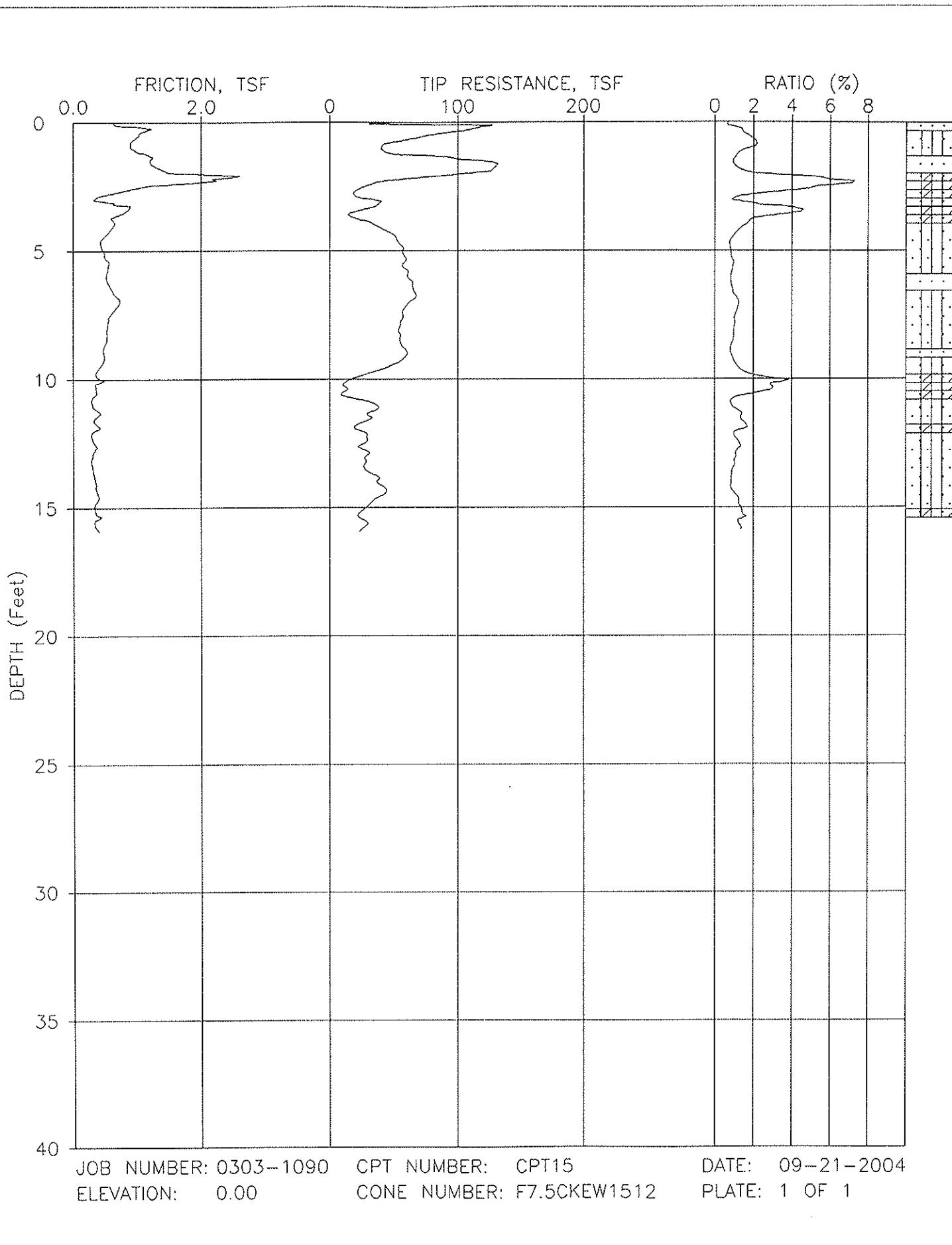


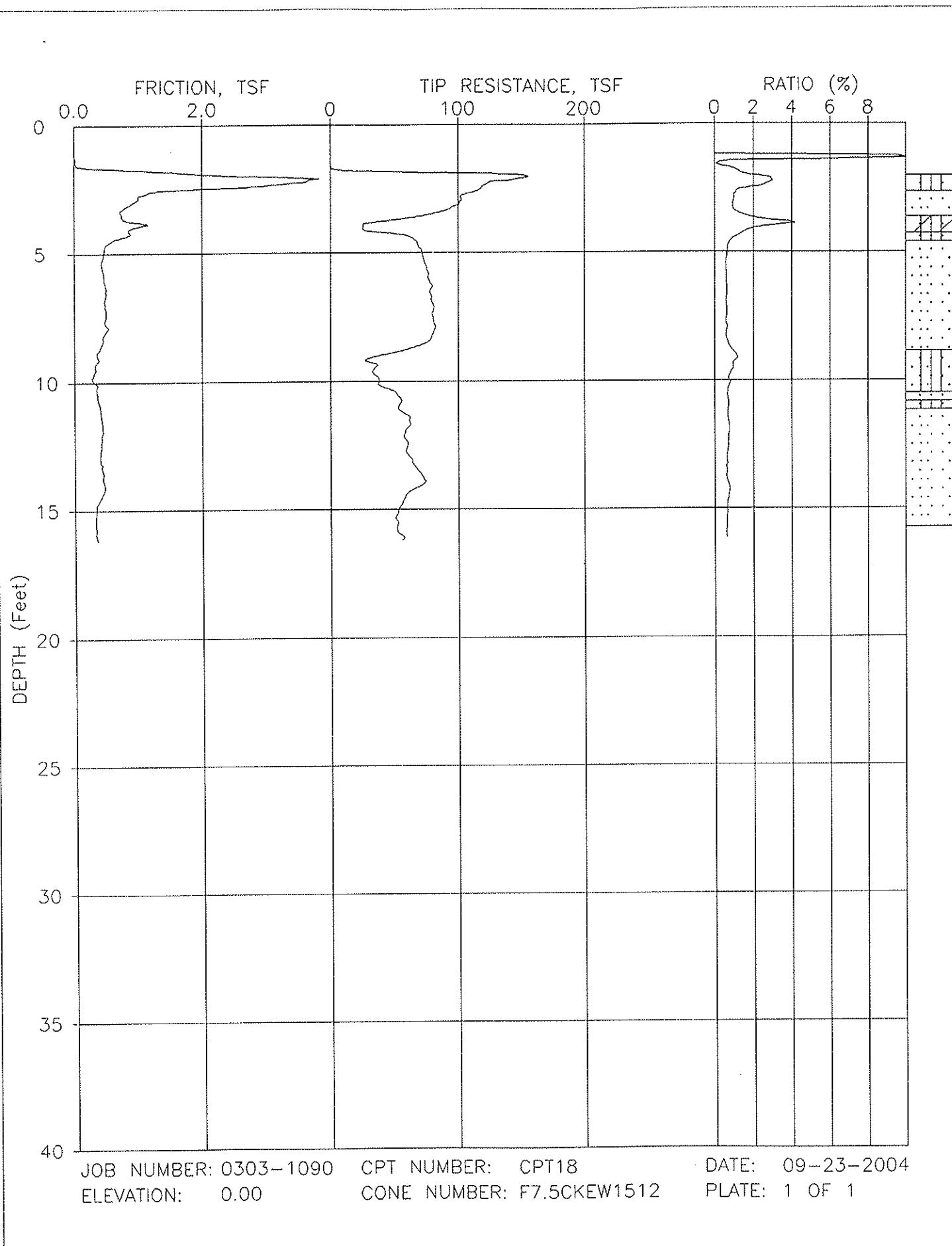


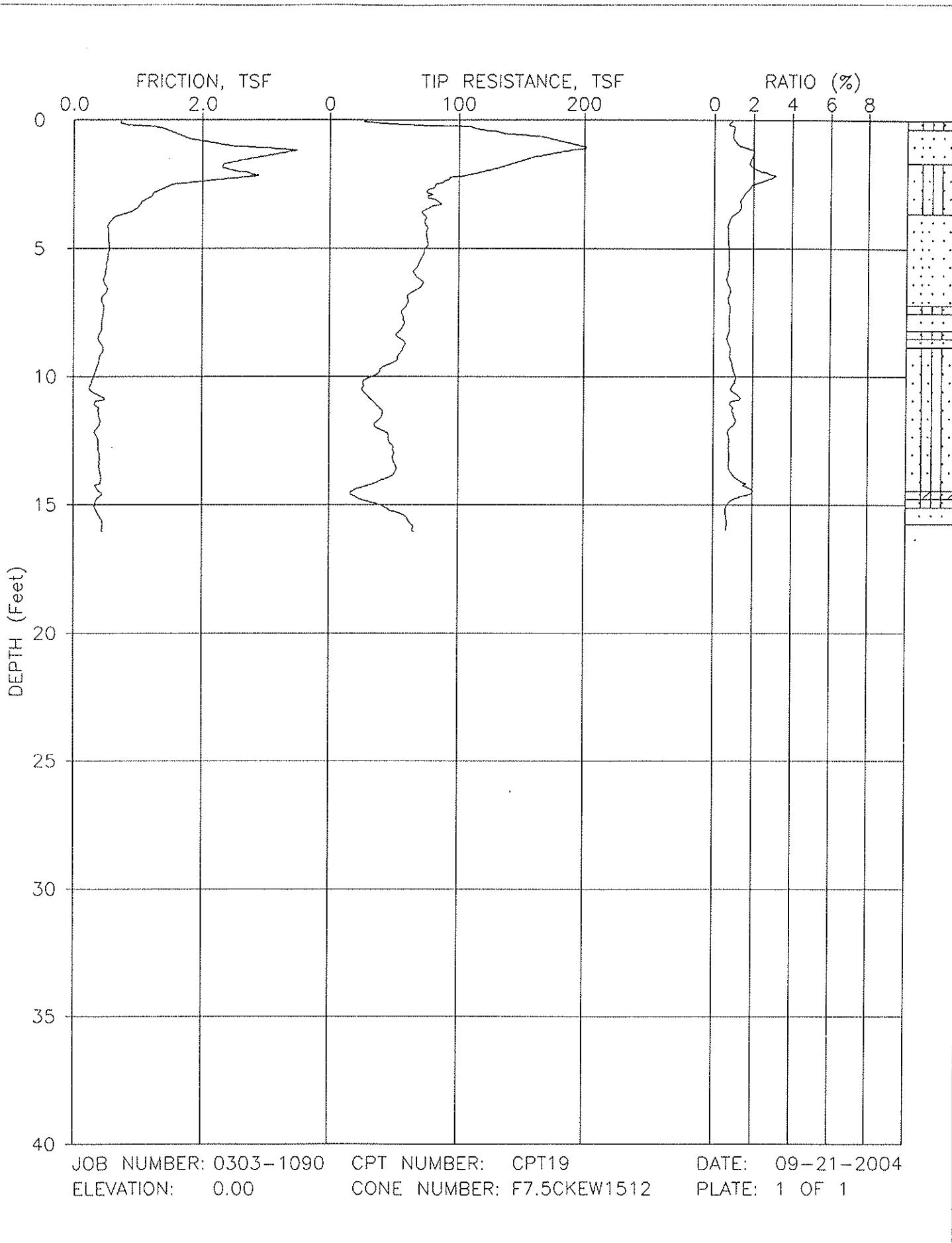


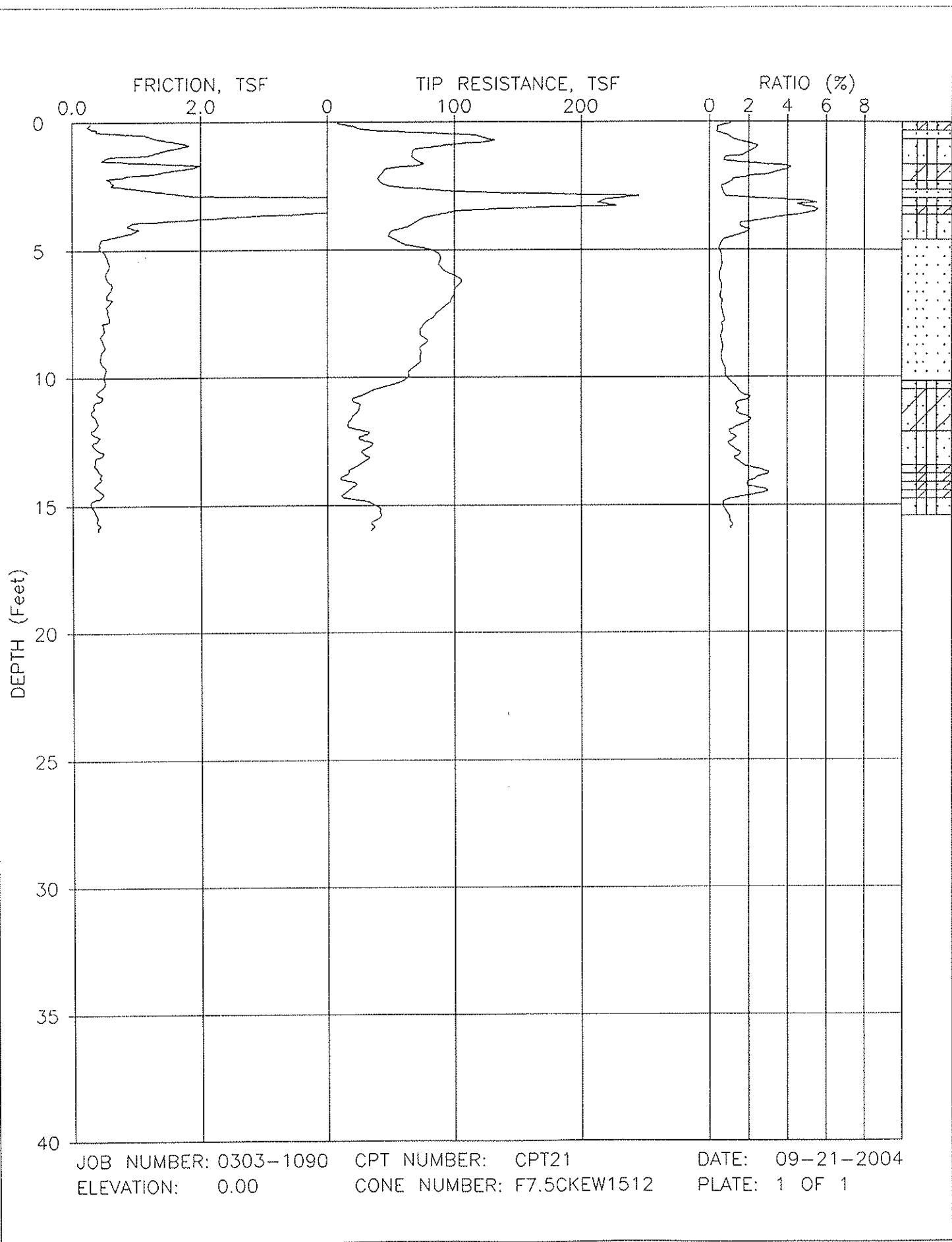


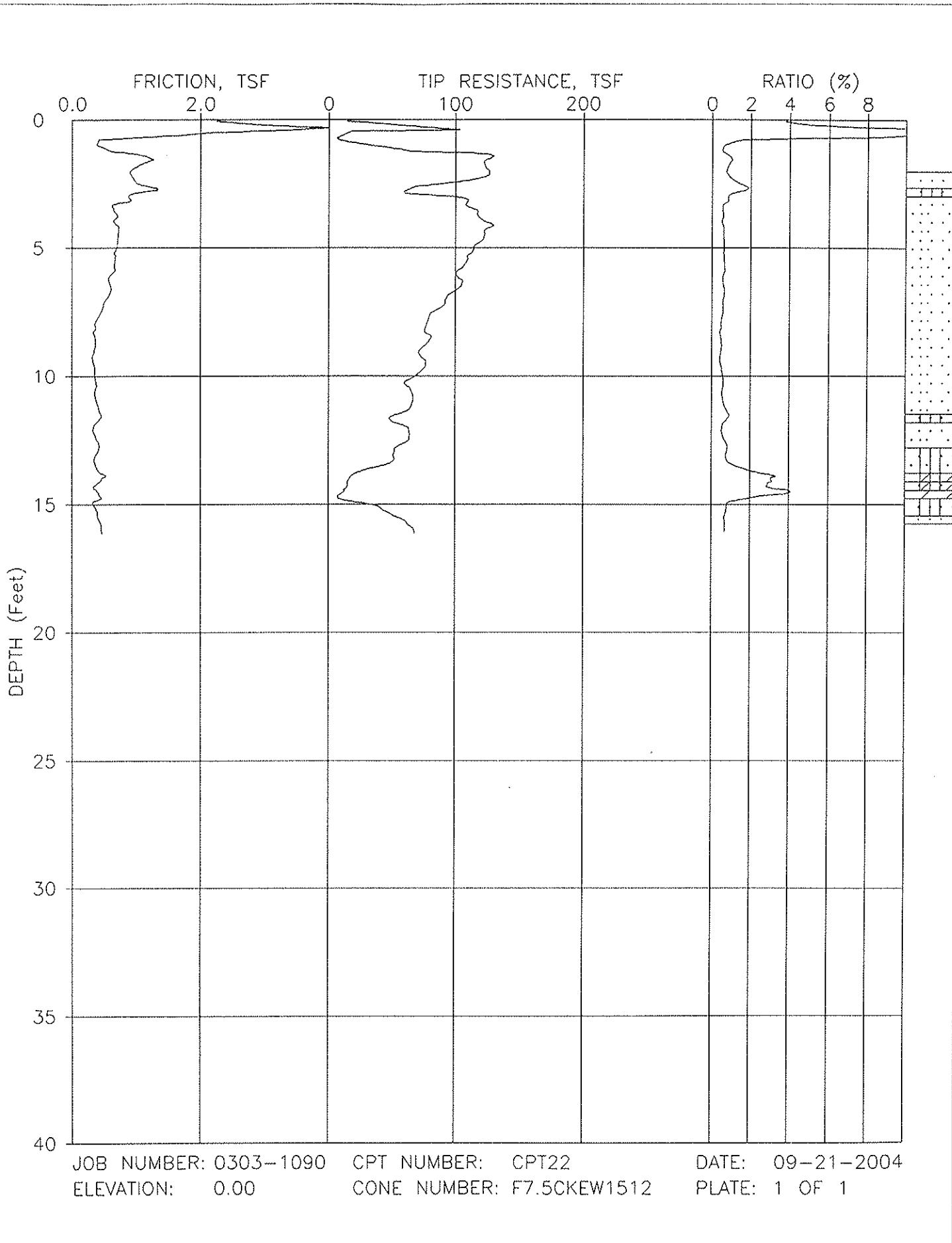


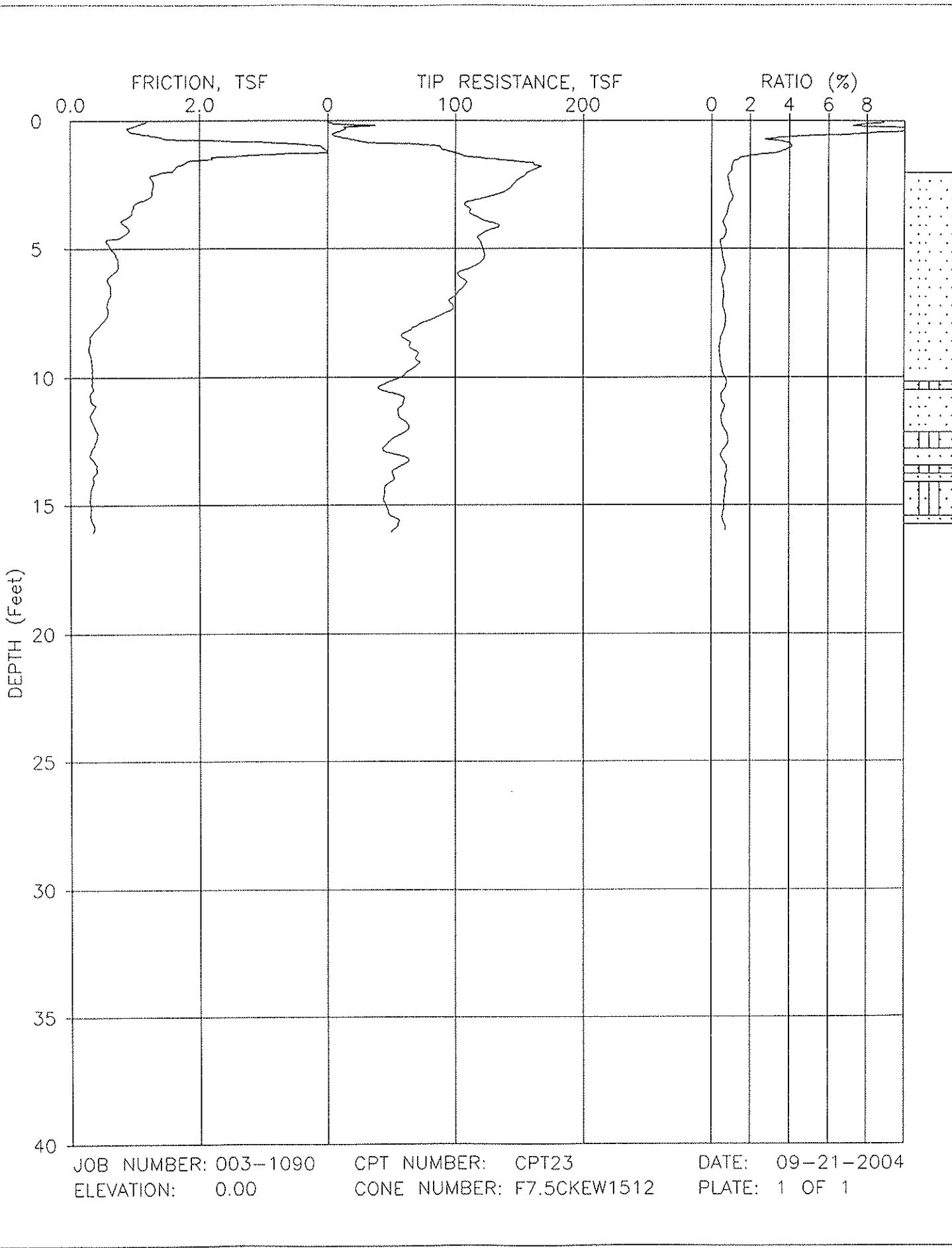


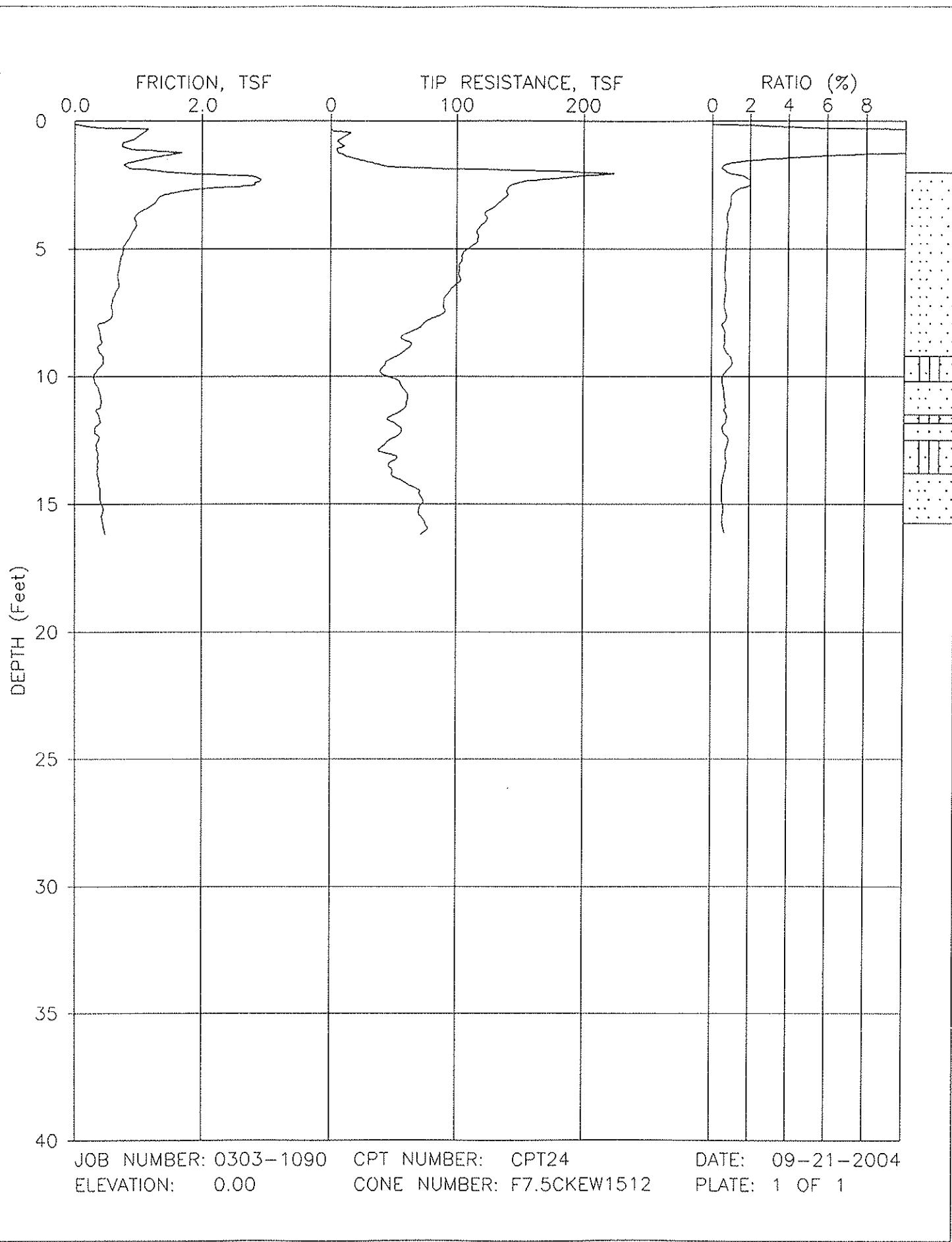


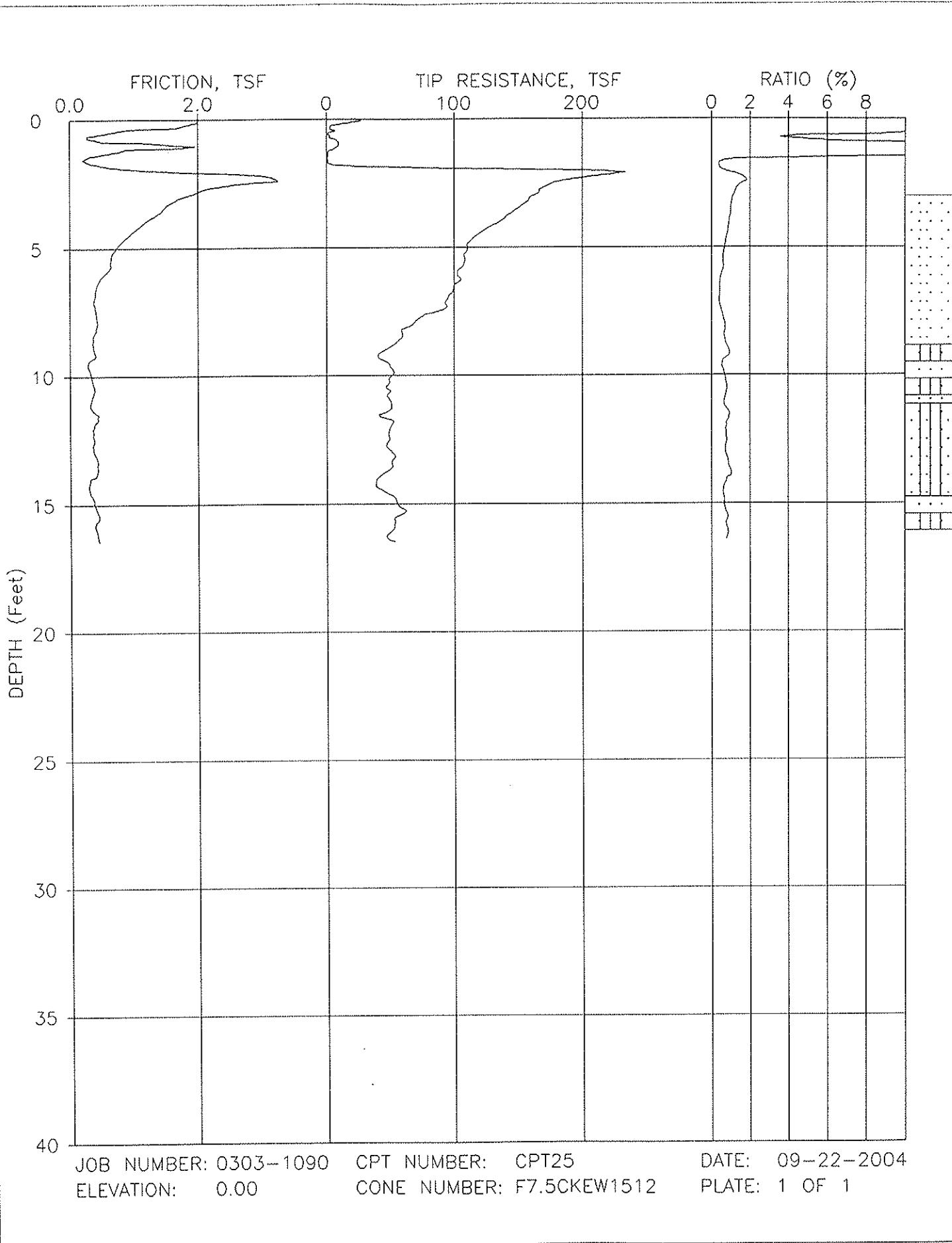


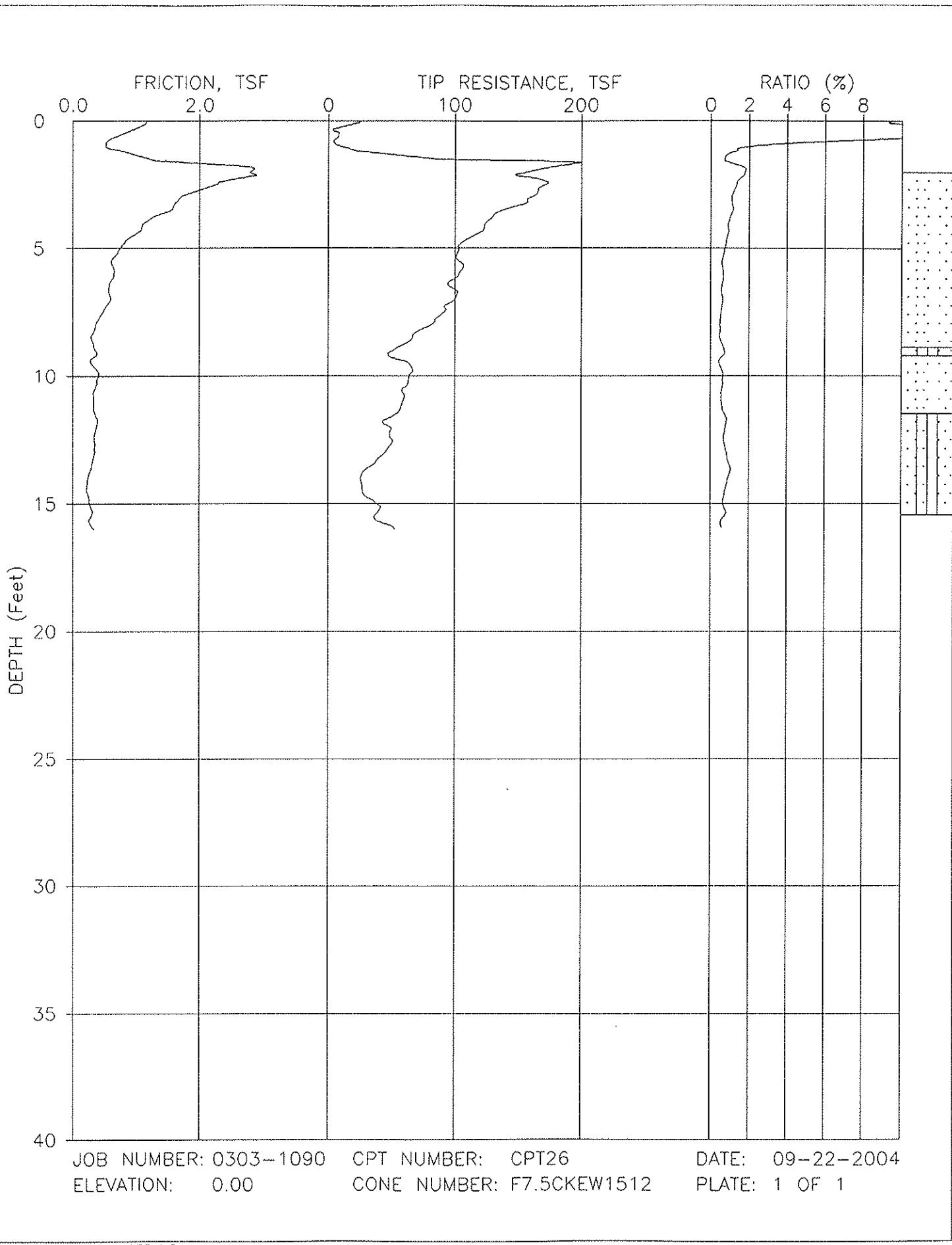


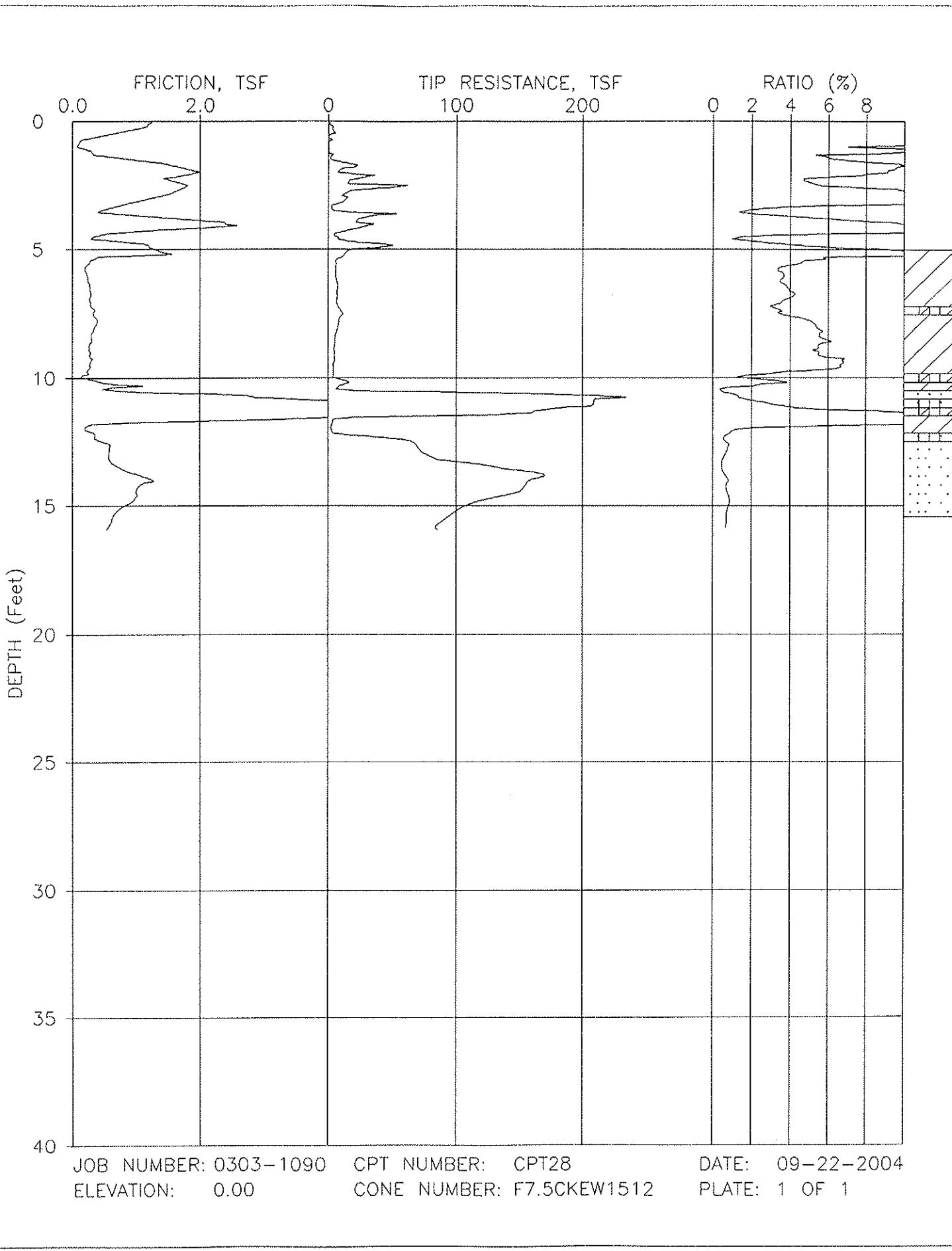


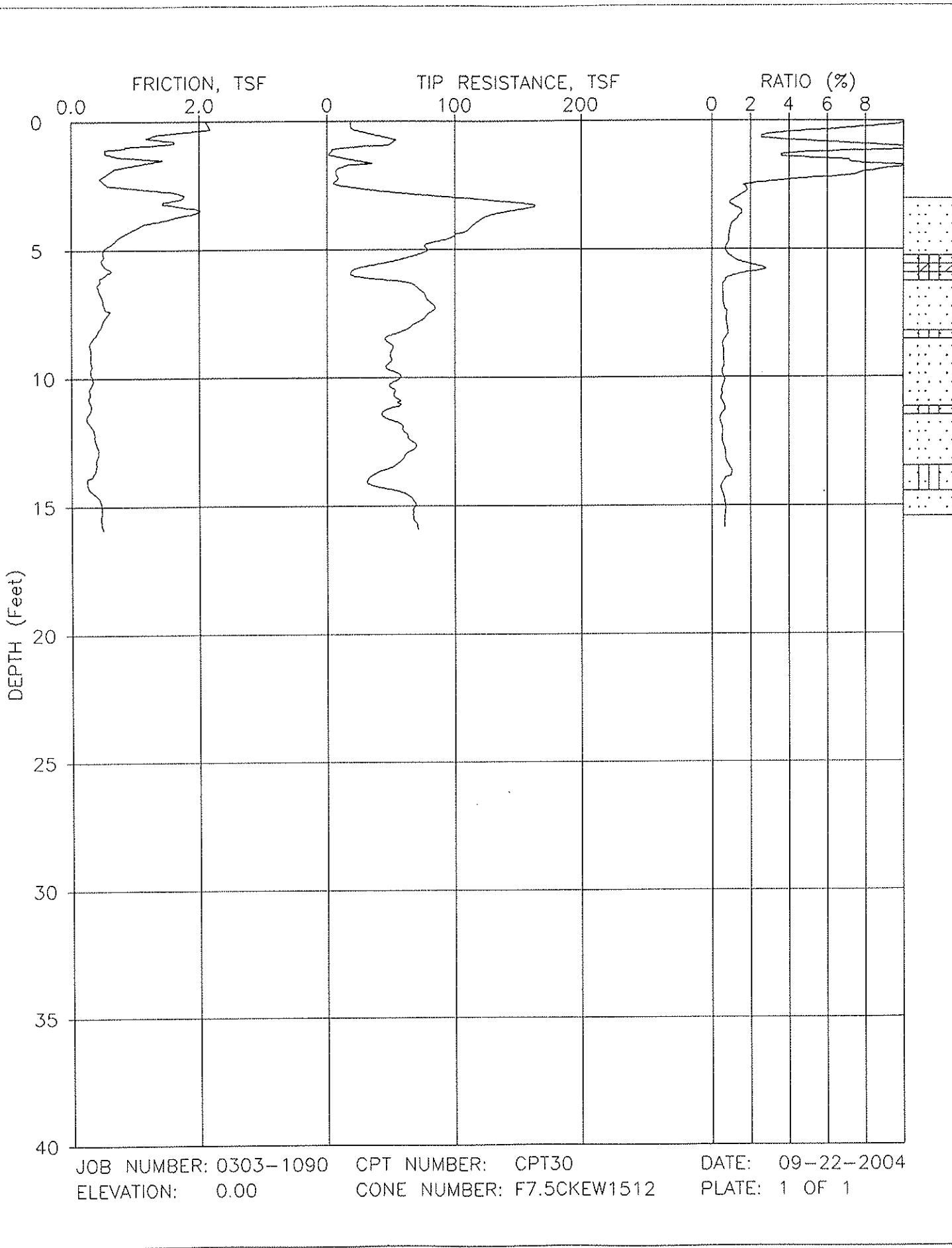


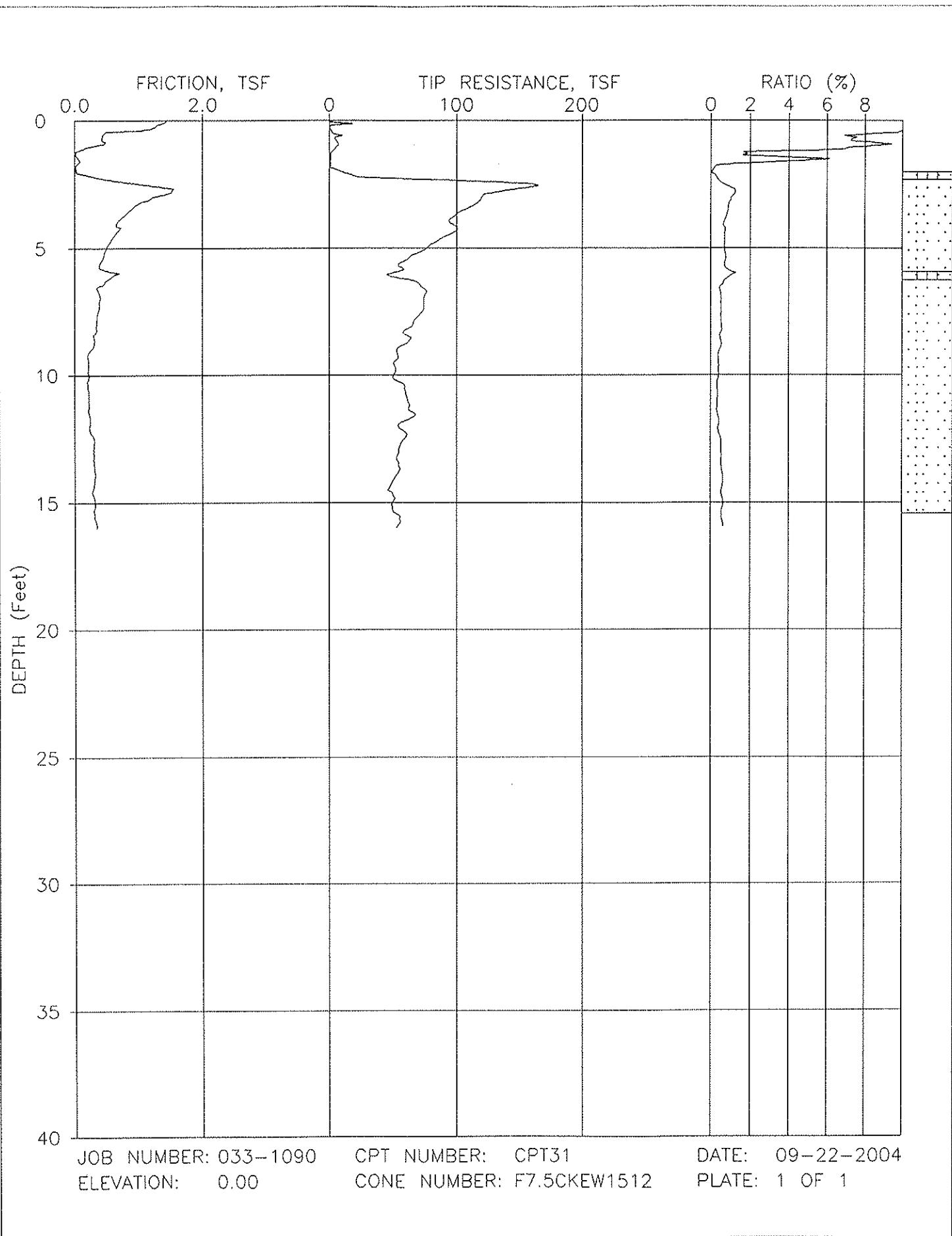


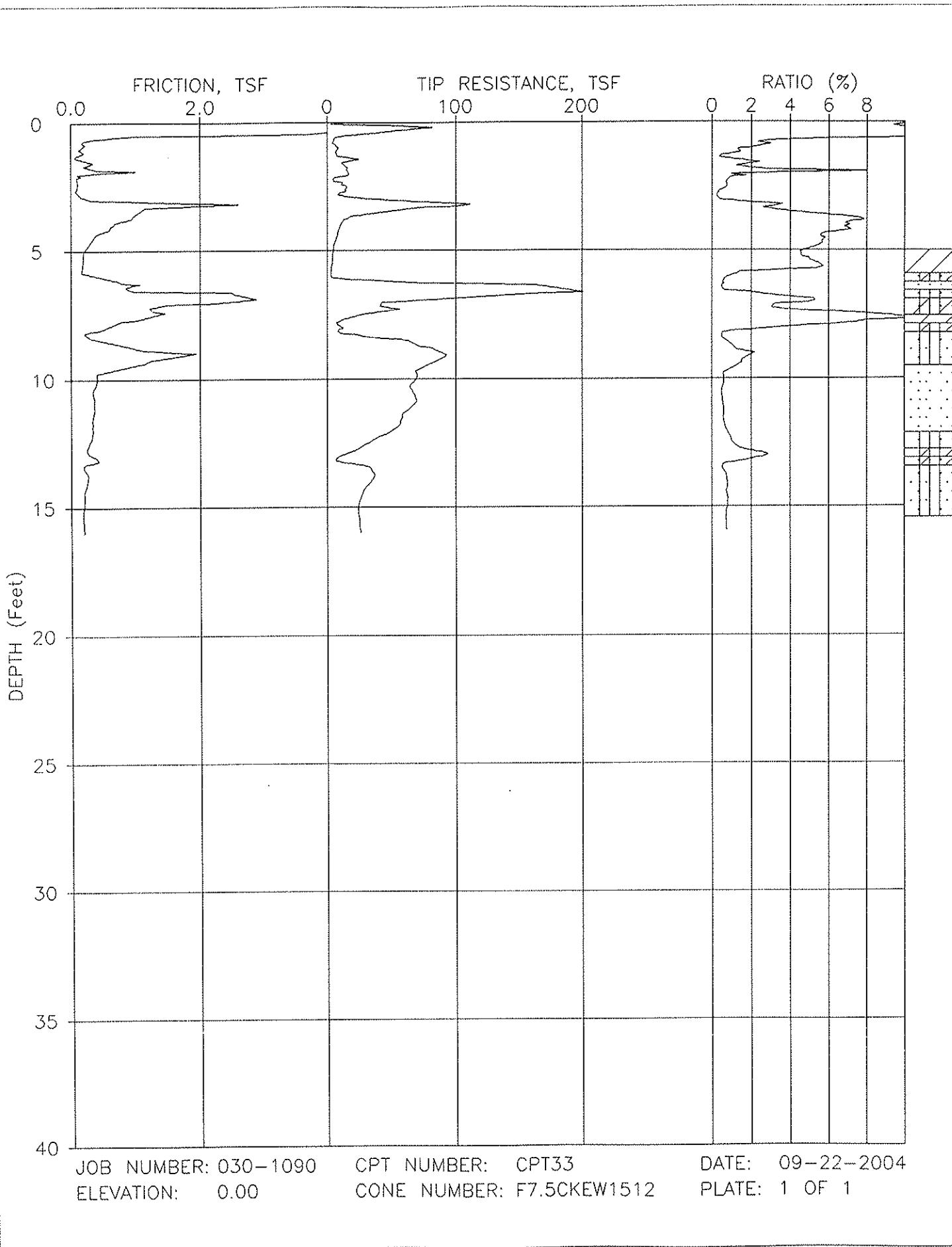


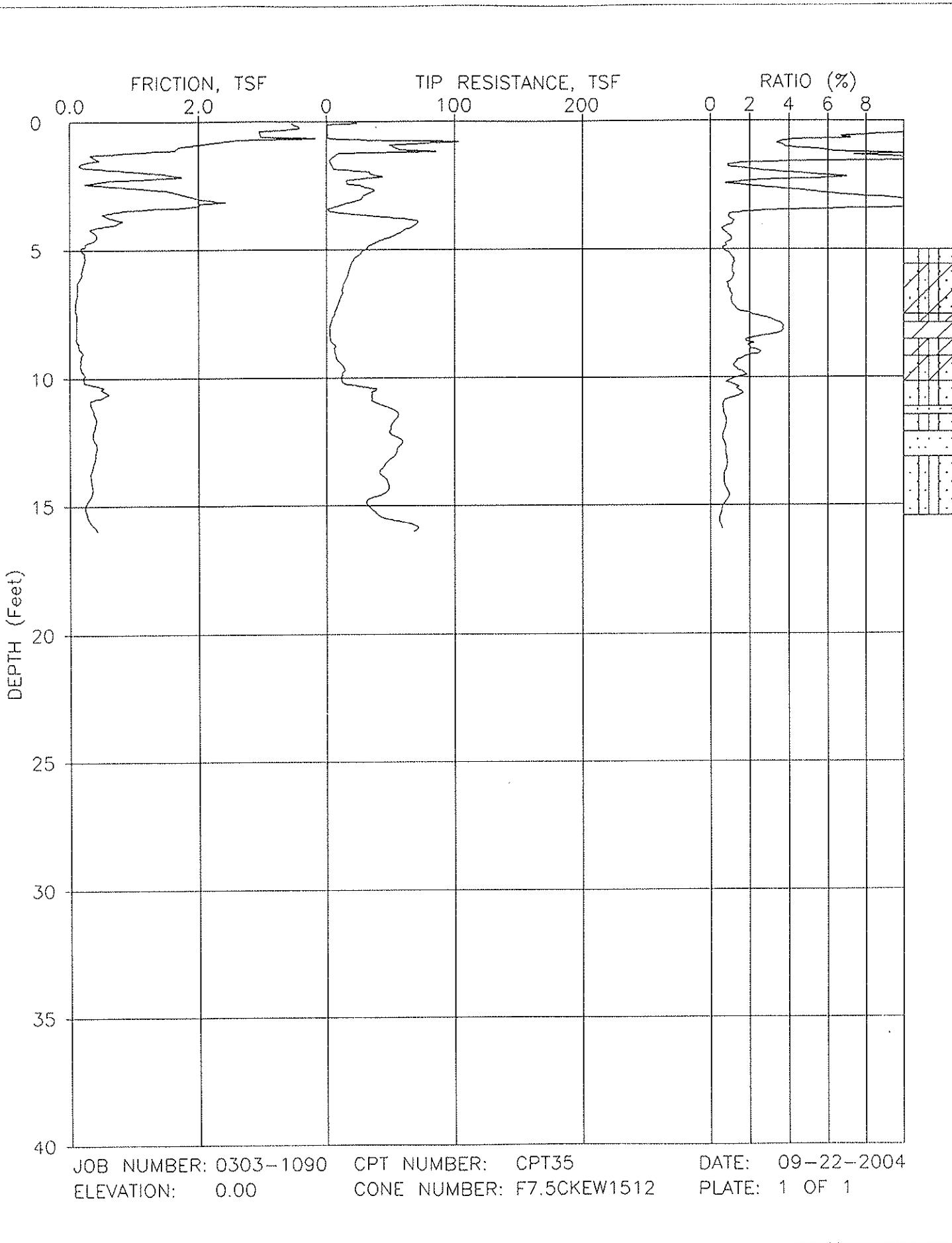


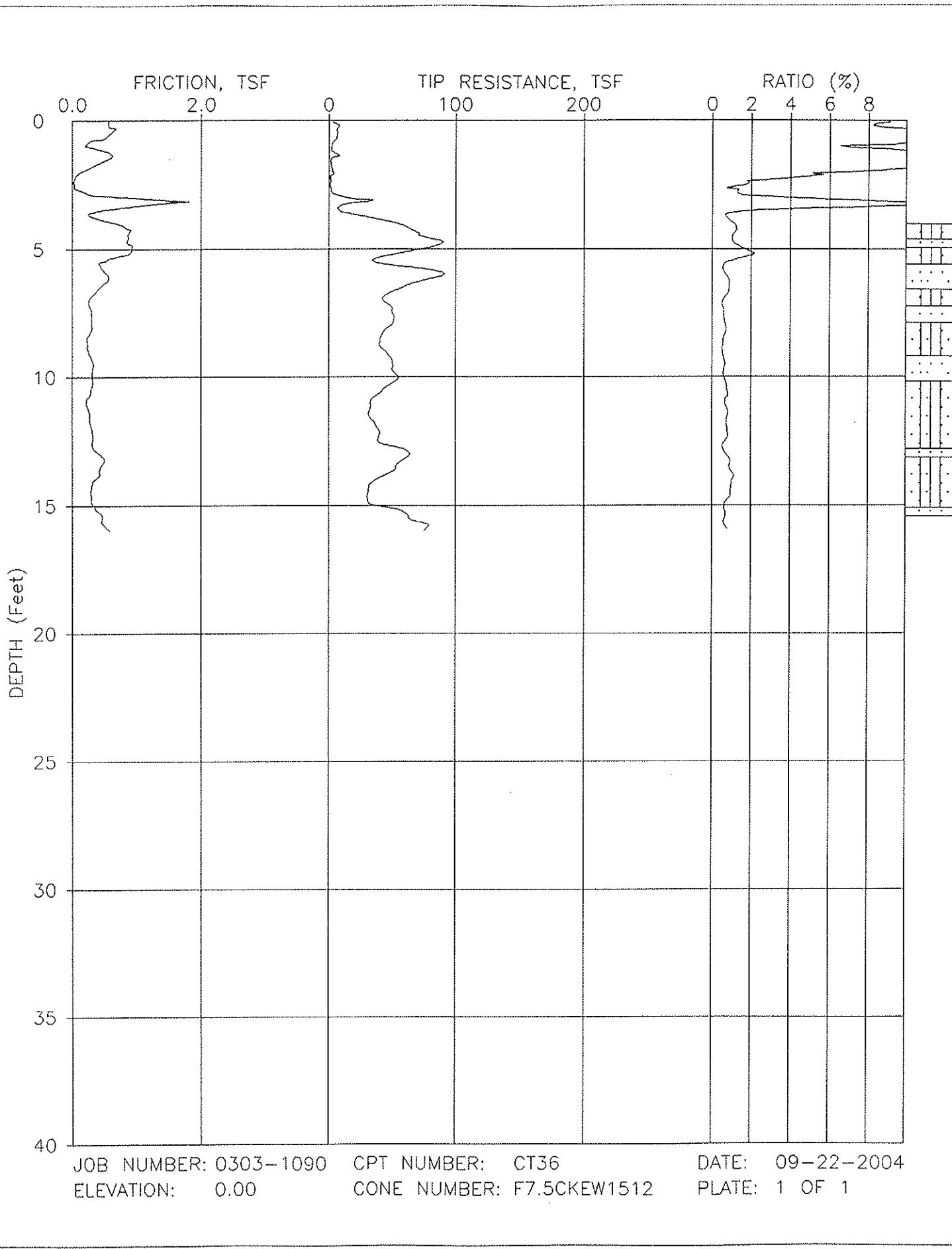


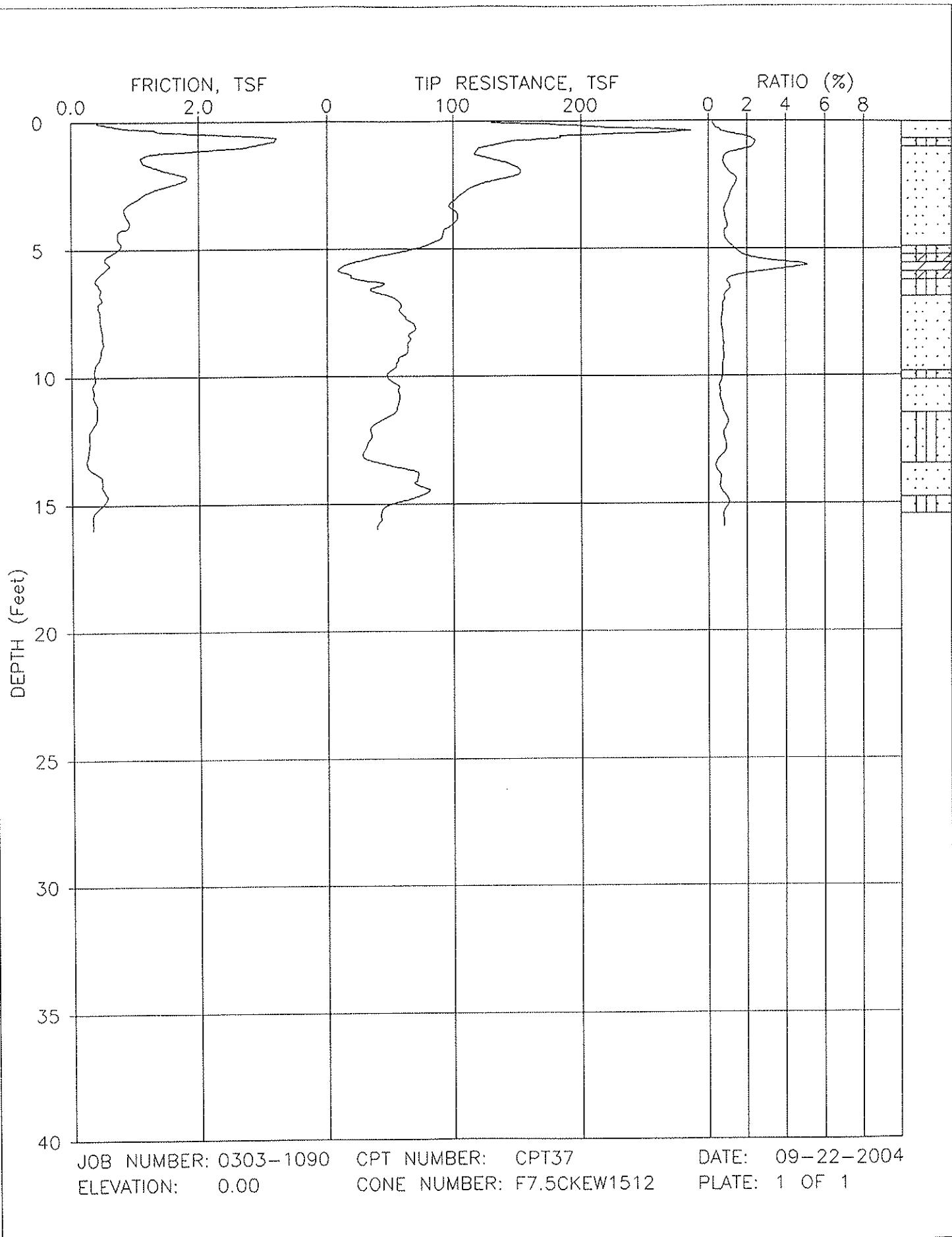


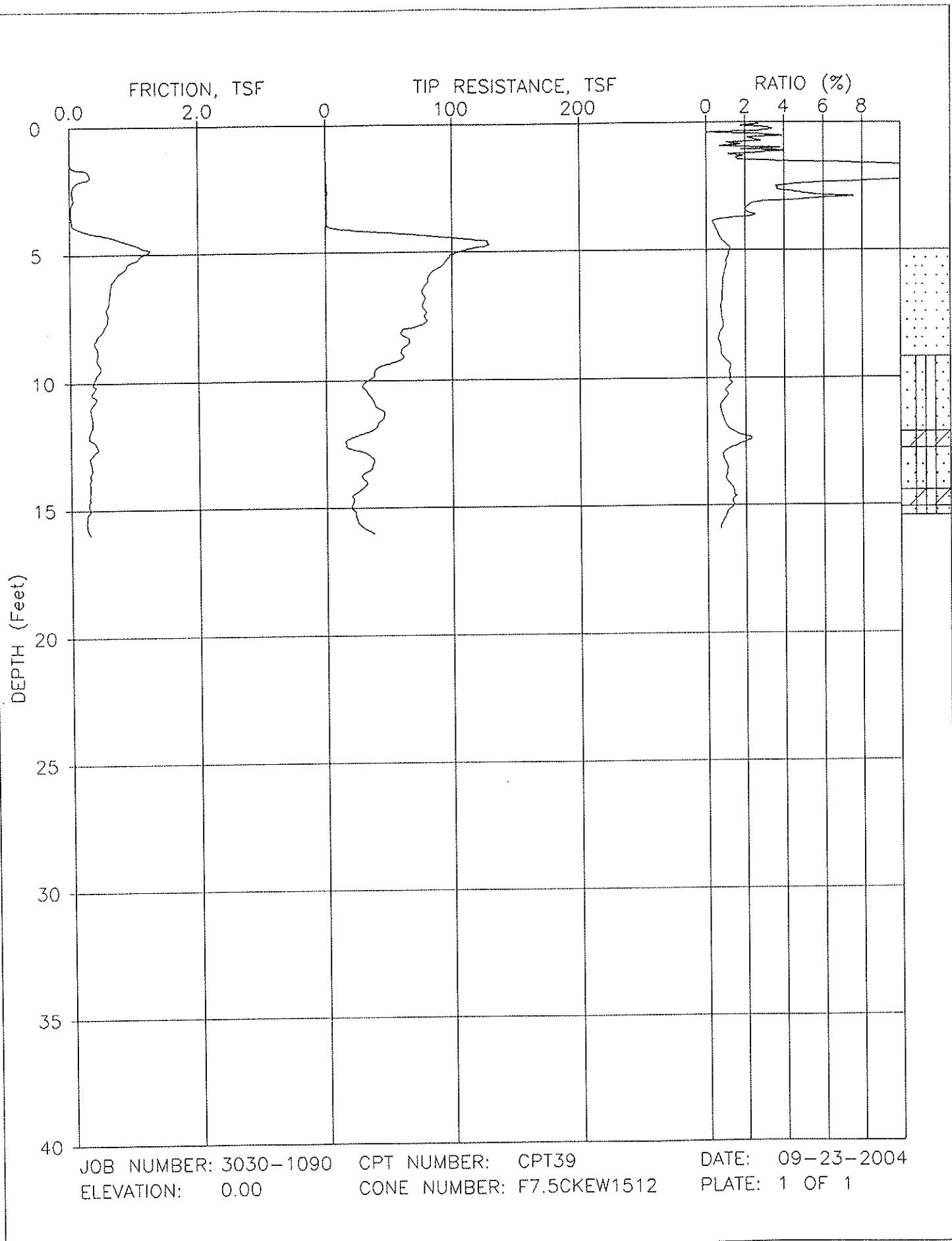


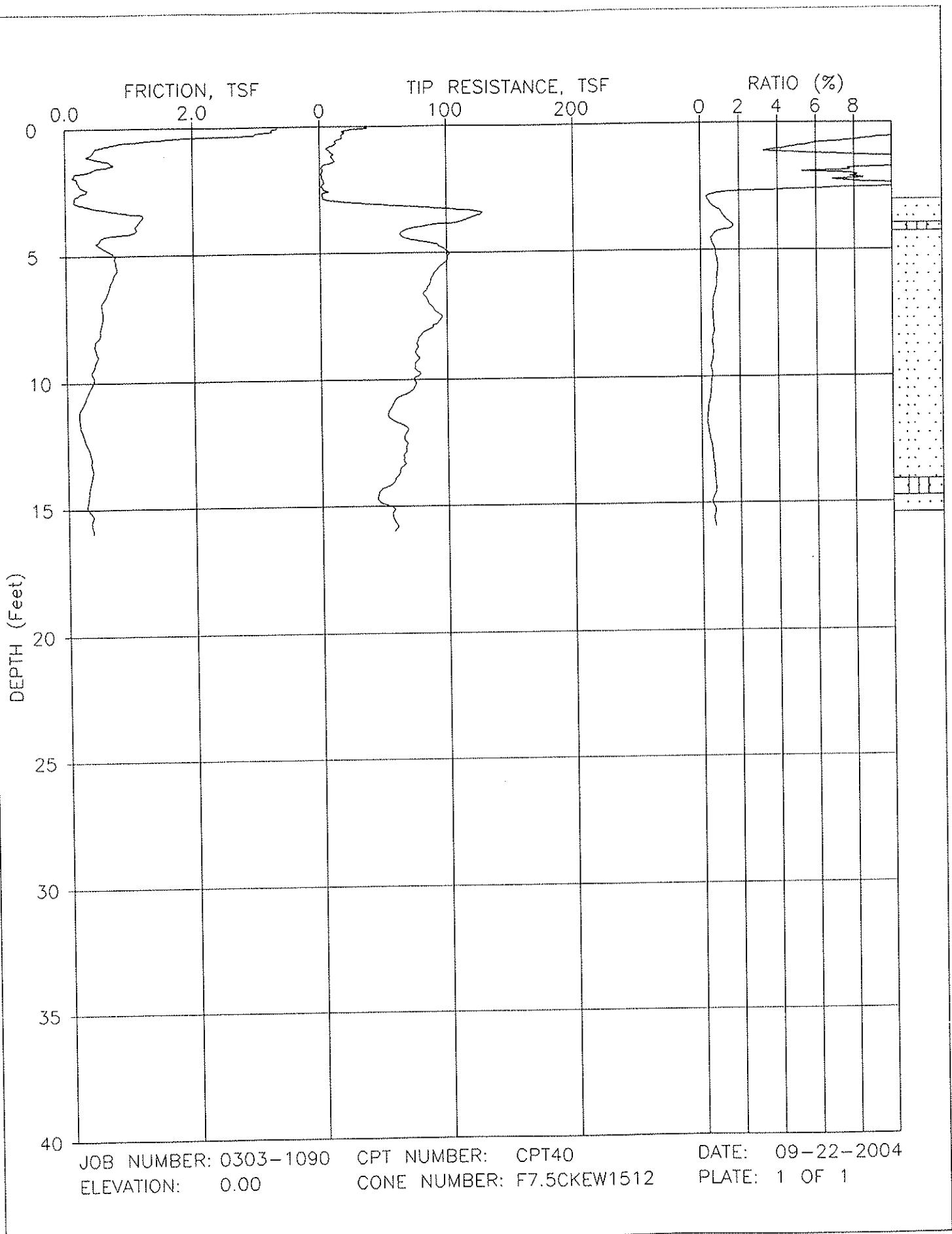


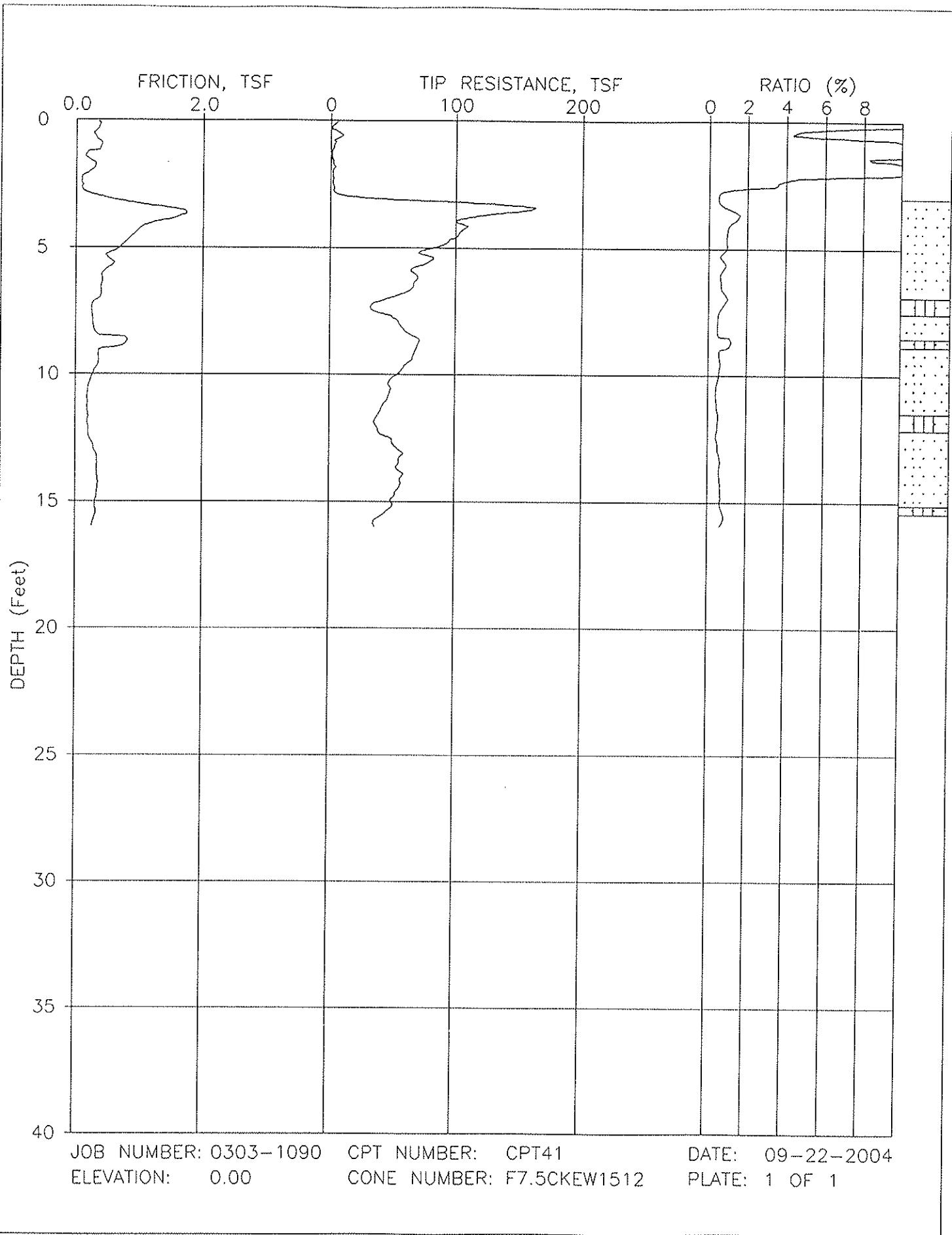


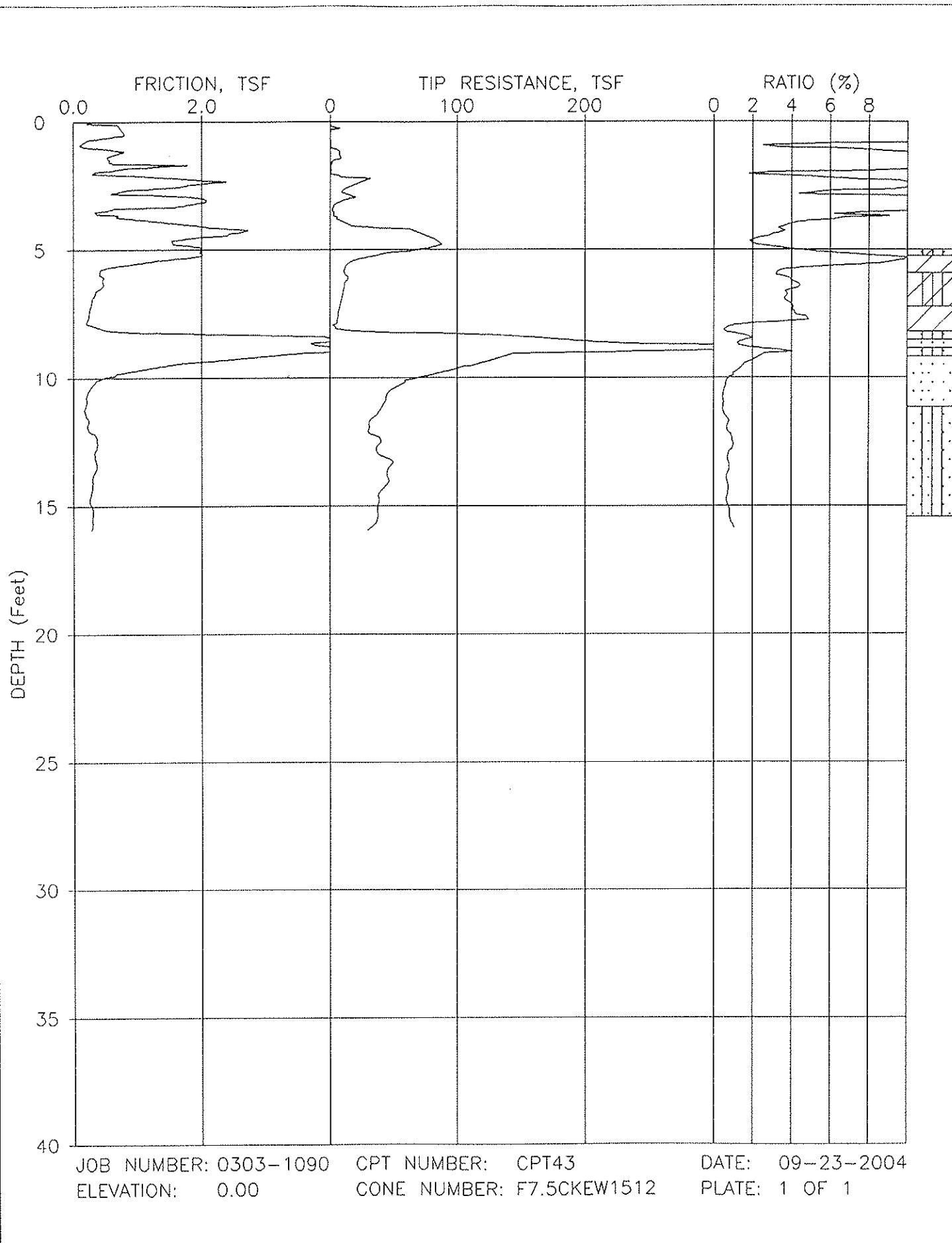


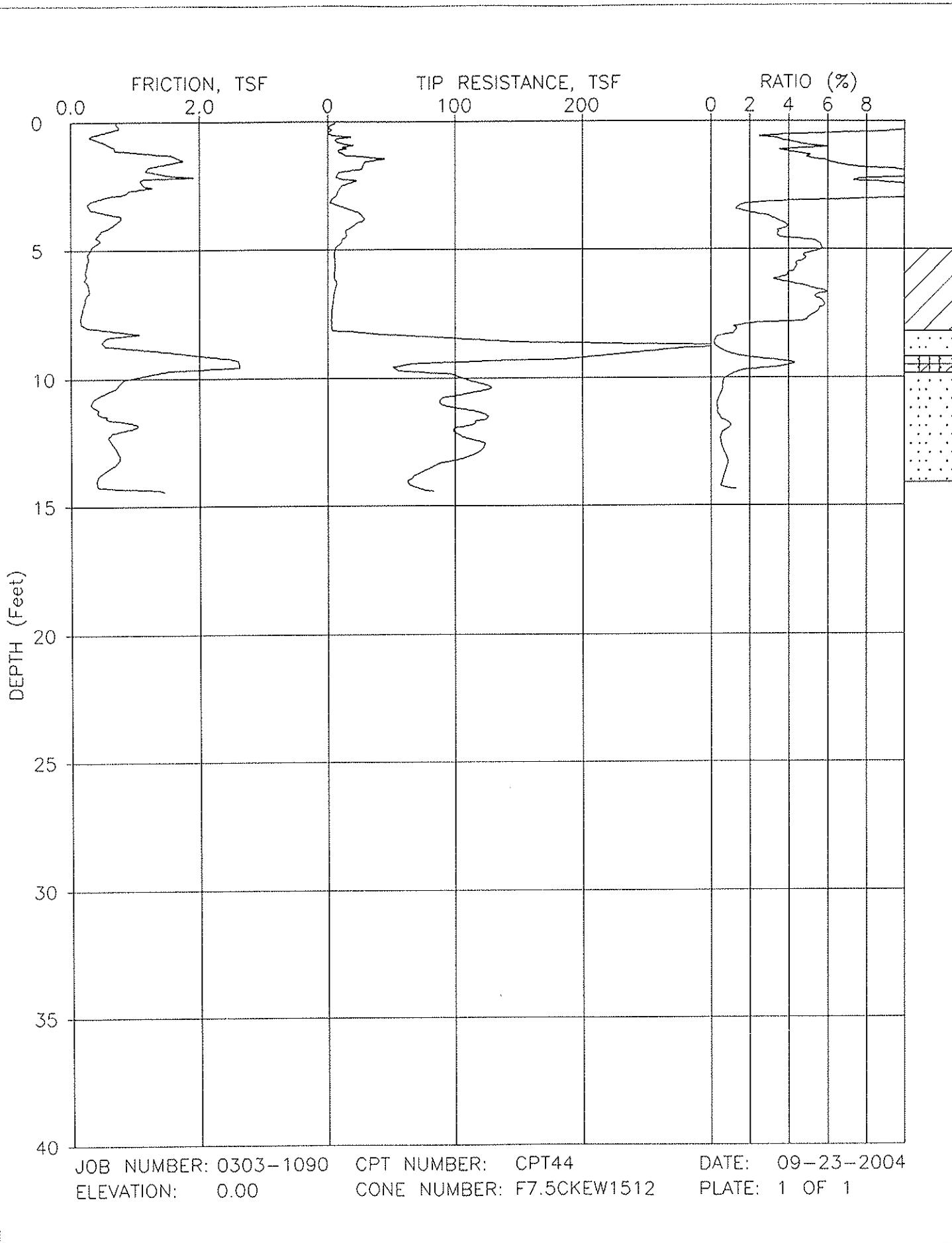












**ROST™  
LOGS**

# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 9:12:19 AM

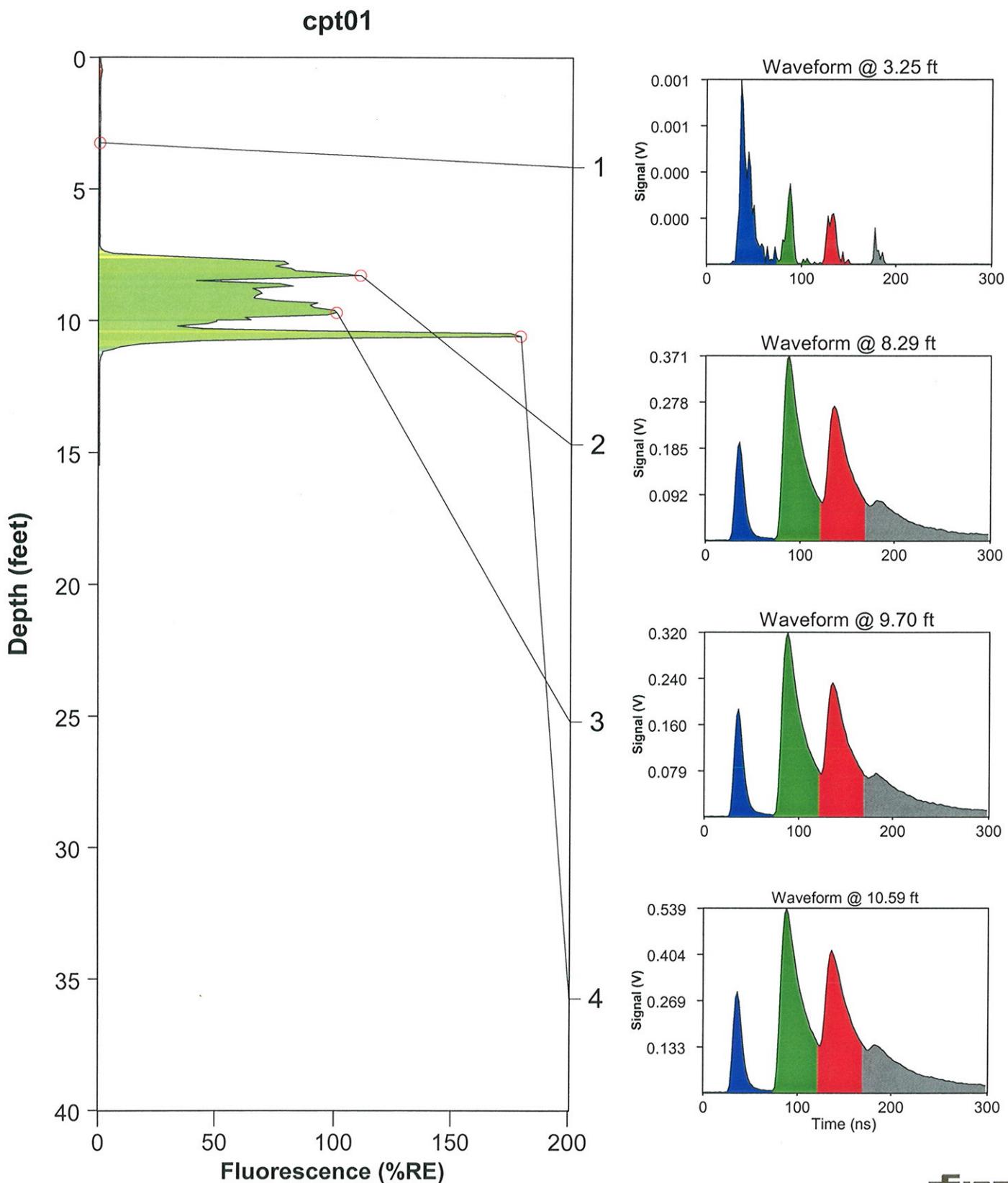
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 178.73% @ 10.59 ft

Final depth BGS: 15.50 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/23/2004 @ 8:34:00 AM

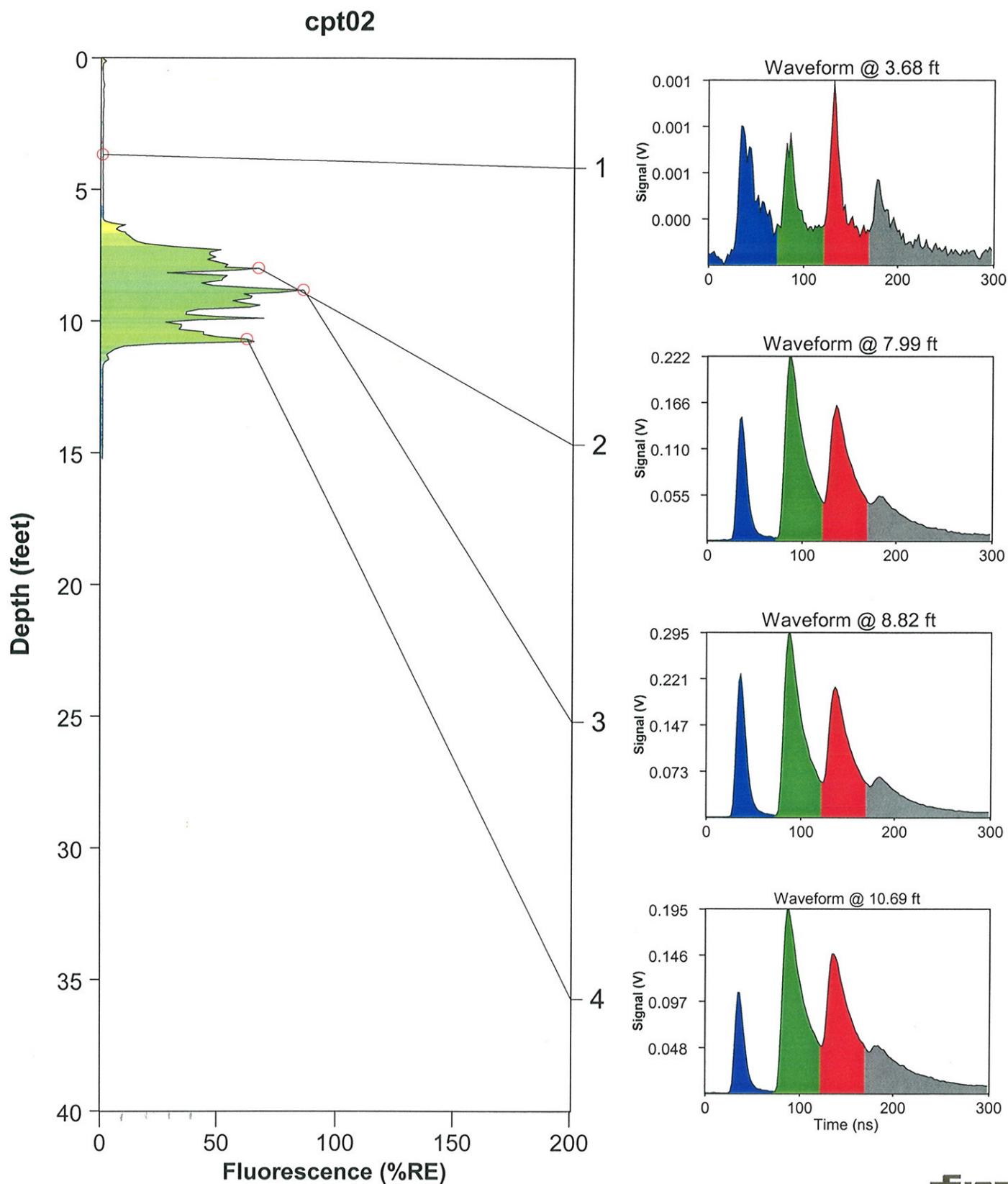
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 85.24% @ 8.82 ft

Final depth BGS: 15.24 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/23/2004 @ 10:12:47 AM

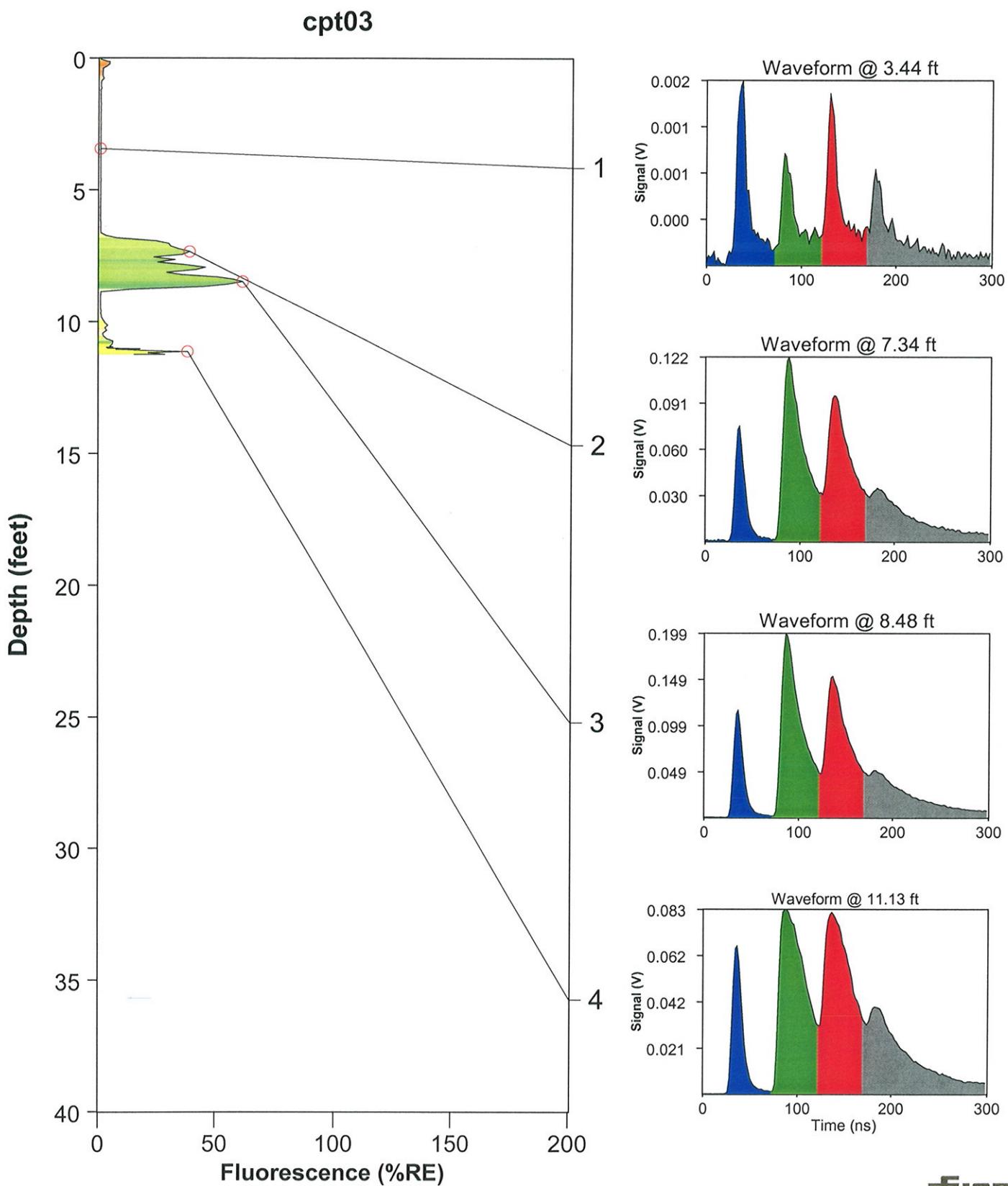
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 60.63% @ 8.48 ft

Final depth BGS: 11.25 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/22/2004 @ 11:41:53 AM

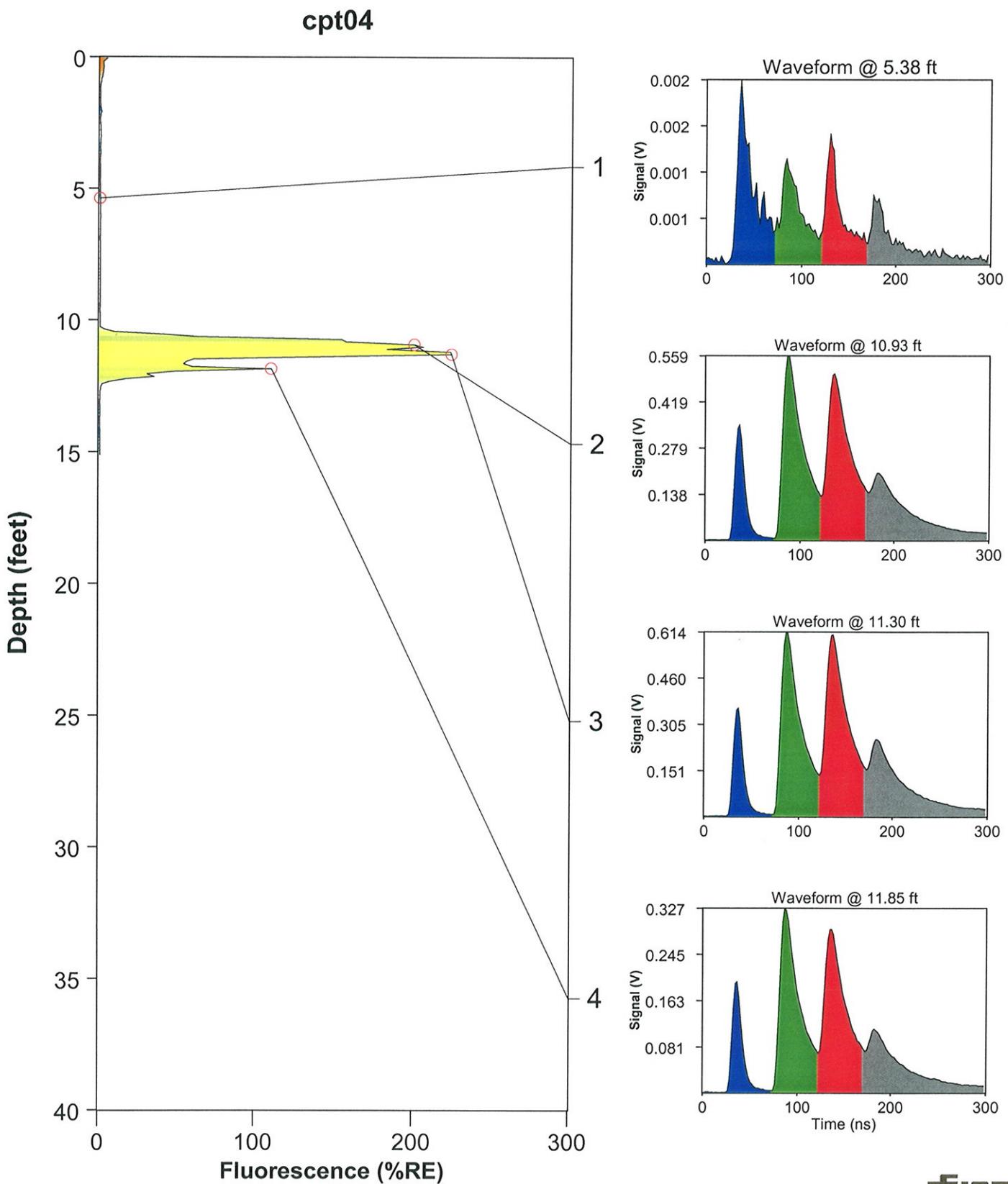
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 223.77% @ 11.30 ft

Final depth BGS: 15.12 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 10:47:57 AM

ROST Unit: 1

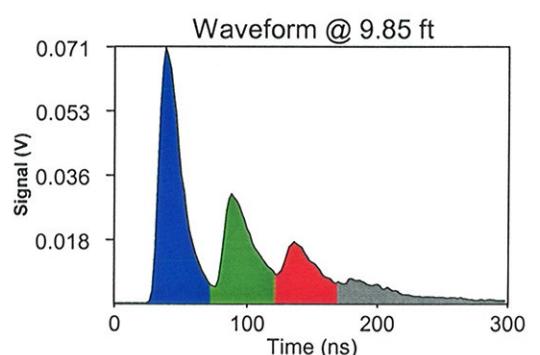
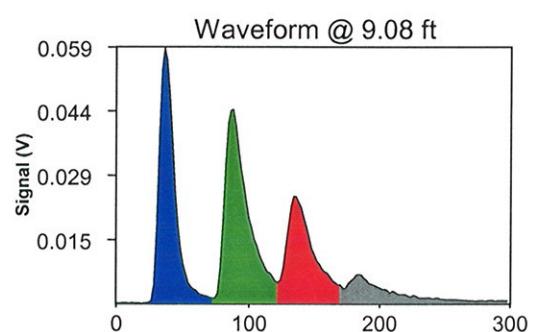
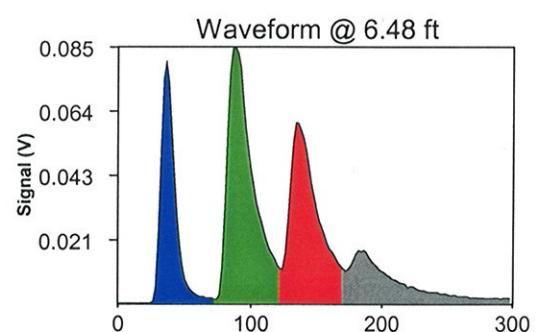
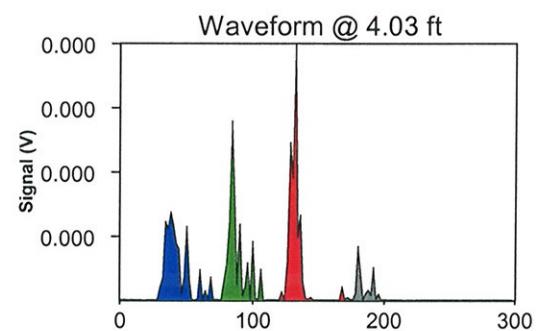
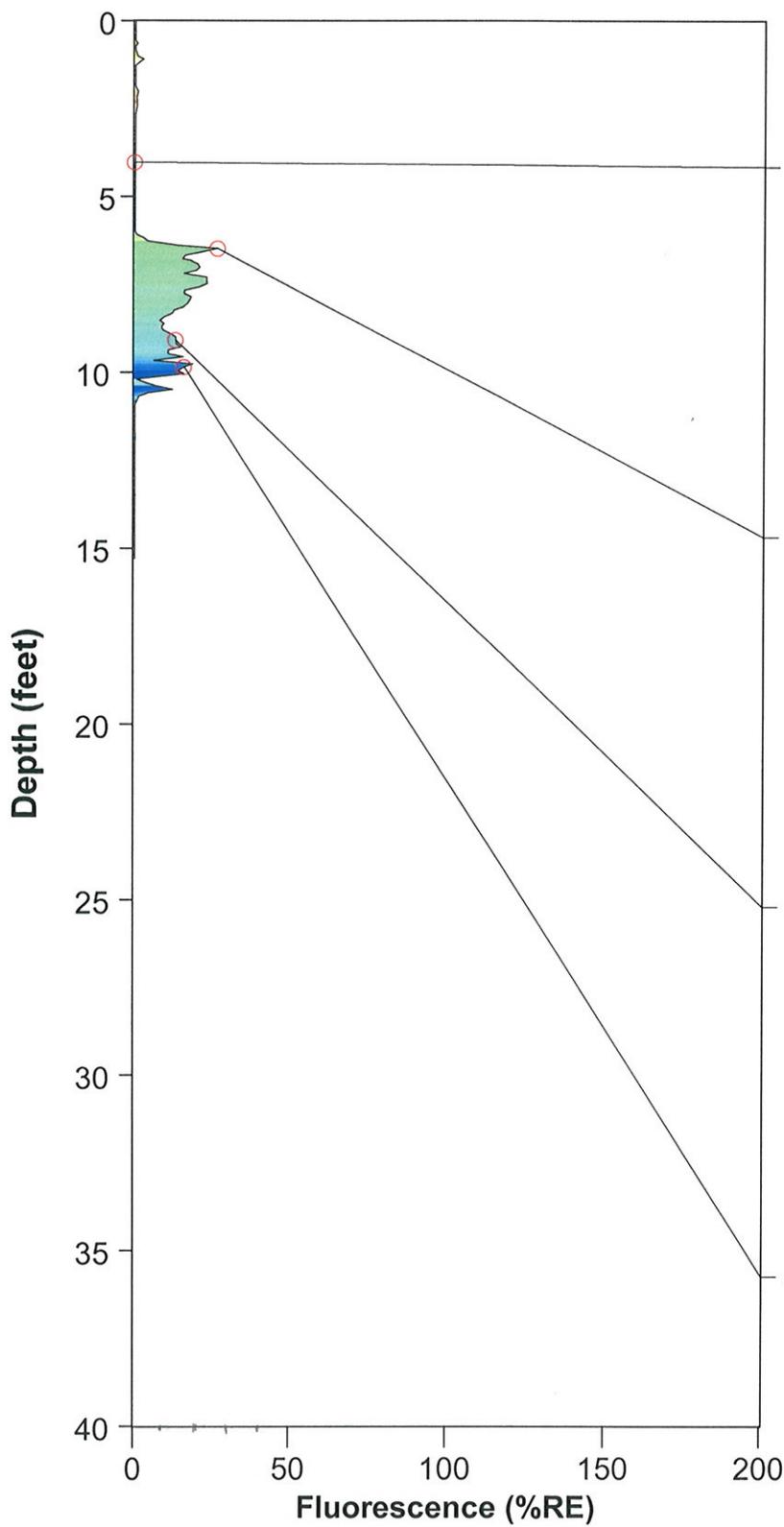
Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 26.48% @ 6.48 ft

Final depth BGS: 15.30 ft

**cpt05**



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 11:21:41 AM

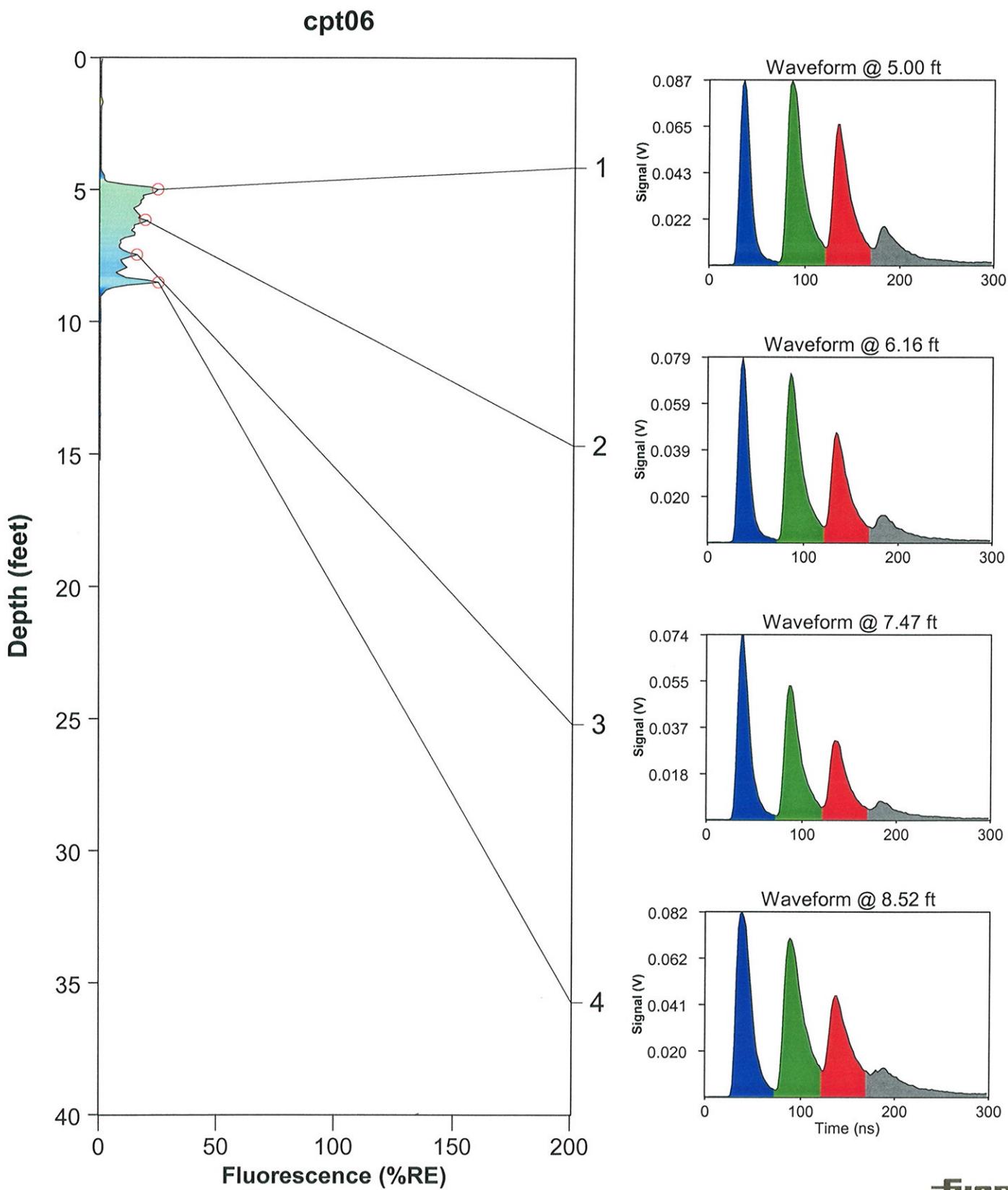
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 24.59% @ 8.52 ft

Final depth BGS: 15.25 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 11:04:39 AM

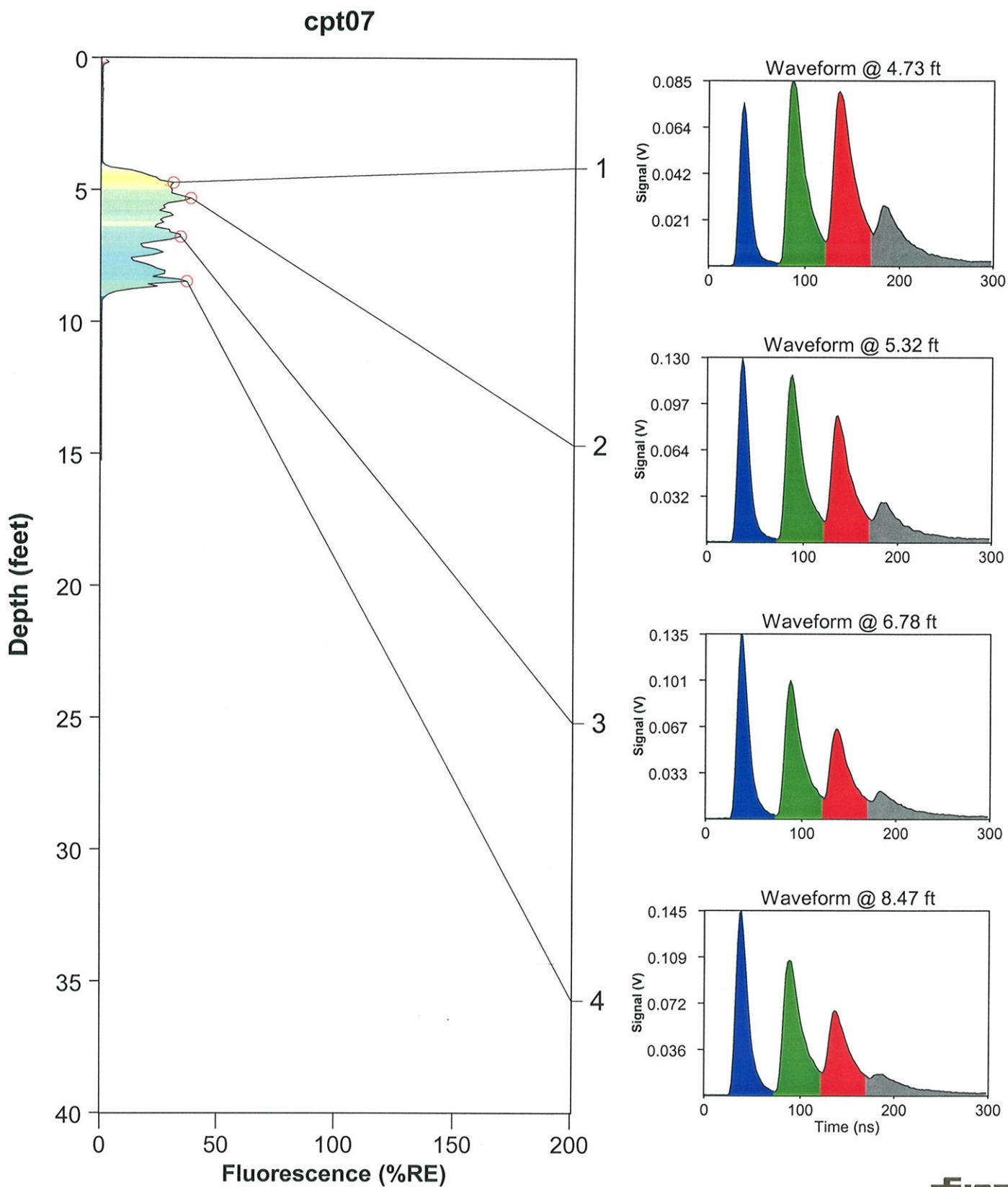
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 37.71% @ 5.32 ft

Final depth BGS: 15.27 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 11:37:44 AM

ROST Unit: 1

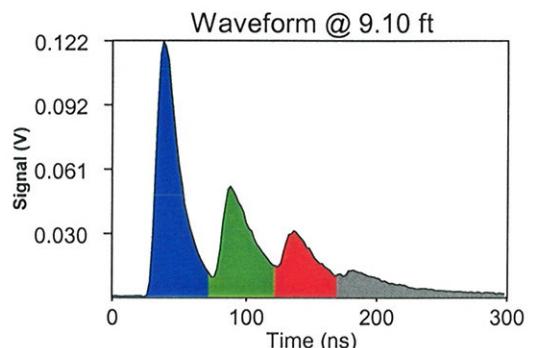
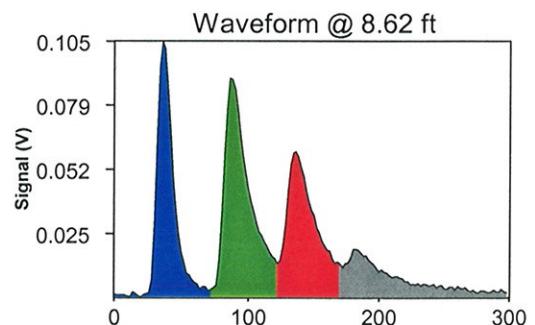
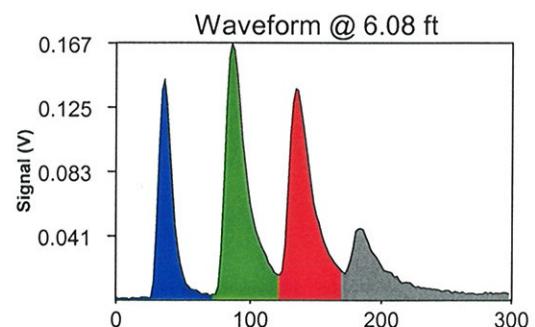
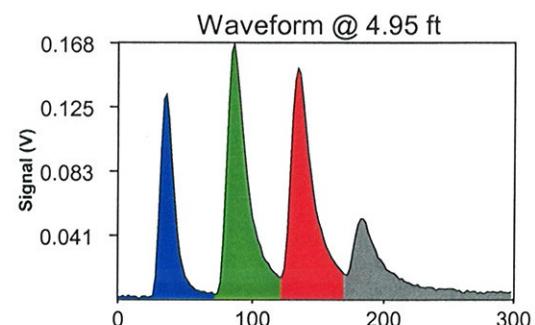
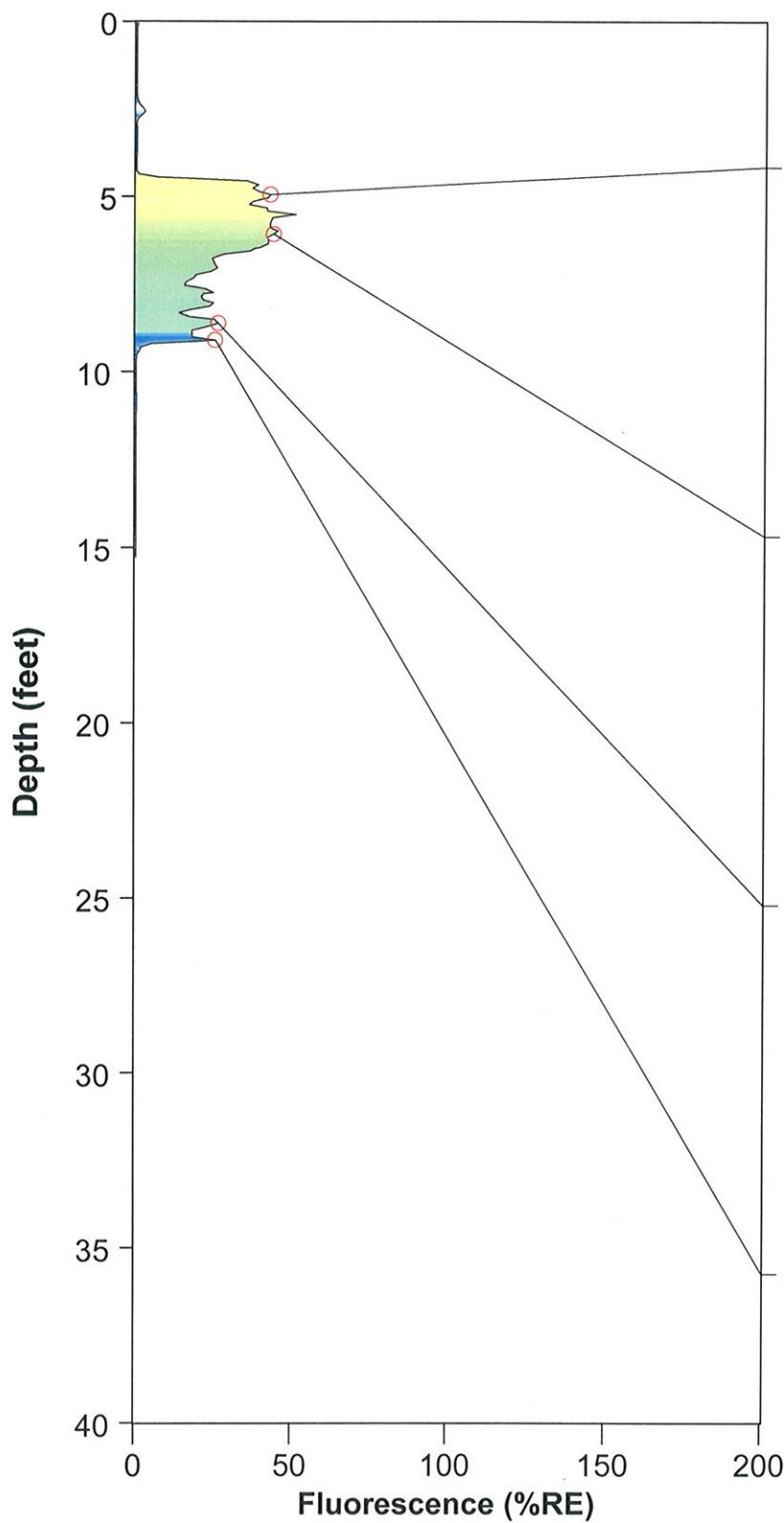
Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 50.69% @ 5.52 ft

Final depth BGS: 15.28 ft

**cpt08**



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 11:55:54 AM

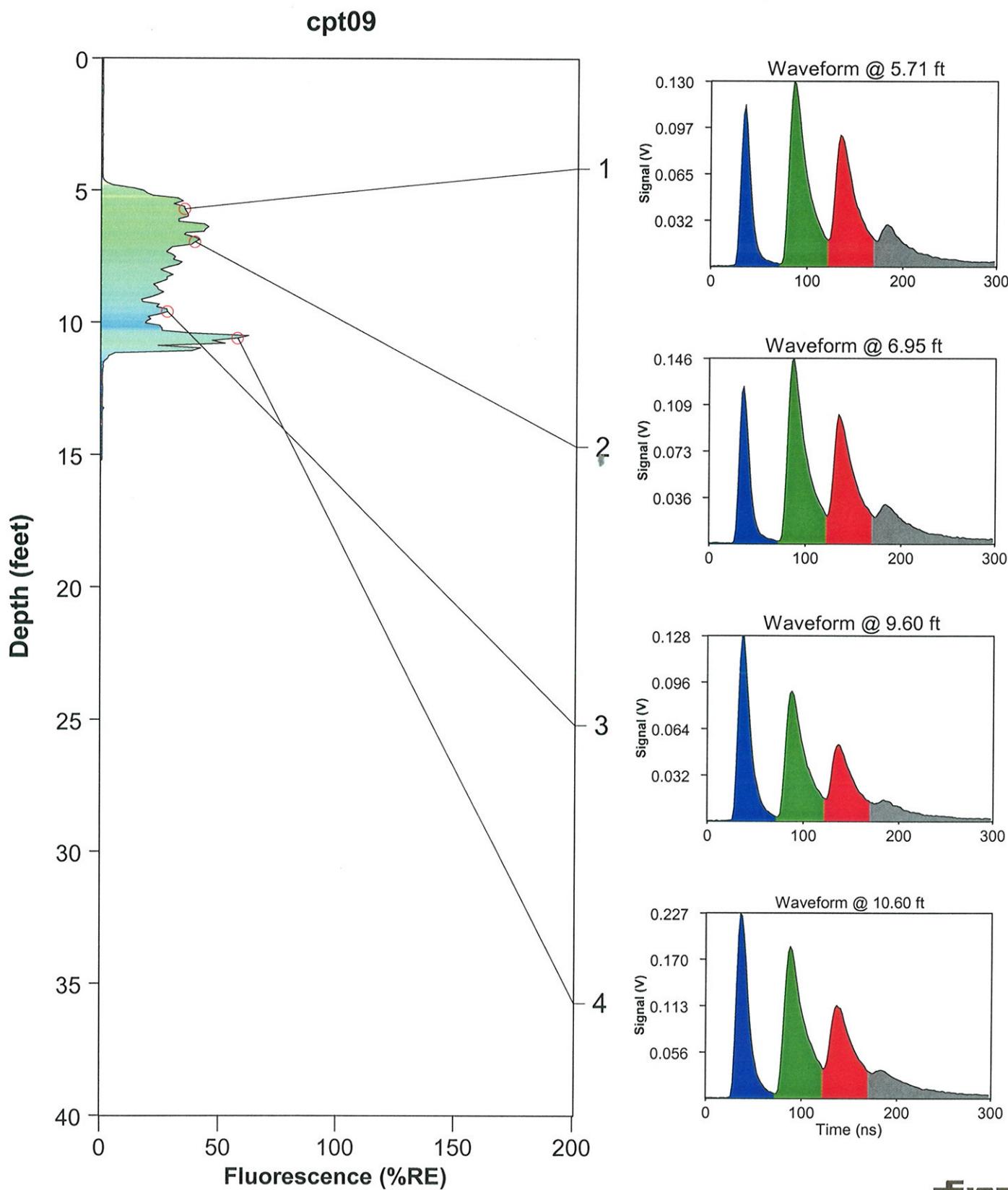
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 61.64% @ 10.50 ft

Final depth BGS: 15.23 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 1:10:28 PM

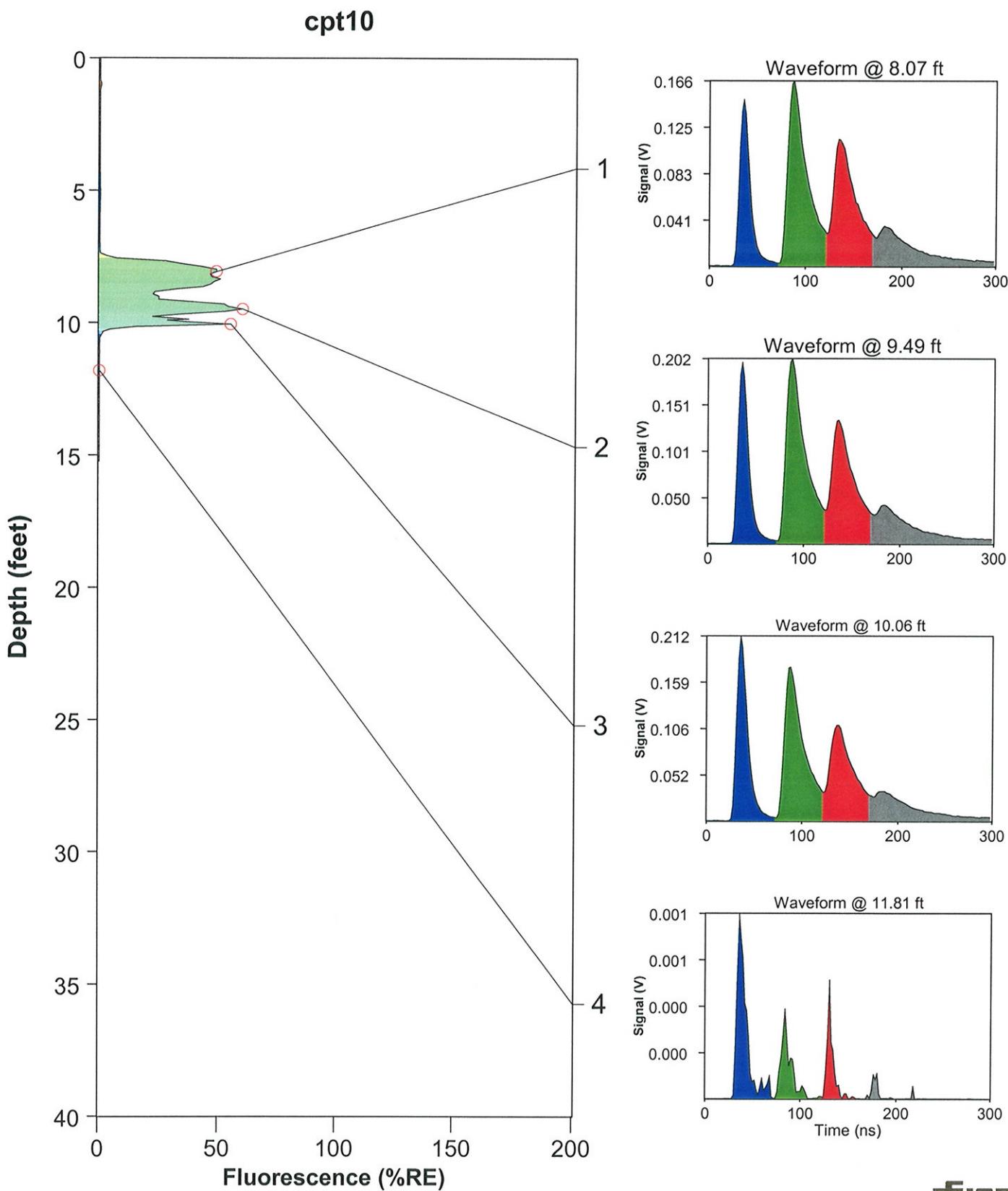
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 59.77% @ 9.49 ft

Final depth BGS: 15.25 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 1:27:22 PM

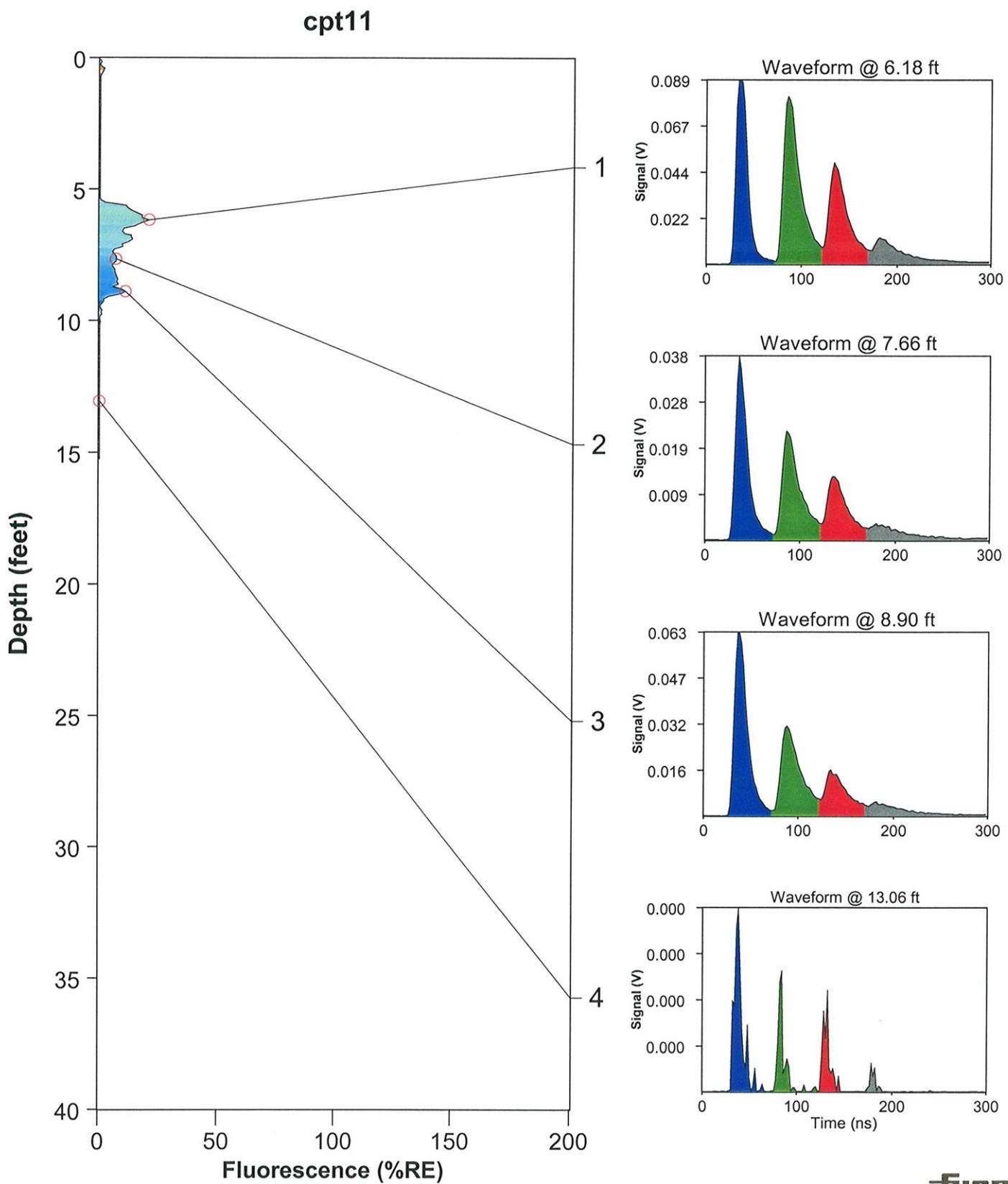
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 20.77% @ 6.18 ft

Final depth BGS: 15.27 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 1:43:57 PM

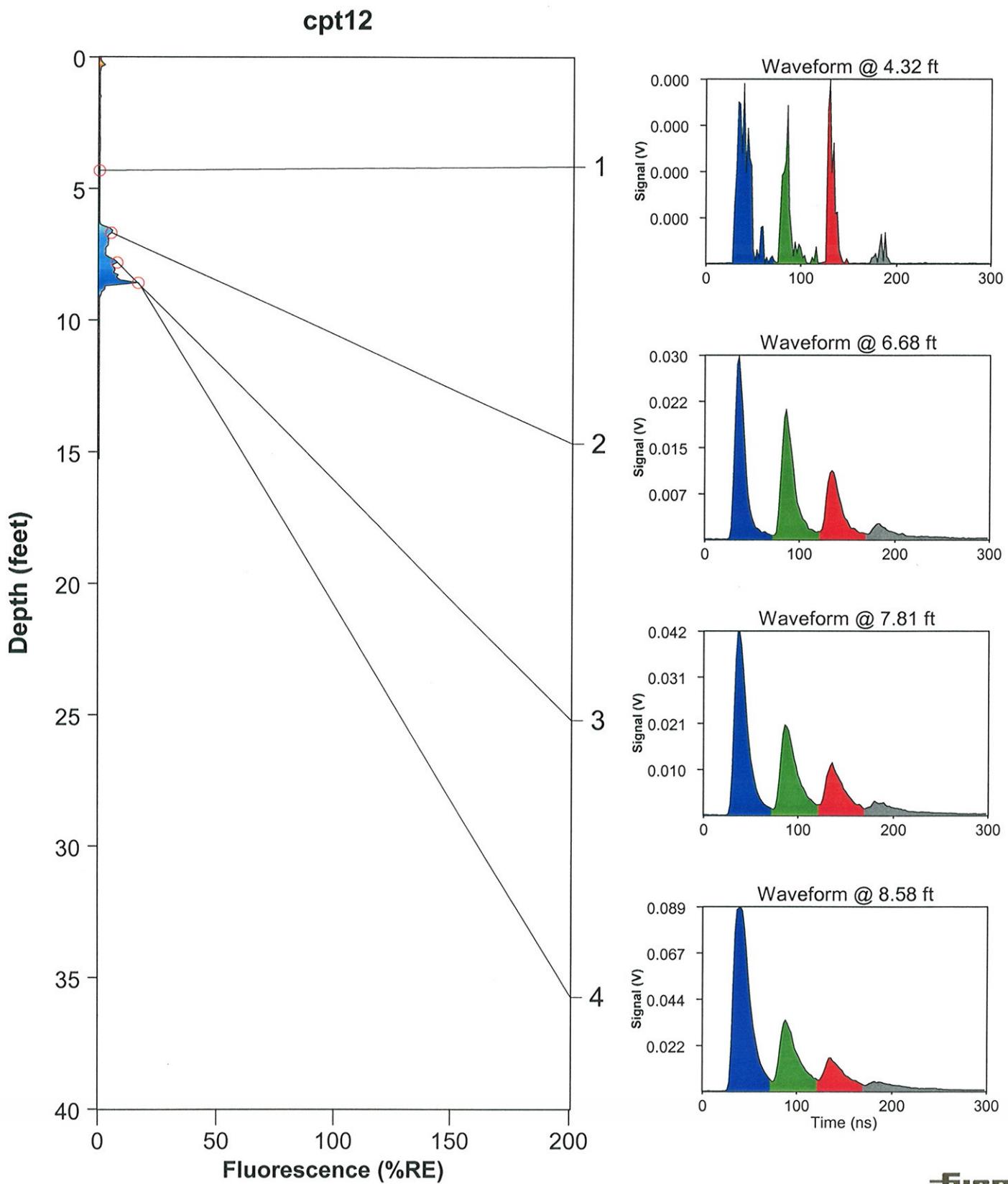
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 16.55% @ 8.58 ft

Final depth BGS: 15.28 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 2:03:23 PM

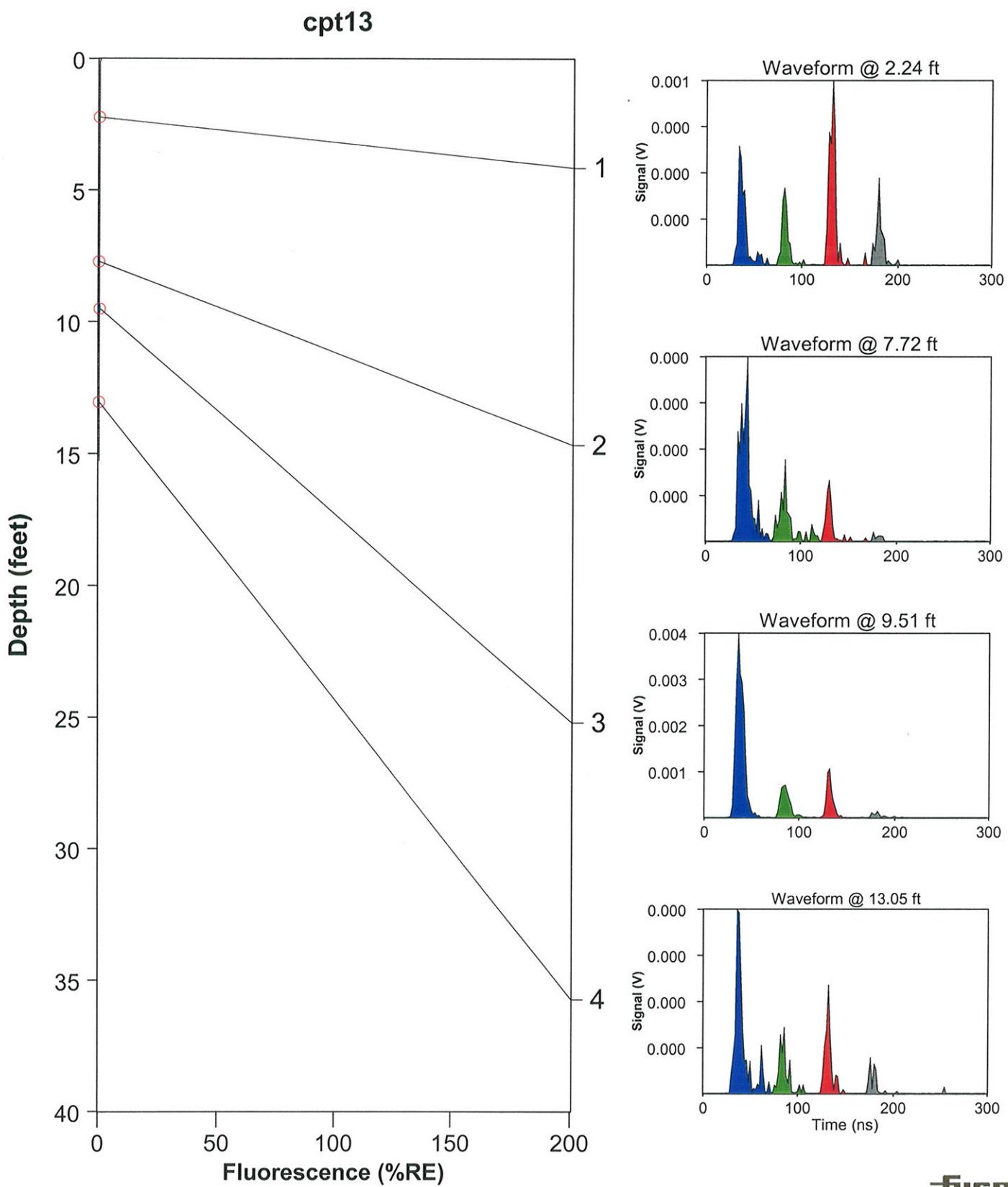
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 0.54% @ 0.04 ft

Final depth BGS: 15.27 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 2:20:42 PM

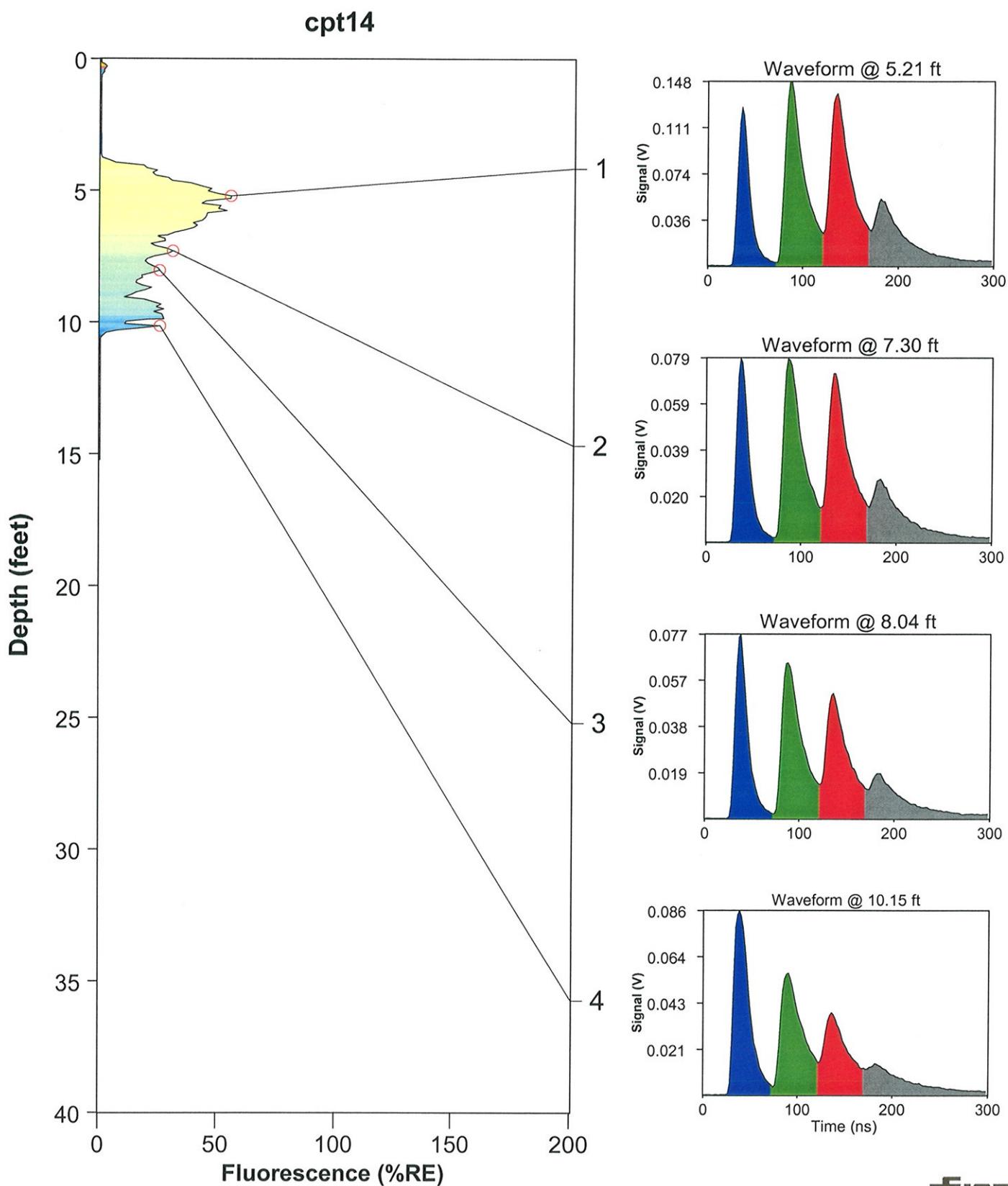
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 54.80% @ 5.21 ft

Final depth BGS: 15.24 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 2:37:11 PM

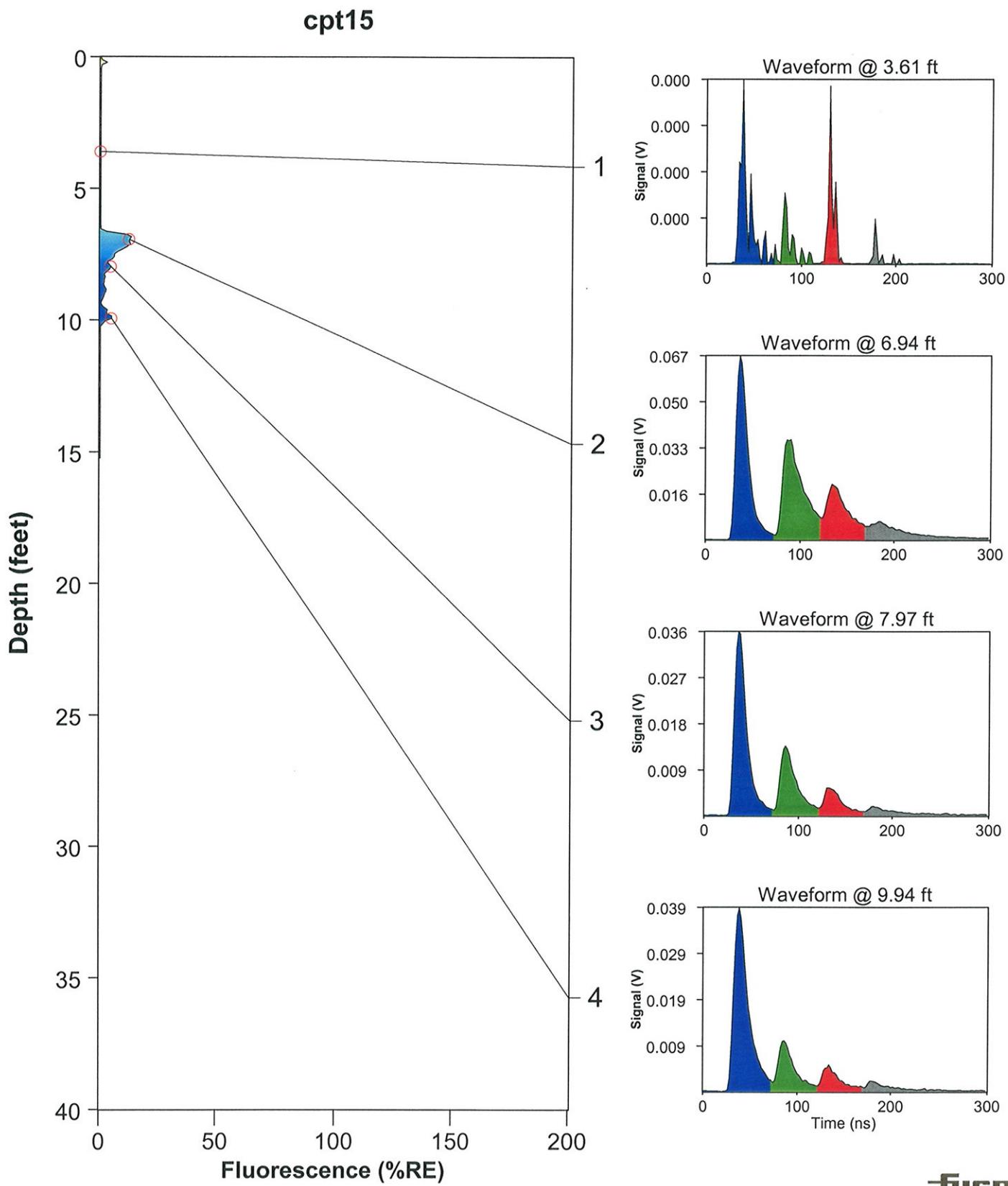
ROST Unit: 1

Operator: ddleon

Fugro Job #: 03-1090

Max fluorescence: 13.21% @ 6.84 ft

Final depth BGS: 15.25 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/23/2004 @ 7:18:04 AM

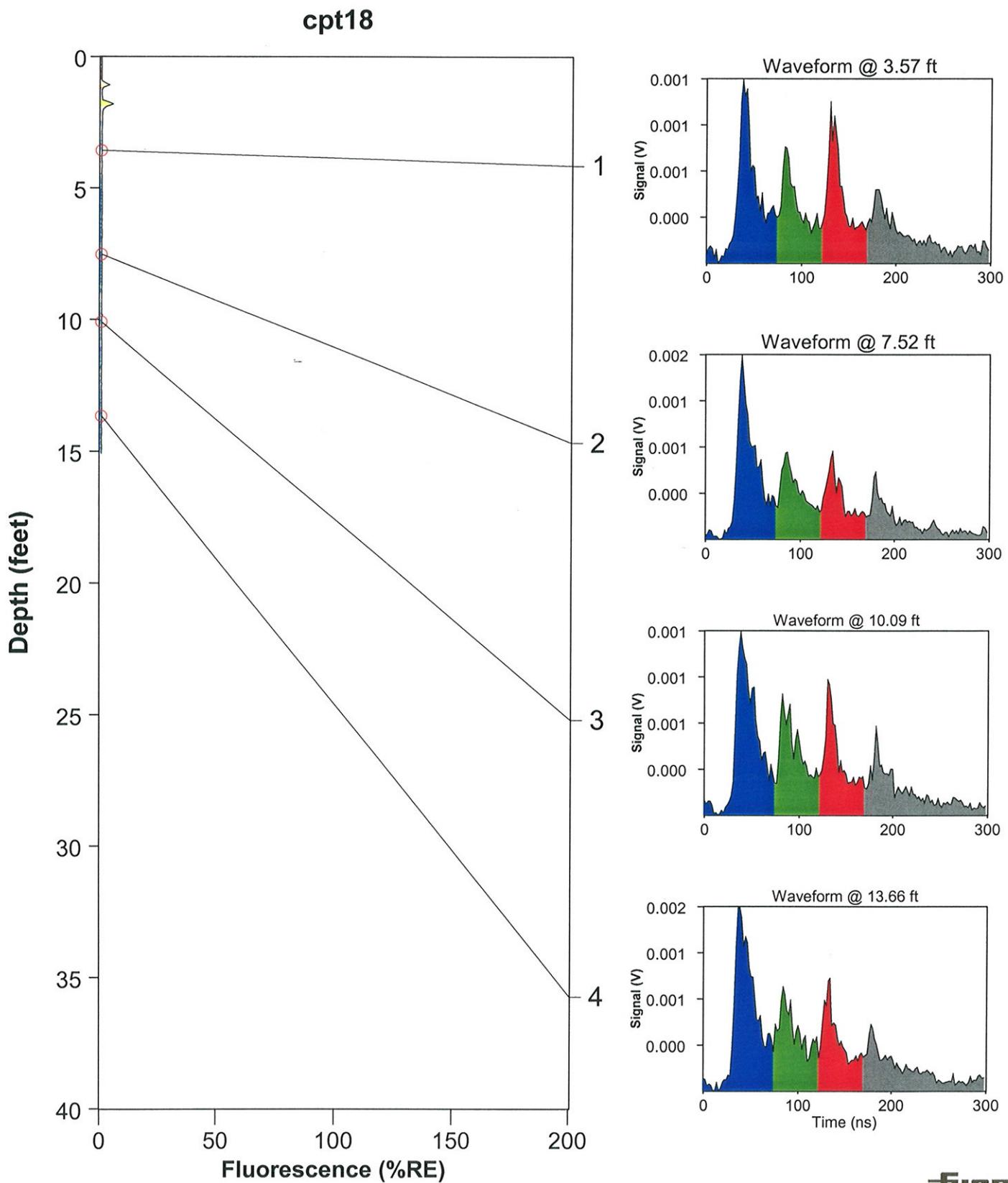
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 5.27% @ 1.81 ft

Final depth BGS: 15.09 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 4:03:36 PM

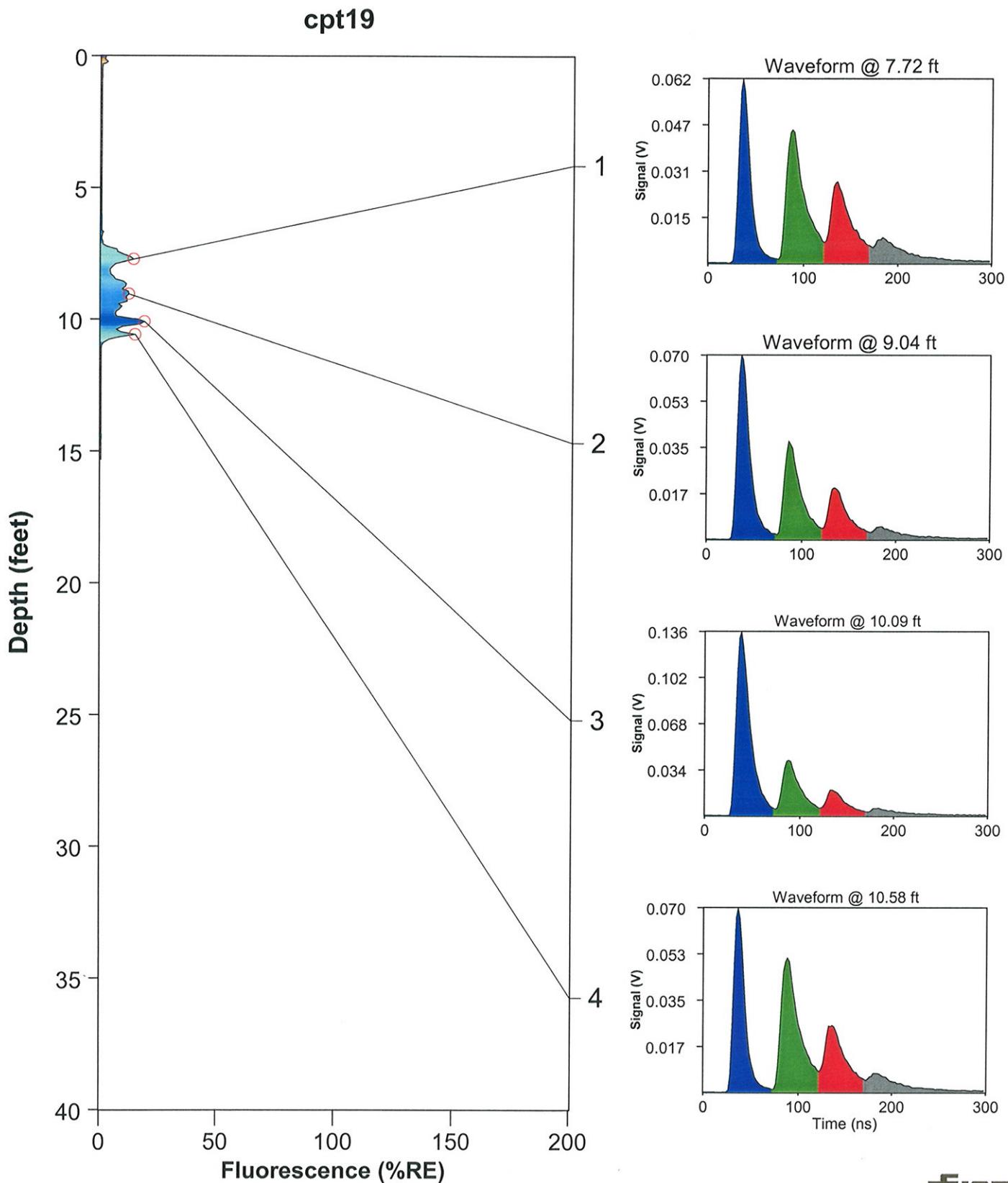
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 18.53% @ 10.09 ft

Final depth BGS: 15.33 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 4:38:09 PM

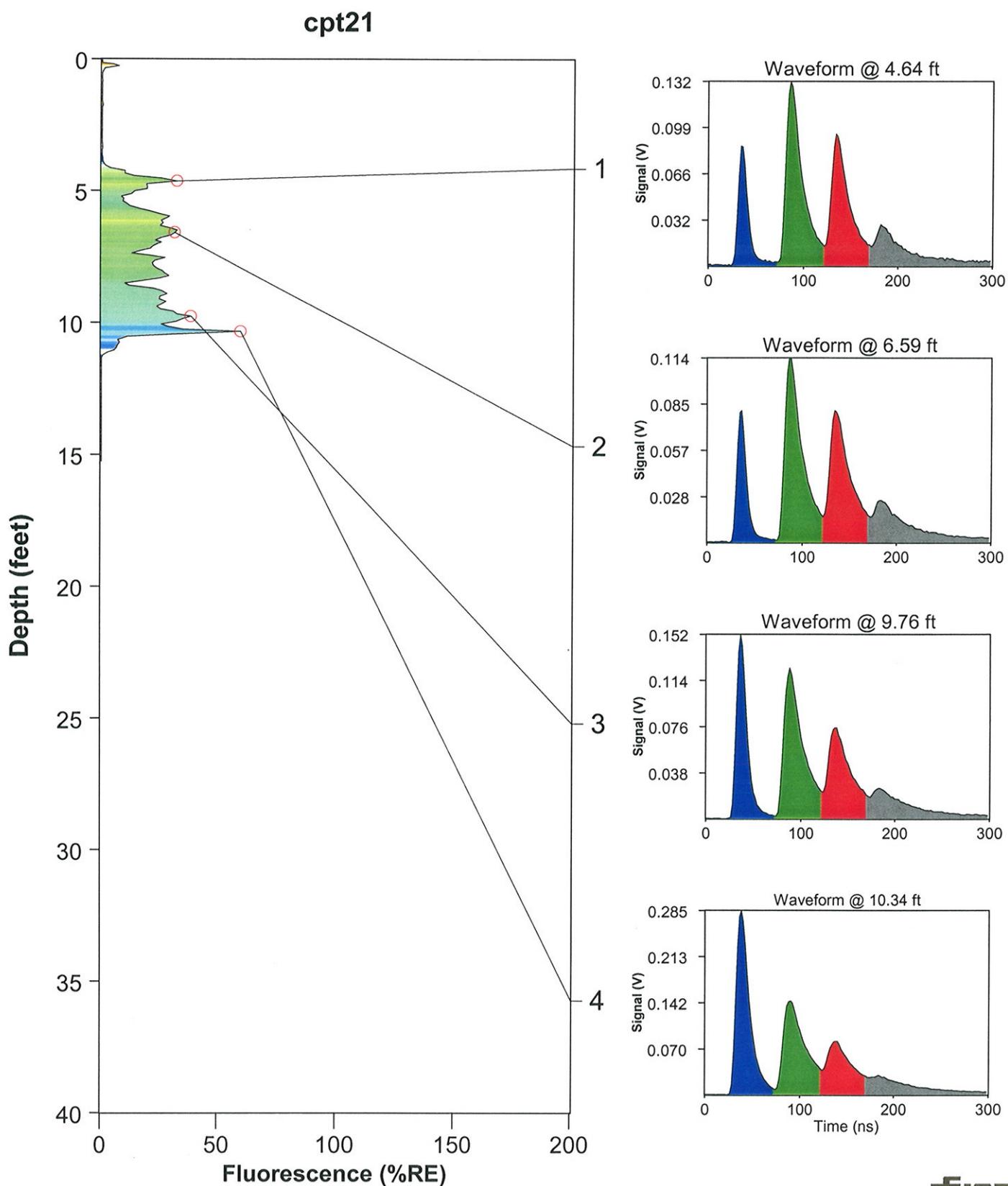
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 59.27% @ 10.34 ft

Final depth BGS: 15.26 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 4:59:44 PM

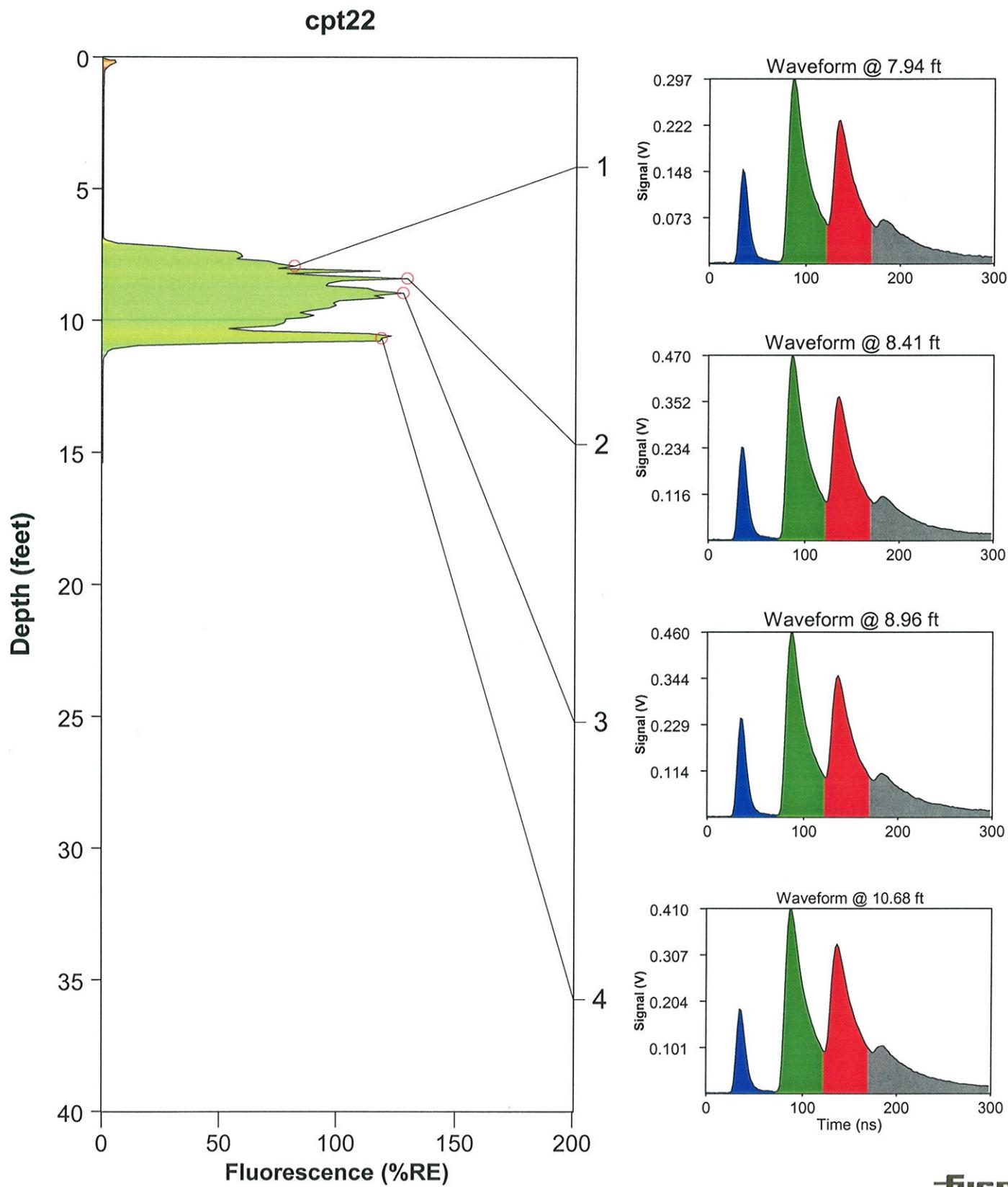
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 128.73% @ 8.41 ft

Final depth BGS: 15.40 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 5:17:01 PM

ROST Unit: 1

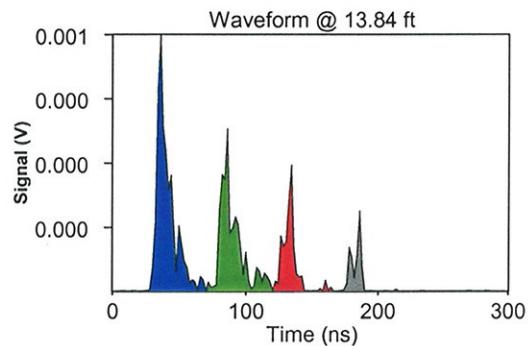
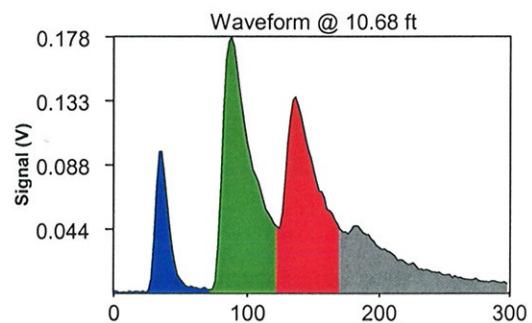
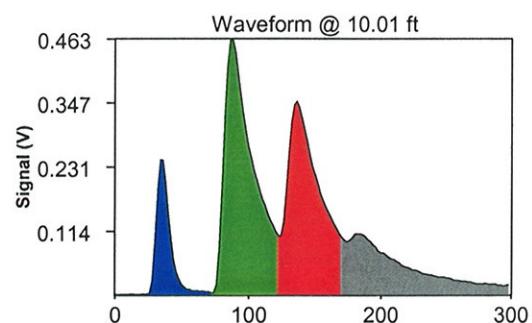
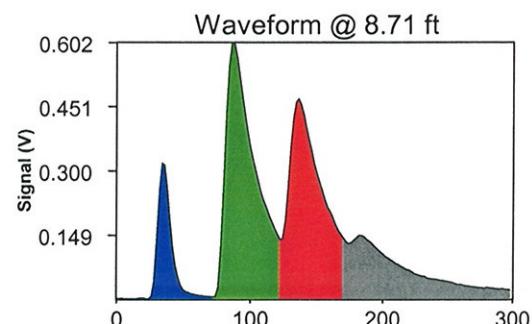
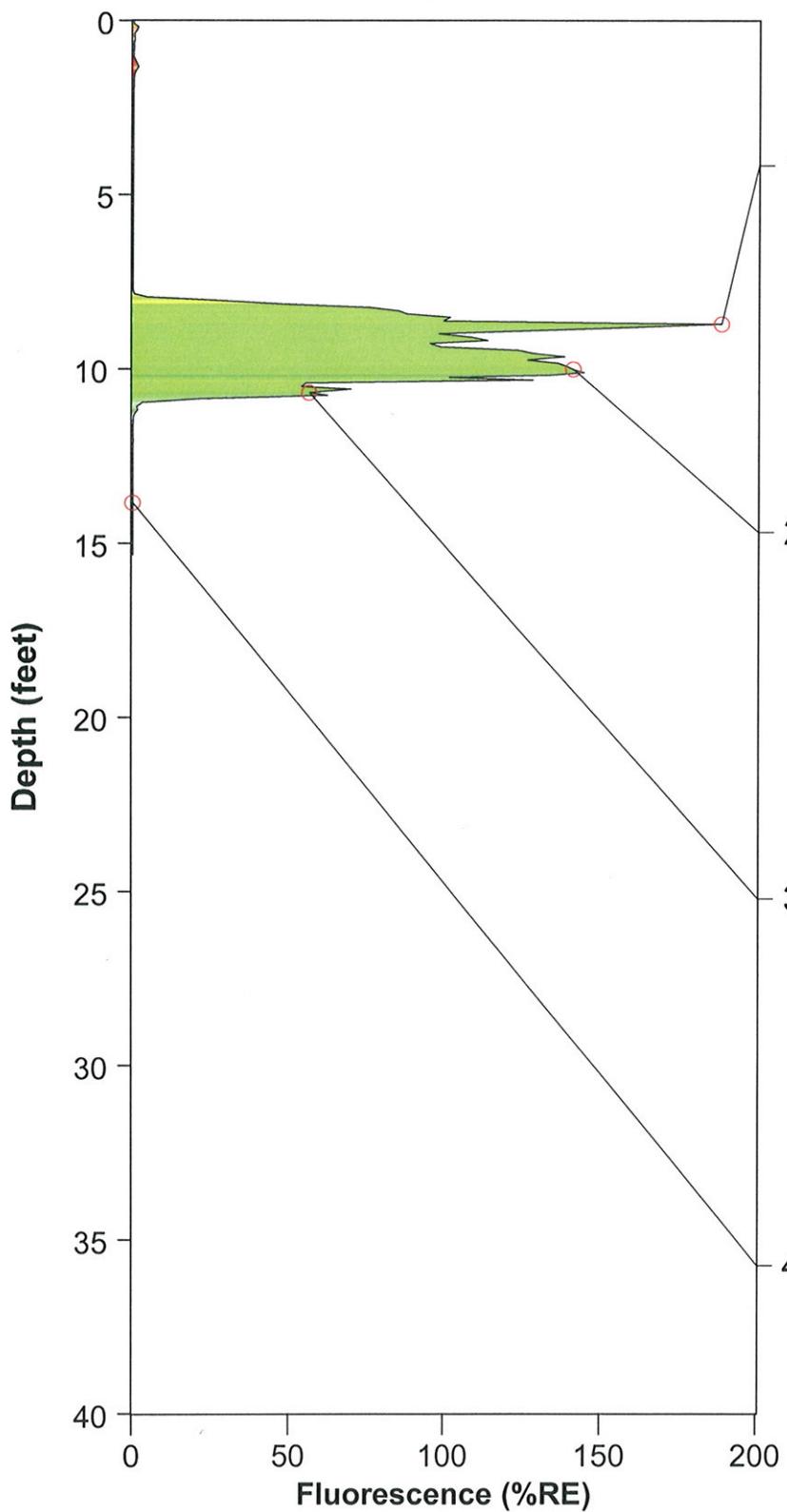
Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 188.11% @ 8.71 ft

Final depth BGS: 15.34 ft

**cpt23**



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/21/2004 @ 5:40:36 PM

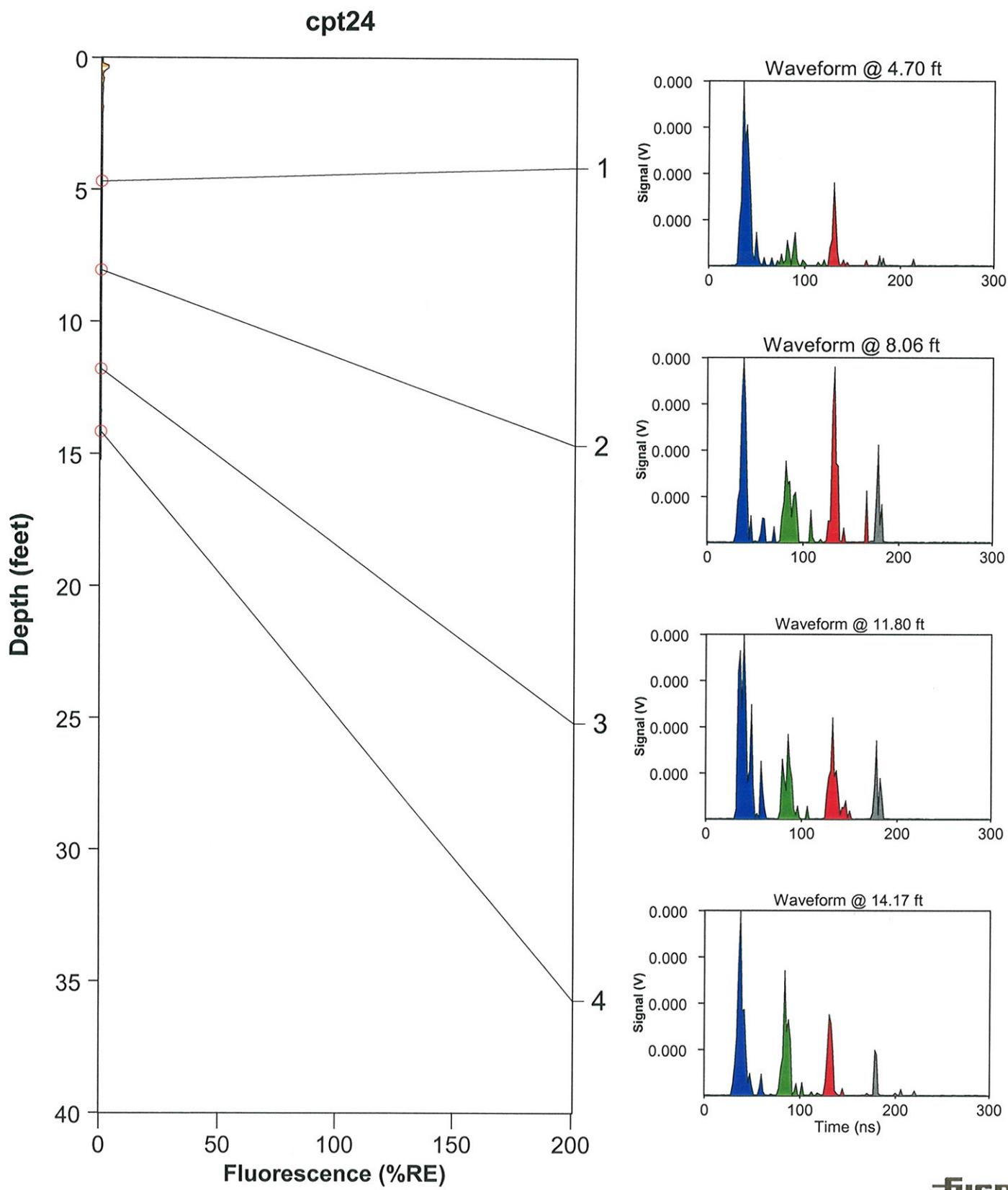
ROST Unit: 1

Operator: ddleon

Fugro Job #: 03-1090

Max fluorescence: 2.50% @ 0.30 ft

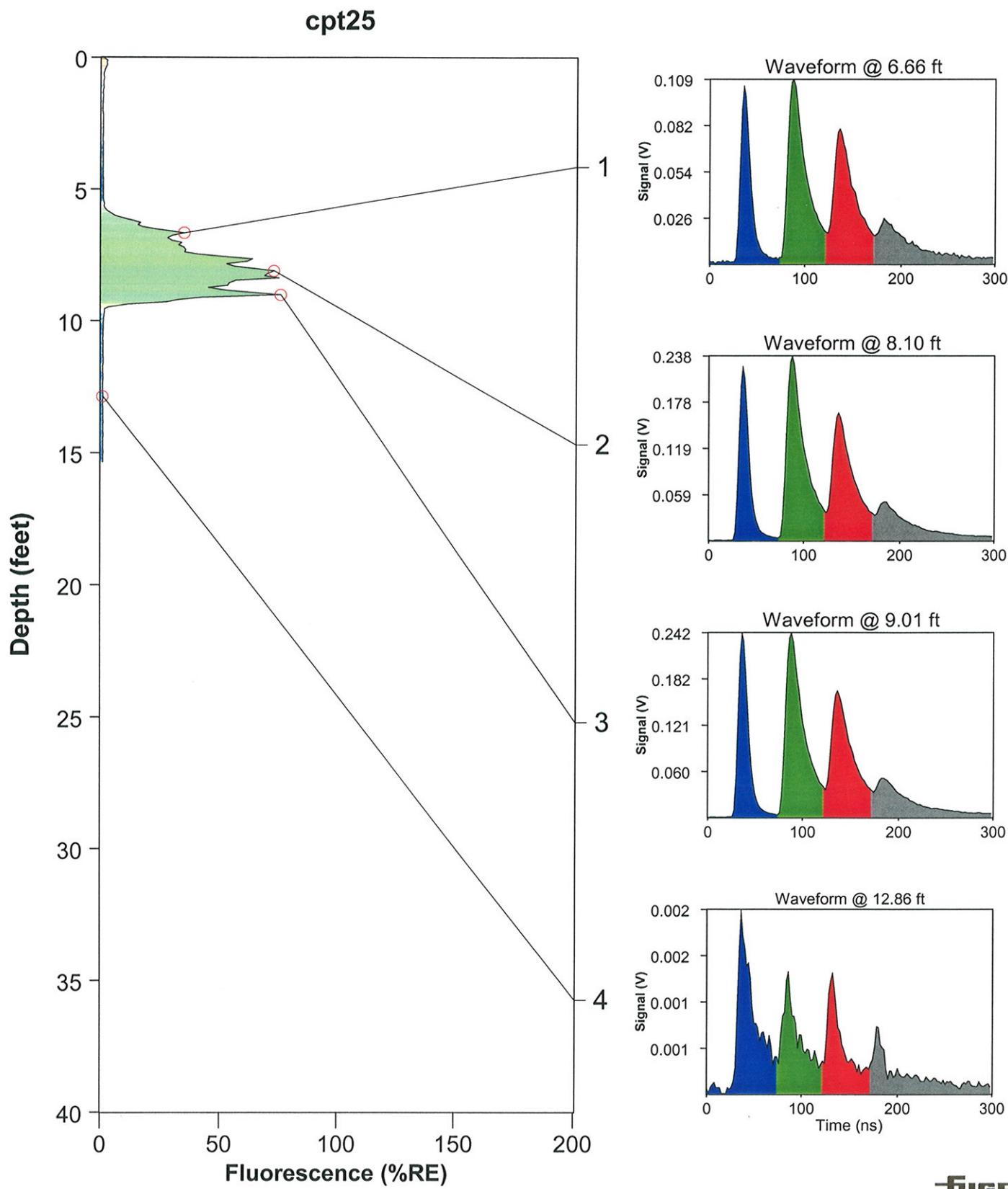
Final depth BGS: 15.25 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon  
 Client: envirologic  
 Date/Time: 9/22/2004 @ 8:38:07 AM  
 ROST Unit: 1

Operator: ddleon  
 Fugro Job #: 03-1090  
 Max fluorescence: 75.26% @ 9.01 ft  
 Final depth BGS: 15.35 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/22/2004 @ 9:00:12 AM

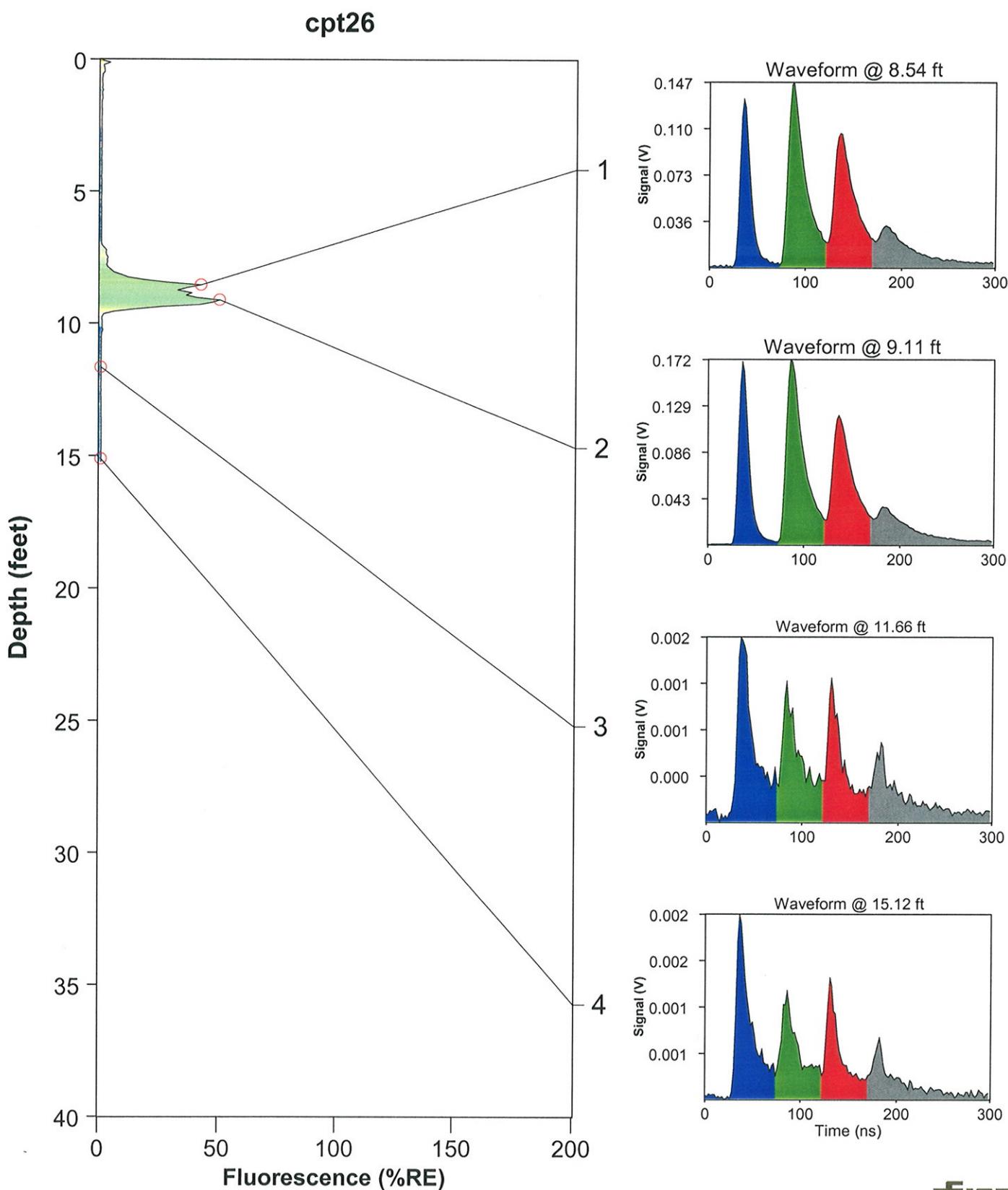
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 49.89% @ 9.11 ft

Final depth BGS: 15.24 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/22/2004 @ 11:06:10 AM

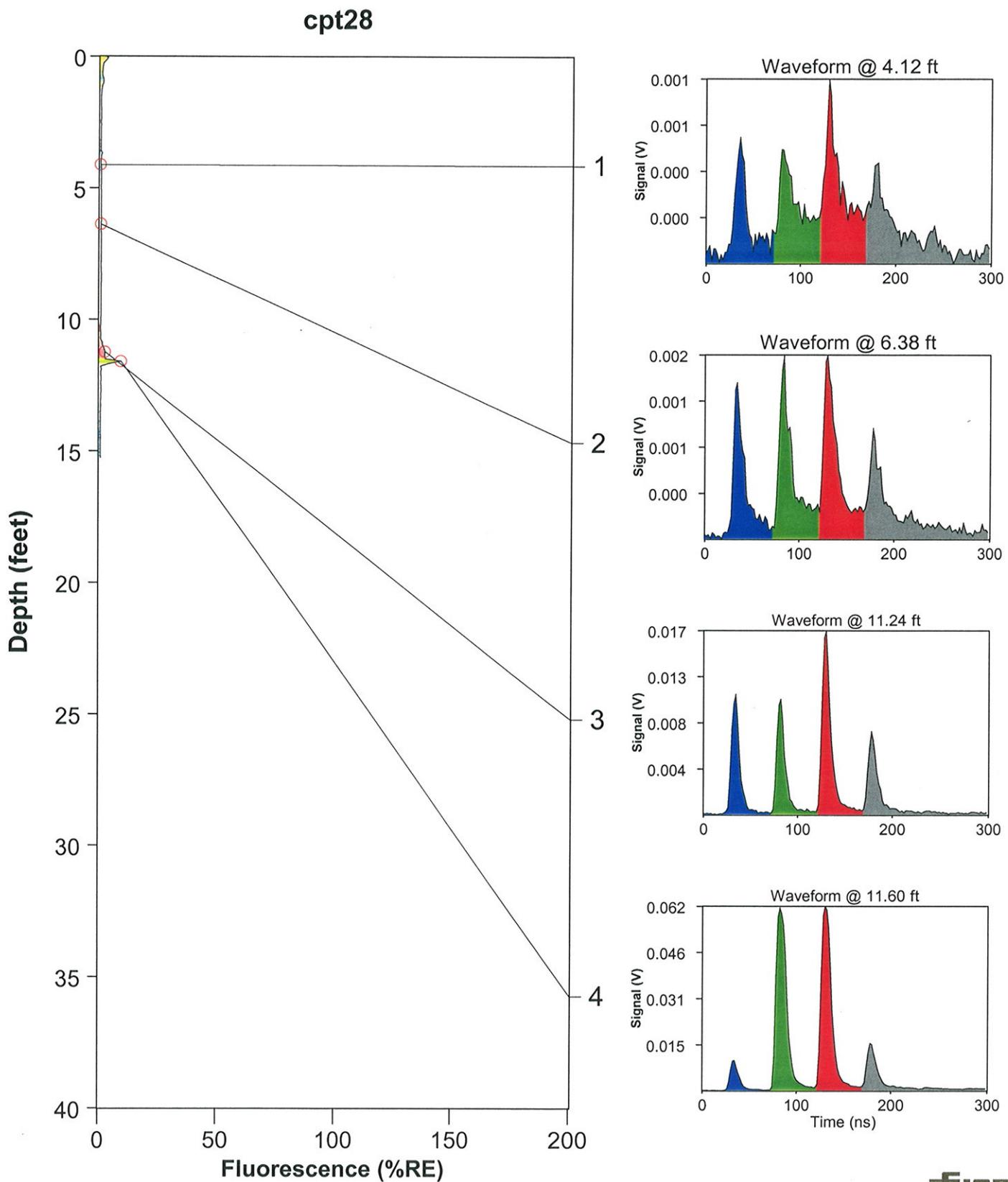
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 9.15% @ 11.60 ft

Final depth BGS: 15.26 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/22/2004 @ 12:58:55 PM

ROST Unit: 1

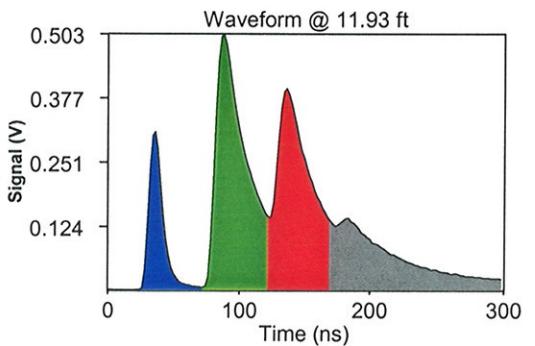
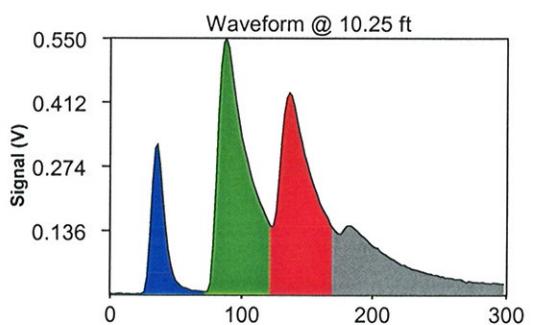
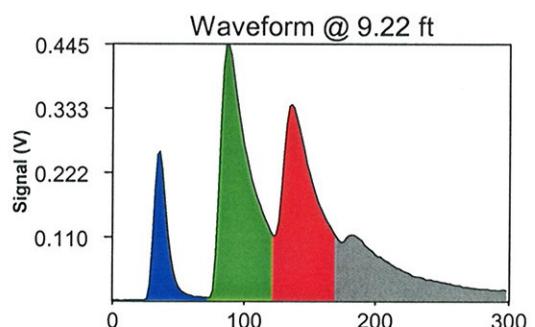
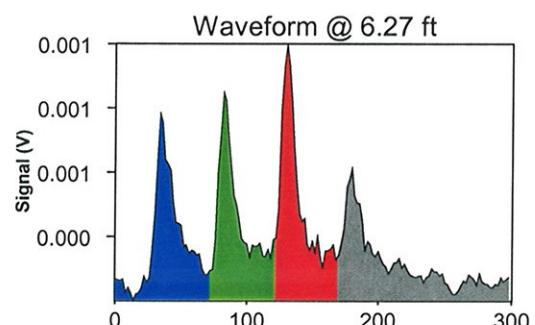
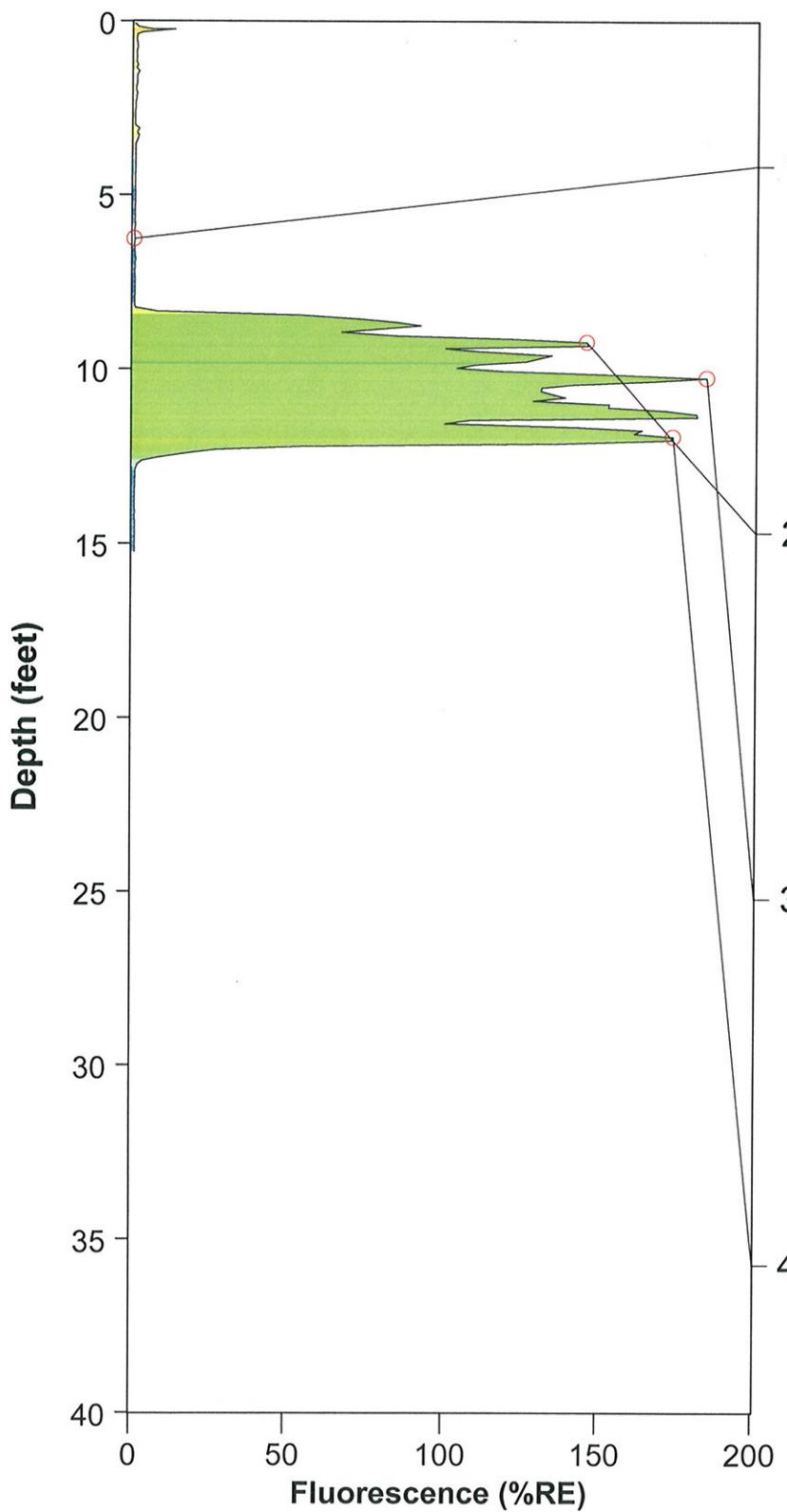
Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 184.24% @ 10.25 ft

Final depth BGS: 15.25 ft

**cpt30**



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/22/2004 @ 1:23:40 PM

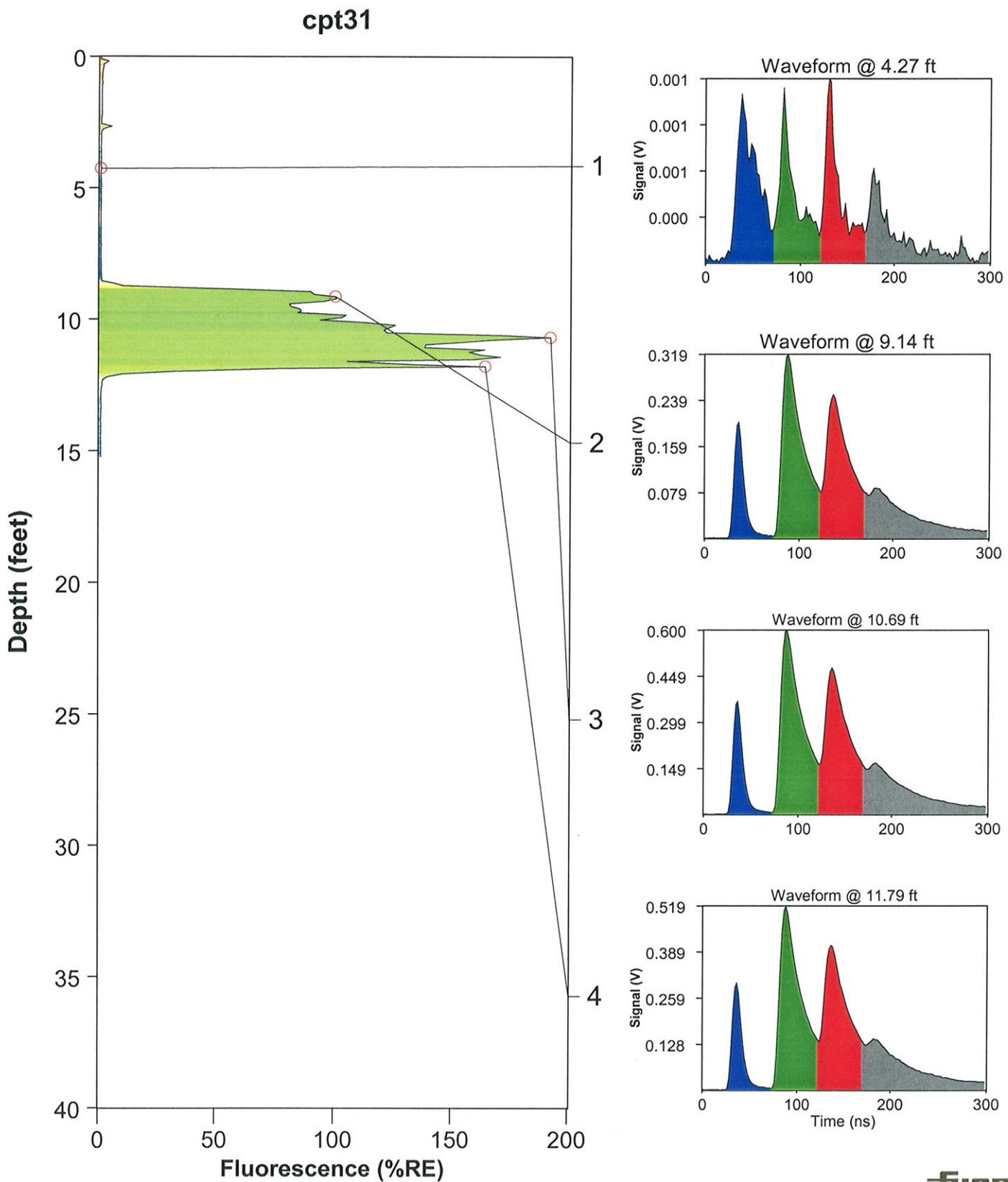
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 191.57% @ 10.69 ft

Final depth BGS: 15.24 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/22/2004 @ 2:07:02 PM

ROST Unit: 1

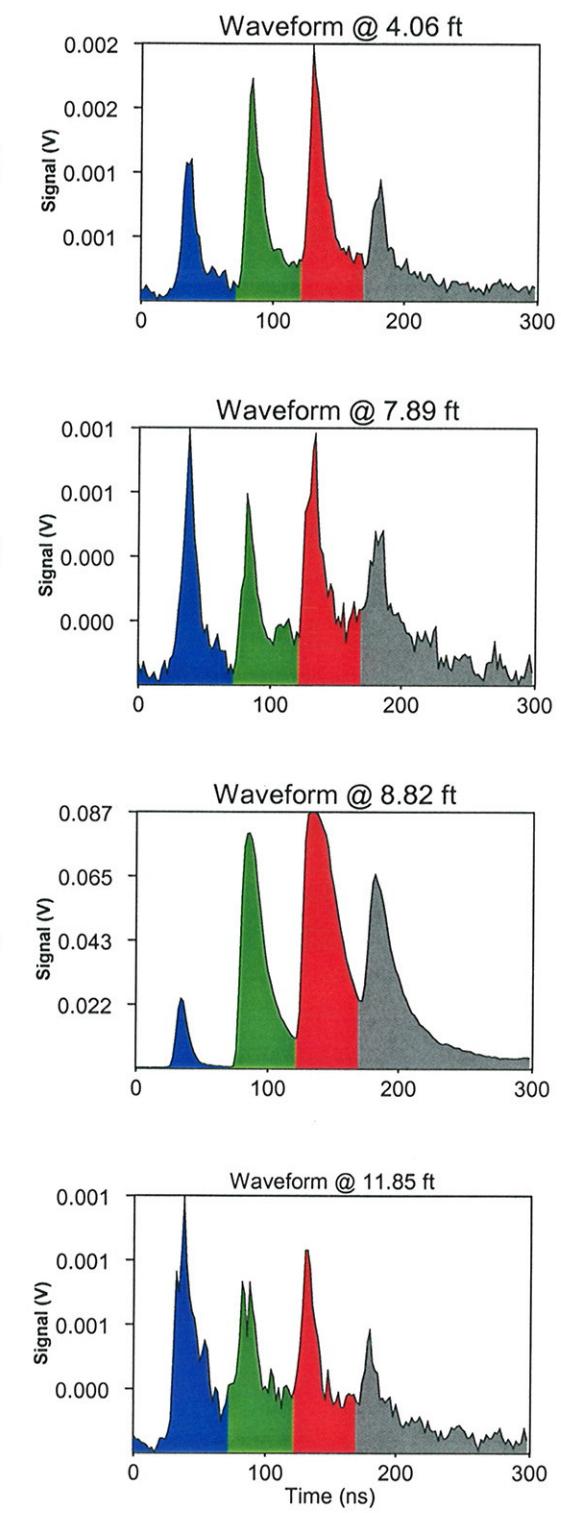
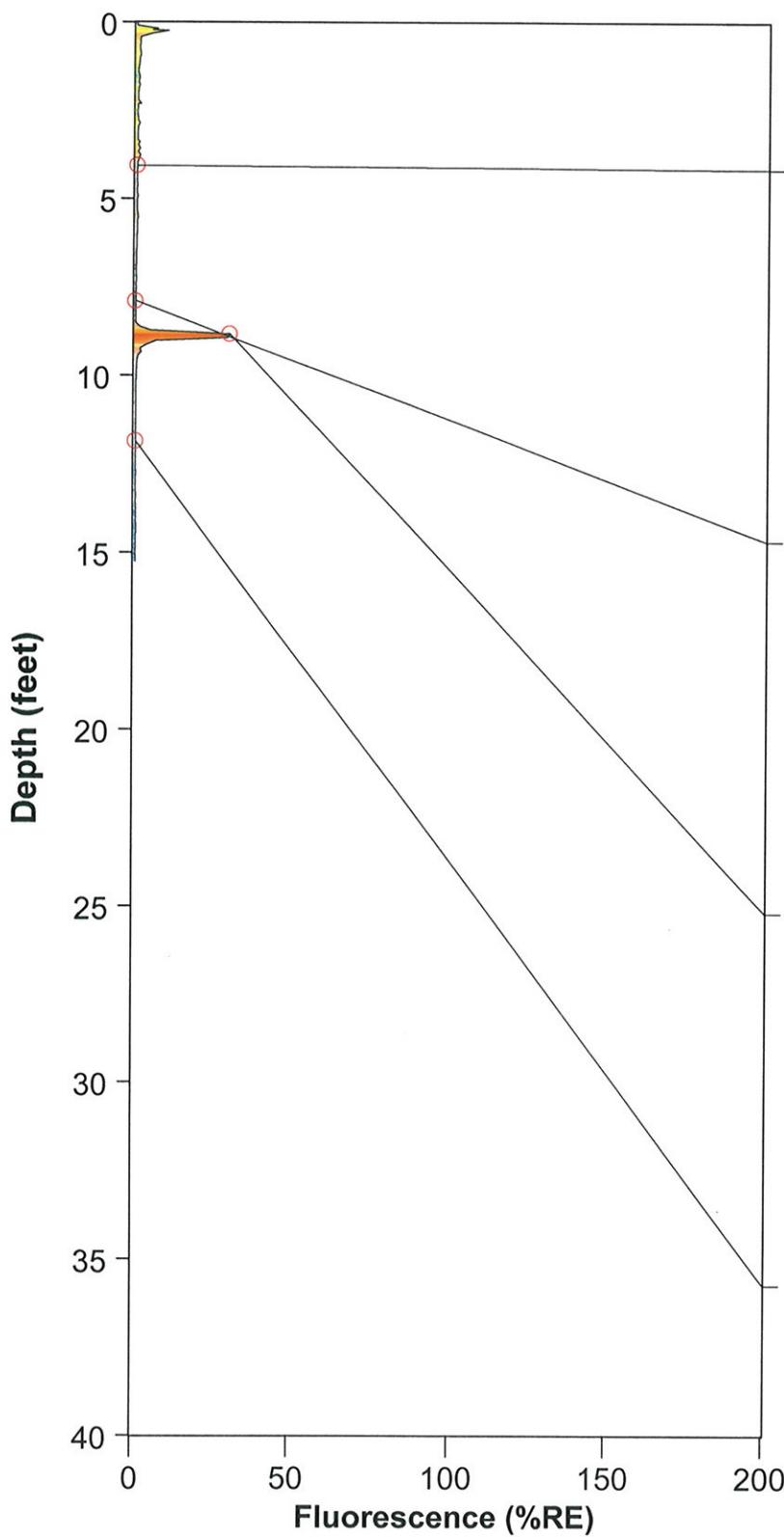
Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 30.23% @ 8.82 ft

Final depth BGS: 15.26 ft

**cpt33**



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/22/2004 @ 2:55:55 PM

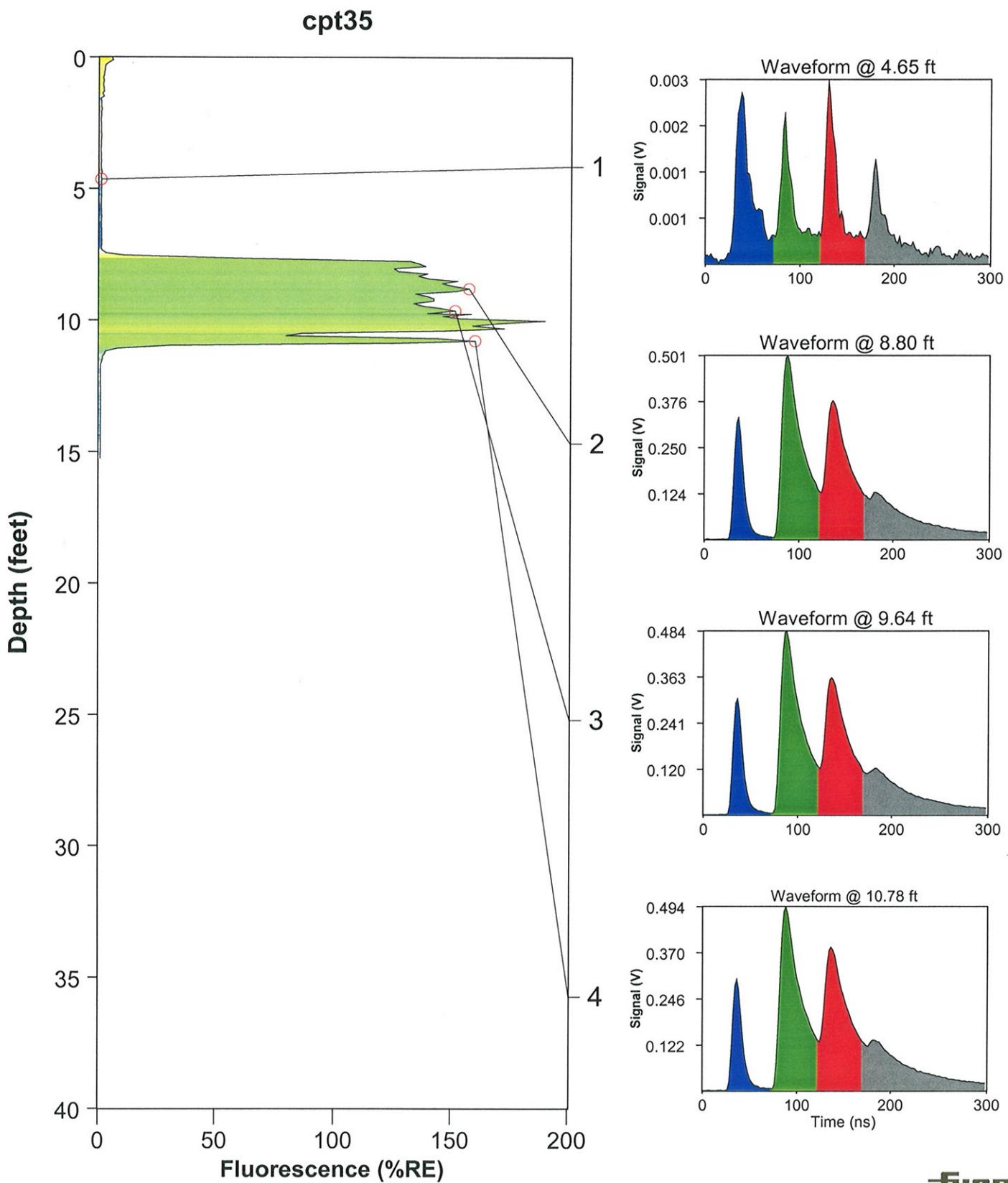
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 189.30% @ 10.02 ft

Final depth BGS: 15.26 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/22/2004 @ 3:15:40 PM

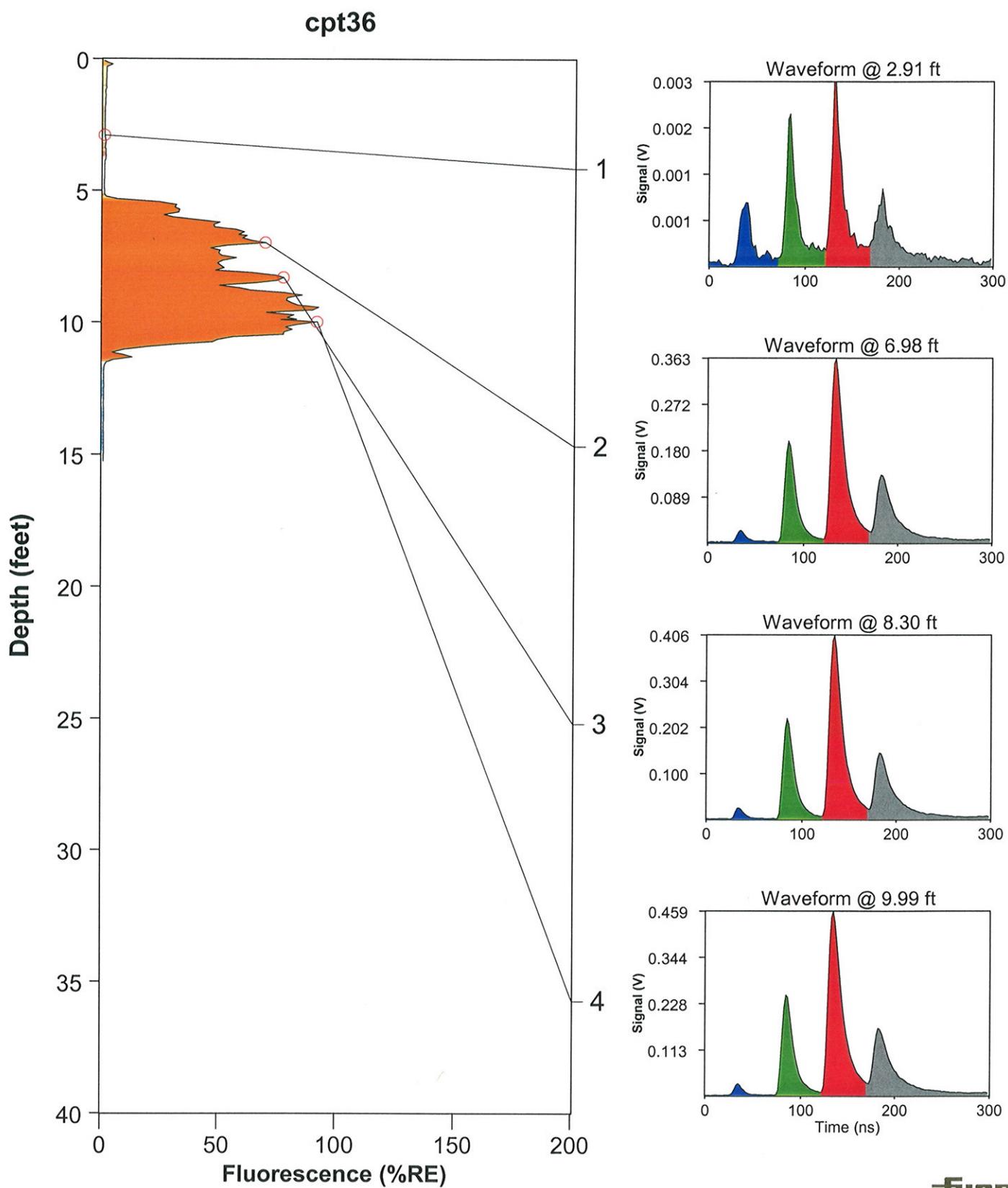
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 91.53% @ 9.43 ft

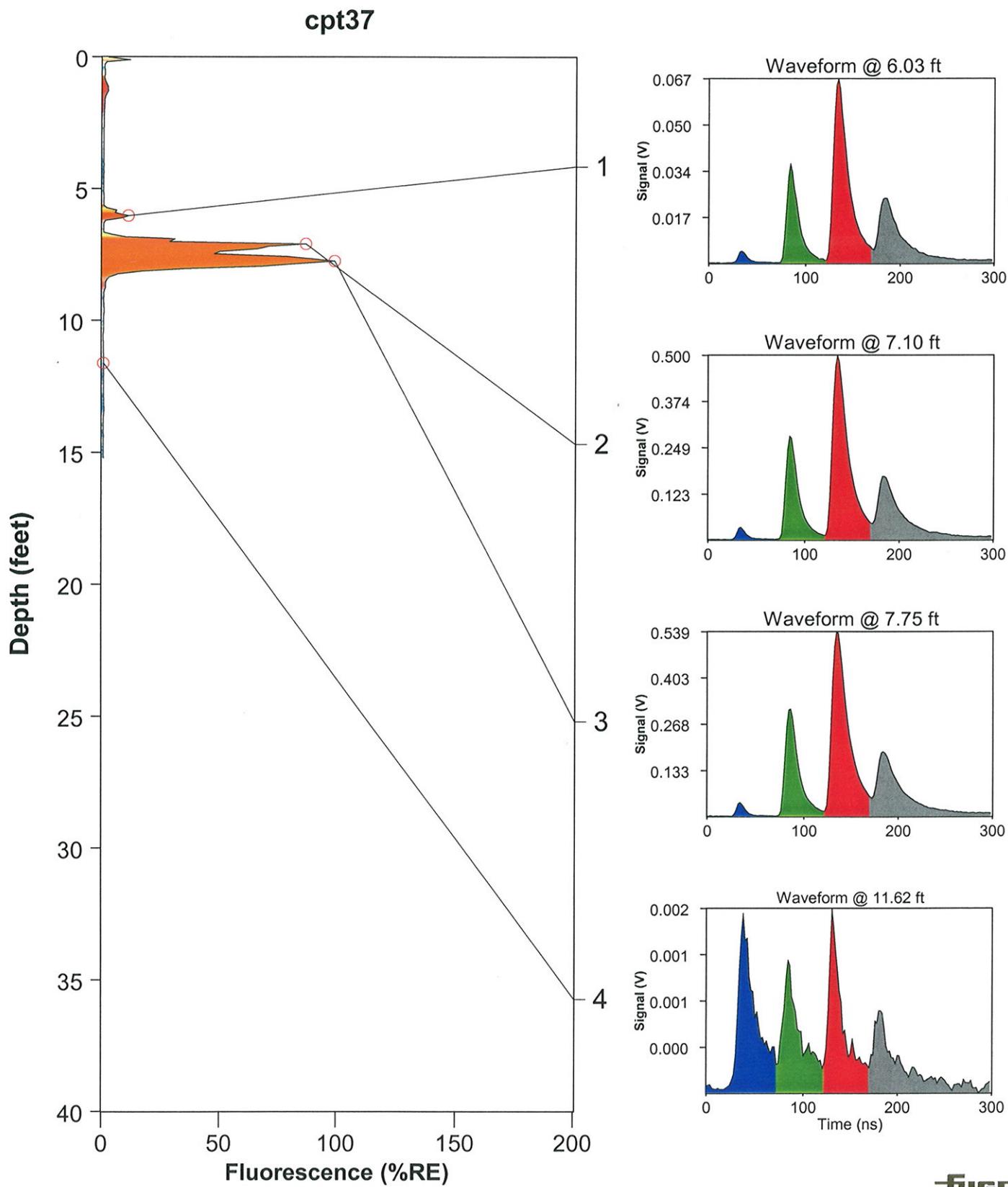
Final depth BGS: 15.27 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon  
 Client: envirologic  
 Date/Time: 9/22/2004 @ 3:32:07 PM  
 ROST Unit: 1

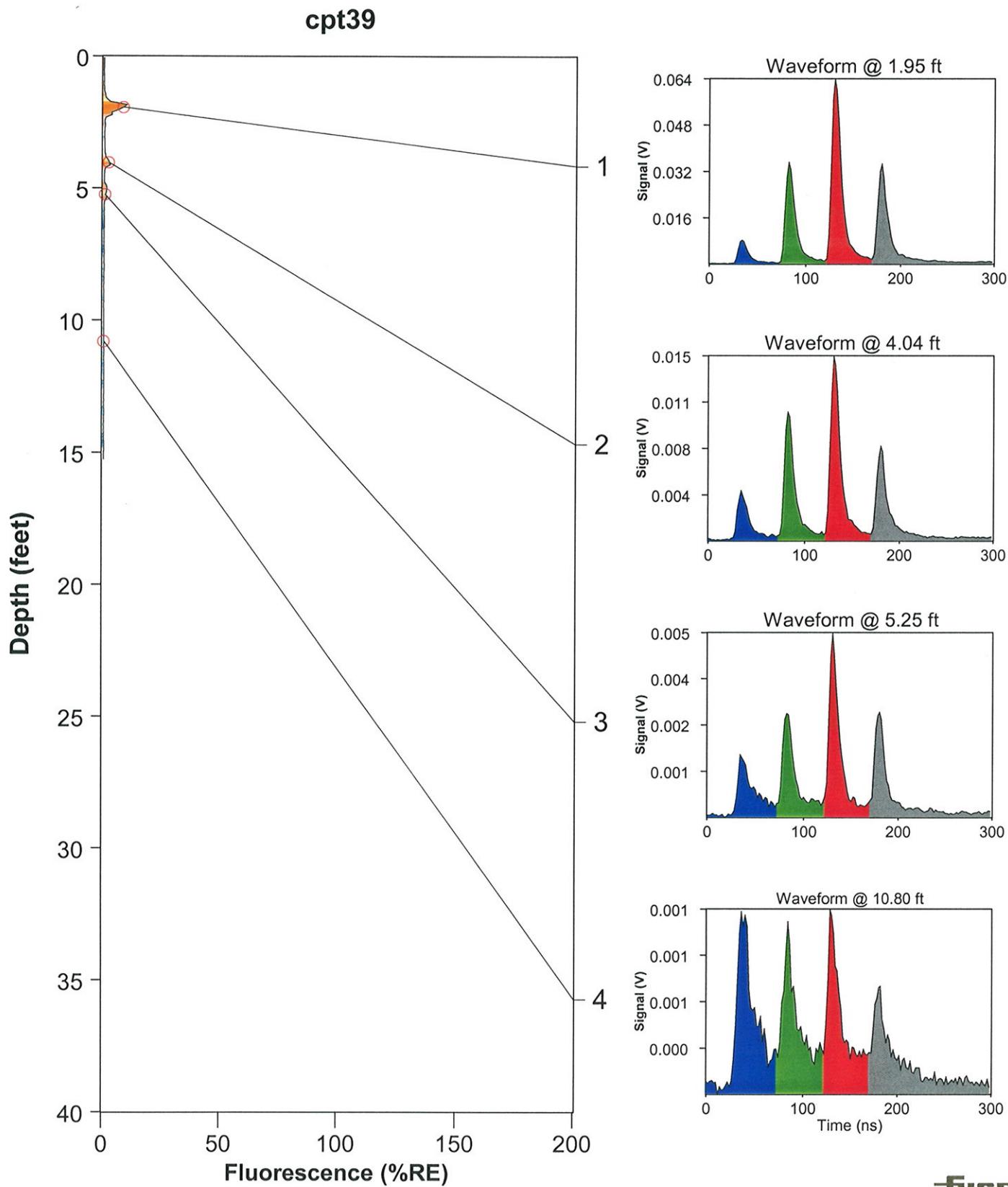
Operator: ddeleon  
 Fugro Job #: 03-1090  
 Max fluorescence: 98.33% @ 7.75 ft  
 Final depth BGS: 15.22 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon  
 Client: envirologic  
 Date/Time: 9/23/2004 @ 9:39:08 AM  
 ROST Unit: 1

Operator: ddeleon  
 Fugro Job #: 03-1090  
 Max fluorescence: 9.97% @ 1.85 ft  
 Final depth BGS: 15.26 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/22/2004 @ 4:22:33 PM

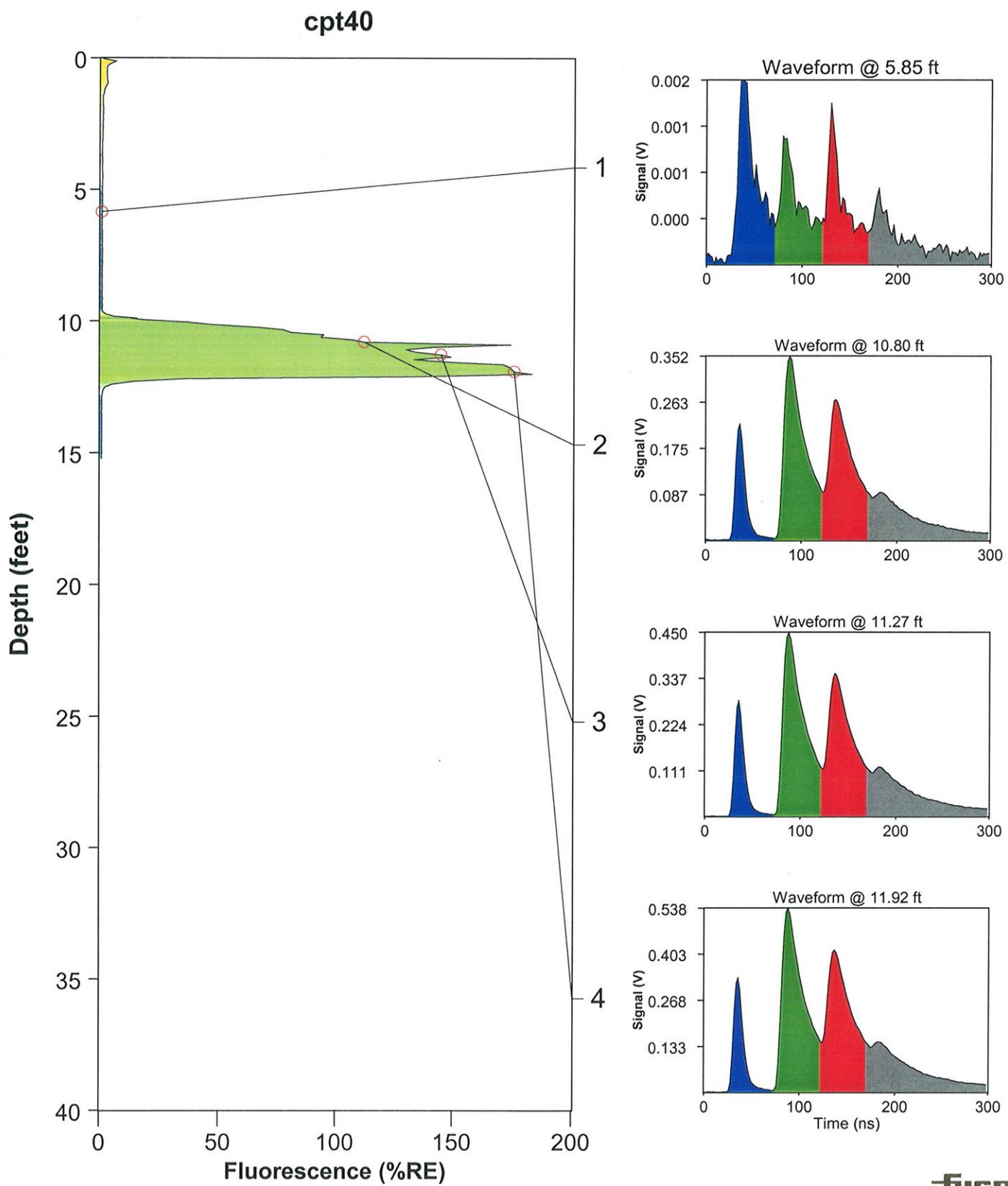
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 182.32% @ 12.01 ft

Final depth BGS: 15.23 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/22/2004 @ 4:41:05 PM

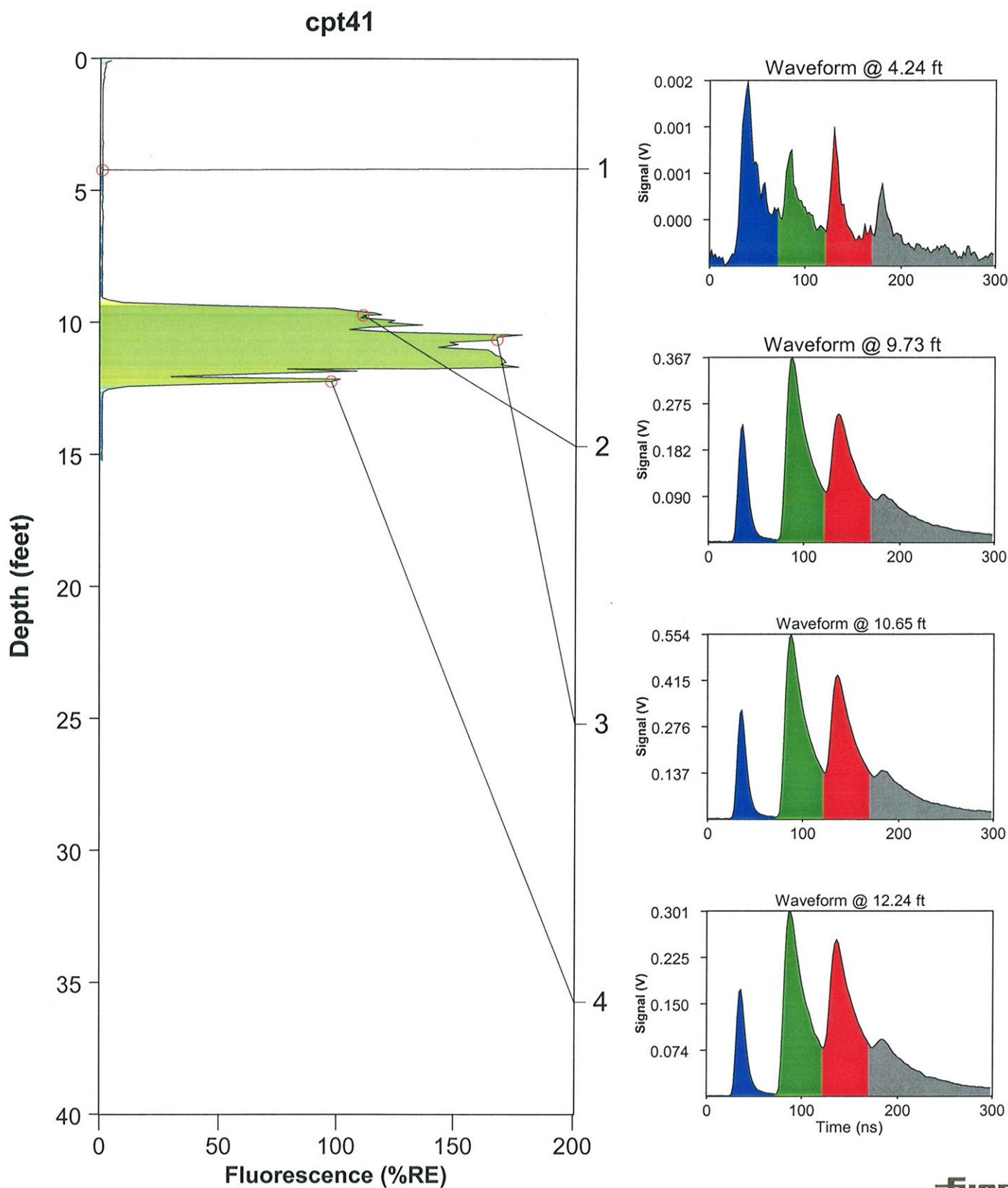
ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 177.48% @ 10.46 ft

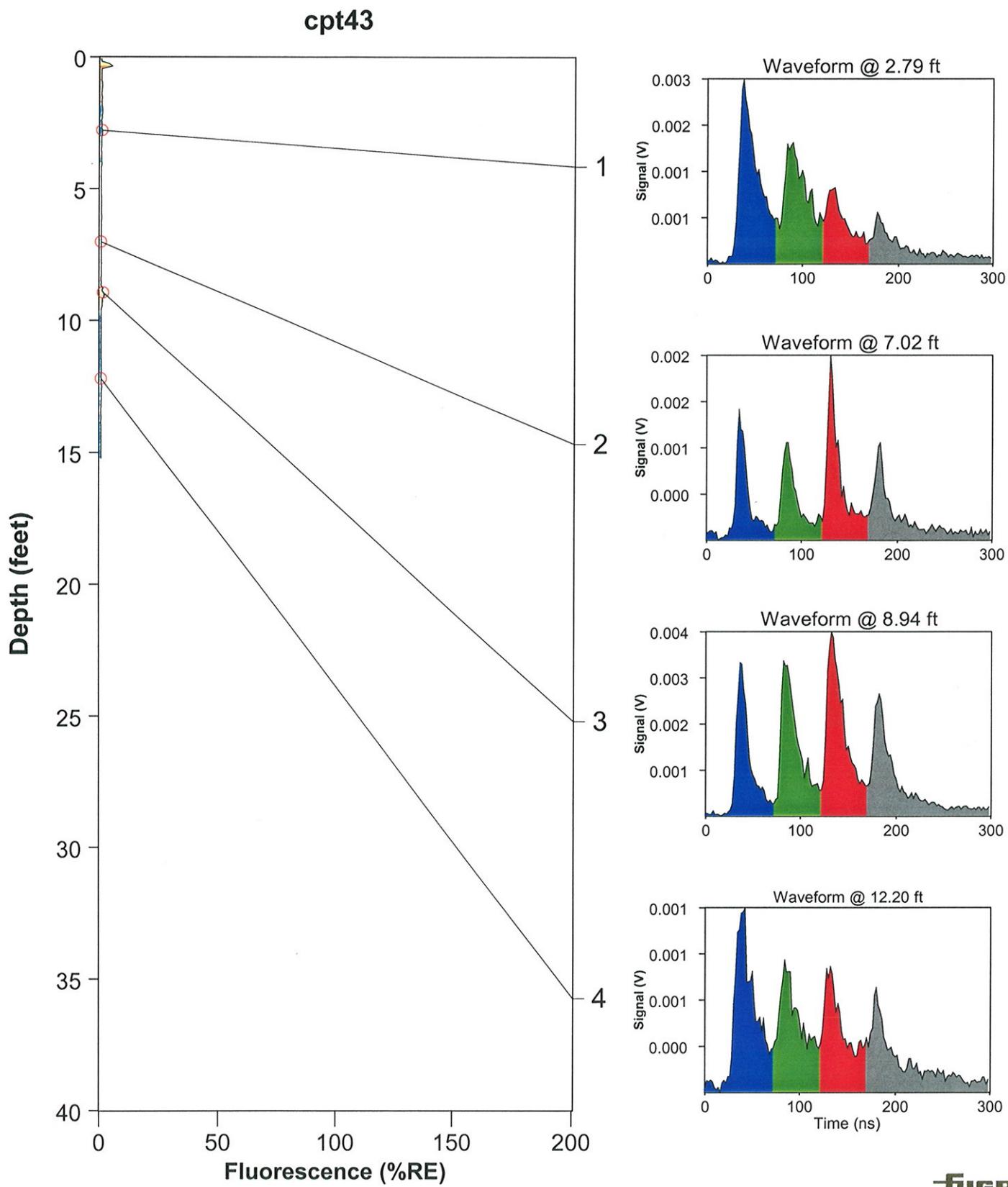
Final depth BGS: 15.24 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon  
 Client: envirologic  
 Date/Time: 9/23/2004 @ 8:09:35 AM  
 ROST Unit: 1

Operator: ddeleon  
 Fugro Job #: 03-1090  
 Max fluorescence: 5.02% @ 0.35 ft  
 Final depth BGS: 15.23 ft



# ROST Fluorescence Response Data

Site: port of astoria, oregon

Client: envirologic

Date/Time: 9/23/2004 @ 9:00:42 AM

ROST Unit: 1

Operator: ddeleon

Fugro Job #: 03-1090

Max fluorescence: 181.87% @ 10.12 ft

Final depth BGS: 13.89 ft

