INVESTIGATION REPORT

of

FREE-PHASE HYDROCARBON EXTENT and HYDROSTRATIGRAPHY

SEPTEMBER 2004

Former Amoco Terminal and Barge Dock Properties
(Former Amoco Terminal No. 406)
2904 Winter Street, Superior, Wisconsin 54880
Delta Project No. G006N

BRRTS Numbers:

Former Oil Water Separator Area	02-16-297979
Former Railroad Loading Rack Area	02-16-297993
Former Manifold Area	02-16-117873
Former AST Area	02-16-284811
Former Terminal Property	02-16-000331 54880-1460-04

Prepared for:

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February 2005

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1.0 INTRODUCTION

This report presents the results of the subsurface investigation conducted in September 2004 at the properties known as the Terminal Property and Barge Dock Property located at 2904 Winter Street in Superior, Wisconsin. Together, both properties comprised the former Amoco Terminal (Figure 1).

The two properties are separated by Winter Street, the Terminal Property to the south and the Barge Dock Property to the north. The Terminal Property formerly operated with above ground petroleum bulk tanks, an office building, truck loading racks, and a railroad loading rack. The Barge Dock Property formerly included underground and above ground pipe lines, a railroad loading rack and a truck loading rack. All Amoco petroleum operations ceased at both properties in 2000.

The former Terminal Property, as it formerly operated, is thrice parceled and owned by Vinje Warehouse LLC, Lake City Towing, and Boyer Trucking. The Barge Dock Property is currently owned by BP Products North America, Inc. (BP).

1.1 Objectives

The purpose of this additional investigation was to further delineate the extents of the free-phase hydrocarbon (FPH) plumes and to further assess site hydrostratigraphy for evidence of favorable areas for possible FPH recovery. Investigative soil probes were advanced using cone penetration testing (CPT) utilizing a laser-induced fluorescence (LIF) technology to accomplish the assessment. Information describing the LIF technology, methodology used, and subsurface equipment used during this investigation is included in Appendix A.

1.2 Scope of Work

Fugro Geosciences, Inc. advanced 26 CPT soil probes during this investigation. Twenty-one of the 26 probes were advanced at the Barge Dock Property including on the adjacent C. Reiss Coal Property and Hallett Dock Properties located to the west. Five probes were advanced on the former Amoco Terminal Property.

The CPT-LIF method was used to investigate the extent of FPH due to its ability to interpret complex soil stratigraphy and provide insitu real-time identification of FPH. Field results of the CPT-LIF investigation are presented in Fugro Geosciences report included as Appendix A.

The investigation targeted the FPH plumes present on the Barge Dock Property and adjacent west properties, and the smaller (west) plume on the Terminal Property (Figure 2). Objectives included the following:

<u>Barge Dock Property</u>:

- **Former Oil Water Separator Area** – Assess the northwest extent of the FPH plume.
- **Former Railroad Loading Rack Area** – Assess the west, northwest, and south extents of the FPH plume to provide a better understanding of plume size. Ascertain the presence or absence of higher permeable (silty sand) dome-like structures that may induce an increased accumulation of FPH.
- **Former Manifold Area** – Assess the horizontal and vertical extent of the plume. Locate possible undulations or dome-like structures where FPH may preferentially accumulate.
- **Former AST Area** – Evaluate the south extent of the FPH.
- **Clay-Sand Interface Modeling** – Evaluate the relationship between the FPH and clay-sand interface elevations for potential future remedial strategizing purposes.

<u>Former Terminal Property:</u>

- **West Plume Area** – Evaluate the magnitude and extent of the small (West) FPH plume.
- **Clay-Sand Interface Modeling** – Evaluate the relationship between the FPH and clay-sand interface elevations for potential future remedial strategizing purposes.

1.3 Previous Investigations

Investigation of the Barge Dock Property in 2001 and 2002 identified FPH in four separate areas on the Barge Dock property: former oil-water separator area, former railroad loading rack area, former manifold area, and former aboveground storage tank (AST) area. Figures 3 and 4 depict the estimated extent of the FHP in these four areas.

Additional investigation of the horizontal and vertical distribution of these FPH plumes was conducted in 2002 using the CPT - Ultraviolet Fluorescence (UVF) technology. The results of this investigation are presented in Delta's *Report on Ground Water Quality, Hydrostratigraphy and Free-Phase Hydrocarbon Delineation, October 2002.* Although the extent and magnitude of the four plumes were further characterized, some plume margins warranted further investigation.

The CPT-LIF investigation supplements the previous CPT-UVF investigation. In addition to the investigation of the Barge Dock property, the CPT-LIF investigation included assessing the vertical and lateral distribution of the FPH at the West Terminal Plume.

2.0 FINDINGS OF CPT-LIF INVESTIGATION

The wave form results of all elevated fluorescence encountered throughout the study area indicated patterns typical of gasoline and diesel hydrocarbons. Results of the CPT-LIF investigation are summarized below for each of the areas investigated.

The LIF technology provided a wave form of the measured fluorescence that was used to identify the encountered hydrocarbon product(s) in each probe sounding. Examples of the different wave form shapes and their representative petroleum constituent is presented in the Fugro Geosciences report included in Appendix A. A description of the CPT-LIF technology is provided below in Section 3.0 and more thoroughly in Appendix A.

2.1 Former Oil-Water Separator Area

Historically, FPH located in the former Oil-Water Separator area have been observed in monitoring wells MWOW-1 and MWOW-5 only. Measurable FPH thicknesses in both wells have been less than 0.5 feet since the wells were installed in 2003. The lateral extents of this plume have been characterized to the west-southwest, south, and east by borings/wells MWOW-2, MWOW-3, and OW-4, respectively (Figure 3).

One sounding probe, LIF-17, was advanced in the former Oil-Water Separator area for the purpose of delineating the downgradient lateral extent of FPH to the northwest (Figure 3). Probe LIF-17 was advanced to 13 feet ground surface (bgs). Soils encountered included silty clay from surface grade to approximately 7 feet bgs and silty sand from approximately 7 to 13 feet bgs. Water was encountered within six inches of the ground surface.

LIF analysis indicated no elevated fluorescence above a background level of four percent. Fluorescence percentages of four percent or less are considered background interference for the LIF and are not considered an indication of FPH.

The location of probe LIF-17 delineates the downgradient extent or the northwest leading edge of the FPH plume located at the former Oil-Water Separator area. The delineation of FPH in this direction indicates that the FPH observed in well MWOW-1 extends less than 70 feet to the northwest of well MWOW-1 and may be present on the adjoining C. Reiss Coal Property. The estimated lateral extent of the Oil Water Separator plume is shown on Figure 3.

Evidence indicating that the FPH measured in the two wells, MWOW-1 and MWOW-5, are either separate or connected as one plume, as suggested by Figure 3, is not conclusive. The FPH in these wells may represent separate historic releases that may still be separate or have combined.

2.2 Former Railroad Loading Rack Area

Historically, FPH in the former Railroad Loading Rack area have been observed in monitoring wells MWRR-4 and MWRR-8. Measurable FPH thicknesses have ranged intermittently from 0 to 2.45 feet thick in well MWRR-4 and 0.01 to 0.21 feet thick in well MWRR-8. Additional delineation was needed west and south of this area.

Therefore, three CPT-LIF probes (LIF-15, LIF-16, and LIF-20) were advanced to the west and south of the FPH plume located in the former Railroad Loading Rack area for purposes of further delineating the plume extent and to identify more permeable (silty-sand) dome-like structures. The soundings at probes LIF-15, LIF-16, and LIF-20 were advanced to depths of 25, 12, and 25 feet bgs, respectively (Figure 3).

The lateral extent of the plume had previously been characterized to the north and east by wells MWOW-3 and MWRR-2, respectively. Additional characterization of the west and northwest (downgradient) extents of this plume was supplemented by probes LIF-16 and LIF-15, respectively. No elevated fluorescence was observed in either the LIF-15 or LIF-16 probe soundings to be typical of the presence of FPH. Previously advanced borings TWRR-3 and TWRR-5, and well MWRR-1 further characterize the lateral extent to the west and southwest.

The southern extent of the FPH was not delineated by probe LIF-20 which displayed elevated fluorescence and a wave form typical of FPH from 16 to 19 feet bgs. The highest reading of 50 percent fluorescence was observed at 18 feet bgs. The depth of the observed fluorescence corresponds with the depth (16 to 20 feet) of the FPH measured in wells MWRR-4 and MWRR-8. The probable FPH observed in probe LIF-20 is delineated by previously advanced borings RR-6 and RR-7 which did not contain FPH. The RR-6 and RR-7 borings were located to the southeast (approximately 100 feet) and south (approximately 180 feet) from probe LIF-20, respectively.

The lack of FPH evidence at probes LIF-15 and LIF-16 suggests that the FPH present at the former Railroad Loading Rack area is likely limited in extent to the Barge Dock Property. Sounding results from probe LIF-20 and previously completed borings, RR-6 and RR-7, appears to indicate that the FPH extends less than 100 feet south from well MWRR-4. The estimated extent of the FPH plume at the former Railroad Loading Rack area is shown on Figure 3.

The soil encountered in the three LIF probes and previously advance borings had little to no overlying clay suggesting that the silty-sand dome structure is present at this location. The top of the silty sand typically observed at 15 feet bgs, rises to near the surface as a dome-like structure. The soil encountered in probes LIF-15 and LIF-16 primarily consisted of silty sand with little to no silty clay near the surface. The lack of clay at or near the ground surface is typical of this location which is characterized by lower elevation areas to the north. The overlying clay layer appears to thicken slightly to the south of MWRR-4. Soil encountered in probe LIF-20 consisted of silty clay from ground surface to three feet bgs and underlain by silty sand to the depth of the probe. The presence of silty sand with little overlying clay suggests that the silty-sand dome-like structure is present at this location.

Evidence indicating that the FPH measured in the two wells, MWRR-4 and MWRR-8, are either separate or connected as one contiguous plume, as suggested by Figure 3, is not conclusive. The FPH in these wells may represent separate historic releases that may still be separate or have combined over time.

2.3 Former Manifold Area

FPH identified at the former Manifold area appear to extend laterally westward onto the adjacent C. Reiss Coal property and also slightly onto the Hallett Dock property (Figure 4). Historically, FPH have been observed in wells LRMW-1 through LRMW-5, MWM-3, and MWM-6. The lateral extent of FPH is characterized as follows:

- to the north by wells MWM-2 and MWM-7,
- to the south by well MWM-4,
- to the east by wells ABCMW-6 and LRMW-6, and
- to the west by well MWM-9.

Previous investigations indicate that the migration pathway and thickness of the FPH are influenced by the clay-sand interface. The FPH are located directly beneath the clay sand interface and also below the groundwater potentiometric surface as observed in the monitoring wells located within the plume. The depth to FPH ranging 18 to 22 feet bgs in the formation may rise several feet above the interface elevation once pressure (head) is reduced such as in a monitoring well.

Sixteen probes (LIF-1 through LIF-14, LIF-18, and LIF-19) were advanced in the suspected plume area and in its vicinity to further verify the presence of FPH and further characterize the lateral extent of the Manifold plume. Fourteen of the soundings were advanced on the C. Reiss Coal Property, one on the adjacent Hallett Dock property, and one on the Barge Dock property. The probes ranged in depth between 20 and 30 feet.

Probe soundings performed in and surrounding the Manifold plume further characterized and delineated the Manifold plume and provided the following observations:

- Soil encountered in the probes was prominently clay overlying silty sand. The overlying clay layer ranged from 15 to 22 feet thick in the vicinity of the Manifold plume.

- The overlying clay layer dips to the northwest and as a result may divert the potential migration of the FPH from an expected northward direction to a more westerly and possibly southwesterly direction. The FPH plume preferentially occupies the higher elevations of the silty sand. Surfer modeling results of the clay-sand interface elevations and the FPH elevations support the field observation of the sloping clay and also indicate little to no undulations or dome-like structures in the vicinity of the Manifold plume.

- The lateral extent of the plume was further delineated to the north and south by probes LIF-6, LIF-9, LIF-10, LIF-18, and LIF-19 which did not show fluorescence indicative of the presence of FPH.

- The FPH thickness along the center line of the plume generally became thinner moving east to west from the Barge Dock Property. Sounding data collected from probe LIF-3, located approximately 120 feet west of the Barge Dock property, showed a FPH thickness of approximately 2.5 feet; whereas, sounding data collected from probe LIF-13 located near the west fringe of the plume, showed the thinnest FPH of approximately 0.5 feet.

- The west extent of the FPH plume is likely within approximately 130 feet west of probe LIF 13 and does not extend beyond the location of well MWM-9 (Figure 4).

- The FPH in the Manifold plume exhibited a layered complexity in probe soundings LIF-1, LIF-7, and LIF-8. The FPH was found to exist at different layers in the stratigraphy rather than one contiguous plume. Elevated fluorescence was observed in probe sounding LIF-1 at approximate depths ranging from 7 to 8 feet, 17.5 to 18 feet, and 20 to 21 feet. This finding may be due local preferential pathways due to differing soil types (lenses) within the silty sand unit, multiple releases, and/or the commingling of separate and local FPH.

- Probes LIF-7 and LIF-8 were located midway along the length of the Manifold plume. FPH in probe sounding LIF-7 were observed at approximate depths of 19 to 20 feet and 21 to 22 feet. FPH in sounding probe LIF-8 were observed at approximate depths of 18.5 to 19 feet and 24 to 25 feet which was the deepest FPH observed in the Manifold plume. The separation of FPH layers in probe LIF-7 appear to be influenced by a silt lens at approximately 21 feet bgs and in boring LIF-8 by a clay seam from approximately 19 to 22 feet bgs.

Based on these findings, remedial efforts at the east portion of the Manifold plume would likely yield a higher percentage of the total FPH plume due to its apparent greater availability or greater thickness. The FPH under head throughout the plume is also anticipated to aid in remedial efforts. The FPH preferentially accumulates in the monitoring wells and recovery wells. Recovery well MRW-3 at the east end of the plume has shown FPH recovery rates of three to seven gallons per day through skimming technology without the use of vacuum enhancement or water table drawn down.

2.4 Former AST Area

FPH present in the former AST area are located adjacent to the south of the Manifold plume (Figure 4). FPH have been measured in wells MWAST-2, MWAST-4, MWAST-6, and MWAST-8 and ranging from up to 7.2 feet thick since the wells were installed in 2003. The goal this phase of the investigation was to delineate the extent of FPH to the south (Figure 4).

To accomplish this goal, one CPT-LIF probe, LIF-21, was installed approximately 80 feet south of well MWAST-8 which historically contained measurable FPH. Soil encountered in probe LIF-21 consisted of clay from ground surface to approximately 21 feet bgs and then silty sand to the probe terminus.

Elevated fluorescence was observed immediately under the clay at a depth of 21 to 21.5 feet which indicated the presence of FPH at this interval. The highest fluorescence reading of 50 percent was observed at 21.3 feet bgs.

The location of probe LIF-21 did not delineate the south extent of the AST plume on the Barge Dock Property. The limited extent of elevated fluorescence to 50 percent and limited vertical extent of six inches suggests that the FPH are thinning in the southerly direction. The plume does not appear to extent off-site to the south onto the adjacent BNSF property based on the relatively thinner FPH thickness measured in probe LIF-21 and the upgradient distance to the south adjacent property estimated at 200 feet from LIF-21 (Figure 4).

2.5 West Terminal Plume Area (Terminal Property)

FPH have been present in the northwest-west portion of the former terminal property since at least 1990 as evident by the measurable FPH in monitoring well MW-12 that have ranged from 0.08 to 4.78 feet thick. Five probe soundings, LIF-22 through LIF-26, were advanced in the vicinity of the plume for the purpose of further delineating the lateral extent of the plume.

Probes LIF-22, LIF-23, LIF-24, and LIF-25 were located within 140 feet of well MW-12 to the north, west, south, and east, respectively (Figure 5). Probe LIF-23 was the only location that exhibited a sounding with elevated fluorescence indicating the presence of FPH. Sounding LIF-26 was therefore advanced approximately 90 feet westward (approximately 200 feet west from well MW-12) to further assess the extent of the west fringe of the plume. No elevated fluorescence was observed in the sounding of probe LIF-26 which indicated that the west extent was delineated to within 90 feet of probe LIF-23 (Figure 5).

Sounding LIF-23 showed elevated fluorescence and wave forms indicative of FPH from 14 to 16 feet bgs. The highest fluorescence was measured at 50 percent fluorescence. FPH were observed directly beneath the clay layer which extended to approximately 14 feet bgs.

The overlying clay layer ranged from approximately 11 feet thick in probe LIF-25 to approximately 14.5 feet thick in probes LIF-24 and LIF-26.

The elevation of the clay-sand interface was modeled using Surfer® modeling software to evaluate where FPH would most likely accumulate and whether FPH were accumulating in areas where the sand elevation was the highest (Figure 6). The lowest sand-clay interface of 616.8 feet was observed at probes LIF-23 and LIF-26. The highest sand-clay interface elevation of 620.8 feet was observed at probe LIF-25. The clay-sand interface dips to the west-southwest in this area. The modeling and field data indicated that FPH was not readily accumulating in areas having higher clay-sand interface elevations.

2.6 Clay-Sand Interface Modeling

Surfer® modeling software was used to map the interface of the clay-sand interface. The clay-sand interface was integrated with the locations of the FPH plumes to create Figures 6 and 7. The data presented on Figure 7 confirms that the location of FPH is influenced by the clay-sand interface. This influence can most easily be seen in plumes that have migrated from their suspected source areas, including the east Terminal Plume and Manifold plume.

The East Terminal plume appears to have migrated downgradient to the north and has primarily resided in locations with the highest clay-sand interface elevations. The plume appears not to have migrated to the east or west where the clay-sand interface dips to lower elevations.

The Manifold plume appears to have migrated to the west-southwest and has resided in the locations with higher clay-sand elevations. The FPH have not migrated with the hydraulic gradient to the north-northwest due to the dipping clay-sand interface in this direction.

The Manifold plume was also modeled using a combination of the sounding data from the CPT-UVF and CPT-LIF investigations to create a map of the clay-sand interface (Figure 6). This map was used to investigate the likely presence of undulations or dome-like structures at the clay-sand interface that may create a preferential location for FPH to accumulate. The clay-sand interface elevation map shows smooth and relatively straight contour lines through the Manifold plume area with little to no evidence of undulations or doming-like structures at the clay-sand interface (Figure 6). This data generally indicates a relatively flexible scenario for locating future remedial activities.

3.0 CPT-LIF METHOD

The CPT-LIF provides a wave form of the measured fluorescence that can used to identify encountered hydrocarbon products. Examples of the different wave form shapes and their representative petroleum constituent are presented in the Fugro Geosciences report included as Appendix A.

The CPT method advances a 1.7-inch diameter probe directly into the ground. Electronic sensors mounted inside the probe, called a penetrometer, provide a continuous record of the response of the soil to penetration (cone-end and skin friction resistance). The ratio of skin friction to cone-end bearing resistance is indicative of the "fines" content of the soil. In addition to a continuous record of skin friction resistance, pore-water pressure response is measured continuously to allow rapid evaluation of soil saturation.

LIF was performed simultaneously with the CPT soundings using a Rapid Optical Screening Tool (ROST™). The ROST™ 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 the down-hole sensor. 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 was set at 290 nanometers (nm) during this project.

The laser light is absorbed by aromatic hydrocarbon molecules in contact with the laser window on the side of the probe. The aromatic hydrocarbons fluoresce when exposed to the laser. The florescence is measured every 2 centimeter (cm) interval. The wave form of the fluorescence is also measured as the wave form shape is unique to different petroleum hydrocarbons. A description of the CPT-LIF technique is included in Appendix A.

The 0 to 5 foot interval of each sounding was vacuum excavated by Hance Utility Services of Buffalo, Minnesota. This method was used as an added precaution to avoid hitting any underground utilities not marked by the private or public utility locators. The vacuum excavating was done using a "Jet-Vac" trailer mounted vacuum unit combined with a pressurized water sprayer. No utilities underground utilities were encountered using this excavation technique. The excavated upper five feet was filled with sand prior to advancing the CPT probe for added rod stability.

4.0 CONCLUSIONS

The objectives of the investigation were to further assess the extent of the FPH plumes present at the Barge Dock and former Terminal Property and to locate undulations or dome-like structures at the clay-sand interface where FPH may preferentially accumulate; thereby, providing evidence of favorable areas for possible future FPH recovery.

Four plume areas were assessed at the Barge Dock Property and referred as the former Oil-Water Separator area, the former Railroad Loading Rack area, the former Manifold area, and the former AST area. One area, referred to as the West Terminal plume area, was assessed at the former Terminal property

4.1 Plume Delineation

The extent of the FPH plumes were all further delineated with the exception of the south extent of the plume at the former AST area. Estimated lateral extents of the FPH plumes are shown on Figures 3 through 7 and summarized below.

Oil-Water Separator Plume
The majority of the plume is limited to the Barge Dock Property. Probe soundings did not indicate FPH off-site to the west. However, the historic detection of FPH in well MWOW-1 located at the west property boundary suggests that some FPH may have migrated off-site to the west and if so, less than 70 feet to the northwest of well MWOW-1 (Figure 3).

Evidence indicating that the FPH measured in the two wells, MWOW-1 and MWOW-5, are either separate or connected as one plume, as suggested by Figure 3, is not conclusive. The FPH in these wells may represent separate historic releases that may still be separate or have combined.

Railroad Loading Rack Plume
Probe soundings advanced off-site to the west of the plume and Barge Dock Property did not show evidence of FPH which suggests that the Railroad Loading Rack plume is restricted to the Barge Dock Property (Figure 3).

Evidence indicating that the FPH measured in the two wells, MWRR-4 and MWRR-8, are either separate or connected as one contiguous plume, as suggested by Figure 3, is not conclusive. The FPH in these wells may represent separate historic releases that may still be separate or have combined over time.

Manifold Plume
Probe soundings performed at the Manifold plume further defined the horizontal extent of the plume to the north, south, and west which indicates a slightly narrower plume than previous estimated. The plume is present on the Barge Dock Property and two off-site properties to the west that include the C. Reiss Coal and Hallet Dock properties (Figure 4).

The FPH thickness along the center line of the plume generally became thinner moving east to west from the Barge Dock Property. The clay-sand interface was observed to dip to the northwest indicating that the clay is likely inhibiting the Manifold plume from migrating to the north-northwest.

AST Plume
One probe sounding was performed in the former AST area to delineate the south extent. The sounding did indicate a relative thinning of FPH compared to measured FPH in other AST plume wells.

West Terminal Plume
The five probes advanced at the West Terminal plume area delineated the plume to an area within approximately 100 feet radius of well MW-12 which was the former location of former bulk storage tank No.37 (Figure 5). Soundings in the vicinity of the West Terminal Plume identified a southwesterly dipping clay layer.

4.2 Preferential FPH Accumulation Areas

The investigation indicated one area exhibiting a silty-sand dome-like structure located at the south end of the Railroad Loading Rack plume (Figure 7). Additional dome-like structures and significant undulations in the sand-clay interface that would provide a preferred area for FPH to accumulate were not observed in the areas investigated.

5.0 REMARKS

The recommendations contained in this report represent Delta's professional opinions based upon the currently available information and are arrived at in accordance with currently acceptable professional standards. This report is based upon a specific scope of work requested by the client. The Contract between Delta and its client outlines the scope of work, and only those tasks specifically authorized by that contract or outlined in this report were performed. This report is intended only for the use of Delta's Client and anyone else specifically listed on this report. Delta will not and cannot be liable for unauthorized reliance by any other third party. Other than as contained in this paragraph, Delta makes no express or implied warranty as to the contents of this report.

This report was prepared by **DELTA ENVIRONMENTAL CONSULTANTS, INC.**

Date: March 4, 2005

Scott Rademaker, P.G.
Hydrogeologist

"I, Scott Rademaker, hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03(1), Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

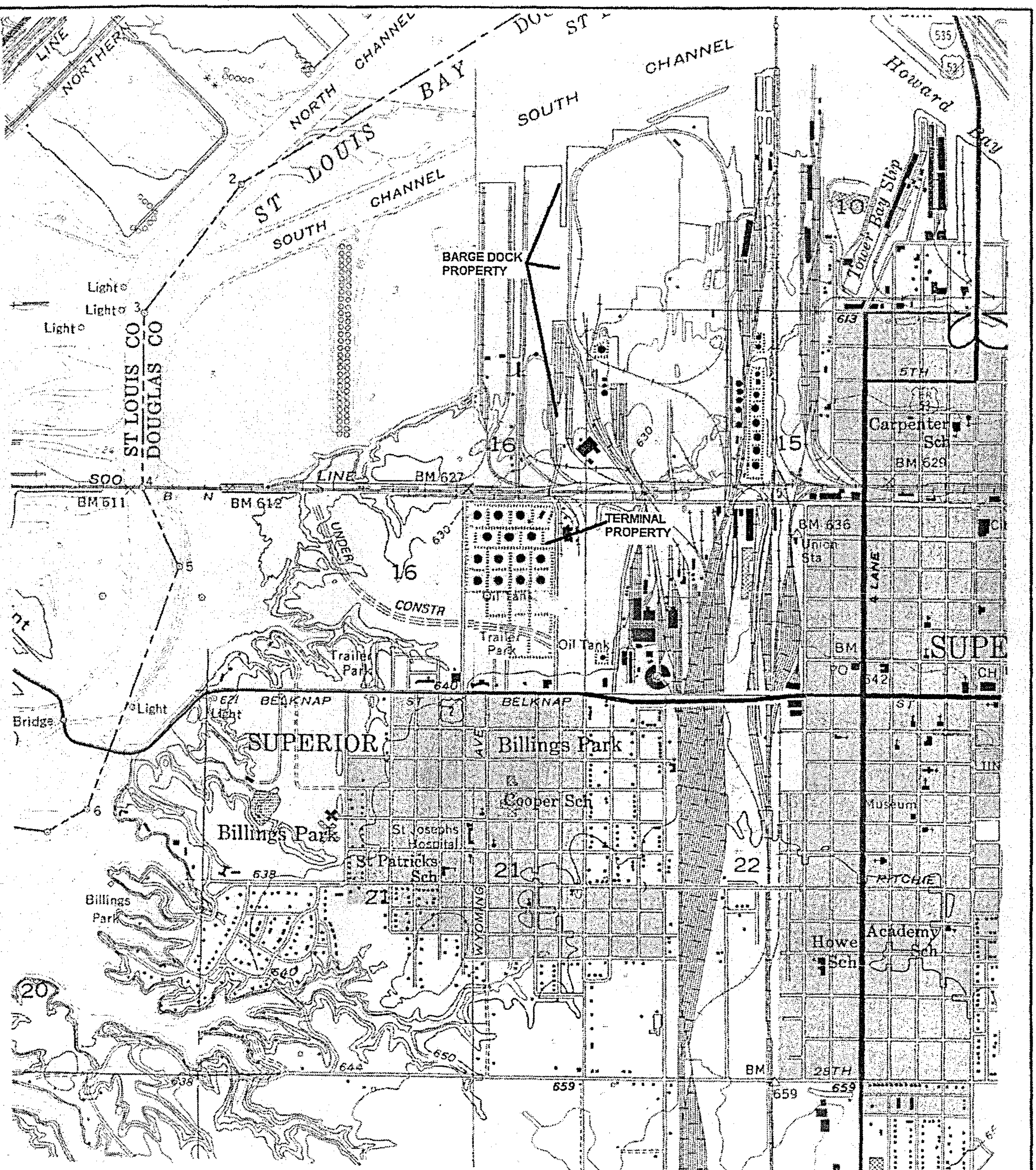
Date: 3-4-05

Tim Mueller, PG, CHMM
Hydrogeologist

"I, Tim Mueller, hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03(1), Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

5.0 REFERENCES

Delta Environmental Consultants Inc., *Report on Ground Water Quality, Hydrostratigraphy and Free-Phase Hydrocarbon Delineation*, October 2002.



WEST DULUTH QUADRANGLE
MINNESOTA
7.5 MINUTE SERIES (TOPOGRAPHIC)

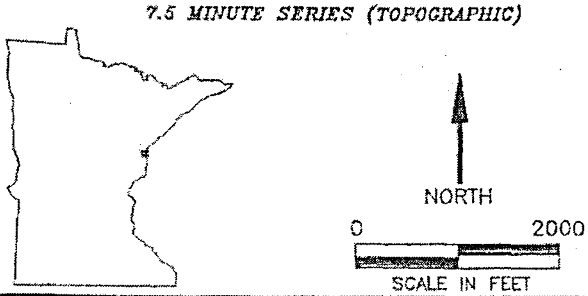


FIGURE 1
SITE LOCATION MAP
FORMER AMOCO TERMINAL AND BARGE
DOCK PROPERTIES
SUPERIOR, WISCONSIN

PROJECT NO.	PREPARED BY	
10-88-457		Delta Environmental Consultants, Inc.
DATE 4/1/91	REVIEWED BY [illegible]	

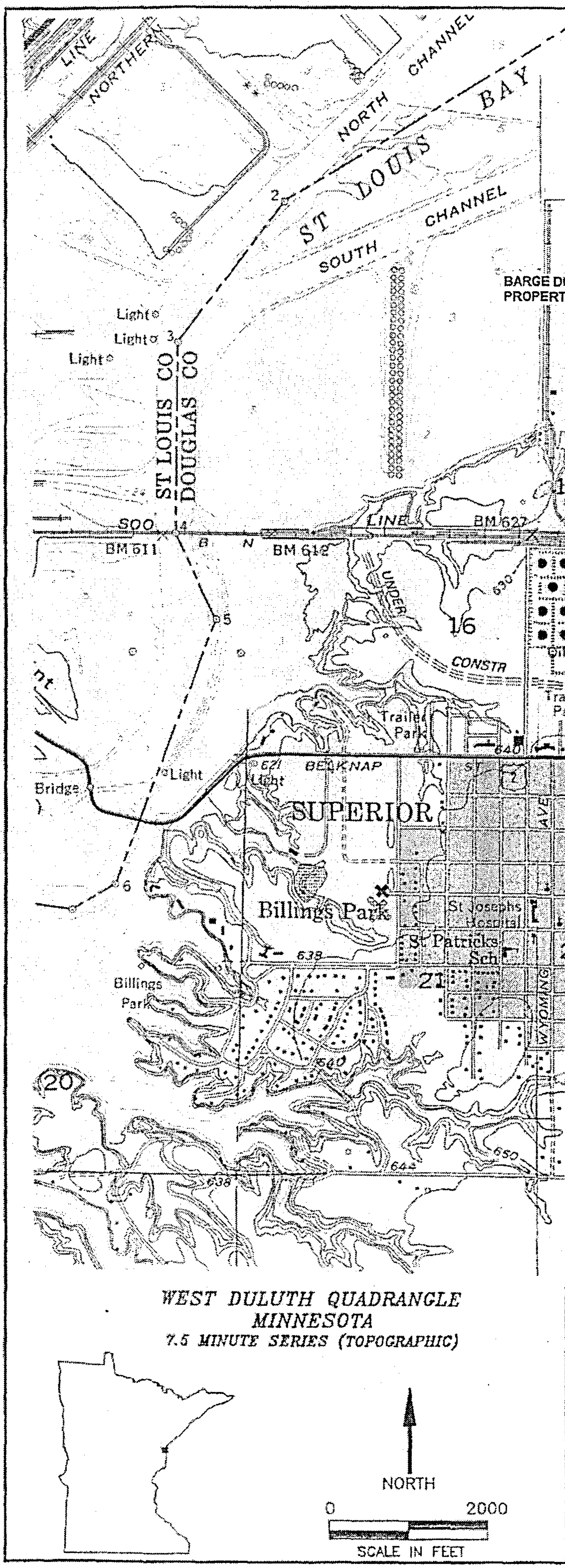
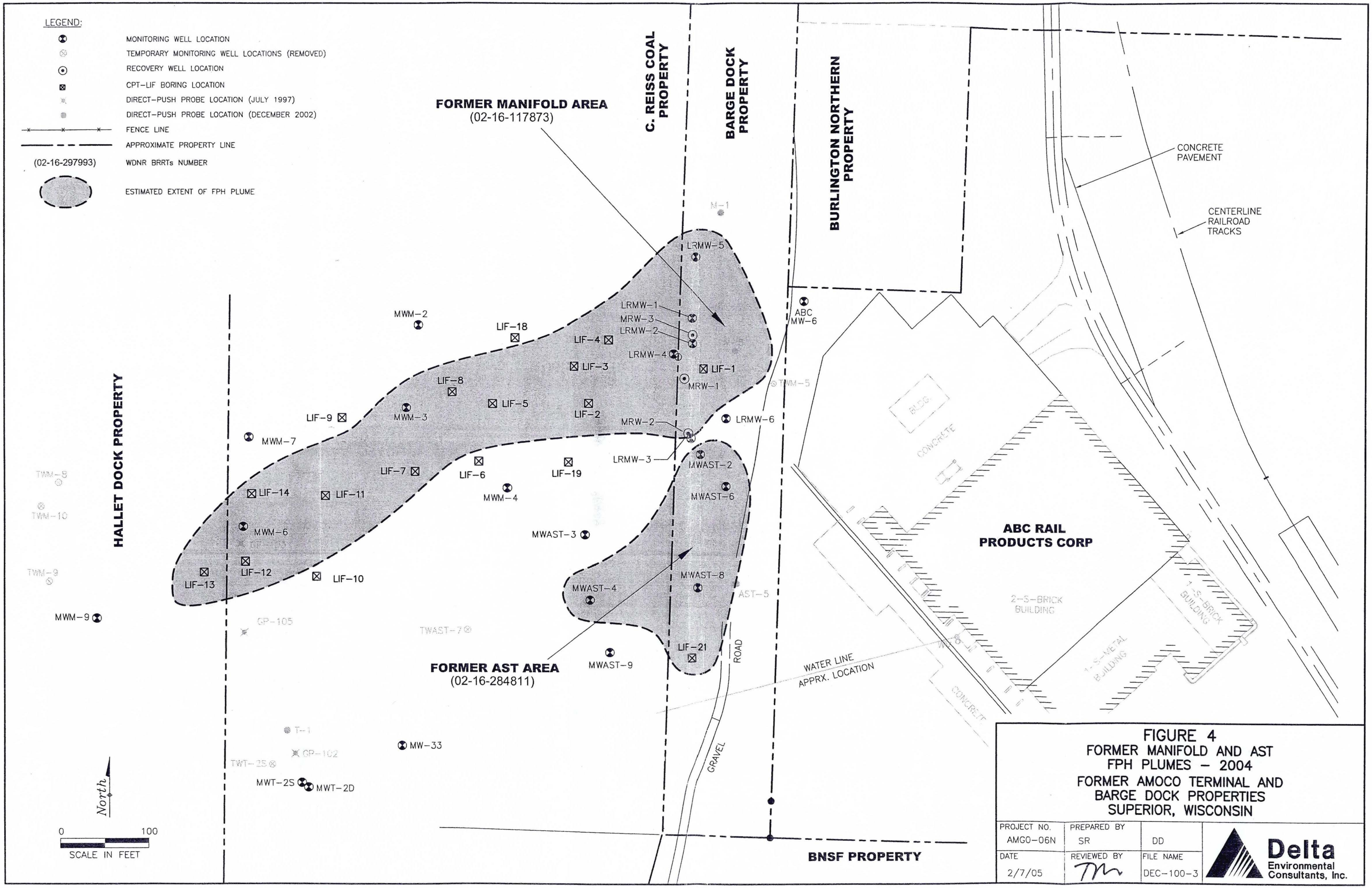


FIGURE 1

SITE LOCATION MAP
FORMER AMOCO TERMINAL AND BARGE
DOCK PROPERTIES
SUPERIOR, WISCONSIN

PROJECT NO.	PREPARED BY
10-88-457	
DATE 4/1/91	REVIEWED BY

Delta Environmental Consultants, Inc.



LEGEND:
MONITORING WELL LOCATION
TEMPORARY MONITORING WELL LOCATIONS (REMOVED)
RECOVERY WELL LOCATION
CPT–LIF BORING LOCATION
DIRECT–PUSH PROBE LOCATION (JULY 1997)
DIRECT–PUSH PROBE LOCATION (DECEMBER 2002)
FENCE LINE
APPROXIMATE PROPERTY LINE
(02-16-297993) WDNR BRRTs NUMBER
ESTIMATED EXTENT OF FPH PLUME
FORMER MANIFOLD AREA
(02-16-117873)
C. REISS COAL PROPERTY
BARGE DOCK PROPERTY
BURLINGTON NORTHERN PROPERTY
CONCRETE PAVEMENT
CENTERLINE RAILROAD TRACKS
HALLET DOCK PROPERTY
M–1
LRMW–5
LRMW–1
MRW–3
LRMW–2
LRMW–4
MRW–1
MRW–2
LRMW–3
LRMW–6
ABC MW–6
TWM–5
MWM–2
LIF–18
LIF–4
LIF–3
LIF–1
LIF–8
LIF–5
LIF–2
LIF–9
MWM–3
MWM–7
LIF–7
LIF–6
LIF–19
MWM–4
LIF–14
LIF–11
MWM–6
LIF–12
LIF–13
LIF–10
MWAST–2
MWAST–6
MWAST–3
MWAST–8
MWAST–4
AST–5
LIF–21
MWAST–9
TWM–8
TWM–10
TWM–9
MWM–9
GP–105
TWAST–7
FORMER AST AREA
(02-16-284811)
ROAD
GRAVEL
WATER LINE APPRX. LOCATION
ABC RAIL PRODUCTS CORP
2–S–BRICK BUILDING
1–S–BRICK BUILDING
1–S–METAL BUILDING
BLDG.
CONCRETE
T–1
GP–102
TWT–2S
MWT–2S
MWT–2D
MW–33
North
0
100
SCALE IN FEET
BNSF PROPERTY
FIGURE 4
FORMER MANIFOLD AND AST FPH PLUMES – 2004
FORMER AMOCO TERMINAL AND BARGE DOCK PROPERTIES
SUPERIOR, WISCONSIN
PROJECT NO. AMGO–06N
PREPARED BY SR DD
DATE 2/7/05
REVIEWED BY
FILE NAME DEC–100–3
Delta Environmental Consultants, Inc.

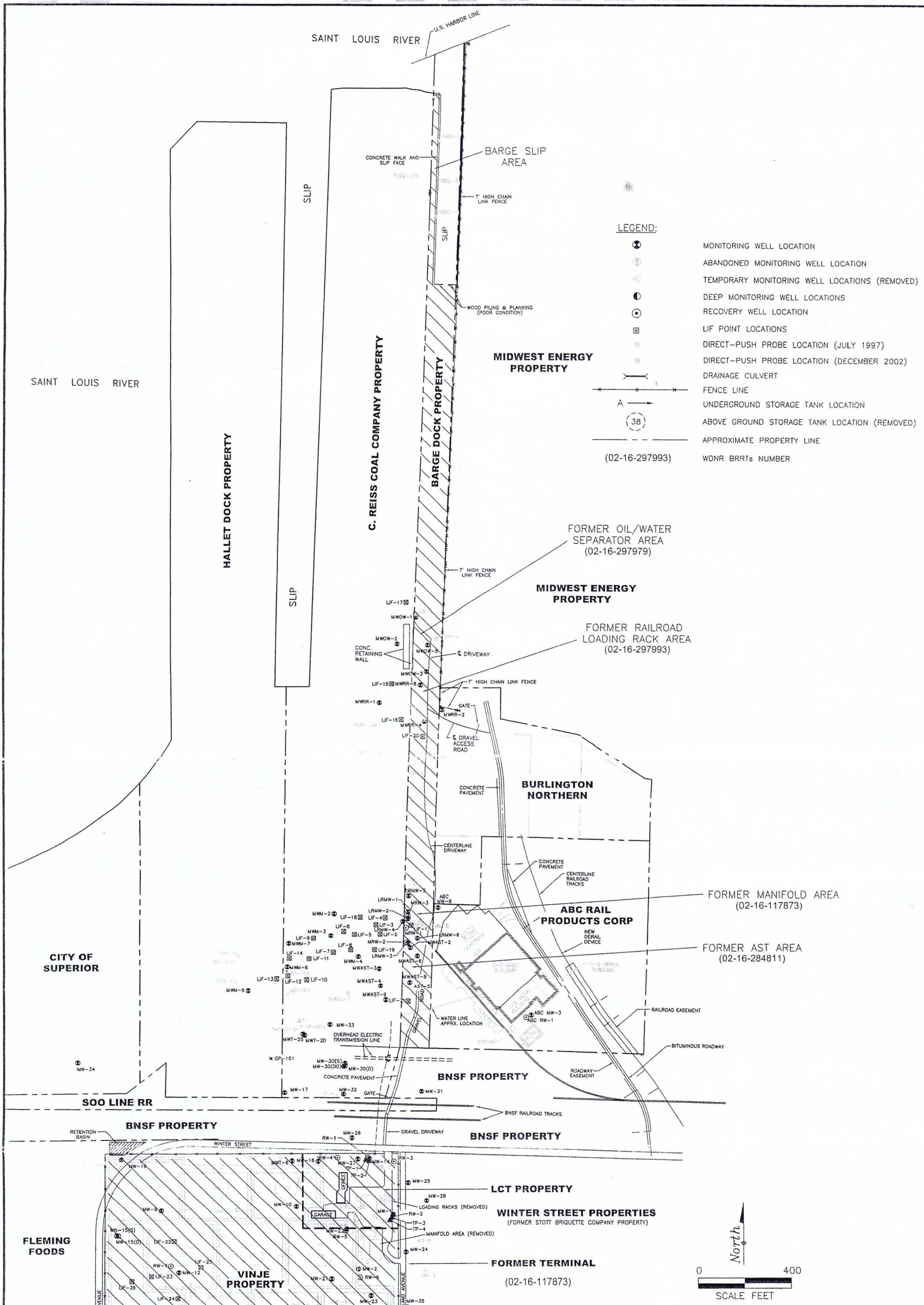


FIGURE 2
SITE MAP AND SURROUNDING PROPERTY USE

FORMER AMOCO TERMINAL AND BARGE DOCK PROPERTIES
SUPERIOR, WISCONSIN

PROJECT NO.	PREPARED BY	DRAWN BY
AMGO-06N	SR	DD
DATE	REVIEWED BY	FILE NAME
10/7/04	TM	SITE-400

Delta Environmental Consultants, Inc.

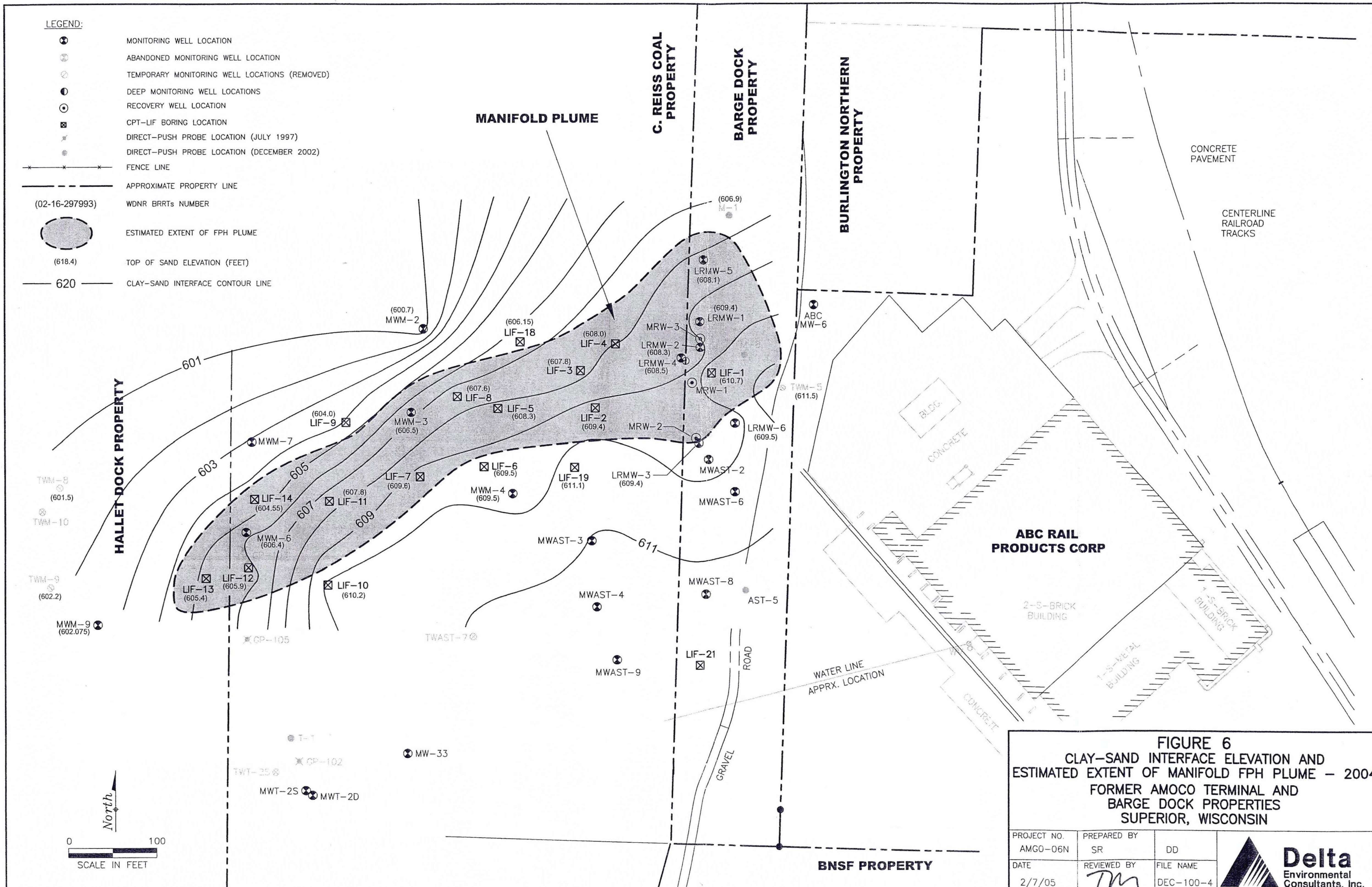


FIGURE 6
CLAY-SAND INTERFACE ELEVATION AND ESTIMATED EXTENT OF MANIFOLD FPH PLUME – 2004
FORMER AMOCO TERMINAL AND BARGE DOCK PROPERTIES
SUPERIOR, WISCONSIN

PROJECT NO.	PREPARED BY		
AMGO-06N	SR	DD	Delta Environmental Consultants, Inc.
DATE	REVIEWED BY	FILE NAME	
2/7/05	TM	DEC-100-4	

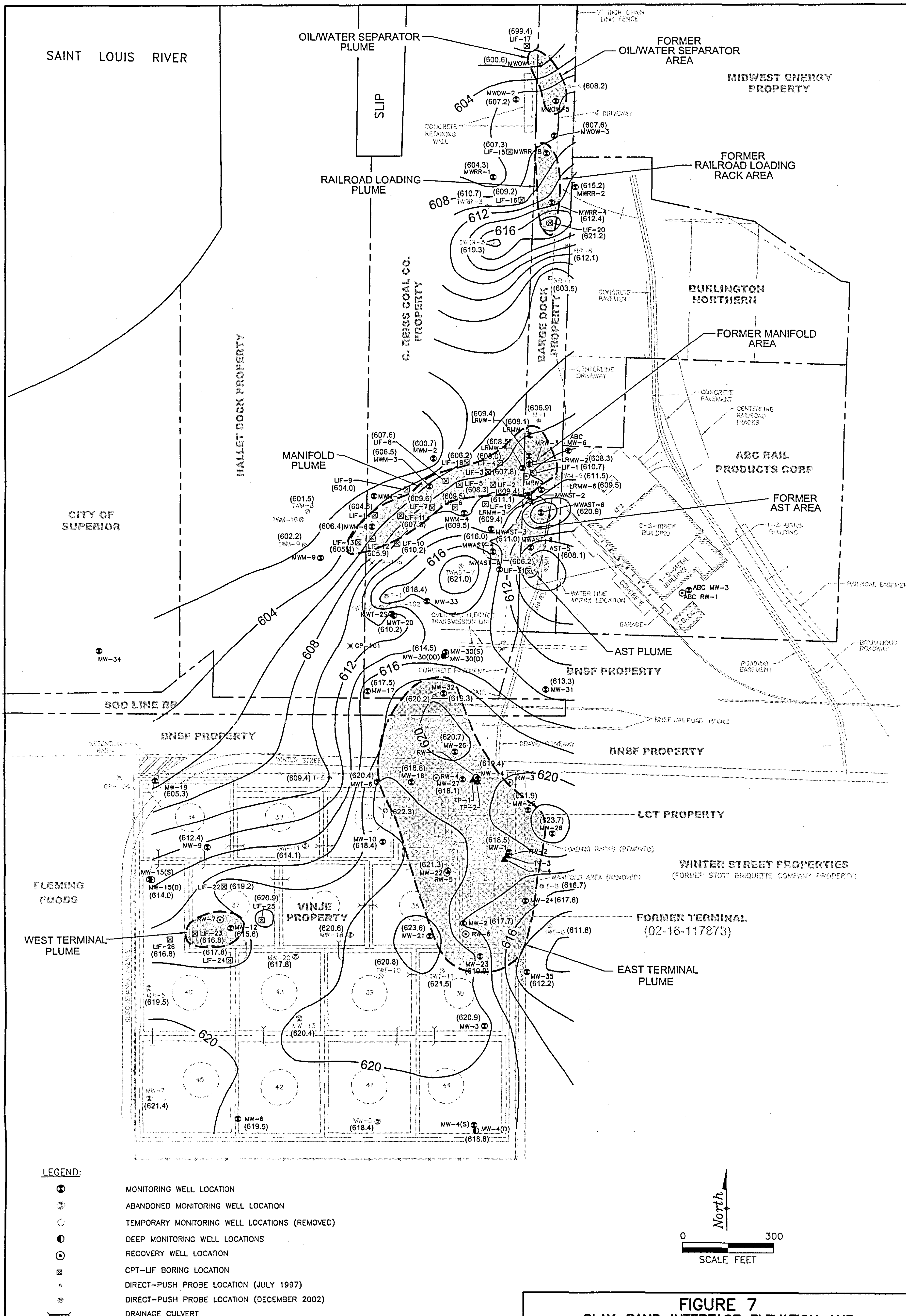


FIGURE 7
CLAY–SAND INTERFACE ELEVATION AND ESTIMATED EXTENT OF FPH PLUMES – 2004
FORMER AMOCO TERMINAL AND BARGE DOCK PROPERTIES
SUPERIOR, WISCONSIN

PROJECT NO.	PREPARED BY	DRAWN BY
AMG0-06N	SR	DD
DATE	REVIEWED BY	FILE NAME
2/7/05	TM	Clay-Plume

Delta Environmental Consultants, Inc.

4252 Rhoda Drive
Baton Rouge, LA 70816
Tel : 225-292-5082
Fax : 225-292-8084

September 28, 2004
Report Number: 0302-0605

Delta Environmental Consultants, Inc.
17500 W. Liberty Lane
Suite A
New Berlin, WI 53146

Attn.: Mr. Scott Rademaker

DATA REPORT
PIEZOCONE PENETRATION AND
RAPID OPTICAL SCREENING TOOL TESTING
SUPERIOR, WISCONSIN

Dear Mr. Rademaker:

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 (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.).

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.

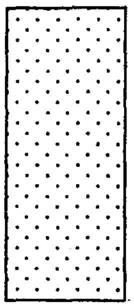
Sincerely,
FUGRO GEOSCIENCES, INC.

Recep Yilmaz
President

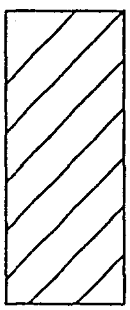
RY/mdt

Enclosure: - 1 CD

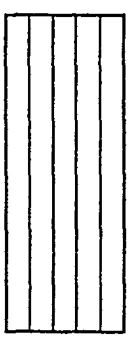
KEY TO SOIL BEHAVIOR TYPE



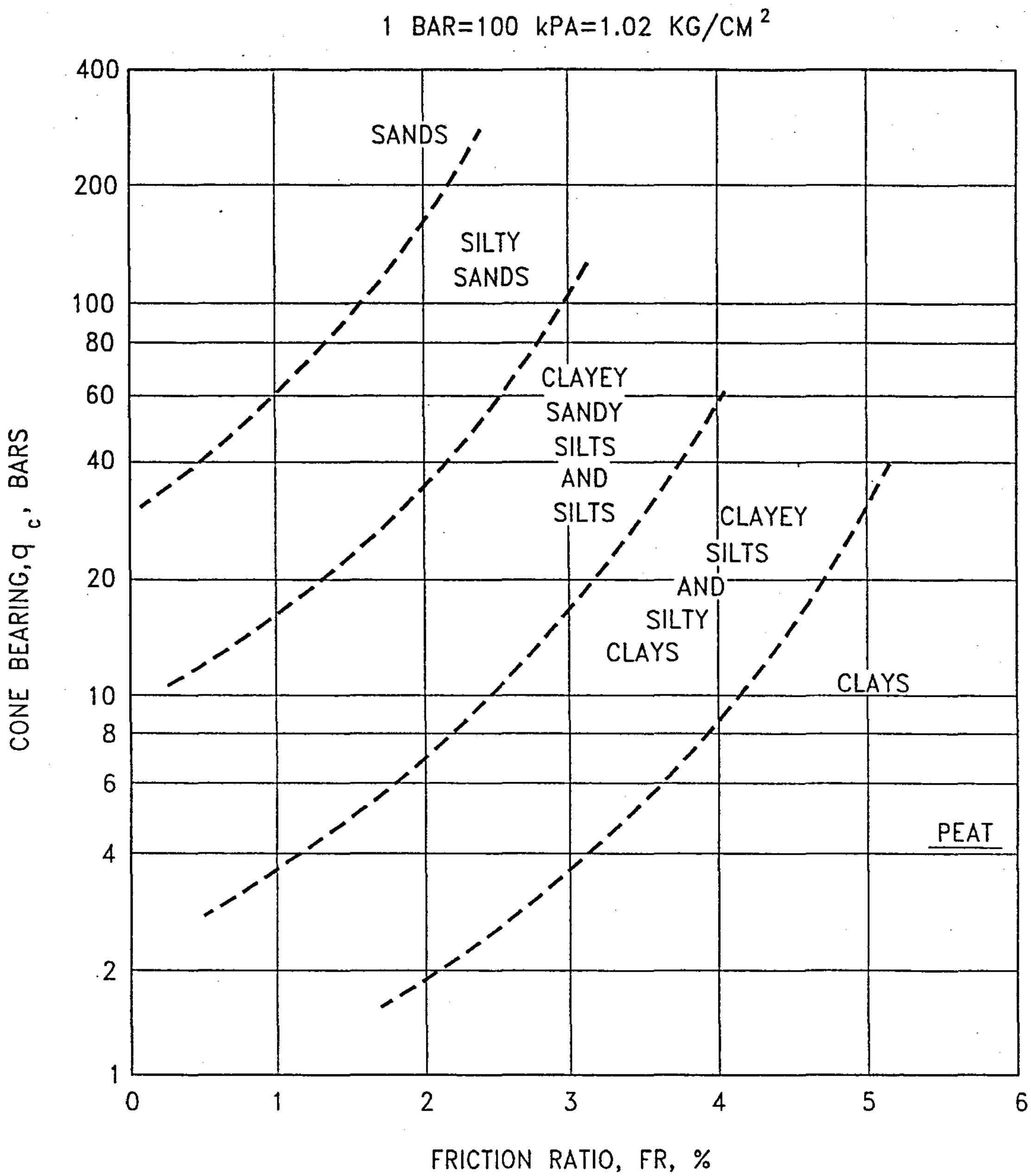
SAND AND SANDY SOIL



CLAY AND CLAYEY SOIL

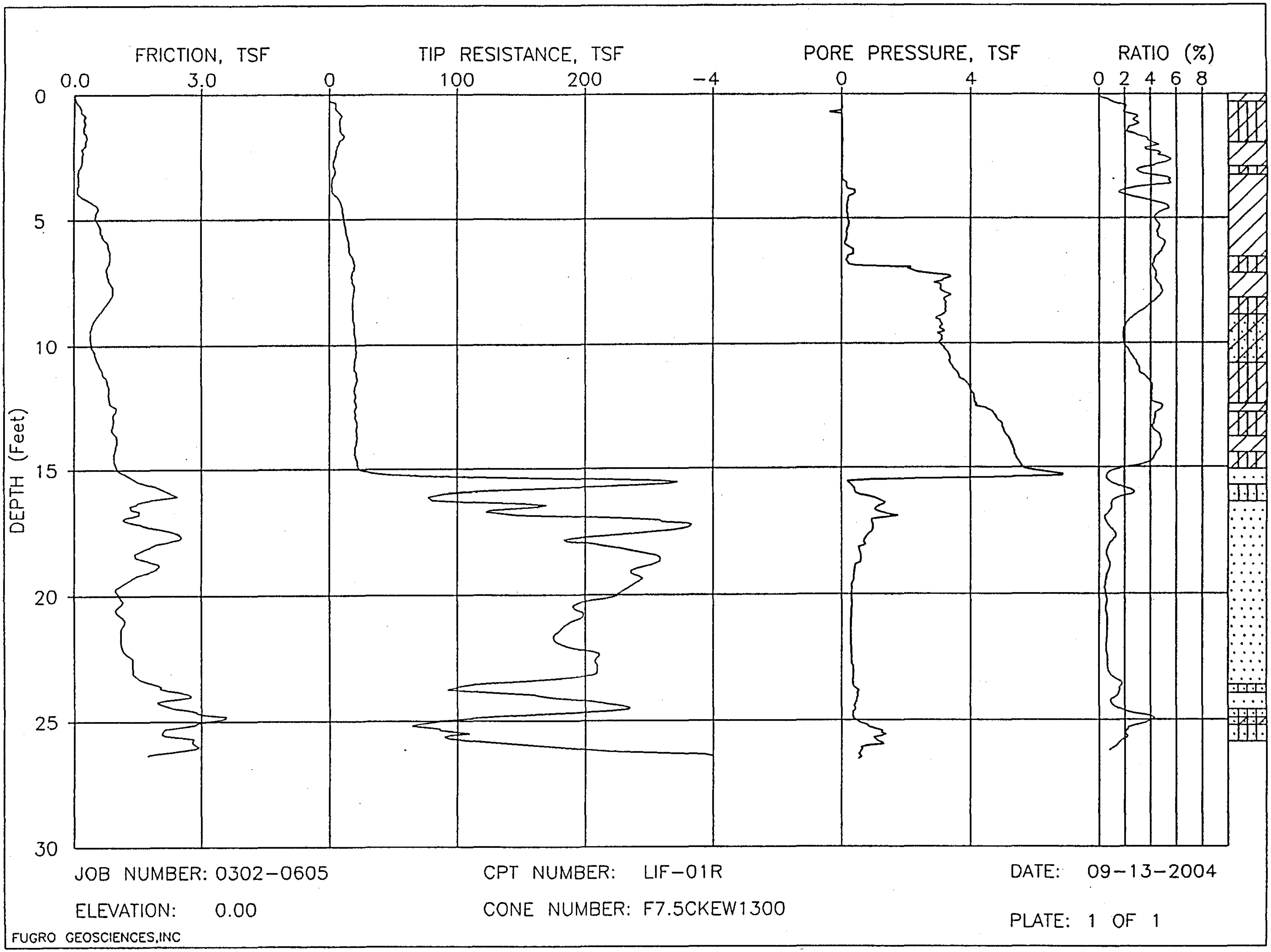


SILT AND SILTY SOIL



MODIFIED CAMPANELLA AND ROBERTSON SOIL BEHAVIOR CHART (1983)

CPT LOGS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TIP RESISTANCE, TSF
PORE PRESSURE, TSF
RATIO (%)
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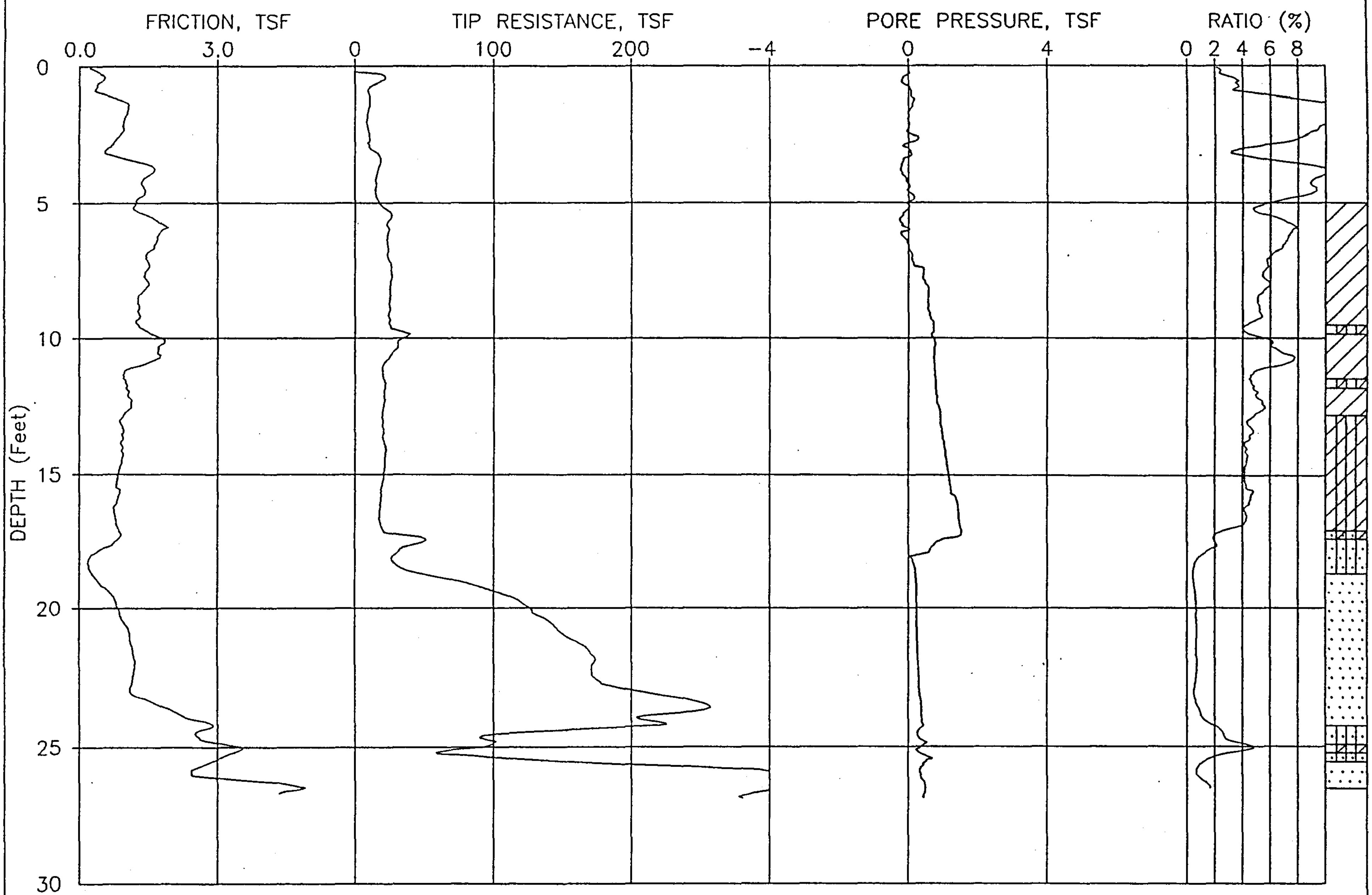
3.0
0
100
200
-4
0
4
0
2
4
6
8
DEPTH (Feet)
0
5
10
15
20
25
30
JOB NUMBER: 0302-0605
CPT NUMBER: LIF-01R
DATE: 09-13-2004
ELEVATION: 0.00
CONE NUMBER: F7.5CKEW1300
PLATE: 1 OF 1
FUGRO GEOSCIENCES,INC



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CPT NUMBER: LIF-02R

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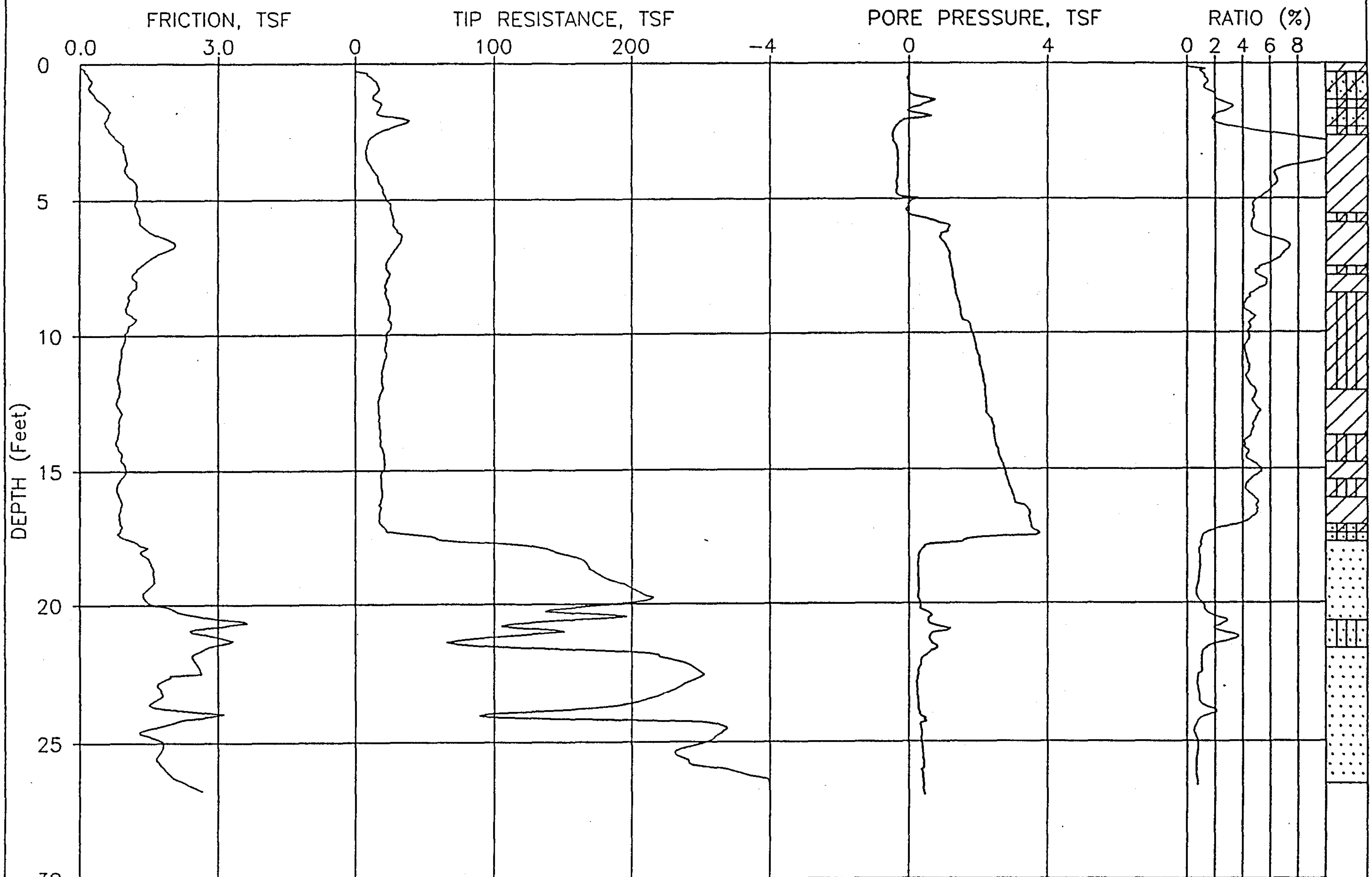
ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1300

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



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CPT NUMBER: LIF-03

DATE: 09-13-2004

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1300

PLATE: 1 OF 1

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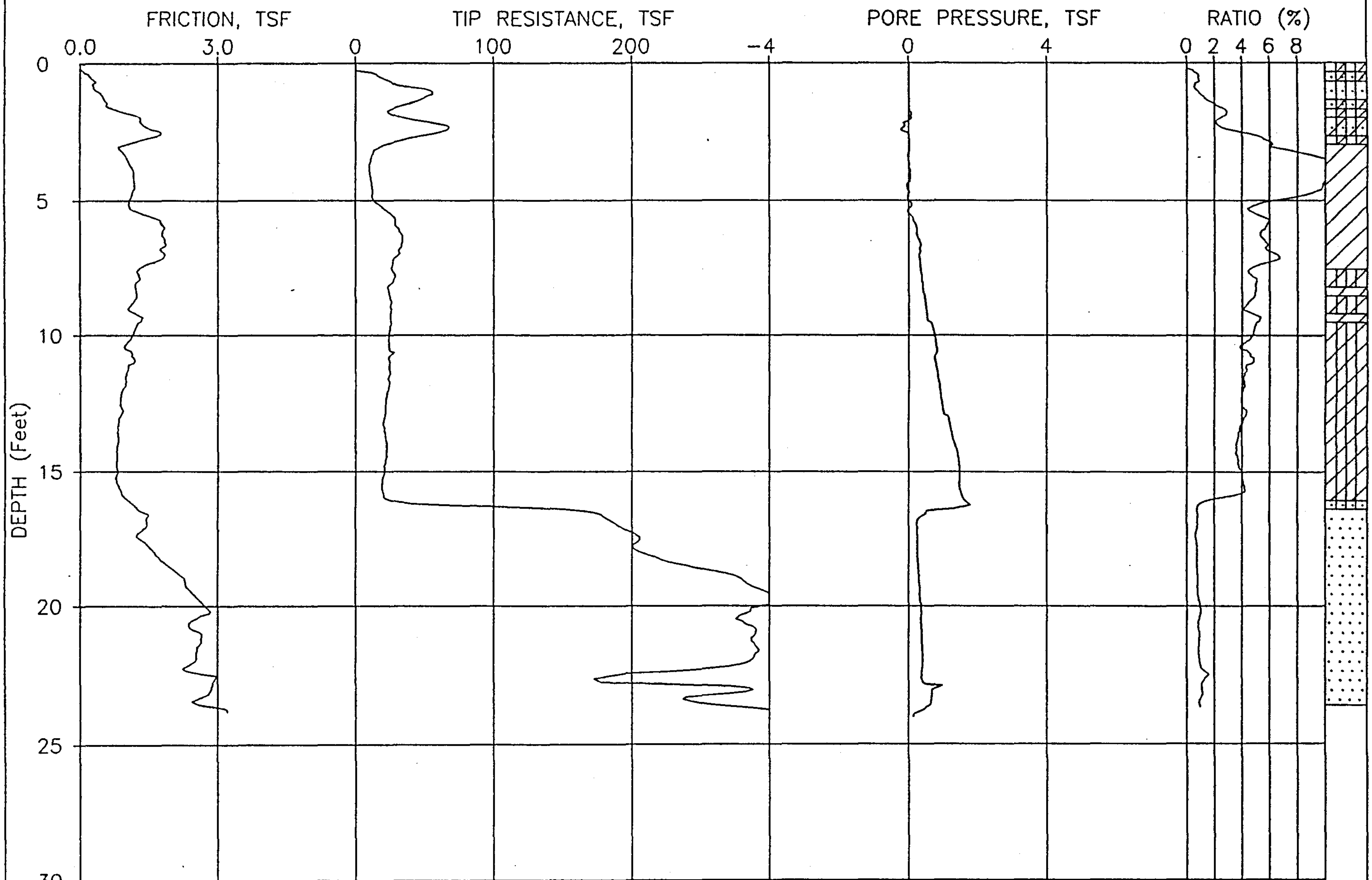

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ELEVATION: 0.00

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CONE NUMBER: F7.5CKEW1300

DATE: 09-14-2004

PLATE: 1 OF 1

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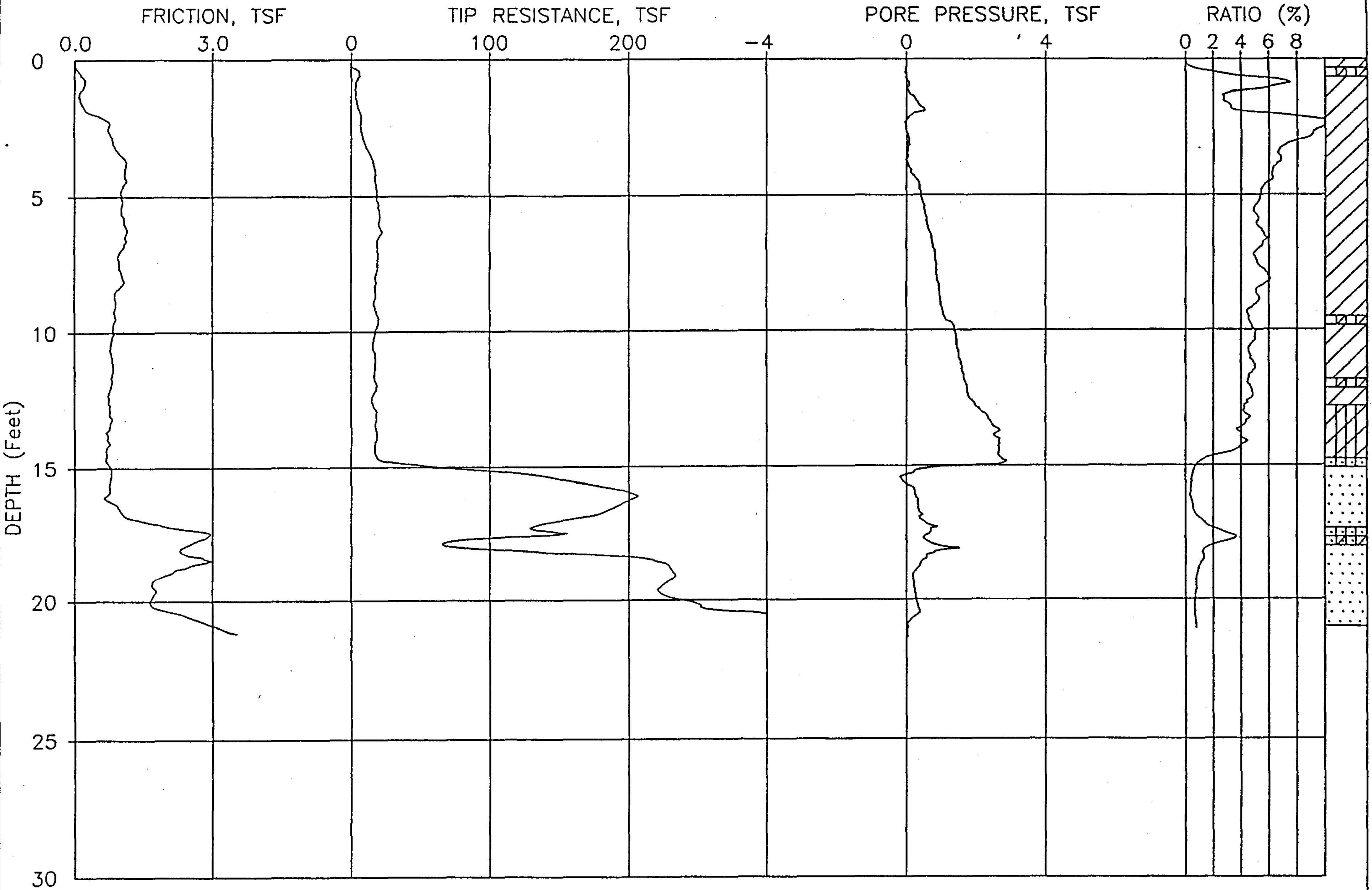

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DATE: 09-14-2004

ELEVATION: 0.00

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PLATE: 1 OF 1

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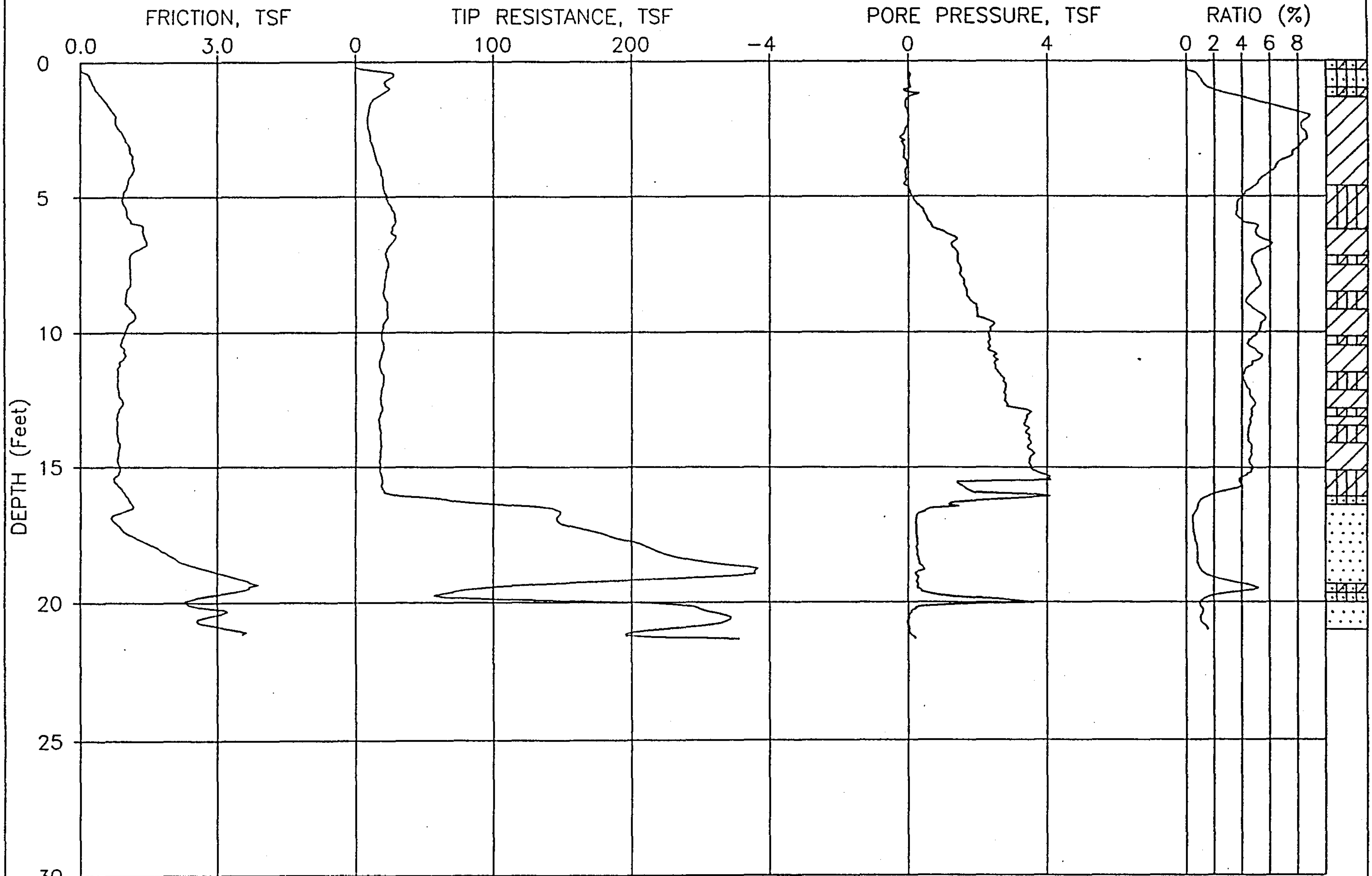

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CPT NUMBER: LIF-06

DATE: 09-14-2004

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1300

PLATE: 1 OF 1

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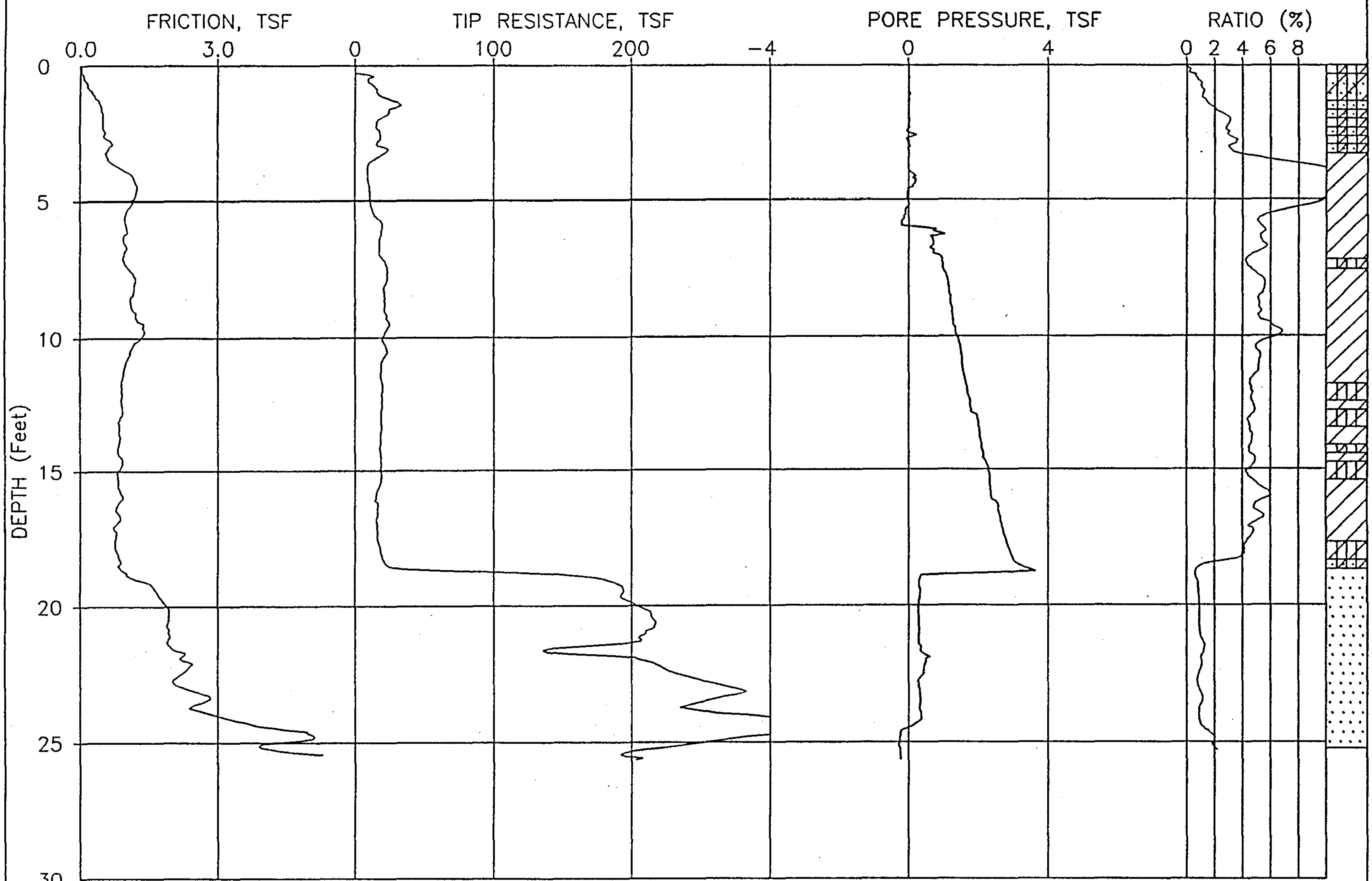

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CONE NUMBER: F7.5CKEW1300

DATE: 09-14-2004

PLATE: 1 OF 1

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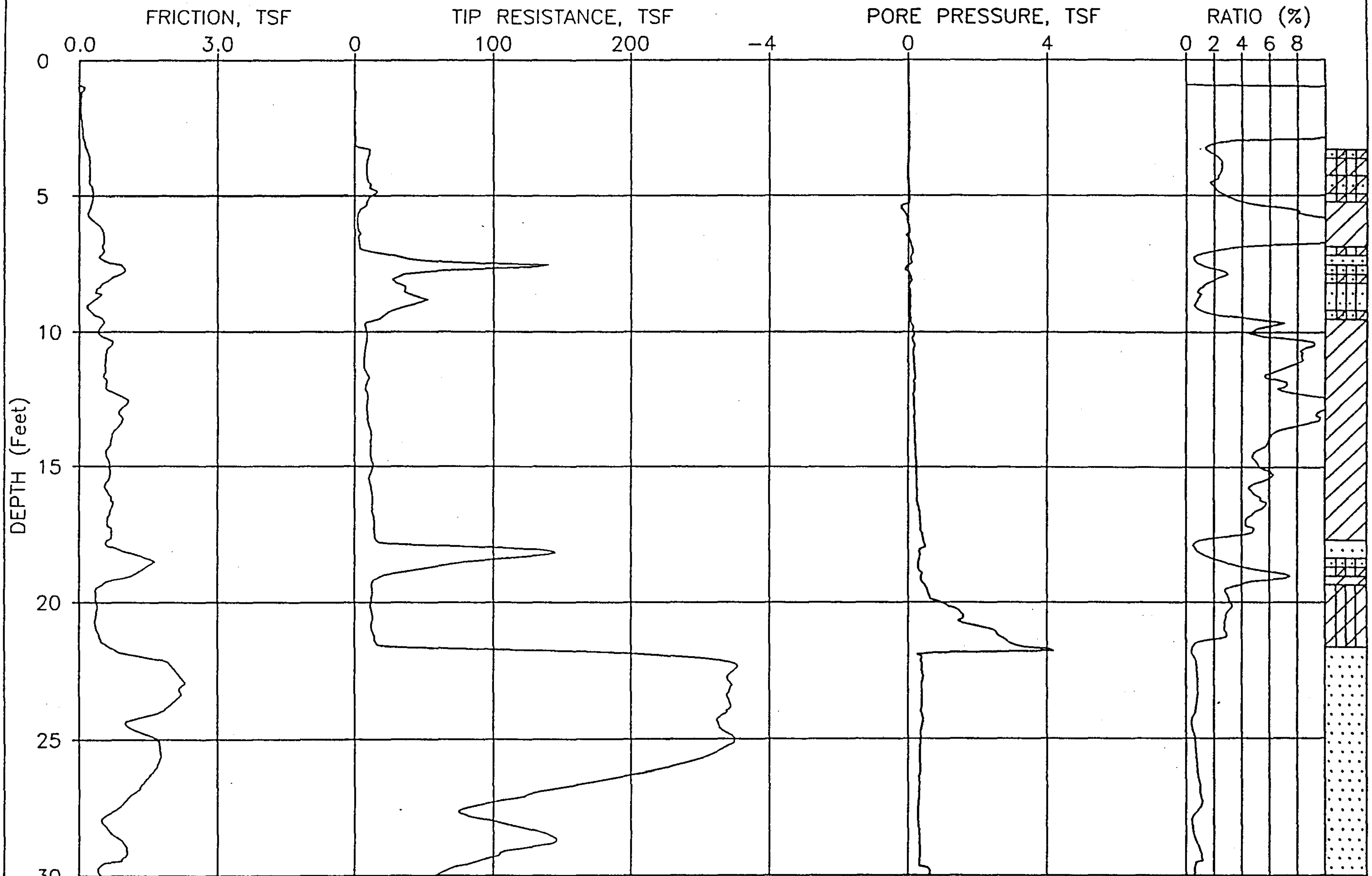

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CPT NUMBER: LIF-08

DATE: 09-14-2004

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1300

PLATE: 1 OF 2

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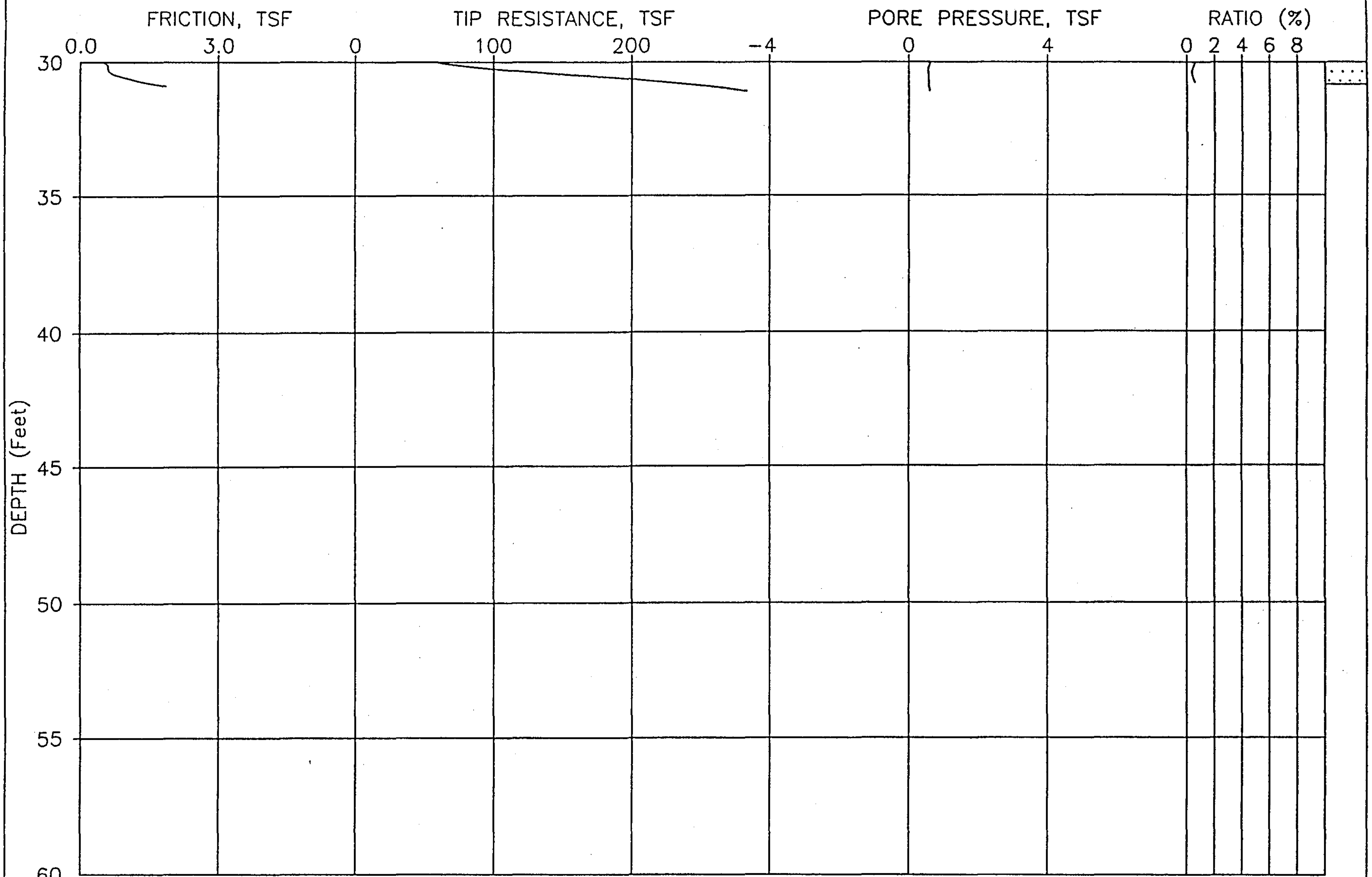

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CPT NUMBER: LIF-08

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PLATE: 2 OF 2

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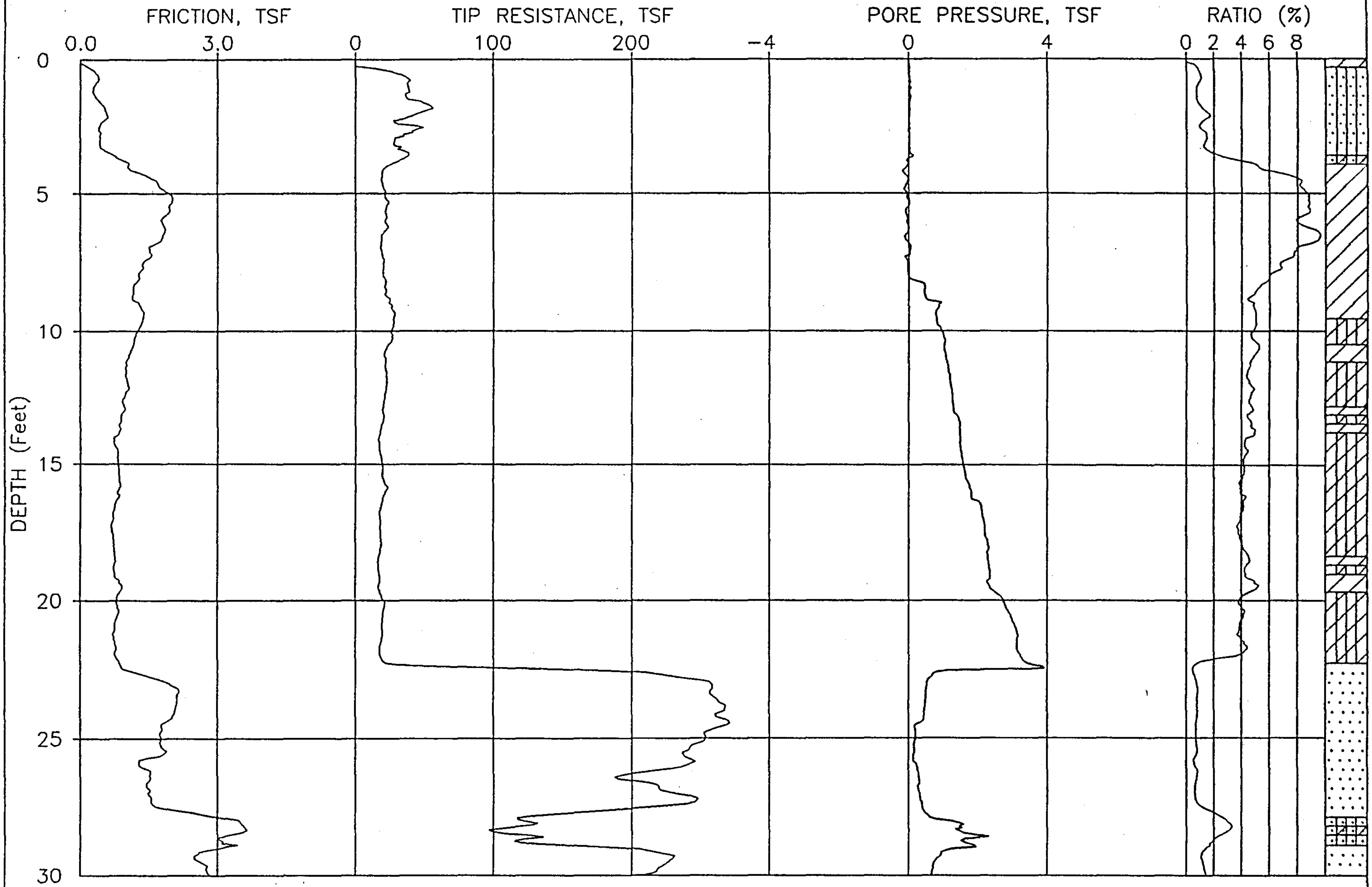

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DATE: 09-14-2004

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PLATE: 1 OF 2

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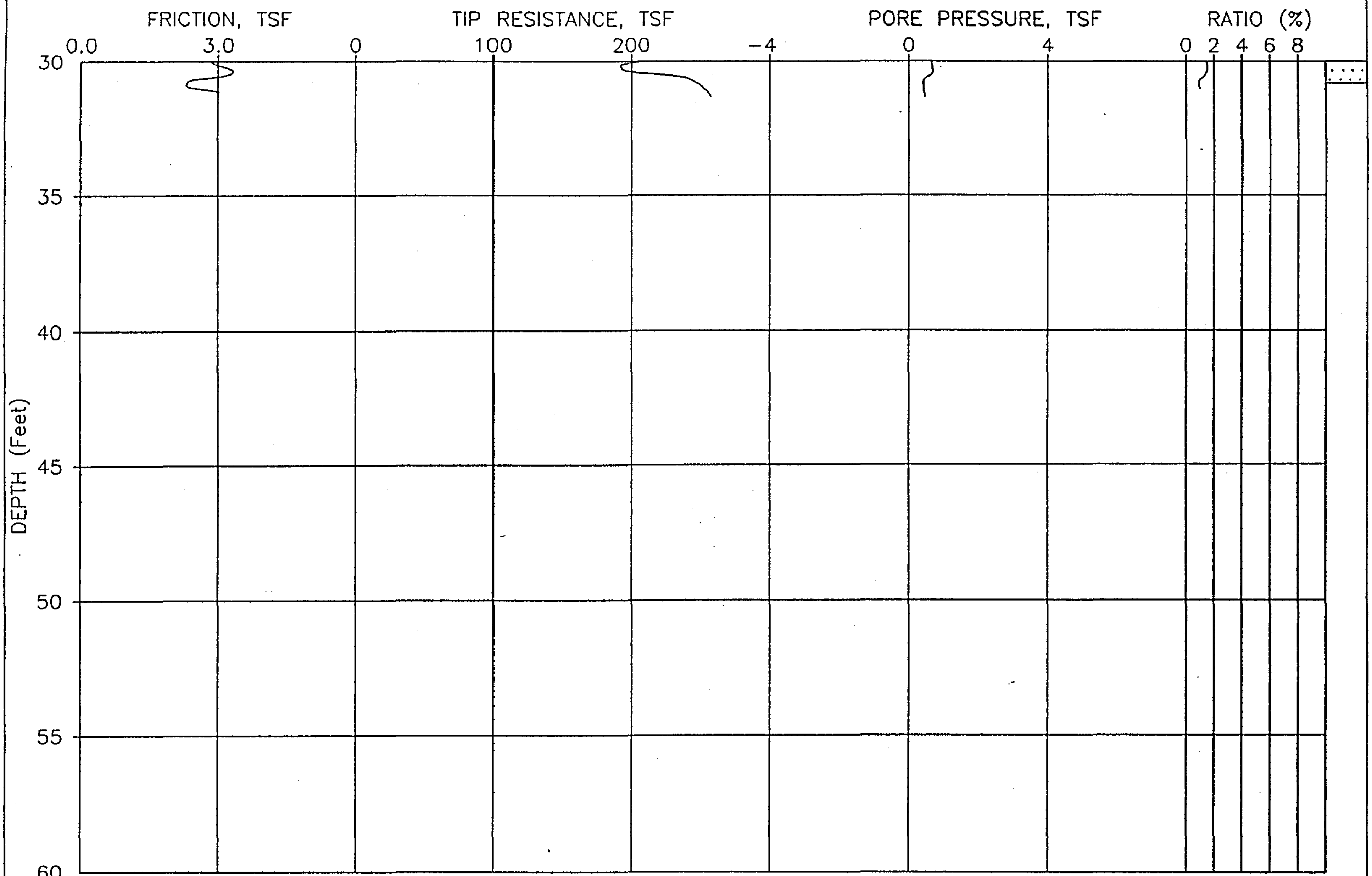

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CONE NUMBER: F7.5CKEW1300

DATE: 09-14-2004

PLATE: 2 OF 2

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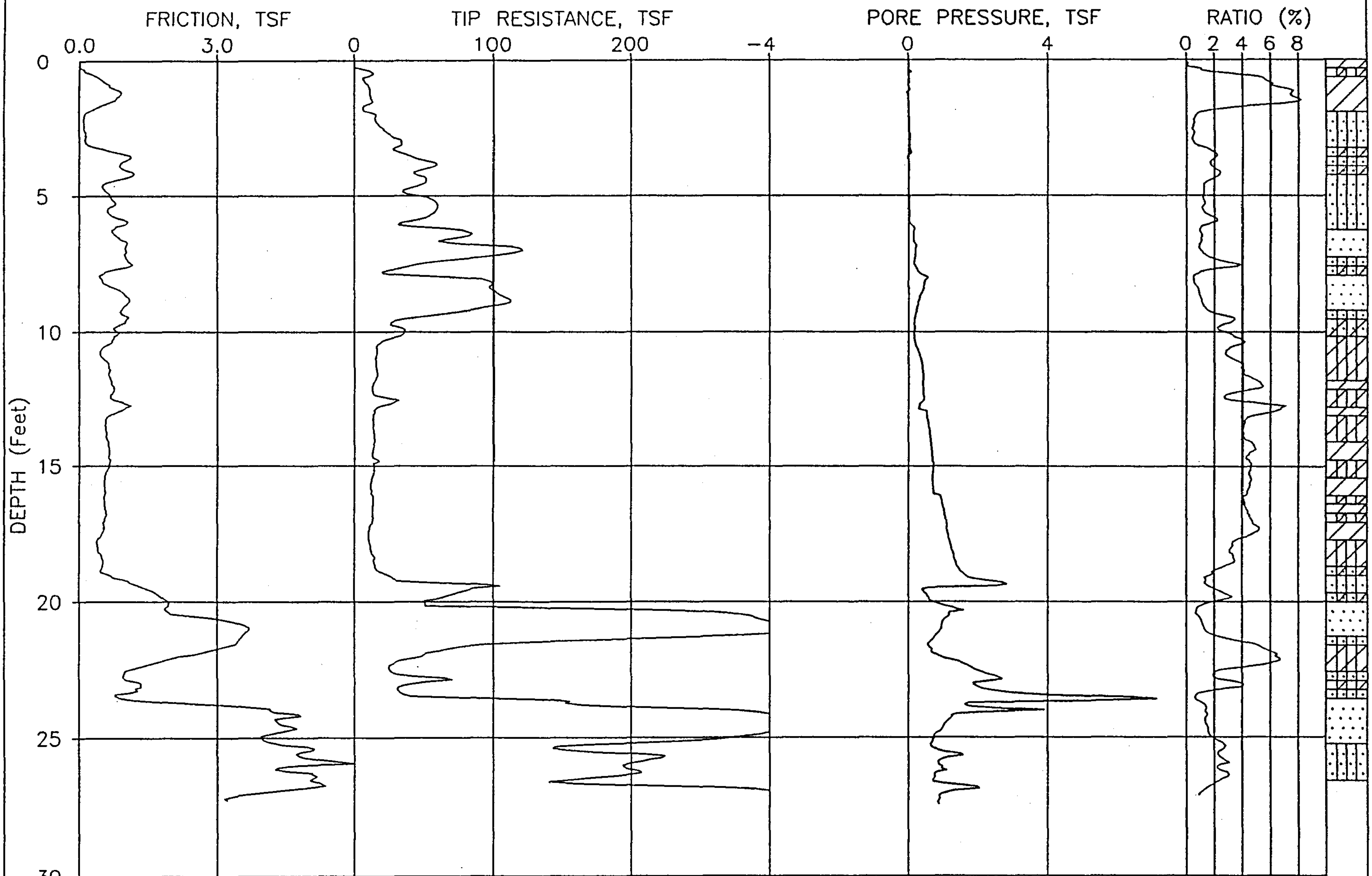

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PLATE: 1 OF 1

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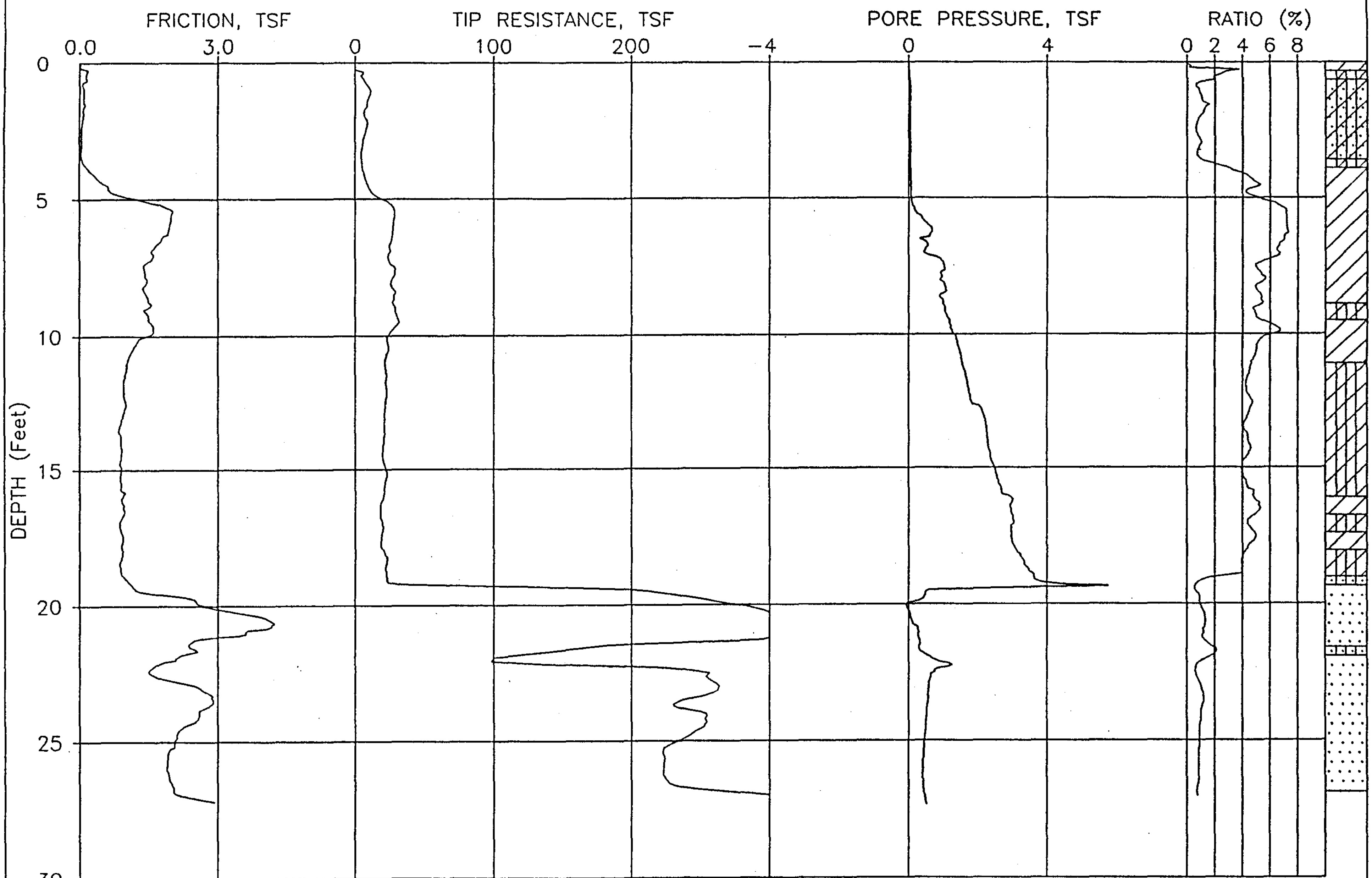

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DATE: 09-15-2004

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PLATE: 1 OF 1

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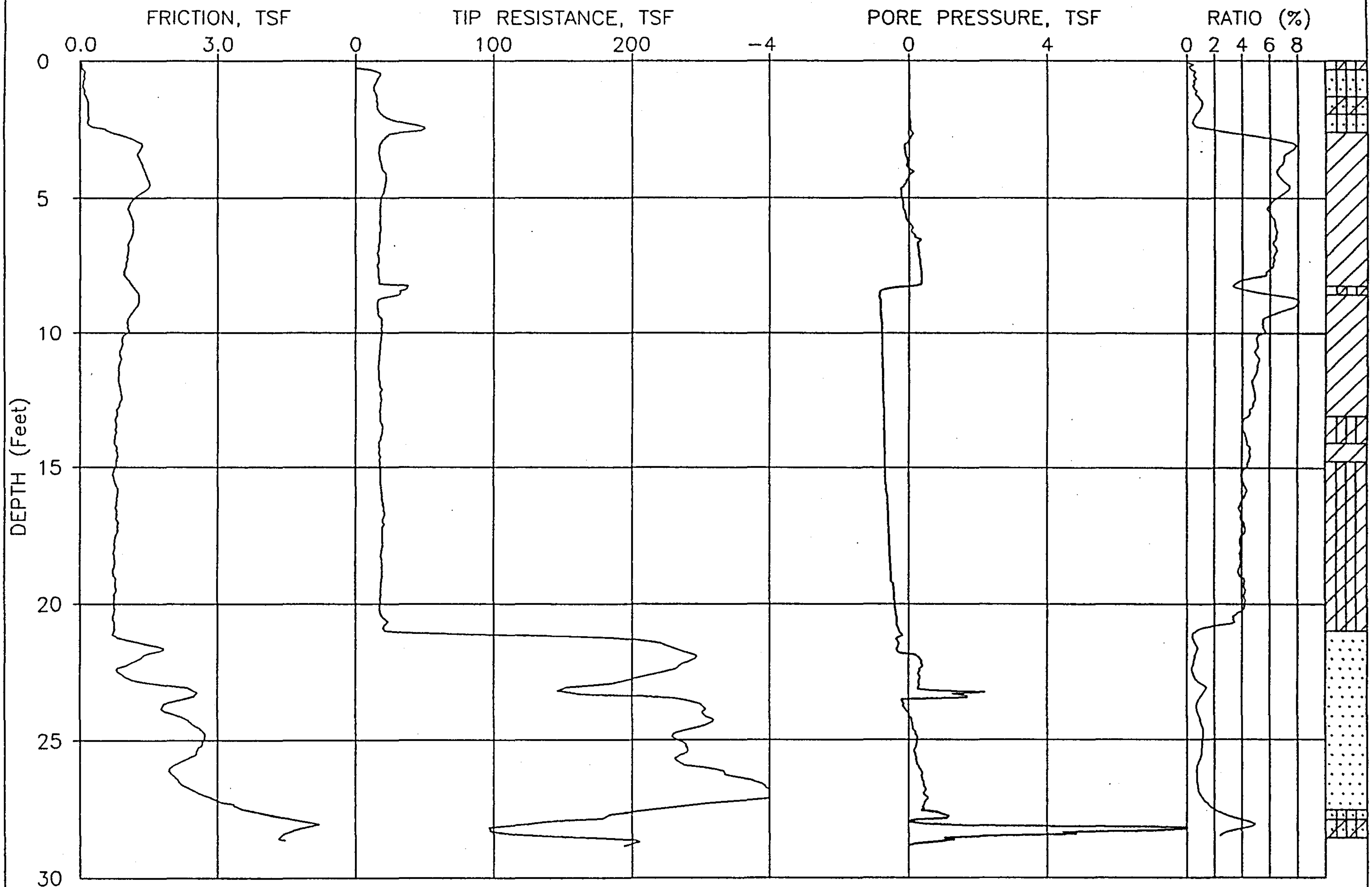

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CONE NUMBER: F7.5CKEW1300

DATE: 09-15-2004

PLATE: 1 OF 1

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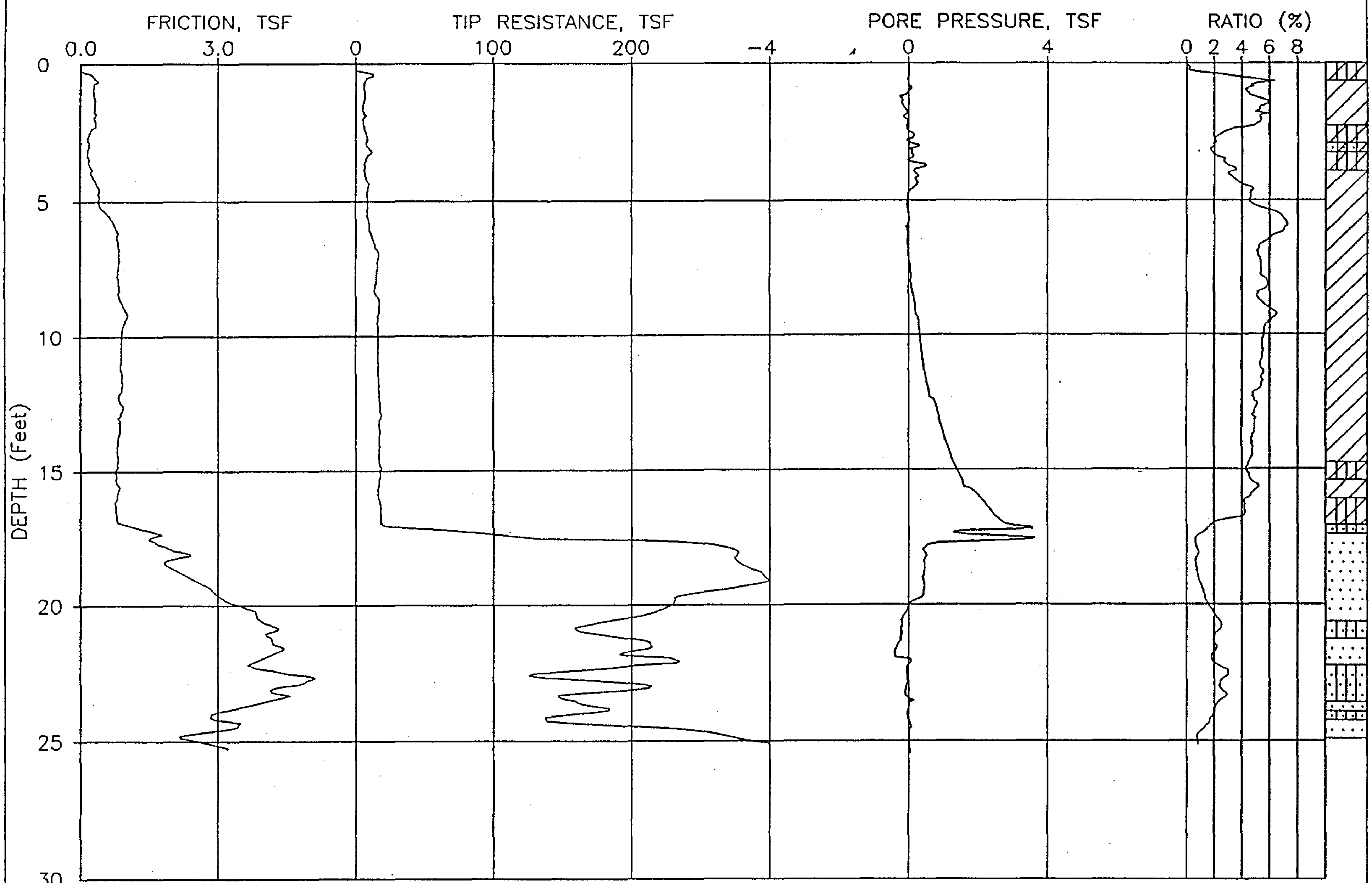


JOB NUMBER: 0302-0605

CPT NUMBER: LIF-13

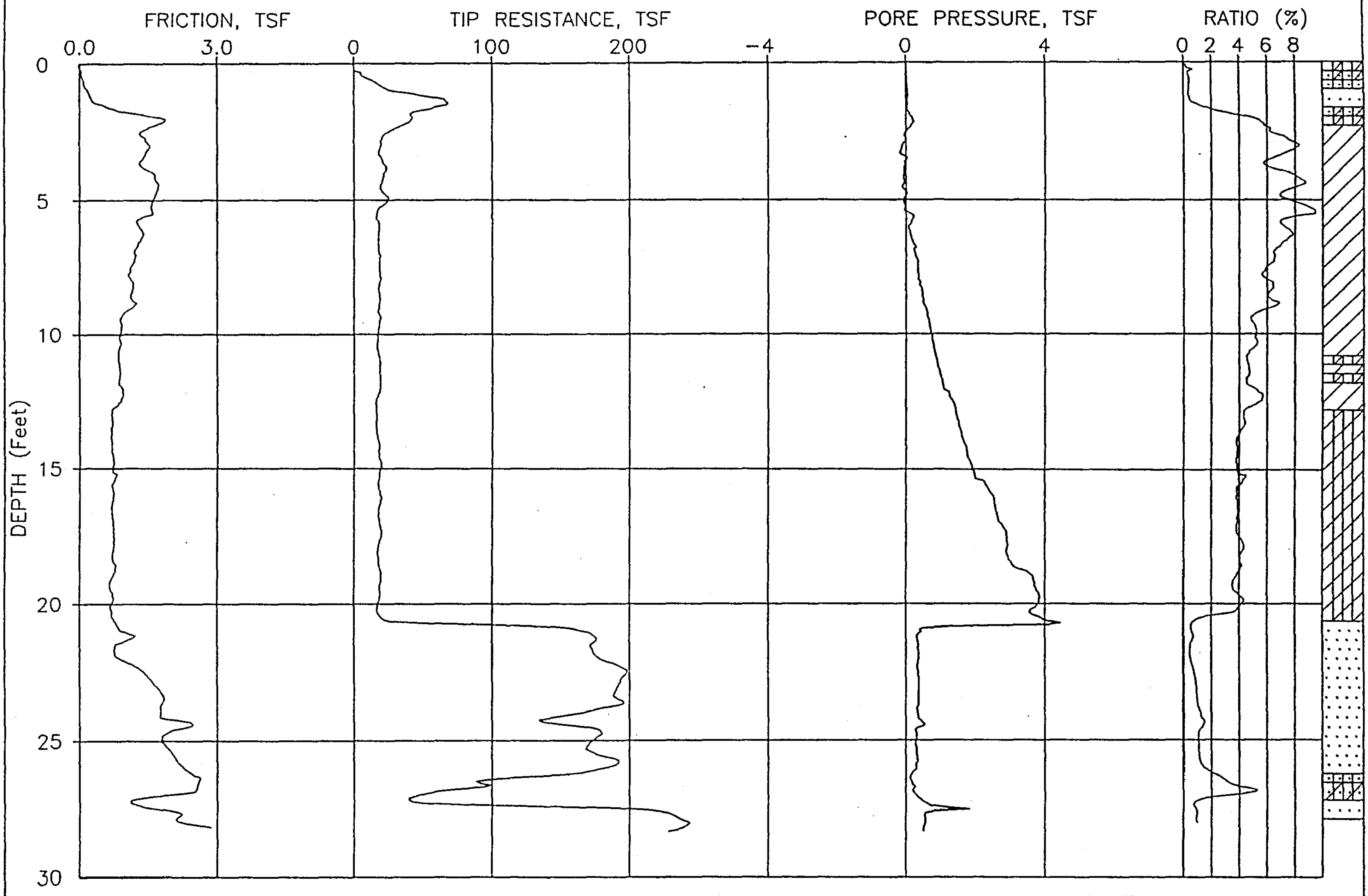
DATE: 09-15-2004

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1300

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



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CPT NUMBER: LIF-14

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PLATE: 1 OF 1

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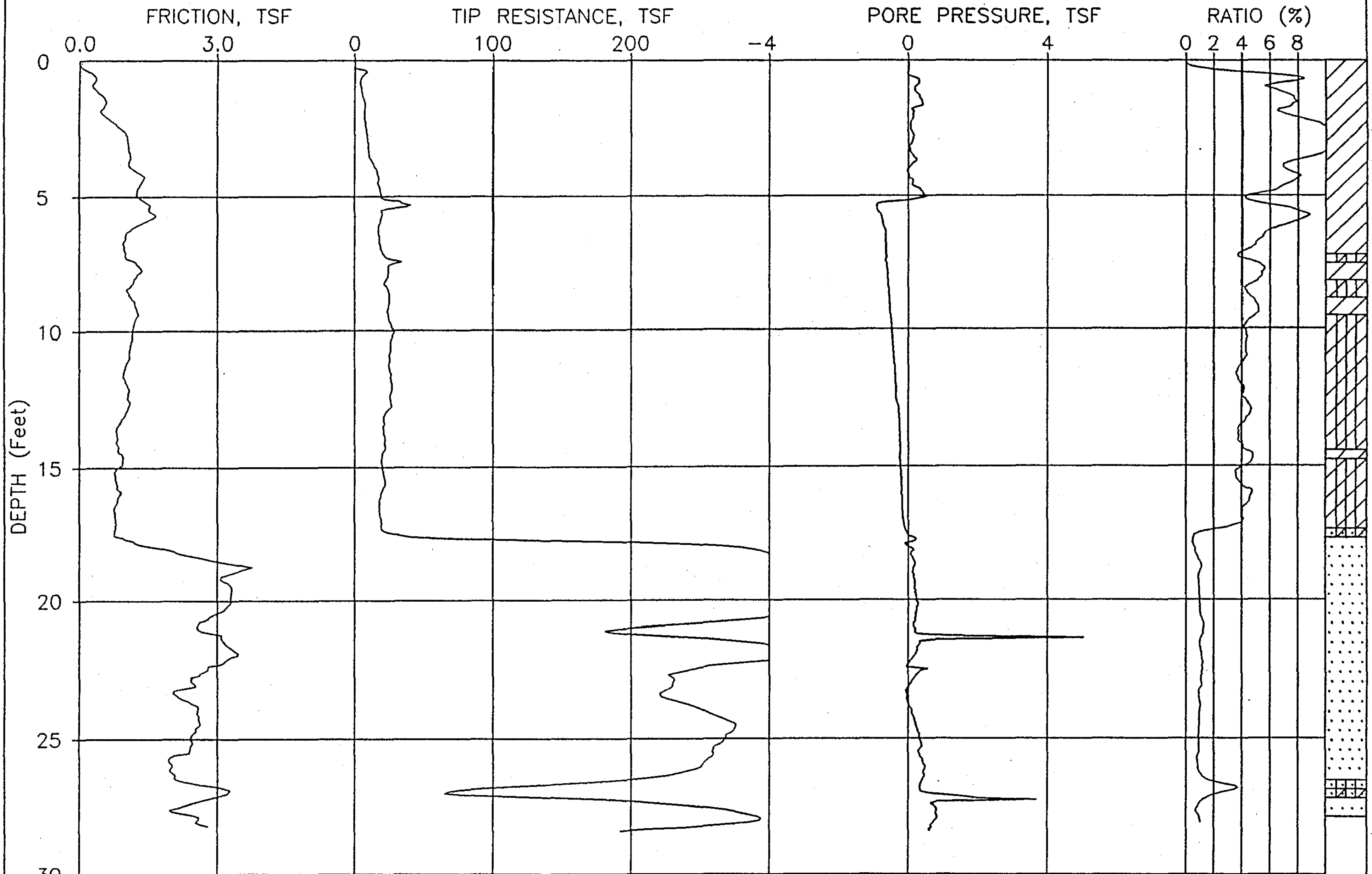

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DATE: 09-15-2004

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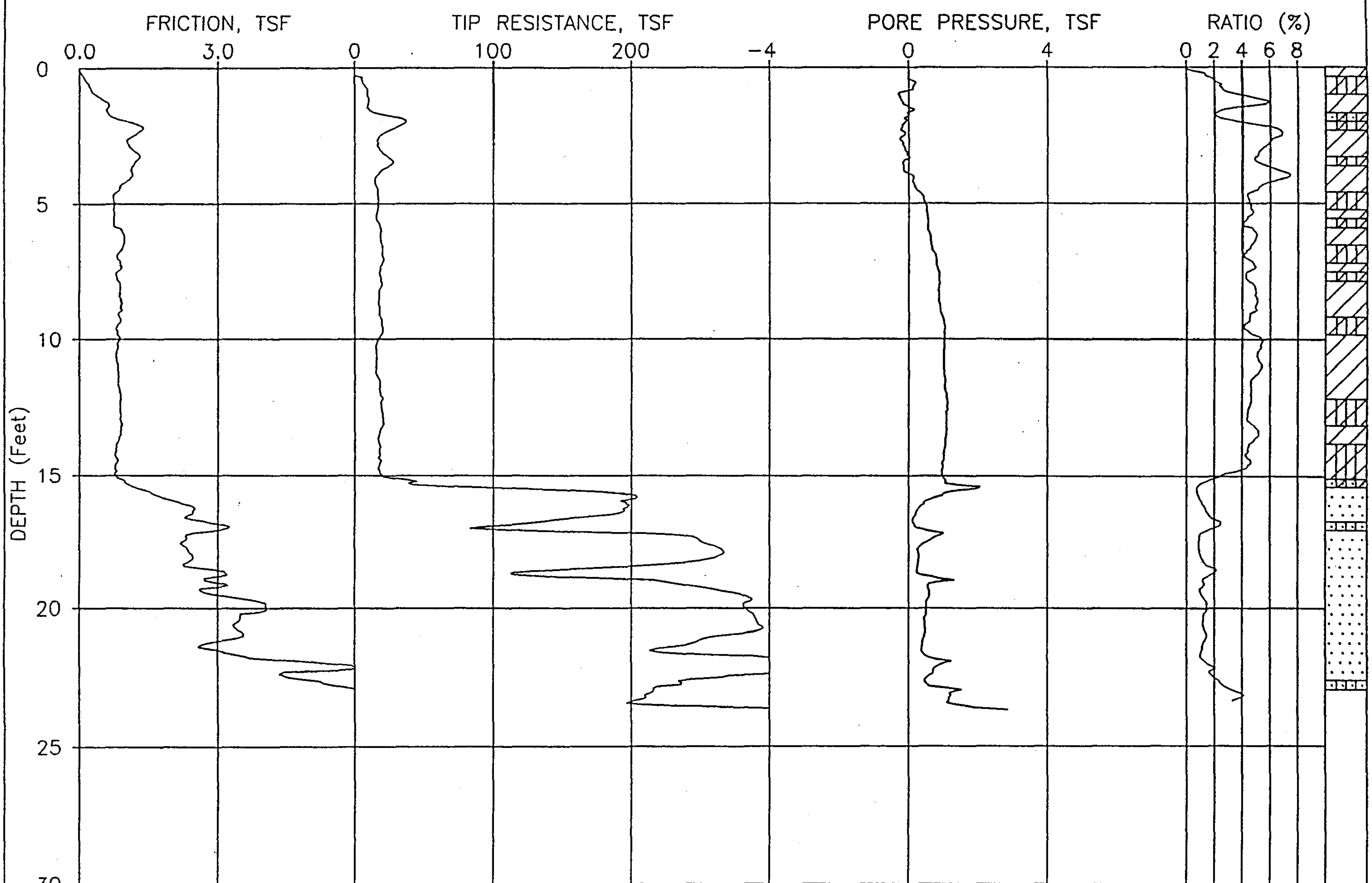
CONE NUMBER: F7.5CKEW1300

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



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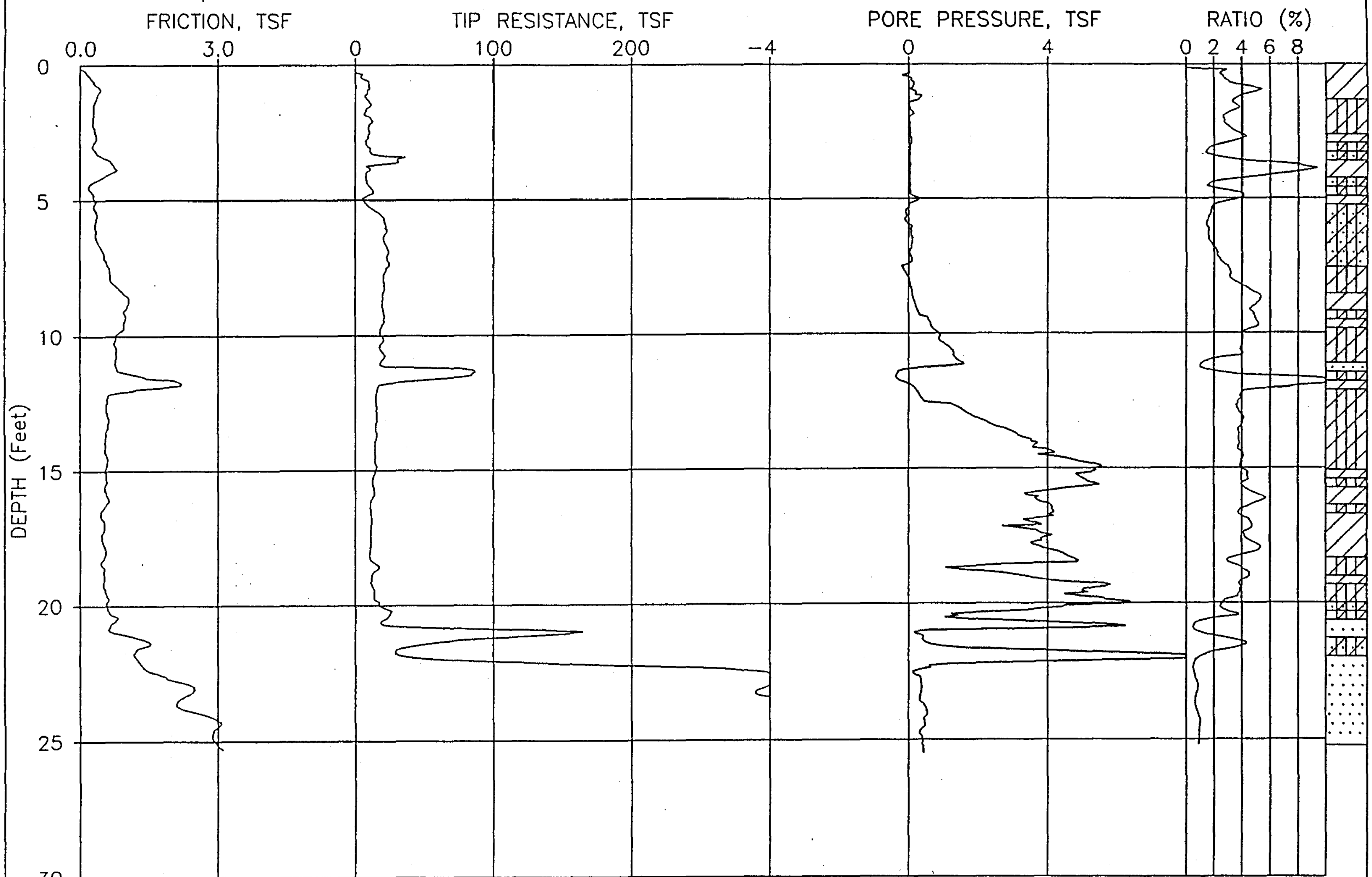
CONE NUMBER: F7.5CKEW1300

DATE: 09-16-2004

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0302-0605

ELEVATION: 0.00

CPT NUMBER: LIF-21

CONE NUMBER: F7.5CKEW1300

DATE: 09-16-2004

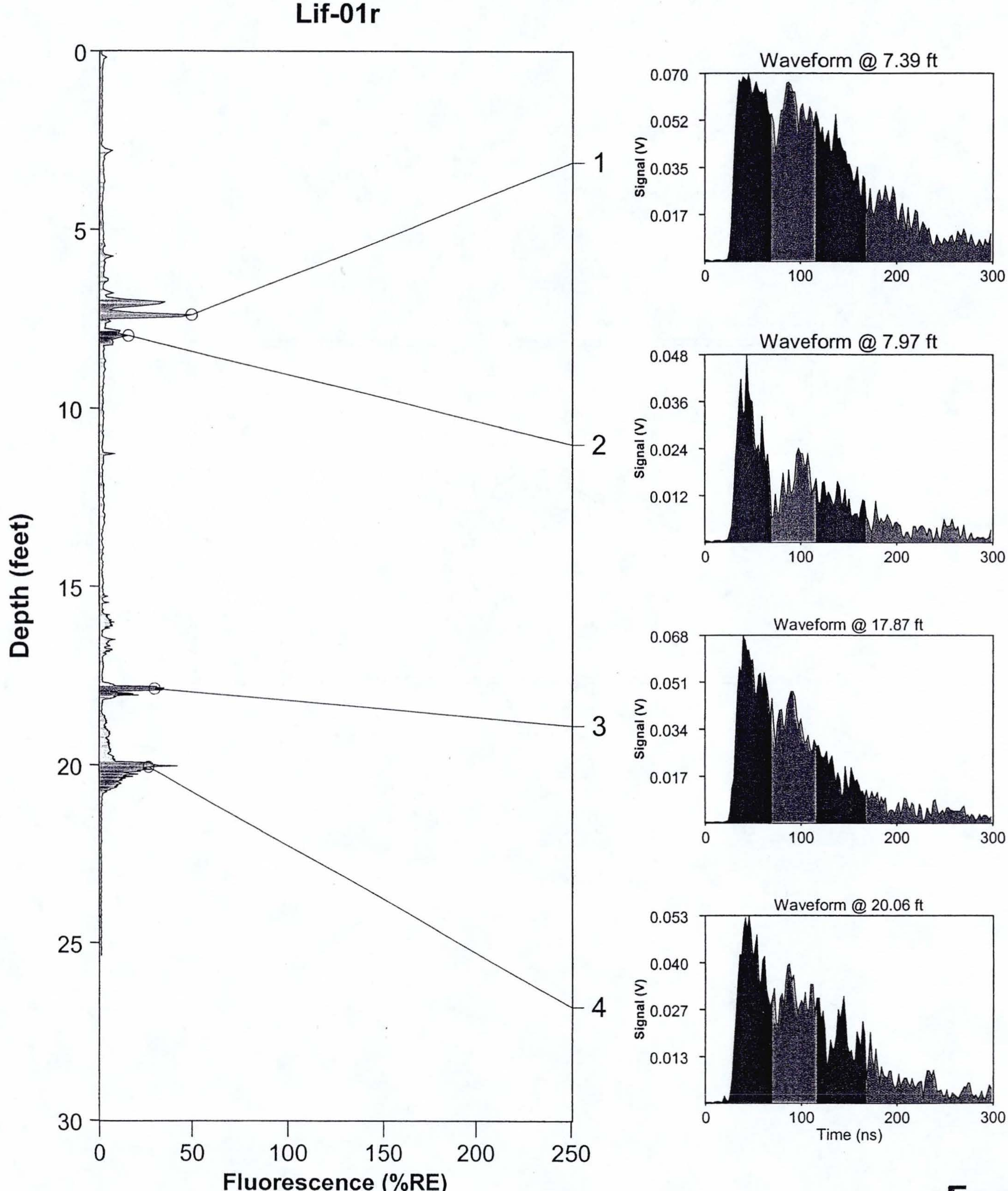
PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC

ROST™
LOGS

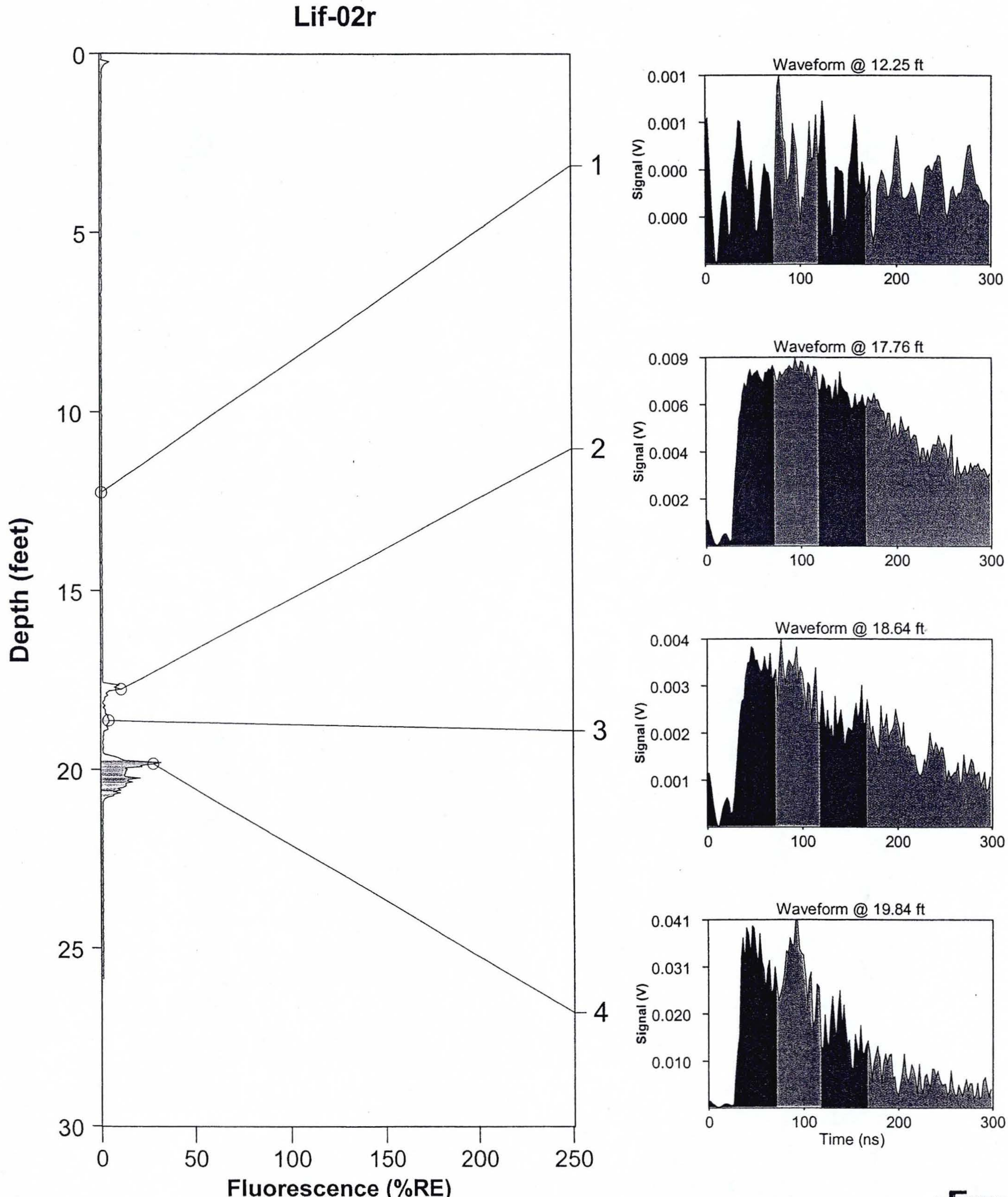
ROST Fluorescence Response Data

Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/13/2004 @ 11:30:58 AM	Max fluorescence: 49.55% @ 7.39 ft
ROST Unit: 5	Final depth BGS: 25.37 ft



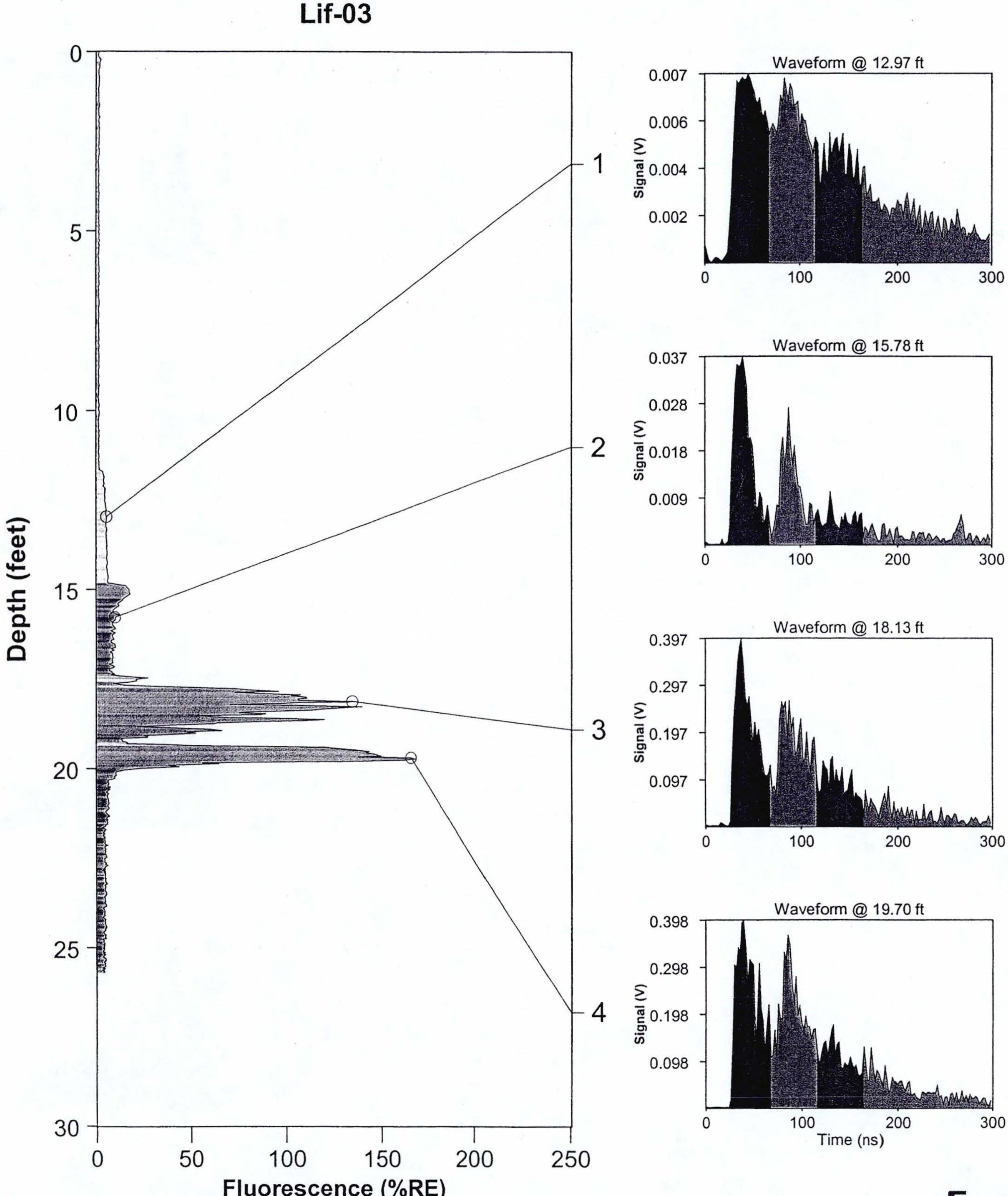
ROST Fluorescence Response Data

Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/16/2004 @ 6:39:07 AM	Max fluorescence: 31.32% @ 19.80 ft
ROST Unit: 5	Final depth BGS: 25.88 ft



ROST Fluorescence Response Data

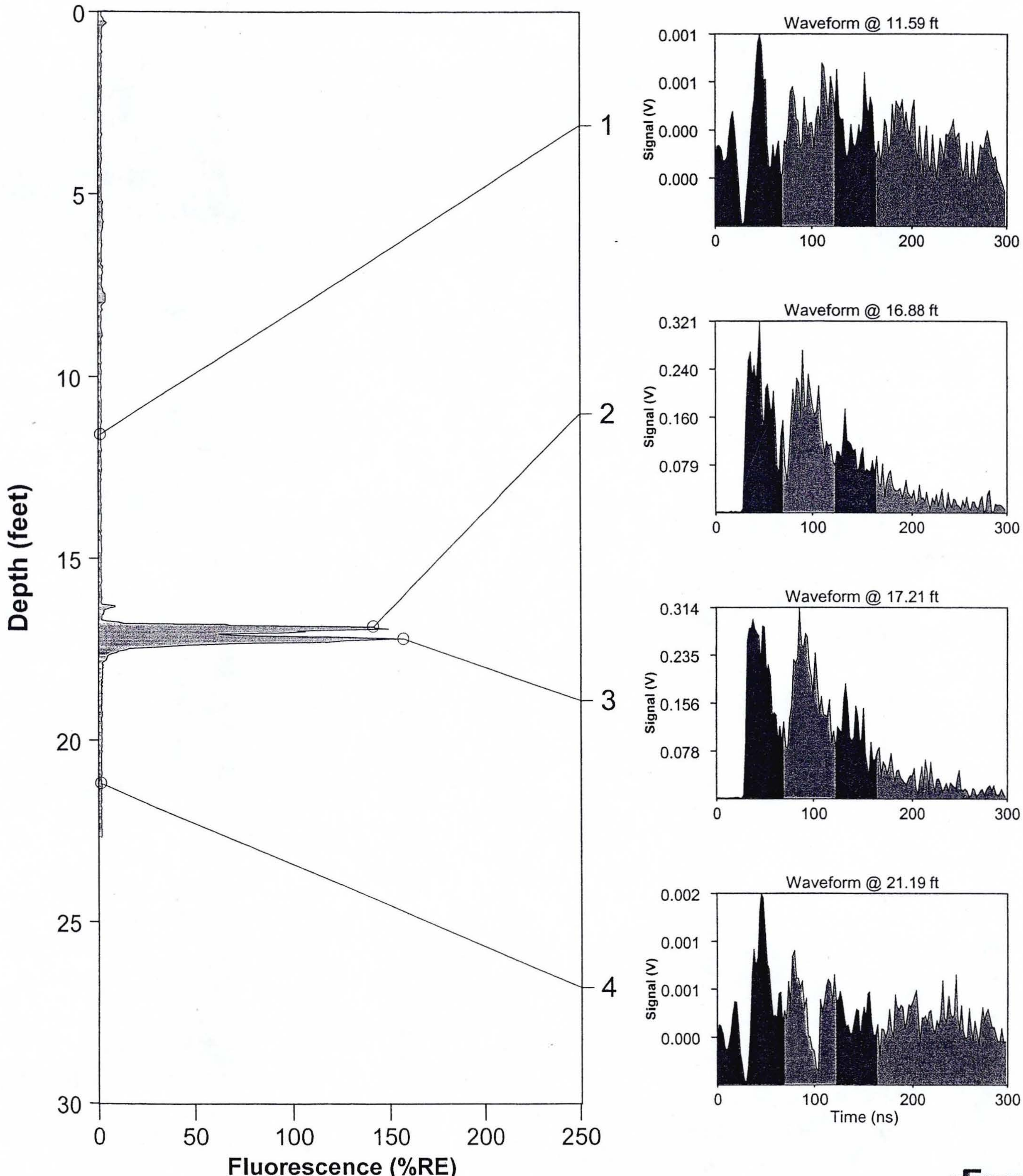
Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/13/2004 @ 1:53:28 PM	Max fluorescence: 167.39% @ 19.73 ft
ROST Unit: 5	Final depth BGS: 25.70 ft



ROST Fluorescence Response Data

Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/14/2004 @ 7:38:09 AM	Max fluorescence: 157.19% @ 17.21 ft
ROST Unit: 5	Final depth BGS: 22.68 ft

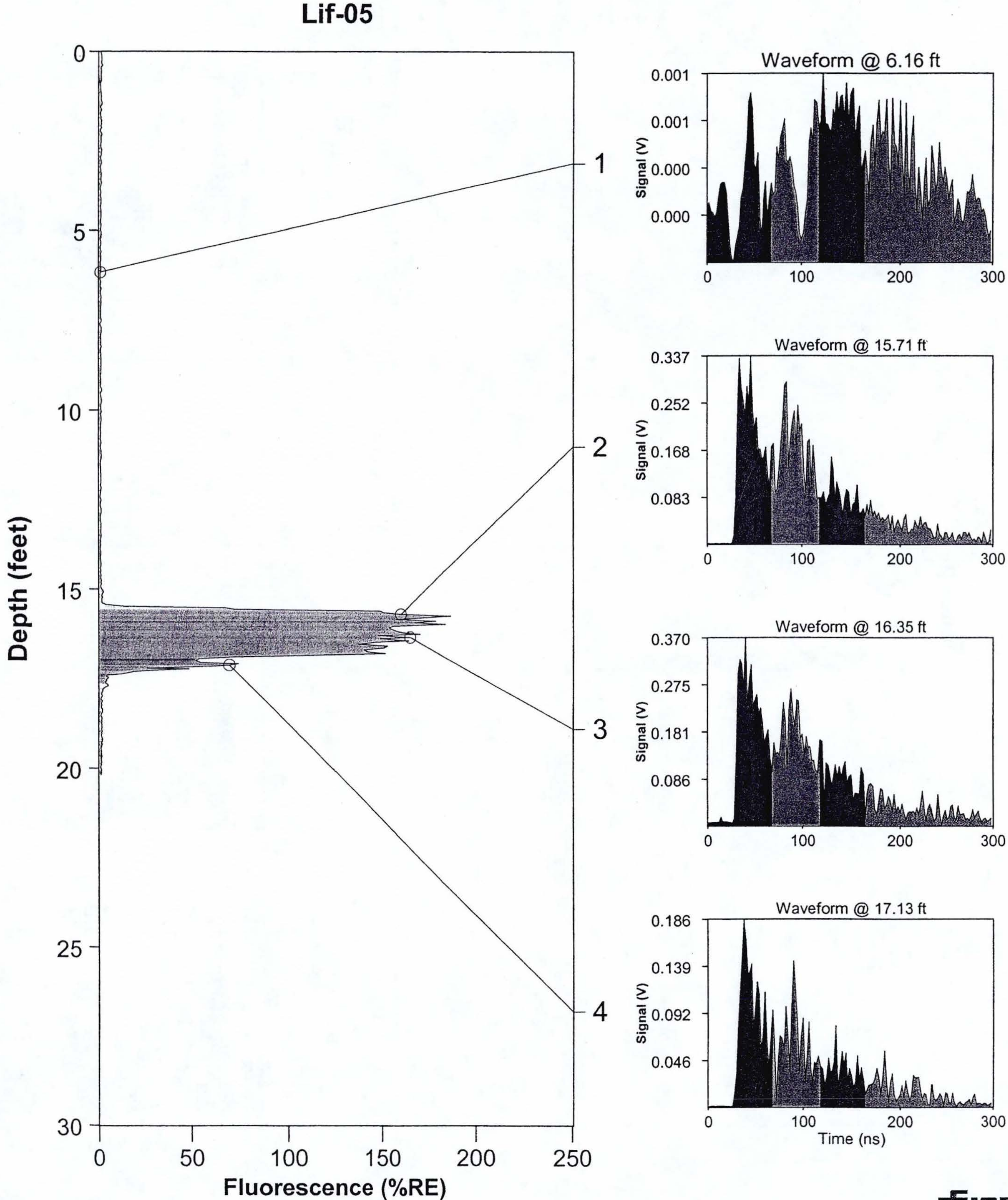
Lif-04



FUGRO

ROST Fluorescence Response Data

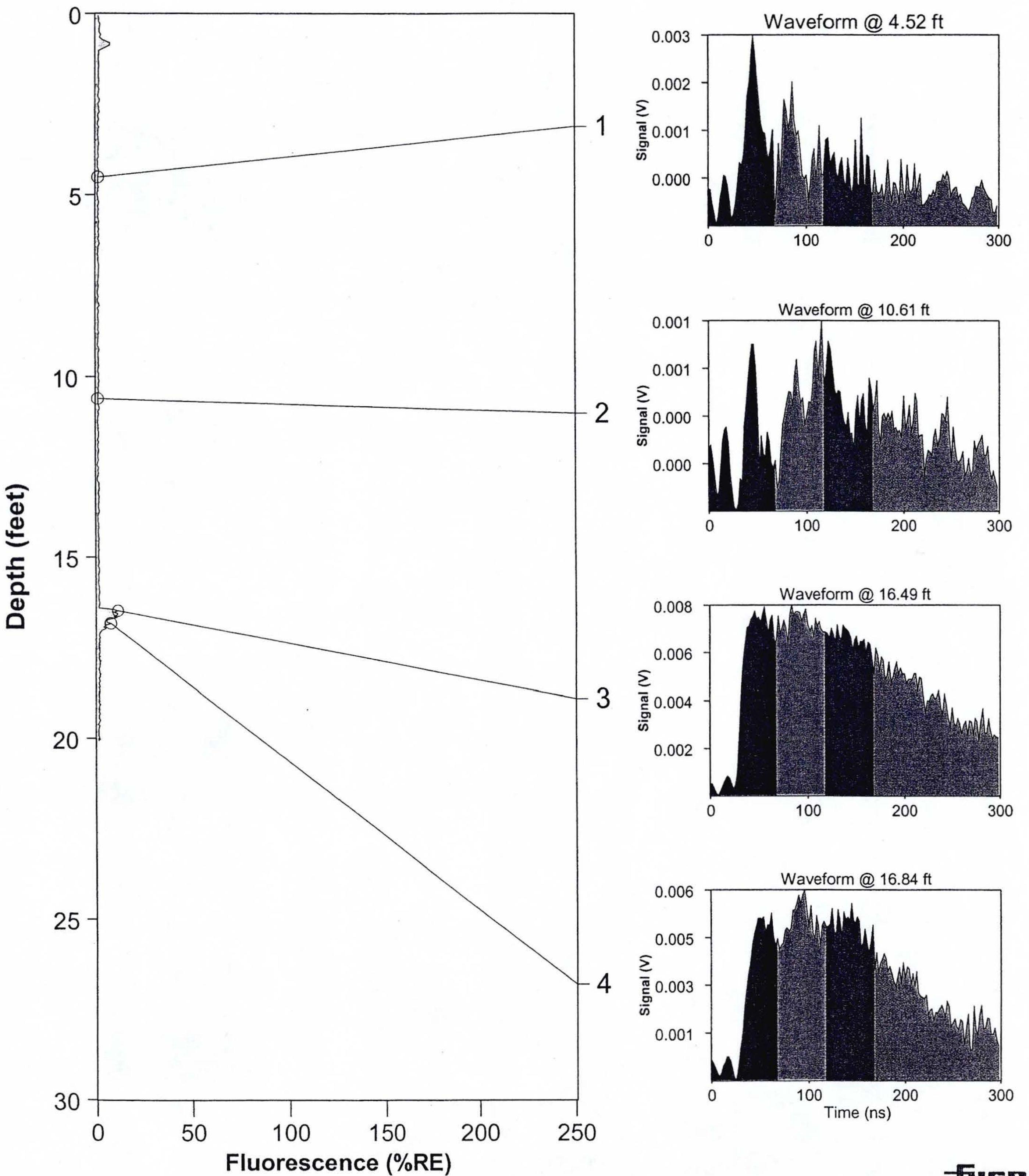
Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/14/2004 @ 8:34:04 AM	Max fluorescence: 186.18% @ 15.76 ft
ROST Unit: 5	Final depth BGS: 20.19 ft



ROST Fluorescence Response Data

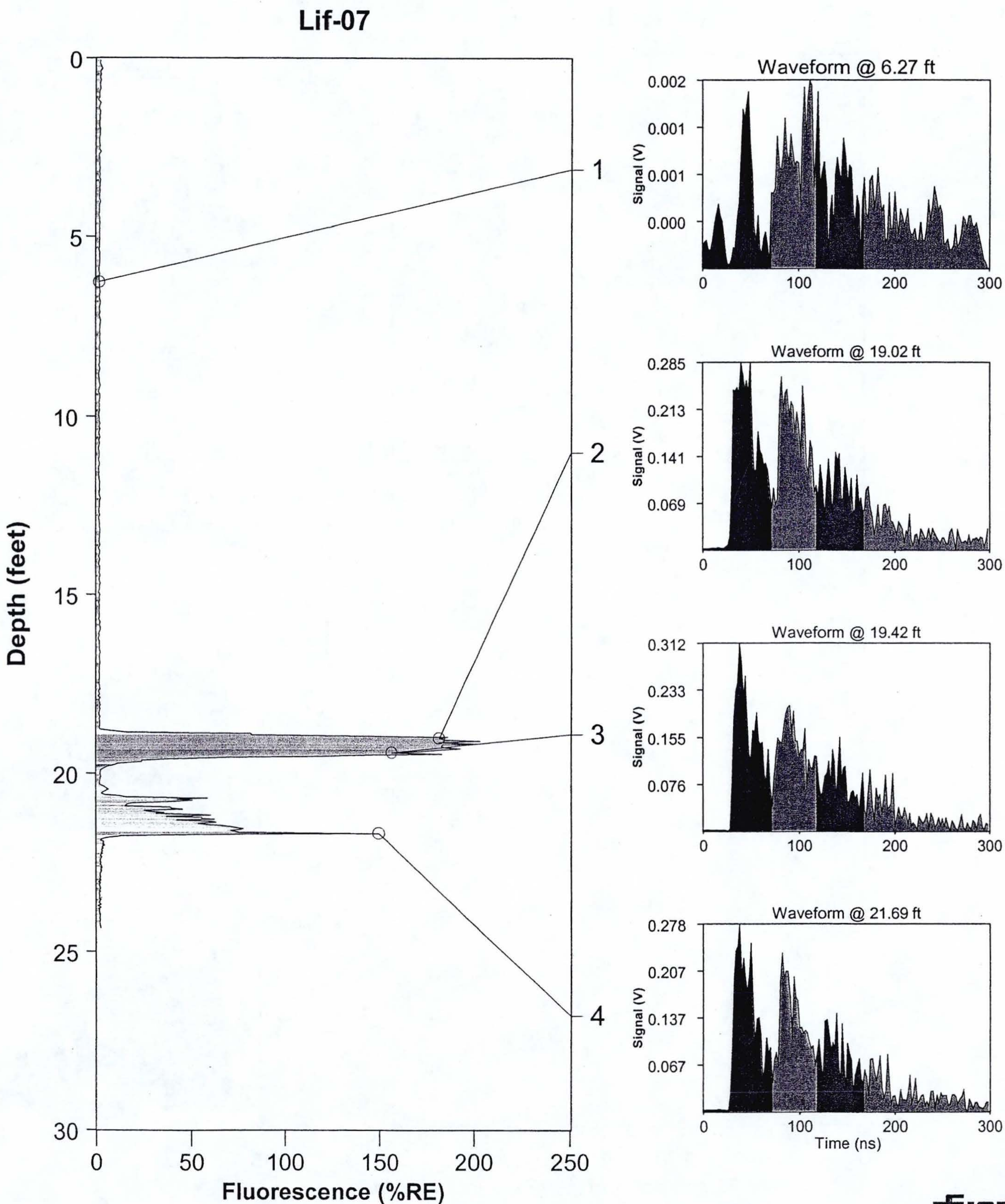
Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/14/2004 @ 9:17:46 AM	Max fluorescence: 10.83% @ 16.49 ft
ROST Unit: 5	Final depth BGS: 20.07 ft

Lif-06



ROST Fluorescence Response Data

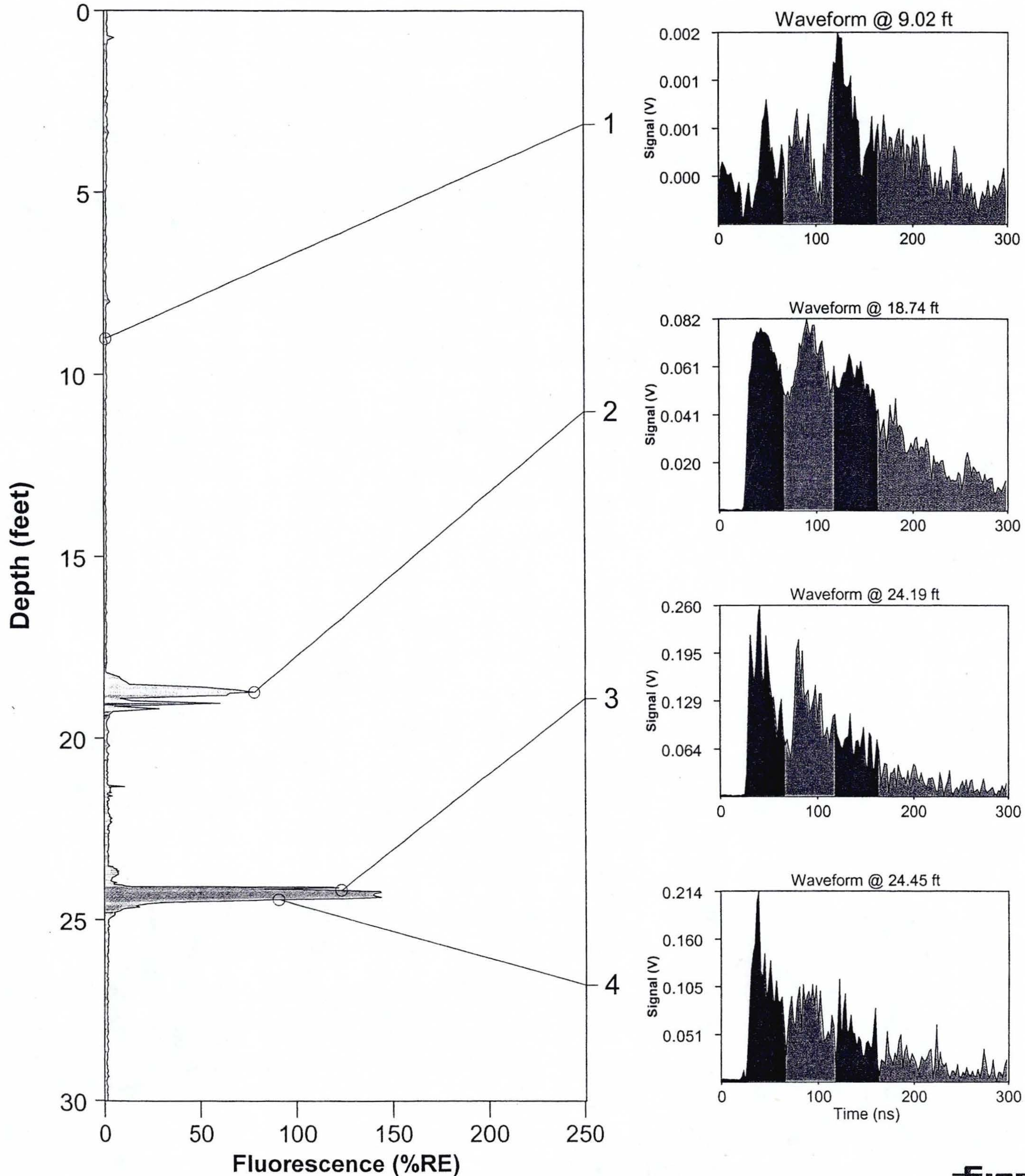
Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/14/2004 @ 10:30:25 AM	Max fluorescence: 202.87% @ 19.09 ft
ROST Unit: 5	Final depth BGS: 24.35 ft



ROST Fluorescence Response Data

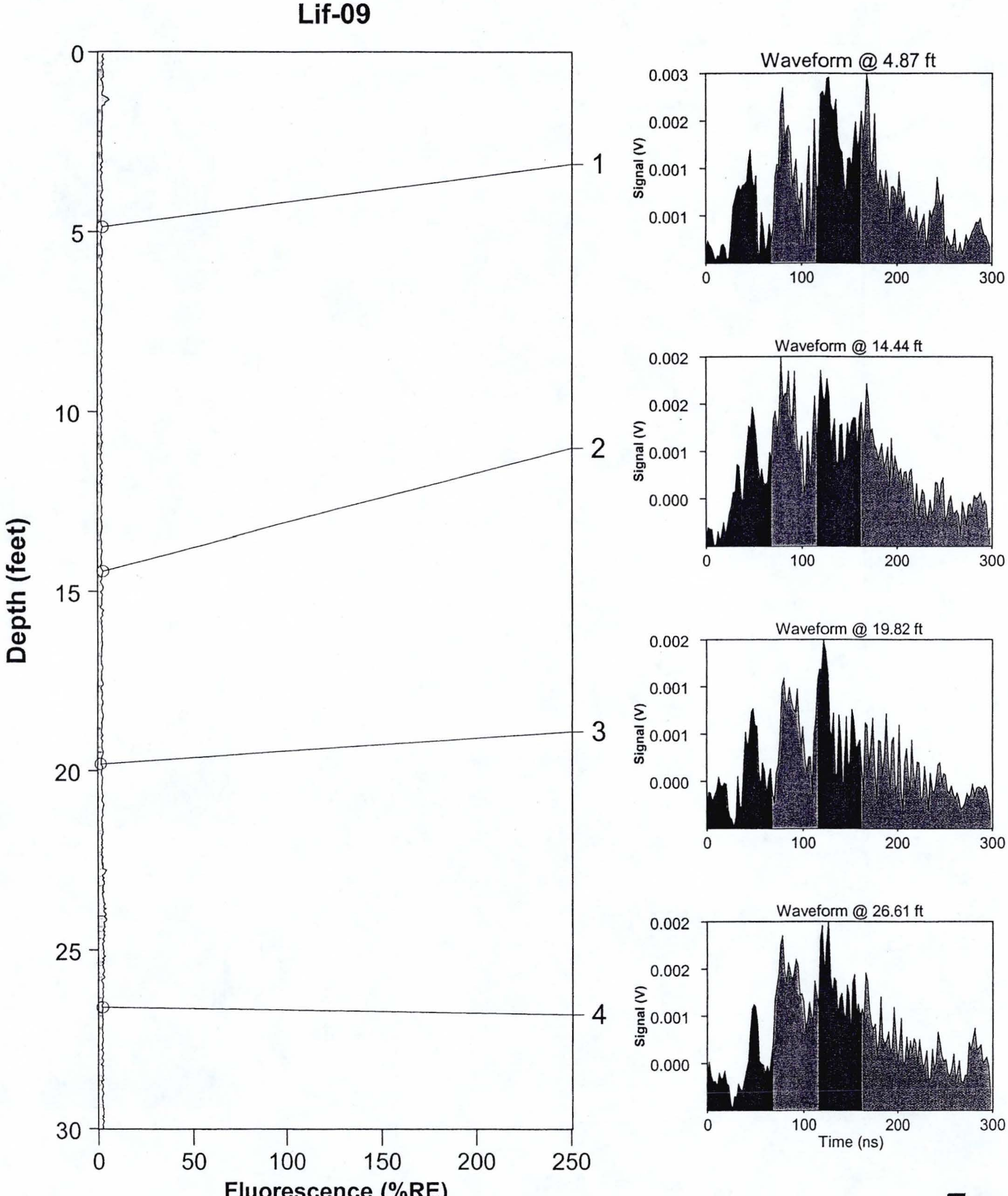
Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/14/2004 @ 1:21:27 PM	Max fluorescence: 143.82% @ 24.38 ft
ROST Unit: 5	Final depth BGS: 30.04 ft

Lif-08



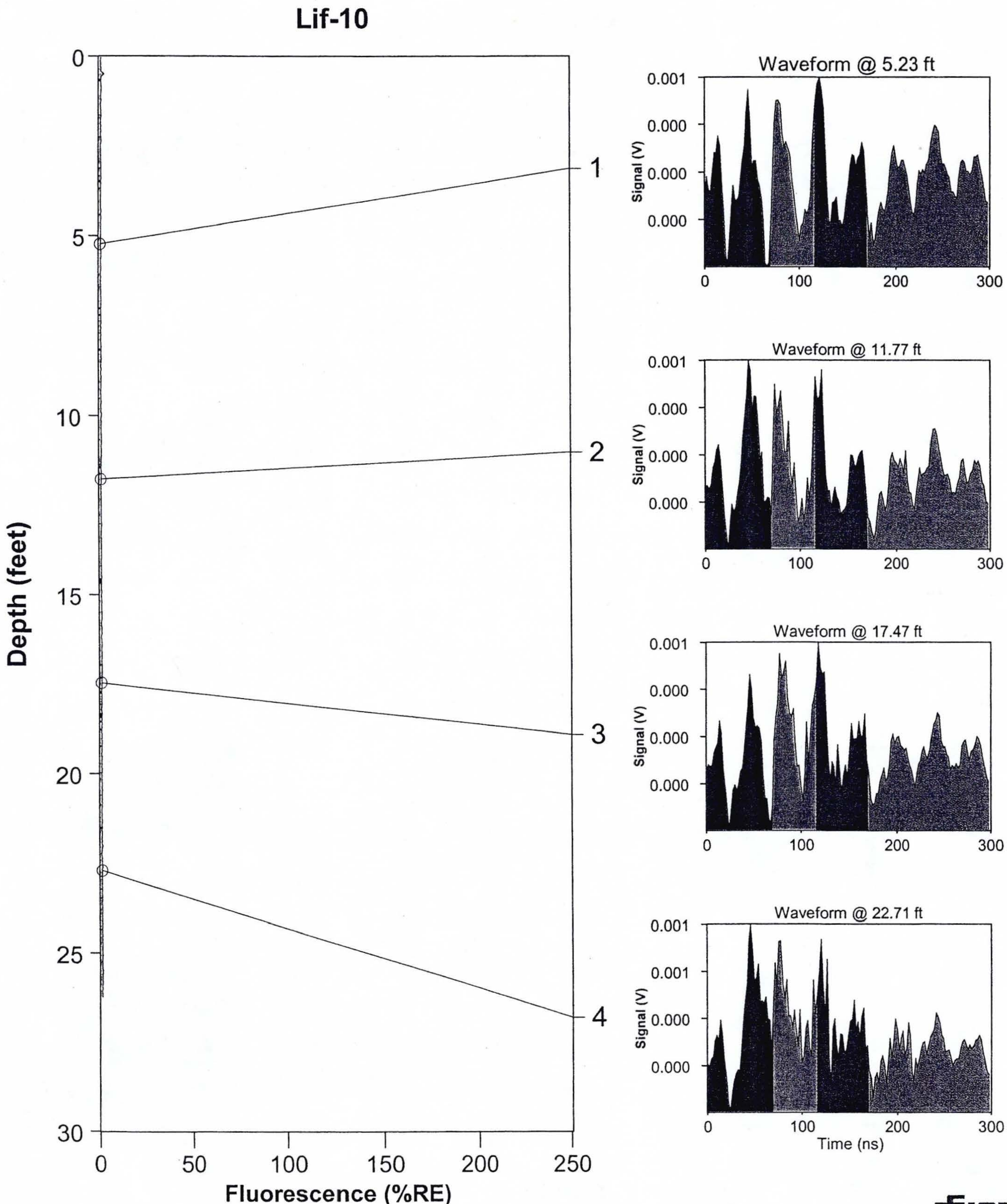
ROST Fluorescence Response Data

Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/14/2004 @ 2:13:49 PM	Max fluorescence: 5.36% @ 1.35 ft
ROST Unit: 5	Final depth BGS: 30.07 ft



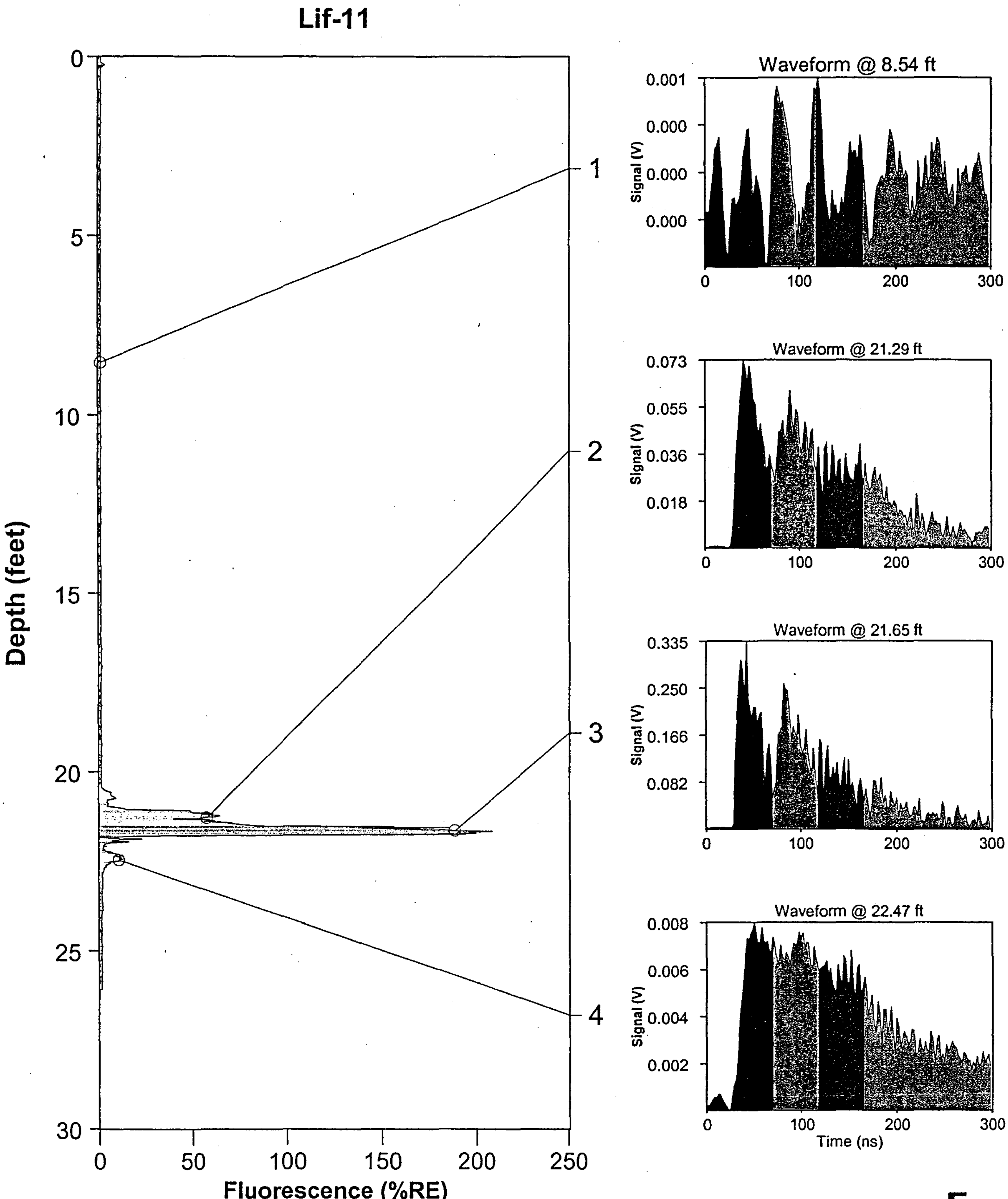
ROST Fluorescence Response Data

Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/15/2004 @ 7:54:47 AM	Max fluorescence: 2.59% @ 0.50 ft
ROST Unit: 5	Final depth BGS: 26.24 ft



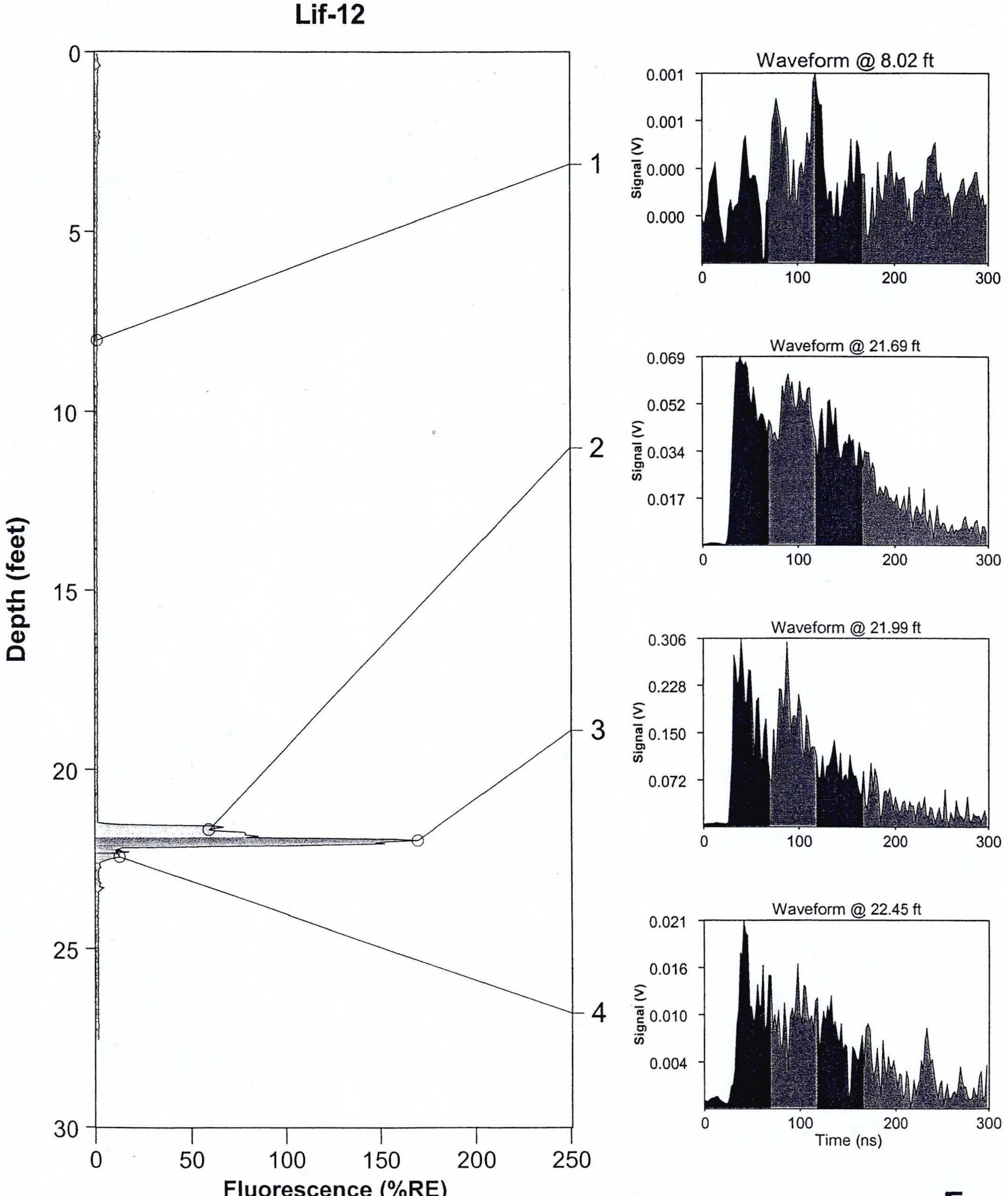
ROST Fluorescence Response Data

Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/15/2004 @ 8:42:06 AM	Max fluorescence: 207.92% @ 21.67 ft
ROST Unit: 5	Final depth BGS: 26.10 ft



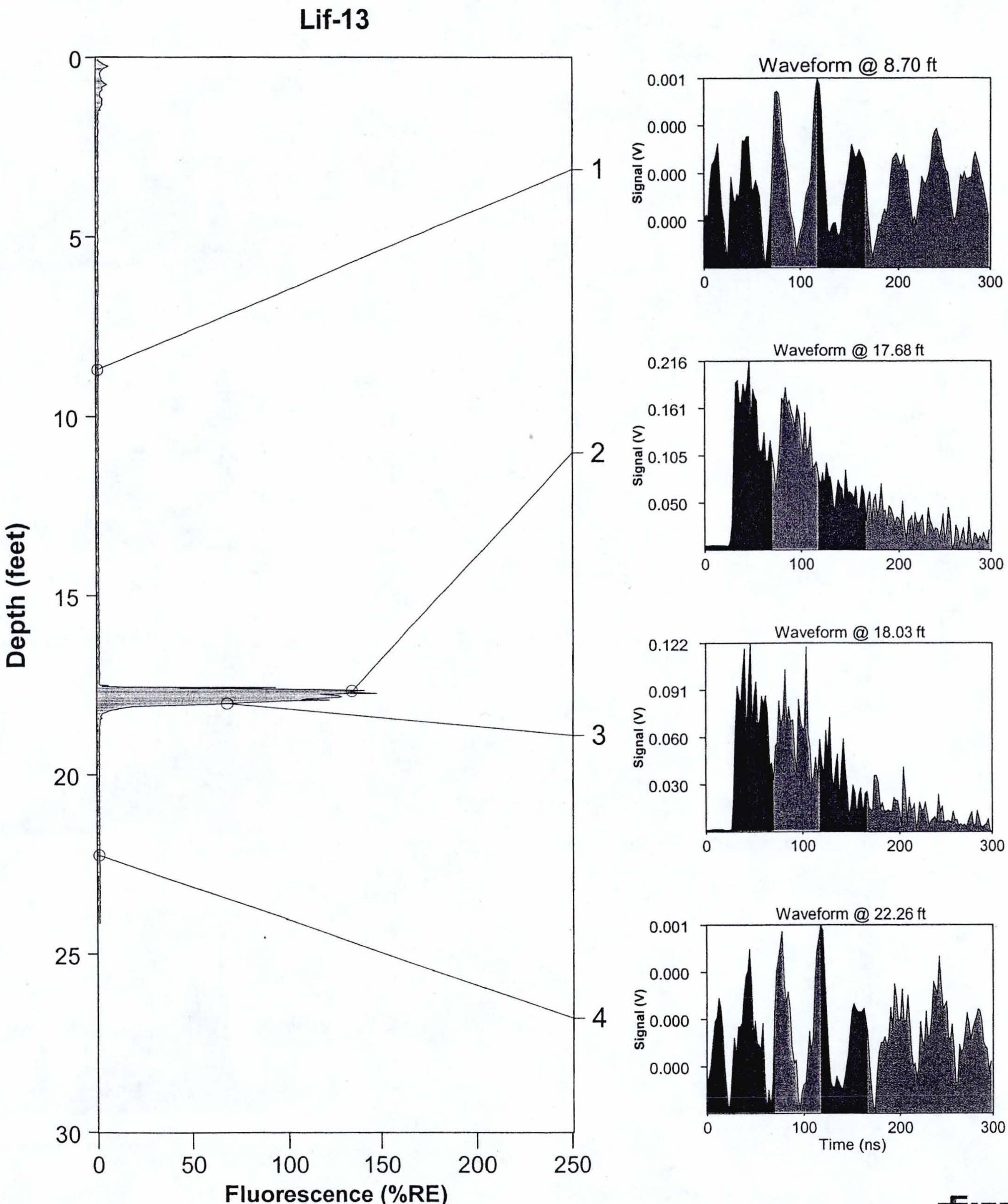
ROST Fluorescence Response Data

Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/15/2004 @ 9:35:10 AM	Max fluorescence: 169.62% @ 21.99 ft
ROST Unit: 5	Final depth BGS: 27.55 ft



ROST Fluorescence Response Data

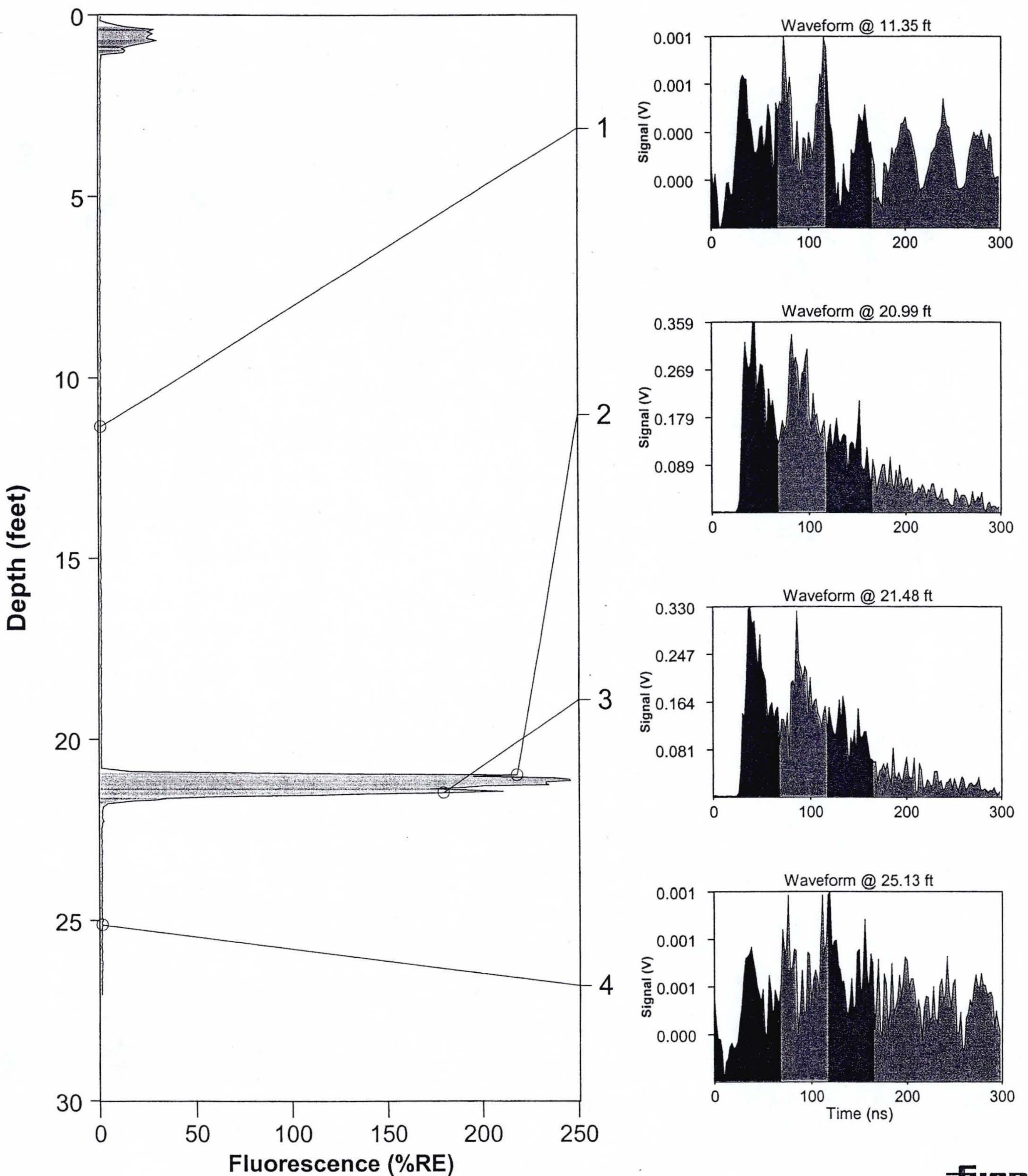
Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/15/2004 @ 10:30:47 AM	Max fluorescence: 147.25% @ 17.74 ft
ROST Unit: 5	Final depth BGS: 24.16 ft



ROST Fluorescence Response Data

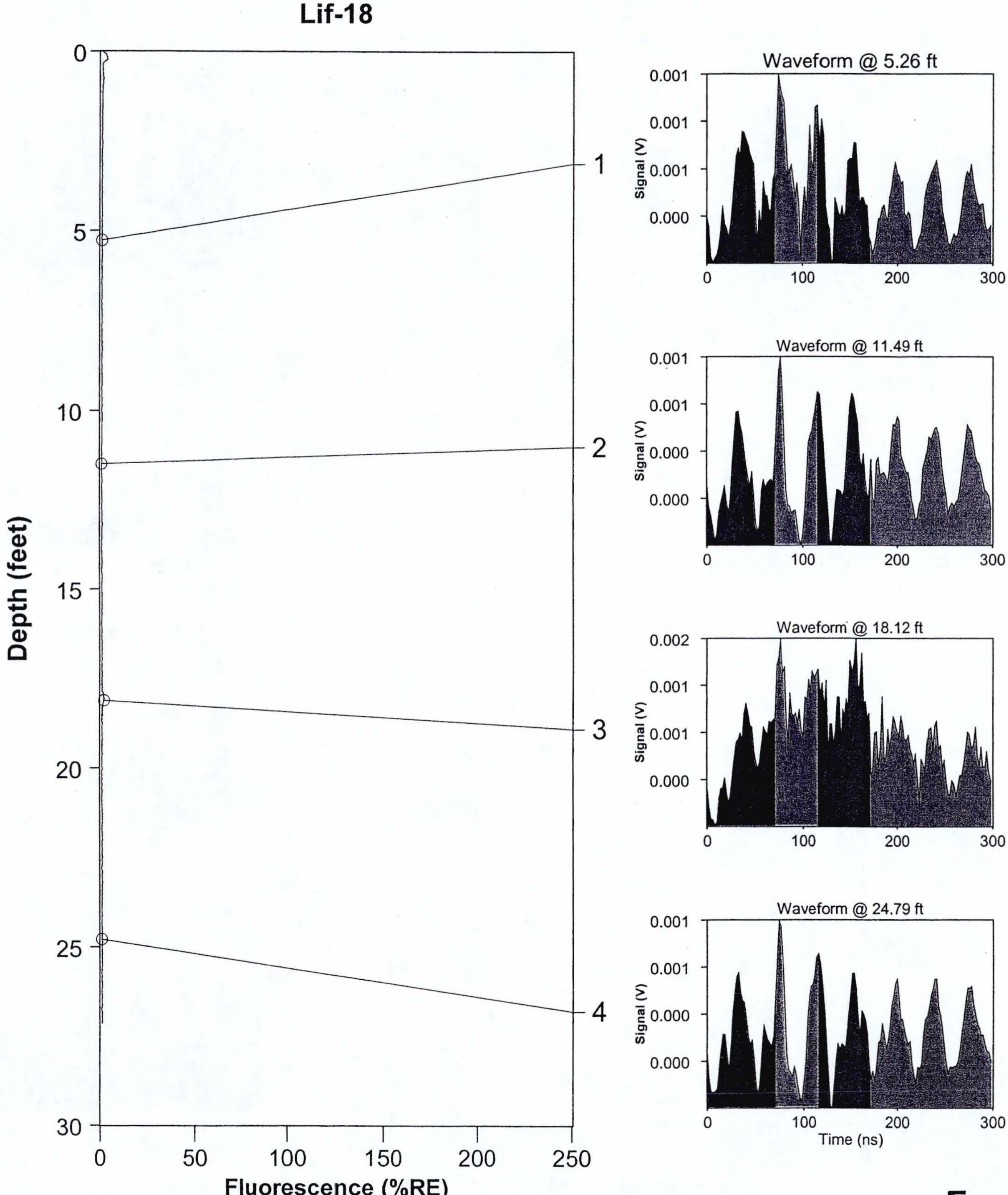
Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/15/2004 @ 11:56:34 AM	Max fluorescence: 245.67% @ 21.15 ft
ROST Unit: 5	Final depth BGS: 27.07 ft

Lif-14



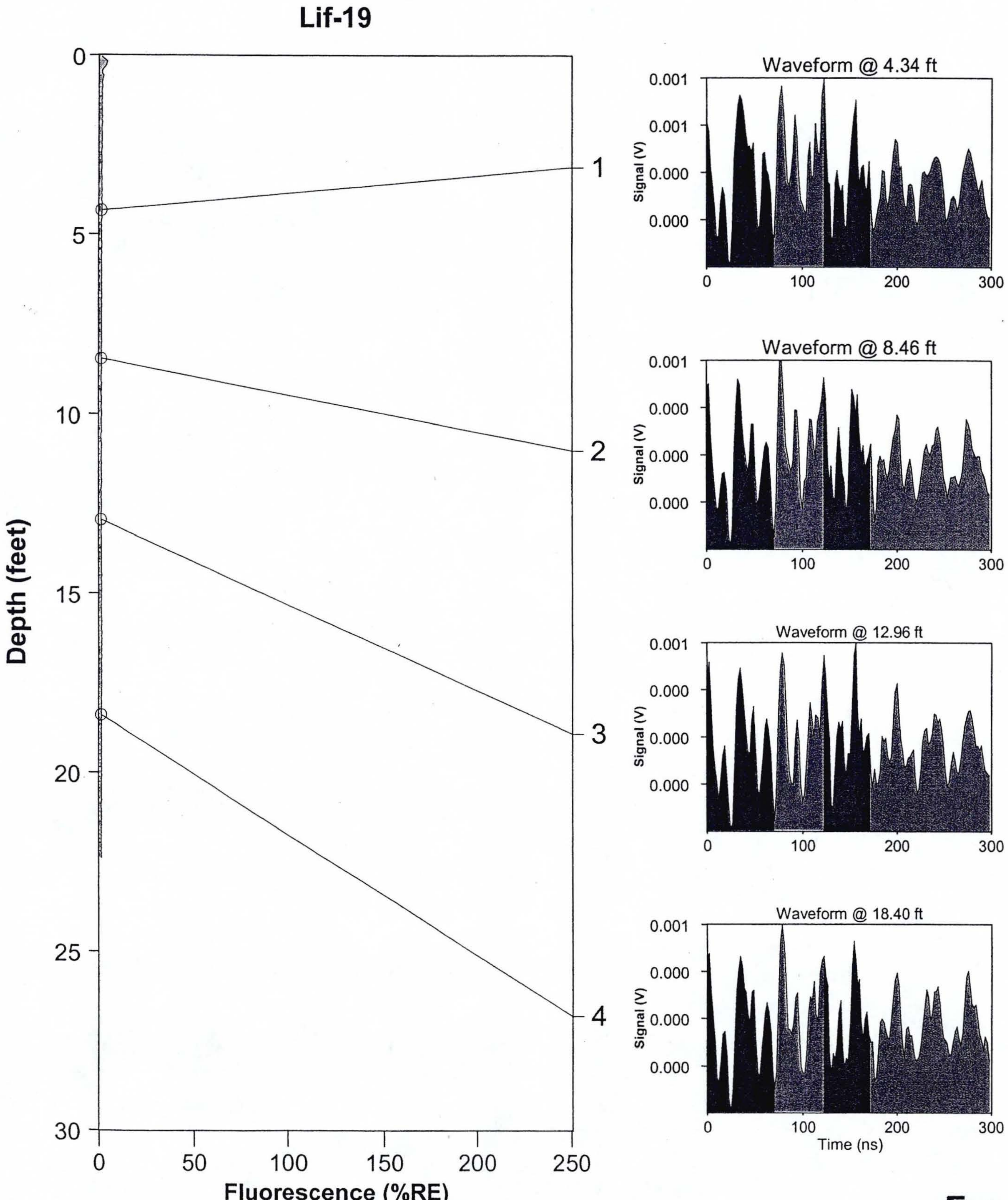
ROST Fluorescence Response Data

Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/15/2004 @ 3:31:03 PM	Max fluorescence: 3.60% @ 0.24 ft
ROST Unit: 5	Final depth BGS: 27.15 ft



ROST Fluorescence Response Data

Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/16/2004 @ 5:37:47 AM	Max fluorescence: 3.83% @ 0.18 ft
ROST Unit: 5	Final depth BGS: 22.40 ft



ROST Fluorescence Response Data

Site: SUPERIOR,WI.	Operator: GLENN
Client: DELTA	Fugro Job #: 0302-0605
Date/Time: 9/16/2004 @ 8:55:26 AM	Max fluorescence: 48.08% @ 21.23 ft
ROST Unit: 5	Final depth BGS: 24.24 ft