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Summary Report of Geophysical Logging for the Seismic Boreholes Project at the Hanford Site Waste Treatment Plant

M. G. Gardner
R. K. Price

February 2007

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SUMMARY REPORT OF GEOPHYSICAL LOGGING FOR THE SEISMIC BOREHOLES PROJECT AT THE HANFORD SITE WASTE TREATMENT PLANT

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TERMS

ASTM	American Society for Testing and Materials
bgs	below ground surface
BNI	Bechtel National, Inc.
DOE	U.S. Department of Energy
HWT	standard designation for wireline drill bits and drill rods of nominally 3.782 in. and 3.5 in., respectively.
NQA-1	ASME NQA1-1, 1989 edition, *Quality Assurance Program Requirements for Nuclear Facilities*
PC-3	Performance Category 3
PNNL	Pacific Northwest National Laboratory
QAPjP	Quality Assurance Project Plan
SBP	Seismic Boreholes Project
Vp	compressional wave velocity
Vs	shear wave velocity
WELNAV	Wellbore Navigation, Inc.
WTP	Waste Treatment Plant

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SUMMARY REPORT OF GEOPHYSICAL LOGGING FOR THE SEISMIC BOREHOLES PROJECT AT THE HANFORD SITE WASTE TREATMENT PLANT

1.0 INTRODUCTION

During the period of June through October 2006, three deep boreholes and one corehole were drilled beneath the site of the Waste Treatment Plant (WTP) at the U.S. Department of Energy (DOE) Hanford Site near Richland, Washington. The boreholes were drilled to provide information on ground-motion attenuation in the basalt and interbedded sediments underlying the WTP site. This report describes the geophysical logging of the deep boreholes that was conducted in support of the Seismic Boreholes Project, defined below. The detailed drilling and geological descriptions of the boreholes and seismic data collected and analysis of that data are reported elsewhere.

1.1 WASTE TREATMENT PLANT AND THE SEISMIC BOREHOLES PROJECT

The seismic design basis for the WTP was reevaluated in 2005, resulting in an increase by up to 40% in the seismic design basis. In 1999, the original seismic design basis for the WTP was based on a probabilistic seismic hazard analysis completed in 1996. The 2005 analysis was performed to address questions raised by the Defense Nuclear Facilities Safety Board about the assumptions used in developing the original seismic criteria and about the adequacy of the site geotechnical surveys. The updated seismic response analysis used existing and newly acquired seismic velocity data, statistical analysis, expert elicitation, and ground-motion simulation to develop interim design ground-motion response spectra that enveloped the remaining uncertainties. The uncertainties in these response spectra were enveloped at approximately the 84th percentile to produce conservative design spectra, which contributed significantly to the increase in the seismic design basis.

A key uncertainty identified in the 2005 analysis was the velocity contrasts between the basalt flows and the sedimentary interbeds beneath the WTP. The velocity structure of the upper four basalt flows (Saddle Mountains Basalt) and that of the interlayered sedimentary interbeds (Ellensburg Formation) produce strong reductions in modeled earthquake ground motions propagating through them. Uncertainty in the strength of velocity contrasts between these basalts and interbeds resulted primarily from an absence of measured shear wave velocities (Vs) in the interbeds. For the 2005 analysis, Vs in the interbeds was estimated from older, limited compressional wave (Vp) data using estimated ranges for the ratio of the two velocities (Vp/Vs) based on analogues in similar materials. A range of possible Vs for the interbeds and basalts was used and produced additional uncertainty in the resulting response spectra.

Because of the sensitivity of the calculated response spectra to the velocity contrasts between the basalts and interbedded sediments, DOE initiated the Seismic Boreholes Project (SBP) to emplace additional boreholes at the WTP site and obtain direct Vs measurements and other physical property measurements in these layers. One corehole and three boreholes were installed at the WTP site to a maximum depth of 447.45 m (1,468 ft) below ground surface (bgs). The three boreholes are within 152.4 m (500 ft) of and surround the high-level waste vitrification and pretreatment facilities of the WTP, the Performance Category 3 (PC-3) structures affected by the interim design spectra. The corehole is co-located with the borehole closest to the two PC-3 structures. The new measurements from the seismic boreholes are expected to reduce the uncertainty in the modeled site response that has been caused by the lack of direct knowledge of the Vs contrasts within these basalt and interbed layers.

1.2 ORGANIZATION AND RESPONSIBILITY

Work described in this report was conducted by Pacific Northwest National Laboratory (PNNL) and subcontractors for the U.S. Department of Energy. Bechtel National, Inc. (BNI) is responsible for WTP construction and all WTP site control. Drilling was subcontracted by PNNL, and drill site supervisory and logistical services were provided by Energy*Solutions*, Inc. (formerly Duratek Federal Services, Inc.) and subcontractors. Additional site personnel were provided by Fluor Hanford, Inc. Drilling of the entry holes for the deep boreholes was performed by Blue Star Enterprises Northwest, Inc., of Richland, Washington. The cored portion (basalt and interbeds) of the C4998 corehole was drilled by Layne Christensen Company of Salt Lake City, Utah. The remaining three deep boreholes were drilled by WDC Exploration and Wells of Woodland, California.

1.3 PROCEDURE REQUIREMENTS AND QUALITY ASSURANCE

PNNL has primary responsibility for quality assurance and quality control, with recognition of BNI requirements for NQA-1 standards. The Sampling and Analysis Plan (PNNL-15848) and Quality Assurance Project Plan (QAPjP[1]) were used to guide the procedure development and data collection activities needed to support borehole drilling, geophysical measurements, and sampling. The Sampling and Analysis Plan identifies standards (e.g., American Society for Testing and Materials [ASTM]), Hanford Site procedures, and other guidance documents for data collection activities.

1.4 REPORT SCOPE

This report provides and describes the data collected during geophysical logging of the three deep boreholes and the corehole. Other logging results are reported elsewhere.

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[1] *Waste Treatment Plant (WTP) Seismic Boreholes Project Quality Assurance Project Plan*, Rev. 0, March 2006, Pacific Northwest National Laboratory, Richland, Washington.

Borehole completion, geologic formations and drilling operations are summarized, where necessary, to help in understanding the geophysical logging operations.

A detailed discussion of data processing of logging is beyond the scope of this report. There is no analysis or interpretation of the log results, either, since these are discussed in other reports yet to be completed at the time of this document. The other types of logging, such as suspension logging, seismic logging, and gravity/density logging will be reported in documents to be released by PNNL.

1.5 OBJECTIVES

The objective of this report is to present the results of the geophysical logging activities. The overall objectives for conducting geophysical logging in the boreholes and corehole were to acquire subsurface data to support the progression of the drilling activities and to supplement the geologic and seismic data collection. The depth unit (feet) for this project was selected as dominant over the metric unit (meter) for the following reasons.

- Drilling equipment depth is in feet (drill stem and drill collar lengths are 20 ft. Drilling recorder depths are in feet).
- Logging equipment (logging cable measuring wheel) depth is calibrated in feet.

The borehole/corehole deviation and orientation as well as the borehole gauge (diameter) were tracked throughout the drilling process as the holes were advanced. The borehole size (diameter) unit (inch) for this project was selected as dominant over the metric unit (centimeter) for the following reasons.

- The drill bit size is in inches (7-7/8 in.)
- The logging equipment caliper calibration jig is in inches. The two calibration sizes for this project were 6 in. and 12 in.
- Casing diameter is manufactured in inches.

The caliper logs collected during the boreholes advancement were used to support the borehole cementing activities as well as the collection of seismic data (to orient the down-hole data collection instruments). The suite of geophysical logs conducted once the boreholes and corehole reached total depth provided additional data to support the geologic interpretation.

2.0 DEEP BOREHOLE DESCRIPTION

2.1 BOREHOLE LOCATION

The three deep boreholes and corehole were drilled at the WTP at the DOE Hanford Site near Richland, Washington. Figure 1 is a map of the Hanford Site showing the location of the WTP. Figure 2 is a schematic of the WTP providing borehole locations and survey coordinates. The boreholes were located to surround the Pretreatment Facility and the High-Level Vitrification Facility. The corehole was paired with one of the deep boreholes at the center of the WTP site.

Figure 1. Hanford Site.

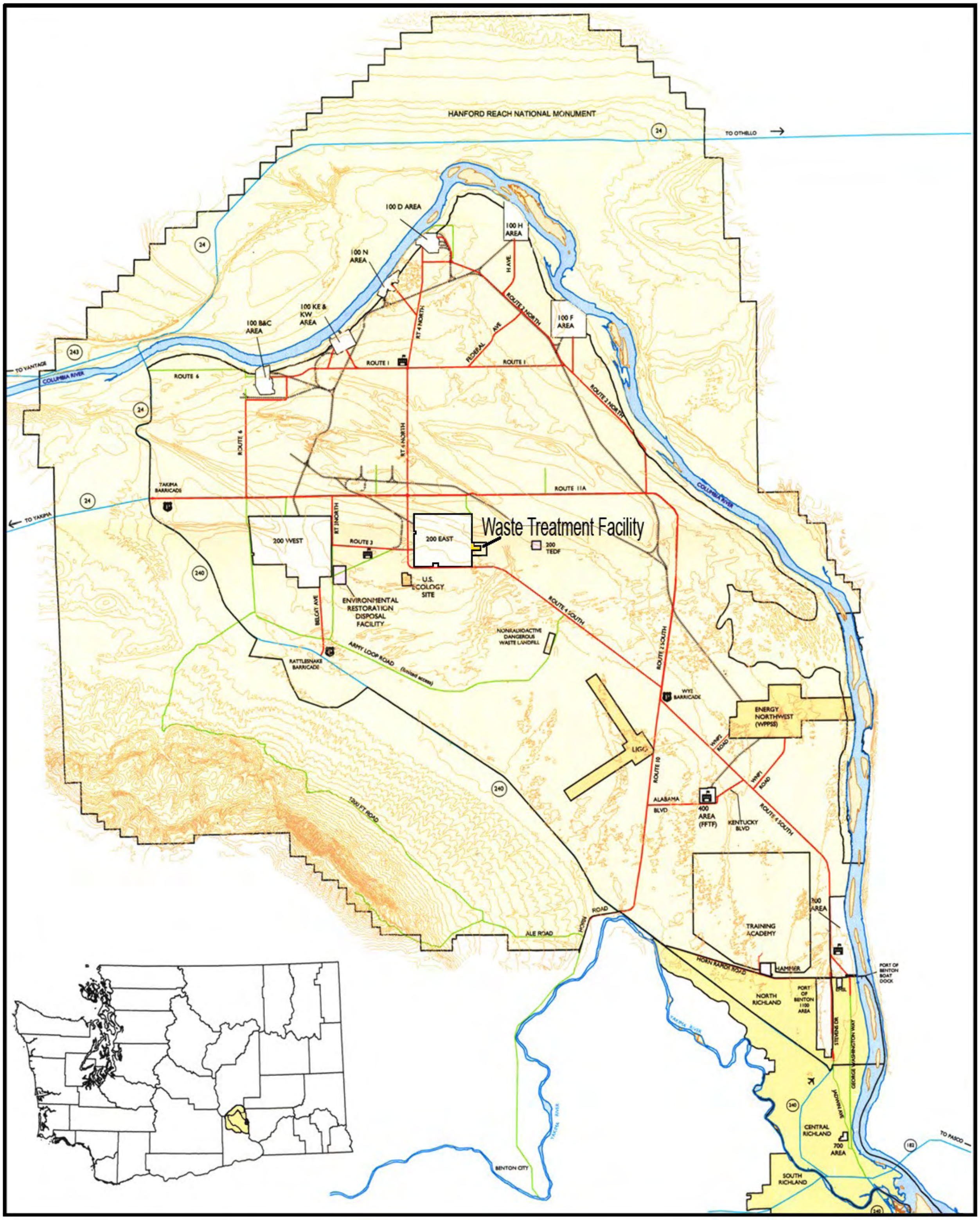
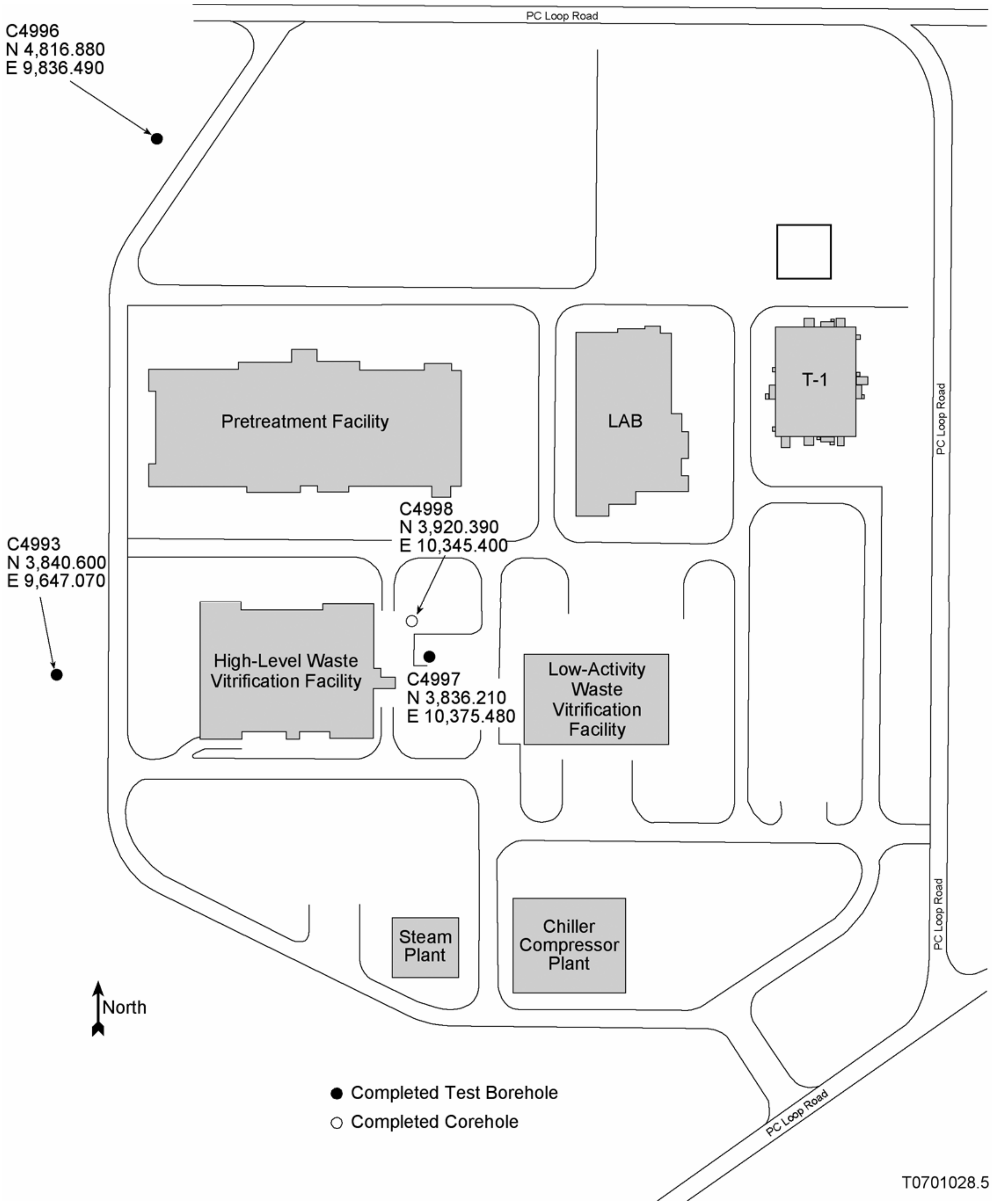


Figure 2. Waste Treatment Plant Site.



2.2 AS-BUILT DRAWINGS AT COMPLETION OF DRILLING

The main geologic units of interest at the WTP are the Saddle Mountains Basalt and the interbedded sediments of the Ellensburg Formation. The seismic boreholes at the WTP penetrated the upper part of the Wanapum Basalt and provide information on the upper Wanapum Basalt and a local sedimentary interbed, the Byron Interbed. Borehole C4996 penetrated the deepest, reaching the upper part of the Roza Member, Wanapum Basalt (C4996). The as-built drawings are provided in Figures 3, 4, 5 and 6.

The as-built design of each borehole at the completion of drilling activities is summarized in this section. The depths of the geologic units were pulled from the final geology report (reference to be inserted later) where detailed descriptions of the geology are found. This report does not attempt to describe the borehole geology. All cementing is not shown in the figures. Please see Section 2.3 for details of the cementing activities during drilling operations.

Figure 3 shows the as-built for C4993 with the depths of formation interfaces. Details of drilling the upper section of the borehole are in WMP-32119, *Entry Boreholes Summary Report for the Waste Treatment Plant Seismic Boreholes Project*, and the details of the mud rotary section are given in PNNL-16303, *Borehole Summary Report for Core Hole C4998—Waste Treatment Plant Seismic Boreholes Project*.

Figure 3. Borehole C4993.

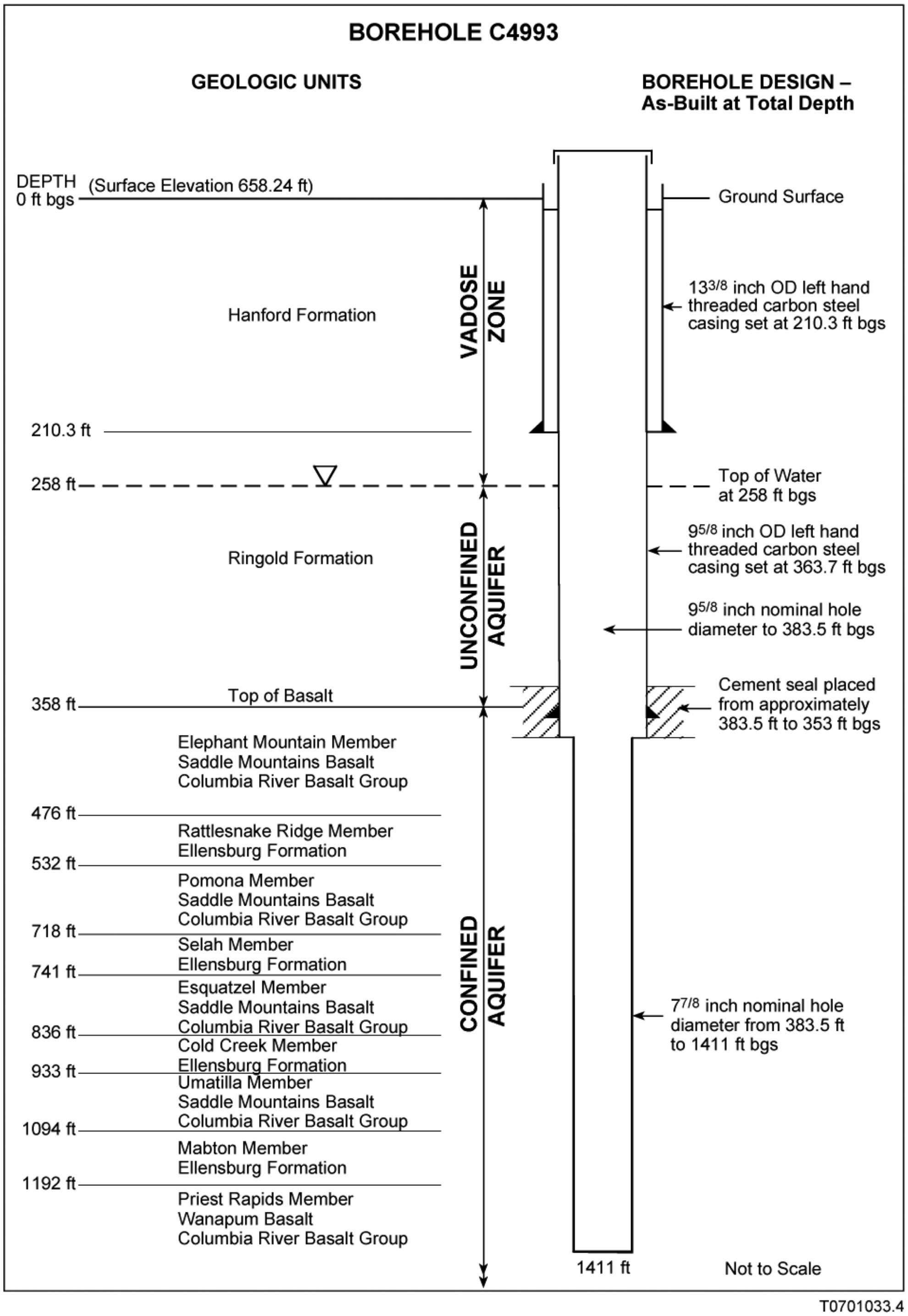


Figure 4 shows the as-built for C4996 with the depths of formation interfaces. Details of drilling the upper section of the borehole are in WMP-32119, and the details of the mud rotary section are given in WMP-32076, *Borehole Summary Report for Waste Treatment Plant Seismic Borehole C4996*.

Figure 4. Borehole C4996.

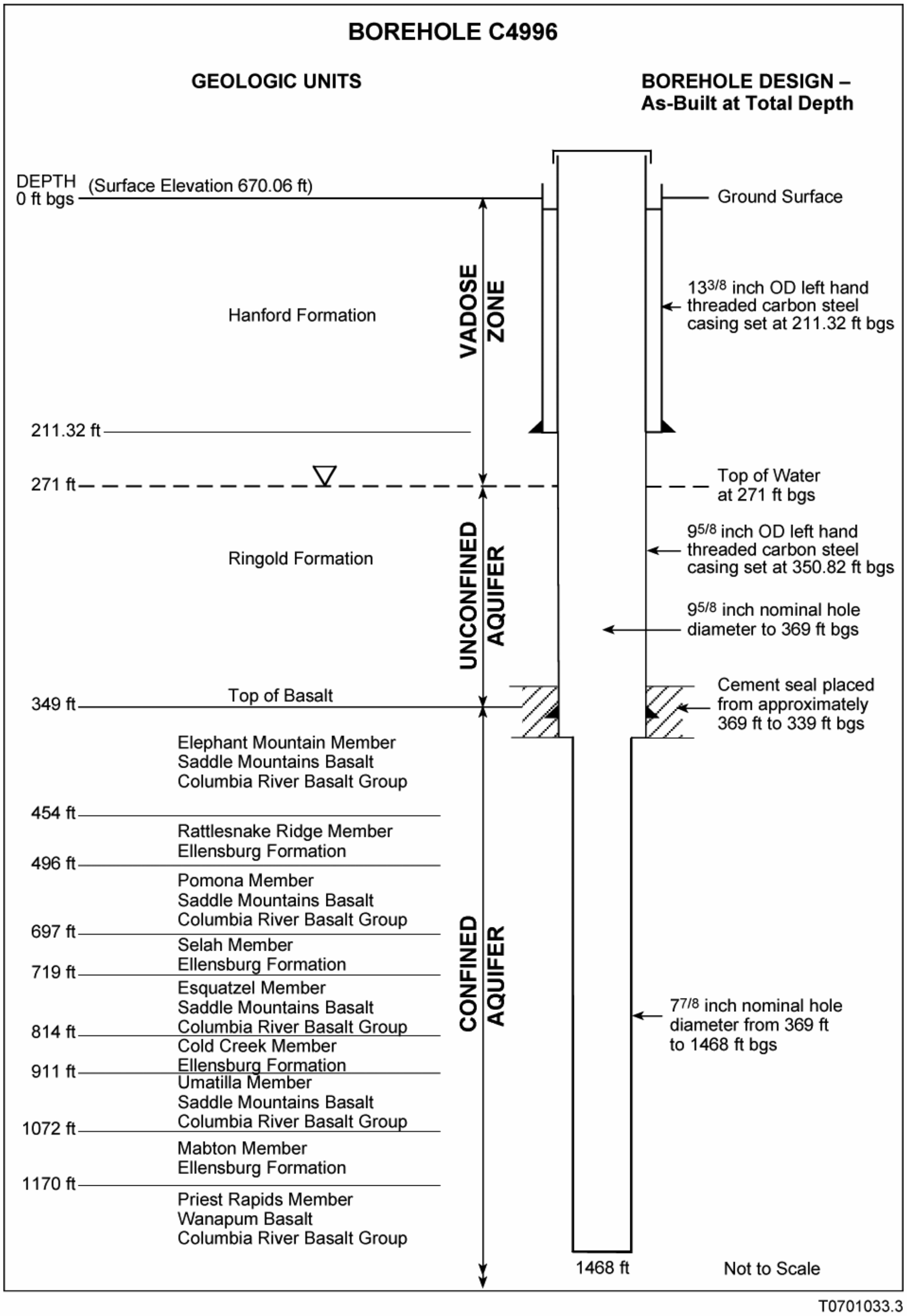


Figure 5 shows the as-built for C4997 with the depths of formation interfaces. Details of drilling the upper section of the borehole are in WMP-32119, and the details of the mud rotary section are given in Landau and Groundwater Associates (Fluor).

Figure 5. Borehole C4997.

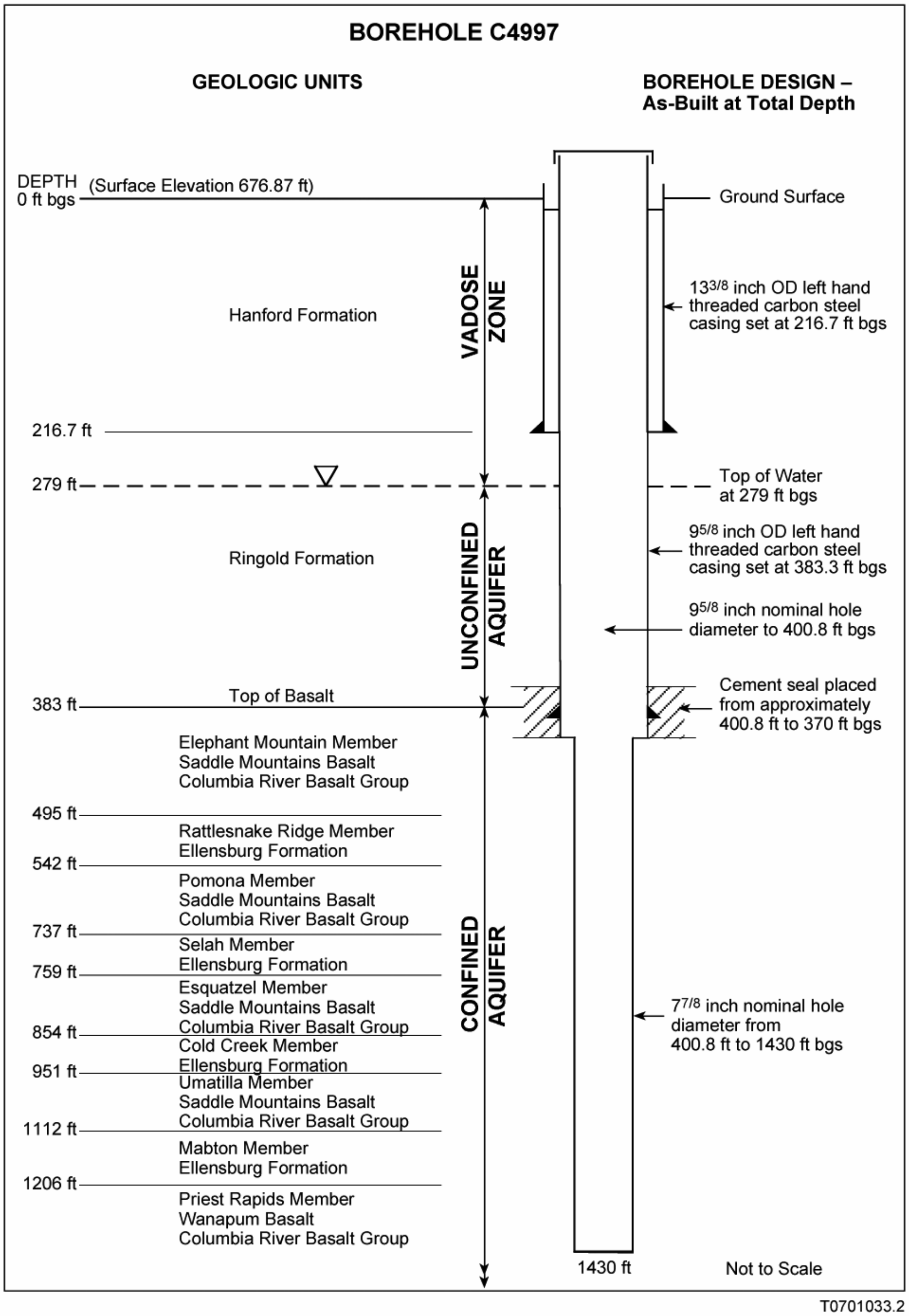
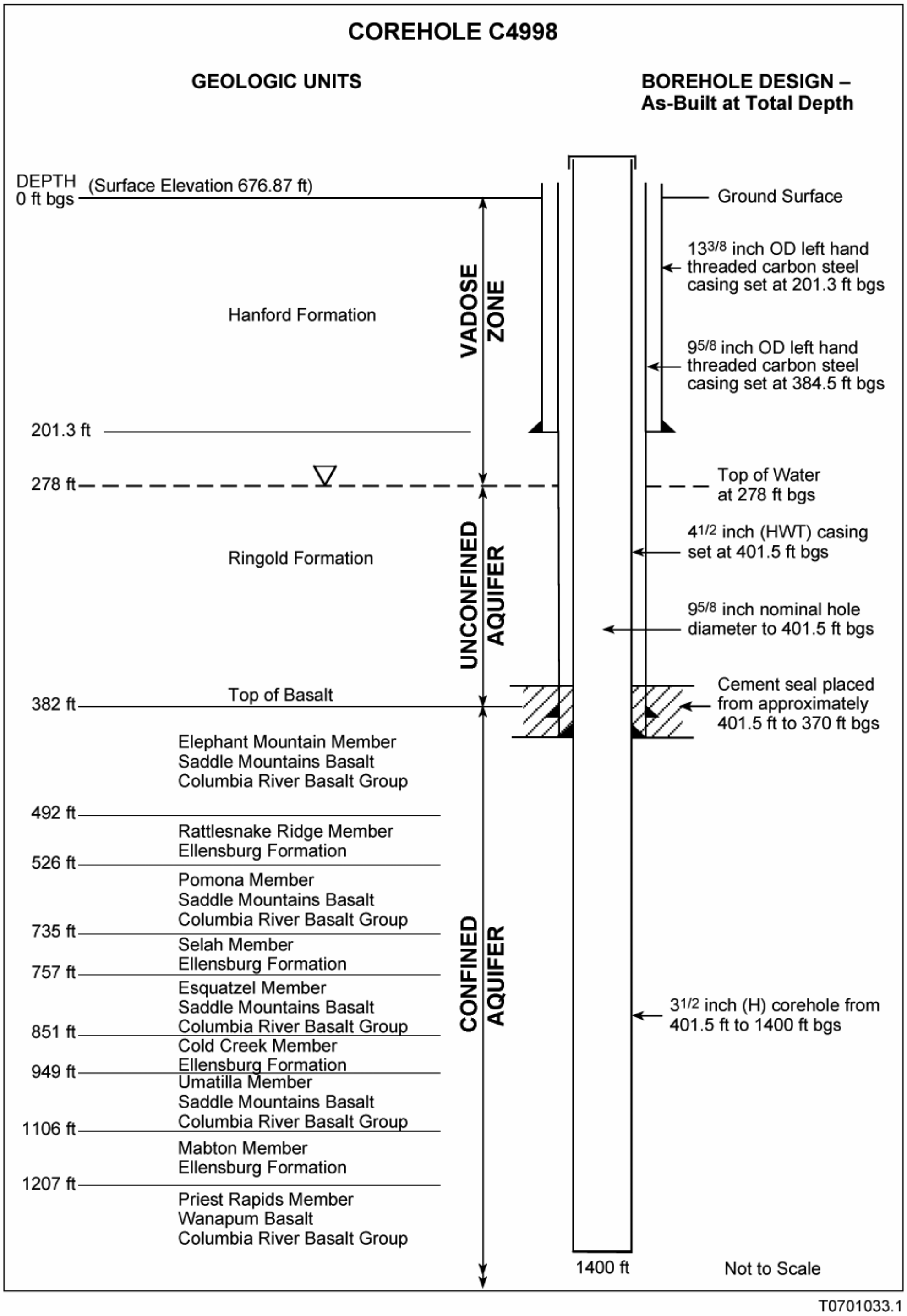


Figure 6 shows the as-built for C4998 with the depths of formation interfaces. Details of drilling the upper section of the borehole are in WMP-32119 and the details of the core section are given by PNNL-16303.

Figure 6. Corehole C4998.



2.3 CEMENTING OPERATIONS

During the drilling of the boreholes and corehole, cement grout was placed at predetermined intervals and as needed to maintain control of the borehole. The two types of cementing operations are discussed in the following sections.

2.3.1 Entry Hole Cementing

All the boreholes and the corehole were started in preconstructed entry holes. These entry holes were drilled using a cable tool rig to drill through the Ringold and Hanford formations. These suprabasalt formations were lined with casing and sealed to the upper Elephant Mountain basalt with the placement of a small cement interval. This is the first cement operation in each table. The temporary casing sealed to the formation was 24.448 cm (9.625 in.) outside diameter on P-110 carbon steel casing for the boreholes and 11.43 cm (4.5 in.) outside diameter HWT carbon steel casing for the corehole.

This cement placement was designed to provide a seal at the bottom of the casing to isolate the unconfined aquifer (in the Ringold) from the confined aquifers in the Wanapum basalts.

2.3.2 Deep Boreholes Cementing

Cementing operations during drilling of the deep boreholes were intended to help provide a hard, uniform diameter surface in the interbeds and basalt to assist the seismic logging operations that were scheduled after drilling was completed. In addition, the cement placement provided for hole control to prevent the formation from spalling and reduce/eliminate fluid loss to the interbeds. The whole borehole below the casing was cemented at least once, unless noted below.

Normal operations consisted of drilling through the interbed and into the underlying basalt for 9.14 m (30 ft) to advance past the flow top and allow room for suspension logging operations. After Televiewer and suspension logging in the open borehole, cement was placed up through the interbed and into the overlying basalt until reaching the previously placed cement level. This cement was drilled out and deepening of the borehole continued.

After the boreholes were completed, a second phase of cementing began in order to re-cement the Mabton and Cold Creek interbeds. Plugs were placed to leave open borehole intervals where possible. This saved cement and the time it would take to drill it back out. The plug intervals are in the comments columns of Tables 1 through 3.

Tables 1 through 3 show the date cement was placed, interval cemented, and approximate volumes of cement mix used for the three deep boreholes.

2.3.3 Borehole C4993

Table 1. Cementing Operations in Borehole C4993.

Date	Interval	Estimated Volume	Comments
9/6/06	355' – 383.5' bgs	108 gal	Seal casing to Elephant Mt
9/11/06	332' – 562' bgs	625 gal	Pomona, Rattlesnake Ridge and Elephant Mt.
9/18/06	488' – 775' bgs	760 gal	Esquatzel, Selah, Pomona and Rattlesnake Ridge
9/23/06	742' – 965' bgs	570 gal	Umatilla, Cold Creek and Esquatzel
10/1-2/06	918' – 1,222' bgs	840 gal	Priest Rapids, Mabton, Umatilla and Cold Creek
10/8-9/06	1,190' – 1,411' bgs	690 gal	Priest Rapids-borehole bottom- and Mabton
11/2-3/06	1,203' – 1,255' bgs	90 gal	Plug attempt failed
11/3/06	1,200' – ~1,255' bgs	80 gal	Plug set
11/4/06	1,065' – ~1,255' bgs	400 gal	Priest Rapids, Mabton and Umatilla
11/4-5/06	775' – 1,065' bgs	750 gal	Umatilla, Cold Creek, Esquatzel

2.3.4 Borehole C4996

Table 2. Cementing Operations in Borehole C4996.

Date	Interval	Estimated Volume	Comments
7/27/06	340' – 369' bgs	90 gal	Seal casing to Elephant Mt
8/3/06	413' – 532' bgs	330 gal	Pomona, Rattlesnake Ridge and Elephant Mt.
8/11/06	680' – 747.1' bgs	420 gal	Esquatzel, Selah, and Pomona-but not high enough
8/12/06	620' – 680' bgs	100 gal	Pomona
8/17/06	702' – 941' bgs	585 gal	Umatilla, Cold Creek, Esquatzel and Selah
8/23/06	910' – 1,198' bgs	990 gal	Priest Rapids, Mabton, Umatilla and Cold Creek
8/29/06	896' – 1,368' bgs	1200 gal	Priest Rapids, Mabton, Umatilla and Cold Creek
9/6/06	1,340' – 1,468' bgs	310 gal	Priest Rapids – borehole bottom
10/27/06	1,166' – ~1,200' bgs	90 gal	Plug set
10/28/06	1,020' – 1,166' bgs	420 gal	Mabton and Umatilla
10/29/06	1,008' – 1,020' bgs	90 gal	Plug failed and slid down onto previous lift in Umatilla
10/30/06	815' – 1,008' bgs	620 gal	Umatilla and Cold Creek

2.3.5 Borehole C4997

Table 3. Cementing Operations in Borehole C4997.

Date	Interval	Estimated Volume	Comments
8/18/06	343' – 400.8' bgs	120 gal	Seal casing to Elephant Mt
8/27/06	244' – 567' bgs	800 gal	Pomona, Rattlesnake Ridge and Elephant Mt.
8/29-30/06	487' – 582' bgs	260 gal	Pomona, Rattlesnake Ridge and Elephant Mt., re-cement
9/6/06	519' – 791' bgs	900 gal	Esquatzel, Selah, Pomona and Rattlesnake Ridge
9/13/06	774' – 955' bgs	670 gal	Umatilla, Cold Creek and Esquatzel – Failed
9/14/06	893' – 955' bgs	385 gal	Umatilla and Cold Creek – added another lift
9/14/06	860' – 893' bgs	184 gal	Cold Creek
9/25/06	918' – 1,137' bgs	580 gal	Mabton (partial) and Umatilla
10/2/06	1,120' – 1,248.7' bgs	340 gal	Priest Rapids and Mabton (partial) – added another lift; suspect the 1,120' might be a bad tag
10/3/06	1,170' – 1,248.7' bgs	140 gal	Priest Rapids and Mabton (partial) – after adding cement tag is 50' lower than previous day; however, drilling log notes starting drilling at 1,109' bgs – gave up cementing interval
10/25/06	~760' – ~780' bgs	90 gal	Plug failed in the Esquatzel
10/28/06	1,187' – ~1,240' bgs	148 gal	Plug in Priest Rapids and Mabton (across interface)
10/29/06	1,094' – 1,187' bgs	440 gal	Mabton and Umatilla
10/29/06	978' – 990' bgs	100 gal	Plug in Umatilla
10/30/06	900' – 978' bgs	444 gal	Umatilla and Cold Creek (partial)
10/31/06	830' – 900' bgs	610 gal	Cold Creek and Esquatzel (void between 870' – 895' bgs)
11/1/06	843' – 900' bgs	336 gal	Cold Creek and Esquatzel – re-cement

2.3.6 Corehole Cementing

The corehole was only cemented when it was judged advantageous to the coring operation itself (for control of mud loss and spalling formations).

Table 4 shows the date cement was placed, interval cemented, and approximate volumes of cement mix used for the corehole.

2.3.7 Corehole C4998

Table 4. Cementing Operations in Corehole C4998.

Date	Interval	Estimated Volume	Comments
7/12/06	348.5' – 401.5' bgs	100 gal	Seal casing to Elephant Mt
7/27/06	495' – 595' bgs	110 gal	Pomona, Rattlesnake Ridge (partial)
8/1/06	400' – 613' bgs	110 gal	Pomona, Rattlesnake Ridge and Elephant Mt. – done with a packer
8/17/06	934' – 994' bgs	90 gal	Umatilla and Cold Creek – interface
8/29/06	1,088' – 1,188' bgs	145 gal	Mabton and Umatilla – interface, Failed
8/31/06	1,061' – 1,188' bgs	145 gal	Mabton and Umatilla – interface, Failed

3.0 GYROSCOPE SURVEYS

Gyroscope surveys were acquired to track the inclination of the boreholes at periodic times as drilling progressed. The surveys were recorded approximately each 15 m (50-ft) during installation of the entry holes, and each 30 m (100-ft) as the rotary rig was drilling the basalt and interbed formations. Gyroscopic surveys were not performed below the cased interval of the corehole. Two stainless steel centralizers were used to centralize the gyroscope when logging the entry hole casing path. During rotary rig drilling, gyro surveys were performed without centralizers through the drill pipe.

The Humphrey gyroscope used for this project is owned by the DOE. The gyroscope sonde and up-hole electronics control box was recently examined by the equipment vendor (Wellbore Navigation, Inc. [WELNAV]). New gimble bearings were installed and a performance check performed.

The gyro surveys were acquired at stationary measure points along the borehole and the survey results are presented in this report or in the appendices. Examination of the initial survey of the first two boreholes, i.e. C4998 and C4996, revealed that the precision (repeatability) of the system should be investigated. In the initial gyro runs, it was noticed that successive gyro surveys in the same borehole were generally following the same path; however, the XYZ coordinates did not overlay (i.e., the numbers agreed to the first significant digit, sometimes to the second digit, but rarely to third digit). The equipment vendor (WELNAV) was contacted and the results discussed. The procedure for initial drift check, duration for tool warm-up, and data processing was clarified. Equipment operation is described in the following section. Final results are presented in this document in Appendices A through D.

3.1 EQUIPMENT CHARACTERISTICS

The gyroscope survey probe contains three key components: (1) x-axis accelerometer, (2) y-axis accelerometer (also called inclinometers), and (3) the uncaged gyro. These components are delicate (very susceptible to vibrations and shock) and the corresponding sensor responses are susceptible to incorrect readings resulting from shock and vibrations. The gyro is powered by a dynamic motor. The gyro is supported in two-gimble yokes by four small sealed bearings.

Due to the sensitivity of the gyro sensors, extra measures were taken during operation. One or more drift checks were recorded during each survey. A drift check is a set of up to 20 measurements, 15 seconds apart, with the probe at a stationary location in the borehole. Generally, during a drift check, there is no change in the inclinometer reading, and negligible change in the gyro orientation readings. However, occasionally non-linear changes were observed and the logging operators began to recognize that small actions by people in the area of the drill rig (such as a member of the drilling staff opening the door of the cab on the drill rig and stepping on to the running board) could cause a change in the gyro drift rate, during a drift check.

There were several conditions managed in order to minimize errors in the gyroscope surveys.

- Drift of the gyro during the survey was minimized through the following activities. When the gyro was uncaged, the tool drift readings were observed for at least three minutes to verify that the drift rate was low (near zero). If the drift rate was high, then the tool would be moved into position at the hole, the gyro would be oriented to 0 degrees and re-caged. After five minutes, the gyro would be uncaged. This action would reduce the gyro drift to less than 5 degrees during the survey. When the drift exceeded 10 degrees between the start and final reference point, the survey would be rerun.

- The gyro tool was run centralized in the casing. During rotary rig drilling, the gyro tool was run inside the drill stem. Close tolerance between tool outside diameter and drill pipe inside diameter prevented the use of centralizers.

- The gyroscope probe was powered up for at least 30 minutes for the equipment to warm up to operating temperature before conducting the survey. The gyro wheel requires seven minutes to come up to speed, which is 30,000 rpm.

The purpose of a gyroscope probe survey is to track the path of a borehole from its starting location at the top of the borehole into the subsurface (XYZ coordinates). The initial starting orientation (azimuth, compass bearing) is required at the beginning of a borehole survey.

Azimuth (true north compass bearing): Analysis software needs as input the compass direction that the tool face is pointing. The azimuth is determined by the following: (1) A rifle scope is attached to the probe and is sighted to a “survey reference point” object, (2) it is the “magnetic compass reading” of the survey reference point, and (3) it is “local magnetic declination” (16.5 degrees east at the WTP site).

3.1.1 Humphrey Gyro Limitations

Following are the limitations of the Humphrey gyro system.

- 2-axis accelerometers (inclinometers) with maximum inclination of 30 degrees from vertical (accelerometer range limit). Must use 3-axis tool for improved precision.
- Accelerometers are not accurate if dip is less than 0.5 degrees. The precision (repeatability) of response is 0.25 degrees at inclination angles from 0 to 30 degrees. Half (0.50) a degree error in inclination translates to 2.74 m (9-ft) error in a 304.8 m (1000-ft) hole.
- In vertical (near vertical) boreholes, the direction (azimuth) will appear to have a large error. But remember that at deviation angles of 0 degrees, the azimuth becomes undefined (i.e., at vertical position, even though the tool can face any direction, it is still at the same location.)
- Maximum precision of inclination readings is 0.1 degree (if calibrated).

4.0 ACOUSTIC TELEVIEWER

The Acoustic Televiewer logging sonde is designed to generate an image of the borehole wall by transmitting ultrasonic pulses from a rotating sensor and then recording the amplitude and travel time of the signal that reflects at the interface between the borehole fluid and formation (i.e., borehole wall).

The Televiewer logging probe used for this project is owned by the DOE (purchased for this project). It was purchased from Mount Sopris Instruments, located in Golden, Colorado. The logging sonde (Model ABI40) was manufactured by Advanced Logic Technology (ALT), located in Luxembourg, Belgium.

The Televiewer was selected to provide information on the condition of the borehole wall and caliper measurements during drilling. The sensor performance is best when the borehole fluid is clear water. Unfortunately, the equipment performance was degraded by drilling conditions that prevented reliable caliper measurements when the borehole diameter exceeded about 24.13 cm (9.5 in.). Also, the measurements were adversely affected by the high viscosity of the drilling mud, which significantly attenuated the acoustic signal. Additionally, measurements were possibly affected by debris suspended in the mud that reflected the acoustic signal back to the sensor (i.e., shortened travel time).

4.1 CHARACTERISTICS

The operational properties of the Televiewer logging sonde are as follows.

- *Centralizer*. The probe should be centered in the borehole for best operation. Eccentered (i.e., side walled) operation will produce unusable results. Two centralizers were attached to the 1.5 m (5-ft) long probe, one at the top and one above the mirror window (near the bottom). Each centralizer had six non-metallic bow-rods. The centralizer diameter of 19 cm (7.5-in.) was generally appropriate to permit the 5.9 kg (13-lb) probe to travel to the bottom of the borehole (nominal hole diameter of 20 cm [7.875 in.]). Occasionally, the centralizer diameter had to be reduced to permit the probe to travel through tight-hole conditions of the interbeds between basalt flows. The smallest was 13.97 cm (5.5 in.) in C4996 on September 5, 2006, for maximum log depth of 446.84 m (1,466 ft) (see Table 5).

- *Acoustic sensor*. This is a fixed transducer and a rotating focusing mirror. The rotating mirror is attached to a stepper motor and has a focal radius of 15.24 cm (6 in.). The rotating mirror and acoustic transducer acquire 72, 144, or 288 measurements per revolution (turn). The mirror rotation rate is 10 turns per second for settings of 72 and 144, and the mirror rotates eight turns per second for the 288 setting.

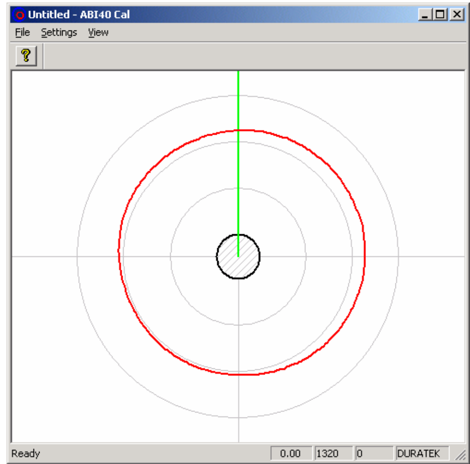
- *Logging Parameters*. The acoustic resolution setting for this project was 144 pulses per turn (i.e., 2.5 degrees per pulse) and 10 turns per second (automatic). The minimum depth resolution was 0.28 cm (0.0092 ft) per revolution (turn). The maximum logging speed to prevent data loss was 2.53 m (8.3 ft) per minute.

- *Recorded Data*. The sonde records two values for each acoustic pulse: (1) the two-way travel time (microsecond [μs]) and (2) amplitude of the first arrival. The travel time is expressed in $1/10^{th}$ of a μs. Travel time values range from about 720 to 4200 (x $1/10^{th}$ of μs) or (72 to 420 μs).

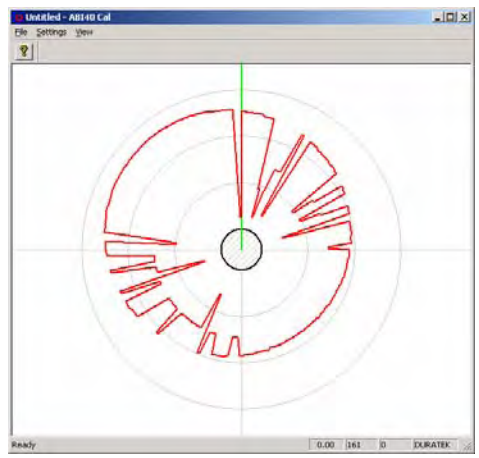
- *WellCAD*. The Televiewer data is processed and displayed with the WellCAD software program using the module for Image Logs.

    - Time Window (acoustic travel time inside the tool) = 75 μs.

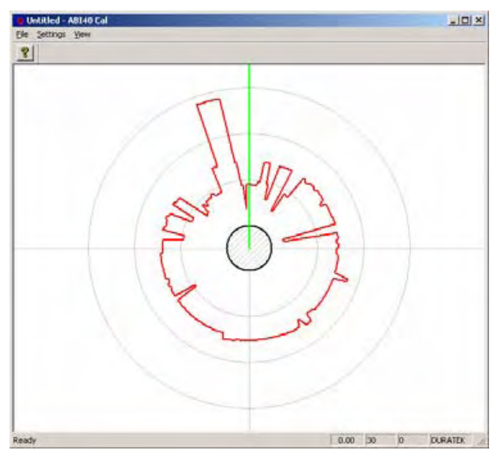
    - Borehole Fluid = 1477 m/sec (This value was derived from WellCAD computation using travel time scans at specific depth and known hole size.)



<u>Televiewer Scan</u>: The scan to the right is an example of a good Televiewer scan. The red line (larger circle) is the travel time response and is slightly offset around the black line (smaller circle), which is the external limit of the acoustical window. The scan is from survey file C4996-1466A near 4.43 m (1,458 ft). In this example the Minimum, Average, and Maximum computed caliper are essentially the same. Acoustic scans with this clarity are rare for the Televiewer surveys of this project.



The next scan shows an example of a Televiewer scan (acoustic response) for tool centralizers that are reduced from 19 cm (7.5 in.) to 16.5 cm (6.5 in.). This scan is from survey file C4997-1280. The red line (travel time response) is noticeably askew around the black circle (external limit of the acoustic window). Also this scan is typical with several travel time response values significantly less than the correct response (from the borehole wall). The detector is responding to either debris suspended in the drilling mud or is triggering on residual signal from the previous transmission of the transducer. (Remember, since both centralizers are above the acoustic window, they may be dislodging materials from the borehole wall as the tool is pulled up during the survey). This scan also shows why the best caliper of the Televiewer log survey is from the maximum caliper based on travel time. The computed minimum is obviously incorrect, and the average is significantly influenced by the number of truncated travel time responses in the scan.



The third Televiewer scan is almost completely dominated by travel time response values that are significantly less than the correct response from the borehole wall. These scans frequently occur in the interbed formation layers, and the interbeds are where the washouts occur. Merged logs that compare the maximum Televiewer caliper with the 4-arm mechanical caliper show that the computed caliper from the travel time is often incorrect at hole size greater than 24 cm (9.5 in.). This scan is from survey file C4996-1360.

The equipment vendor (Jim LoCoco of Mount Sopris) was contacted about the equipment performance, and we transmitted data samples for his review. The conclusion was that the amplitudes of the acoustic signal were very low, which is the result of the high viscosity of the drilling mud. The amount of polymer in the drilling mud is significantly higher than normal and is the source of most of the problems. Since it was not possible during drilling to change out the borehole fluid for the Televiewer surveys, steps were initiated to prepare a mechanical caliper for logging the holes. The 4-arm caliper, discussed later, became available on October 12, 2006.

4.2 TELEVIEWER SURVEYS

The Televiewer surveys are summarized in Table 5. The table contains the date of the Televiewer survey, Depth Range (ft), Raw data file name, Centralizer size (in.), Mud Viscosity (sec/qt), and Comment. The table is organized by borehole identification number.

Table 5. Televiewer Survey Logs.

Hole ID	Televiewer Survey Date	Depth Range (ft)	Raw Data File	Comment	Centralizer Size (in)	Mud Vis. sec/qt
C4993	9/11/2006	349-562	C4993-563ft		7.5	
C4993	9/18/2006	310-770	C4993-772ft		7.5	28
C4993	9/23/2006	460-957	C4993-965ft		7.5	46
C4993	9/30/2006	725-1182	C4993-1185ft		6.5	40
C4993	10/1/2006	725-1220	C4993-1222ft		7.5	42
C4993	10/8/2006	900-1411	C4993-1411ft		7.5	52
C4993	10/11/2006	370-1411	C4993-1411ft		7.5	42
C4996		346-535	No Raw Data File	Colog Televiewer		
C4996	8/11/2006	345-725	C4996-745ft		7.5	
C4996	8/16/2006	575-940	C4996-941ft	Tight hole: 750, 818ft	7.5	
C4996	8/22/2006	700-1196	C4996-1196ft		7.5	36
C4996	8/28/2006	885-1362	C4996-1360ft		7.5	55
C4996	9/5/2006	1000-1466	C4997-1460ft	Tight spots: 1130, 1166, 1313, 1339, 1345ft	5.5	
C4996	9/14/2006	350-1465	C4996-1466ft		7.5	38
C4997	8/26/2006	355-566	C4997-566ft		7.5	35
C4997	9/6/2006	380-790	C4997-790ft		7.5	39
C4997	9/12/2006	500-975	C4997-976ft		7.5	35
C4997	9/24/2006	370-1137	C4997-1137ft	excess cuttings in mud	7.5	55
C4997	10/2/2006	775-1245	C4997-1248ft		7.5	52
C4997	10/9/2006	1102-1427	C4997-1417ft		7.5	46
C4997	10/13/2006	370-1436	C4997-1411ft		7.5	46
C4997	11/5/2006	798-1280	C4997-Nov05-1280ft		6.5	45
C4997	11/17/2006	845-1432	C4997-1430ft		7.5	46

A sample Televiewer survey is shown in order to discuss the type of results that were encountered on this project (see Appendix C, “Borehole C4996”). The borehole conditions for the project are believed to be the cause of the difficulties that were encountered. These conditions (discussed above) should be avoided when the Televiewer is deployed on future projects.

The Televiewer survey results are presented as the standard 3-track plot. The Televiewer survey for C4996, Run 7, Date September 14, 2006, Depth range 350 to 1466 ft is shown as a typical survey for this project.

Track 1. Acoustic travel time of first arrival from ultrasonic pulse is presented with color to show the range of values measured in the travel time sensor responses for each of the 144 pulses per scan revolution (360-degree turn). The color palette grades from low (Blue = 865) to high (Yellow = 2083). The reddish shades represent mid-range values. Unit is μs *10 (or 1/10th of μs)

Track 2. Three curves are presented in the center track with the same scale for all, 7 to 13 in: (1) Black Solid curve—4-arm mechanical caliper, the average of the two x-axis and two y-axis arms. (2) Red Dash curve—Maximum caliper computed from Televiewer travel time response. (3) Blue Dot curve—Average caliper computed from Televiewer travel time response.

Track 3. Amplitude of first arrival from the ultrasonic pulse of the sensor scans (corresponds to the travel time). The color palette grades from low (Blue = 1) to high (Yellow = 70) dB. The amplitude response provides a better image of borehole wall conditions.

NOTE 1: Notice that the maximum travel time caliper is generally tracking the 4-arm mechanical caliper through most of the hole. Significant deviations occur when the 4-arm caliper exceeds about 24 cm (9.5 in.) (which occurs in the depth intervals with the lowest [dark] response values of the travel time and amplitude).

NOTE 2: There is good agreement between the 4-arm mechanical caliper, maximum caliper from travel time, and average caliper from travel time when amplitudes are high (Yellow) and travel times are long (Yellow). This condition can be seen at depths of 767 and 806 ft.

NOTE 3: The amplitude and travel time scan results show significant change at the interface between the basalt and interbed formations. The light color representing long travel time and high amplitude is common in basalt intervals, while the dark color representing truncated travel time and low amplitude is common in the interbeds. Notice the dark (low amplitude and truncated travel time) response character between depth intervals of: (695 to 725 ft—the Selah Interbed), (814 to 913 ft—the Cold Creek Interbed), and (1,059 to 1,164 ft—the Mabton Interbed).

5.0 MECHANICAL 4-ARM CALIPER

The 4-arm mechanical caliper used for this project is owned by DOE. The probe manufacturer is Gearhart Owens International. However, no up-hole electronics control module was available that would record the sonde response data in a digital computer format for integration with the Televiewer, Colog, and other borehole surveys.

When concerns about suitability arose with the Televiewer survey results, a reliable caliper sensor, the 4-arm caliper, was retrieved and shipped to Mount Sopris where its output signals were integrated into a modern up-hole electronics control module. The 4-arm caliper was returned to Hanford with a tool configuration control file for use with the control box or Matrix control box. The tool control file also contained probe-specific calibration coefficients. The first 4-arm caliper survey was performed on October 12, 2006, in borehole C4993.

Caliper surveys identified depth intervals of tight hole and wash-outs. Multiple caliper logs were run in each borehole. The example below for C4997 shows the type of activities that occurred between logging runs, which could change the caliper measurements. See Section 2.0 for cementing details. Example C4997:

- 10/13/2006—Caliper survey identified extent of washout of interbeds.
- 10/28/2006—Cement Bridge Plug installed (1,187–1,240 ft).
- 10/29/2006—Cement rugose (washout) section of hole (1,094–1,187 ft).
- 10/31/2006—Cement Bridge Plug installed (990 ft).
- 11/1/2006—Cement rugose section of hole (870–990 ft).
- 11/2/2006—Continued to add cement to fill washout at 860 ft (finally got cement to 843 ft).
- 11/5/2006—Caliper survey (drill bit side-tracked original cement-filled hole and began drilling uncemented formation).

5.1 CHARACTERISTICS

The operational properties of the 4-arm mechanical caliper are as follows.

- *Calibration Check*. Calibration of the two x-axis arms and two y-axis arms was checked before and after each borehole log. Two calibration points are used by the electronics control module to convert the caliper arm response values to borehole diameter. Linearity of the sensor response values for the x-axis and y-axis caliper arms is discussed in Section 5.2. The calibration jig has multiple (eight) stops to hold the caliper arms. The stop positions are in inches (from 8 to 24 in.). The 6-in. and 12-in. positions were used for logs during this project.

- *Deploy Logging Probe to Bottom of Borehole*. After the pre-survey calibration check, the caliper arms are retracted and the tool power is turned off. The probe is deployed to the bottom of the borehole with tool power off and the caliper arm retracted. When the probe reaches the bottom of the hole, the tool power is turned on, and the caliper arms are deployed. After 30 seconds (to deploy the caliper arms) the recording mode is activated, and the x-axis and y-axis caliper responses are recorded in a data file.

- *Logging Speed***.** The caliper log survey speed is 30 ft/min.

- *Post-Caliper Calibration Check***.** The caliper arms cannot be retracted while tool power is on. Therefore, only the main log survey interval is recorded, from the maximum borehole depth to the surface. No repeat log interval is recorded. When the caliper is removed from the borehole (with caliper arms deployed) a post-survey calibration check is performed. The results are presented in Appendices A through D.

- *WellCAD***.** Processing of the 4-arm caliper survey data is simple: (1) Read survey data values, no calculations are performed, and (2) format presentation plot and output. The presentation plot contents are as follows. Track 1—Average caliper, Track 2—X-axis caliper, and Track 3—Y-axis caliper.

5.2 CALIBRATION CHECK

Calibration of the caliper was performed by Mount Sopris when the tool was integrated with the up-hole control module and the initial calibration coefficients were provided. During installation of the probe onto the Logging truck, the calibration coefficients were checked (see Table 6).

Table 6. Gearhart Owens International 4-Arm Caliper Calibration Coefficients.

Calibration Jig (inch)	X-Axis Response	Y-Axis Response
6-in	352.5	303.5
12-in	500	431.5

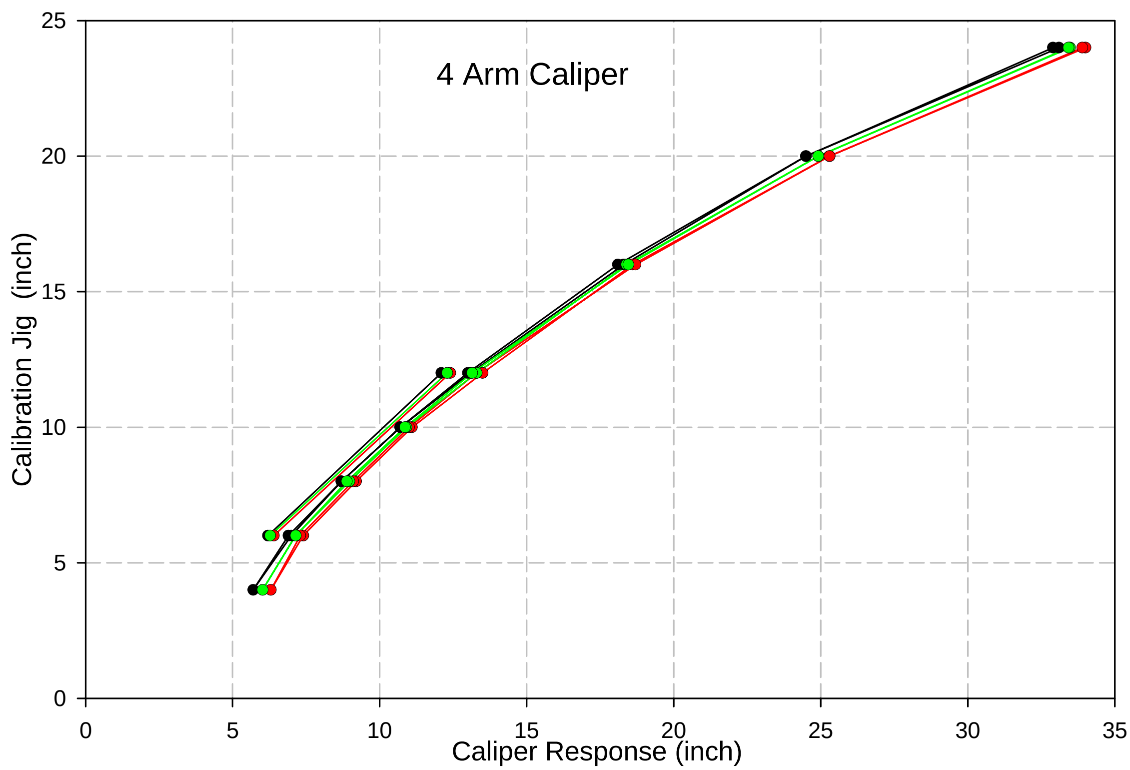
During the initial calibration check, a small degree of non-linearity was noticed. Therefore, the initial calibration coefficients provided by Mount Sopris were used until a later time when further investigation could be performed. During the next caliper log (October 13, 2006), the caliper response was checked with each location of the calibration jig. The data are shown numerically in Table 7 and graphically in Figure 7, (X-axis is black curve, Y-axis is red curve, and average is green curve). The caliper tool was checked for hysteresis during the calibration check by progressively reducing the caliper arms then progressively releasing the caliper arms. No significant hysteresis was identified.

The post-survey calibration check (after the tool has warmed up) is much closer to the actual calibration jig sizes than the pre-survey calibration check.

Table 7. Calibration Check of 4-Arm Caliper.

Jig Size (in)	X (in)	Y (in)	Average (in)
24	33.1	34	33.48
20	24.5	25.3	24.92
16	18.3	18.6	18.4
12	13.1	13.5	13.3
10	10.7	11.1	10.91
8	8.7	9.2	8.97
6	6.9	7.4	7.14
4	5.7	6.3	6.02
6	7	7.3	7.15
8	8.7	9.1	8.88
10	10.7	11	10.86
12	13	13.3	13.15
16	18.1	18.7	18.46
20	24.5	25.3	24.92
24	32.9	33.9	33.43
Post-Survey Calibration Check			
12	12.1	12.4	12.3
6	6.2	6.4	6.28

Figure 7. Calibration Check of 4-Arm Caliper.



Pre-survey and Post-survey caliper calibration checks were performed for each borehole survey. The 4-arm caliper surveys and calibration checks are presented in Table 8.

Table 8. Caliper Survey Logs and Calibration Check.

Hole ID	Survey Date	Total Depth (ft)	Pre-Survey 6-in X	Pre-Survey 6-in Y	Pre-Survey 12-in X	Pre-Survey 12-in Y	Post-Survey 6 In X	Post-Survey 6 In Y	Post-Survey 12-in X	Post-Survey 12-in Y
C4993	10/12/2006	1411	352.5 cnts	303.5 cnts	500 cnts	431.5 cnts				
C4993	11/8/2006	1411	avg=7.3		avg=13.3					
C4993	11/28/2006	1405	6.6	7.1	12.4	13.1	6.2	6.6	12.1	12.3
C4996	10/17/2006	1457	6.6	7.3	12.6	13.0	6.2	6.6	12.3	12.4
C4996	11/2/2006	1467	6.2	7.2	12.9	13.1				
C4996	11/8/2006	1466	6.8	7.3	12.7	13.5	6.1	6.5	12.2	12.4
C4997	10/13/2006	1437	6.9	7.4	13.1	13.5	6.2	6.4	12.1	12.4
C4997	11/5/2006	1124	6.3	7.1	12.5	13.0				
C4997	11/17/2006	1435	6.9	7.6	12.8	13.6	6.3	7.6	12.8	13.6

The caliper logs for each borehole and each survey date are presented in Appendices A through D as separate logs. Also, a merged caliper of all caliper logs for each of the boreholes is also presented at the beginning of the appendix.

6.0 COLOG SURVEYS

The geophysical logging services were provided by Colog, a geophysical logging company based in Colorado. Colog was deployed on five occasions throughout the drilling phase of the project as follows.

- June 22—A gamma-density log was conducted from 200–0 ft bgs in the 13-3/8-in. cased entry hole for C4998.
- July 10—A gamma-density log was conducted from 401.5–200 ft bgs in the 9-5/8-in. cased entry hole for C4998.
- August 2—A Televiewer survey was conducted from 532–401.5 ft bgs in the open hole of borehole C4996.
- September 15–18—Open-hole, gamma-density log was conducted in the C4998 corehole from 1,400–401 ft bgs.
- October 26—Open hole log suites were conducted in boreholes C4993, C4996 and C4997 from total depth to bottom of surface casings. The log suite consisted of gamma-density, caliper, neutron porosity, full wave sonic, and dual induction resistivity.

6.1 COREHOLE C4998

The logging conducted in corehole C4998 on September 15 and 18 was in open hole tubing and in core tubing. The original plan was to conduct the log survey in the core tubing, but due to the stability of the corehole it was decided to conduct open-hole logging. However, due to swelling clays in the interval from 1,174 to 1,215 ft, a portion of the corehole was logged within the core tubing. The log plot (see Appendix D for C4998) was prepared by splicing the data collected from the log runs as described below.

- Run 1—Logged within the surface casing from 2 ft then in open hole from 401.5 to 1,174 ft bgs. Encountered obstruction. Conducted cleanout run made with core tubing.
- Run 2—Obstruction encountered at 1,138 ft. No data collected. Conducted cleanout run with core tubing.
- Run 3—Tripped core tubing to 1,195 ft. Logged open hole to 1,217 ft. Encountered obstruction.
- Run 4—Tripped core tubing and washed to 1,400 ft. Pulled tubing back to 1,213 ft. Logged open hole from 1,396 ft to bottom of core tubing at 1,213 ft. Due to problems with caliper arm entering the tubing, no data collected from approximately 1,213 to 1,215 ft. Logged within the core tubing from approximately 1,213 ft to 1,100 ft.

6.2 OPEN-HOLE LOG SUITES (C4993, C4996 AND C4997)

The open-hole log suites required a log run with each of the four geophysical probes (Compensated Density, Neutron Porosity, Dual Induction Resistivity, and Full Waveform Sonic). The logs were conducted on October 26, 2006, at well completion for the three boreholes (C4993, C4996, and C4997). The log surveys are presented in the Appendix specific for each borehole. The logs are plotted at a depth scale of 1:240 ft.

During the log survey, data values (sensor responses) were recorded at sample increments of 0.1 ft for most surveys, or at increment of 0.2 ft for few surveys. The data values for each log survey and each borehole are stored as electronic computer files (one file per survey). The electronic files are in WellCAD format. The file names are composed of the borehole number (5 characters) and a single character to designate the logging probe type (i.e., D=Density, N=Neutron, E=Electric, S=Sonic).

The following topics provide detail information for each of the four logging probe types.

6.3 COMPENSATED DENSITY LOG

The density log tool contains a radioactive source (cesium-137) and two gamma detectors (near at 20 cm and far at 35 cm). The source and detectors are heavily shielded to prevent direct detection of gamma rays from the source. The principle is to focus gamma rays from the source into the formation, where they collide with electrons in the formation (Compton-scattering) and are reflected back to one of the CsI detectors. The response of the Density tool is determined essentially by the electron density (number of electrons per cubic centimeter) of the formation. Electron density is related to the true bulk density (in grams/cc) of the formation rock matrix material and formation porosity.

In order to minimize the influence from the borehole fluid (drilling mud), the source and detectors are pushed against the wall of the borehole by means of an eccentering arm (caliper). The force exerted is substantial, allowing the probe to cut through most mud cakes. Any mud remaining between the tool and the formation is "seen" as part of the formation and must be accounted for. The two-detector configuration is used to substantially reduce the influence of borehole rugosity and mud cake.

When borehole conditions are ideal, both the long and short spaced density measurements are reading the formation bulk density. Mud cake, rugose hole size and washouts are the main reason for invalid measurements. Since density measurements are also needed when borehole conditions are a problem, the Compensated Density log is used. The Compensated Density log response is derived from the long spaced and short spaced density detector responses. During the development period of the Compensated Density tool (1950s) a spine-and-rib correction chart was developed from testing measurements that showed how the detector response changes with varying thicknesses of drilling mud (and hole size rugosity). The spine-and-rib algorithm is derived during the development phase of each manufacturer's tool and is programmed into the tool processing software. Laboratory analysis of core samples is generally used to correlate density probe measurements with physical properties.

The logging speed is 15 ft/minute for the density log. The results file has five data curves (Natural Gamma, Caliper, Long Spaced Density, Short Spaced Density, and Compensated Density).

The borehole probe (sonde) has two sections. The top section, designated as RAB contains a communications modem and a natural gamma detector (1 in. x 2-in. NaI crystal). The serial number of the RAB section is 2020. The bottom section, designated as HPF, serial number 1516, contains the density detector, diameter 48 mm (1.9 in.), length 1.89 m (74.4 in.), weight 21.5 kg (47.3 lb).

1. The natural gamma detector is scaled 0-100 cps and the count rate does not change when the tool comes out of the borehole fluid, which confirms that a side-wall logging configuration is better for measuring gamma activity of the formation.

2. The density tool is a pad-type device that must maintain contact with the formation wall. The plot scale is 1 to 4 g/cc.

3. The caliper records the amount that the pressure arm must be extended to press the logging probe against the borehole wall. A 1-arm caliper will generally locate the largest axis of a borehole.

6.4 NEUTRON POROSITY LOG

Neutron logs respond primarily to the amount of hydrogen present in the formation (i.e., water, H_2O). High-energy (fast) neutrons from an americium-beryllium (AmBe) source collide with nuclei of the formation materials as elastic “billiard-ball” collisions. With each collision a neutron loses some of its energy. The greatest energy loss occurs in collisions with the hydrogen nucleus. Collisions with heavy nuclei do not slow the neutron down very much. Thus, the slowing-down of neutrons depends largely on the amount of hydrogen in the formation.

Within a few microseconds the neutrons have been slowed down by successive collisions to thermal velocities, corresponding to energies of around 0.025 electron volts. They then diffuse randomly, without losing any more energy until they are captured by the nuclei of atoms such as hydrogen, silicon, or a thermal neutron detector (HE-3).

When the hydrogen concentration of the material surrounding the neutron source is large, most of the neutrons are slowed down and captured within a short distance of the source. On the contrary, if the hydrogen concentrations are low (i.e., low porosity), the neutrons travel further from the source before being captured. Accordingly, the count rate at the detector increases for decreased hydrogen concentration, and vice versa. This source-detector spacing is 20 cm.

The logging speed is 20 ft/min. The results file has four data curves (Natural Gamma, Caliper from Density, Neutron, and Density Porosity). The neutron tool has two sections. The top section is an RAB component (serial number 2171) and contains a communications modem and a natural gamma detector. The bottom section is designated as OPF, serial number 1387, and contains the neutron detector. The probe is free-floating in the borehole (i.e., no centralization).

1. The natural gamma detector response is different from the natural gamma of the density probe. The count-rate response increases when the probe extends above the borehole fluid. Since the neutron probe is free-floating in the borehole, the natural gamma measurements are significantly influenced by the location of the probe within the borehole (i.e., centered or side-walled). The plot scale is 0-100 cps.

2. The caliper is duplicated from the Compensated Density Log (there is no caliper on the neutron probe).

3. The neutron detector indicated formation porosity when the pores of the formation are water saturated.

4. The density porosity is computed from the Compensated Density Log, and the assumed matrix density (3.15 g/cc) is documented in the plot scale. The porosity calculation is a linear relationship between the formation matrix density, the measured bulk density, and formation fluid density (i.e., 1 g/cc).

6.5 DUAL INDUCTION LOG

Induction logging devices are focused in order to minimize the influence of the borehole and surrounding formations on the measurements. The logging tool has multiple transmitter and receiver coils. However, the measurement principle can be understood by considering a sonde with only one transmitter coil and one receiver coil.

High-frequency alternating current of constant intensity is sent through the transmitter coil. The alternating magnetic field induces secondary currents in the formation. These currents flow in circular ground-loop paths coaxial with the transmitter coil. The ground-loop currents, in turn, create magnetic fields, which induce signals in the receiver coil. The receiver signals are essentially proportional to the conductivity of the formation. Any signal produced by direct coupling of transmitter and receiver coils is balanced out by the measuring circuits.

The logging speed is 40 ft/minute. The results file has four curves (Natural Gamma from Density, Caliper from Density, Medium EM Conductivity, and Deep EM Conductivity). The probe sensor curve is EM (Electro-Magnetic) and the units are millisiemens per meter, which is the same as milli-MHOs per meter. The serial number of the DIL probe is 2599. The probe is free-floating in the borehole.

1. The natural gamma curve is duplicated from the Compensated Density Log.

2. The caliper is duplicated from the Compensated Density Log.

3. Medium and deep EM conductivity are only valid in open-hole conditions. The reading inside the steel casing does not represent changes in formation properties.

6.6 FULL WAVEFORM SONIC LOG

The Full Waveform Sonic log produces one omni-directional click each second. The probe has two receivers (3 ft and 4 ft from the transmitter). They record the full waveform for 1,024 milliseconds at an interval of one microsecond. The recording begins at a delay of 56 milliseconds after the transmitted pulse.

Borehole fluid is required for the tool to function properly. The first arrival (shortest travel time) of the acoustic pulse is through the shortest distance to the borehole wall, then through the formation rock matrix to the receiver.

The logging speed is 12 ft/min. The results file has three data curves (Caliper, Near Receiver, and Far Receiver). The sonic probe identification is CLP and its serial number is 1075. The probe is free-floating in the borehole.

1. The caliper is duplicated from the Compensated Density Log.

2. The near and far receivers show changes in the acoustic properties of the formation matrix and are also affected by hole size conditions (washed-out zones).

6.7 MERGED LOGS

A merged log was constructed from the key sensor(s) of each logging probe and assembled into a single presentation plot for each borehole. The merged log has four tracks:

- Track 1: Gamma (Density), Caliper (Density) , Gamma (Neutron)

- Track 2: Compensated Density, Neutron

- Track 3: Deep Electro-magnetic (EM) Conductivity

- Track 4: Near Receiver (Full Waveform Sonic).

7.0 WELNAV EARTH'S MAGNETIC FIELD SURVEY

After borehole completion, Wellbore Navigation, Inc., of Tustin, California, surveyed the local earth's magnetic field within the basalt flows penetrated. The purpose of the surveys was to acquire magnetic north orientation specific to each basalt flow. The data is used to support the oriented velocity logging method.

The magnetometer tool used has three flux gates that acquire data from the X, Y, and Z axes. This data is reported as horizontal field strength and is raw (X, Y, Z) readings. This data is then computed to provide the following results.

- Earth's magnetic declination (degrees).

- Earth's magnetic dip (degrees).
  NOTE: The magnetic field dip is 0 degrees at the equator and 90 degrees at the North Pole.

- Earth's magnetic field intensity (Oerstands).

Measurements were collected in a Move-Stop-Acquire logging mode. The probe had one centralizer at its top to dampen tool movement. The bottom of the probe had electronics for magnetic survey. To prevent metal interference with the magnetic survey, a centralizer was not installed at the bottom. Although the probe was equipped with a gyroscope for deviation measurements, no measurements were acquired.

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WMP-32076, 2007, *Borehole Summary Report for Waste Treatment Plant Seismic Borehole C4996*, Rev. 0, Freestone Environmental Services, Inc., Richland, Washington.

WMP-32119, 2007, *Entry Boreholes Summary Report for the Waste Treatment Plant Seismic Boreholes Project*, Rev. 0, Reissue, Gram, Inc., Richland, Washington.

APPENDIX A

BOREHOLE C4993

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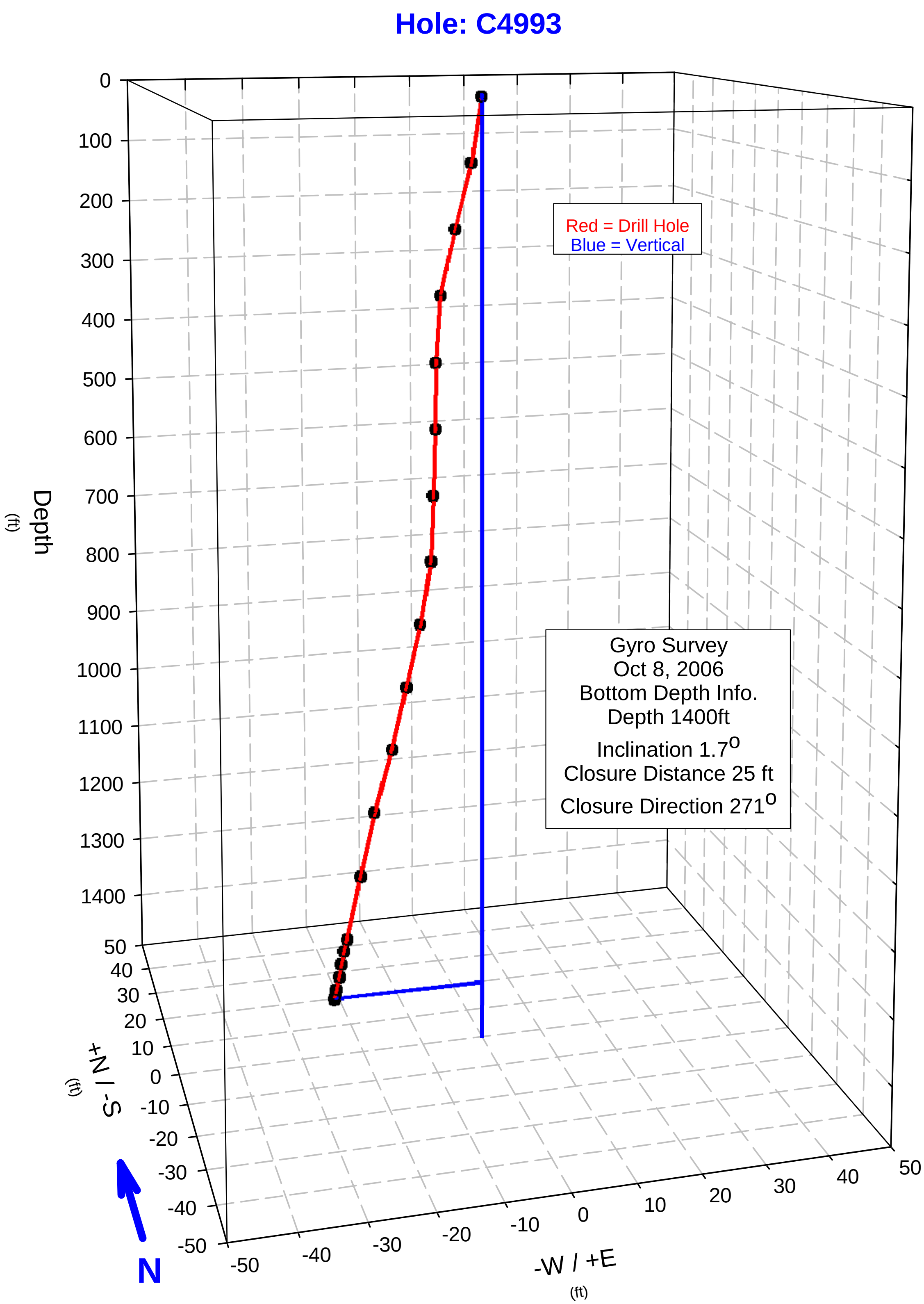
A1.0 BOREHOLE C4993

A1.1 ENERGY*SOLUTIONS* AND PACIFIC NORTHWEST GEOPHYSICS GYROSCOPIC LOGS

Hole: **C4993**

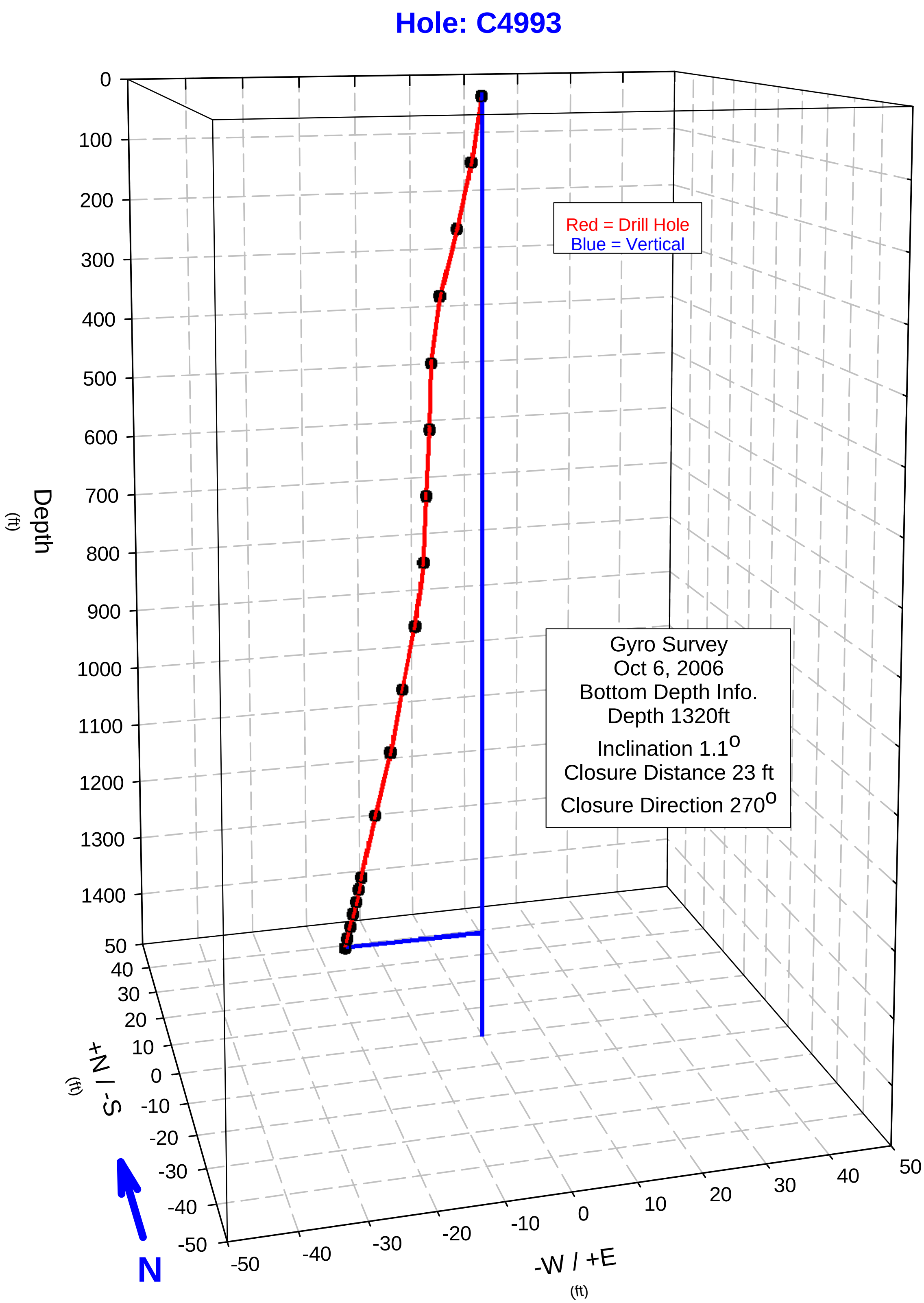
Survey Date	Survey Number	Maximum Depth (feet)	Inclination From Vertical (deg)	Closure Distance (feet)
10/8/2006	17*	1400	1.7	25
10/6/2006	16*	1320	1.1	23
9/30/2006	15*	1218	1.3	19
9/28/2006	14*	1136	1.2	20
9/26/2006	13*	1036	1.7	16
9/22/2006	12*	935	0.6	13
9/21/2006	11*	815	1.8	12
9/17/2006	10*	716	0.9	10
9/15/2006	9*	635	0.5	9
9/11/2006	8*	536	1	10
Casing	Cable-Tool			
9/4/2006	7	368	0.8	9
9/1/2006	6	343	1.4	8
8/30/2006	5	311	1.4	7.1
8/29/2006	4	285	1.7	8.3
8/25/2006	3*	204	1.6	5.1
8/23/2006	2	146	1.6	3.7
8/22/2006	1*	82	1.1	1.2

* = Gyro data includes Out-Run survey check-stations.


Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Oct 8, 2006
Bottom Depth Info.
Depth 1400ft
Inclination 1.7°
Closure Distance 25 ft
Closure Direction 271°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

Hole: **C4993** Survey Date: **10/8/2006**

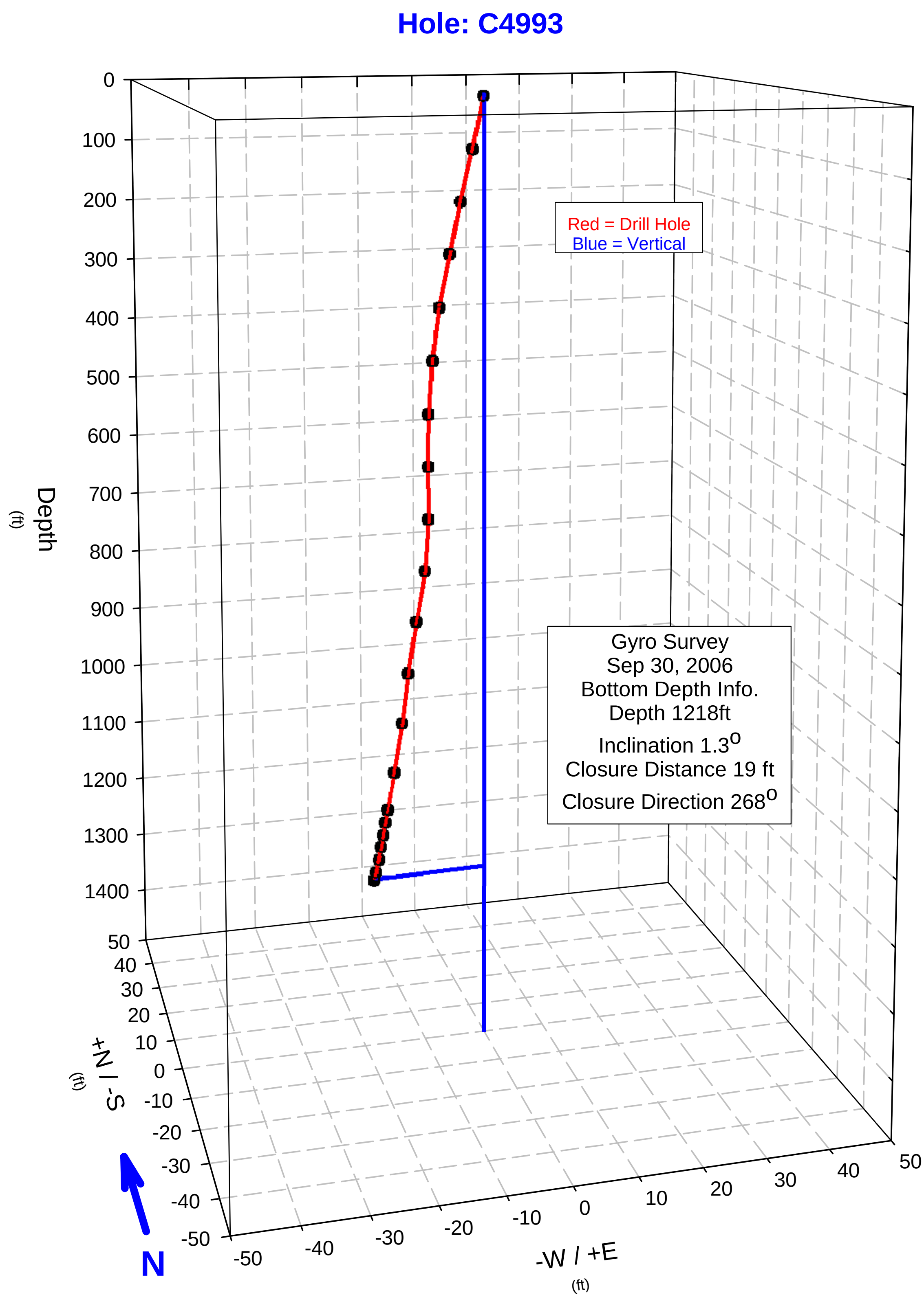
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.68	345.7	0.06	0.06	-0.01	5.3
105	104.98	1.62	279.04	1.67	0.26	-1.64	1.6
205	204.94	1.58	269.14	4.4	-0.07	-4.4	0.4
305	304.91	1.35	266.33	6.91	-0.44	-6.9	0.5
405	404.9	0.75	259.45	8.07	-1.48	-7.94	1.4
505	504.89	0.61	253.72	8.65	-2.42	-8.3	0.7
605	604.89	0.78	249.16	9.52	-3.39	-8.89	0.6
705	704.88	0.44	247.43	10.17	-3.9	-9.4	1
805	804.87	1.56	253.79	11.44	-3.19	-10.99	1.1
905	904.84	1.12	260.88	13.2	-2.09	-13.04	0.5
1005	1004.81	1.67	265.98	15.27	-1.07	-15.23	0.6
1105	1104.77	1.61	268.8	18	-0.38	-18	0.3
1205	1204.74	1.1	269.36	20.34	-0.23	-20.34	0.6
1305	1304.71	1.55	270.43	22.57	0.17	-22.57	0.7
1325	1324.71	1.13	270.77	23.02	0.31	-23.02	2.2
1345	1344.7	1.19	270.87	23.42	0.36	-23.42	1.4
1365	1364.7	1.29	270.77	23.85	0.32	-23.85	1.1
1385	1384.69	1.46	270.58	24.33	0.24	-24.32	0.9
1395	1394.69	1.66	270.57	24.6	0.24	-24.59	4.7
1399	1398.69	1.72	270.56	24.71	0.24	-24.71	10.9
1399.5	1399.19	1.69	270.56	24.73	0.24	-24.73	6.1
1400	1399.69	1.71	270.55	24.74	0.24	-24.74	4



Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Oct 6, 2006
Bottom Depth Info.
Depth 1320ft
Inclination 1.1°
Closure Distance 23 ft
Closure Direction 270°
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

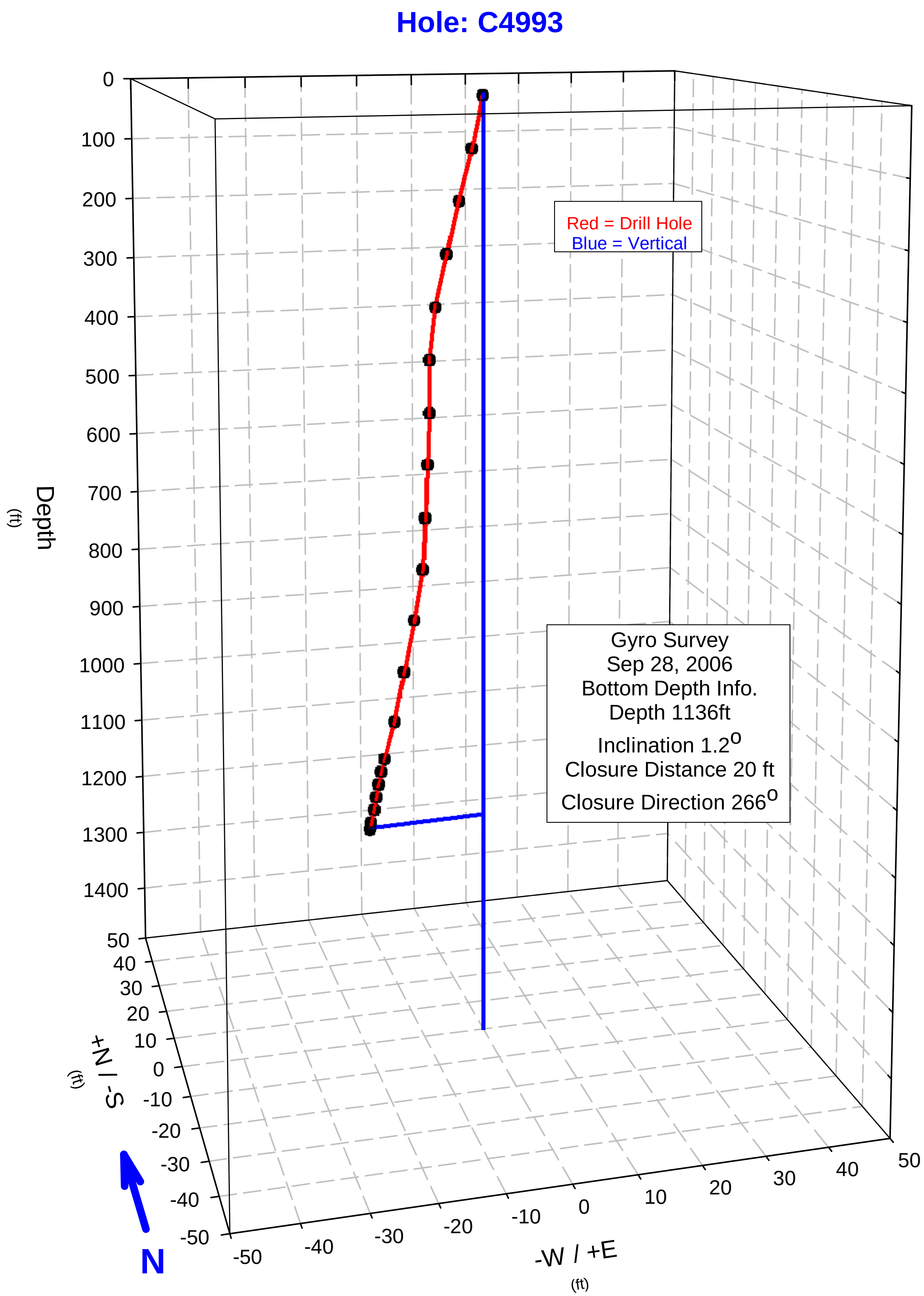
Hole: **C4993** Survey Date: **10/6/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.58	305.26	0.06	0.03	-0.05	9
105	104.99	1.28	279.38	1.68	0.27	-1.65	0.7
205	204.95	1.69	266.61	4.11	-0.24	-4.1	0.9
305	304.9	1.92	261.63	7.18	-1.05	-7.11	0.6
405	404.88	0.88	257.34	9.05	-1.98	-8.83	2
505	504.87	0.75	251.37	9.91	-3.16	-9.39	0.7
605	604.86	0.78	247.87	11.05	-4.16	-10.24	0.3
705	704.86	0.31	246.09	11.87	-4.81	-10.85	0.6
805	804.85	1.36	250.72	12.83	-4.24	-12.11	1.2
905	904.82	1.14	257.78	14.24	-3.01	-13.92	0.2
1005	1004.8	1.15	262	15.85	-2.21	-15.7	0.5
1105	1104.77	1.7	264.95	18.18	-1.6	-18.11	0.5
1205	1204.75	0.97	267.53	20.34	-0.88	-20.32	0.7
1225	1224.74	1.21	268.01	20.68	-0.72	-20.67	1.2
1245	1244.74	1.34	268.56	21.08	-0.53	-21.07	0.6
1265	1264.73	1.6	269.1	21.55	-0.34	-21.55	1.6
1285	1284.72	1.45	269.57	22.05	-0.17	-22.05	0.8
1305	1304.72	1.51	270.03	22.53	0.01	-22.53	0.3
1320	1319.71	1.04	270.24	22.85	0.09	-22.85	3.7


Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sep 30, 2006
Bottom Depth Info.
Depth 1218ft
Inclination 1.3°
Closure Distance 19 ft
Closure Direction 268°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

Hole: **C4993** Survey Date: **9/30/2006**

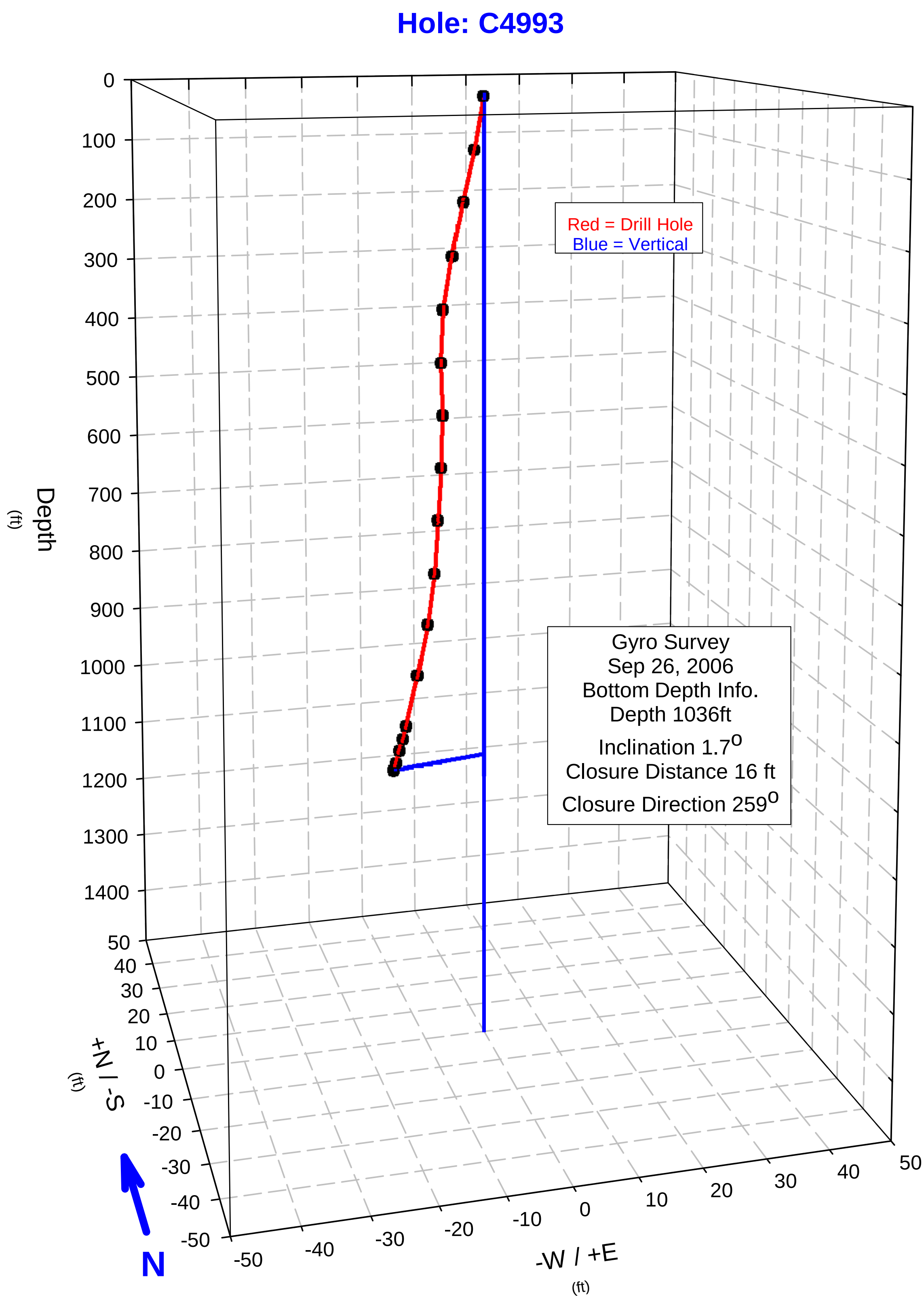
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
5	5	1.02	288.19	0.07	0.02	-0.07	13.3
85	84.98	1.53	280.9	1.83	0.35	-1.8	0.8
165	164.96	1.26	279.66	3.75	0.63	-3.7	0.7
245	244.93	1.59	270.93	5.57	0.09	-5.57	0.9
325	324.9	1.58	263.15	7.6	-0.91	-7.55	0
405	404.88	0.92	258.21	9.16	-1.87	-8.97	1
485	484.87	0.64	254.98	10.1	-2.62	-9.76	0.4
565	564.87	0.29	253.14	10.41	-3.02	-9.97	0.9
645	644.87	0.63	250.58	10.64	-3.54	-10.03	0.8
725	724.87	0.69	251.1	11.25	-3.64	-10.64	1.2
805	804.85	1.38	254.67	12.44	-3.29	-12	1.1
885	884.84	0.55	257.01	13.67	-3.07	-13.32	1.1
965	964.84	0.91	259.62	14.45	-2.6	-14.21	0.5
1045	1044.82	1.13	263.07	15.55	-1.88	-15.44	0.3
1105	1104.81	0.99	264.7	16.54	-1.53	-16.46	0.8
1125	1124.81	1.06	265.04	16.88	-1.46	-16.81	0.9
1145	1144.81	0.94	265.46	17.2	-1.36	-17.15	0.6
1165	1164.8	1.09	265.94	17.53	-1.24	-17.48	0.9
1185	1184.8	1.13	266.49	17.88	-1.1	-17.84	0.3
1205	1204.8	1.51	267.06	18.3	-0.94	-18.28	1.9
1218	1217.79	1.27	267.46	18.59	-0.82	-18.57	2.1



Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sep 28, 2006
Bottom Depth Info.
Depth 1136ft
Inclination 1.2°
Closure Distance 20 ft
Closure Direction 266°
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

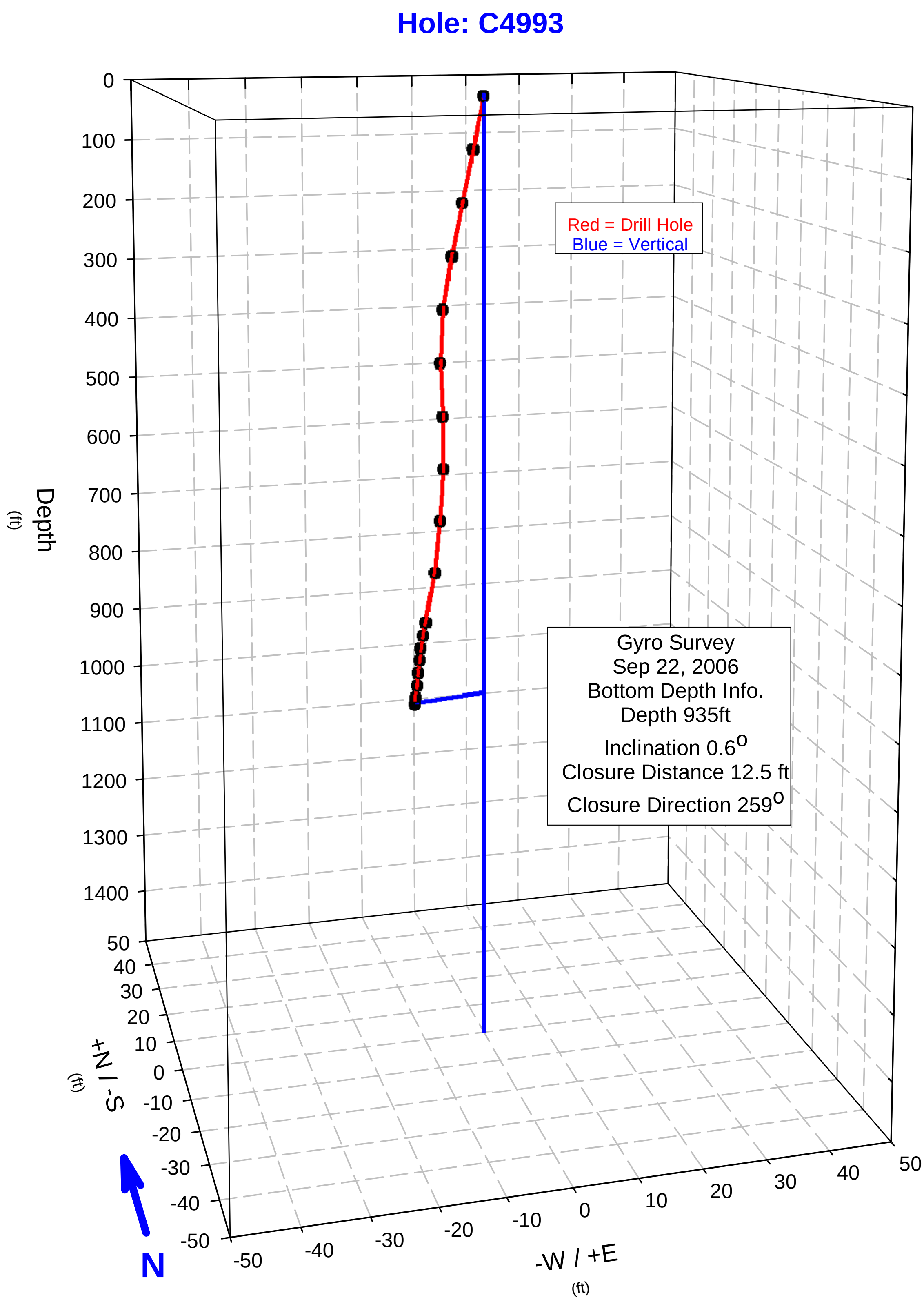
Hole: **C4993** Survey Date: **9/28/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	1.23	310.4	0.09	0.06	-0.07	13.5
85	84.98	1.32	282.16	1.8	0.38	-1.75	0.9
165	164.95	1.85	271.77	3.95	0.12	-3.95	0.7
245	244.92	1.35	266.42	6.13	-0.38	-6.12	0.7
325	324.89	1.61	263.69	8.16	-0.9	-8.11	0.5
405	404.88	0.83	259.85	9.44	-1.66	-9.29	2
485	484.87	0.21	256.03	9.75	-2.35	-9.46	0.8
565	564.87	0.61	254.8	10.27	-2.69	-9.91	0.5
645	644.87	0.62	252.33	10.95	-3.32	-10.43	0.5
725	724.86	0.49	251.76	11.47	-3.59	-10.9	1
805	804.85	1.52	255.23	12.66	-3.23	-12.24	1.3
885	884.83	0.84	257.89	14.18	-2.98	-13.86	0.9
965	964.82	1.54	261.33	15.52	-2.34	-15.34	1.2
1025	1024.79	1.71	264.06	16.98	-1.76	-16.89	1.2
1045	1044.79	1.44	264.39	17.52	-1.71	-17.44	1.7
1065	1064.78	1.12	264.7	17.95	-1.66	-17.88	2.3
1085	1084.78	1.09	265.09	18.32	-1.57	-18.25	0.3
1105	1104.77	0.95	265.42	18.66	-1.49	-18.6	0.7
1125	1124.77	1.63	265.8	19.09	-1.4	-19.04	3.4
1136	1135.77	1.2	266.04	19.35	-1.34	-19.3	4


Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sep 26, 2006
Bottom Depth Info.
Depth 1036ft
Inclination 1.7o
Closure Distance 16 ft
Closure Direction 259o
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

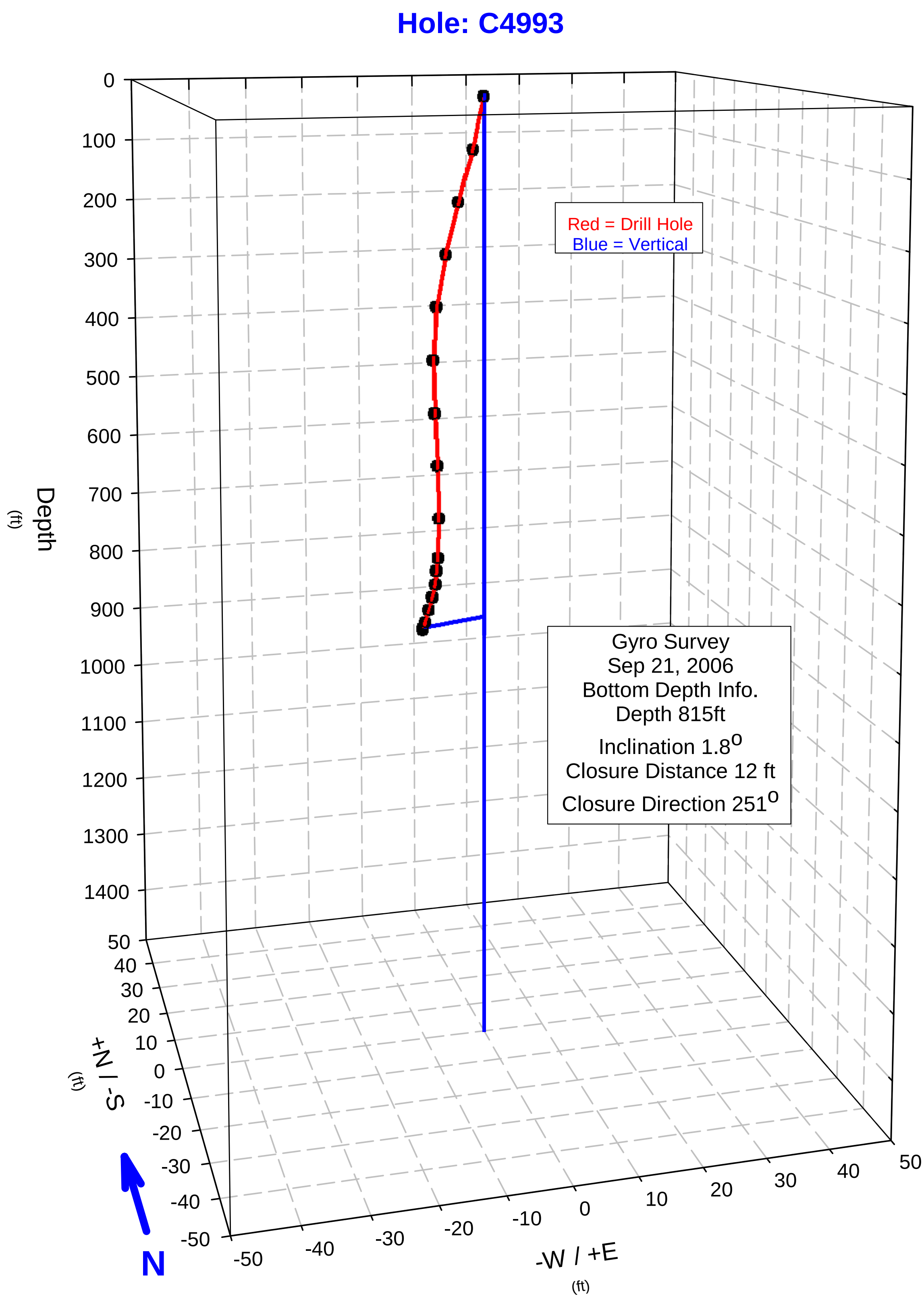
Hole: **C4993** Survey Date: **9/26/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.9	340.34	0.04	0.04	-0.01	20.4
85	84.98	1.51	281.14	1.53	0.3	-1.5	1.5
165	164.95	1.62	263.51	3.57	-0.4	-3.54	0.6
245	244.92	1.59	256.59	5.74	-1.33	-5.58	0.2
325	324.9	1.14	253.09	7.59	-2.21	-7.26	0.7
405	404.89	0.61	248.49	8.42	-3.09	-7.83	1.3
485	484.89	0.22	244.66	8.54	-3.65	-7.72	0.5
565	564.89	0.68	243.27	9.03	-4.06	-8.07	0.8
645	644.88	0.74	241.71	9.98	-4.73	-8.79	0.3
725	724.88	0.67	240.61	10.93	-5.36	-9.52	0.4
805	804.87	1.18	243.99	11.86	-5.2	-10.66	1.2
885	884.85	1.14	249.36	12.99	-4.58	-12.15	0.3
965	964.83	1.52	254.02	14.48	-3.99	-13.92	0.5
985	984.82	1.59	255.31	14.91	-3.78	-14.42	0.8
1005	1004.81	1.7	256.68	15.35	-3.54	-14.94	0.5
1025	1024.8	1.72	258.01	15.82	-3.29	-15.48	0.3
1036.5	1036.3	1.71	258.72	16.11	-3.15	-15.8	0.3


Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sep 22, 2006
Bottom Depth Info.
Depth 935ft
Inclination 0.6°
Closure Distance 12.5 ft
Closure Direction 259°
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

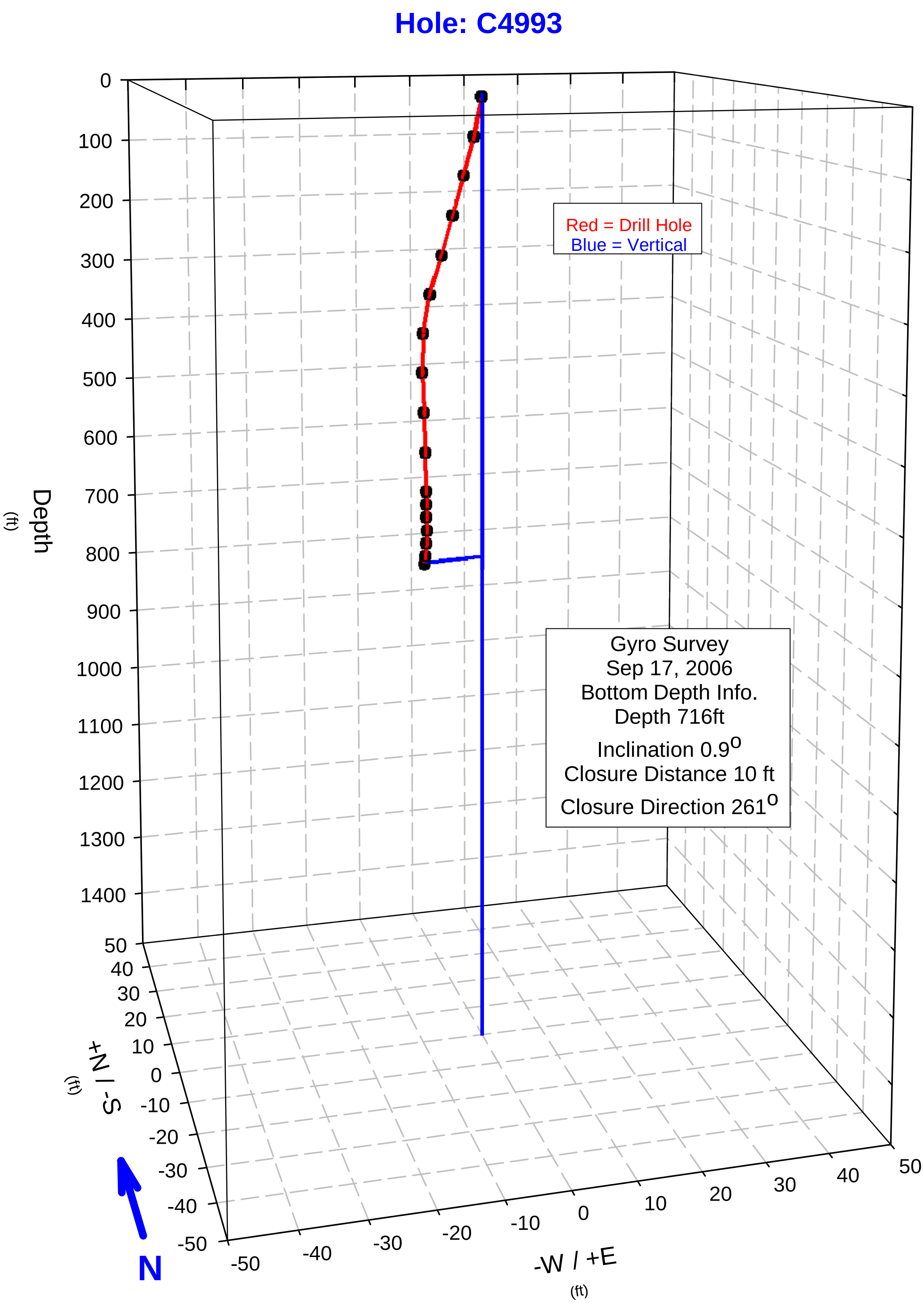
Hole: **C4993** Survey Date: **9/22/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	1.04	309.38	0.07	0.05	-0.06	14.1
85	84.98	1.39	273.87	1.68	0.11	-1.68	1
165	164.96	1.58	261.25	3.67	-0.56	-3.63	0.5
245	244.93	1.54	255.54	5.8	-1.45	-5.62	0.1
325	324.9	1.13	252.68	7.63	-2.27	-7.29	0.6
405	404.89	0.77	248	8.59	-3.22	-7.97	1.2
485	484.89	0.83	241.11	8.95	-4.32	-7.84	0.3
565	564.88	0.35	238.15	9.34	-4.93	-7.93	1.2
645	644.88	0.45	240.04	9.79	-4.89	-8.48	0.3
725	724.88	0.82	243.98	10.34	-4.53	-9.29	0.5
805	804.86	1.43	250.84	11.22	-3.68	-10.6	0.8
825	824.86	1.15	252.69	11.48	-3.42	-10.96	1.4
845	844.85	0.93	254.17	11.69	-3.19	-11.25	1.1
865	864.85	0.82	255.42	11.86	-2.98	-11.47	0.6
885	884.85	0.59	256.37	12	-2.83	-11.67	1.3
905	904.85	0.71	257.25	12.13	-2.68	-11.83	1
925	924.85	0.74	258.28	12.26	-2.49	-12	0.2
935.5	935.35	0.54	258.58	12.35	-2.44	-12.1	5.2


Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sep 21, 2006
Bottom Depth Info.
Depth 815ft
Inclination 1.8°
Closure Distance 12 ft
Closure Direction 251°
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

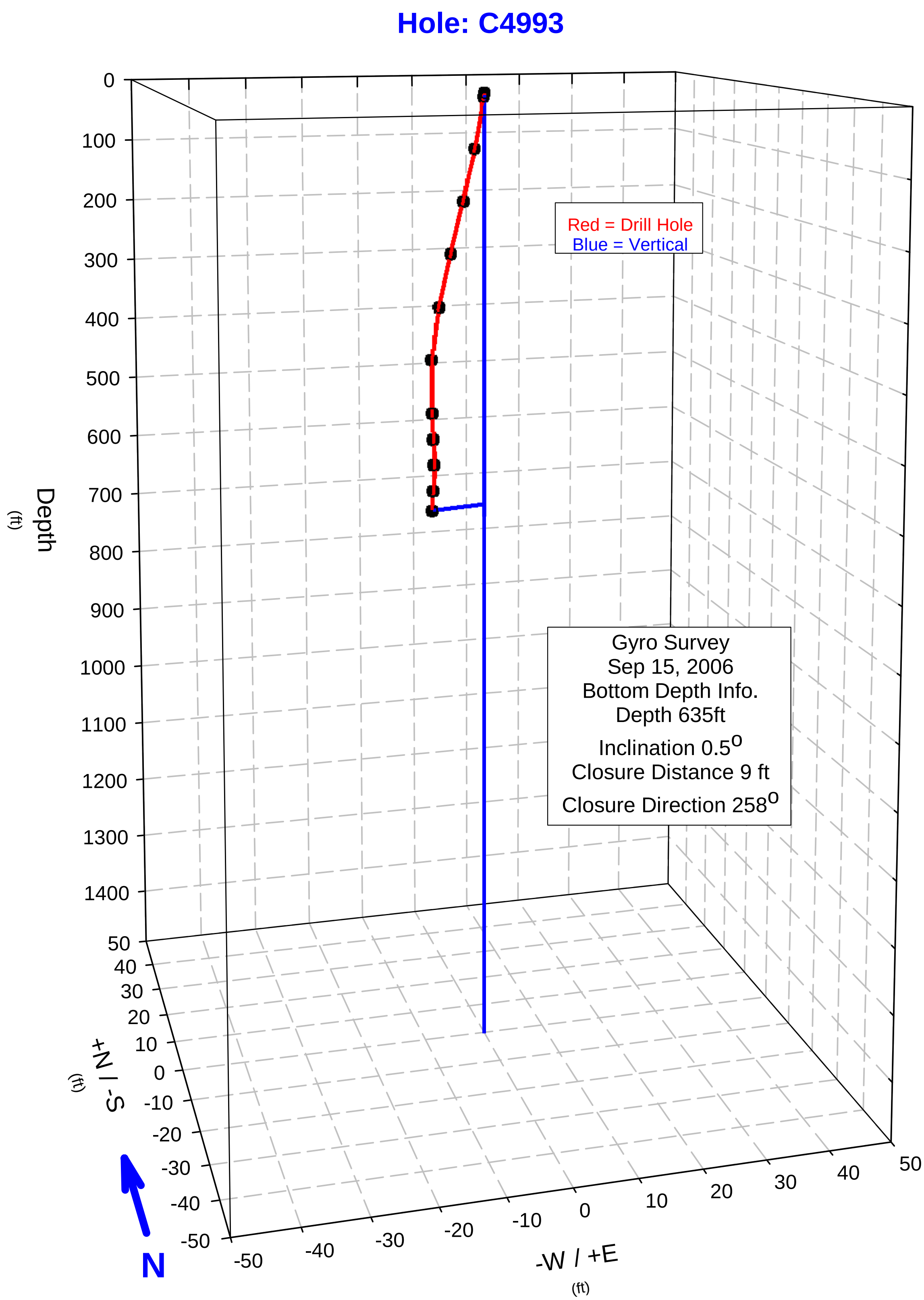
Hole: **C4993** Survey Date: **8/21/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.82	260.64	0.06	-0.01	-0.06	13.3
85	84.98	1.68	278.38	1.8	0.26	-1.78	1.1
165	164.95	1.6	277.04	4.09	0.5	-4.06	0.1
245	244.92	1.41	274.62	6.17	0.5	-6.15	0.5
325	324.9	1.2	269.96	7.87	-0.01	-7.87	0.7
405	404.89	1.01	262.81	8.77	-1.1	-8.7	1.3
485	484.88	0.71	255.28	9	-2.29	-8.7	0.5
565	564.87	0.4	250.39	9	-3.02	-8.47	0.4
645	644.87	0.71	246.2	9.27	-3.74	-8.48	0.6
705	704.87	0.49	244.18	9.77	-4.25	-8.79	0.7
725	724.87	0.62	244.2	9.96	-4.33	-8.97	1.2
745	744.86	1.02	244.73	10.23	-4.36	-9.25	2.2
765	764.86	1.65	246.22	10.6	-4.27	-9.7	3.9
785	784.85	1.71	248.19	11.05	-4.1	-10.26	0.8
805	804.84	1.7	249.96	11.53	-3.95	-10.83	0.3
815.5	815.34	1.76	250.89	11.79	-3.86	-11.14	1.1


Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sep 17, 2006
Bottom Depth Info.
Depth 716ft
Inclination 0.9°
Closure Distance 10 ft
Closure Direction 261°
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

Hole: **C4993** Survey Date: **9/17/2006**

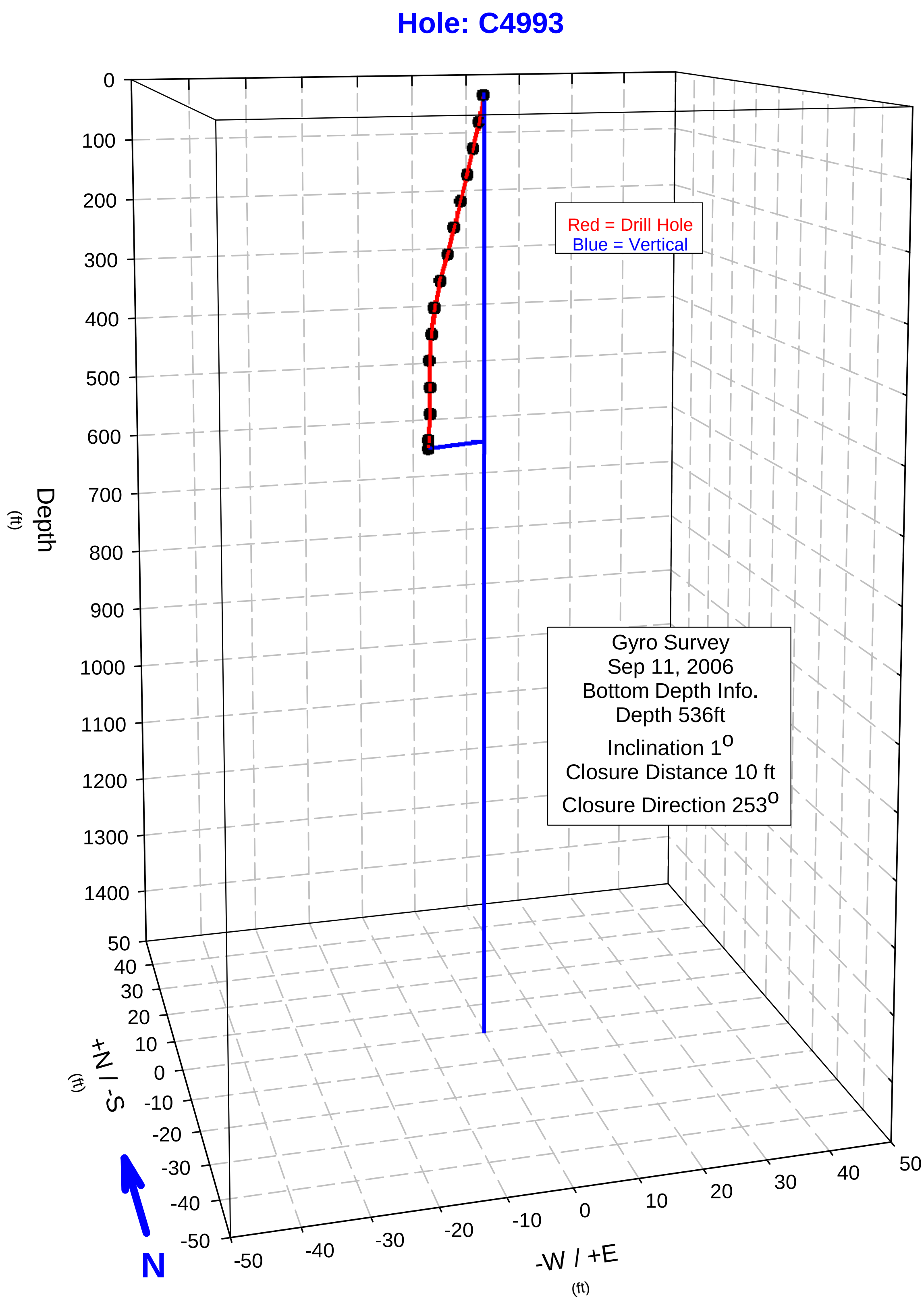
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
5	5	1.12	317.57	0.07	0.05	-0.04	15.2
65	64.99	1.44	299.7	1.3	0.64	-1.13	1.7
125	124.96	1.79	286.69	2.93	0.84	-2.81	0.6
185	184.94	1.53	281.68	4.64	0.94	-4.55	0.5
245	244.91	1.95	279.16	6.45	1.03	-6.36	0.7
305	304.88	1.74	278.03	8.37	1.17	-8.29	0.4
365	364.87	0.34	277.37	9.46	1.21	-9.38	2.3
425	424.87	0.54	275.4	9.61	0.9	-9.57	1
485	484.86	0.83	271.14	9.53	0.19	-9.53	0.5
545	544.86	0.6	266.65	9.49	-0.55	-9.48	0.4
605	604.85	0.36	263.65	9.52	-1.05	-9.47	0.4
625	624.85	0.26	263.01	9.53	-1.16	-9.46	0.5
645	644.85	0.28	262.44	9.53	-1.25	-9.45	0.2
665	664.85	0.38	261.79	9.56	-1.36	-9.46	0.7
685	684.85	0.39	261.36	9.66	-1.45	-9.55	1.7
705	704.85	0.72	261.26	9.85	-1.5	-9.74	1.7
716	715.85	0.93	261.27	10.01	-1.52	-9.89	2



Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sep 15, 2006
Bottom Depth Info.
Depth 635ft
Inclination 0.5°
Closure Distance 9 ft
Closure Direction 258°
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

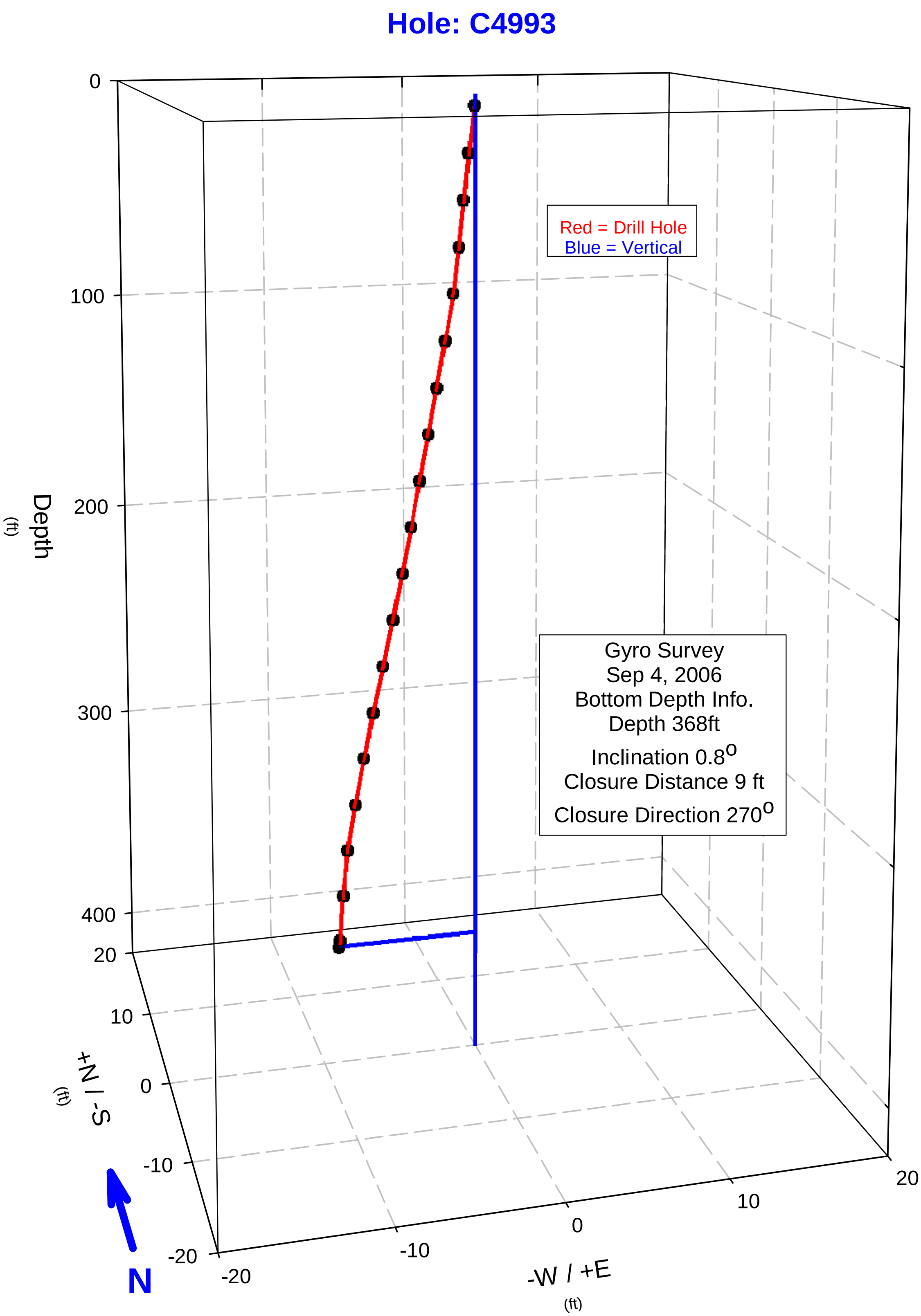
Hole: **C4993** Survey Date: **9/15/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
0	0	1.02	0	0	0	0	0
5	5	1.07	315.93	0.09	0.07	-0.06	1.2
85	84.98	1.17	302.96	1.6	0.87	-1.34	0.7
165	164.96	1.51	288.76	3.35	1.08	-3.17	0.8
245	244.93	1.57	279.43	5.38	0.88	-5.3	0.2
325	324.91	1.35	275.14	7.36	0.66	-7.33	0.3
405	404.89	0.93	270.41	8.66	0.06	-8.66	1.2
485	484.89	0.81	263.58	8.98	-1	-8.92	1
525	524.88	0.57	260.51	8.92	-1.47	-8.8	0.6
565	564.88	0.29	258.65	8.94	-1.76	-8.77	0.9
605	604.88	0.41	257.94	9.13	-1.91	-8.92	0.9
635	634.88	0.44	257.85	9.35	-1.97	-9.14	0.2


Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sep 11, 2006
Bottom Depth Info.
Depth 536ft
Inclination 1°
Closure Distance 10 ft
Closure Direction 253°
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

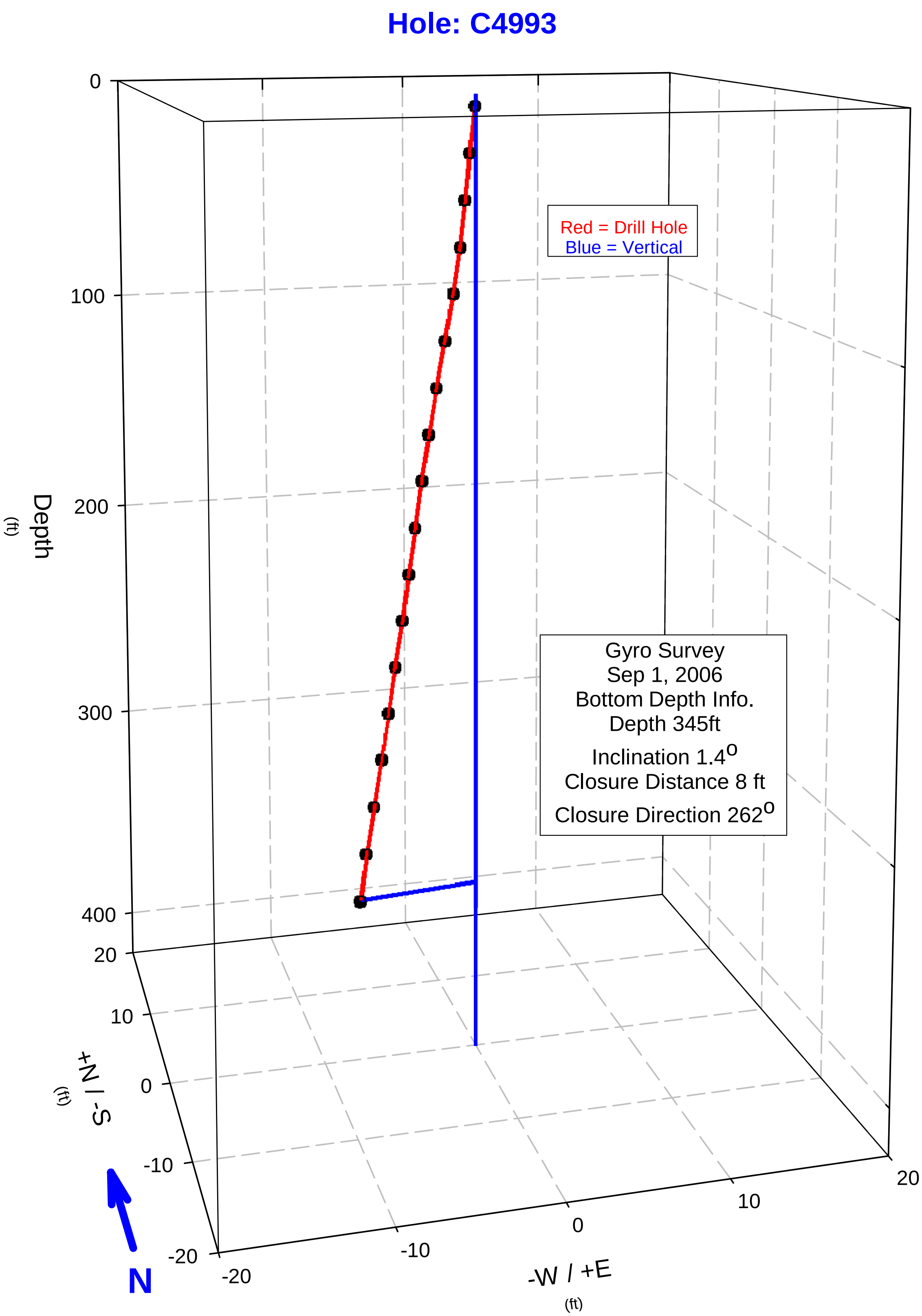
Hole: **C4993** Survey Date: **9/11/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
4	4	0.91	292.6	0.05	0.02	-0.05	21
44	43.99	1.13	289.12	0.71	0.23	-0.67	1.9
84	83.98	1.78	287.1	1.68	0.49	-1.61	2.7
124	123.97	1.15	280.32	2.67	0.48	-2.63	1.6
164	163.95	1.98	276.08	3.74	0.4	-3.72	2.1
204	203.94	1.36	272.06	4.85	0.17	-4.85	2
244	243.92	2.04	268.54	5.99	-0.15	-5.98	1.8
284	283.89	2	265.61	7.35	-0.56	-7.33	0.8
324	323.88	1.05	263.68	8.38	-0.92	-8.33	2.4
364	363.87	0.63	263.19	8.96	-1.06	-8.9	1.1
404	403.87	1.02	261.33	9.39	-1.42	-9.28	2
444	443.87	0.68	258.2	9.61	-1.96	-9.4	1.6
484	483.86	0.68	255.99	9.81	-2.37	-9.52	1.5
524	523.86	0.96	253.9	10.25	-2.84	-9.84	0.8
536	535.86	0.95	253.2	10.4	-3.01	-9.96	1


Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sep 4, 2006
Bottom Depth Info.
Depth 368ft
Inclination 0.8°
Closure Distance 9 ft
Closure Direction 270°
Depth
(ft)
0
100
200
300
400
+N / -S
(ft)
20
10
0
-10
-20
-W / +E
(ft)
-20
-10
0
10
20
N

Hole: **C4993** Survey Date: **9/4/2006**

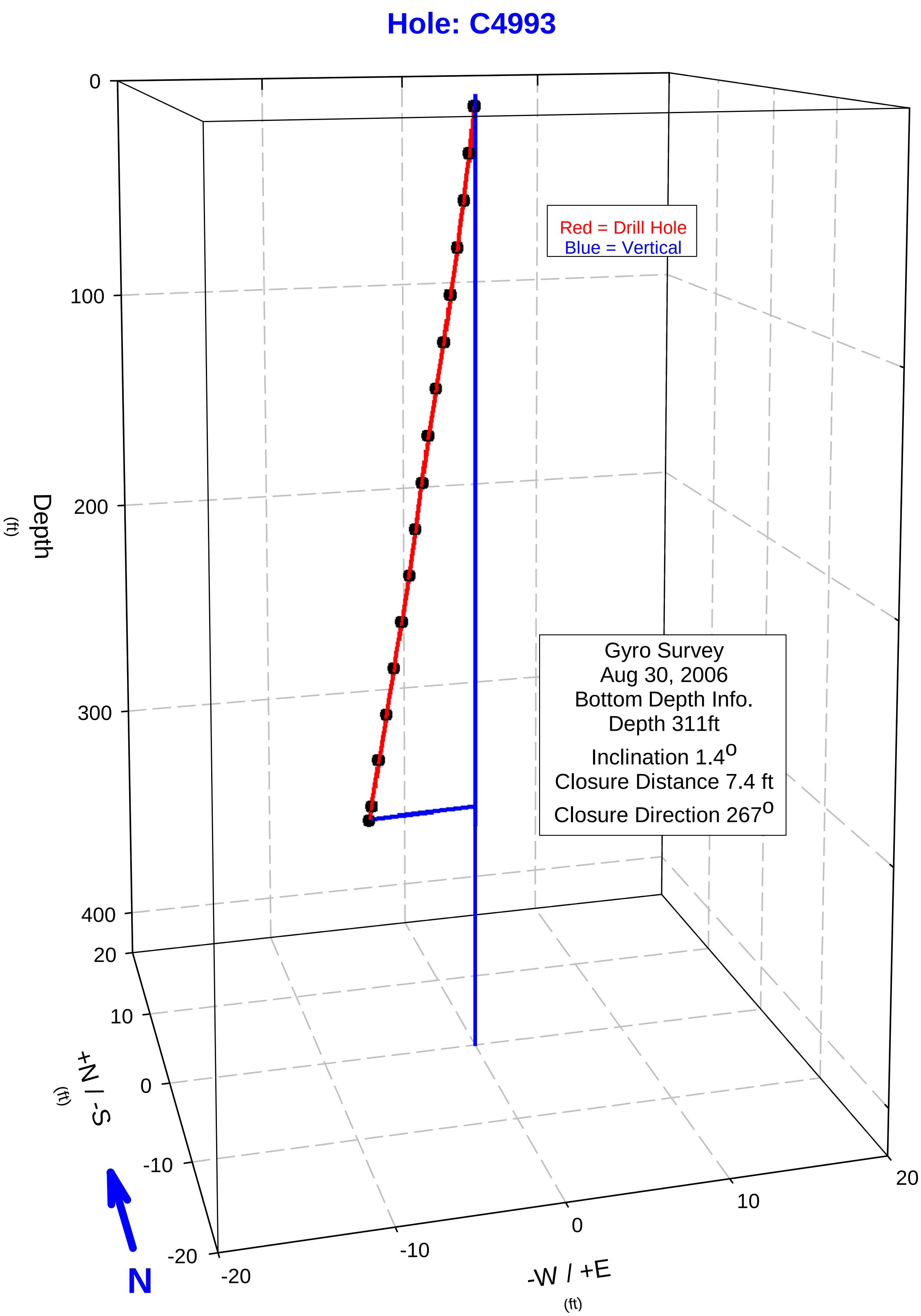
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	1.02	323.58	0.04	0.04	-0.03	21.7
25	25	1.05	297.78	0.39	0.18	-0.35	2.3
45	44.99	0.89	287.81	0.72	0.22	-0.68	1.3
65	64.99	0.79	284.21	1	0.25	-0.97	1
85	84.99	1.32	283.28	1.37	0.31	-1.33	2.6
105	104.98	1.77	279.58	1.89	0.31	-1.87	3.2
125	124.97	1.58	275.96	2.46	0.26	-2.45	1.1
145	144.96	1.62	274.79	3.01	0.25	-3	1
165	164.96	1.6	273.98	3.57	0.25	-3.57	1
185	184.95	1.61	272.99	4.13	0.22	-4.12	0.2
205	204.94	1.83	272.32	4.73	0.19	-4.72	1.1
225	224.93	1.87	271.82	5.37	0.17	-5.37	0.2
245	244.92	1.91	271.45	6.03	0.15	-6.03	0.2
265	264.91	1.8	271.29	6.68	0.15	-6.68	0.7
285	284.9	1.72	271.29	7.29	0.16	-7.29	0.4
305	304.89	1.71	271.02	7.89	0.14	-7.89	1.1
325	324.88	1.34	270.5	8.42	0.07	-8.41	1.9
345	344.88	0.51	270.6	8.72	0.09	-8.72	5.2
365	364.88	0.92	270.59	8.94	0.09	-8.94	3.8
368	367.88	0.8	270.51	8.99	0.08	-8.99	5.8



Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sep 1, 2006
Bottom Depth Info.
Depth 345ft
Inclination 1.4^o
Closure Distance 8 ft
Closure Direction 262^o
Depth
(ft)
0
100
200
300
400
+N / -S
(ft)
20
10
0
-10
-20
-W / +E
(ft)
-20
-10
0
10
20
N

Hole: **C4993** Survey Date: **9/1/2006**

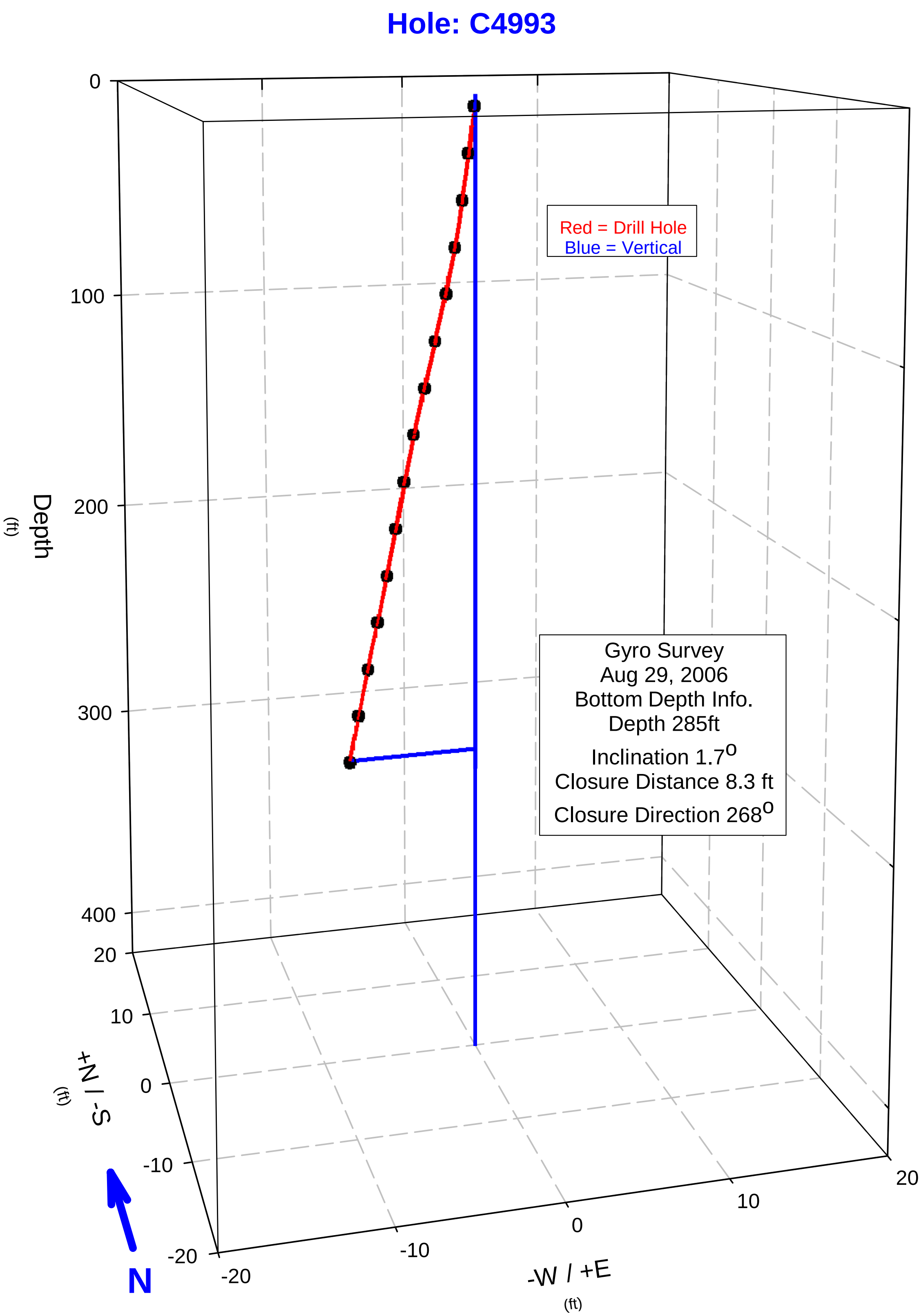
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	1.09	331.83	0.05	0.05	-0.02	20.8
25	25	1.03	306.32	0.39	0.23	-0.31	4
45	44.99	0.66	294.96	0.66	0.28	-0.6	1.8
65	64.99	1.1	289.63	0.96	0.32	-0.91	2.2
85	84.99	1.6	282.92	1.41	0.31	-1.37	2.9
105	104.98	1.62	278.14	1.95	0.28	-1.93	0.7
125	124.97	1.54	276.1	2.5	0.27	-2.48	0.4
145	144.96	1.48	274.05	3.01	0.21	-3	1.4
165	164.96	1.35	272.13	3.49	0.13	-3.49	0.7
185	184.95	1.28	270.97	3.95	0.07	-3.95	0.4
205	204.95	1.28	269.85	4.38	-0.01	-4.38	0.6
225	224.94	1.4	268.74	4.84	-0.11	-4.84	0.7
245	244.94	1.42	267.98	5.33	-0.19	-5.33	0.3
265	264.93	1.4	267.16	5.82	-0.29	-5.81	0.9
285	284.92	1.62	265.85	6.33	-0.46	-6.31	1.4
305	304.91	1.85	264.33	6.91	-0.68	-6.87	1.2
325	324.9	1.59	262.92	7.48	-0.92	-7.42	1.4
345	344.9	1.37	261.69	7.97	-1.15	-7.89	1.2



Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Aug 30, 2006
Bottom Depth Info.
Depth 311ft
Inclination 1.4°
Closure Distance 7.4 ft
Closure Direction 267°
Depth (ft)
0
100
200
300
400
+N / -S (ft)
20
10
0
-10
-20
-W / +E (ft)
-20
-10
0
10
20
N

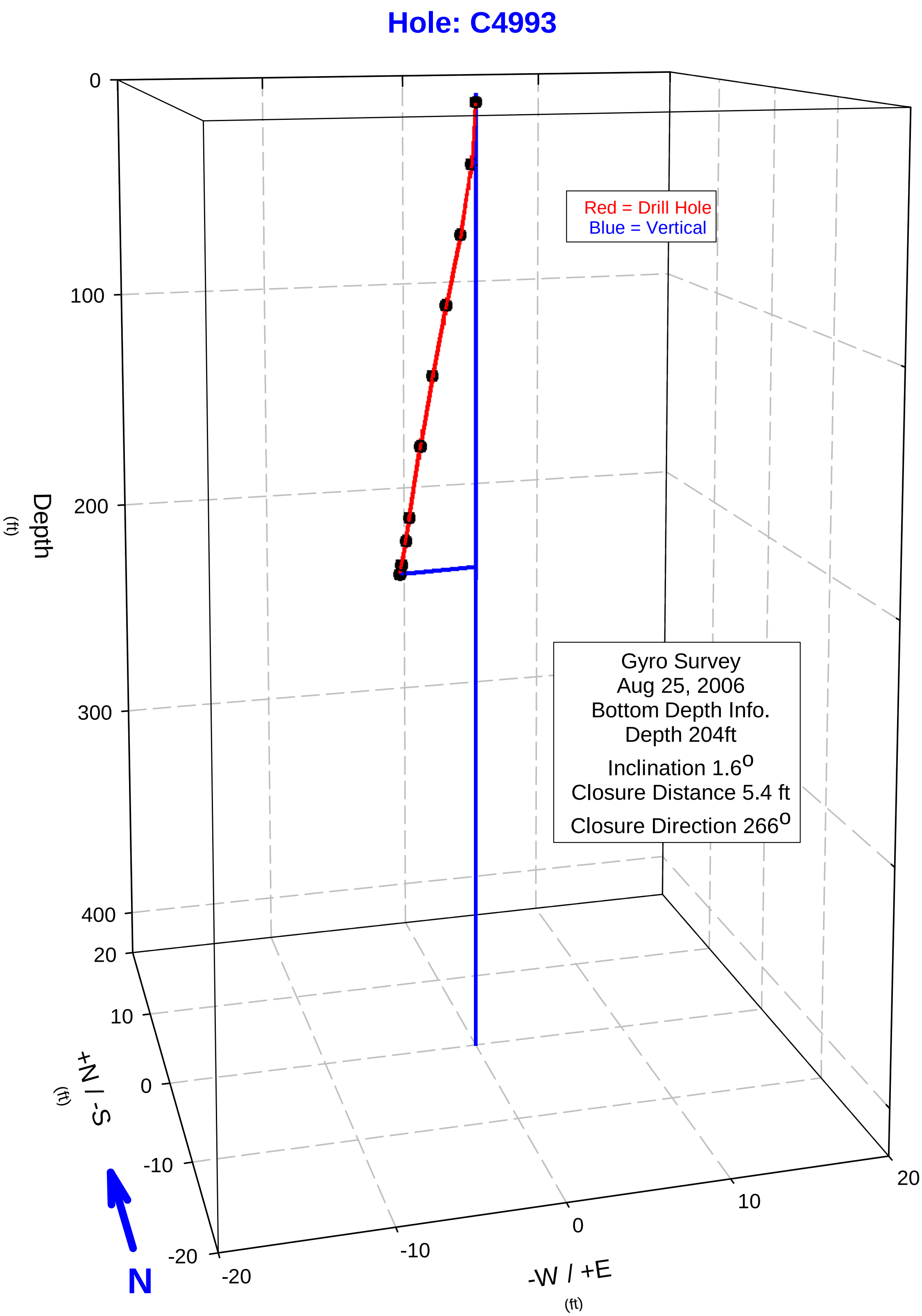
Hole: **C4993** Survey Date: **8/30/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.89	315.66	0.06	0.04	-0.04	12.4
25	25	0.88	294.33	0.35	0.15	-0.32	1.7
45	44.99	1.13	286.2	0.7	0.19	-0.67	1.3
65	64.99	1.29	280.6	1.11	0.2	-1.09	1.3
85	84.98	1.32	275.37	1.55	0.14	-1.54	0.9
105	104.98	1.39	272.3	2.01	0.08	-2.01	0.9
125	124.97	1.58	270.67	2.52	0.03	-2.52	1
145	144.97	1.46	268.91	3.05	-0.06	-3.05	1
165	164.96	1.32	267.36	3.52	-0.16	-3.52	0.7
185	184.95	1.22	266.4	3.96	-0.25	-3.96	0.5
205	204.95	1.4	266.07	4.42	-0.3	-4.41	1.2
225	224.94	1.43	266.09	4.91	-0.33	-4.9	0.2
245	244.94	1.49	266.27	5.42	-0.35	-5.41	0.5
265	264.93	1.47	266.47	5.94	-0.37	-5.93	0.3
285	284.92	1.48	266.46	6.46	-0.4	-6.45	0.3
305	304.92	1.33	266.63	6.95	-0.41	-6.94	1.2
311	310.92	1.43	266.72	7.09	-0.41	-7.08	2.1


Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Aug 29, 2006
Bottom Depth Info.
Depth 285ft
Inclination 1.7°
Closure Distance 8.3 ft
Closure Direction 268°
Depth
(ft)
0
100
200
300
400
+N / -S
(ft)
20
10
0
-10
-20
-W / +E
(ft)
-20
-10
0
10
20
N

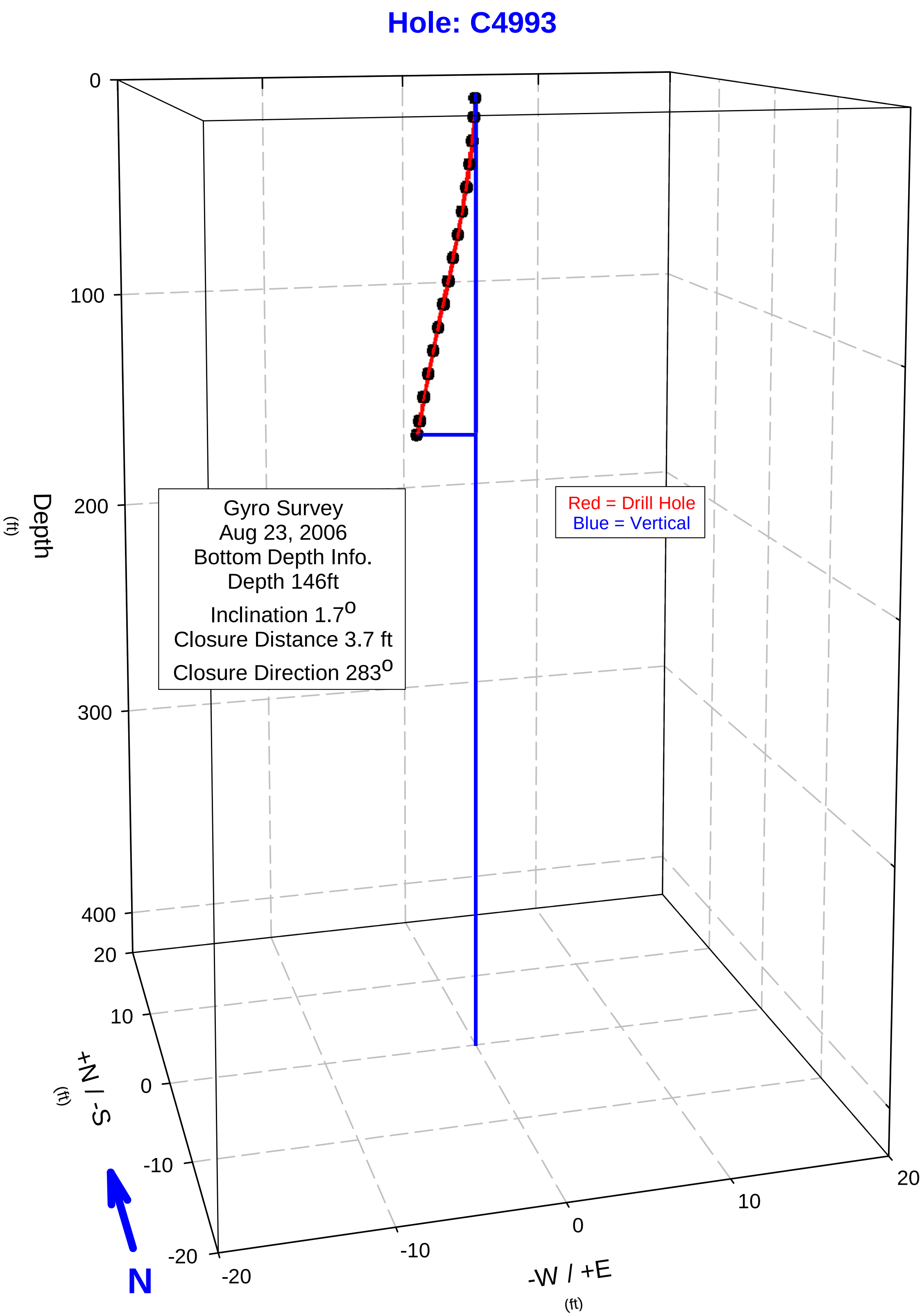
Hole: **C4993** Survey Date: **8/29/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	1.03	268.35	0.03	0	-0.03	32.5
25	25	1.15	295.66	0.4	0.17	-0.36	1.2
45	44.99	1.14	292.34	0.8	0.3	-0.74	0.7
65	64.99	1.49	289.52	1.26	0.42	-1.18	1.8
85	84.98	1.89	285.6	1.83	0.49	-1.77	2.6
105	104.97	2.1	281.22	2.51	0.49	-2.46	1.3
125	124.95	2.1	277.77	3.22	0.44	-3.19	0.6
145	144.94	1.99	275.08	3.91	0.35	-3.9	0.8
165	164.93	1.81	272.93	4.56	0.23	-4.55	0.9
185	184.92	1.75	271.21	5.16	0.11	-5.16	0.4
205	204.91	1.86	269.72	5.78	-0.03	-5.78	0.6
225	224.9	1.9	268.76	6.42	-0.14	-6.42	1
245	244.89	1.87	268.48	7.08	-0.19	-7.08	0.8
265	264.88	1.68	268.33	7.7	-0.22	-7.69	1.1
285	284.87	1.66	268.11	8.28	-0.27	-8.28	0.2


Hole: C4993
Red = Drill Hole
Blue = Vertical
Gyro Survey
Aug 25, 2006
Bottom Depth Info.
Depth 204ft
Inclination 1.6°
Closure Distance 5.4 ft
Closure Direction 266°
Depth
(ft)
0
100
200
300
400
+N / -S
(ft)
20
10
0
-10
-20
-W / +E
(ft)
-20
-10
0
10
20
N

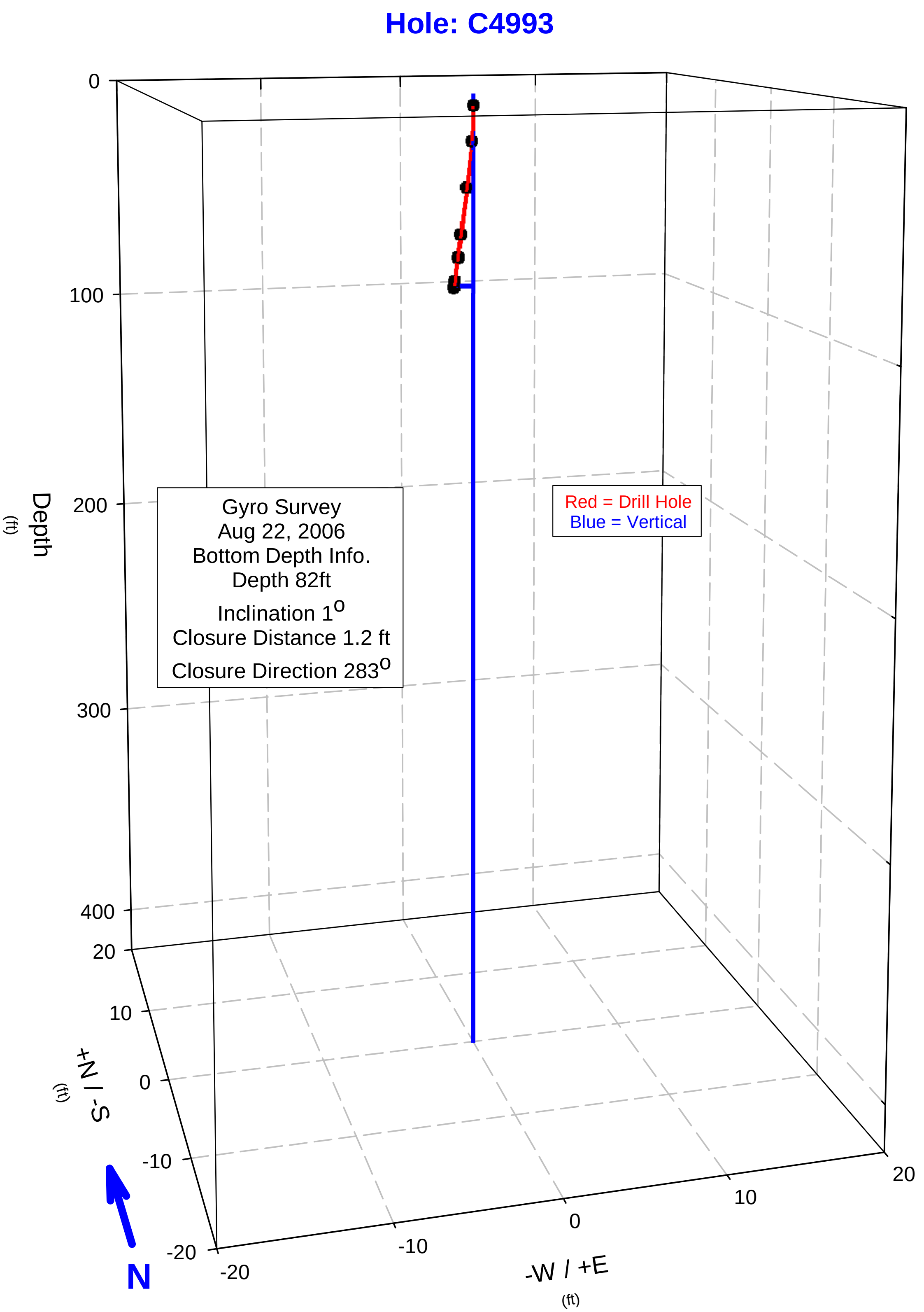
Hole: **C4993** Survey Date: **8/25/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
4	4	0.15	253.18	0	0	0	4.7
30	30	1	303.51	0.26	0.14	-0.21	3.4
60	59.99	1.72	297.01	0.95	0.43	-0.85	3
90	89.98	1.85	287.23	1.85	0.55	-1.77	1.8
120	119.96	1.85	278.41	2.74	0.4	-2.71	1.6
150	149.95	1.73	271.7	3.6	0.11	-3.6	0.6
180	179.93	1.57	267.62	4.42	-0.18	-4.41	0.5
190	189.93	1.6	266.59	4.68	-0.28	-4.67	0.8
200	199.93	1.8	265.9	4.97	-0.35	-4.96	3.9
204	203.92	1.63	265.78	5.09	-0.37	-5.08	4.2


Hole: C4993
0
100
200
300
400
Depth
(ft)
Gyro Survey
Aug 23, 2006
Bottom Depth Info.
Depth 146ft
Inclination 1.7°
Closure Distance 3.7 ft
Closure Direction 283°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+N / -S
(ft)
N
-20
-10
0
10
20
-W / +E
(ft)

Hole: **C4993** Survey Date: **8/23/2006**

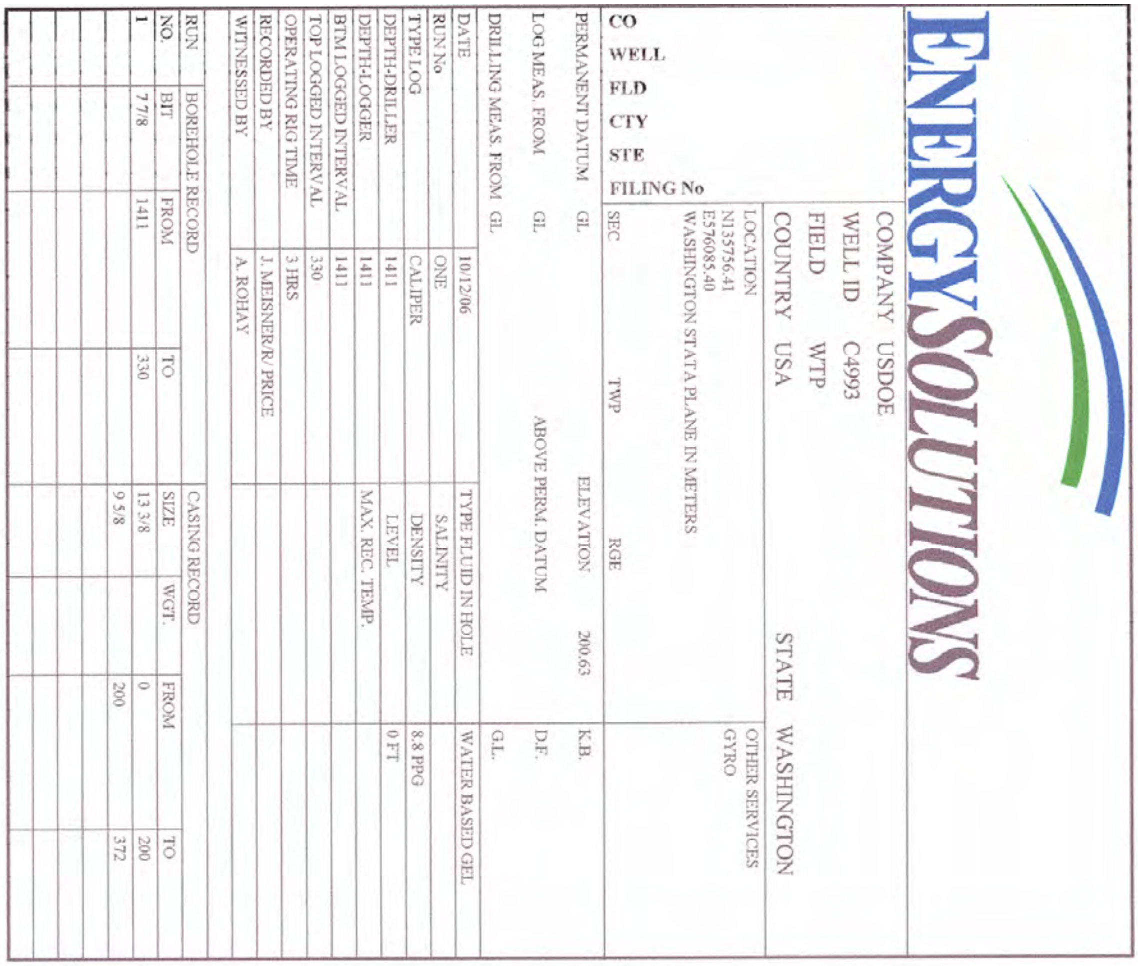
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
2	2	0.24	266.37	0.01	0	-0.01	15.1
10	10	0.61	302.38	0.07	0.04	-0.06	4.6
20	20	1	305.32	0.21	0.12	-0.17	3.9
30	30	1.08	302.61	0.39	0.21	-0.32	2.5
40	39.99	1.39	299.16	0.6	0.29	-0.52	3
50	49.99	1.6	298.12	0.86	0.4	-0.76	2.6
60	59.99	1.61	297.38	1.14	0.52	-1.01	1.8
70	69.98	1.84	296.2	1.44	0.63	-1.29	2.3
80	79.98	1.89	295.28	1.76	0.75	-1.59	0.6
90	89.97	1.83	293.8	2.08	0.84	-1.9	3.3
100	99.97	1.88	291.85	2.39	0.89	-2.22	1
110	109.96	1.77	289.99	2.7	0.92	-2.54	1.7
120	119.96	1.89	288.13	3.01	0.94	-2.86	1.6
130	129.95	1.56	286.29	3.29	0.92	-3.16	3.8
140	139.95	1.68	284.51	3.55	0.89	-3.44	1.3
146	145.95	1.64	283.49	3.71	0.87	-3.61	0.8


Hole: C4993
0
100
200
300
400
Depth
(ft)
Gyro Survey
Aug 22, 2006
Bottom Depth Info.
Depth 82ft
Inclination 1°
Closure Distance 1.2 ft
Closure Direction 283°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+N / -S
(ft)
N
-20
-10
0
10
20
-W / +E
(ft)

Hole: **C4993** Survey Date: **8/22/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
5	5	0.27	52.54	0.03	0.02	0.03	23.6
20	20	0.9	326.3	0.09	0.08	-0.05	7.4
40	40	1.1	305.74	0.41	0.24	-0.34	3.3
60	59.99	1.14	291.85	0.78	0.29	-0.72	1.3
70	69.99	1.16	286.64	0.96	0.27	-0.92	1.8
80	79.99	1.13	283.42	1.15	0.27	-1.12	2.5
82.5	82.49	1.1	283.06	1.2	0.27	-1.17	1.8

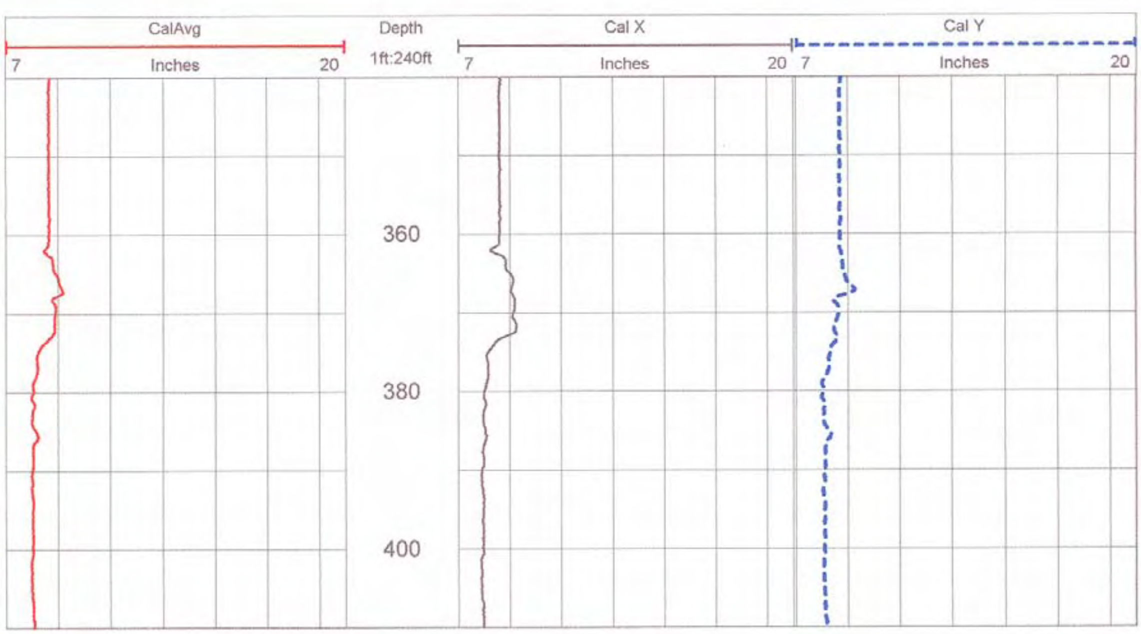
A1.2 ENERGY*SOLUTIONS* AND PACIFIC NORTHWEST GEOPHYSICS CALIPER LOGS

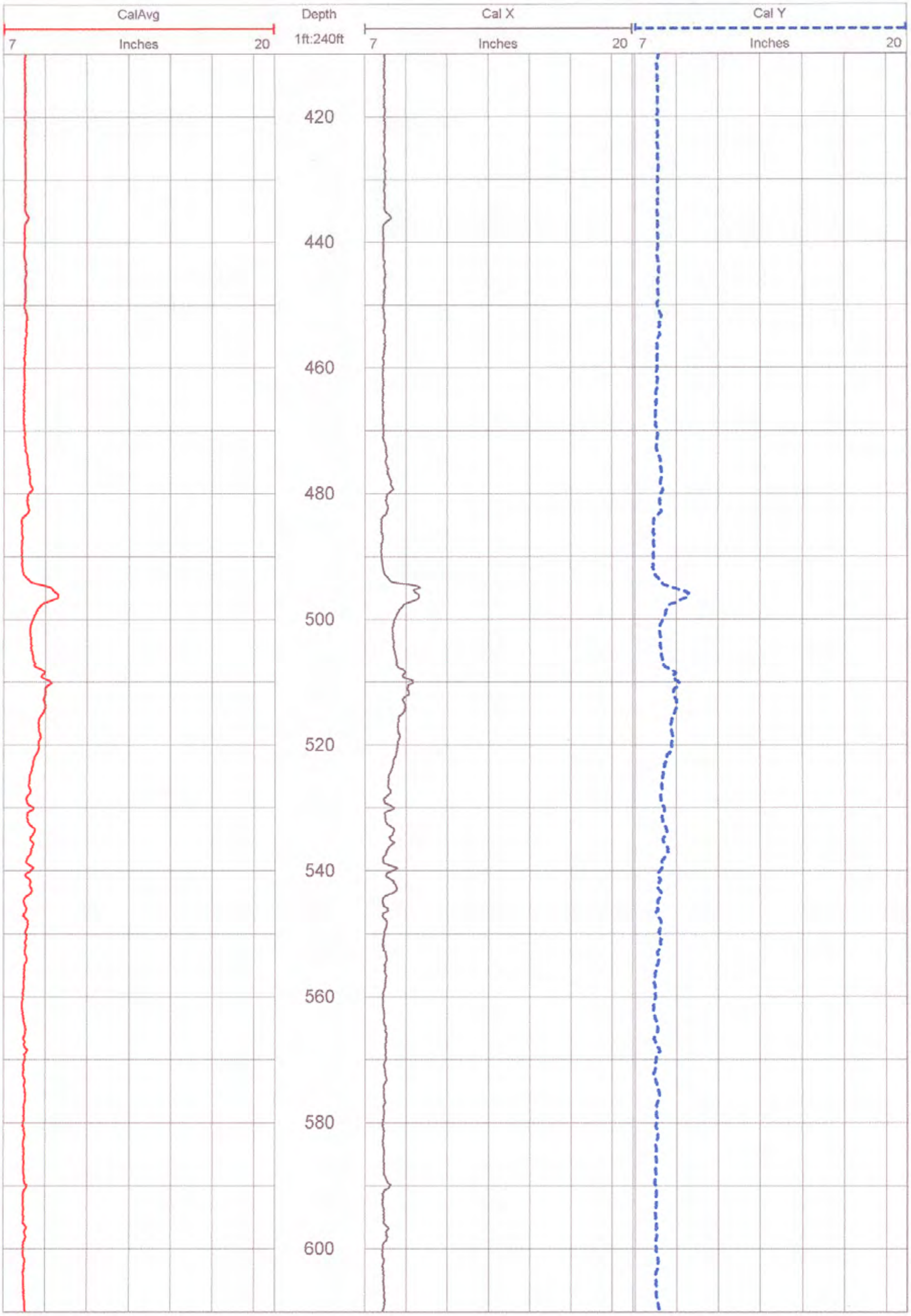

ENERGYSOLUTIONS

CO	COMPANY	USDOE
WELL	WELL ID	C4993
FLD	FIELD	WTP
CTY	COUNTRY	USA STATE WASHINGTON
STE	LOCATION N135756.41 E576085.40 WASHINGTON STATA PLANE IN METERS	OTHER SERVICES GYRO
FILING No	SEC TWP RGE	

PERMANENT DATUM	GL	ELEVATION 200.63	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GL		G.L.
DATE	10/12/06	TYPE FLUID IN HOLE	WATER BASED GEL
RUN No	ONE	SALINITY	
TYPE LOG	CALIPER	DENSITY	8.8 PPG
DEPTH-DRILLER	1411	LEVEL	0 FT
DEPTH-LOGGER	1411	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	1411		
TOP LOGGED INTERVAL	330		
OPERATING RIG TIME	3 HRS		
RECORDED BY	J. MEISNER/R/ PRICE		
WITNESSED BY	A. ROHAY		

BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	7 7/8	1411	330	13 3/8		0	200
				9 5/8		200	372

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7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
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520
540
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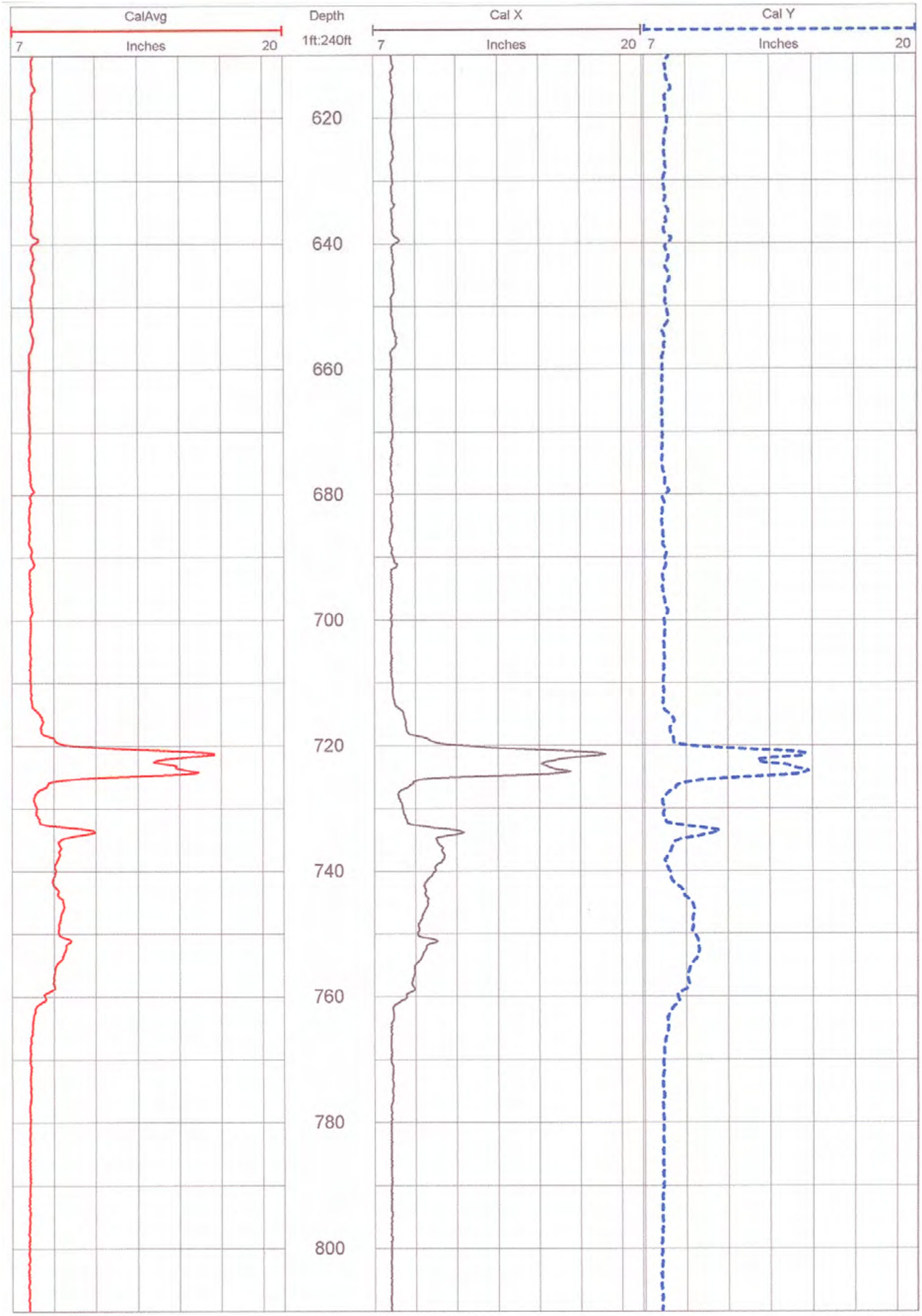
580
600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Cal X
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Cal Y
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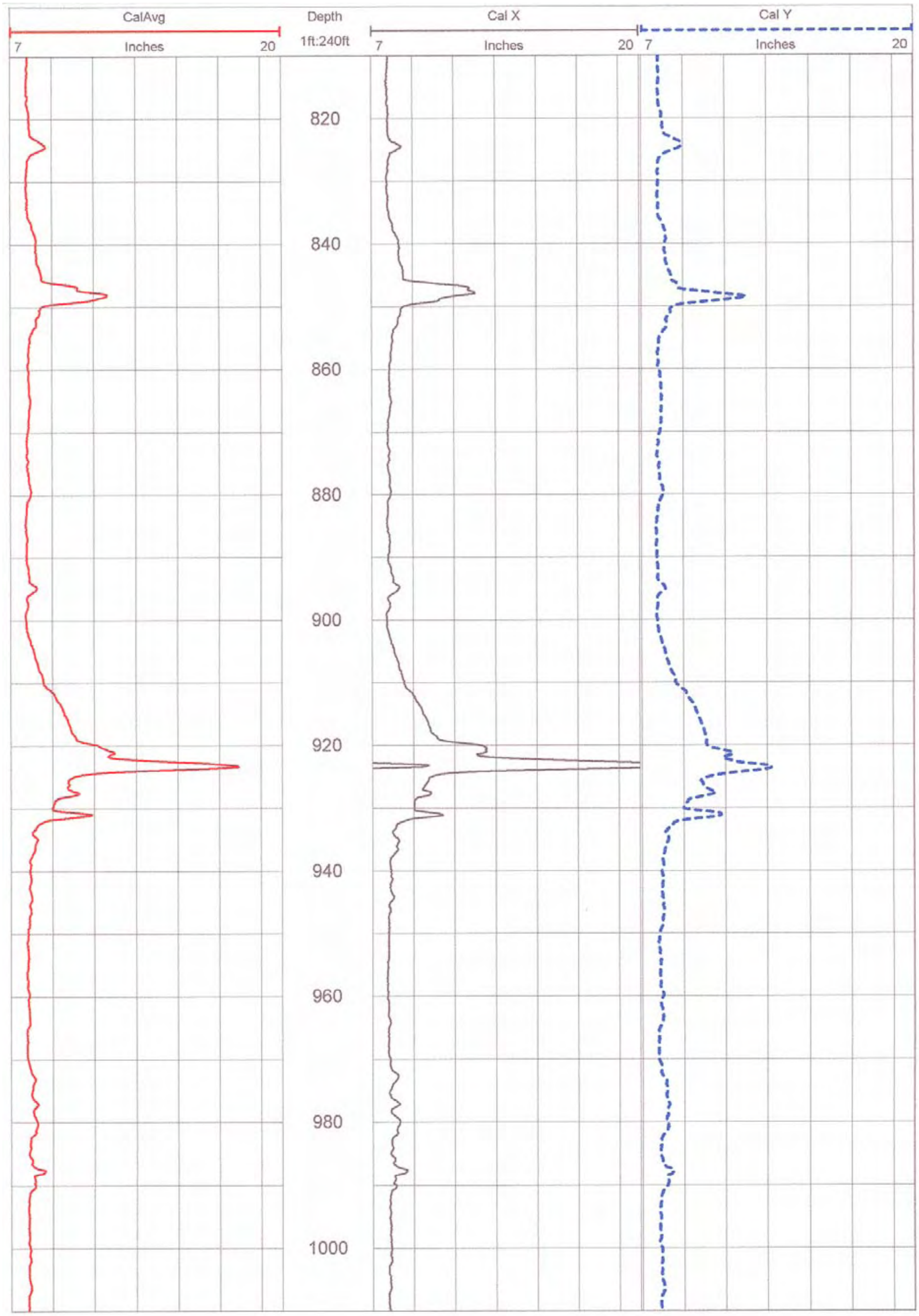
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Inches
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Depth
1ft:240ft
Cal X
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Cal Y
Inches
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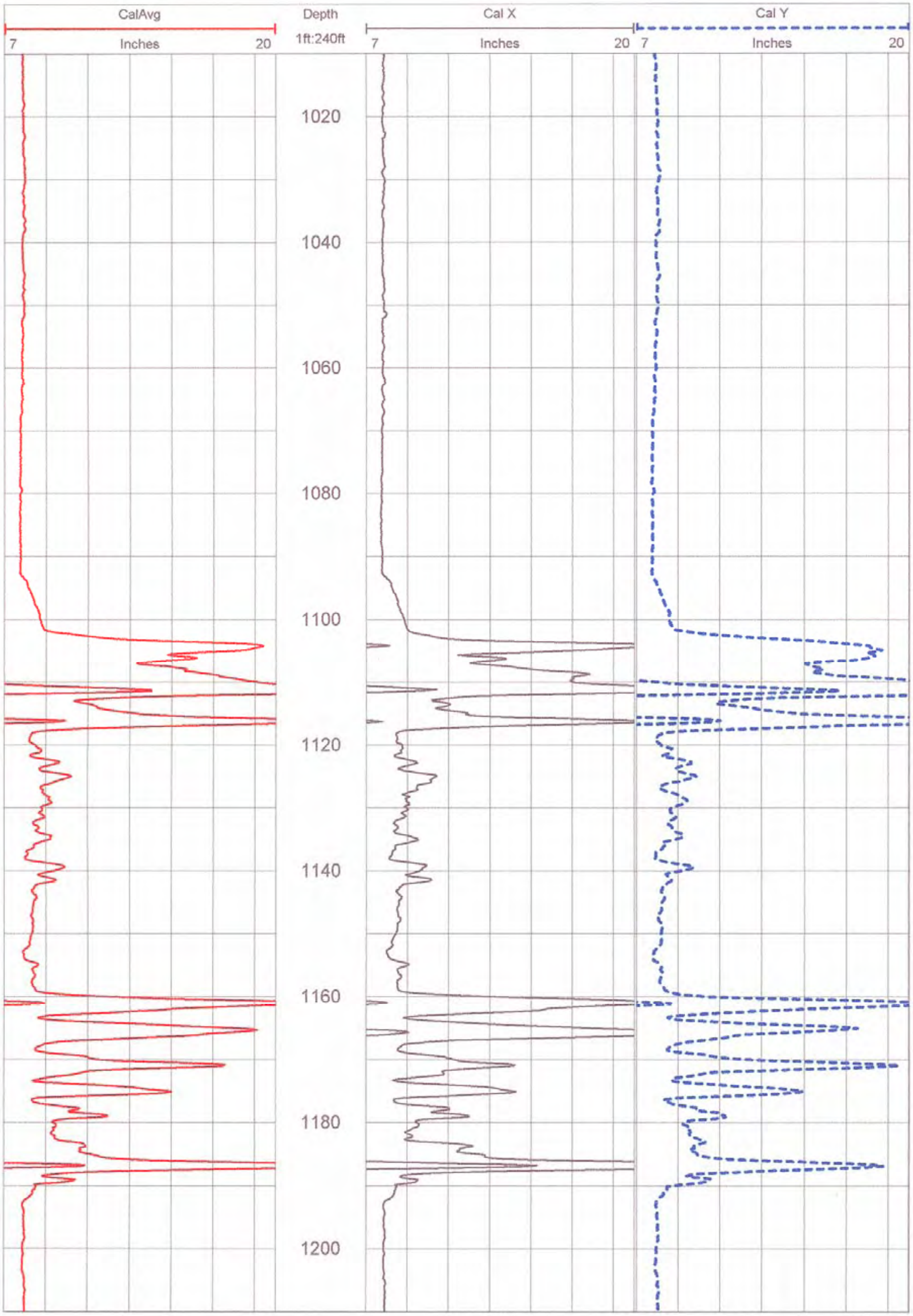
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Cal X
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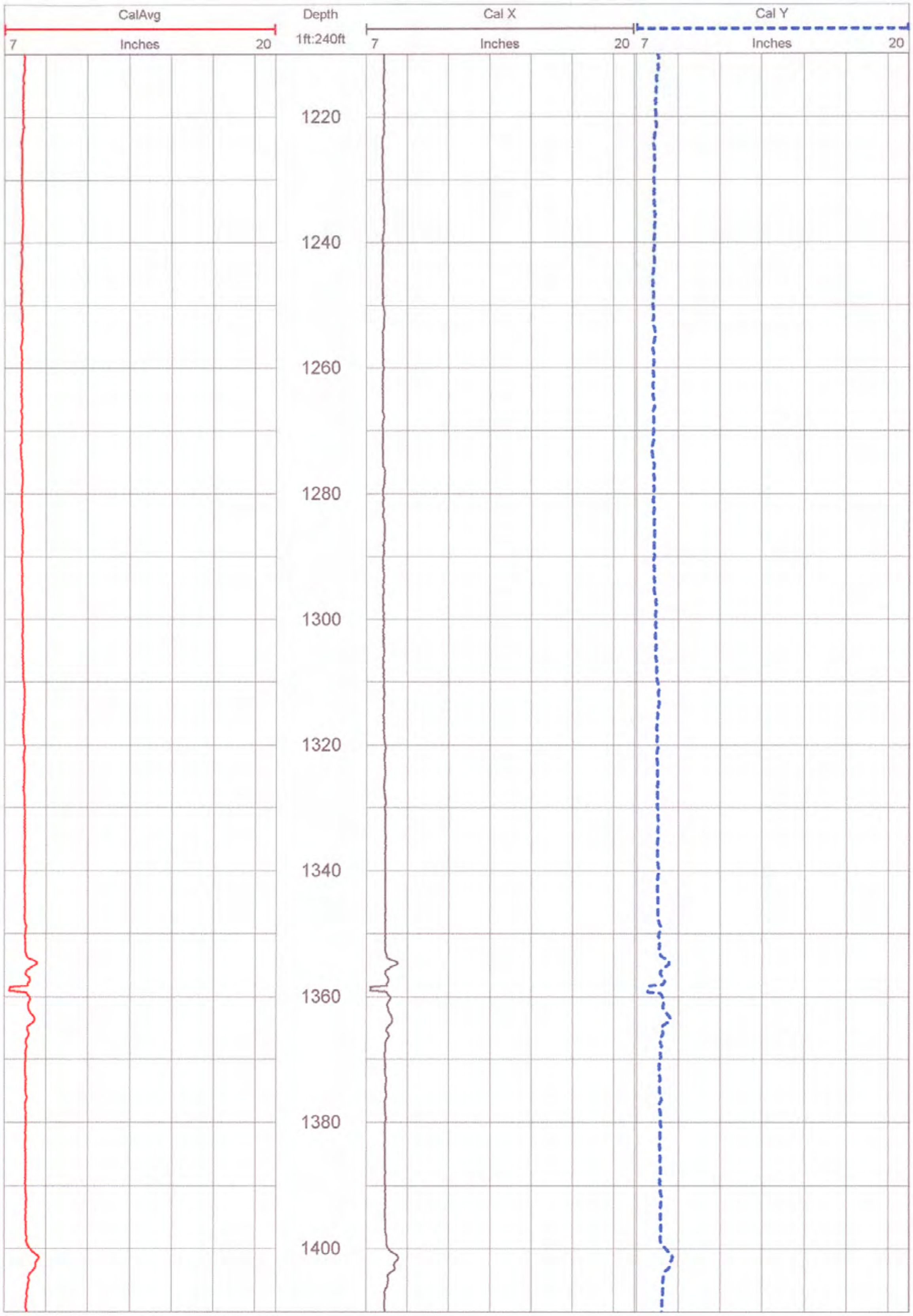
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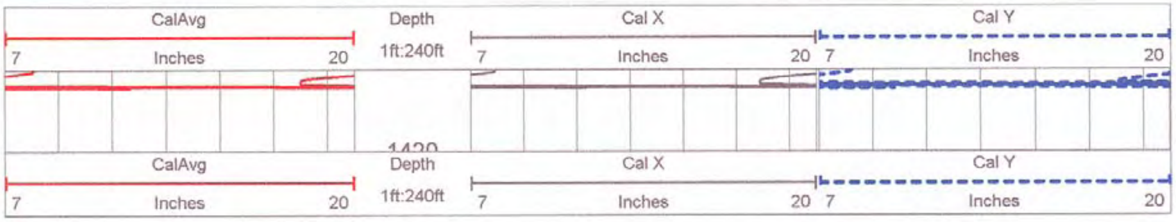
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Cal X
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Inches
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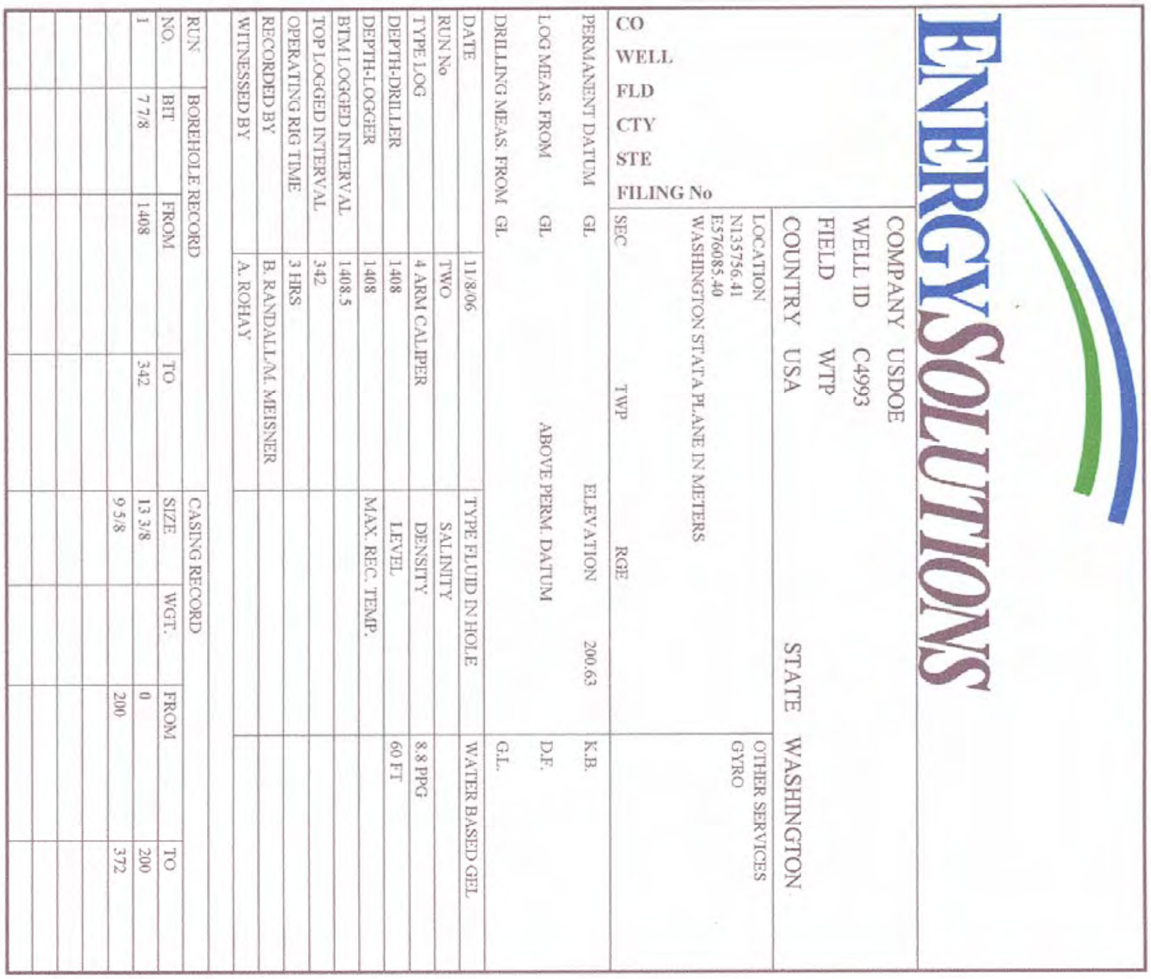
20
Cal Y
7
Inches
20



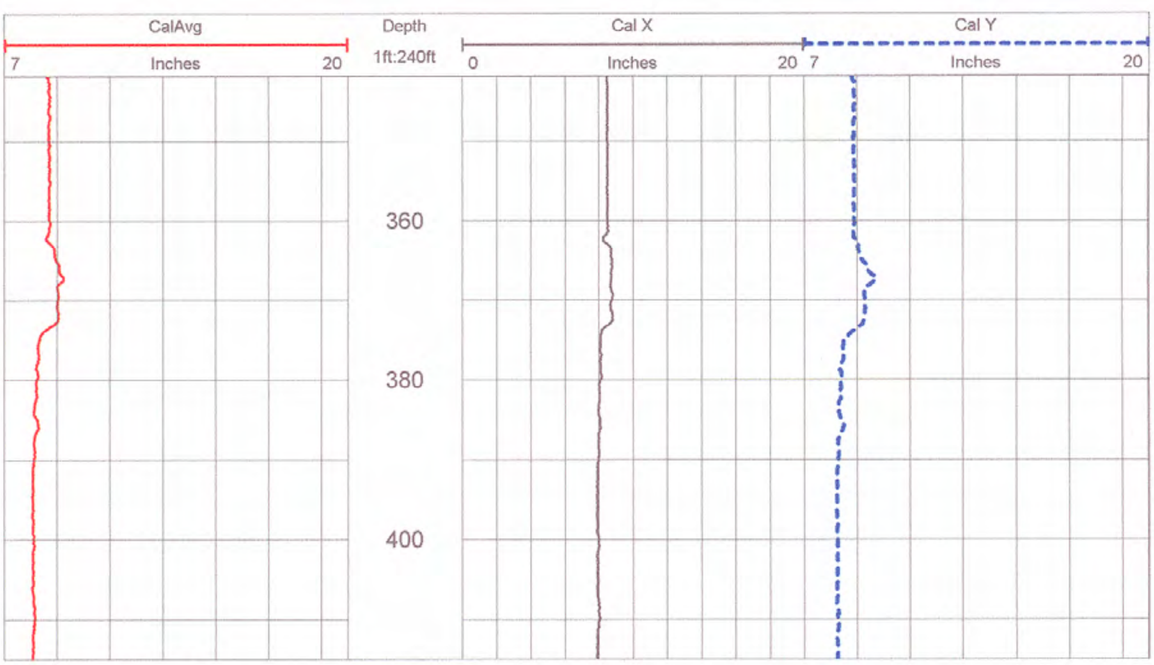
ENERGYSOLUTIONS

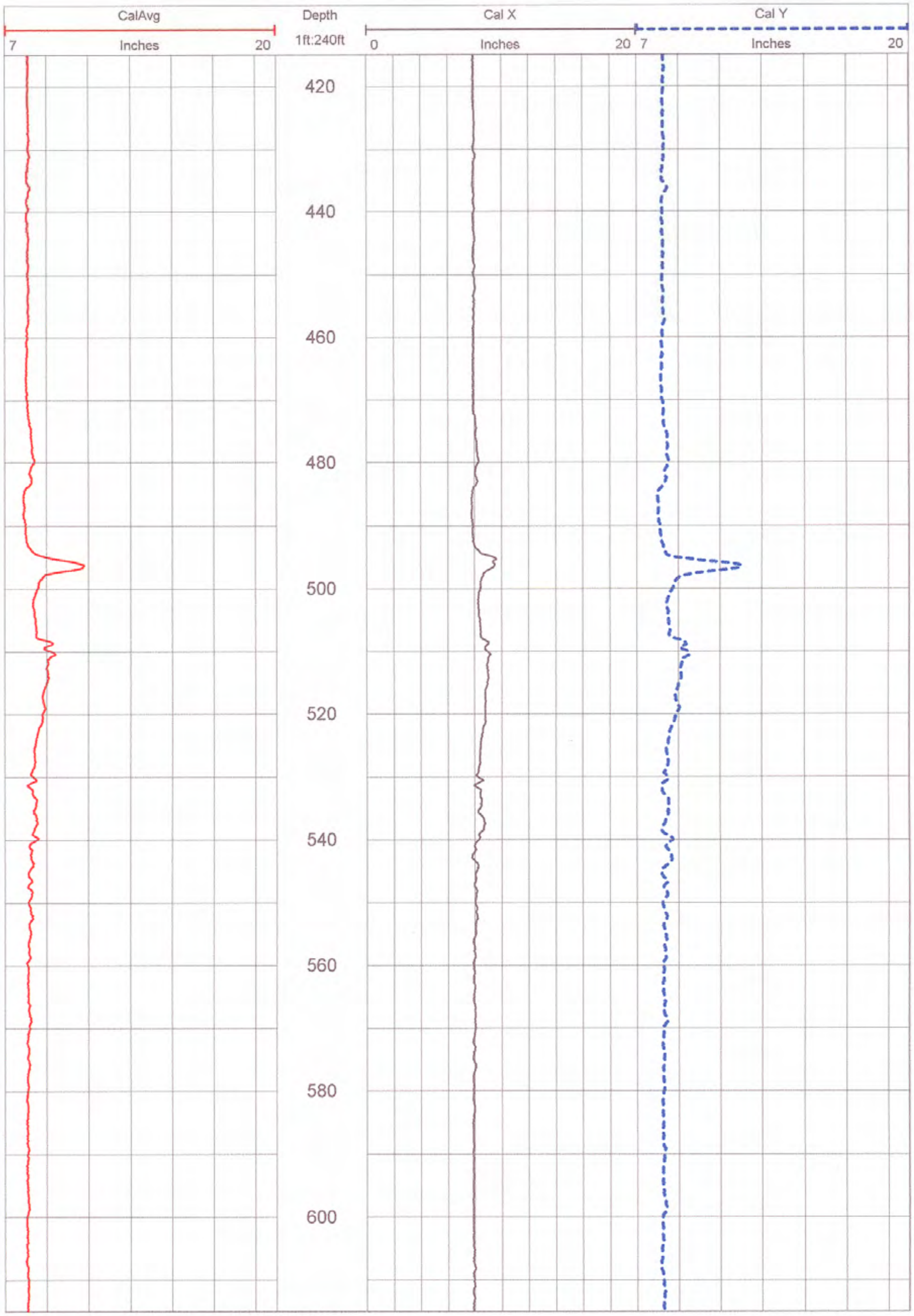
CO	COMPANY USDOE		
WELL	WELL ID C4993		
FLD	FIELD WTP		
CTY	COUNTRY USA	STATE	WASHINGTON
STE	LOCATION N135756.41 E576085.40 WASHINGTON STATA PLANE IN METERS		OTHER SERVICES GYRO
FILING No	SEC TWP RGE		

PERMANENT DATUM	GL	ELEVATION	200.63	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM	GL			G.L.

DATE	11/8/06	TYPE FLUID IN HOLE	WATER BASED GEL
RUN No	TWO	SALINITY	
TYPE LOG	4 ARM CALIPER	DENSITY	8.8 PPG
DEPTH-DRILLER	1408	LEVEL	60 FT
DEPTH-LOGGER	1408	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	1408.5		
TOP LOGGED INTERVAL	342		
OPERATING RIG TIME	3 HRS		
RECORDED BY	B. RANDALL/M. MEISNER		
WITNESSED BY	A. ROHAY		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	7 7/8	1408	342	13 3/8		0	200
				9 5/8		200	372

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Inches
20
Depth
1ft:240ft
Cal X
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20
Cal Y
7
Inches
20
420
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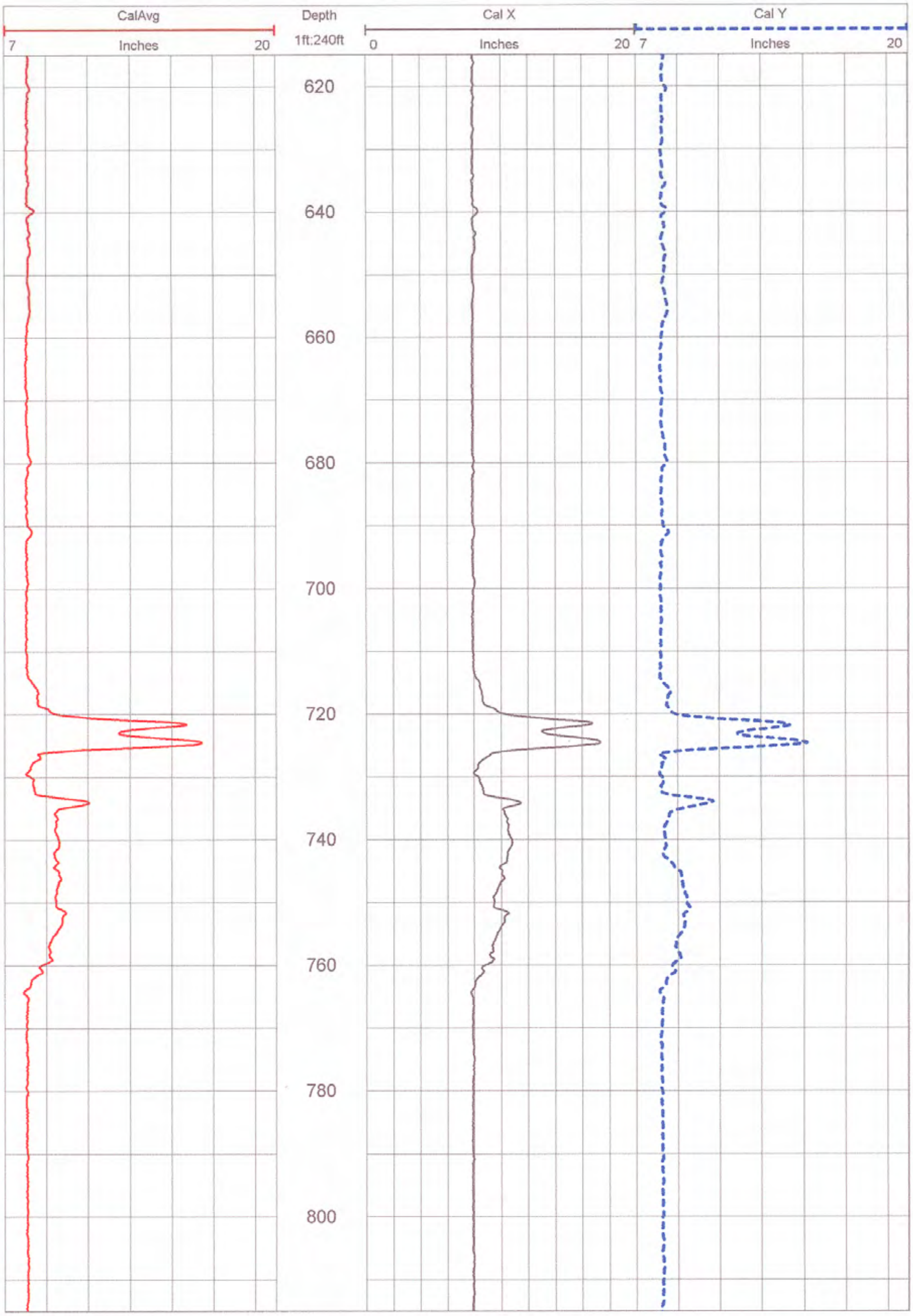
520
540
560
580
600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Inches
20
Depth
1ft:240ft
Cal X
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Cal Y
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Inches
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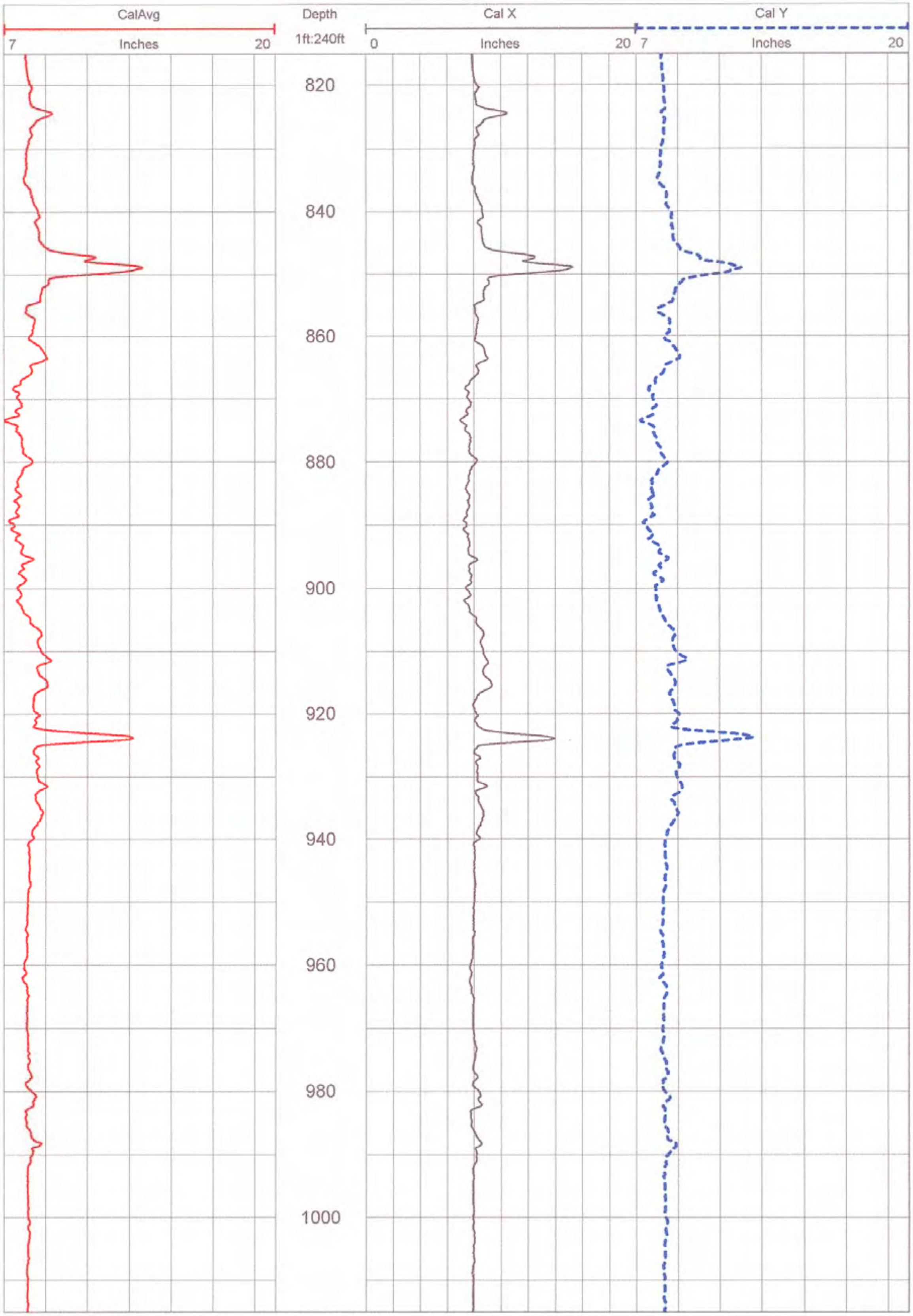
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Inches
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Depth
1ft:240ft
Cal X
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Cal Y
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Inches
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920
940
960
980
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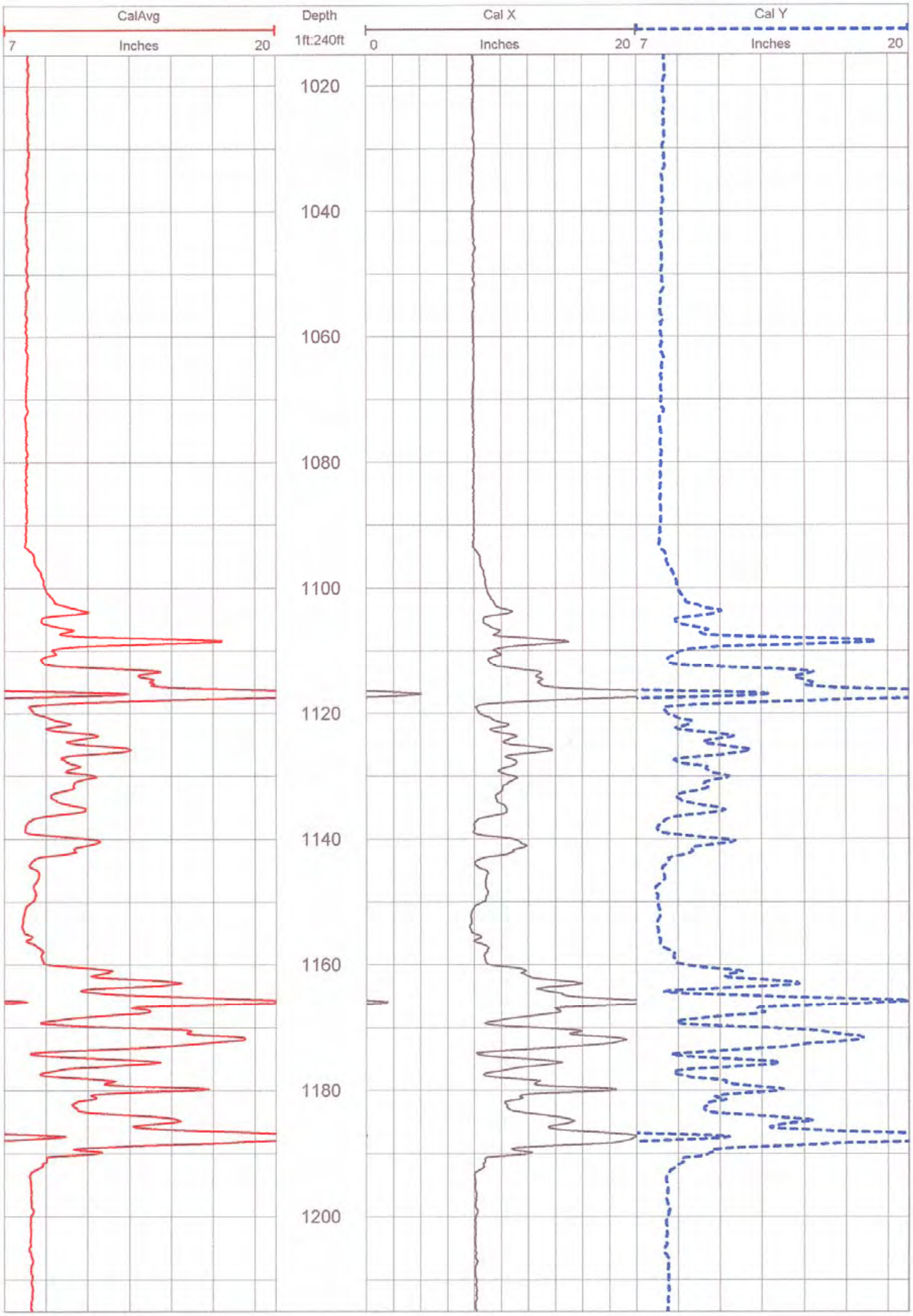
CalAvg
Depth
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Cal Y
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Inches
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1ft:240ft
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1160
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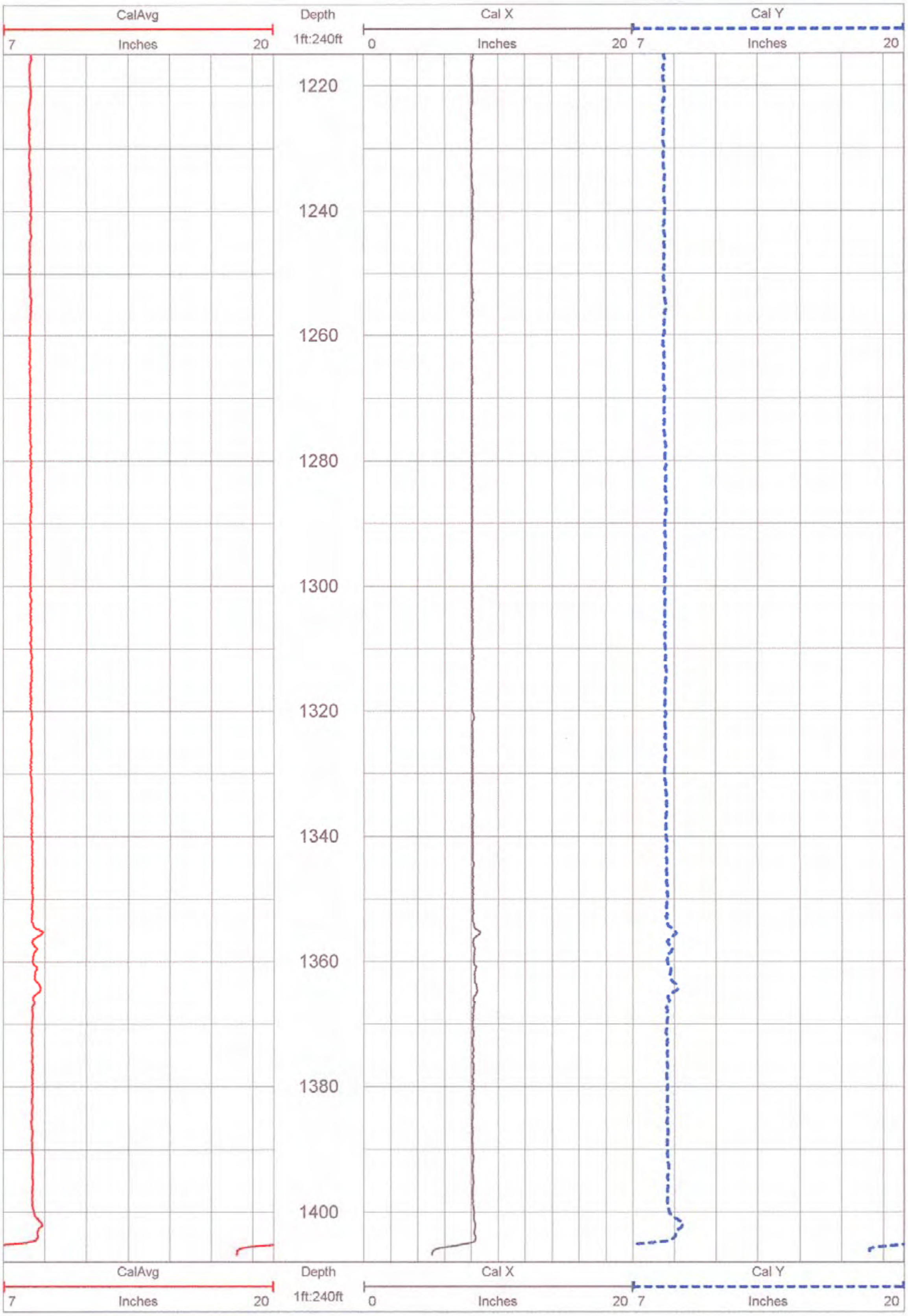
1200



CalAvg
7
Inches
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Depth
1ft:240ft
Cal X
0
Inches
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Cal Y
7
Inches
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1220
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1260
1280
1300
1320
1340
1360
1380
1400
CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
0
Inches
20
Cal Y
7
Inches
20

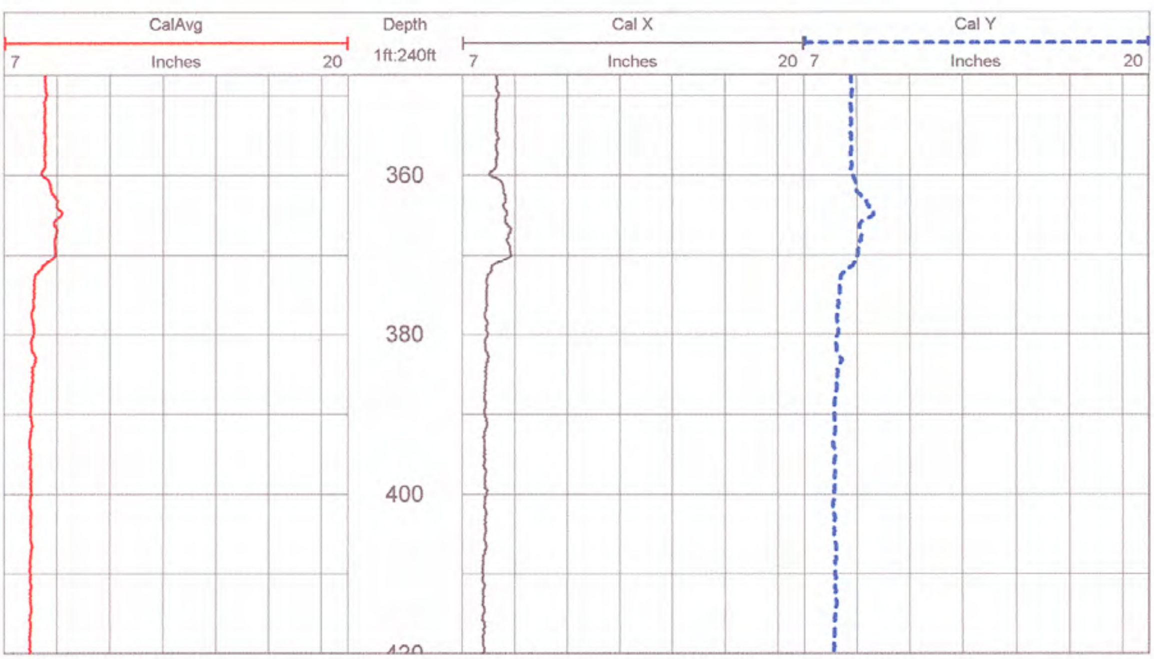
ENERGYSOLUTIONS

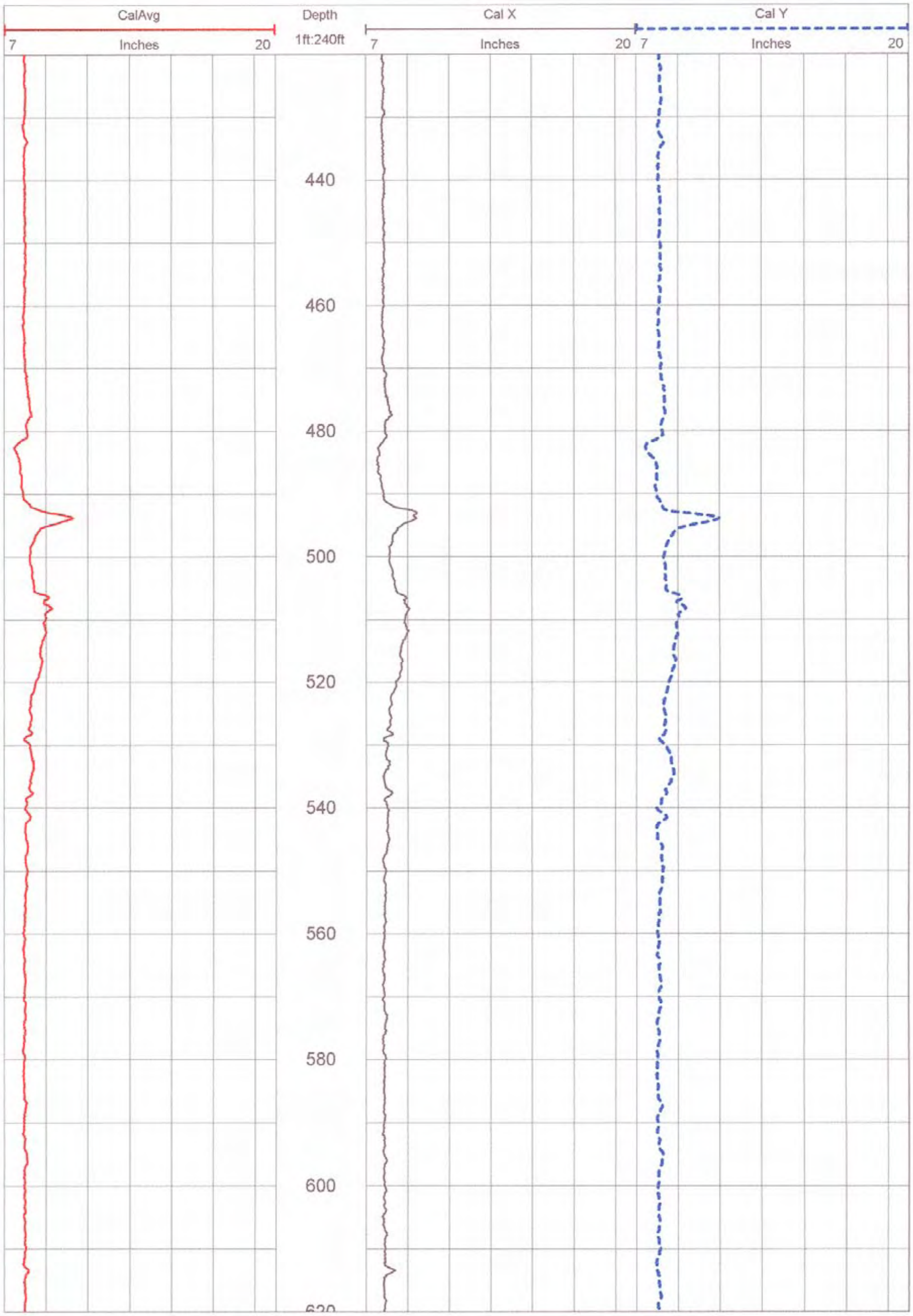
COMPANY	USDOE
WELL ID	C4993
FIELD	WTP
COUNTRY	USA
STATE	WASHINGTON
LOCATION	N135756.41 E576085.40 WASHINGTON STATA PLANE IN METERS
OTHER SERVICES	GYRO ATV

CO
WELL
FLD
CTY
STE
FILING No

SEC		TWP		RGE	
PERMANENT DATUM	GL	ELEVATION	200.63	K.B.	
LOG MEAS. FROM	GL	ABOVE PERM. DATUM		D.F.	
DRILLING MEAS. FROM	GL			G.L.	
DATE	11/28/06	TYPE FLUID IN HOLE		WATER BASED GEL	
RUN No	THREE	SALINITY			
TYPE LOG	4-ARM CALIPER	DENSITY		8.8 PPG	
DEPTH-DRILLER	1405	LEVEL		60 FT	
DEPTH-LOGGER	1398	MAX. REC. TEMP.			
BTM LOGGED INTERVAL	1397				
TOP LOGGED INTERVAL	347				
OPERATING RIG TIME	3 HRS				
RECORDED BY	B. RANDALL/M. MEISNER				
WITNESSED BY	A. ROHAY				

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	7 7/8	347	1397	13 3/8		0	200
				9 5/8		200	372

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7
Inches
20
Depth
1ft:240ft
Cal X
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20
Cal Y
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Inches
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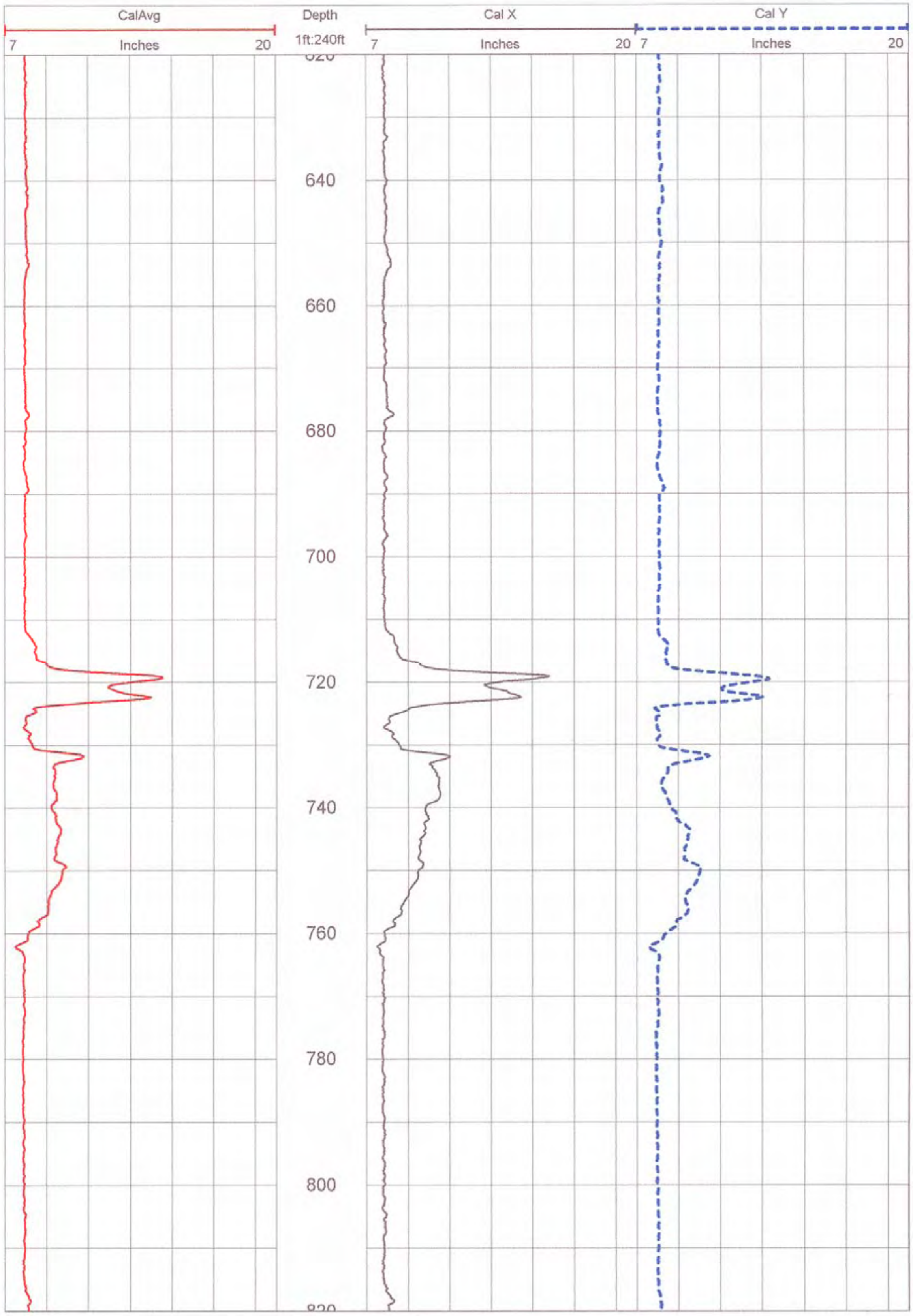
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Inches
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Depth
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Cal X
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20
Cal Y
Inches
7
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780
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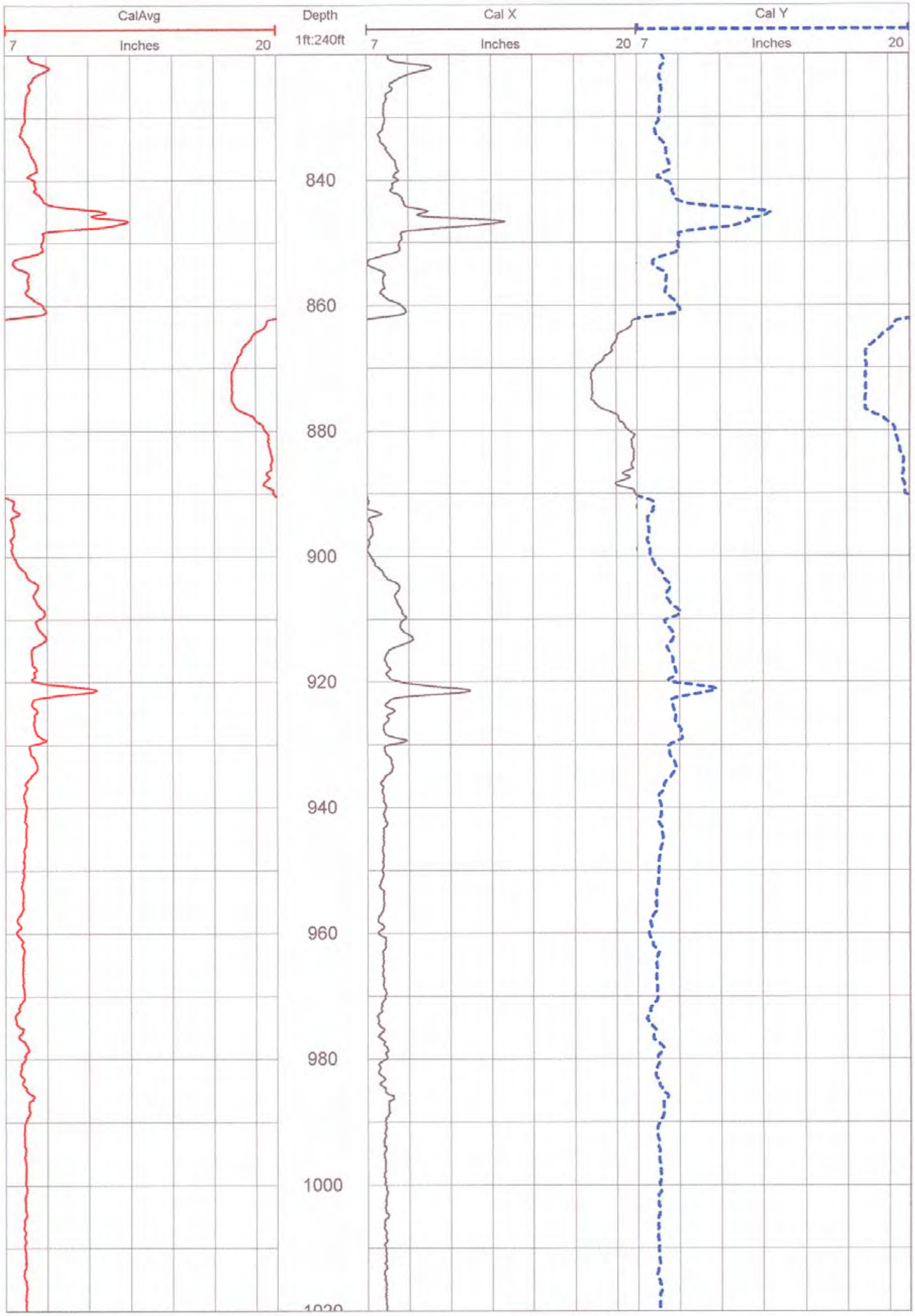
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Inches
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Depth
1ft:240ft
Cal X
Inches
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20
Cal Y
Inches
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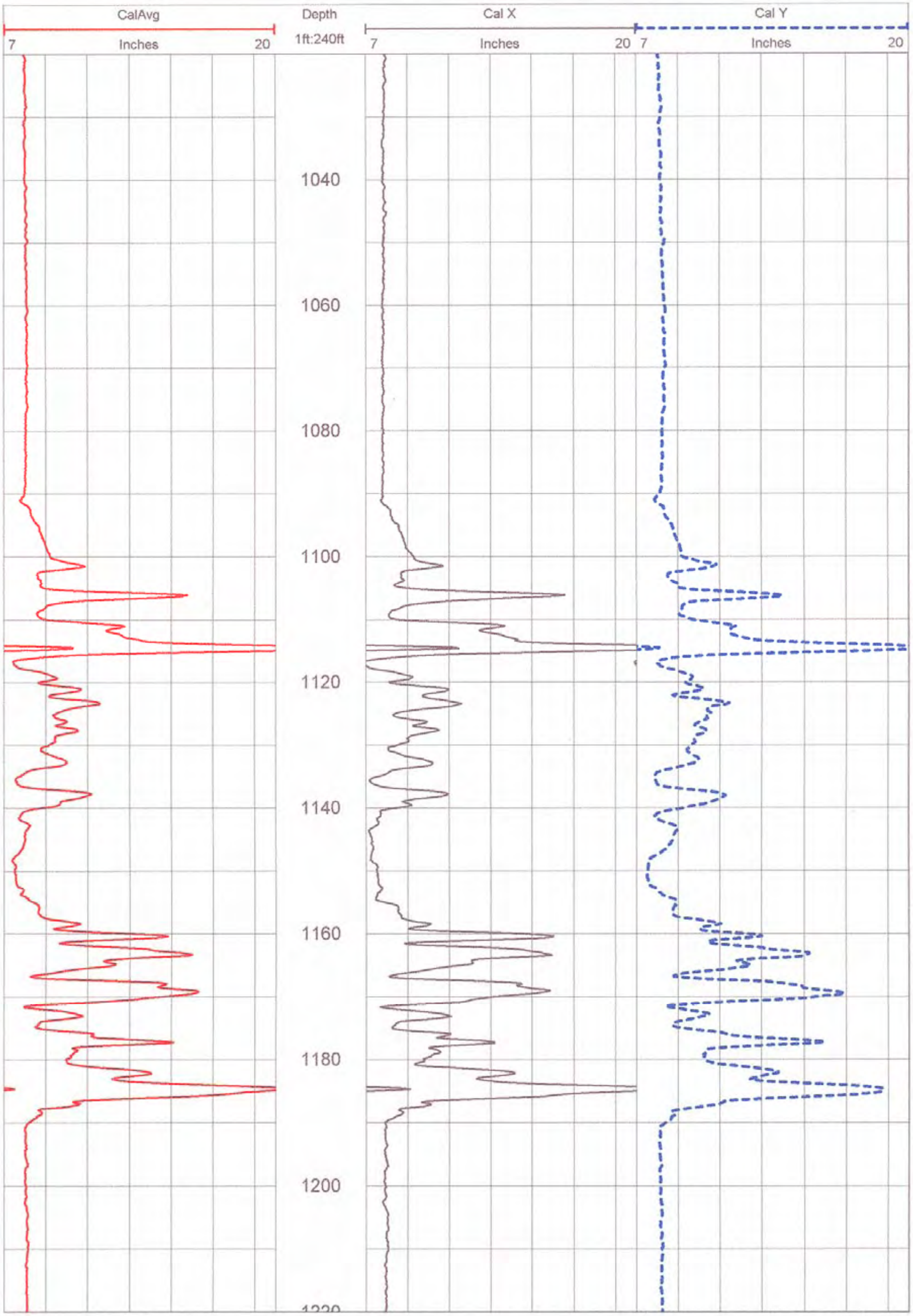
940
960
980
1000
1020



CalAvg
Inches
7
20
Depth
1ft:240ft
Cal X
Inches
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Cal Y
Inches
7
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1180
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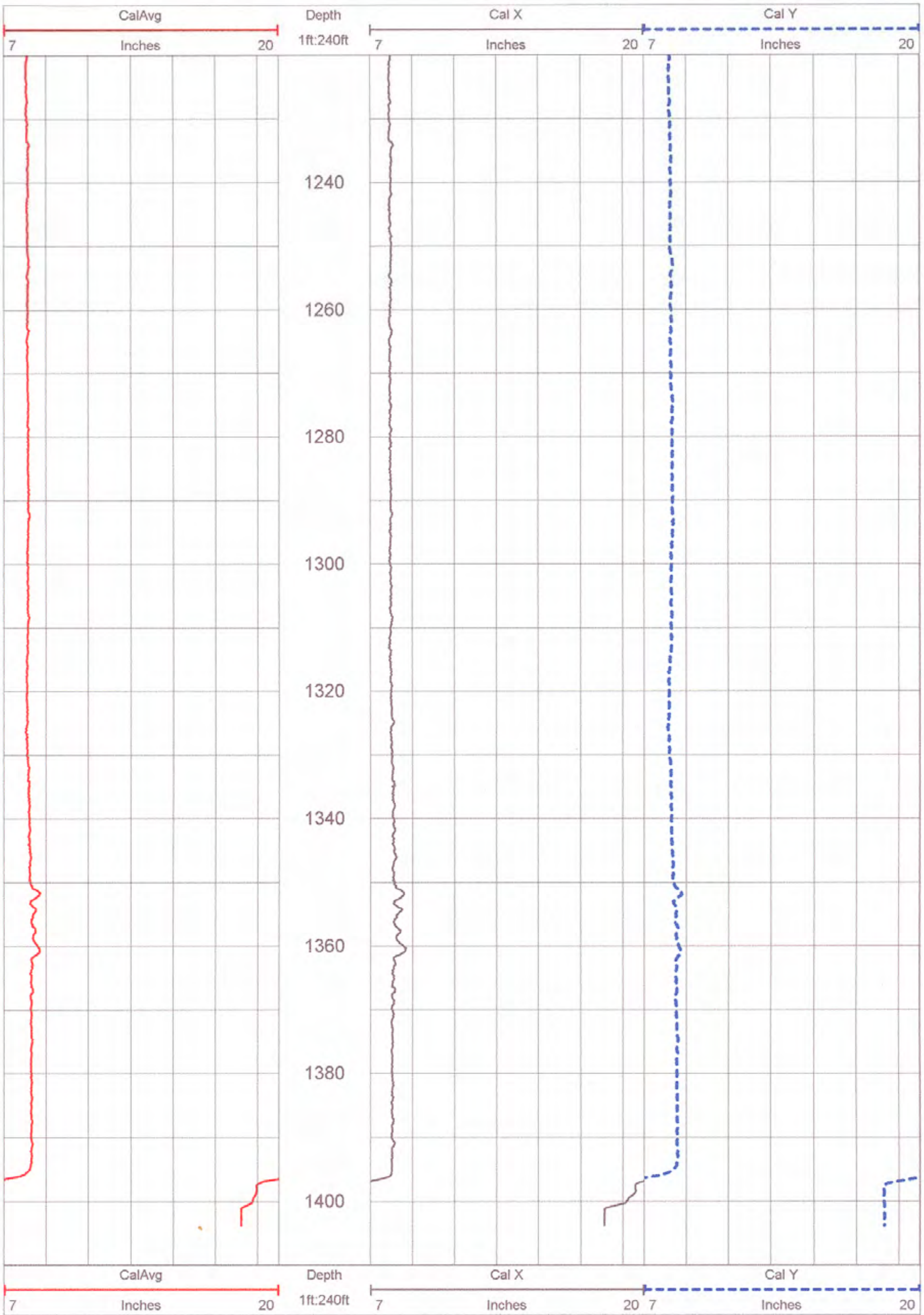
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Inches
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Depth
1ft:240ft
Cal X
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Inches
20
Cal Y
7
Inches
20
1240
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1320
1340
1360
1380
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CalAvg
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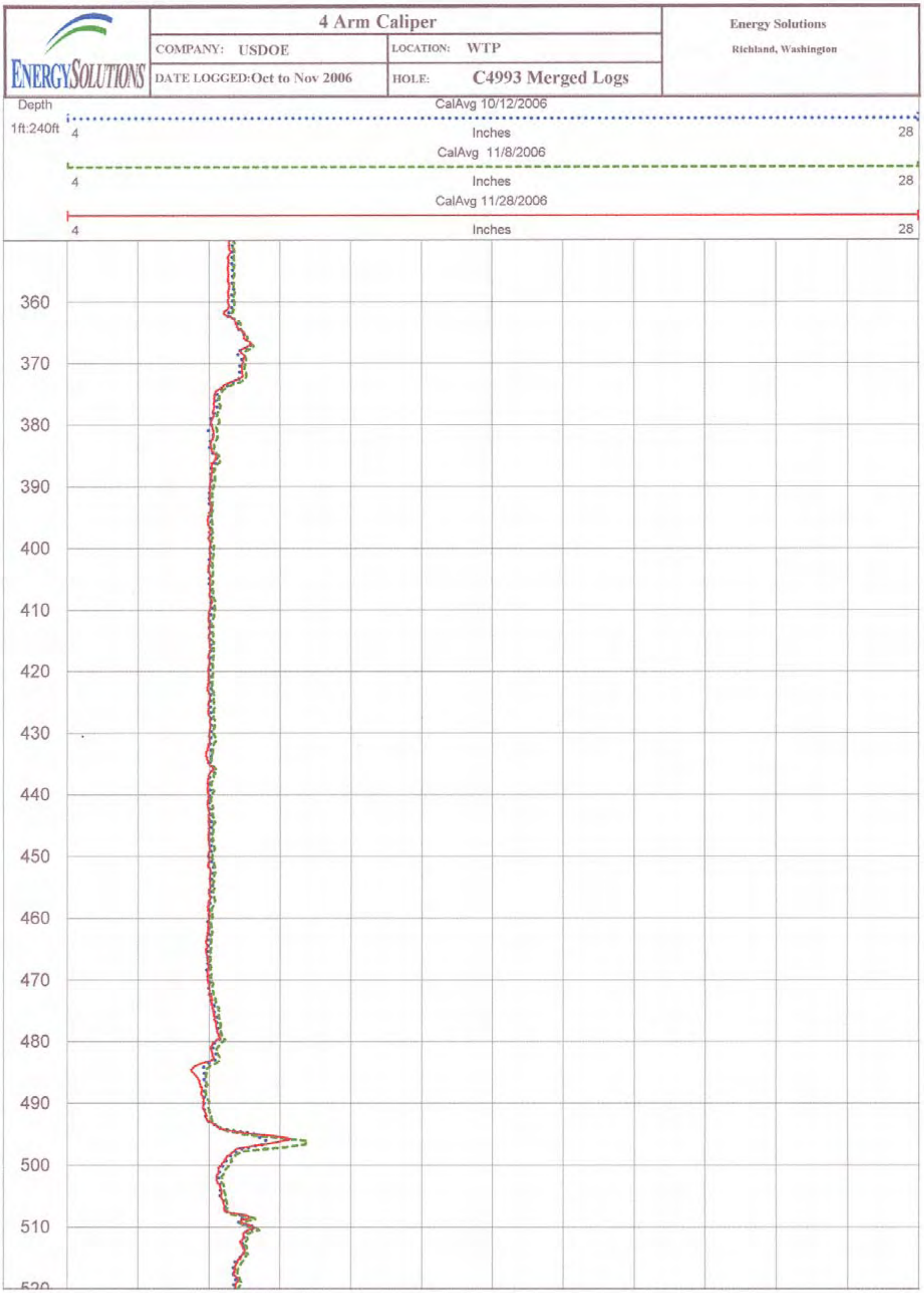
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20



4 Arm Caliper
COMPANY: USDOE
LOCATION: WTP
DATE LOGGED: Oct to Nov 2006
HOLE: C4993 Merged Logs
Energy Solutions
Richland, Washington
EnergySolutions
Depth
1ft:240ft
CalAvg 10/12/2006
4 Inches 28
CalAvg 11/8/2006
4 Inches 28
CalAvg 11/28/2006
4 Inches 28
360
370
380
390
400
410
420
430
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450
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510
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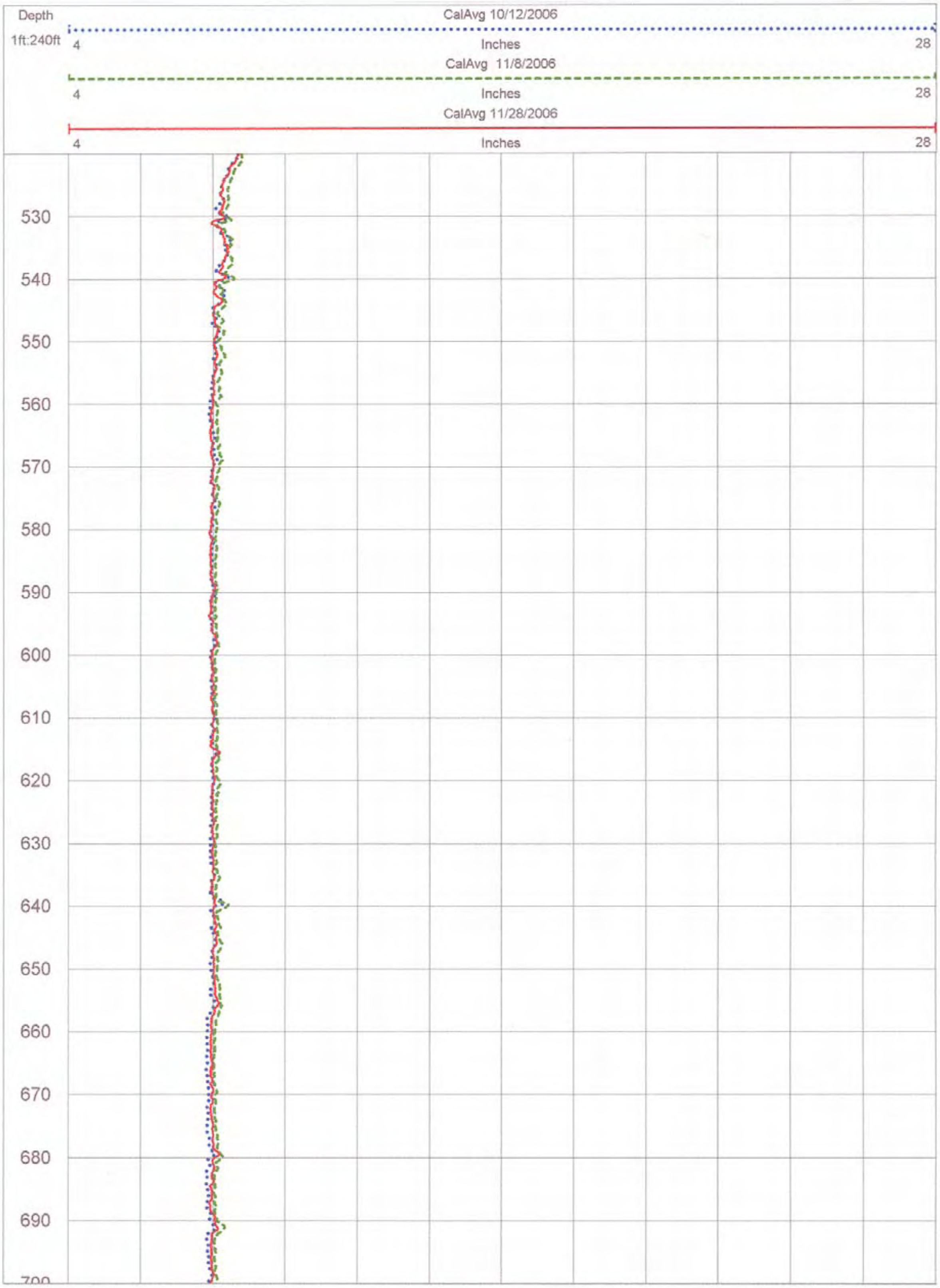
Depth
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CalAvg 10/12/2006
4
Inches
28
CalAvg 11/8/2006
4
Inches
28
CalAvg 11/28/2006
4
Inches
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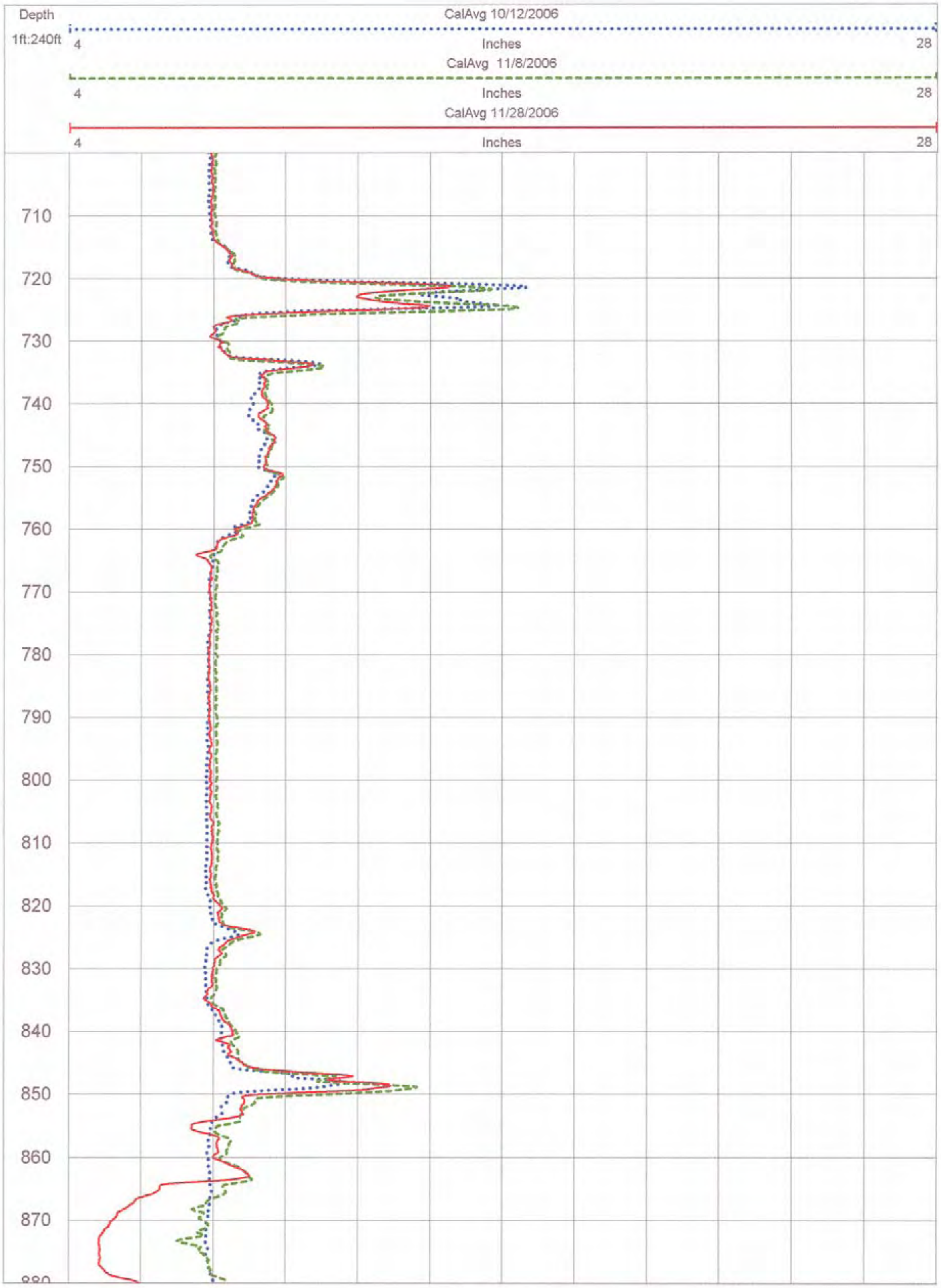
Depth
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CalAvg 10/12/2006
4
Inches
28
CalAvg 11/8/2006
4
Inches
28
CalAvg 11/28/2006
4
Inches
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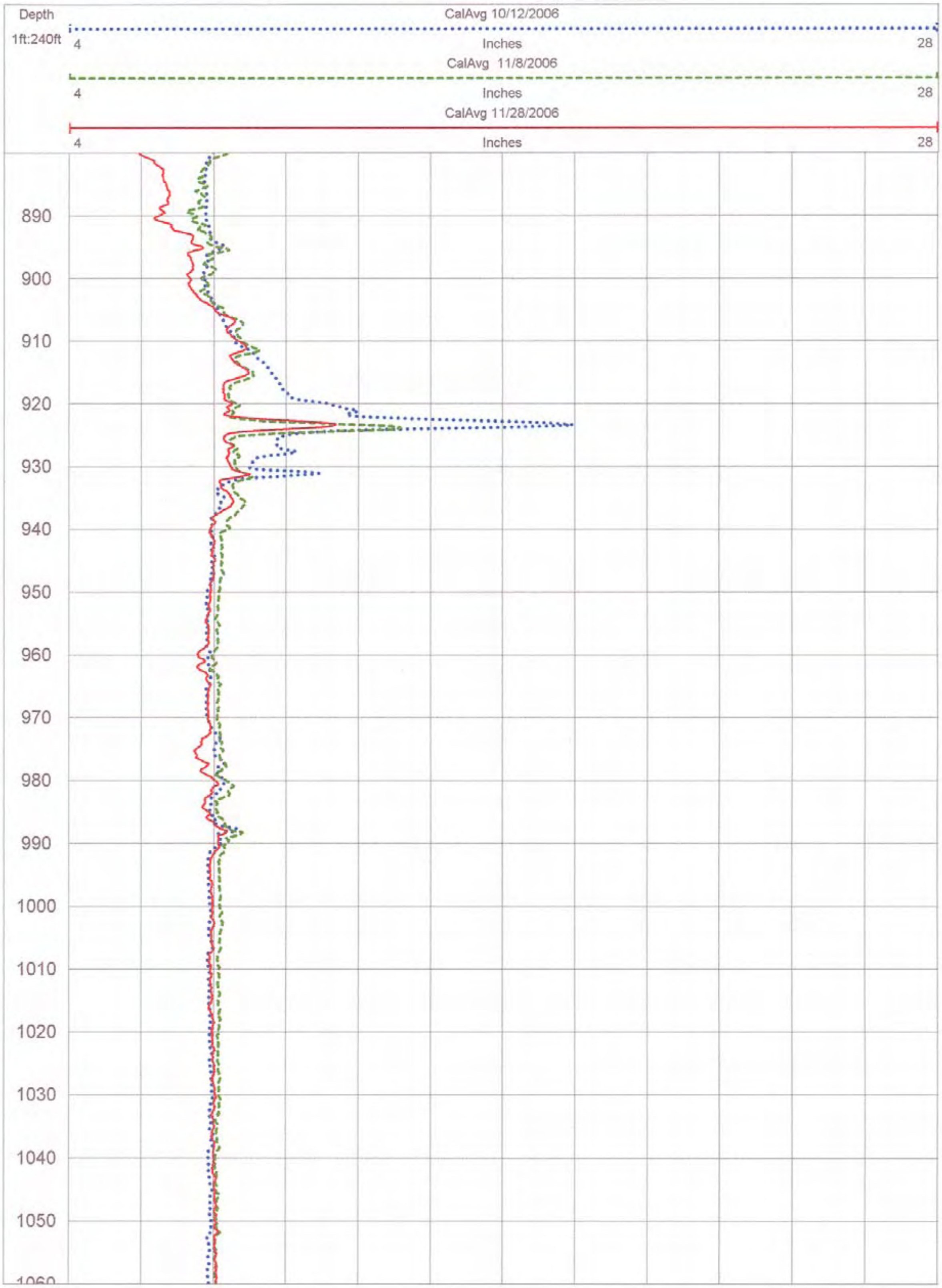
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Inches
28
CalAvg 11/8/2006
4
Inches
28
CalAvg 11/28/2006
4
Inches
28
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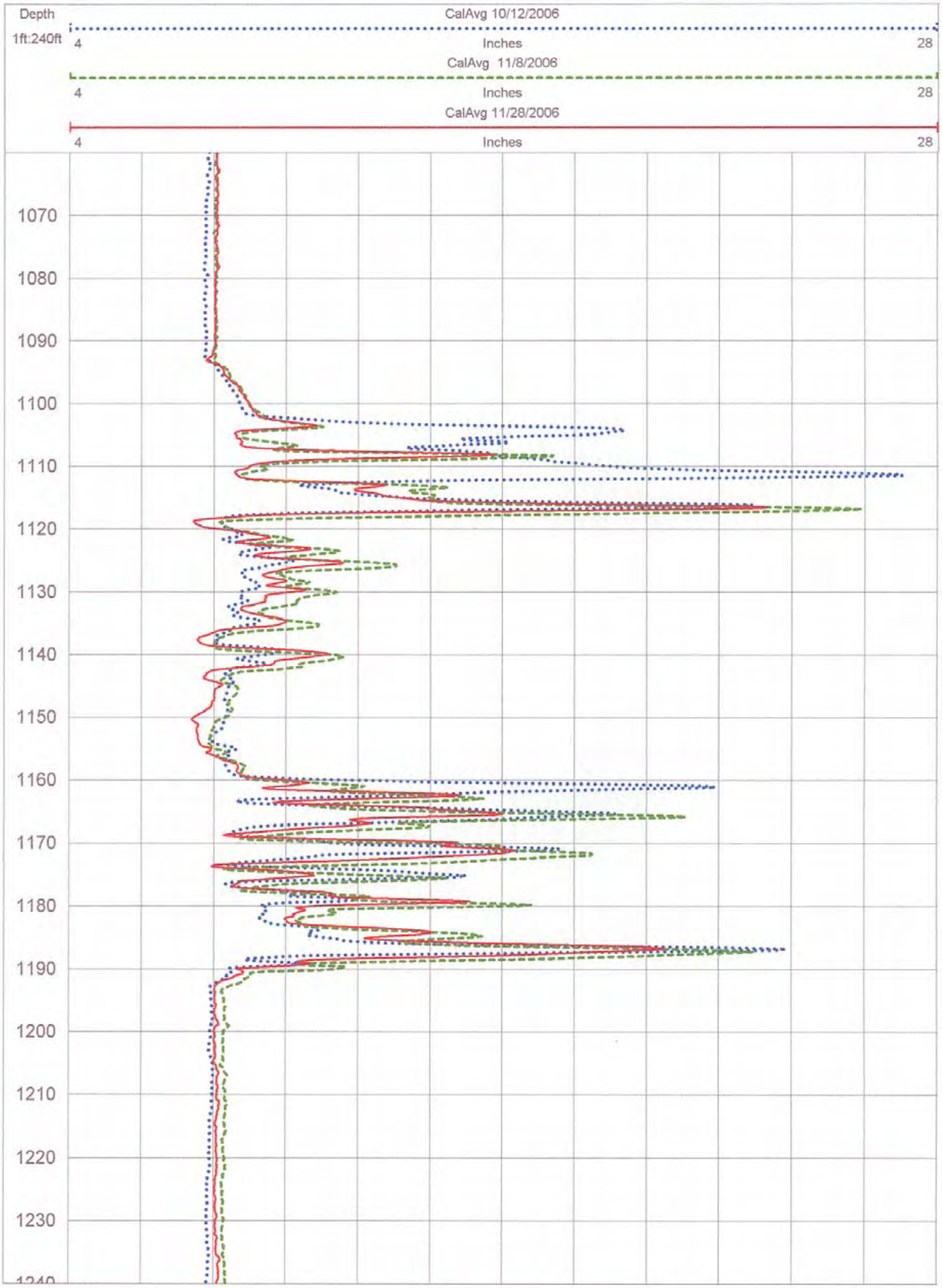
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Inches
28
CalAvg 11/8/2006
4
Inches
28
CalAvg 11/28/2006
4
Inches
28
1070
1080
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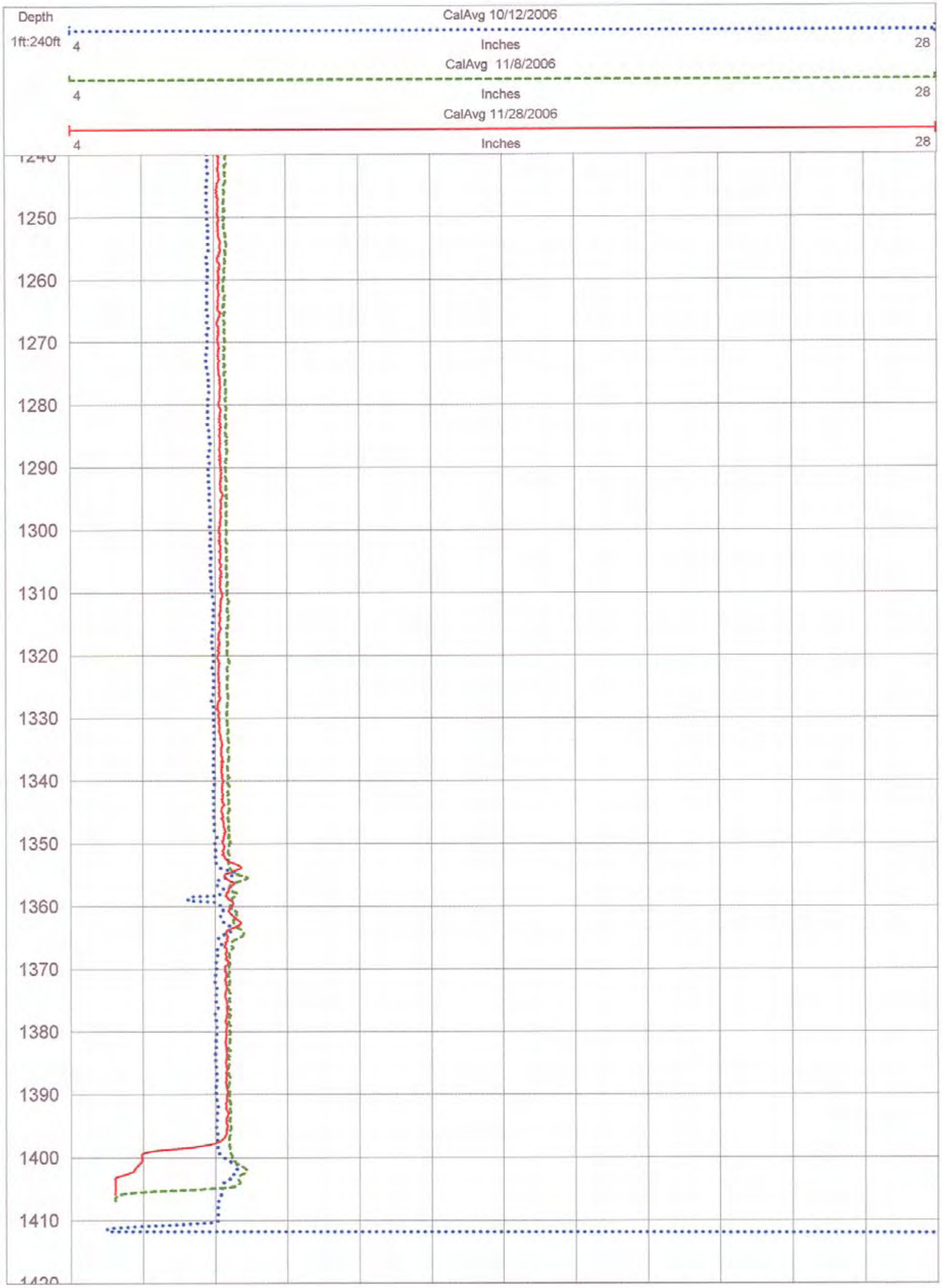
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Inches
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CalAvg 11/8/2006
4
Inches
28
CalAvg 11/28/2006
4
Inches
28
1240
1250
1260
1270
1280
1290
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1350
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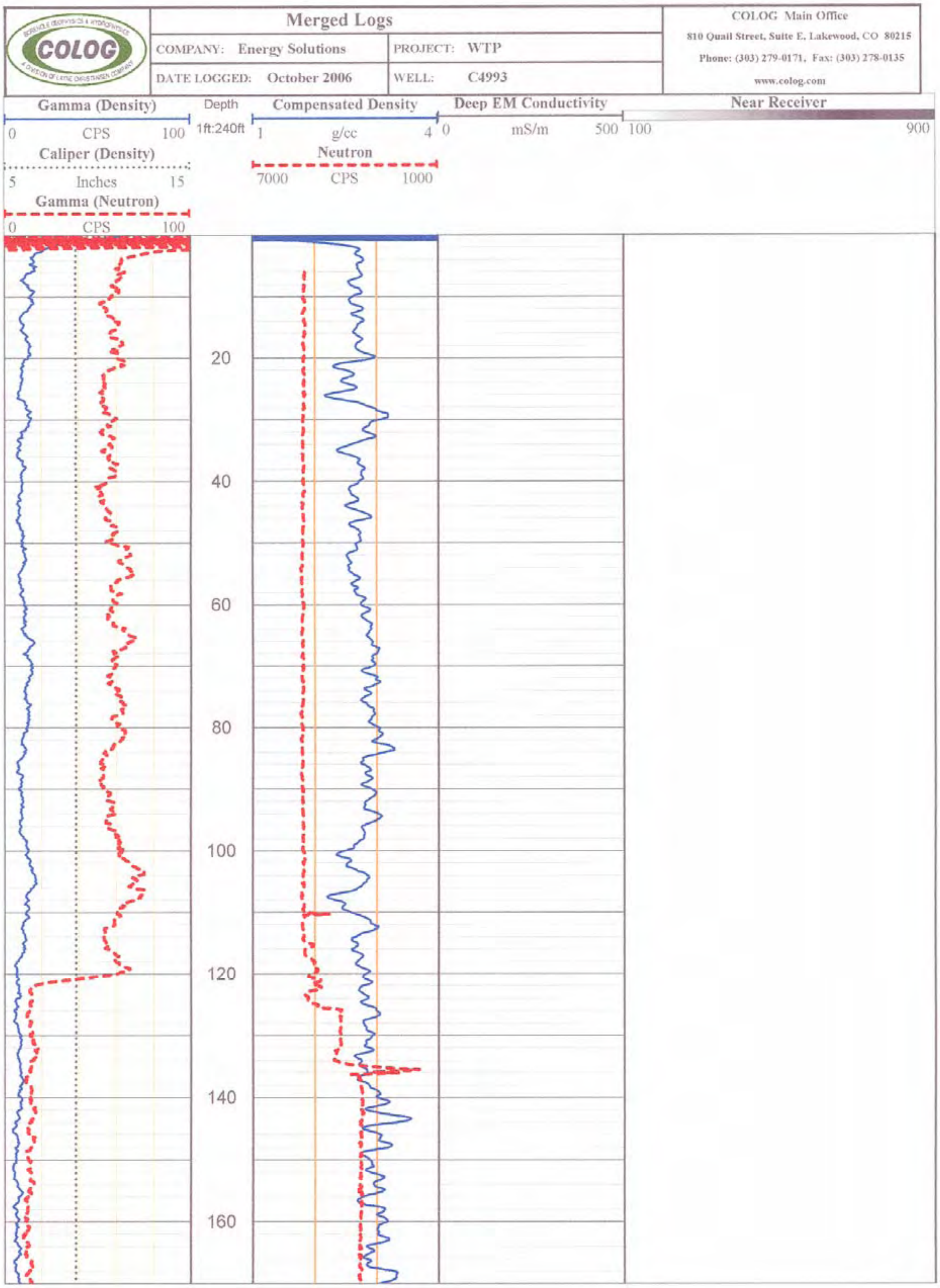
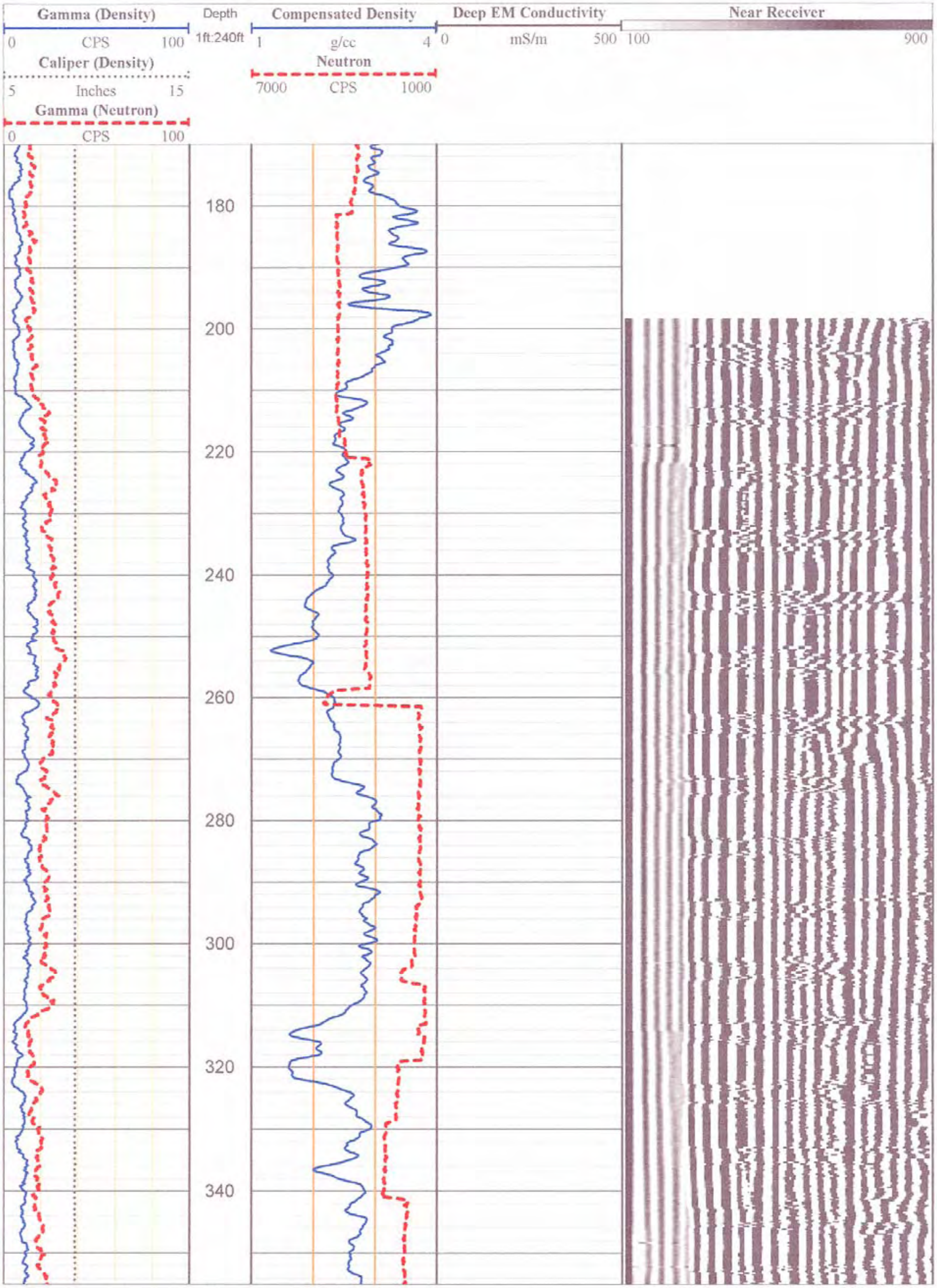
1370
1380
1390
1400
1410
1420

A1.3 COLOG MERGED LOGS




Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
180
200
220
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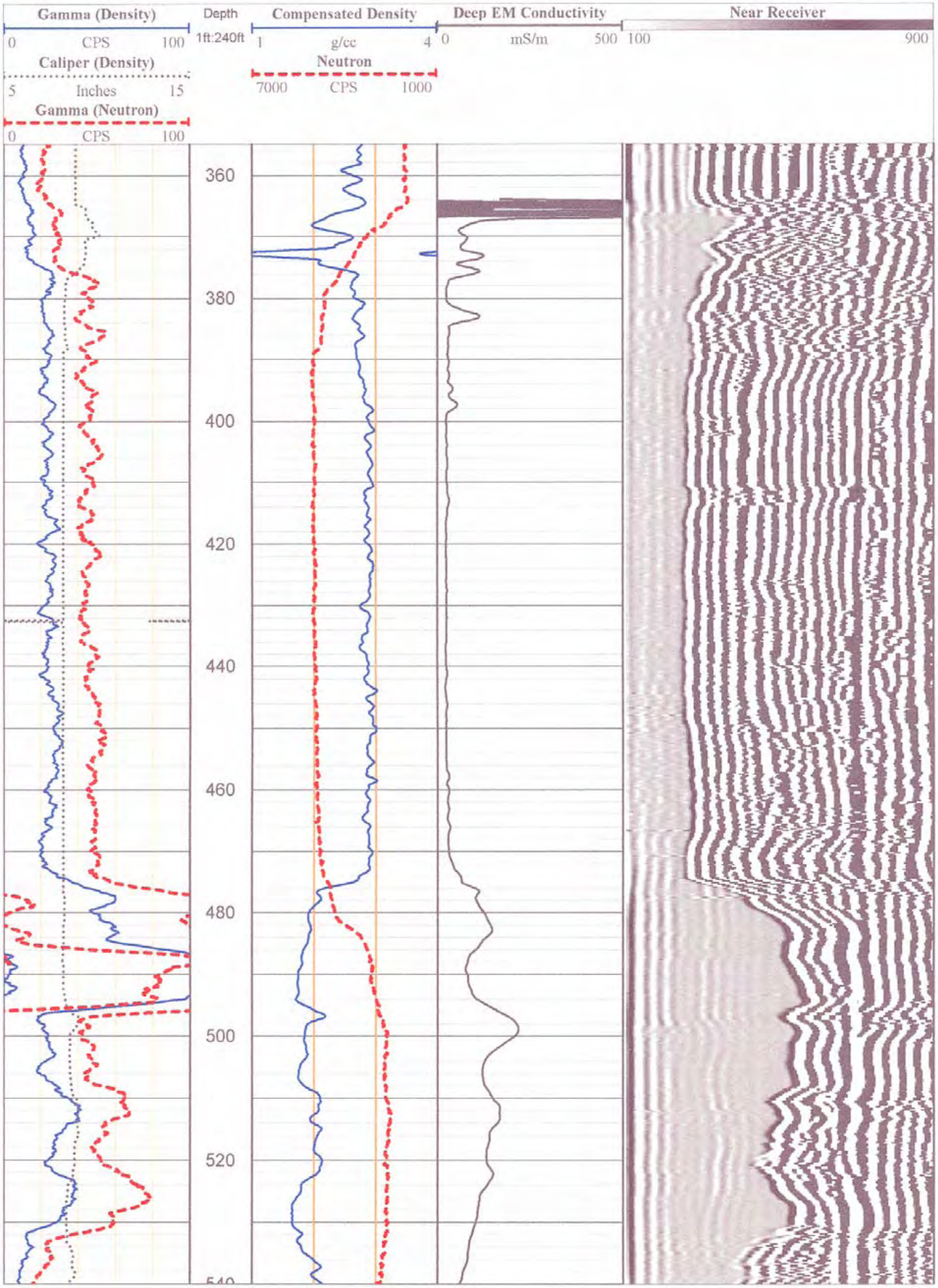
260
280
300
320
340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Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
360
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400
420
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520
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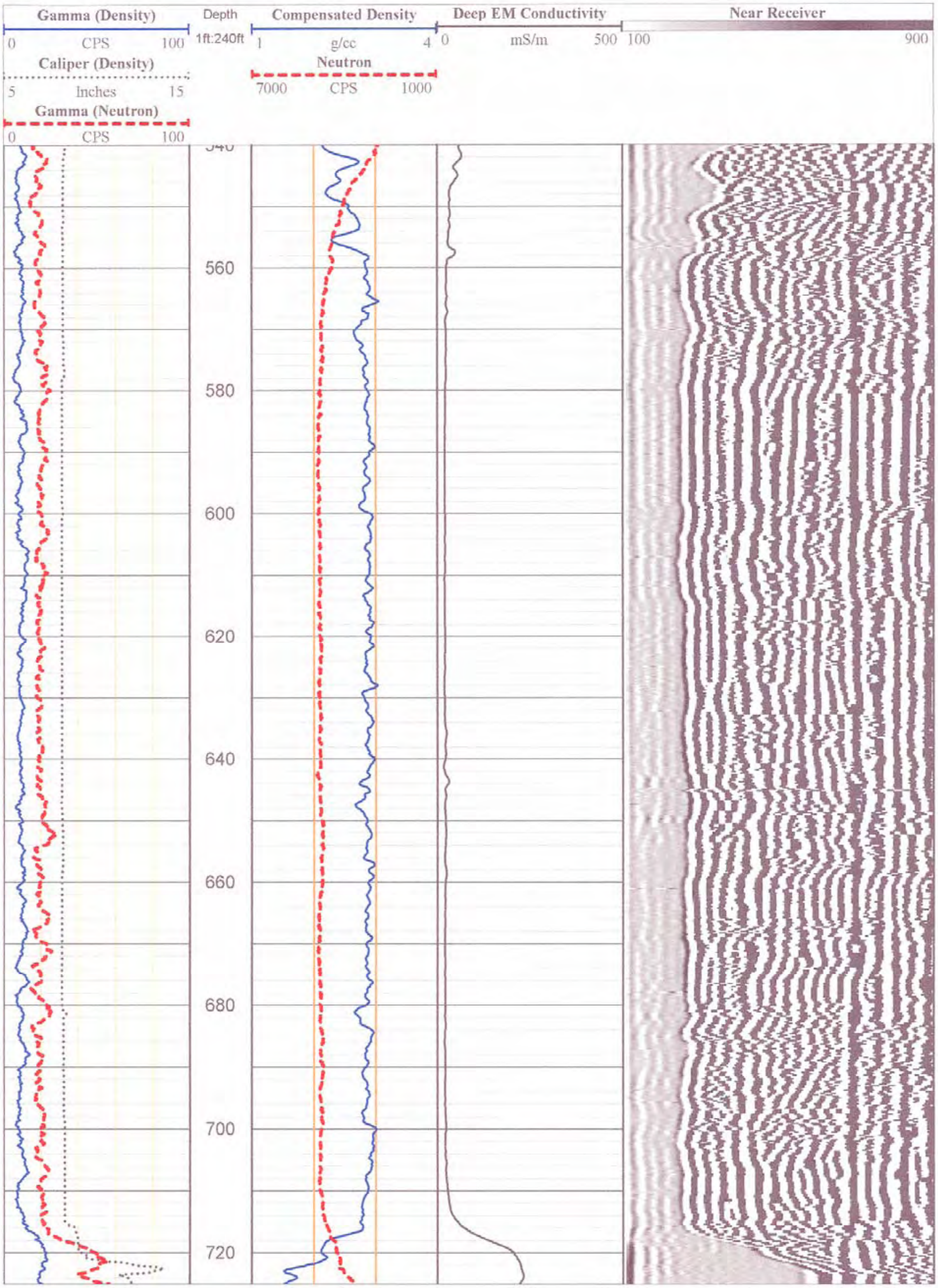
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Caliper (Density)
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Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
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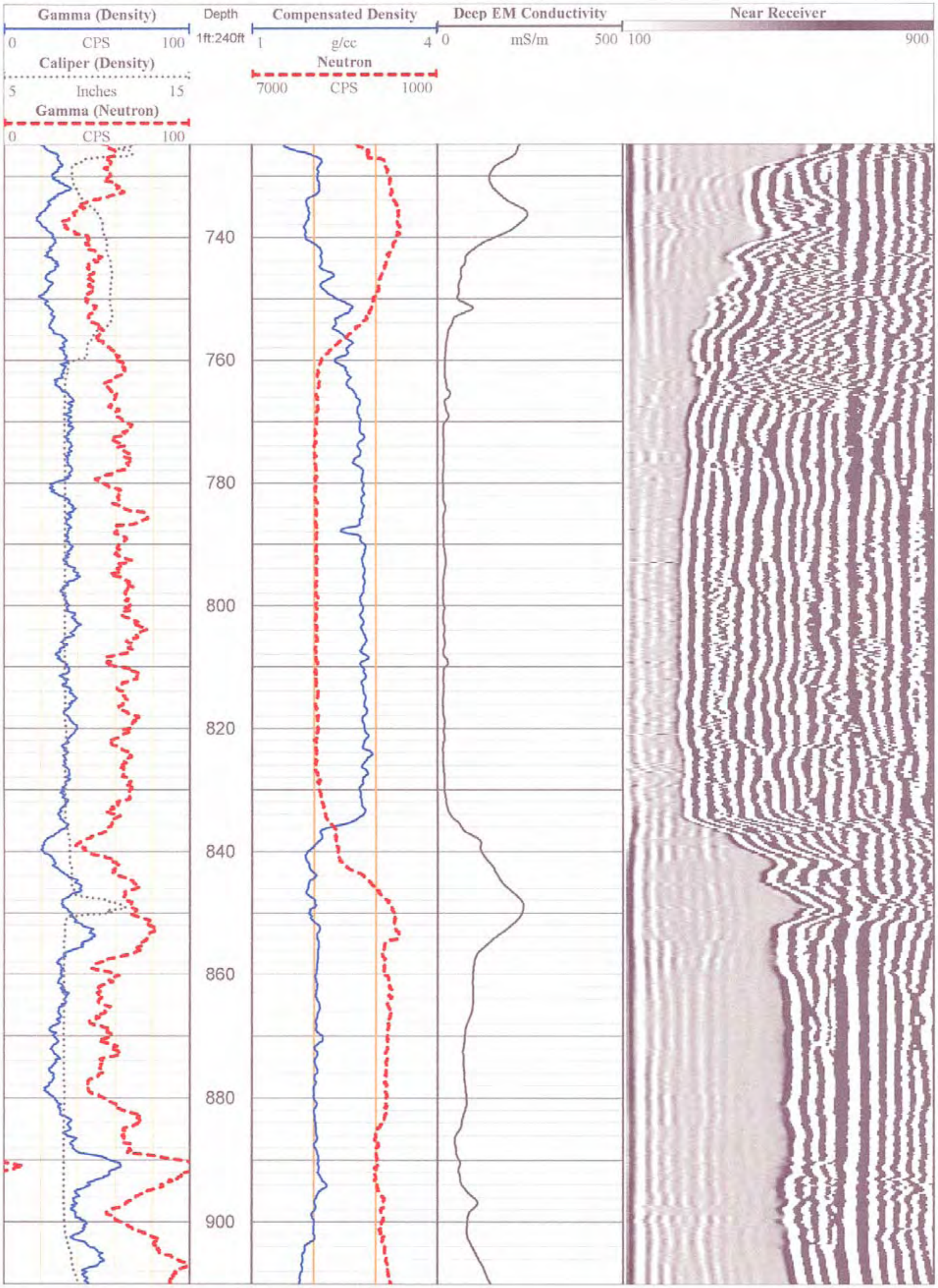
Gamma (Density)
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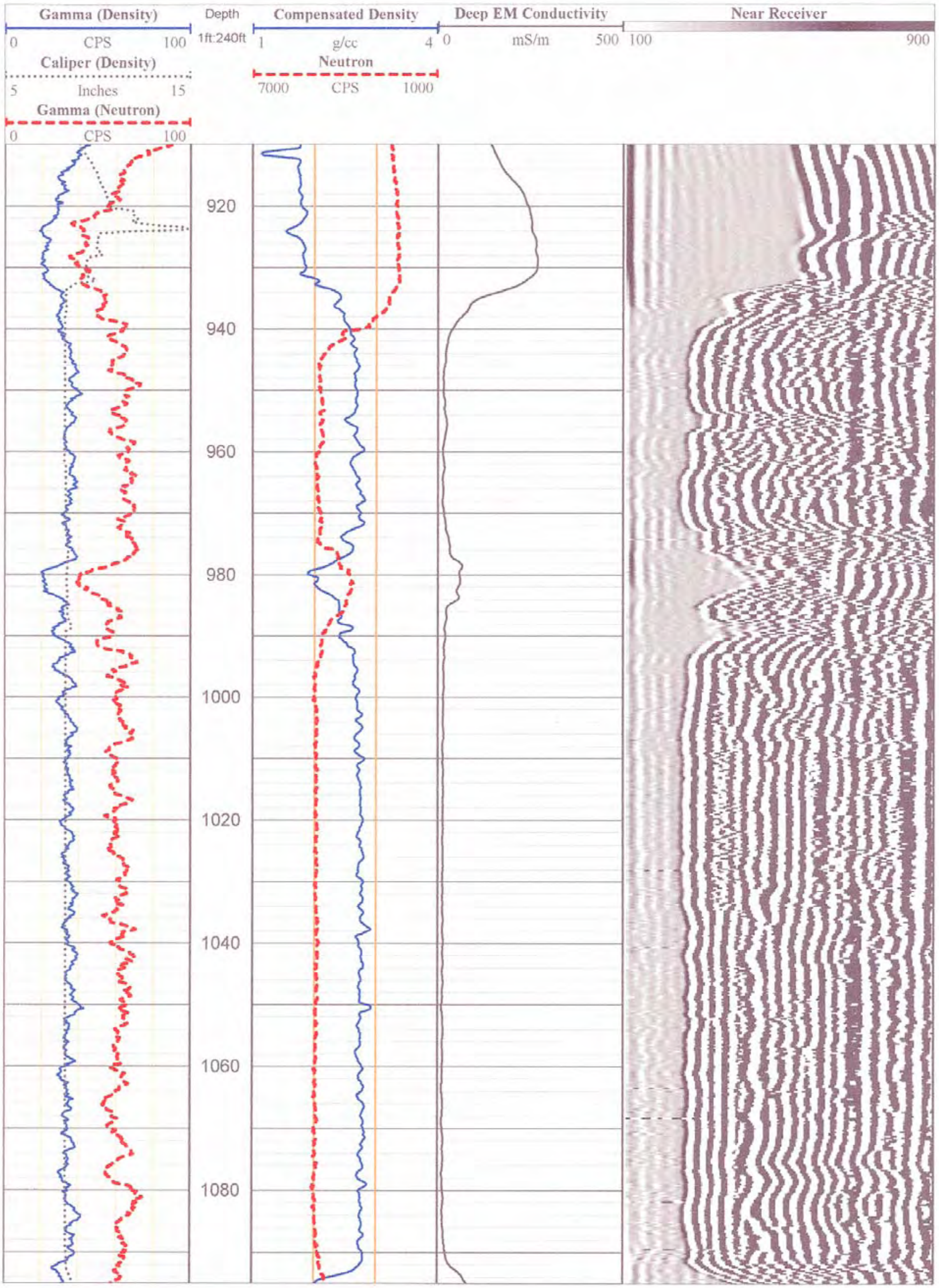
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
740
760
780
800
820
840
860
880
900


Gamma (Density)
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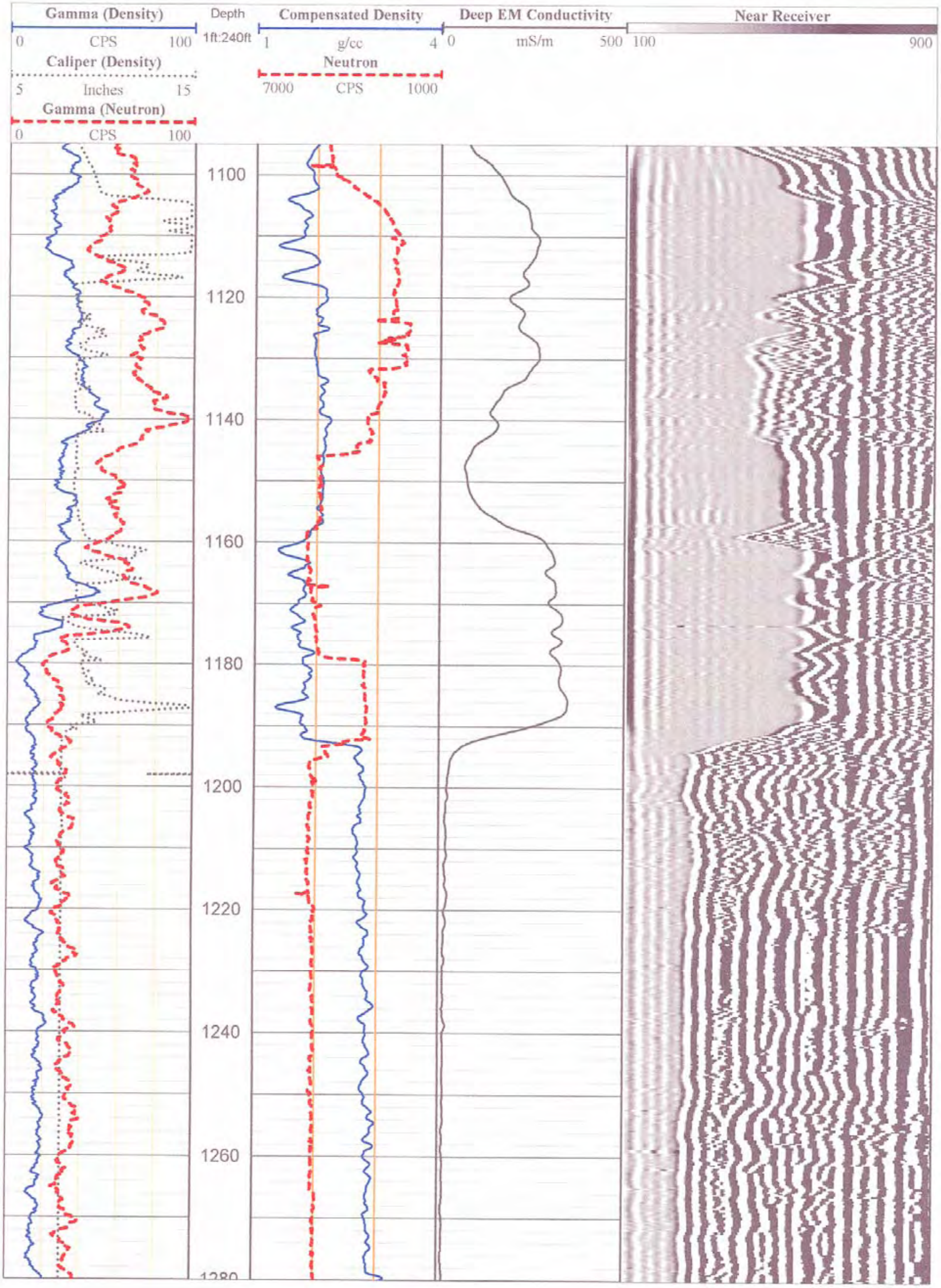
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
920
940
960
980
1000
1020
1040
1060
1080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Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
1100
1120
1140
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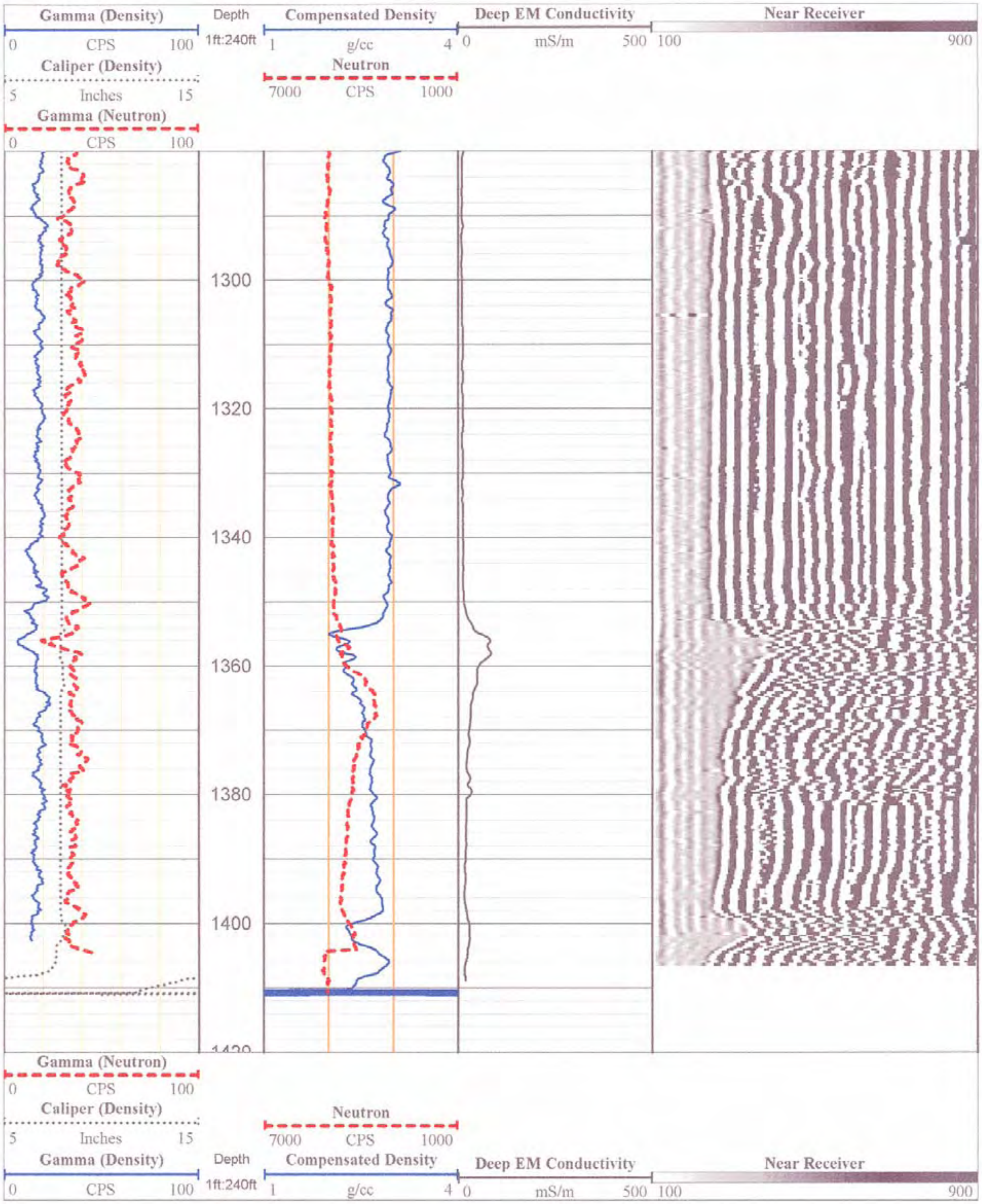
1240
1260
1280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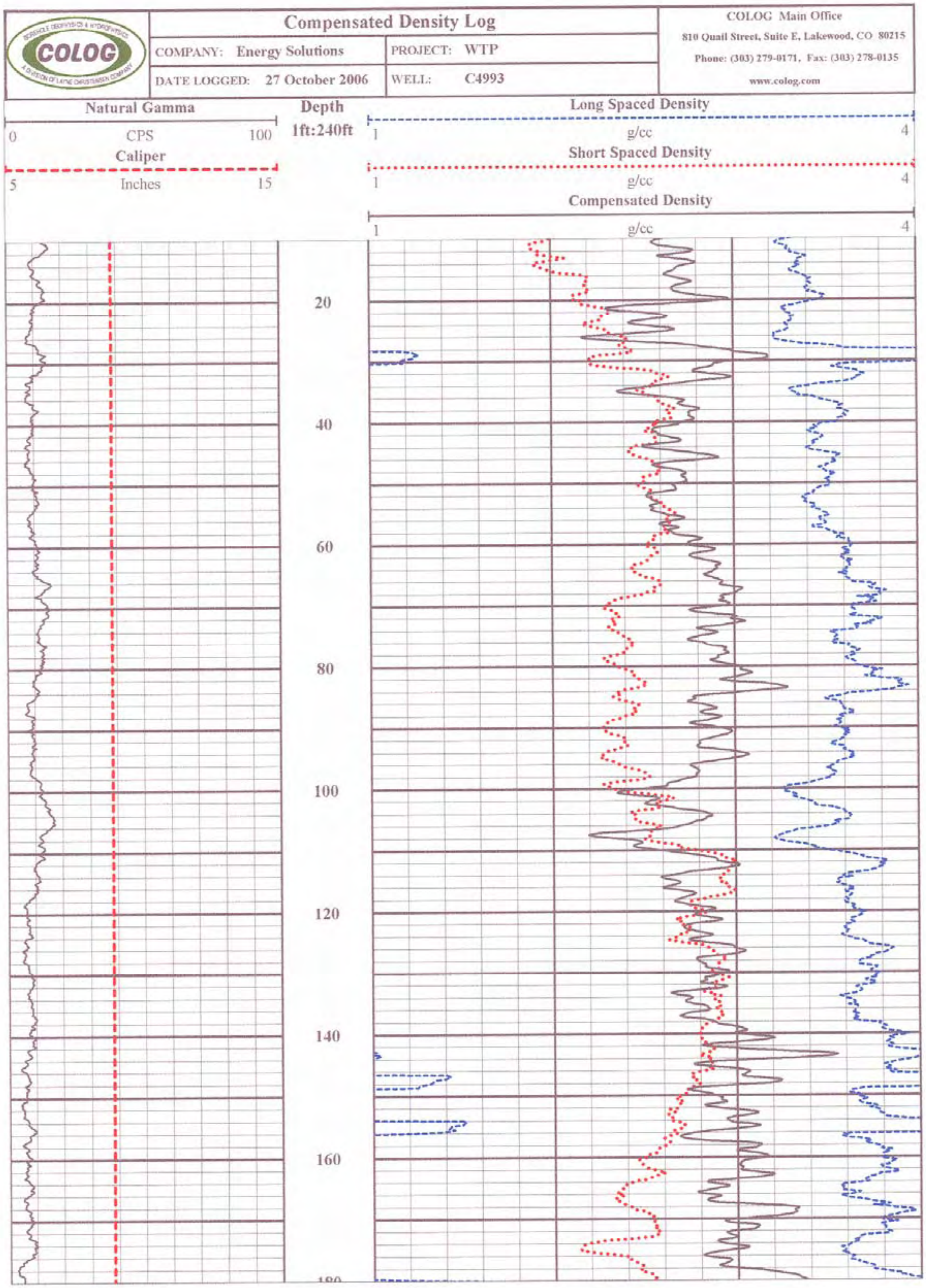
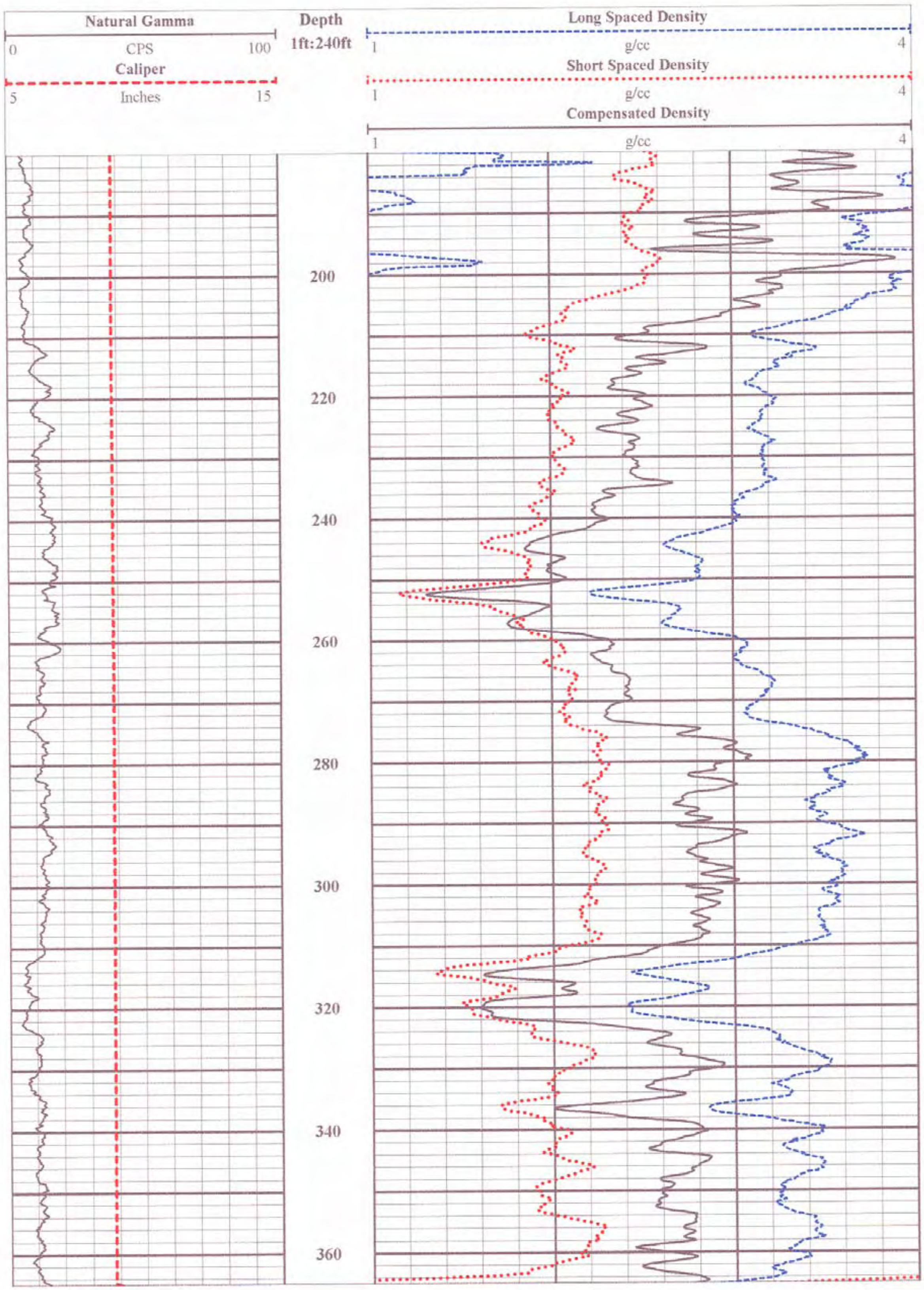
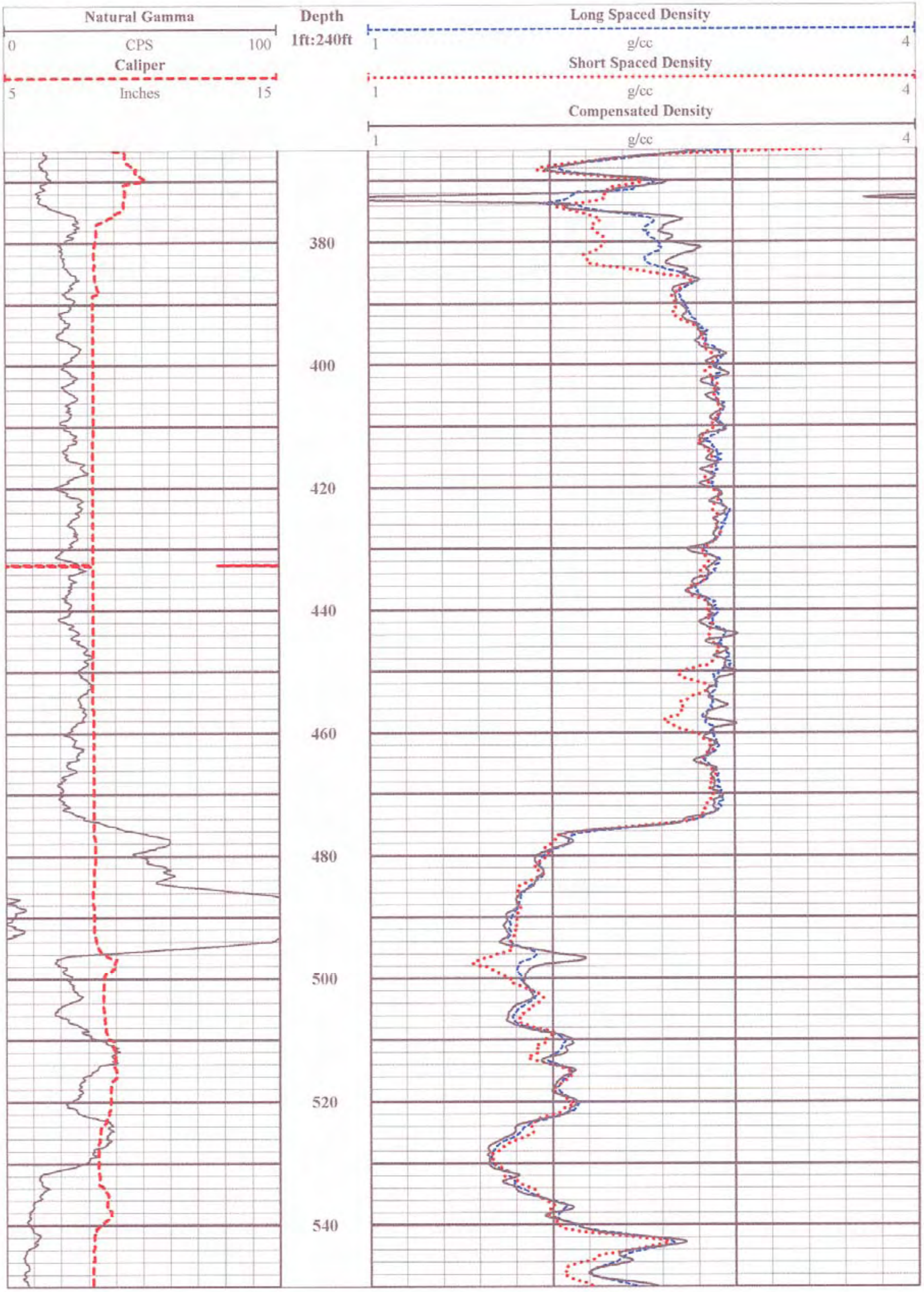
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
1300
1320
1340
1360
1380
1400
Gamma (Neutron)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Density)
0 CPS 100
Depth
1ft:240ft
Neutron
7000 CPS 1000
Compensated Density
1 g/cc 4
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900

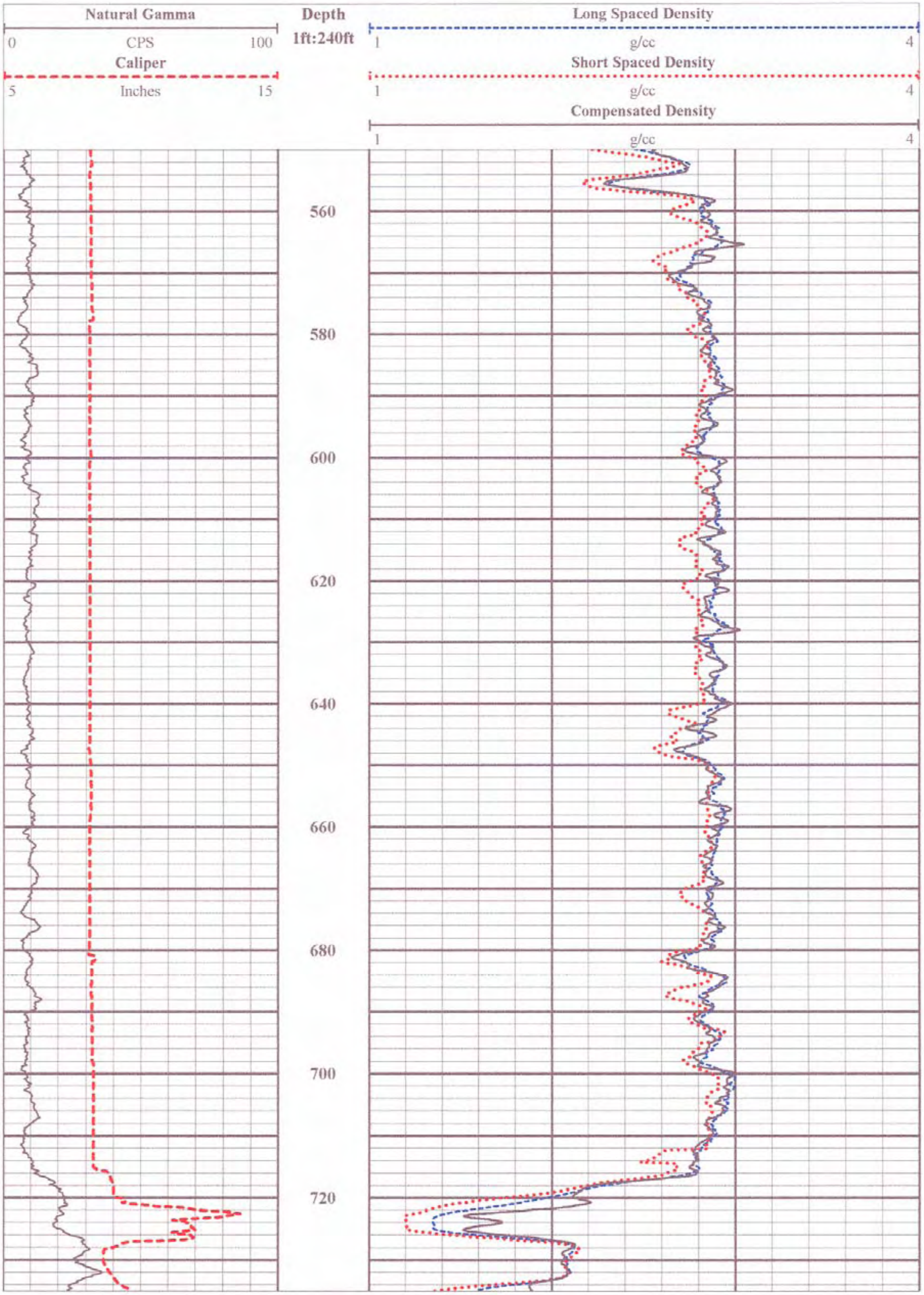
A1.4 COLOG COMPENSATED DENSITY LOG

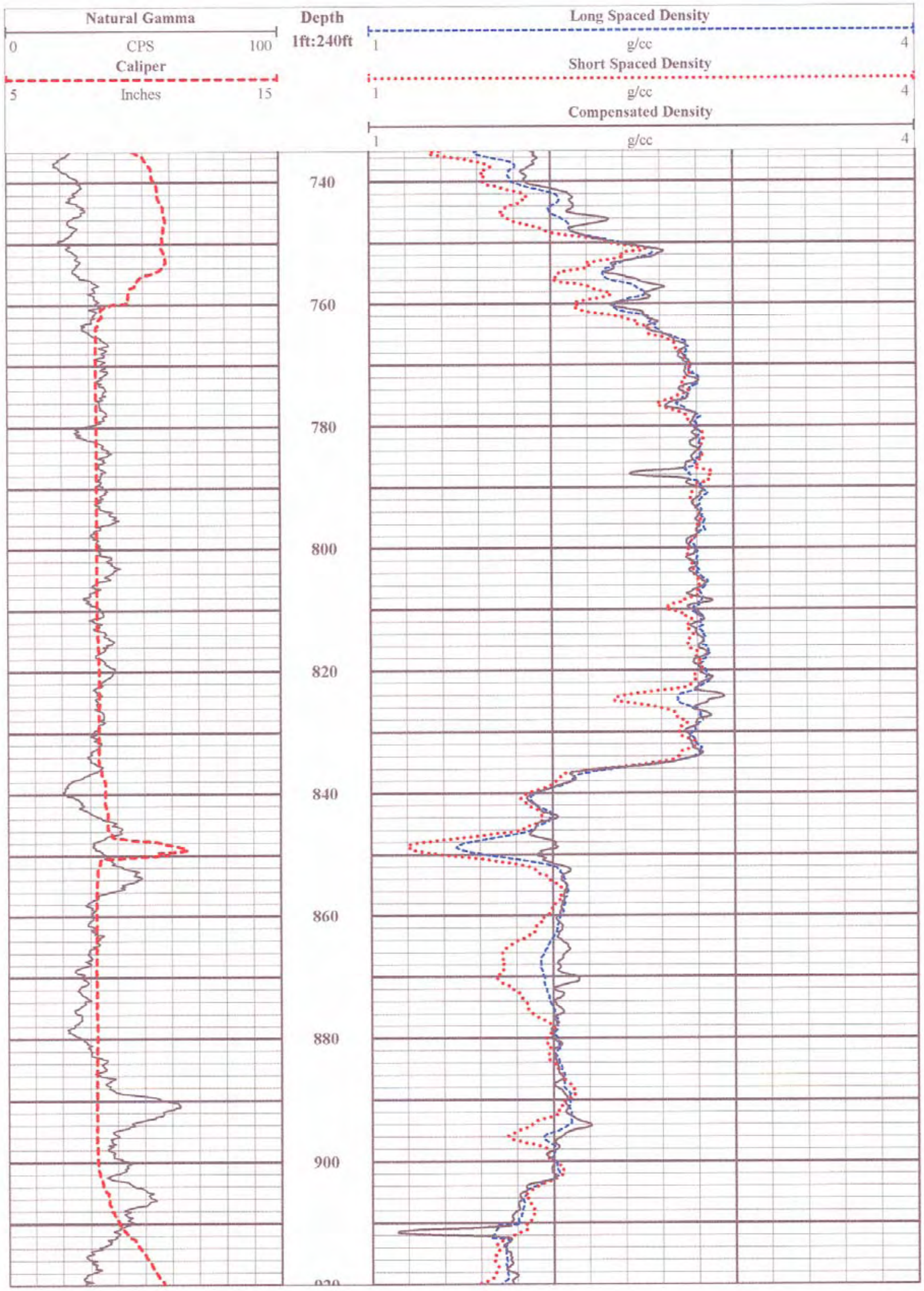


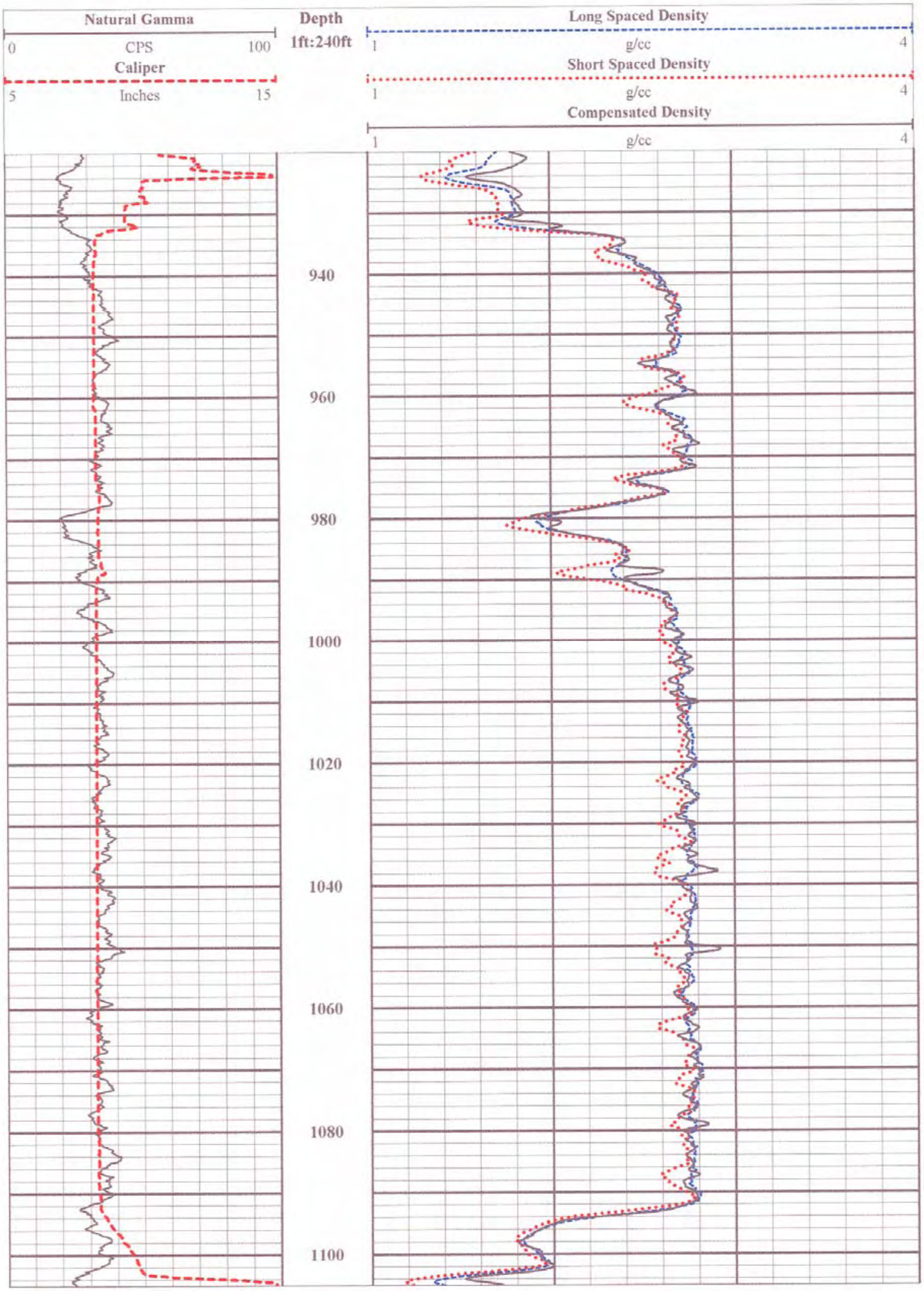

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4
200
220
240
260
280
300
320
340
360

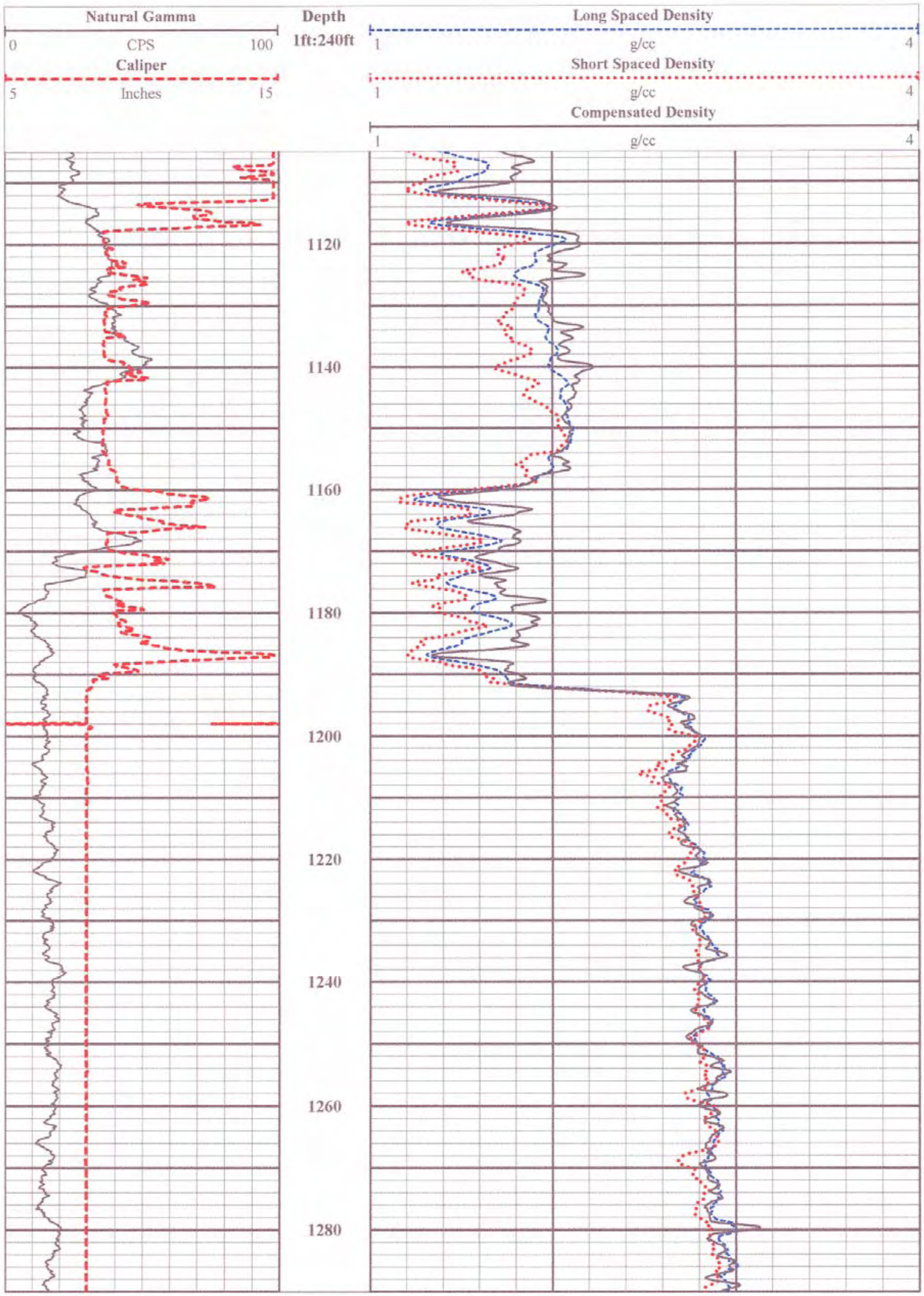


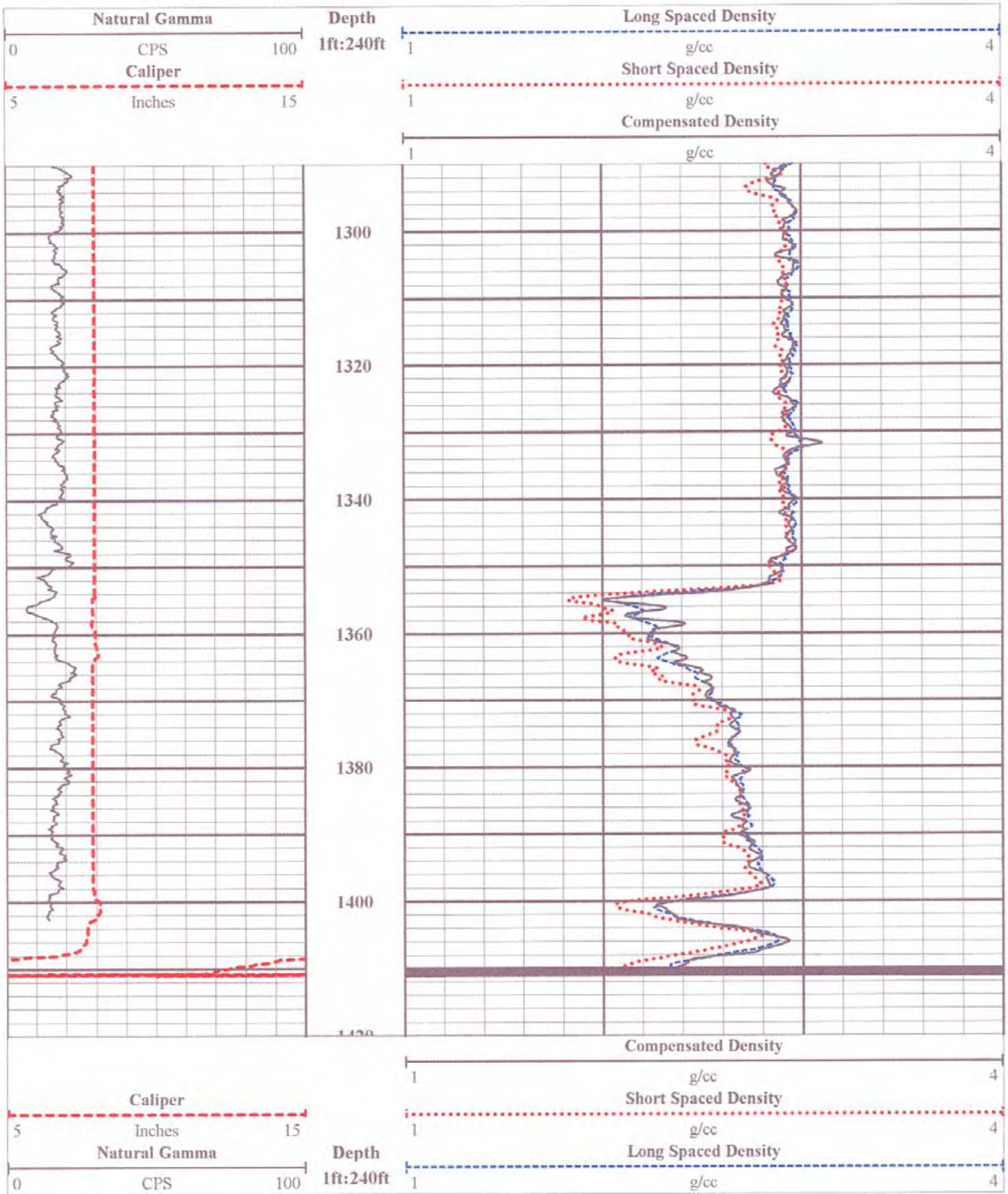
Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4
380
400
420
440
460
480
500
520
540


Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4
560
580
600
620
640
660
680
700
720


Natural Gamma
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Long Spaced Density
1 g/cc 4
Short Spaced Density
1 g/cc 4
Compensated Density
1 g/cc 4
740
760
780
800
820
840
860
880
900

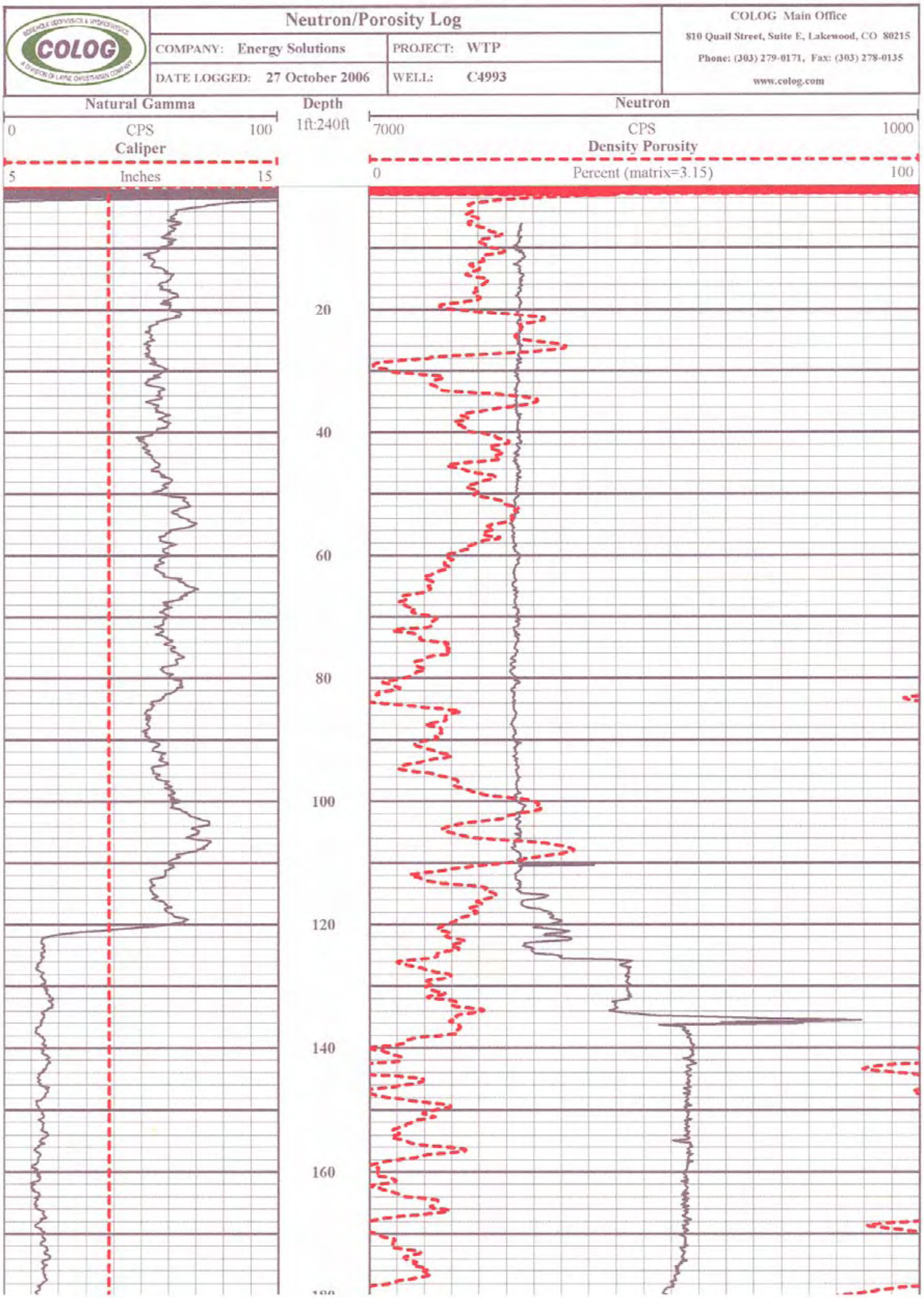

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
940
960
980
1000
1020
1040
1060
1080
1100
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4

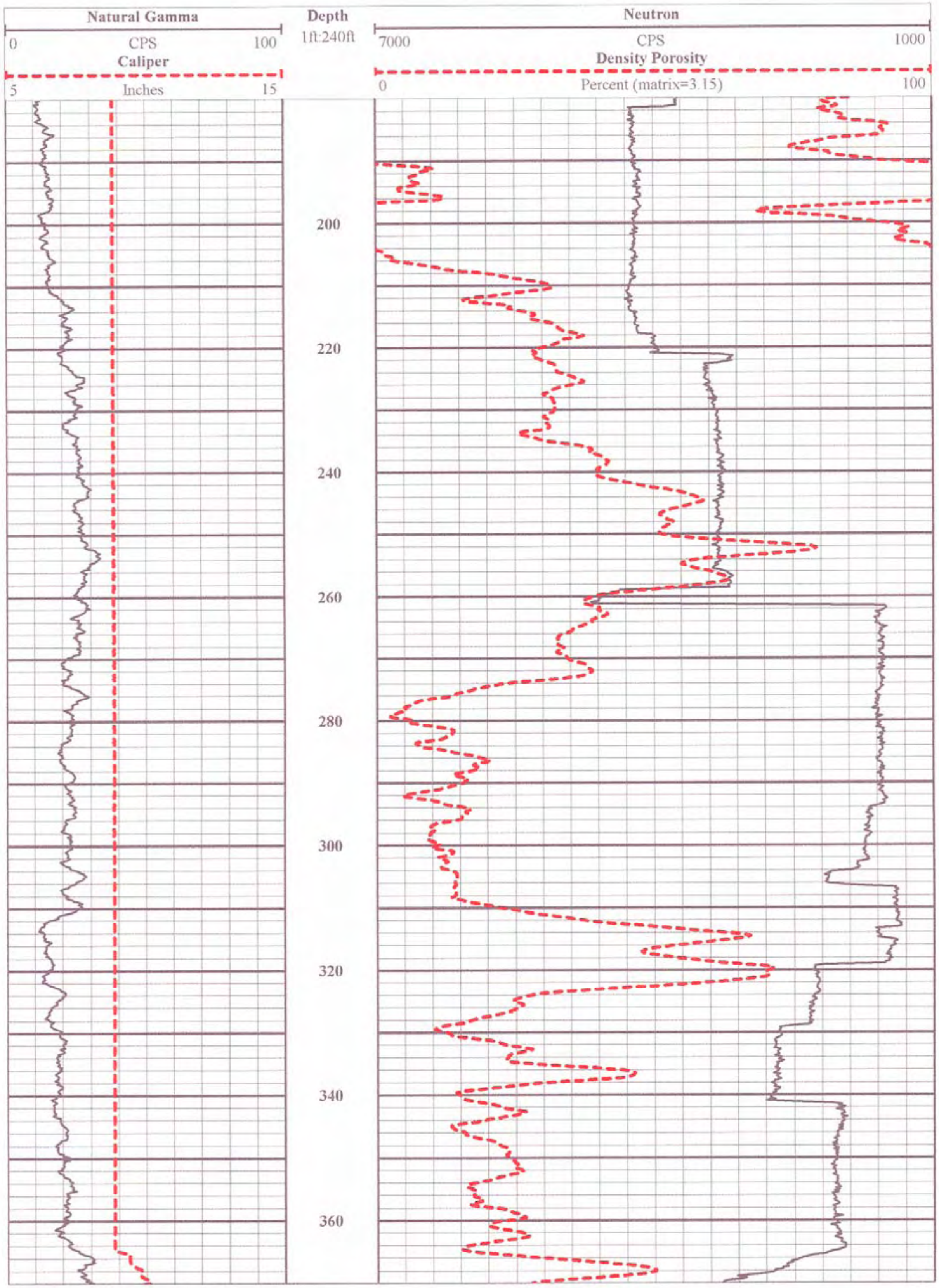

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4
1120
1140
1160
1180
1200
1220
1240
1260
1280

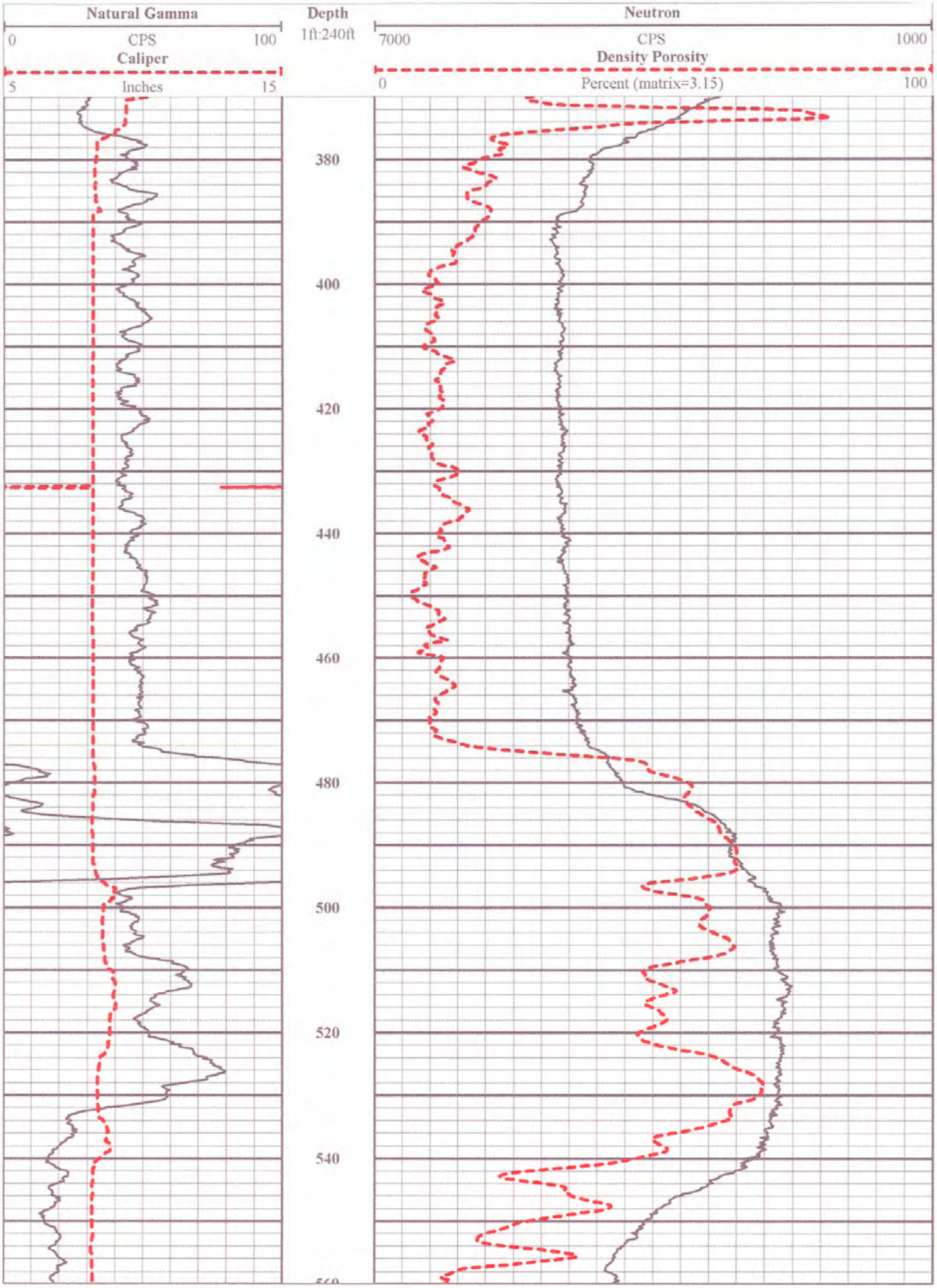


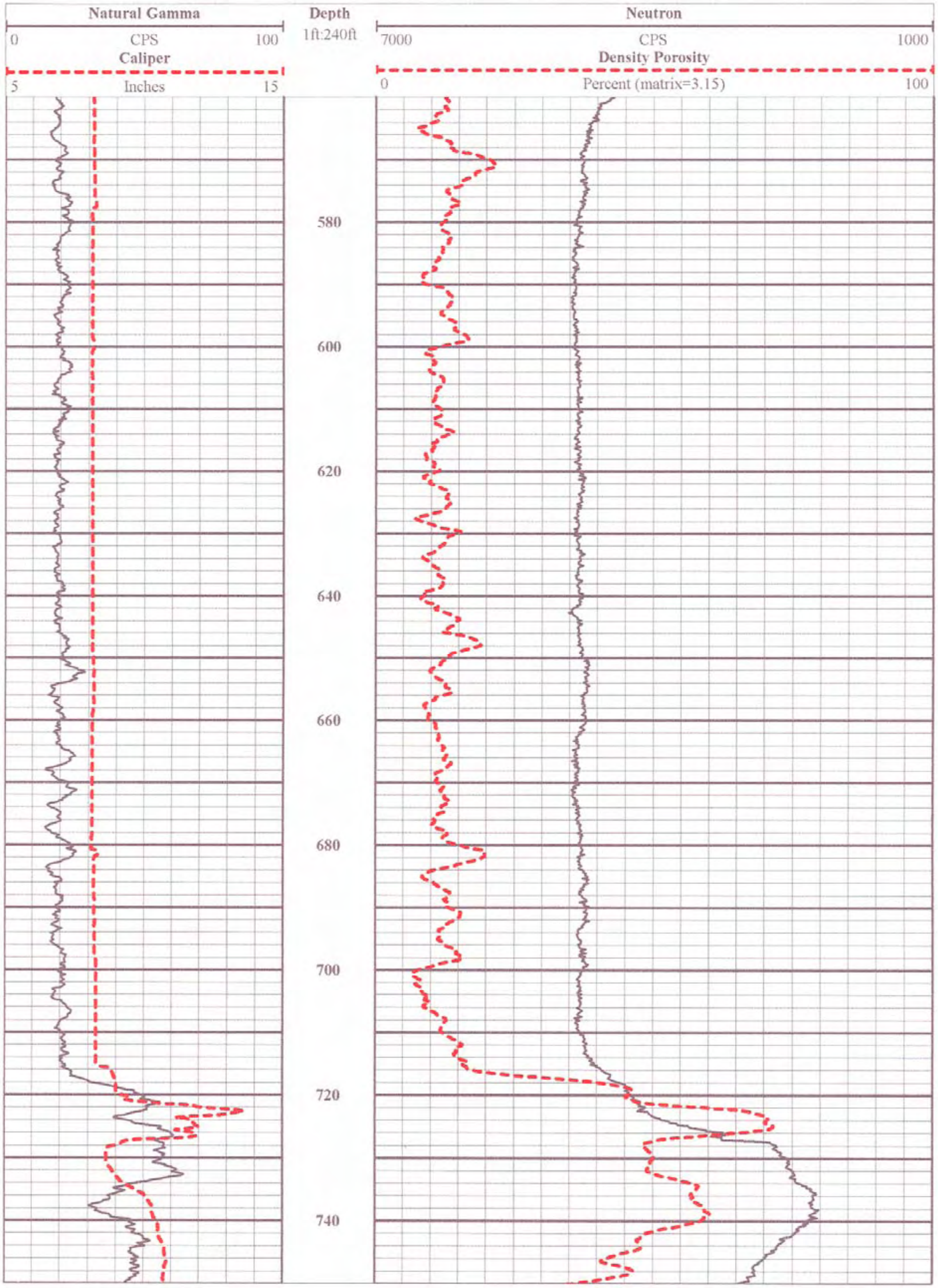
Natural Gamma
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Long Spaced Density
1 g/cc 4
Short Spaced Density
1 g/cc 4
Compensated Density
1 g/cc 4
1300
1320
1340
1360
1380
1400

A1.5 COLOG NEUTRON/POROSITY LOG

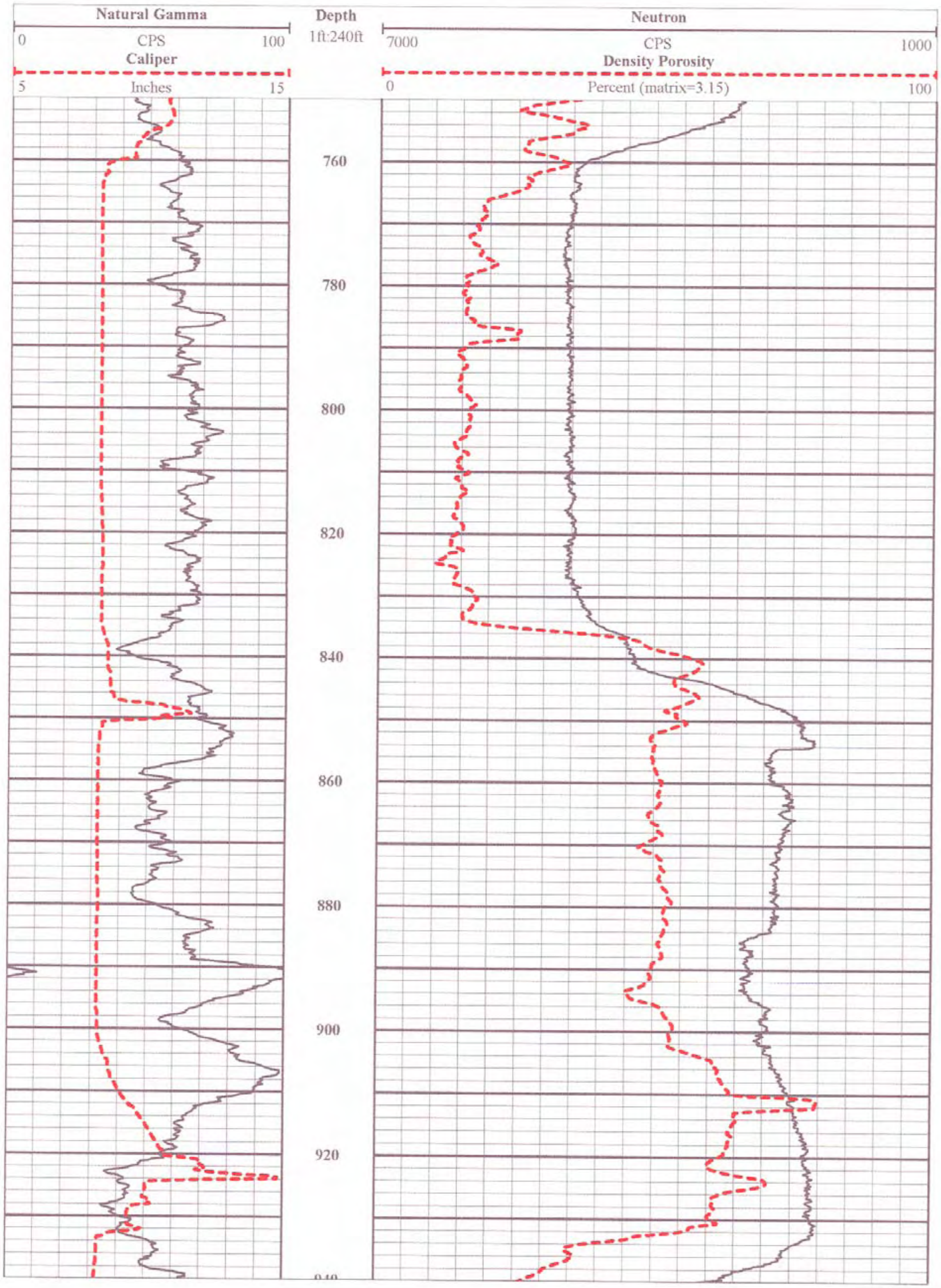


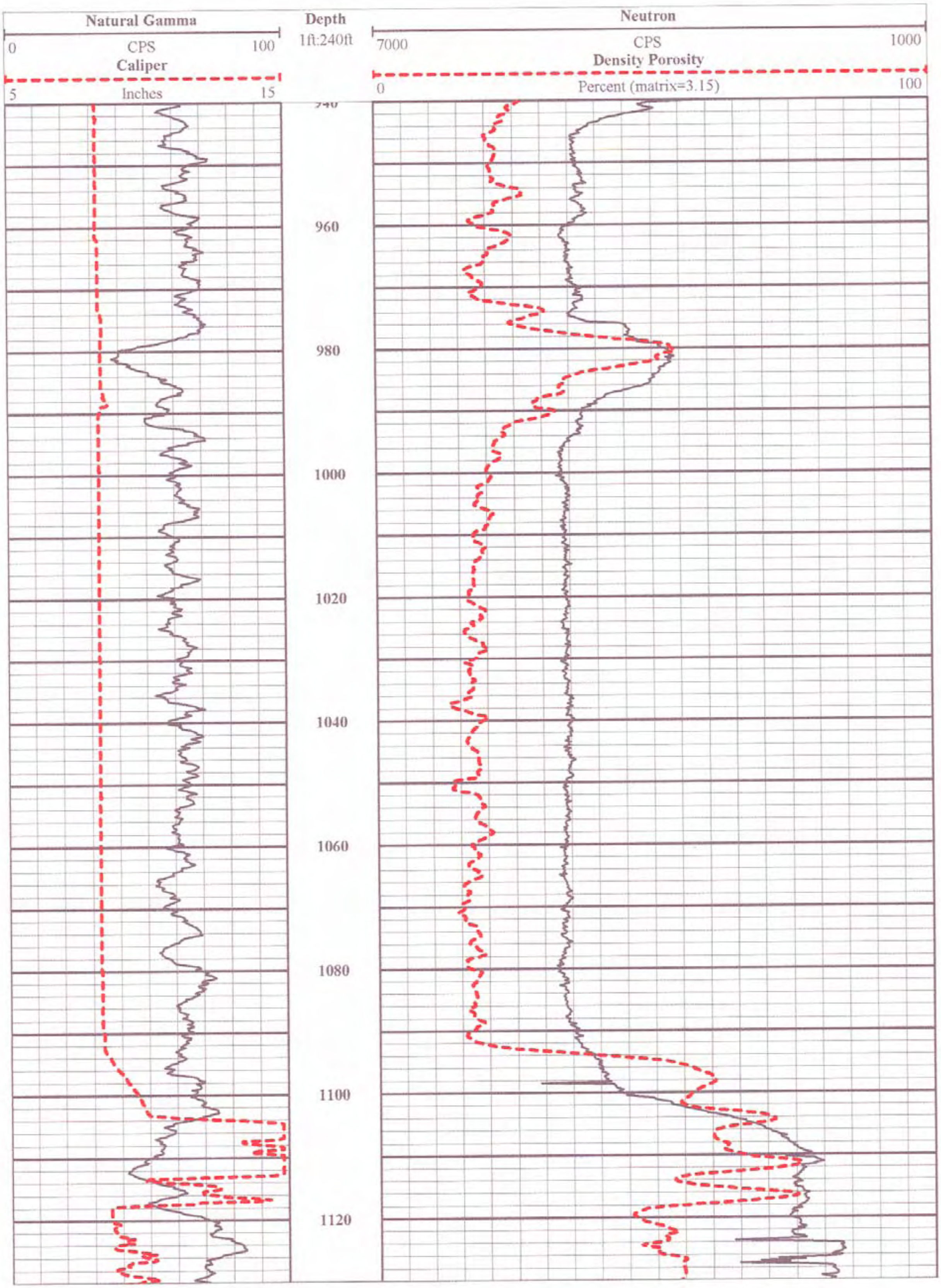

Natural Gamma
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Neutron
7000 CPS 1000
Density Porosity
0 Percent (matrix=3.15) 100
200
220
240
260
280
300
320
340
360

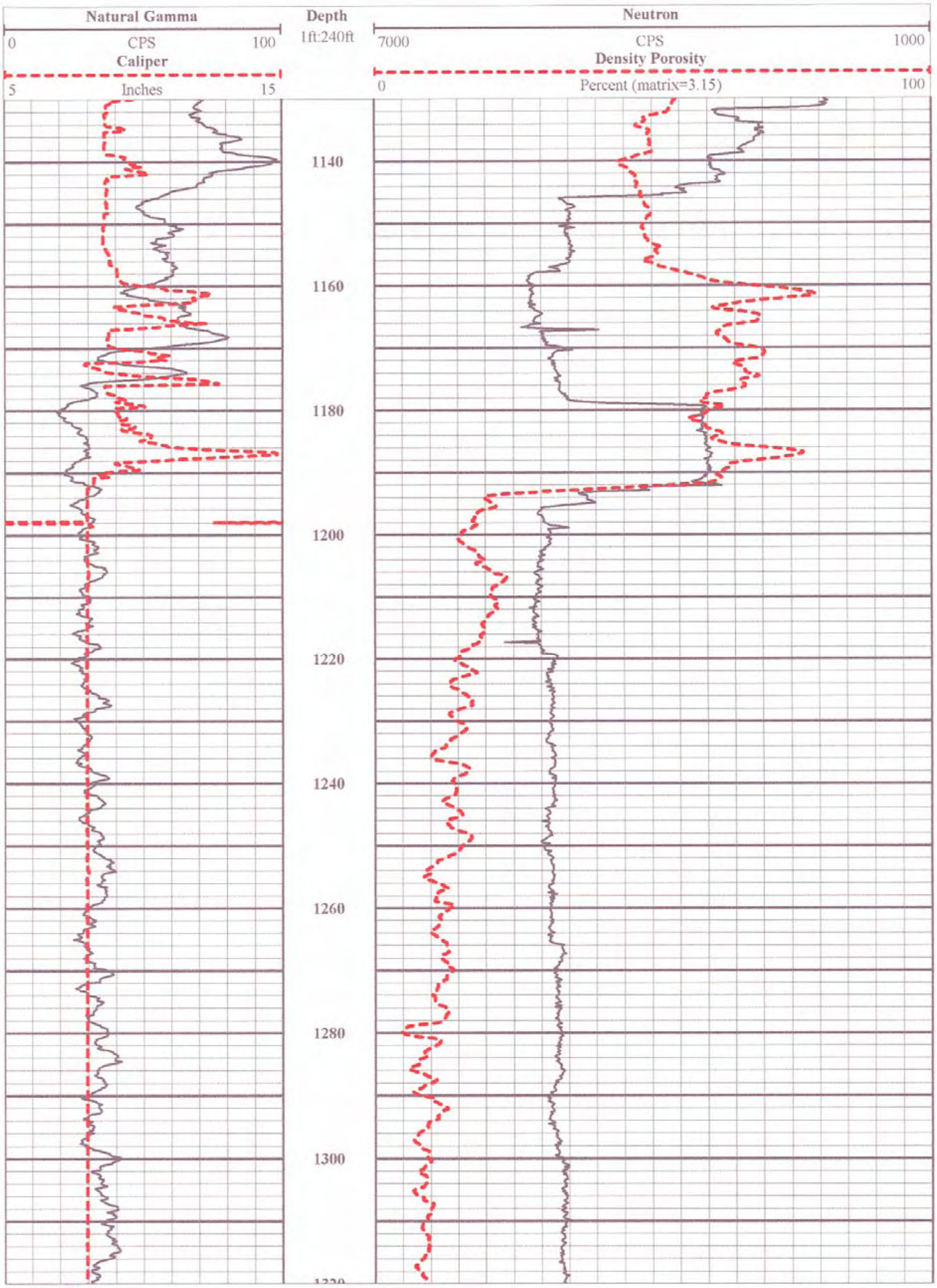

Natural Gamma
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
380
400
420
440
460
480
500
520
540
560
Neutron
7000 CPS 1000
Density Porosity
0 Percent (matrix=3.15) 100

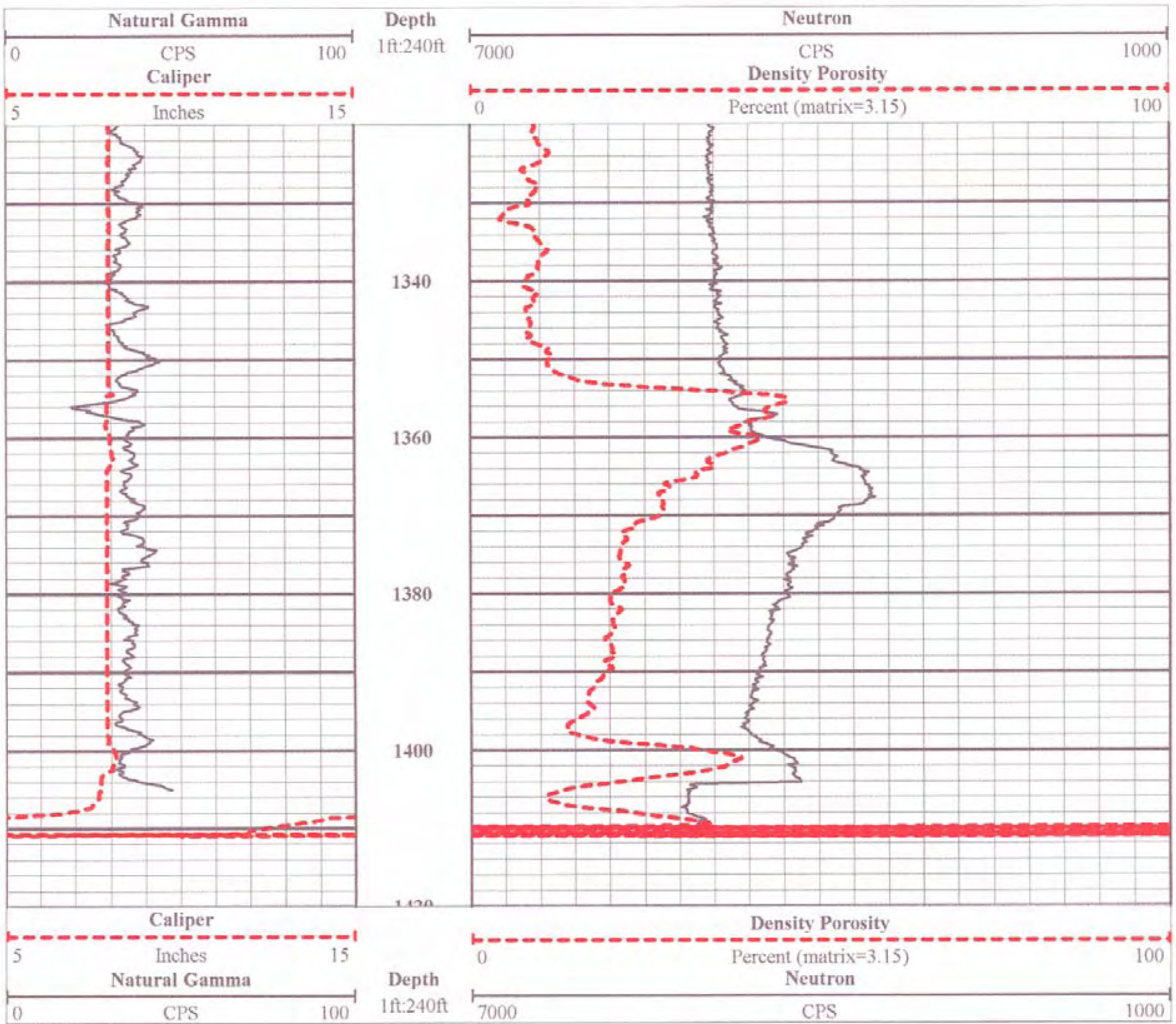


Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
580
600
620
640
660
680
700
720
740
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100


Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
760
780
800
820
840
860
880
900
920
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100

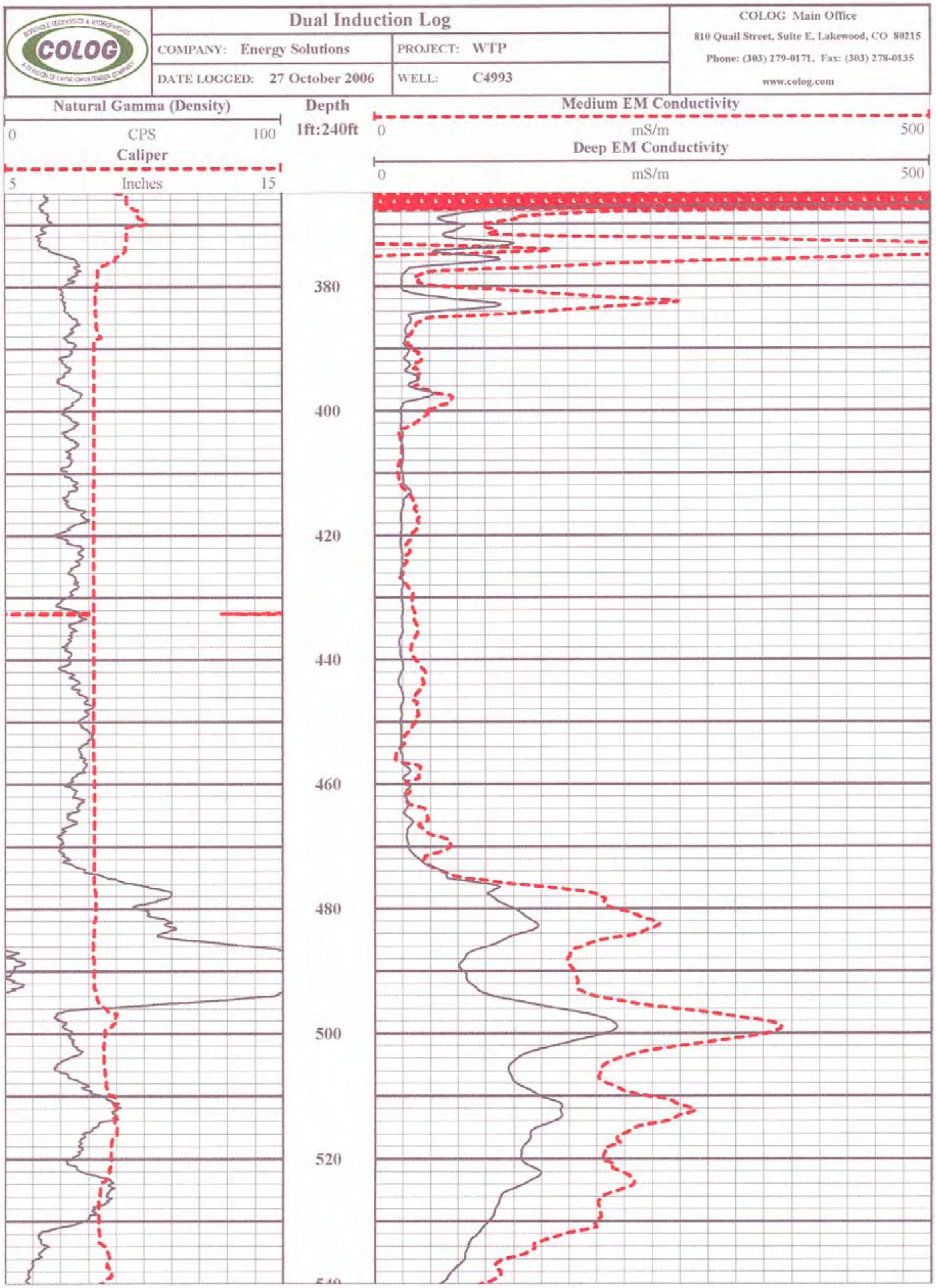

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100
960
980
1000
1020
1040
1060
1080
1100
1120


Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100
1140
1160
1180
1200
1220
1240
1260
1280
1300

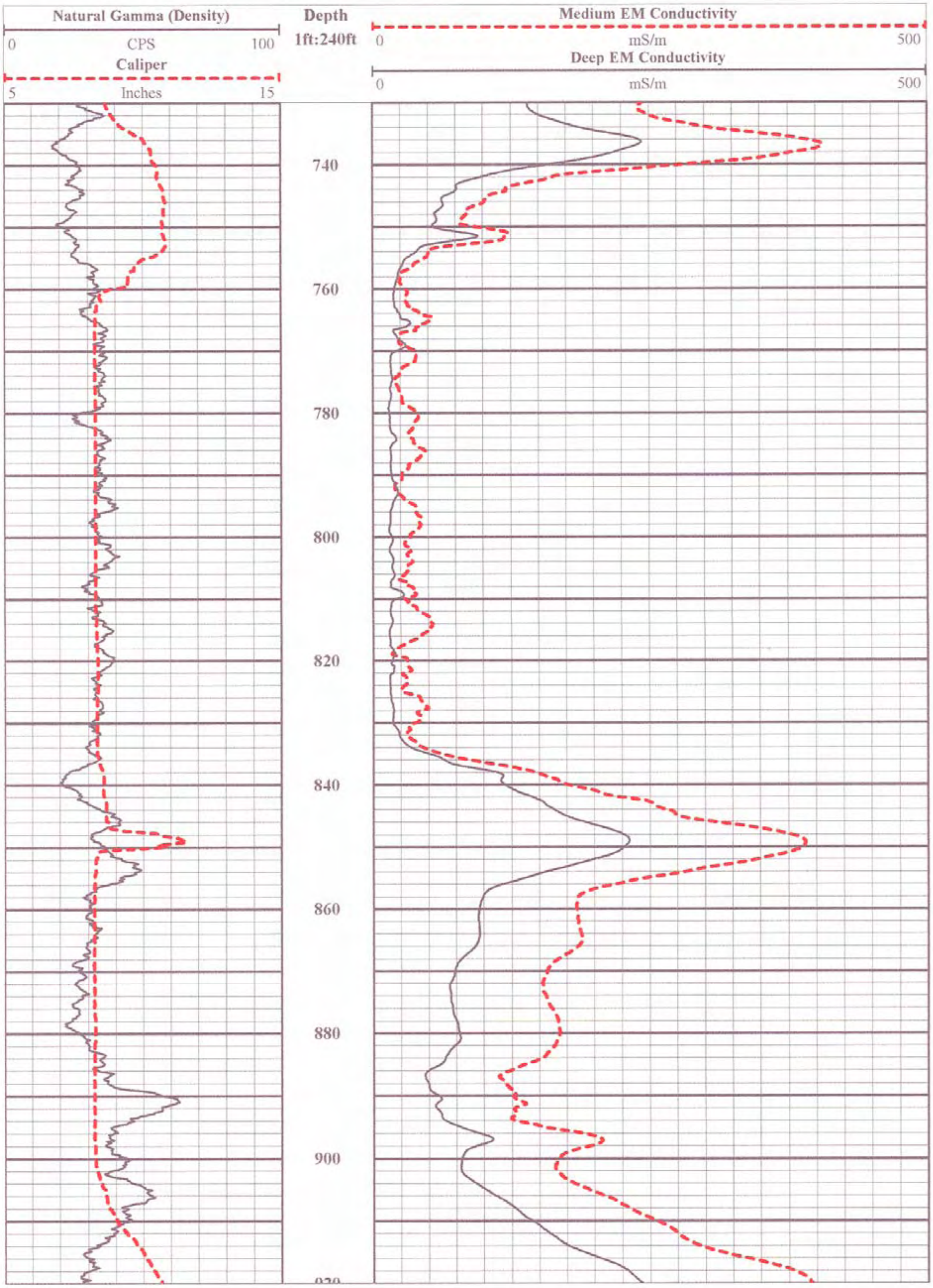


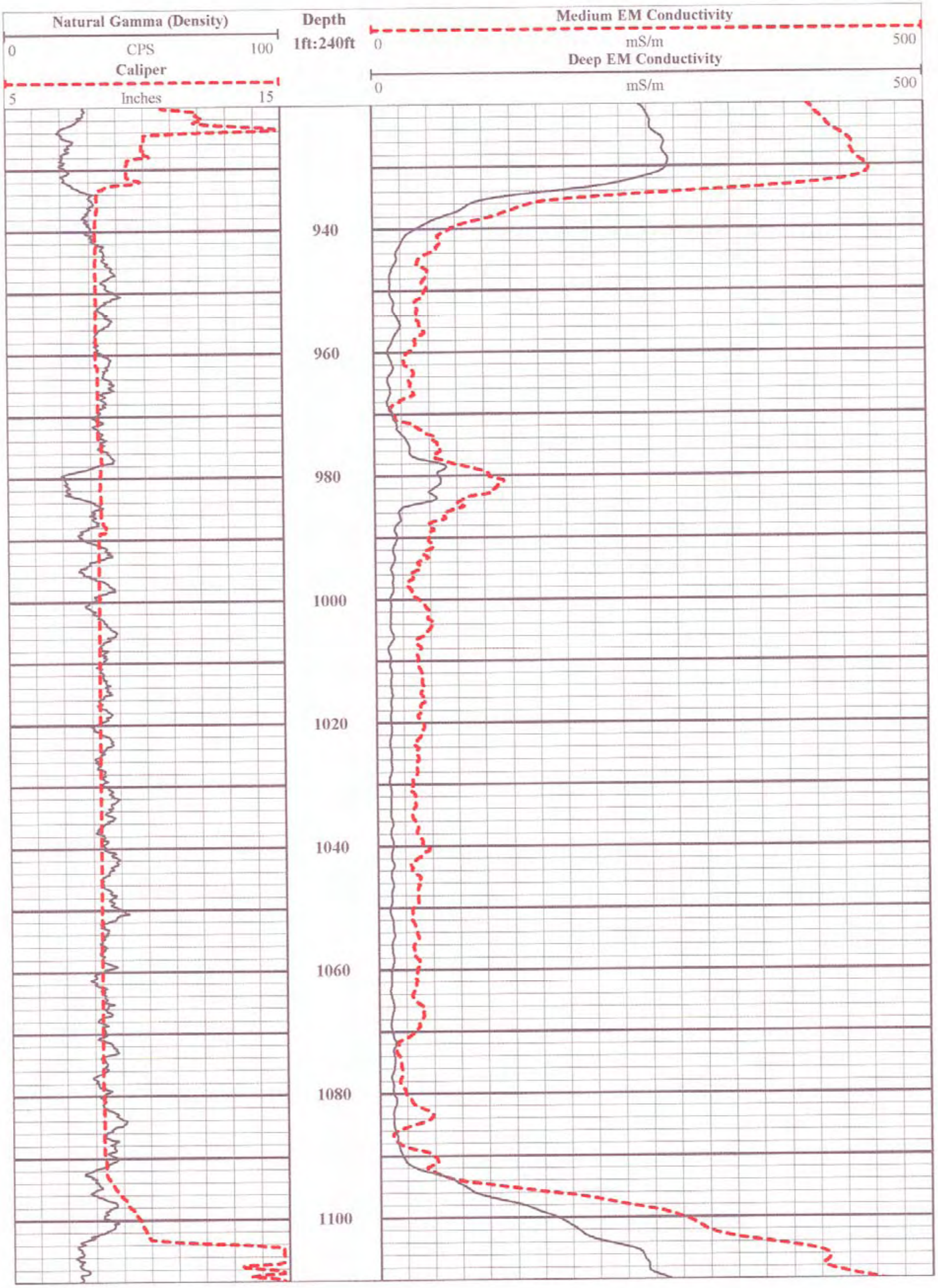
Natural Gamma
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Neutron
7000 CPS 1000
Density Porosity
0 Percent (matrix=3.15) 100
1340
1360
1380
1400
Caliper
5 Inches 15
Natural Gamma
0 CPS 100
Depth
1ft:240ft
Density Porosity
0 Percent (matrix=3.15) 100
Neutron
7000 CPS 1000

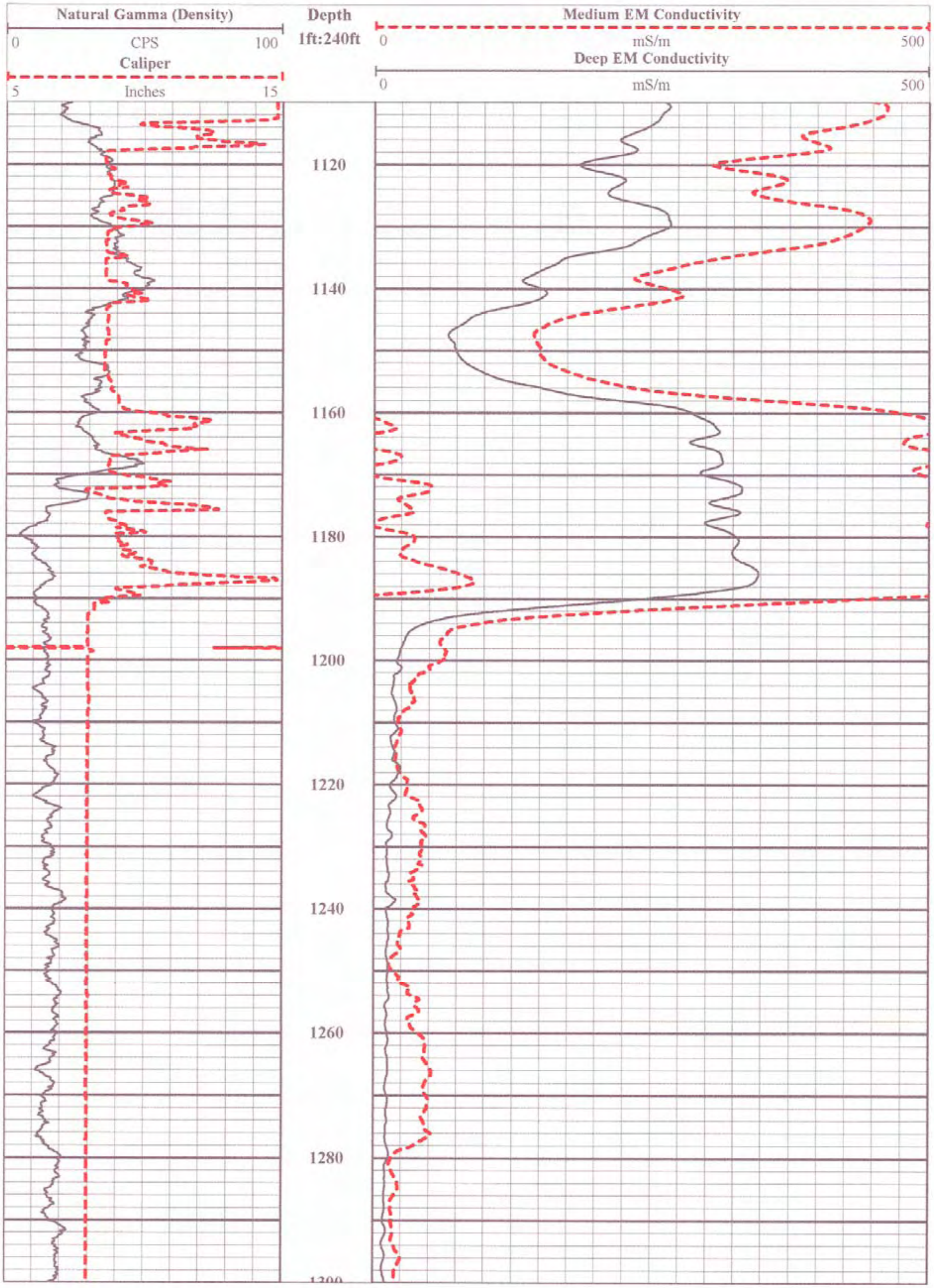
A1.6 COLOG DUAL INDUCTION LOG

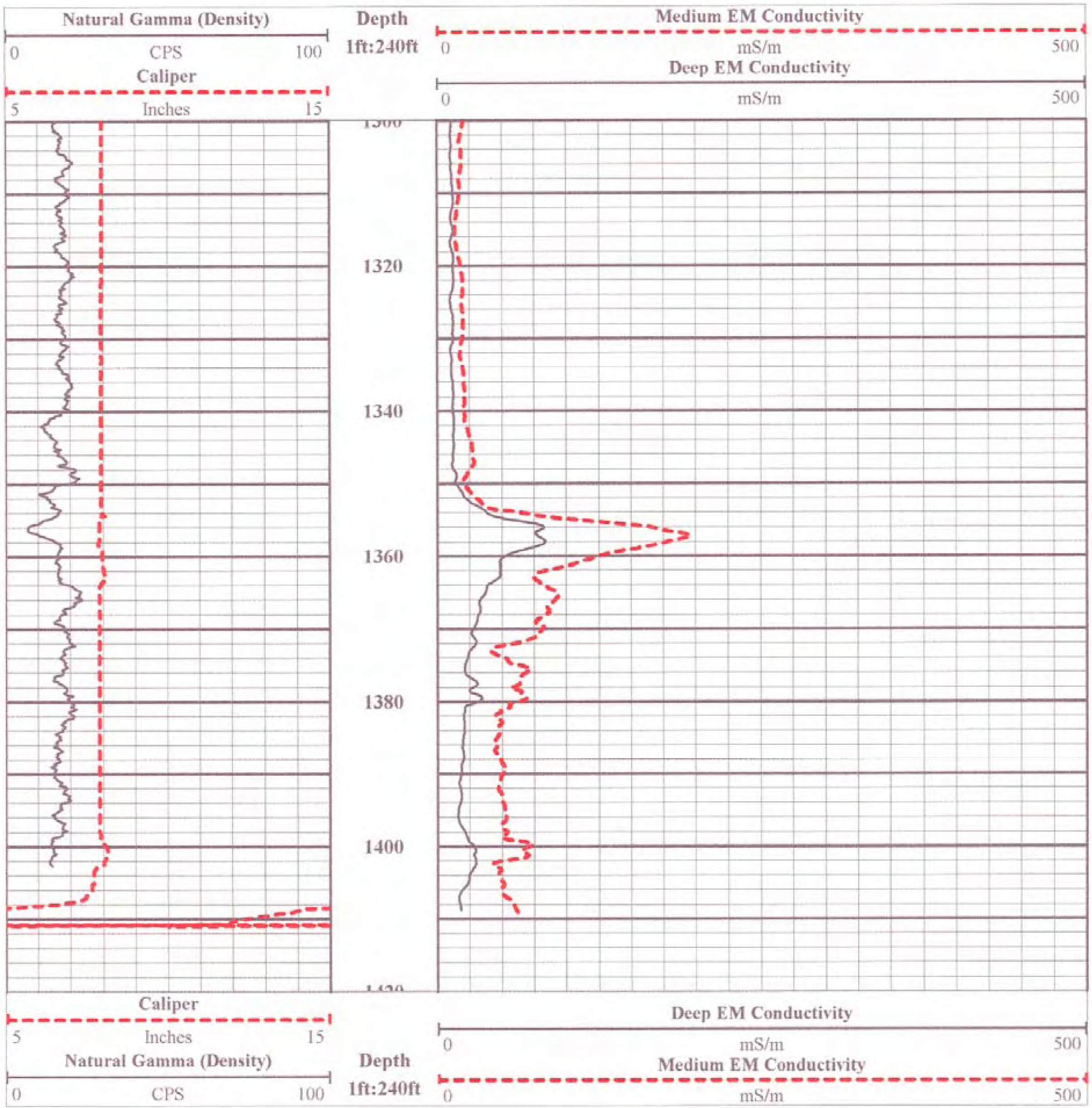



Natural Gamma (Density)
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
540
560
580
600
620
640
660
680
700
720
Medium EM Conductivity
0
mS/m
500
Deep EM Conductivity
0
mS/m
500


Natural Gamma (Density)
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
740
760
780
800
820
840
860
880
900
Medium EM Conductivity
0
mS/m
500
Deep EM Conductivity
0
mS/m
500

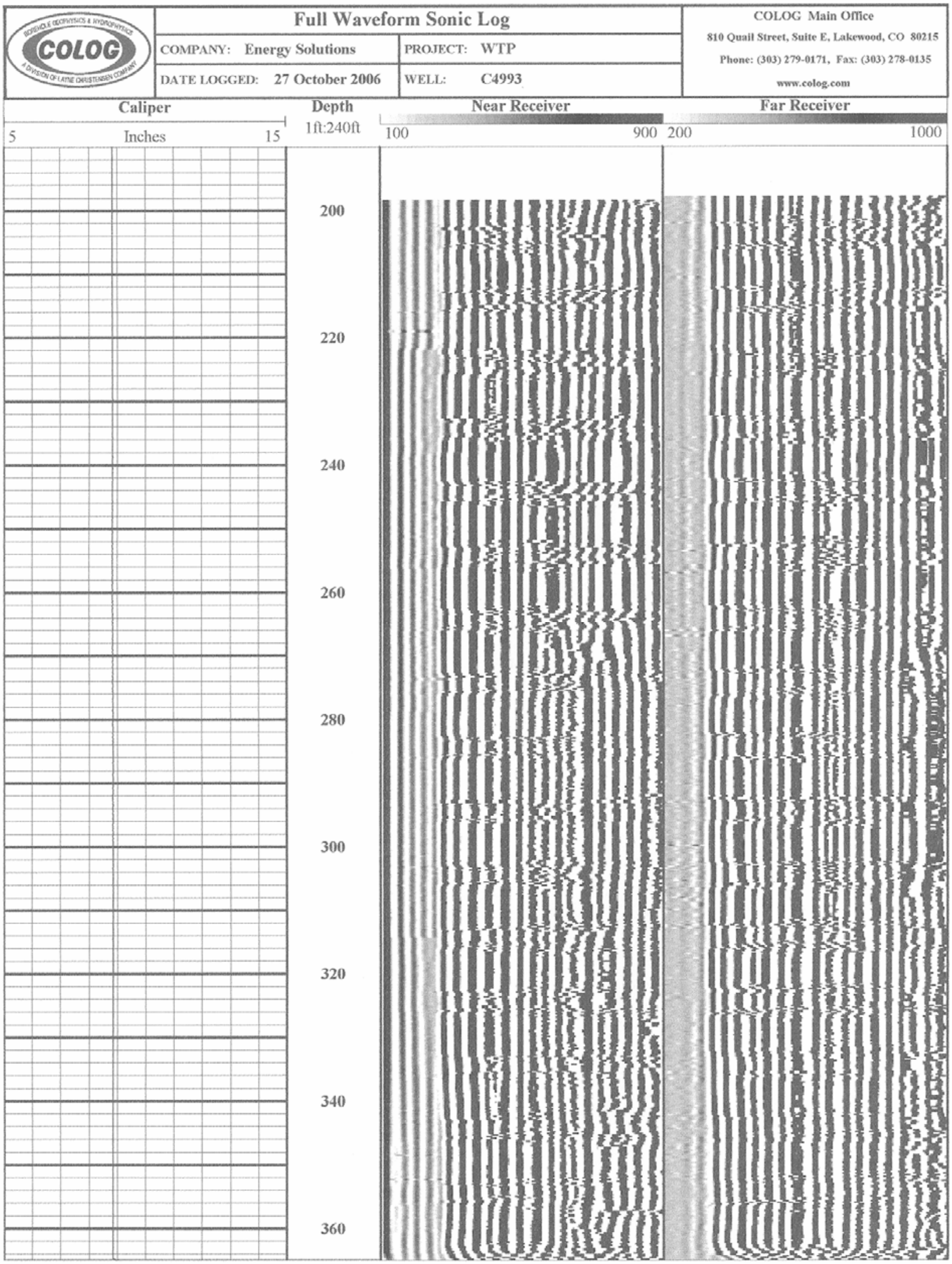

Natural Gamma (Density)
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Medium EM Conductivity
0 mS/m 500
Deep EM Conductivity
0 mS/m 500
940
960
980
1000
1020
1040
1060
1080
1100

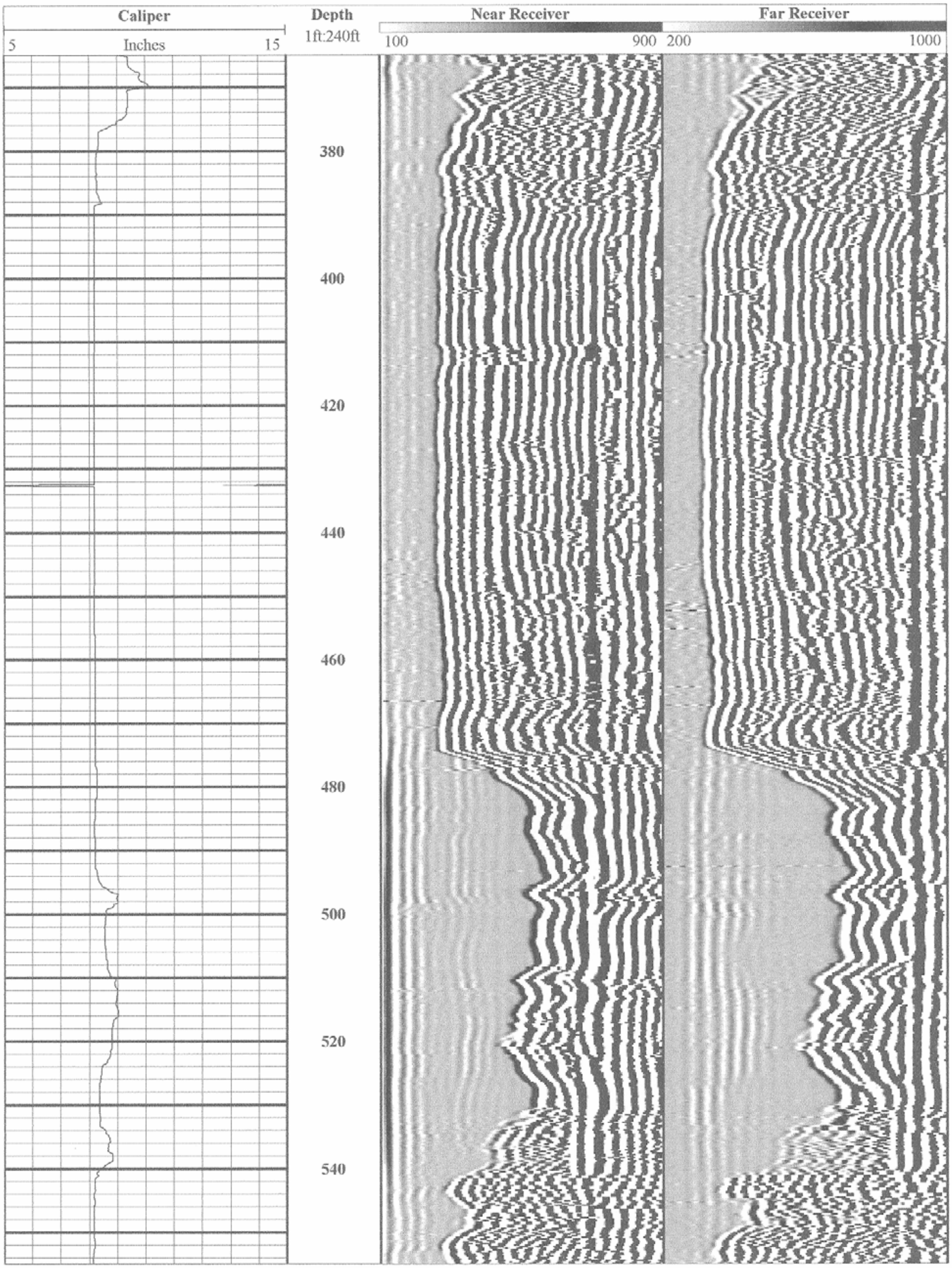

Natural Gamma (Density)
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Medium EM Conductivity
0
mS/m
500
Deep EM Conductivity
0
mS/m
500
1120
1140
1160
1180
1200
1220
1240
1260
1280

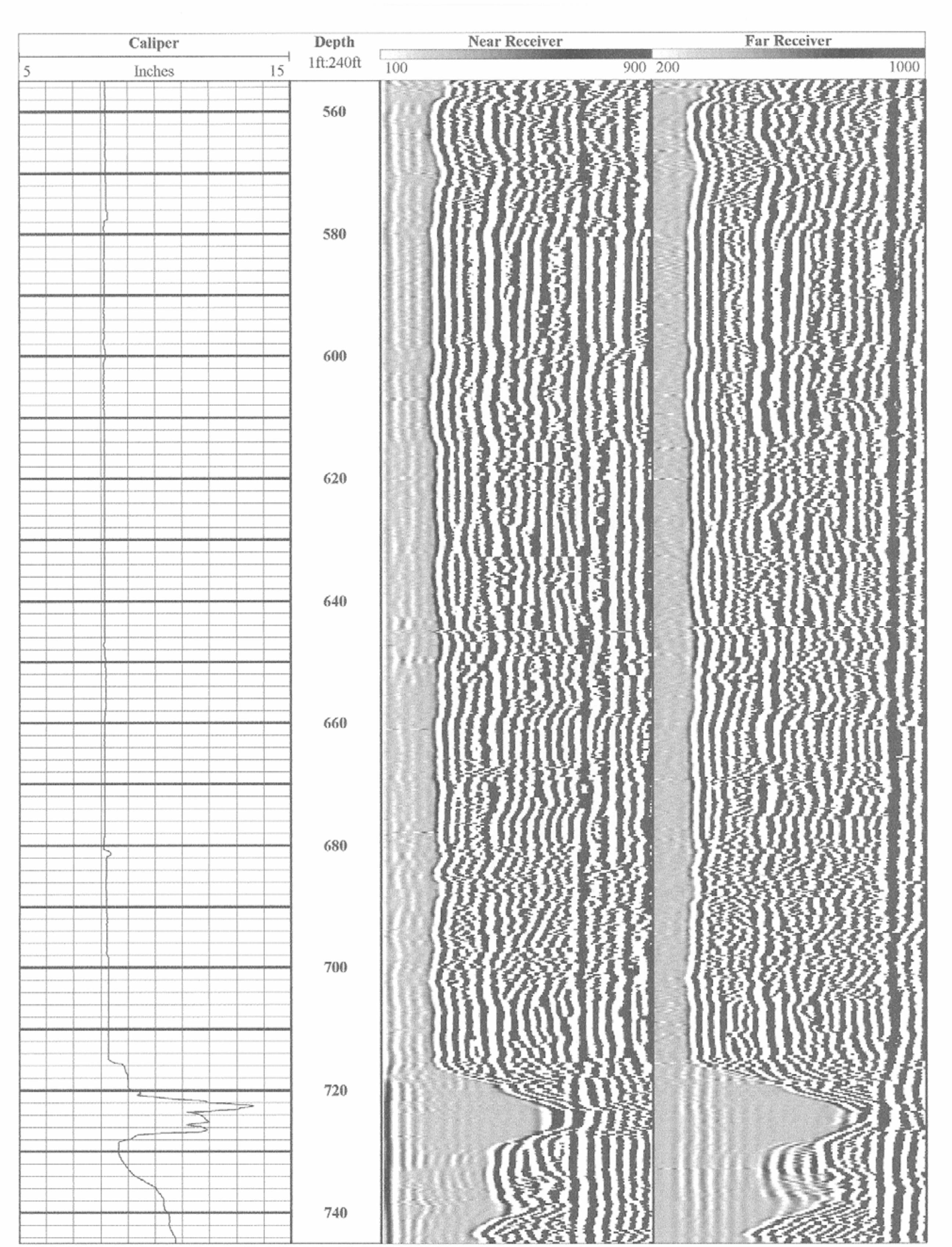


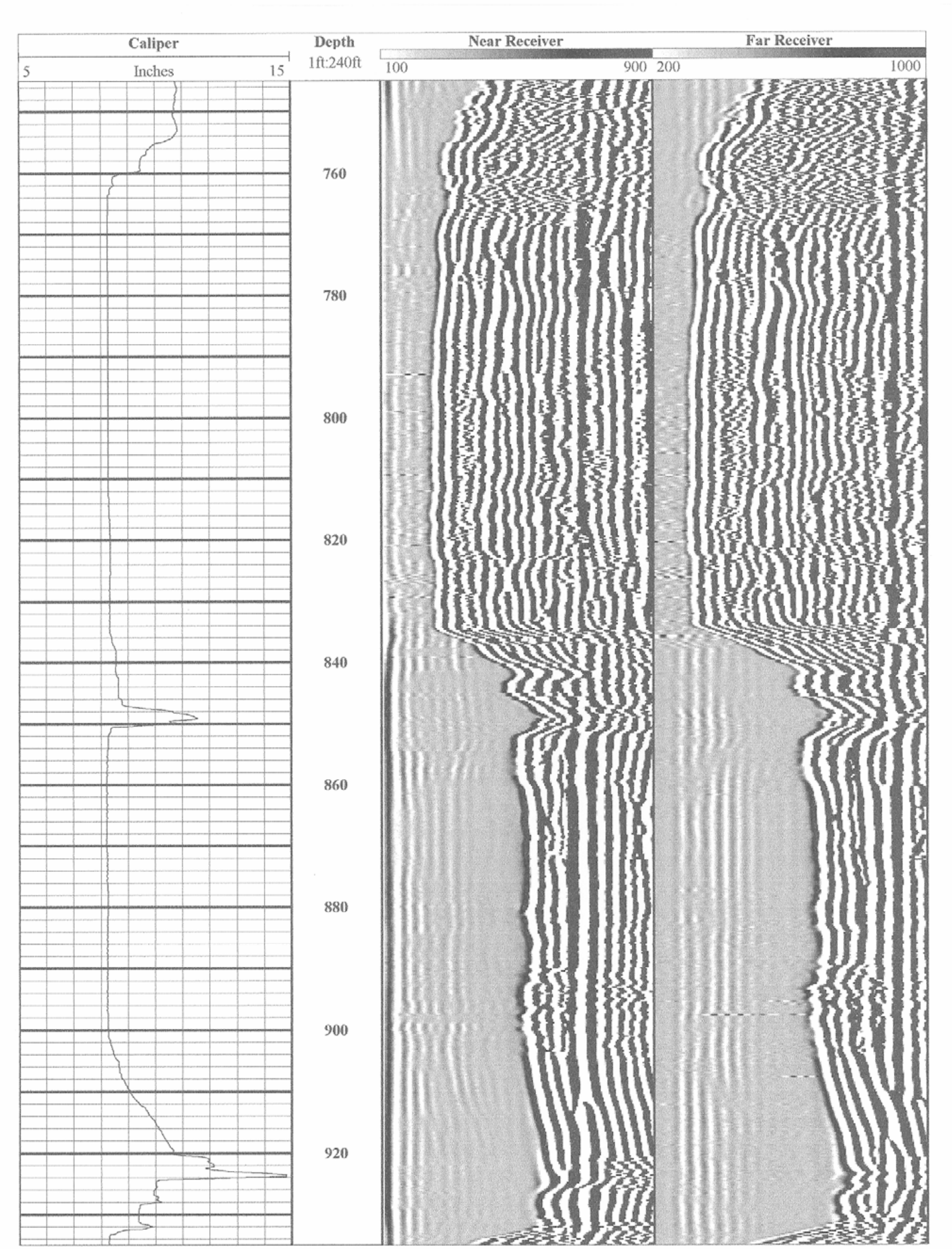
Natural Gamma (Density)
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Medium EM Conductivity
0 mS/m 500
Deep EM Conductivity
0 mS/m 500
1320
1340
1360
1380
1400
Caliper
5 Inches 15
Natural Gamma (Density)
0 CPS 100
Depth
1ft:240ft
Deep EM Conductivity
0 mS/m 500
Medium EM Conductivity
0 mS/m 500

A1.7 COLOG FULL WAVEFORM SONIC LOG

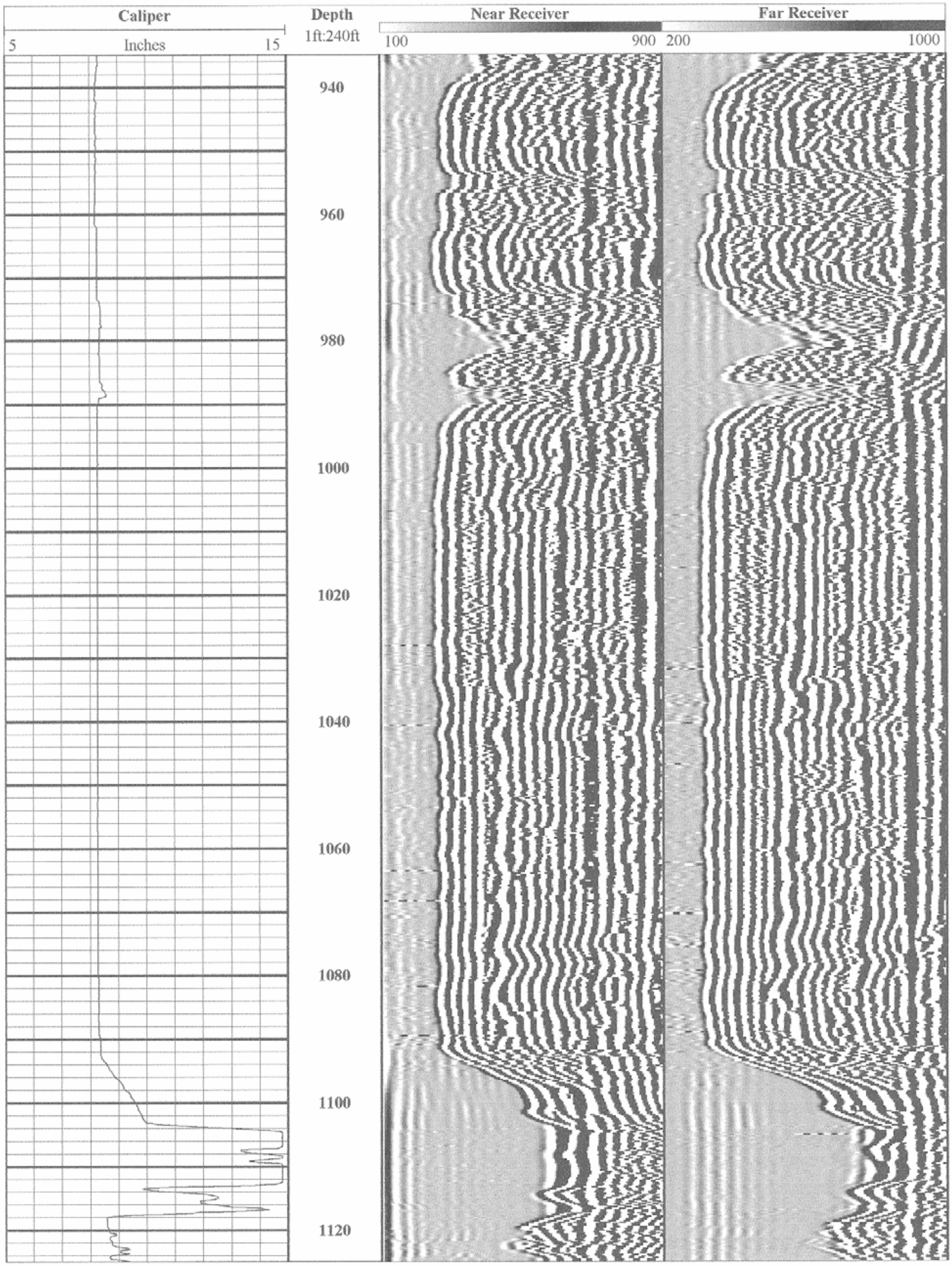



Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
380
400
420
440
460
480
500
520
540

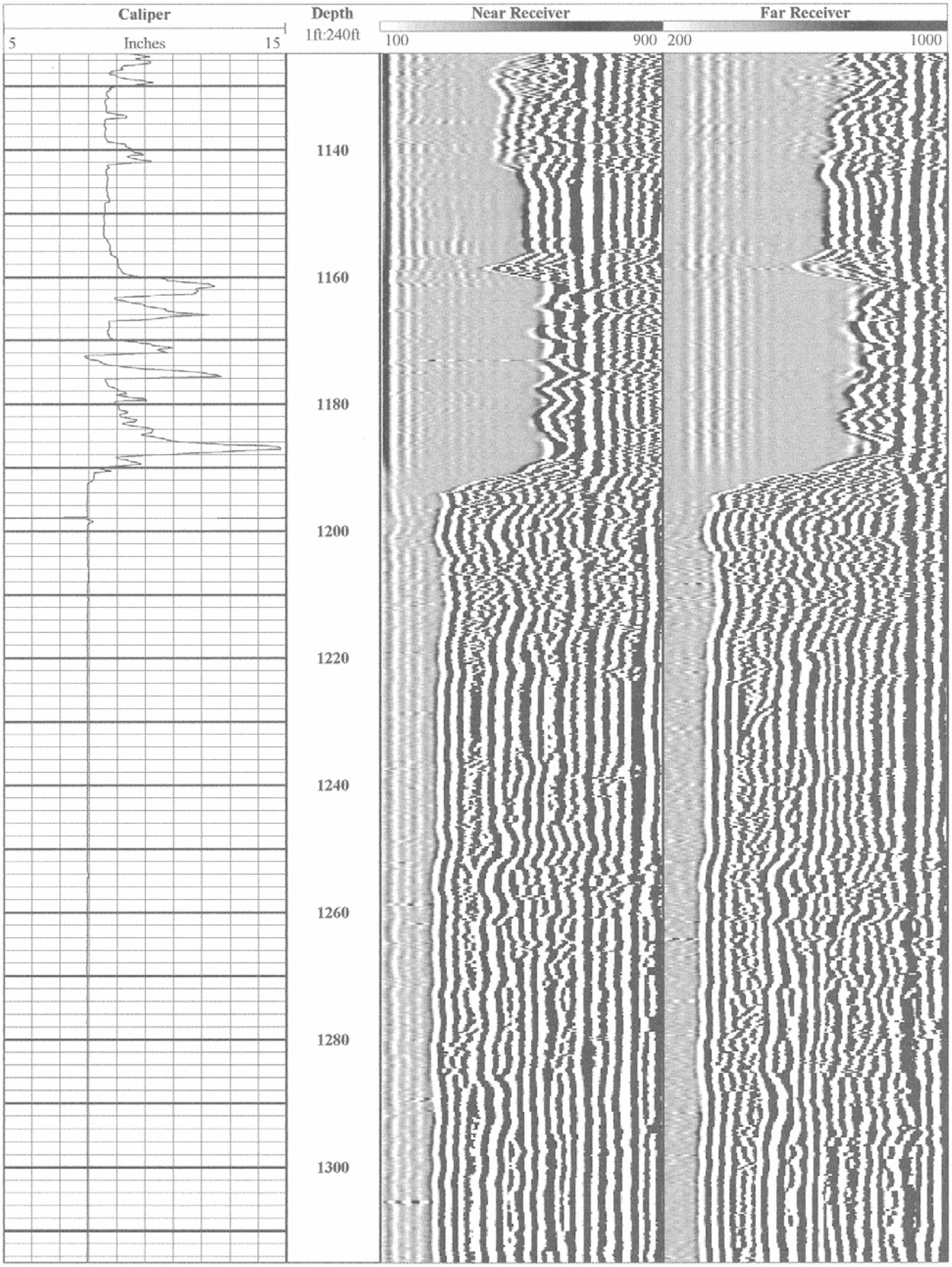

Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
560
580
600
620
640
660
680
700
720
740

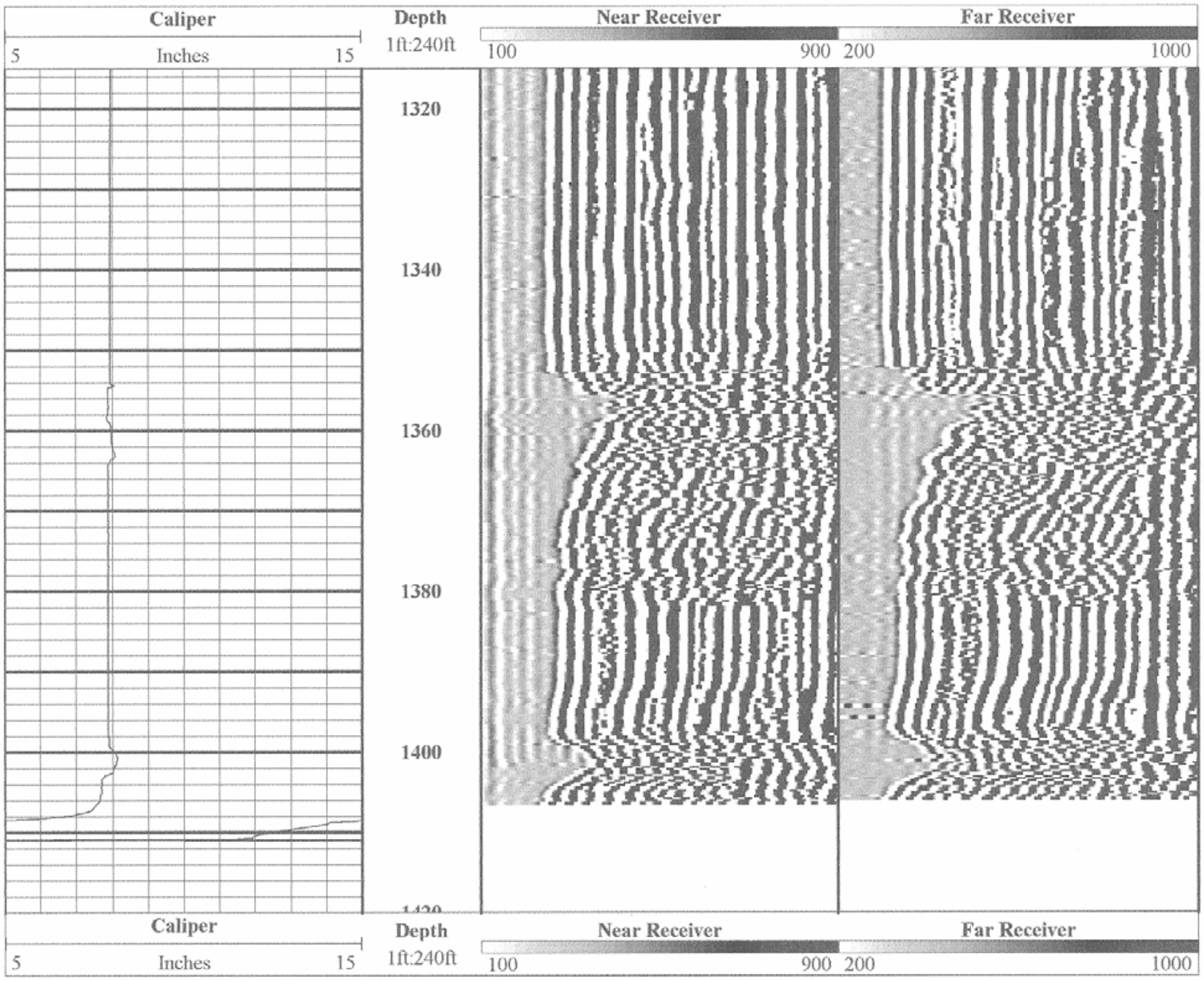


Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
760
780
800
820
840
860
880
900
920



Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
940
960
980
1000
1020
1040
1060
1080
1100
1120


Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
1140
1160
1180
1200
1220
1240
1260
1280
1300



Caliper
5 Inches 15
Depth
1ft:240ft
Near Receiver
100 900
Far Receiver
200 1000
1320
1340
1360
1380
1400
Caliper
5 Inches 15
Depth
1ft:240ft
Near Receiver
100 900
Far Receiver
200 1000

A1.8 WELLBORE NAVIGATION, INC., EARTH'S MAGNETIC FIELD SURVEY

Wellbore Navigation, Inc.
Tustin, California

Earth's Magnetic Field Survey

For

Energy Solutions

Job Number: 48-0350-312

Well Name: C4993

Location: Hanford Site

Survey Date: October 24, 2006

Survey Engineer: Dawson/Adams

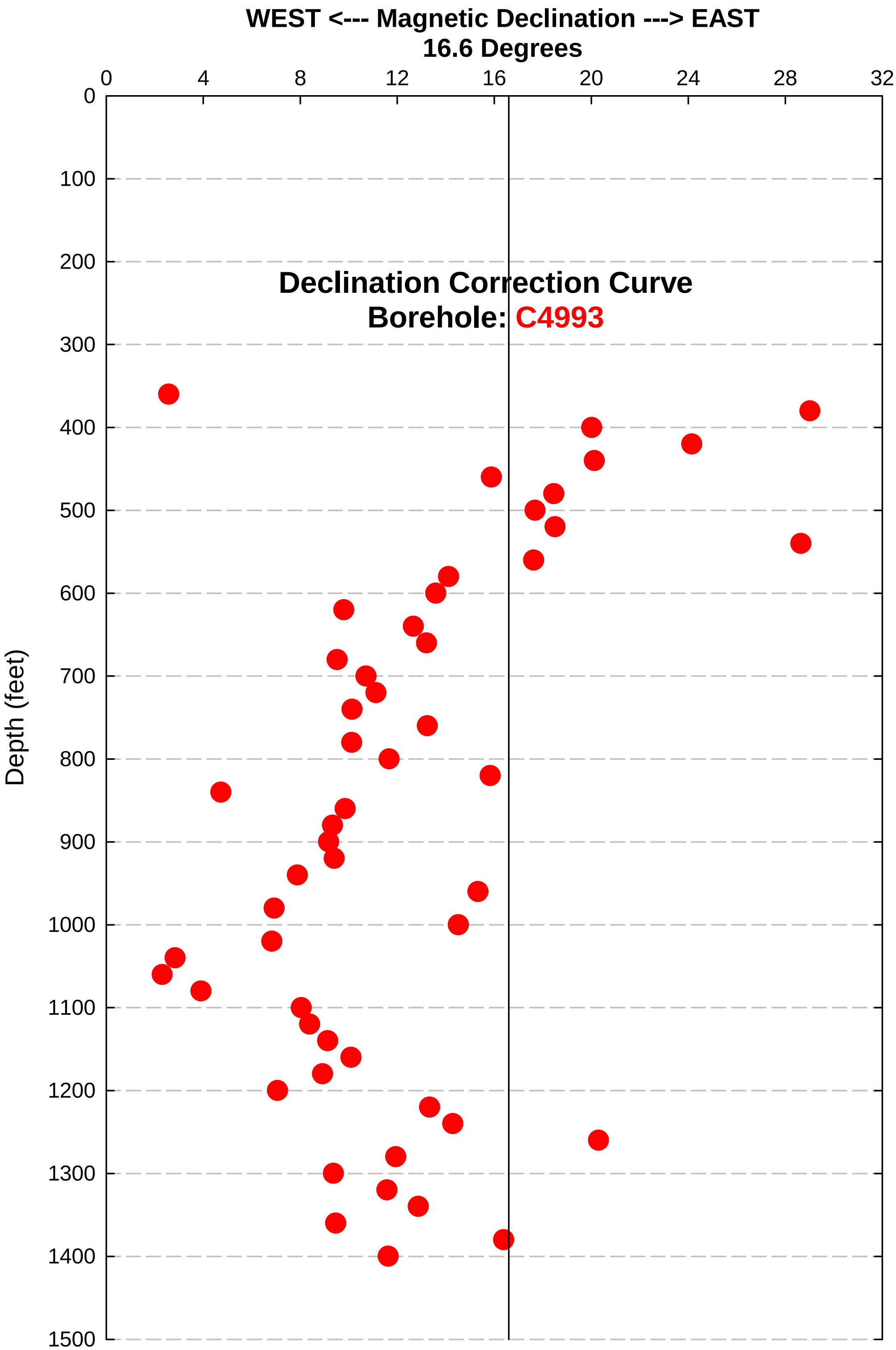
Magnetic Declination: 00.00E True North

Surface Y-Coordinate: 135756.41
Surface X-Coordinate: 576085.40
Surface Elevation: 200.63

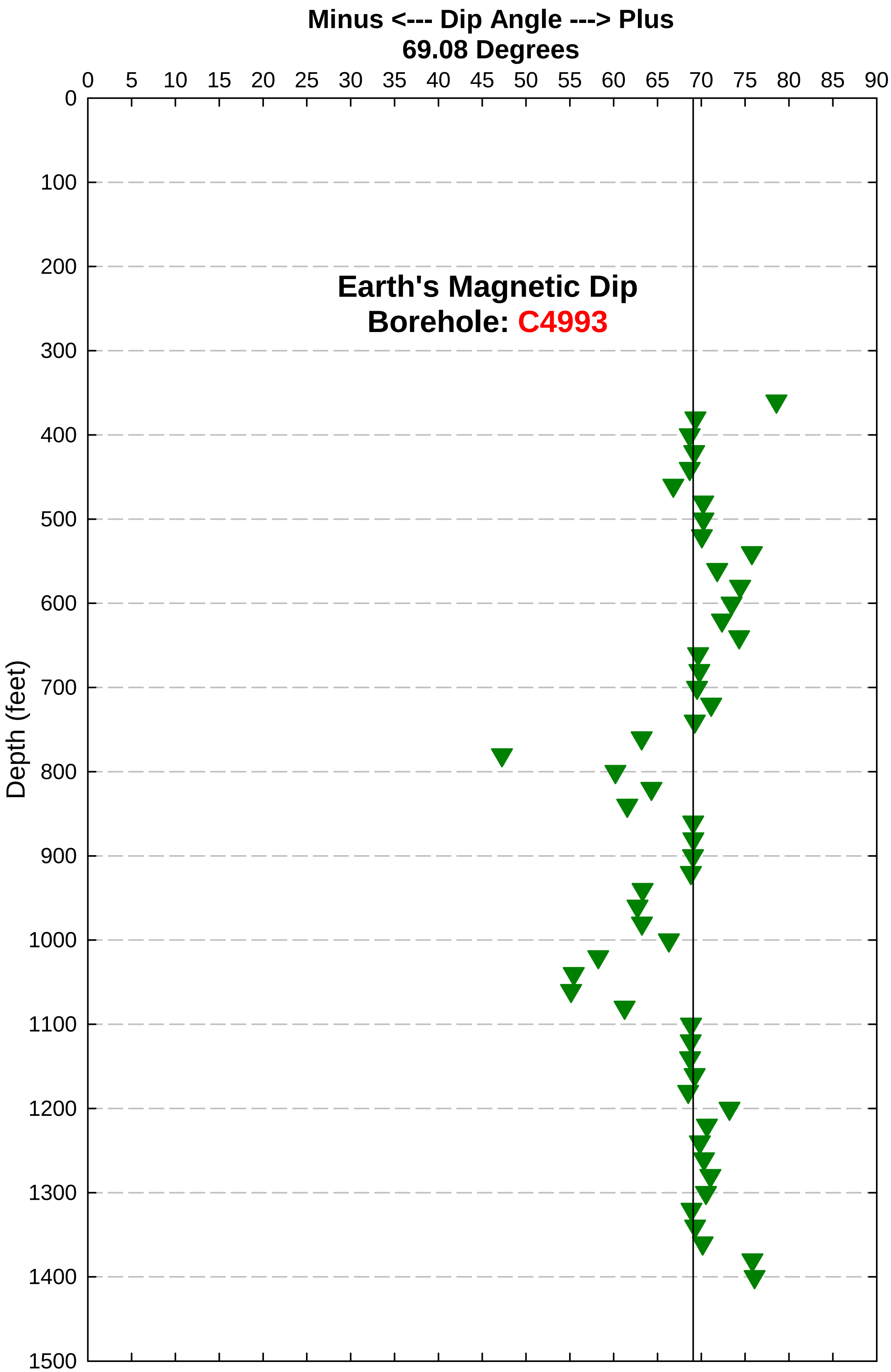
Depth Measured in FEET

Comments: Surface Casing Depth 372 ft.
USGS: Dip=69.08 Degrees
Intensity= 0.54600 Oerstads
Declination= 16.60 Degrees

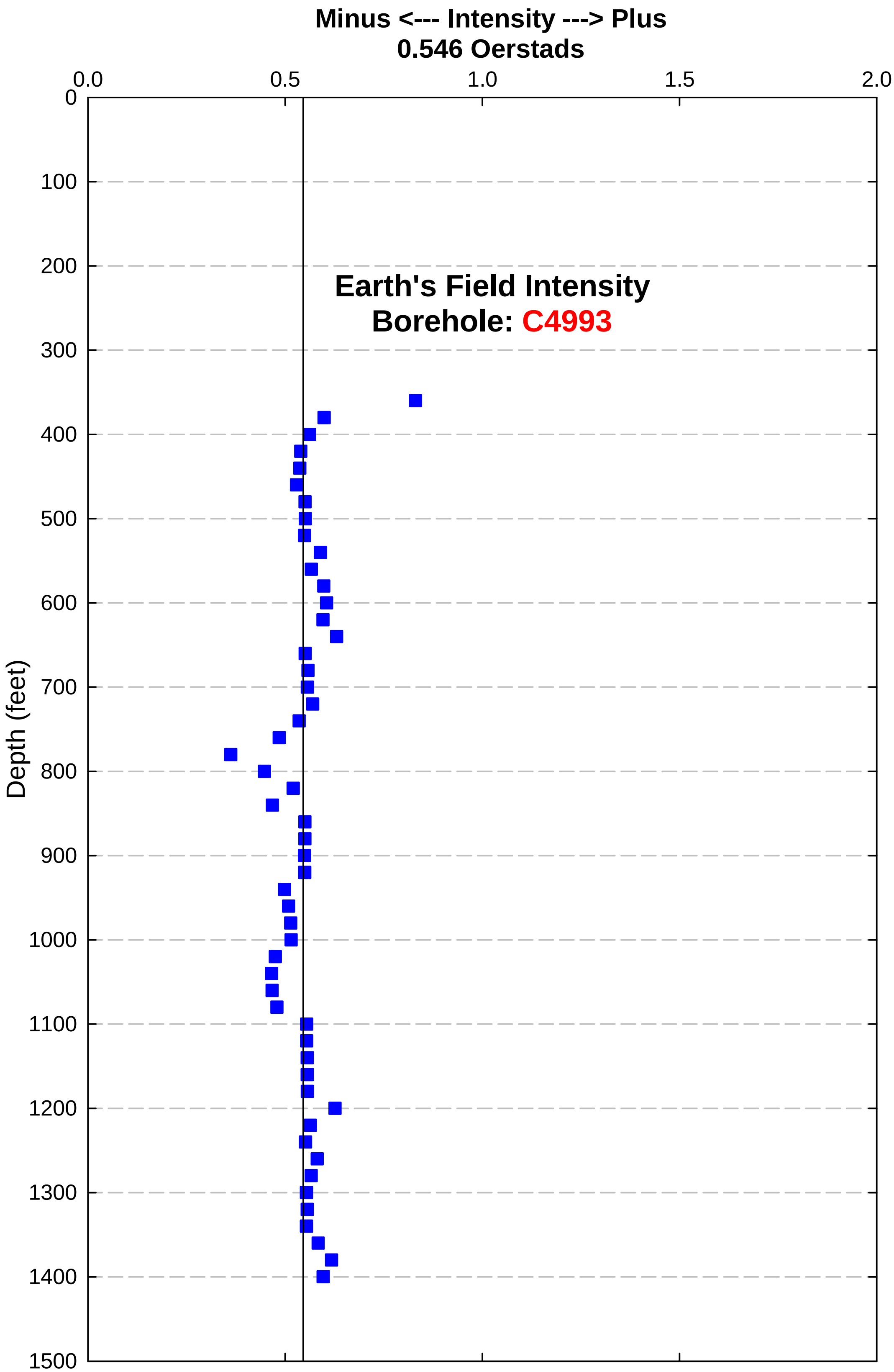
Hole ID	Measured Depth	Magnetic Declination	Magnetic Intensity	Magnetic Dip	HFS	X-HFS	Y-HFS	Z-HFS
C4993	360	2.574844	0.83065	78.57	0.16461	0.0074	0.16444	0.81418
C4993	380	29.01386	0.59893	69.33	0.21141	0.10254	0.18488	0.56038
C4993	400	20.01509	0.56175	68.68	0.20424	0.0699	0.1919	0.52331
C4993	420	24.14086	0.53992	69.18	0.19191	0.07849	0.17512	0.50466
C4993	440	20.12787	0.53727	68.67	0.19543	0.06725	0.18349	0.50047
C4993	460	15.88112	0.52887	66.81	0.20826	0.05699	0.20031	0.48614
C4993	480	18.45747	0.55066	70.2	0.18653	0.05906	0.17693	0.51811
C4993	500	17.67757	0.55126	70.25	0.18628	0.05657	0.17748	0.51883
C4993	520	18.50511	0.54959	70.06	0.18743	0.05949	0.17774	0.51664
C4993	540	28.64401	0.58986	75.77	0.145	0.06951	0.12725	0.57176
C4993	560	17.62399	0.56664	71.81	0.17689	0.05356	0.16859	0.53832
C4993	580	14.11453	0.59806	74.42	0.16063	0.03917	0.15578	0.57609
C4993	600	13.59198	0.60536	73.45	0.17244	0.04052	0.16761	0.58028
C4993	620	9.797577	0.59618	72.35	0.18076	0.03076	0.17813	0.56812
C4993	640	12.66144	0.63068	74.32	0.17045	0.03736	0.16631	0.60721
C4993	660	13.20889	0.55105	69.64	0.19172	0.04381	0.18665	0.51662
C4993	680	9.519836	0.55824	69.78	0.19294	0.03191	0.19029	0.52384
C4993	700	10.70804	0.55652	69.5	0.1949	0.03621	0.1915	0.52128
C4993	720	11.11749	0.56963	71.12	0.18432	0.03554	0.18087	0.53898
C4993	740	10.13504	0.53593	69.26	0.18979	0.0334	0.18683	0.5012
C4993	760	13.23935	0.48509	63.19	0.21879	0.05011	0.21298	0.43295
C4993	780	10.12079	0.36219	47.26	0.24581	0.04319	0.24198	0.26601
C4993	800	11.66327	0.44787	60.2	0.22258	0.045	0.21798	0.38865
C4993	820	15.82974	0.52062	64.31	0.22569	0.06156	0.21713	0.46916
C4993	840	4.724335	0.46765	61.55	0.22278	0.01835	0.22203	0.41117
C4993	860	9.855774	0.55031	69.08	0.1965	0.03363	0.1936	0.51403
C4993	880	9.326294	0.55021	69.09	0.19637	0.03182	0.19377	0.51397
C4993	900	9.166382	0.54959	69.05	0.19651	0.0313	0.194	0.51326
C4993	920	9.400784	0.54962	68.8	0.19876	0.03246	0.19609	0.51242
C4993	940	7.878433	0.49844	63.3	0.22396	0.0307	0.22184	0.44529
C4993	960	15.32608	0.50888	62.73	0.23316	0.06163	0.22487	0.45232
C4993	980	6.921921	0.51423	63.22	0.23169	0.02792	0.23001	0.45908
C4993	1000	14.51632	0.51534	66.31	0.20706	0.0519	0.20045	0.47191
C4993	1020	6.828202	0.47544	58.23	0.25032	0.02976	0.24855	0.4042
C4993	1040	2.836022	0.46574	55.45	0.26413	0.01307	0.26381	0.3836
C4993	1060	2.307987	0.46698	55.14	0.26691	0.01075	0.2667	0.38318
C4993	1080	3.908508	0.47944	61.24	0.23068	0.01572	0.23014	0.4203
C4993	1100	8.04048	0.55472	68.83	0.20033	0.02802	0.19836	0.51728
C4993	1120	8.388569	0.55446	68.79	0.2006	0.02926	0.19845	0.5169
C4993	1140	9.129448	0.55605	68.71	0.2019	0.03203	0.19934	0.5181
C4993	1160	10.09096	0.55617	69.23	0.19723	0.03456	0.19418	0.52003
C4993	1180	8.921036	0.55677	68.49	0.20415	0.03166	0.20168	0.51799
C4993	1200	7.065529	0.62664	73.21	0.18101	0.02227	0.17964	0.59993
C4993	1220	13.33696	0.56405	70.64	0.18698	0.04313	0.18194	0.53216
C4993	1240	14.28964	0.55164	69.83	0.19021	0.04695	0.18432	0.51781
C4993	1260	20.29974	0.58131	70.29	0.19605	0.06802	0.18388	0.54725
C4993	1280	11.93675	0.56603	71.03	0.184	0.03806	0.18002	0.53529
C4993	1300	9.363754	0.55402	70.54	0.18457	0.03003	0.18211	0.52237
C4993	1320	11.57204	0.5562	68.88	0.20041	0.0402	0.19634	0.51884
C4993	1340	12.86716	0.55425	69.29	0.196	0.04365	0.19108	0.51844
C4993	1360	9.464157	0.58397	70.16	0.1982	0.03259	0.1955	0.54931
C4993	1380	16.38838	0.61768	75.83	0.15121	0.04266	0.14506	0.59889
C4993	1400	11.62325	0.59671	76.07	0.14365	0.02894	0.1407	0.57916



WEST <--- Magnetic Declination ---> EAST
16.6 Degrees
Declination Correction Curve
Borehole: C4993
Depth (feet)
0
4
8
12
16
20
24
28
32
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500



Minus <--- Dip Angle ---> Plus
69.08 Degrees
Earth's Magnetic Dip
Borehole: C4993
Depth (feet)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500


Minus <--- Intensity ---> Plus
0.546 Oerstads
0.0
0.5
1.0
1.5
2.0
Earth's Field Intensity
Borehole: C4993
Depth (feet)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500

APPENDIX B

BOREHOLE C4996

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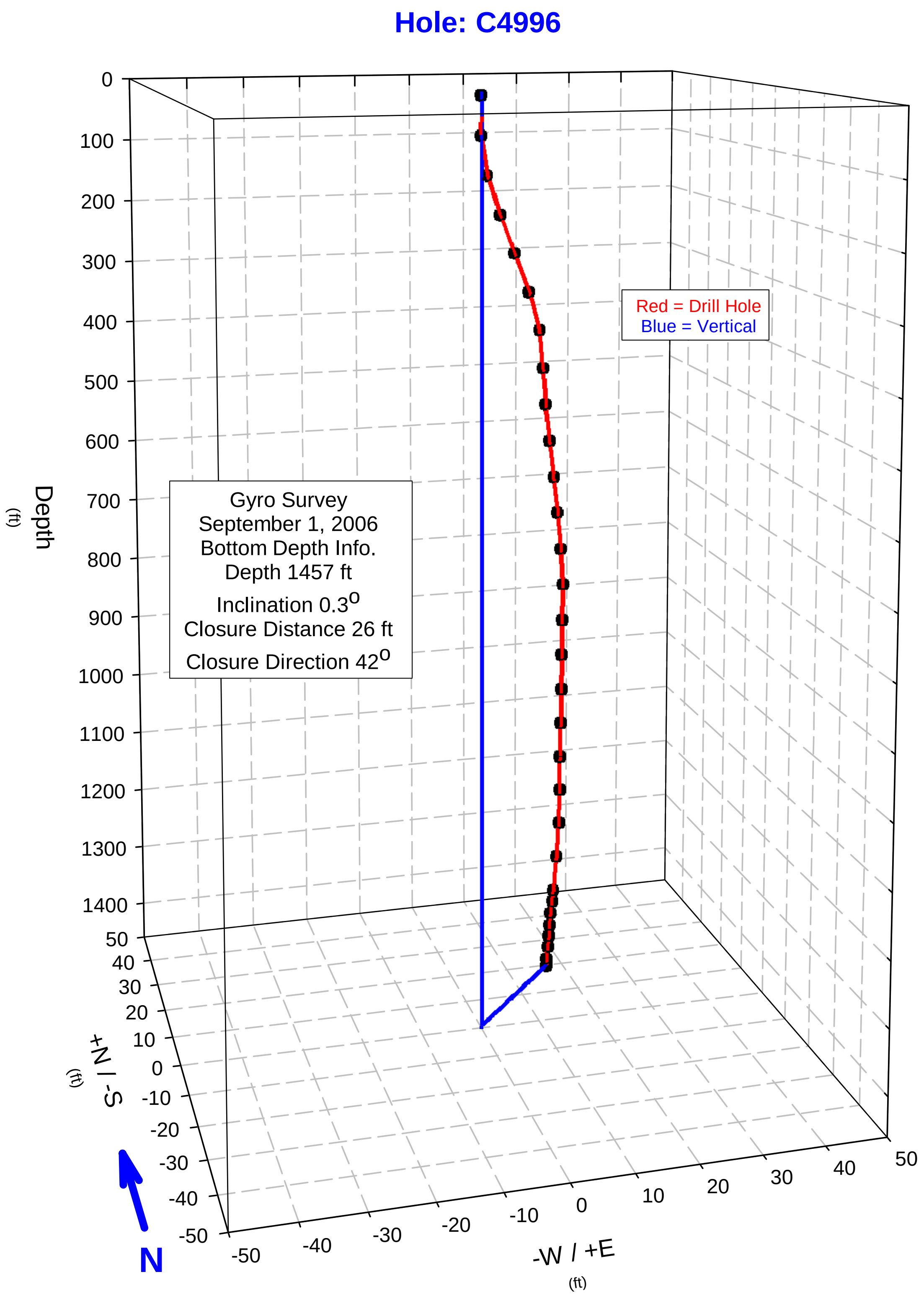
B1.0 BOREHOLE C4996

B1.1 ENERGY*SOLUTIONS* AND PACIFIC NORTHWEST GEOPHYSICS GYROSCOPIC LOGS

Hole: **C4996**

Survey Date	Survey Number	Maximum Depth (feet)	Inclination From Vertical (deg)	Closure Distance (feet)
9/1/2006	18*	1457	0.3	26
8/26/2006	17*	1356	0.8	27
8/25/2006	16*	1257	0.6	27
8/21/2006	15*	1158	1.1	25
8/20/2006	14*	1055	0.7	25
8/19/2006	13	965	1.2	21
8/16/2006	12*	861	1.0	23
8/14/2006	11	785	1.2	19
8/10/2006	10*	676	1.3	18
8/4/2006	9	576	1.7	17
8/2/2006	8	477	1.1	13
Casing	Cable-Tool			
7/26/2006	7	351	2.7	13.5
7/24/2006	6	294	2.9	9.2
7/20/2006	5	244	3.5	7.3
7/14/2006	3	94	1.1	0.7
7/13/2006	2	37	0.9	0.3

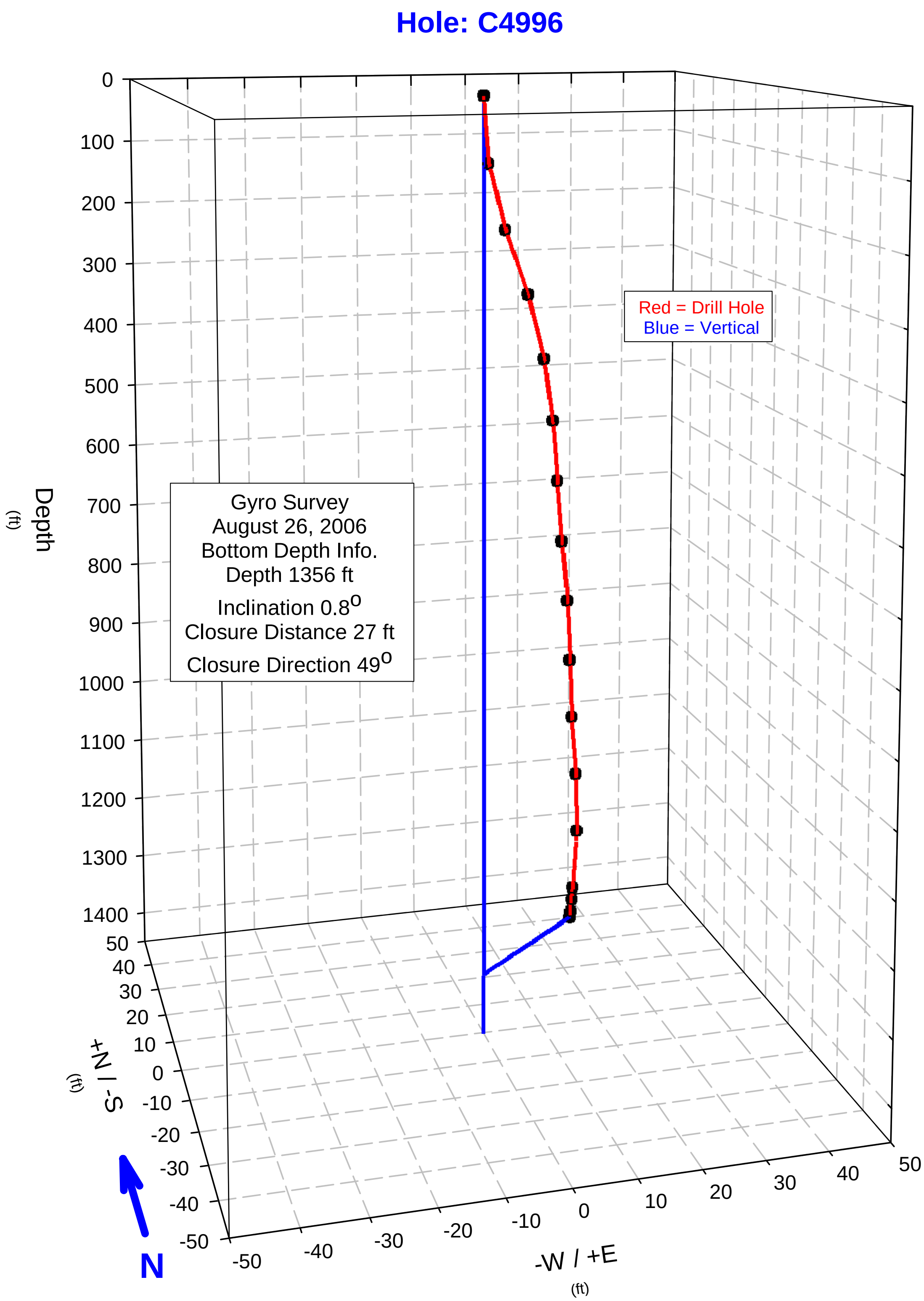
* = Gyro data includes Out-Run survey check-stations.



Hole: C4996
Red = Drill Hole
Blue = Vertical
Gyro Survey
September 1, 2006
Bottom Depth Info.
Depth 1457 ft
Inclination 0.3°
Closure Distance 26 ft
Closure Direction 42°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

Hole: **C4996** Survey Date: **9/1/2006**

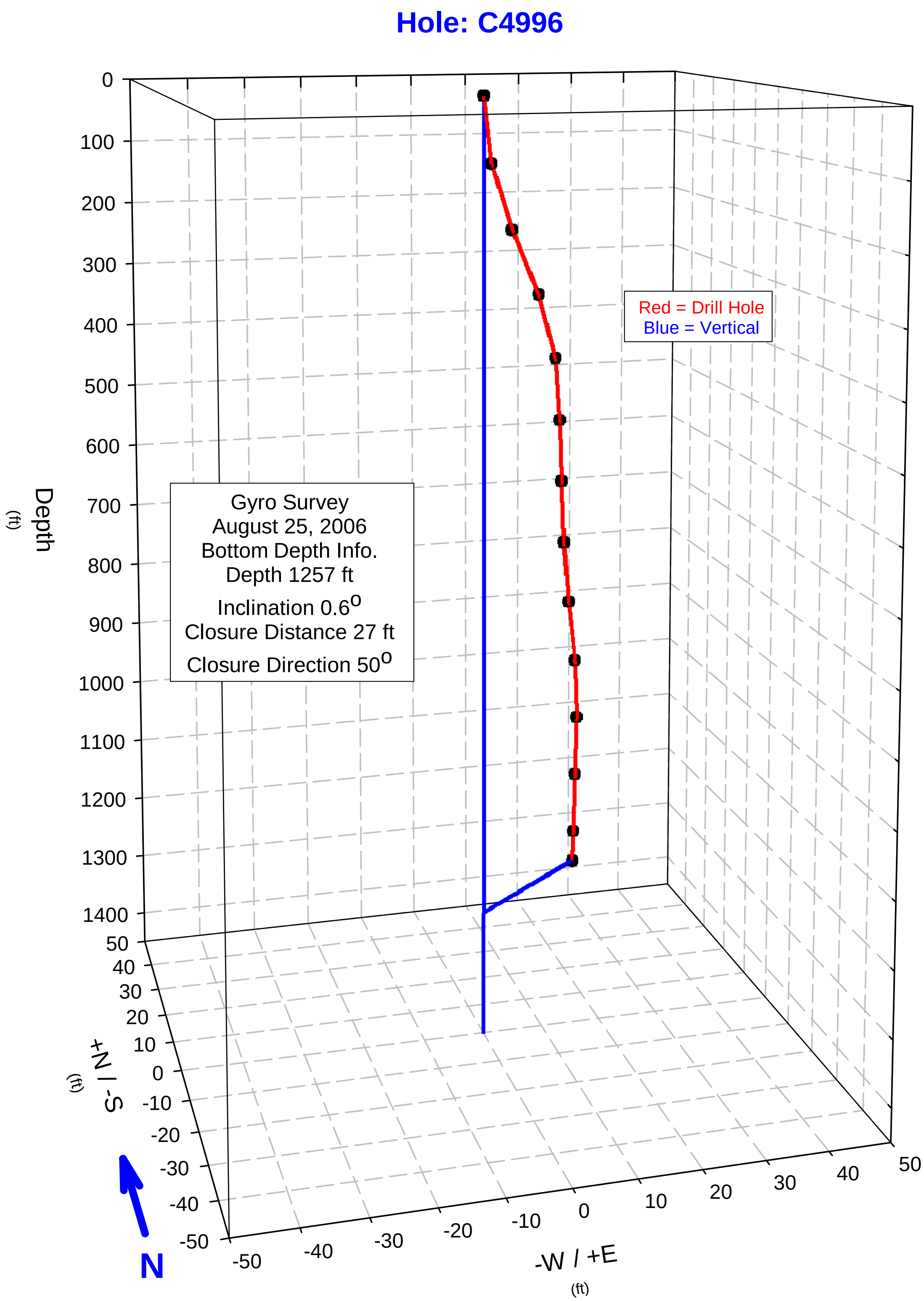
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.47	317.98	0.05	0.03	-0.03	5
65	65	0.43	357.11	0.23	0.23	-0.01	1.4
125	124.99	1.54	82.61	1.01	0.13	1	1.9
185	184.95	2.81	83.75	3.24	0.35	3.22	2.6
245	244.88	2.39	79.68	5.94	1.06	5.85	0.7
305	304.83	2.63	80.16	8.55	1.46	8.43	1
365	364.79	1.14	80.1	10.49	1.8	10.33	2.8
425	424.78	1.31	76.52	11.51	2.68	11.19	1.2
485	484.76	1.71	71.64	12.71	4	12.06	0.7
545	544.73	1.7	67.66	14.23	5.41	13.17	0.2
605	604.71	1.4	65.22	15.72	6.59	14.27	0.6
665	664.7	1.19	63.83	17.02	7.5	15.27	0.3
725	724.68	1.02	62.83	18.13	8.28	16.13	0.3
785	784.68	0.79	61.64	18.97	9.01	16.7	0.7
845	844.67	1.04	59.59	19.62	9.93	16.92	0.6
905	904.66	1.24	57.18	20.45	11.09	17.19	0.6
965	964.65	1.02	55.11	21.36	12.22	17.52	0.4
1025	1024.64	0.95	53.25	22.12	13.23	17.72	0.2
1085	1084.62	1.4	51.2	23.04	14.44	17.96	0.8
1145	1144.61	1.27	49.27	24.19	15.78	18.33	0.3
1205	1204.6	0.8	47.72	25.02	16.83	18.51	1
1265	1264.59	0.97	46.1	25.61	17.76	18.45	0.3
1325	1324.59	0.74	44.39	25.95	18.55	18.15	1
1345	1344.58	0.64	43.87	25.92	18.69	17.96	1.4
1365	1364.58	0.75	43.37	25.83	18.78	17.74	0.7
1385	1384.58	0.44	42.94	25.81	18.89	17.58	2.8
1405	1404.58	0.78	42.52	25.91	19.09	17.51	1.7
1425	1424.58	0.8	41.98	25.91	19.26	17.33	3.6
1445	1444.58	0.4	41.59	25.9	19.37	17.19	3.8
1457.5	1457.08	0.25	41.47	25.95	19.45	17.19	1.2



Hole: C4996
Red = Drill Hole
Blue = Vertical
Gyro Survey
August 26, 2006
Bottom Depth Info.
Depth 1356 ft
Inclination 0.8°
Closure Distance 27 ft
Closure Direction 49°
Depth
(ft)
+N / -S
(ft)
-W / +E
(ft)
N

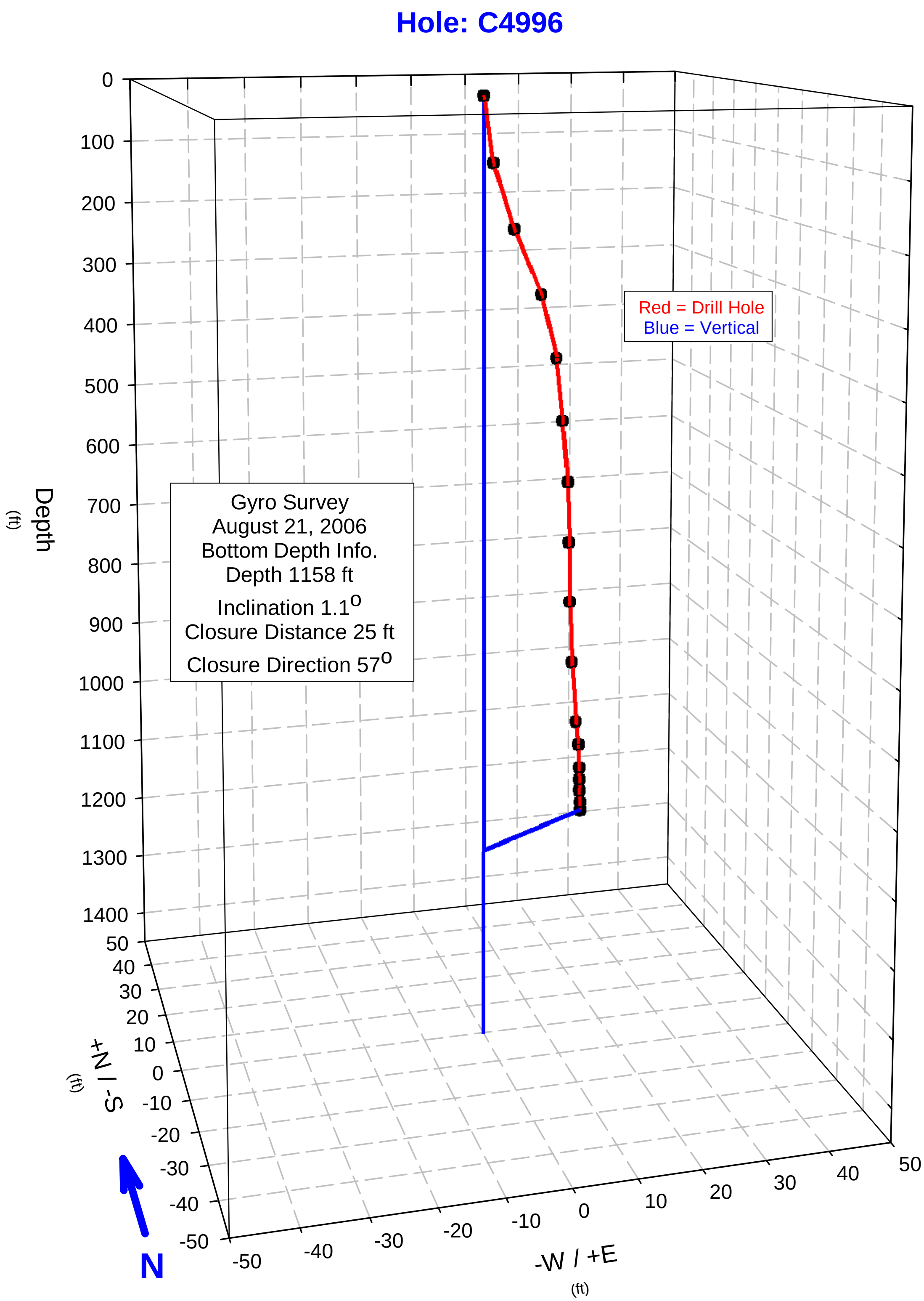
Hole: **C4996** Survey Date: **8/26/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.13	274.79	0	0	0	4.8
105	104.99	1.03	85.1	0.84	0.07	0.84	1.1
205	204.94	2.51	77.5	3.92	0.85	3.83	1.5
305	304.86	2.32	77.03	8.12	1.82	7.92	0.3
405	404.8	1.37	76.16	11.32	2.71	10.99	1
505	504.77	1.75	71.35	13.77	4.4	13.04	0.8
605	604.73	1.53	64.97	16.07	6.8	14.56	0.5
705	704.7	1.38	61.08	18.26	8.83	15.98	0.6
805	804.68	0.9	59.88	20.2	10.14	17.48	0.5
905	904.66	1.1	57.84	21.7	11.55	18.37	0.6
1005	1004.64	1.46	54.97	23.6	13.55	19.33	0.5
1105	1104.62	0.92	53.79	25.58	15.11	20.64	0.7
1205	1204.6	0.99	52.26	26.93	16.48	21.3	0.8
1305	1304.59	0.62	49.75	27.41	17.71	20.92	0.8
1325	1324.59	0.47	49.37	27.36	17.82	20.76	1.1
1345	1344.59	0.22	49.14	27.31	17.87	20.65	1.3
1356	1355.59	0.82	48.93	27.3	17.94	20.58	5.7


Hole: C4996
Red = Drill Hole
Blue = Vertical
Gyro Survey
August 25, 2006
Bottom Depth Info.
Depth 1257 ft
Inclination 0.6°
Closure Distance 27 ft
Closure Direction 50°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

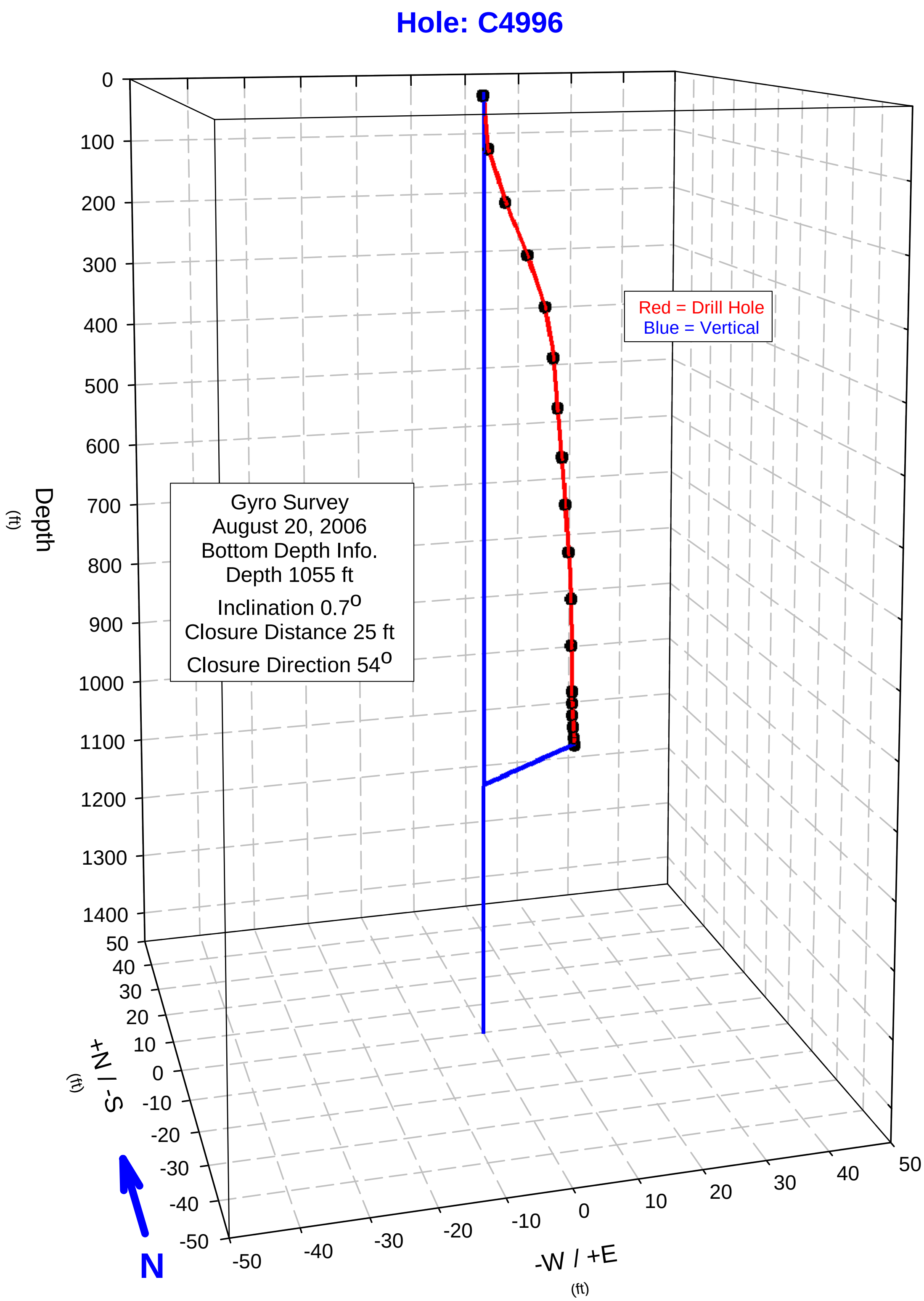
Hole: **C4996** Survey Date: **8/25/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
5	5	0.23	147.76	0.01	-0.01	0	7.8
105	104.99	1.49	111.07	1.27	-0.46	1.19	1.6
205	204.92	2.69	91.09	4.71	-0.09	4.71	1.5
305	304.8	3.06	82.91	9.63	1.19	9.56	0.4
405	404.72	1.51	77.54	13.27	2.86	12.96	2.1
505	504.69	1.31	71.16	15.15	4.89	14.34	0.3
605	604.66	1.3	65.67	16.84	6.94	15.35	0.2
705	704.65	0.67	62.63	18.26	8.39	16.21	0.7
805	804.63	1.34	61.42	19.97	9.55	17.53	0.7
905	904.6	1.56	59.29	22.35	11.41	19.21	0.4
1005	1004.57	1.18	56.23	24.33	13.53	20.23	0.7
1105	1104.56	0.96	53.24	25.67	15.37	20.57	0.2
1205	1204.55	0.54	51.21	26.6	16.66	20.73	0.4
1257	1256.54	0.58	50.34	26.9	17.17	20.71	0.3


Hole: C4996
Red = Drill Hole
Blue = Vertical
Gyro Survey
August 21, 2006
Bottom Depth Info.
Depth 1158 ft
Inclination 1.1°
Closure Distance 25 ft
Closure Direction 57°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

Hole: **C4996** Survey Date: **8/21/2006**

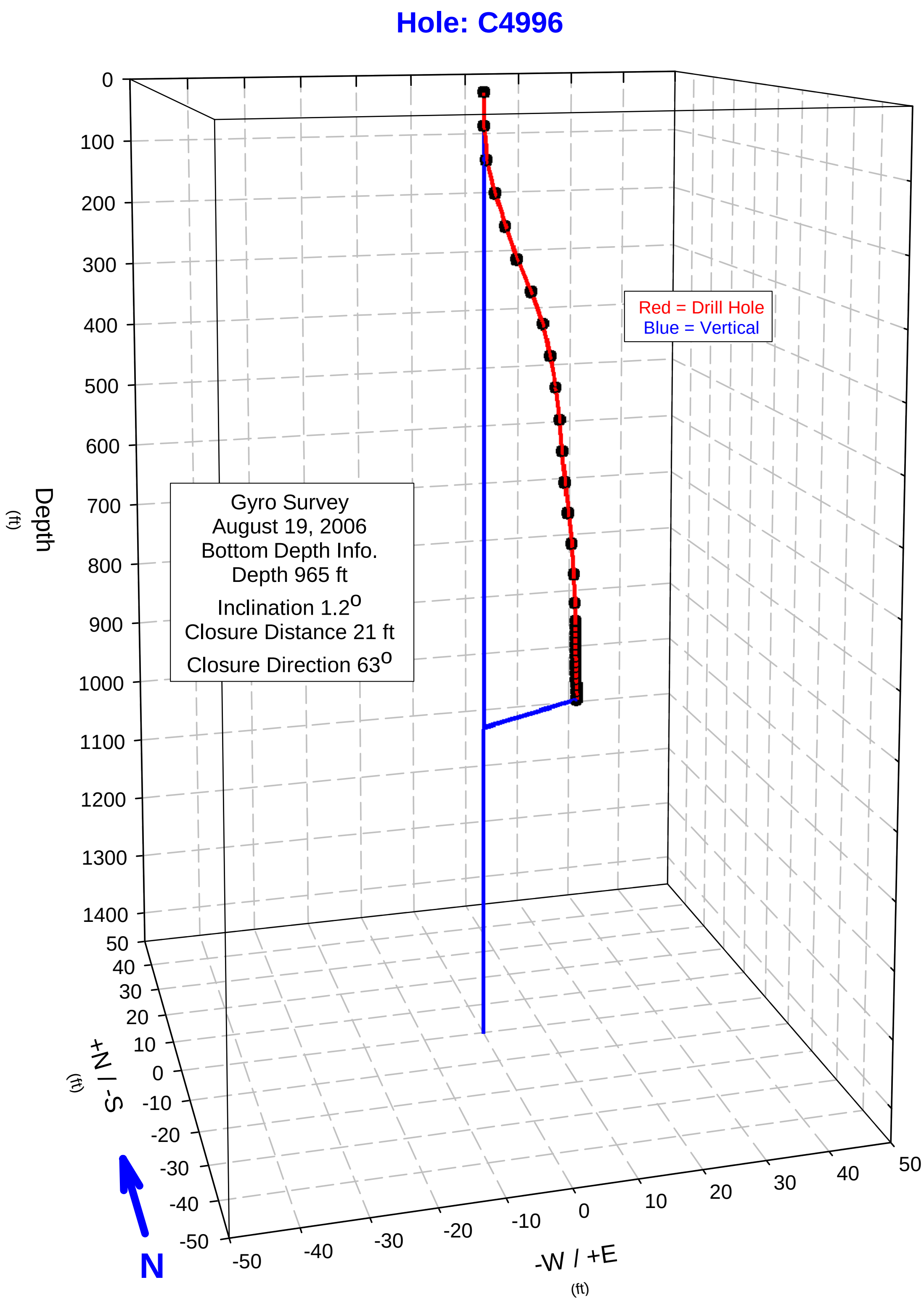
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
4	4	0.65	64.65	0.05	0.02	0.04	11.1
104	103.98	1.42	71.69	1.77	0.55	1.68	1
204	203.92	2.71	81.77	5.33	0.76	5.27	1.3
304	303.81	2.59	85.22	9.93	0.83	9.9	0.1
404	403.76	1.3	82.24	12.92	1.75	12.81	2.1
504	503.73	1.58	75.93	14.9	3.62	14.45	0.4
604	603.69	1.55	70.25	17.07	5.77	16.07	0.5
704	703.67	0.86	65.63	18.6	7.68	16.95	0.7
804	803.65	0.94	62.55	19.78	9.12	17.55	0.1
904	903.65	0.63	60.78	20.97	10.24	18.31	0.4
1004	1003.63	1.12	59.92	22.46	11.26	19.44	0.5
1044	1043.63	0.81	59.53	23.12	11.72	19.92	0.8
1084	1083.62	0.86	58.98	23.65	12.19	20.27	0.4
1104	1103.62	1.26	58.49	23.96	12.52	20.43	2.2
1124	1123.62	0.69	57.97	24.22	12.85	20.53	3
1144	1143.62	0.97	57.72	24.47	13.07	20.69	3.1
1158	1157.61	1.1	57.46	24.68	13.27	20.81	5.3



Hole: C4996
Red = Drill Hole
Blue = Vertical
Gyro Survey
August 20, 2006
Bottom Depth Info.
Depth 1055 ft
Inclination 0.7°
Closure Distance 25 ft
Closure Direction 54°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

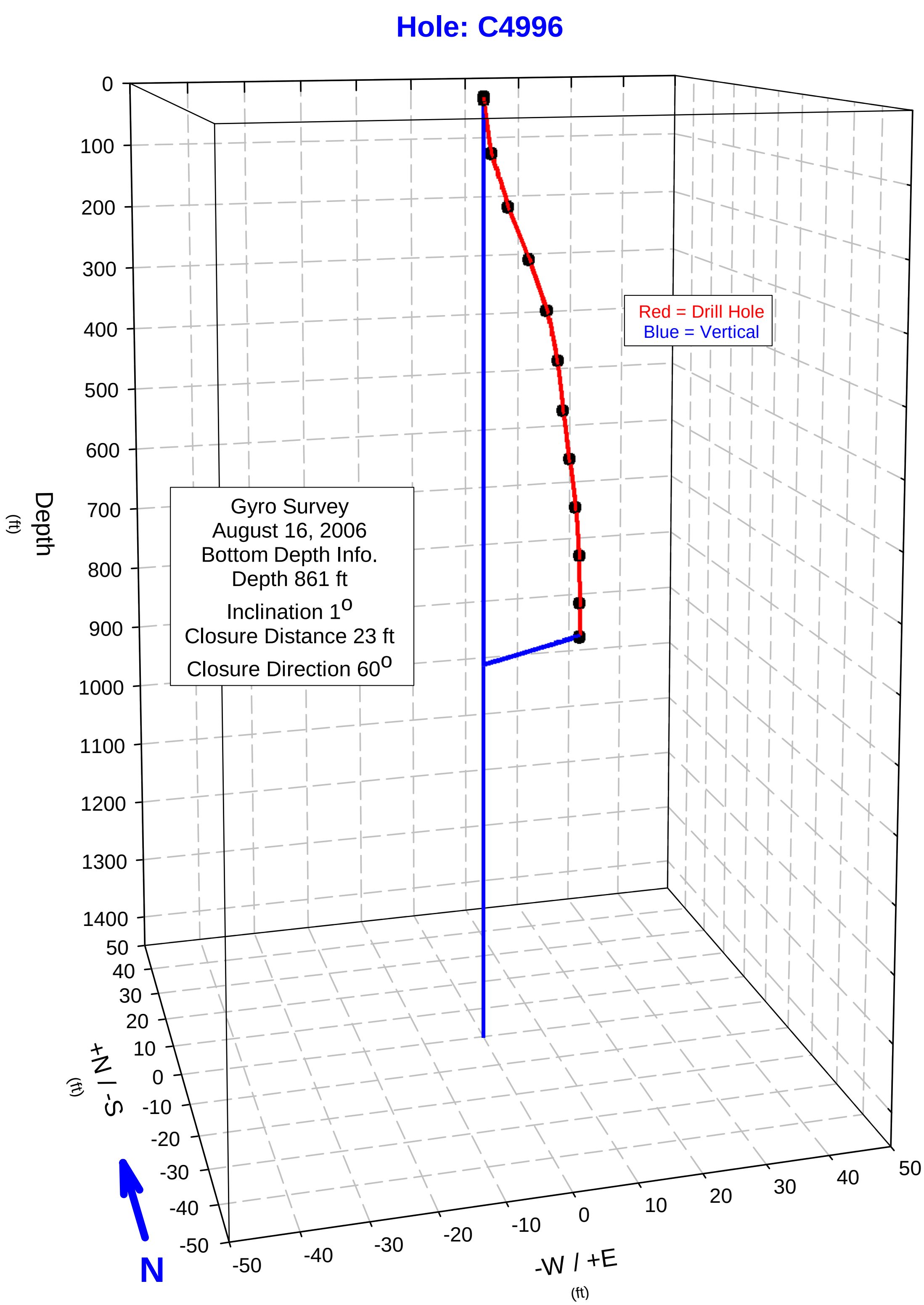
Hole: **C4996** Survey Date: **8/20/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
4	4	0.47	320.99	0.02	0.02	-0.01	10.4
84	83.99	1.5	82.08	0.76	0.1	0.75	2.4
164	163.94	2.65	88.67	3.65	0.08	3.65	1.5
244	243.85	2.6	87.78	7.31	0.28	7.31	0.1
324	323.79	1.99	85.88	10.49	0.75	10.46	0.9
404	403.76	1.29	81.49	12.44	1.84	12.3	1.7
484	483.74	1.53	75.57	13.86	3.45	13.42	0.3
564	563.7	1.68	70.29	15.64	5.27	14.73	0.2
644	643.67	1.53	65.98	17.51	7.13	15.99	0.2
724	723.65	1.39	62.68	19.25	8.84	17.1	0.2
804	803.62	1.53	59.64	20.99	10.61	18.11	0.2
884	883.6	1.23	56.57	22.5	12.4	18.78	0.6
964	963.58	0.94	54.5	23.74	13.79	19.32	0.6
984	983.58	0.92	54.17	24.03	14.07	19.48	0.7
1004	1003.58	0.73	53.89	24.29	14.32	19.63	1.2
1024	1023.58	0.86	53.76	24.56	14.52	19.81	1
1044	1043.57	1.11	53.63	24.9	14.77	20.05	1.3
1055	1054.57	0.68	53.53	25.07	14.9	20.16	4.2


Hole: C4996
Red = Drill Hole
Blue = Vertical
Gyro Survey
August 19, 2006
Bottom Depth Info.
Depth 965 ft
Inclination 1.2°
Closure Distance 21 ft
Closure Direction 63°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

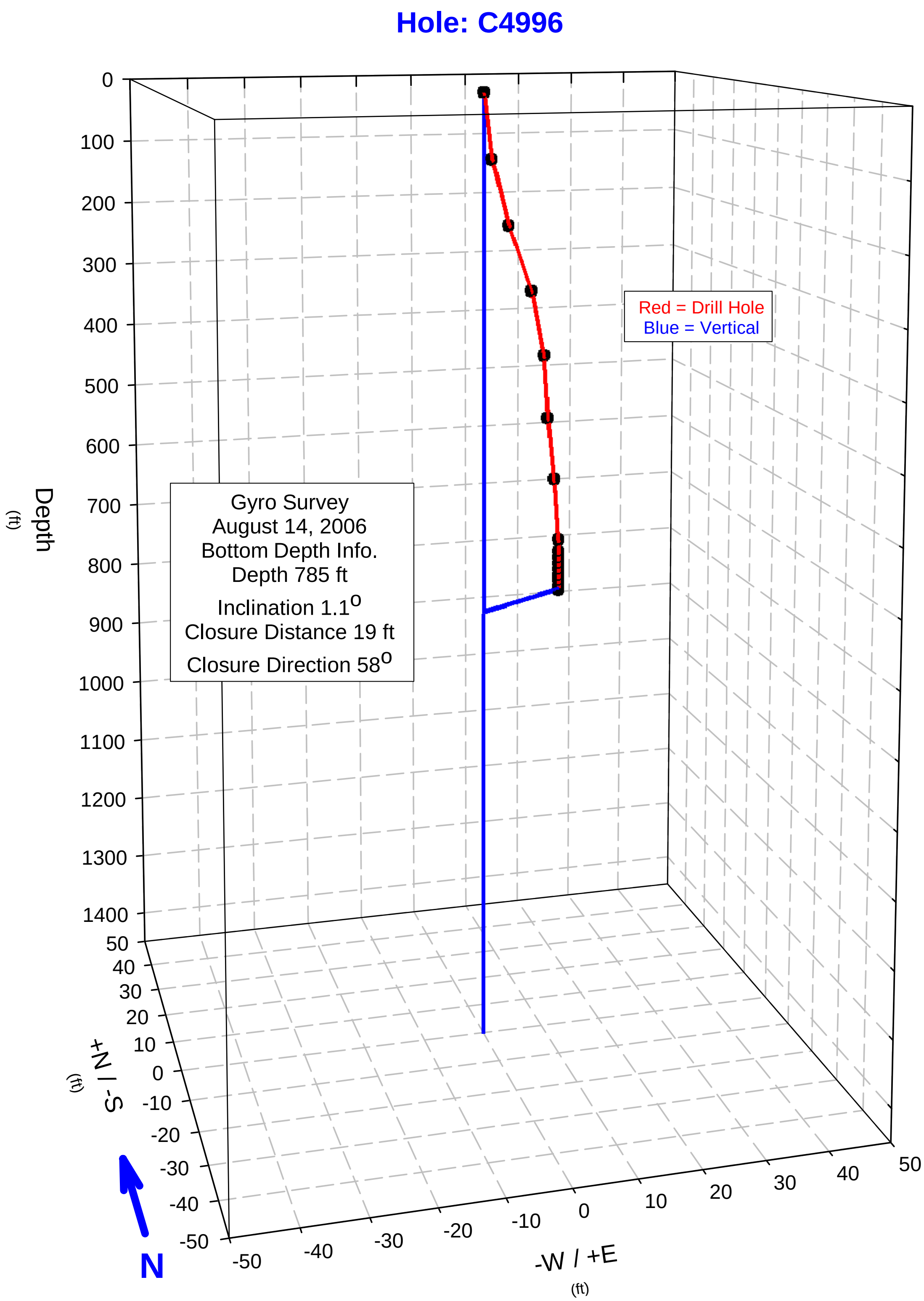
Hole: **C4996**   Survey Date: **8/19/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
0	0	0.68	0	0	0	0	0
50	50	0.61	20.44	0.43	0.4	0.15	1.7
100	100	0.59	49.73	0.85	0.55	0.64	0.4
150	149.98	2.46	74.17	2.06	0.56	1.98	3.8
200	199.94	1.95	78.14	3.95	0.81	3.86	1.7
250	249.9	2.68	79.77	5.94	1.05	5.84	2.1
300	299.84	2.82	82.29	8.31	1.11	8.24	0.5
350	349.8	1.94	82.75	10.39	1.31	10.3	1.8
400	399.78	1.33	82.2	11.81	1.6	11.7	1.3
450	449.76	1.33	80.87	12.93	2.05	12.76	0.5
500	499.75	0.83	79.45	13.81	2.53	13.57	1
550	549.75	1.04	77.96	14.53	3.03	14.21	0.5
600	599.74	0.89	76.67	15.3	3.53	14.88	0.5
650	649.73	1.19	75.63	16.16	4.01	15.65	0.6
700	699.72	1.02	74.5	17.06	4.56	16.44	0.4
750	749.71	1.58	72.28	17.93	5.46	17.08	1.7
800	799.69	1.6	69.32	18.93	6.68	17.71	0.4
830	829.68	1.3	67.8	19.49	7.36	18.04	1.4
840	839.68	1.24	67.31	19.63	7.57	18.11	0.6
850	849.68	0.95	66.89	19.76	7.76	18.17	3
860	859.68	1.25	66.48	19.89	7.94	18.24	3.1
870	869.67	0.73	66.13	20.01	8.1	18.3	5.2
880	879.67	0.84	65.86	20.11	8.22	18.35	1.3
890	889.67	0.8	65.59	20.22	8.35	18.41	1.6
900	899.67	1.09	65.31	20.35	8.5	18.49	2.9
910	909.67	1.12	64.97	20.49	8.67	18.57	1
920	919.67	1.06	64.57	20.62	8.85	18.62	2.4
930	929.66	1.13	64.18	20.75	9.04	18.68	2.1
940	939.66	1.09	63.87	20.9	9.21	18.77	3
950	949.66	1.06	63.65	21.07	9.35	18.88	0.8
960	959.66	1.15	63.38	21.23	9.51	18.98	3.4
965	964.66	1.15	63.21	21.31	9.61	19.02	0


Hole: C4996
Red = Drill Hole
Blue = Vertical
Gyro Survey
August 16, 2006
Bottom Depth Info.
Depth 861 ft
Inclination 1°
Closure Distance 23 ft
Closure Direction 60°
Depth (ft)
+N / -S (ft)
-W / +E (ft)
N

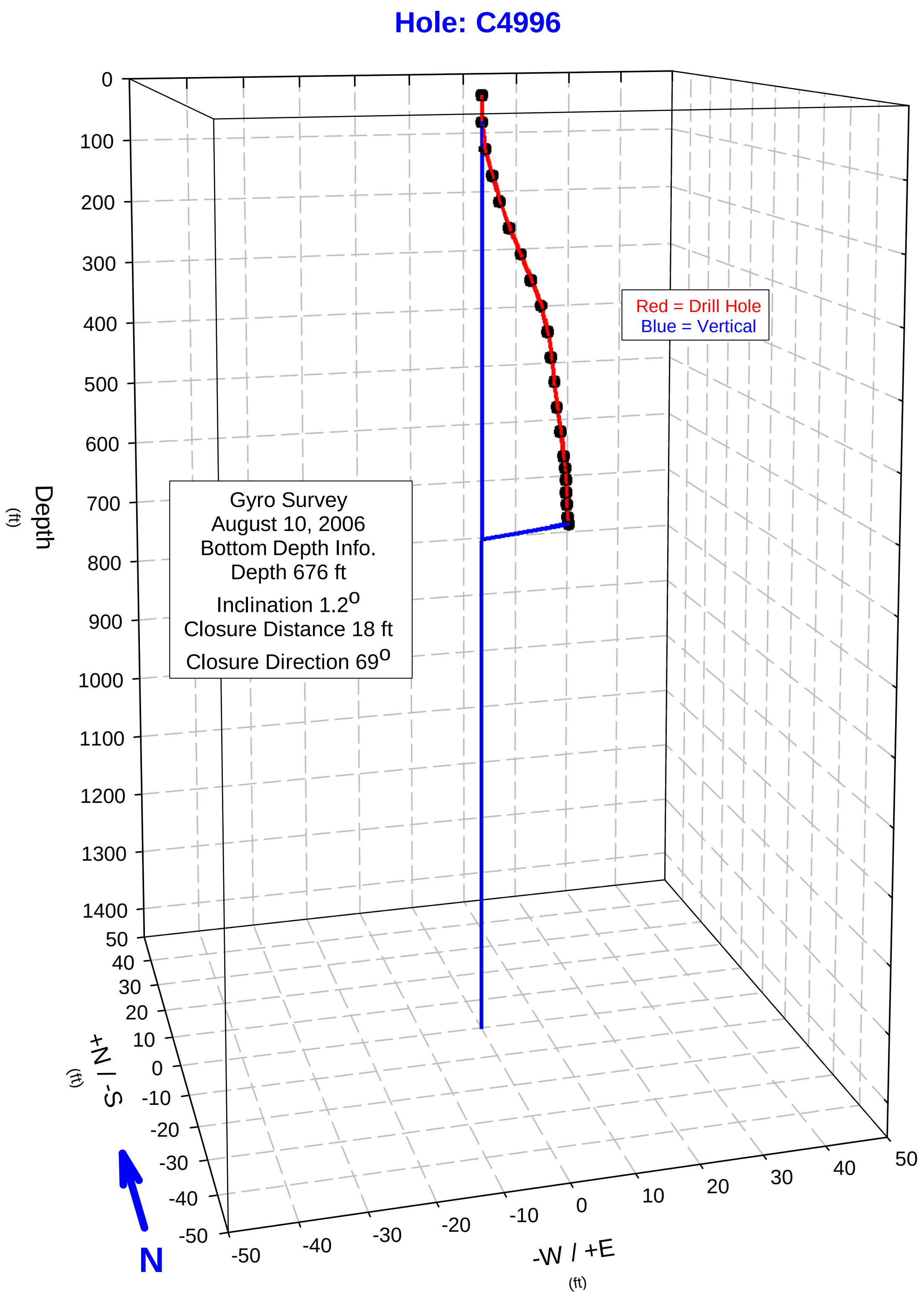
Hole: **C4996** Survey Date: **8/16/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
0	0	0.55	0	0	0	0	0
4	4	0.64	85.97	0.03	0	0.03	16.6
84	83.99	1.47	72.53	1.47	0.44	1.41	1.2
164	163.94	2.56	80.5	4.26	0.7	4.2	1.4
244	243.85	2.59	83.55	7.84	0.88	7.79	0.1
324	323.78	2.3	81.68	11.19	1.62	11.07	1.1
404	403.74	1.7	76.73	13.7	3.14	13.33	1.3
484	483.7	1.7	71.59	15.68	4.95	14.88	0.1
564	563.67	1.63	68.2	17.78	6.6	16.51	0.4
644	643.64	1.3	66.22	19.72	7.95	18.05	0.4
724	723.62	0.93	64.57	21.16	9.09	19.11	0.5
804	803.61	1.17	62.06	22.22	10.41	19.63	0.7
861.5	861.1	0.99	60.25	23	11.42	19.97	0.8


Hole: C4996
Red = Drill Hole
Blue = Vertical
Gyro Survey
August 14, 2006
Bottom Depth Info.
Depth 785 ft
Inclination 1.1°
Closure Distance 19 ft
Closure Direction 58°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

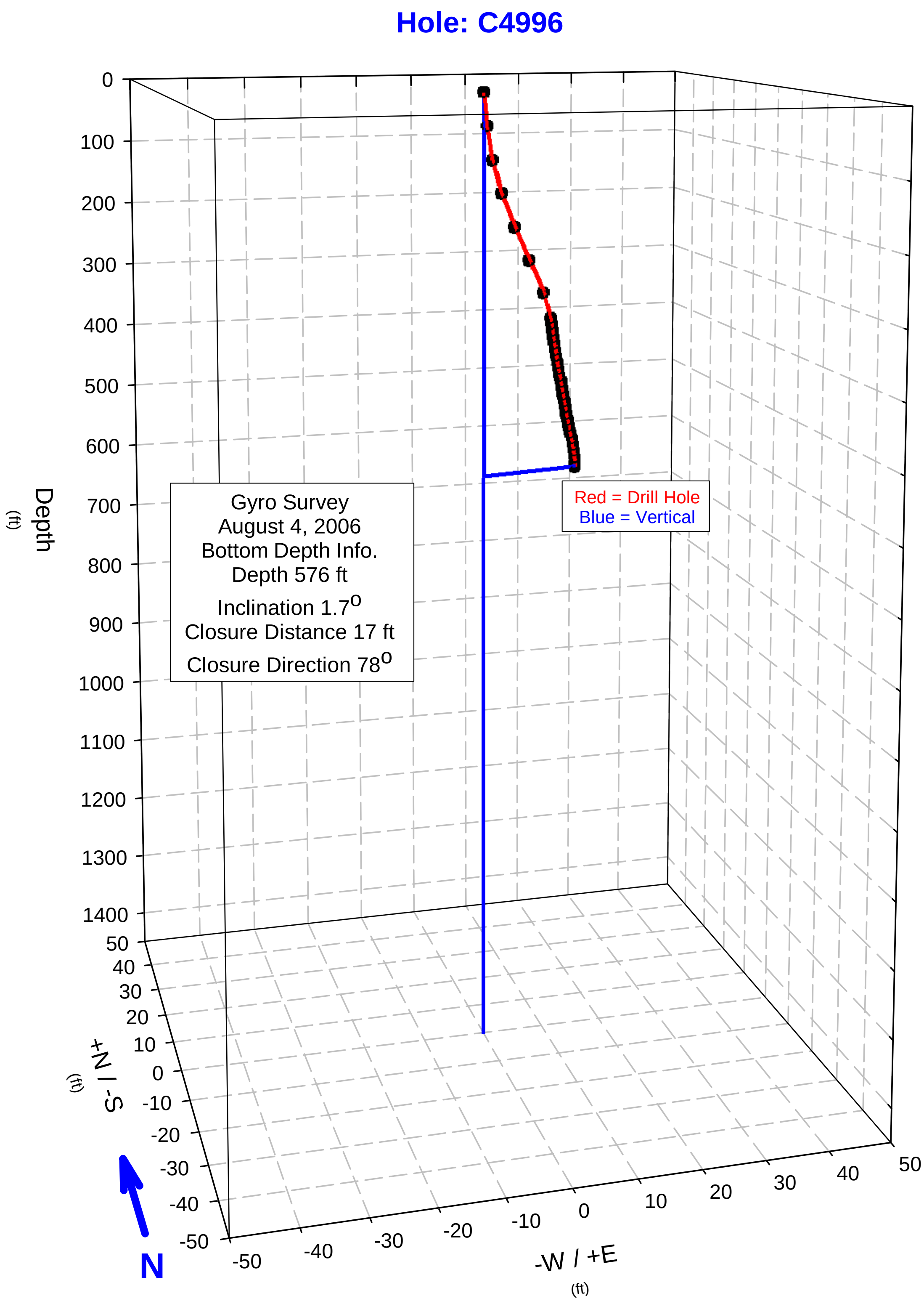
Hole: **C4996** Survey Date: **8/14/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
0	0	0.96	0	0	0	0	0
100	99.98	1.05	64.3	1.75	0.76	1.58	0.1
200	199.93	2.51	72	4.82	1.49	4.58	1.5
300	299.86	2.04	77.46	8.73	1.9	8.52	0.6
400	399.82	0.84	77.26	11.09	2.45	10.82	1.6
500	499.81	1.35	71.61	12.6	3.97	11.95	0.6
600	599.77	1.64	66.51	14.88	5.93	13.65	0.5
700	699.74	1.37	62.03	17.09	8.02	15.1	0.8
720	719.73	1.64	60.9	17.49	8.51	15.28	1.4
730	729.73	1.48	60.32	17.7	8.76	15.37	2.5
740	739.73	1.16	59.78	17.85	8.99	15.43	3.5
750	749.72	1.35	59.27	18	9.2	15.48	2.3
760	759.72	1.29	58.8	18.18	9.42	15.55	1.3
770	769.72	1.24	58.36	18.35	9.63	15.62	0.8
780	779.72	1.16	57.95	18.51	9.82	15.69	1
785	784.71	1.14	57.76	18.59	9.92	15.73	0.4


Hole: C4996
Red = Drill Hole
Blue = Vertical
Gyro Survey
August 10, 2006
Bottom Depth Info.
Depth 676 ft
Inclination 1.2°
Closure Distance 18 ft
Closure Direction 69°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

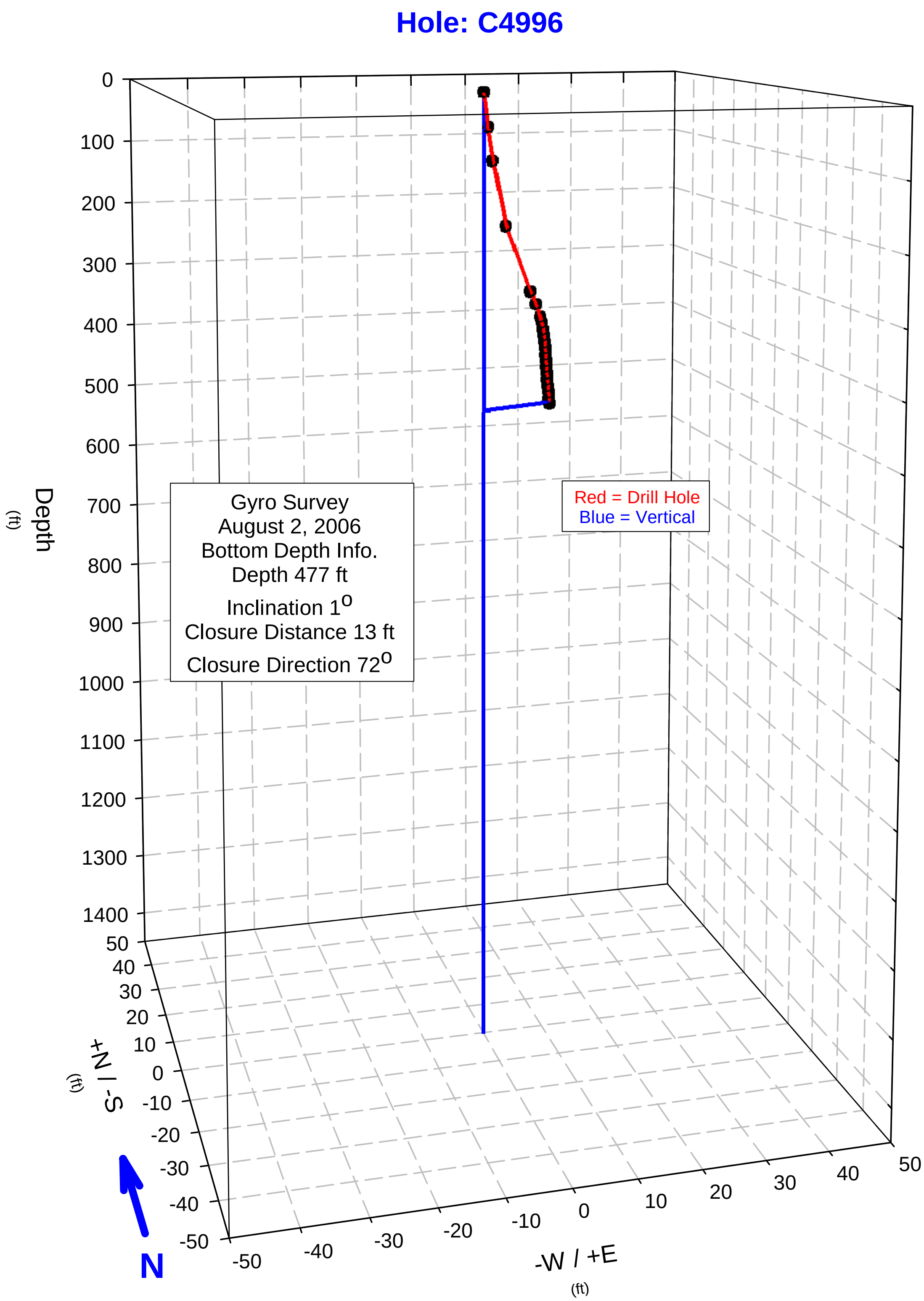
Hole: **C4996** Survey Date: **8/10/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
4	4	0.28	168.07	0.02	-0.02	0	6.5
44	44	0.18	153.66	0.1	-0.09	0.04	1
84	84	1.39	106.16	0.59	-0.17	0.57	3.1
124	123.98	1.85	96.65	1.7	-0.2	1.68	1.8
164	163.96	2.05	89.07	3.02	0.05	3.02	0.8
204	203.92	2.68	87.47	4.66	0.21	4.65	2.1
244	243.87	2.97	86.28	6.61	0.43	6.6	1.8
284	283.83	2.5	85.32	8.51	0.69	8.48	1.8
324	323.79	2.49	85.34	10.25	0.83	10.22	0.5
364	363.77	1.26	83.94	11.49	1.21	11.42	3.9
404	403.76	1.42	82.04	12.33	1.71	12.21	0.8
444	443.75	1.44	79.73	13.15	2.35	12.94	1.8
484	483.74	1.4	77.69	13.98	2.98	13.66	1.8
524	523.72	1.76	75.71	14.93	3.69	14.47	2
564	563.71	1.34	73.76	15.86	4.44	15.23	1.6
584	583.7	1.71	72.99	16.34	4.78	15.63	2.4
604	603.69	1.4	71.9	16.78	5.21	15.95	2.8
624	623.69	1.2	70.82	17.1	5.62	16.15	1
644	643.68	0.89	70.05	17.38	5.93	16.34	1.7
664	663.68	1.2	69.51	17.7	6.2	16.58	1.9
676	675.68	1.24	69.2	17.94	6.37	16.77	0.5


Hole: C4996
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
Gyro Survey
August 4, 2006
Bottom Depth Info.
Depth 576 ft
Inclination 1.7°
Closure Distance 17 ft
Closure Direction 78°
Red = Drill Hole
Blue = Vertical
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
N
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50

Hole: **C4996** Survey Date: **8/4/2006**

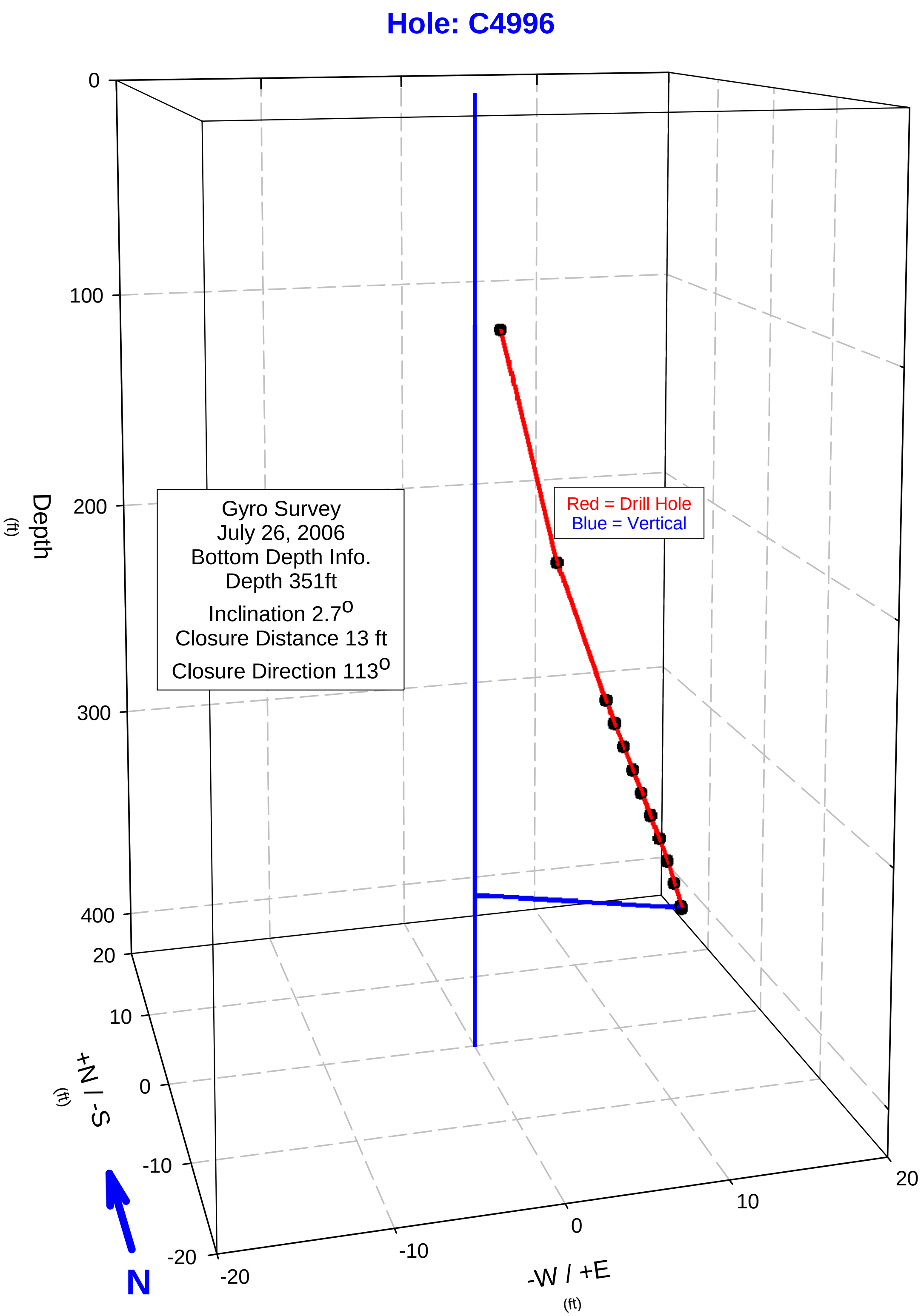
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
0	0	0.41	0	0	0	0	0
50	50	1.04	85.9	0.63	0.04	0.63	1.3
100	99.99	0.71	90.48	1.39	-0.01	1.39	0.7
150	149.96	2.79	92.61	2.91	-0.13	2.91	4.2
200	199.92	2.18	93.22	5.07	-0.28	5.07	1.2
250	249.86	3.29	92.59	7.45	-0.34	7.45	2.3
300	299.79	2.56	90.26	9.97	-0.05	9.97	1.9
340	339.77	1.38	88.32	11.29	0.33	11.29	3
350	349.77	1.82	87.76	11.55	0.45	11.54	4.9
360	359.76	0.79	87.31	11.76	0.55	11.74	10.5
370	369.76	1.38	86.92	11.93	0.64	11.91	6.2
380	379.76	1.07	86.42	12.11	0.76	12.09	3
390	389.76	1.23	86.02	12.29	0.85	12.26	2.1
400	399.75	1.35	85.63	12.5	0.95	12.47	1.1
410	409.75	1.38	85.24	12.72	1.05	12.68	0.5
420	419.75	1.43	84.86	12.95	1.16	12.9	0.6
430	429.75	1.44	84.49	13.19	1.27	13.13	0.8
440	439.74	1.35	84.19	13.42	1.36	13.35	0.9
450	449.74	1.35	83.91	13.65	1.45	13.57	0.1
460	459.74	1.42	83.65	13.88	1.54	13.8	0.9
470	469.73	1.27	83.42	14.11	1.62	14.02	1.5
480	479.73	1.42	83.18	14.34	1.7	14.24	1.5
490	489.73	1.55	82.91	14.59	1.8	14.48	1.3
500	499.72	1.48	82.63	14.84	1.9	14.72	0.6
510	509.72	1.67	82.34	15.11	2.01	14.97	2
520	519.72	2.07	81.94	15.42	2.16	15.26	4.3
530	529.71	1.84	81.43	15.73	2.34	15.55	2.9
540	539.7	1.78	80.83	15.99	2.55	15.79	4.2
550	549.7	1.83	80.14	16.24	2.78	16	0.5
560	559.69	1.83	79.44	16.49	3.02	16.21	1.3
570	569.69	1.71	78.7	16.71	3.27	16.39	2.9
576.5	576.19	1.73	78.2	16.84	3.44	16.49	0.5



Hole: C4996
Gyro Survey
August 2, 2006
Bottom Depth Info.
Depth 477 ft
Inclination 1°
Closure Distance 13 ft
Closure Direction 72°
Red = Drill Hole
Blue = Vertical
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

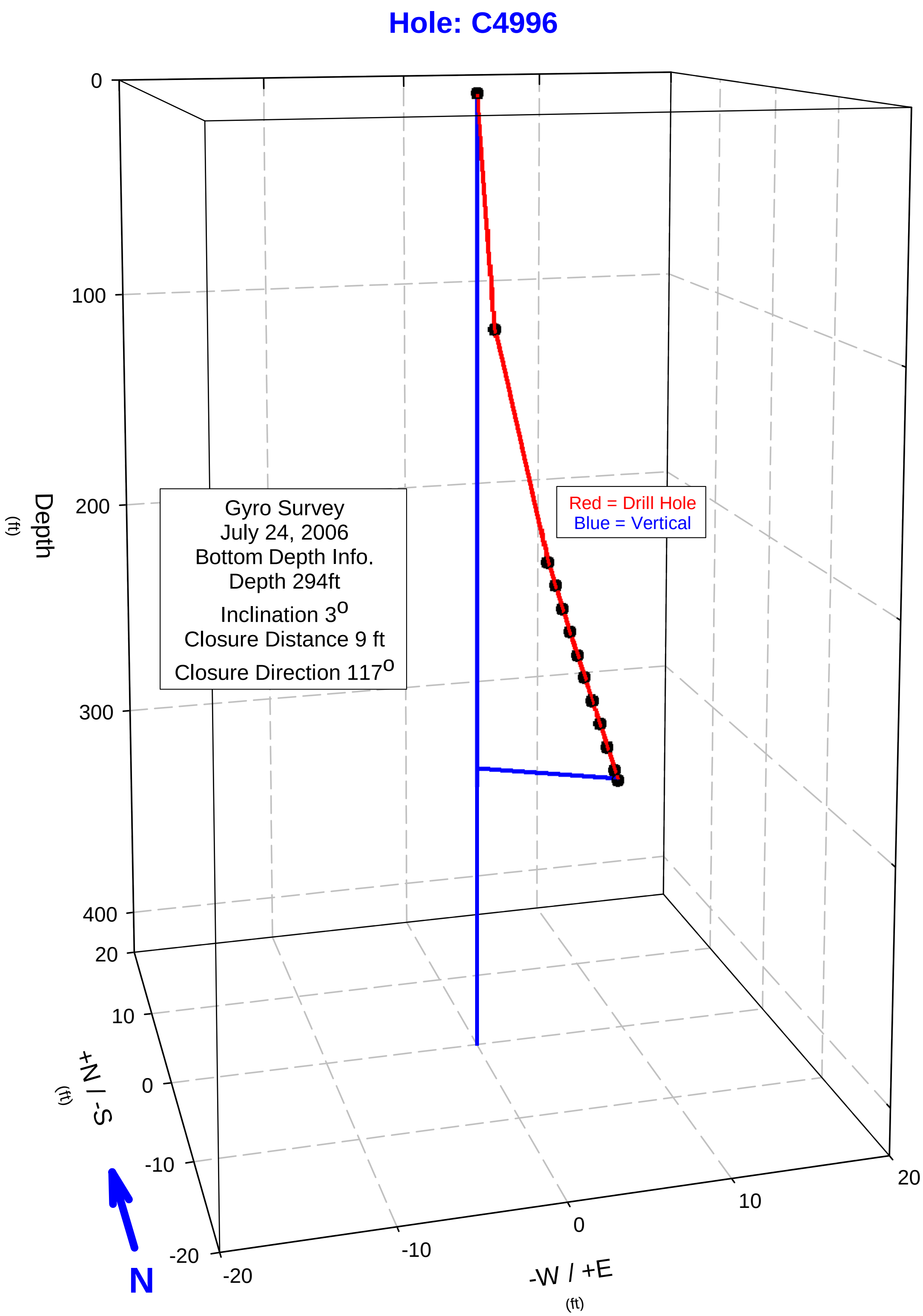
Hole: **C4996** Survey Date: **8/2/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
0	0	0.49	0	0	0	0	0
50.5	50.49	1.22	80.19	0.74	0.13	0.73	1.6
101	100.99	0.8	80.05	1.61	0.28	1.59	1.1
200	199.96	1.94	81.01	3.96	0.62	3.91	1.2
300	299.87	2.93	82.51	8.2	1.07	8.13	1
320	319.84	2.8	82.27	9.2	1.24	9.11	1
340	339.82	2.25	81.38	10.06	1.51	9.95	4.3
350	349.81	1.93	80.69	10.4	1.68	10.27	3.8
360	359.81	1.88	79.94	10.7	1.87	10.54	1.6
370	369.8	1.68	79.08	10.97	2.08	10.77	4.2
380	379.8	1.56	78.15	11.18	2.3	10.95	1.9
390	389.8	1.45	77.24	11.38	2.51	11.1	1.3
400	399.79	1.33	76.4	11.55	2.72	11.23	1.3
410	409.79	1.22	75.68	11.72	2.9	11.35	1.6
420	419.79	1.54	74.95	11.91	3.09	11.5	3.2
430	429.79	1.34	74.21	12.1	3.29	11.65	2
440	439.78	1.21	73.6	12.28	3.47	11.78	1.4
450	449.78	1.12	73.16	12.46	3.61	11.93	2.5
460	459.78	1.05	72.8	12.63	3.74	12.07	1.3
470	469.78	1.02	72.38	12.79	3.87	12.19	1.3
477	476.78	1.03	72.11	12.9	3.96	12.27	2.4


Hole: C4996
0
100
200
300
400
Depth
(ft)
Gyro Survey
July 26, 2006
Bottom Depth Info.
Depth 351ft
Inclination 2.7°
Closure Distance 13 ft
Closure Direction 113°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+N / -S
(ft)
N
-20
-10
0
10
20
-W / +E
(ft)

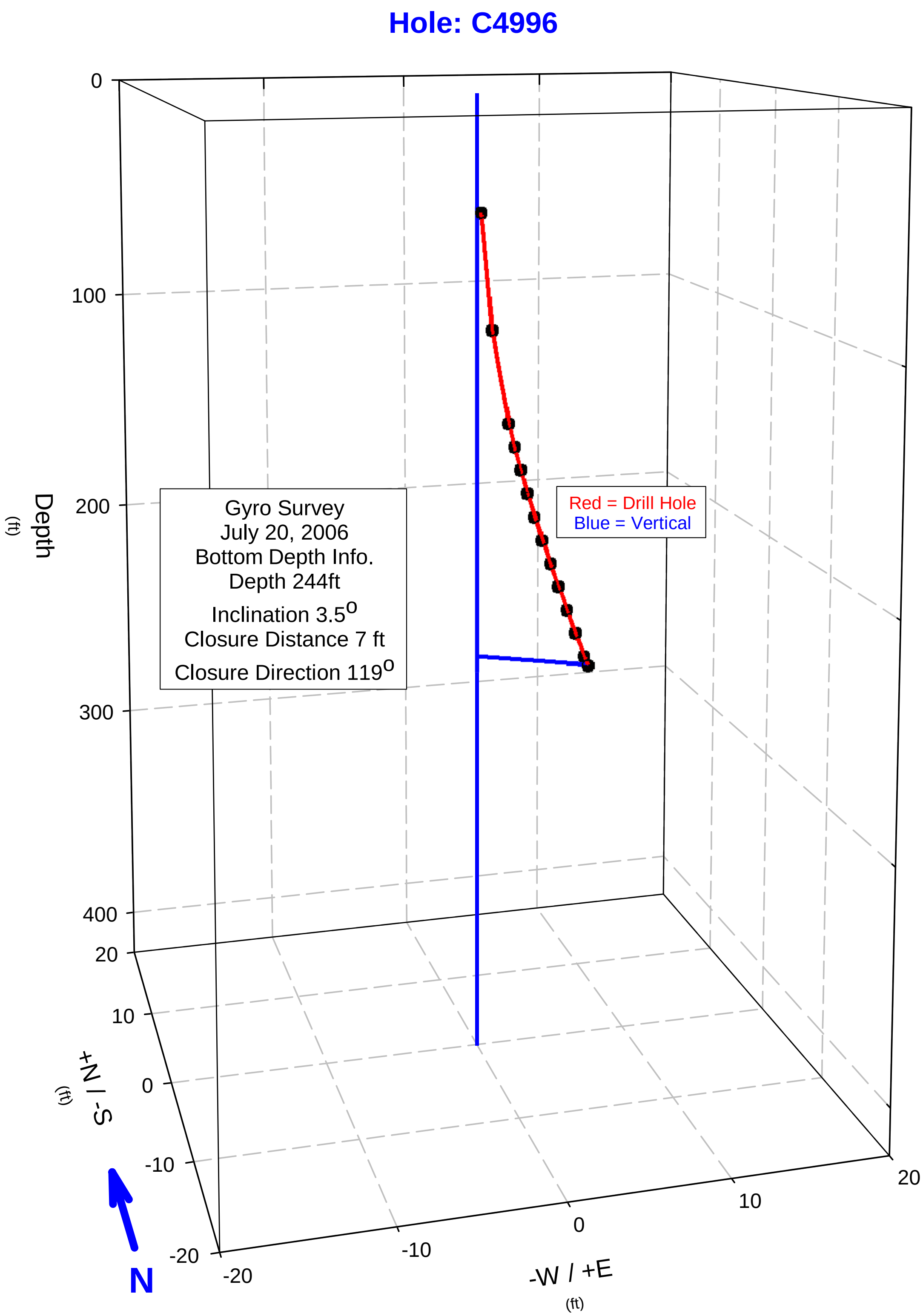
Hole: **C4996** Survey Date: **7/26/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
100	99.98	1.33	117.88	1.69	-0.79	1.49	0.9
200	199.91	2.9	116.92	5.34	-2.42	4.76	1.7
260	259.83	3.13	114.3	8.48	-3.49	7.73	0.4
270	269.82	3.34	114.15	9.05	-3.7	8.25	3.6
280	279.8	3.36	114.19	9.63	-3.95	8.78	0.3
290	289.78	3.45	114.24	10.22	-4.2	9.32	0.9
300	299.76	3.38	114.29	10.82	-4.45	9.86	0.7
310	309.75	3.25	114.27	11.4	-4.69	10.39	1.7
320	319.73	3.1	114.16	11.95	-4.89	10.91	2
330	329.72	2.9	113.97	12.47	-5.07	11.4	2.3
340	339.71	2.57	113.68	12.94	-5.2	11.86	4.2
350	349.7	2.61	113.36	13.39	-5.31	12.29	1.2
351.2	350.89	2.67	113.33	13.44	-5.33	12.35	10.5


Hole: C4996
0
100
200
300
400
Depth
(ft)
Gyro Survey
July 24, 2006
Bottom Depth Info.
Depth 294ft
Inclination 3°
Closure Distance 9 ft
Closure Direction 117°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+N / -S
(ft)
N
-20
-10
0
10
20
-W / +E
(ft)

Hole: **C4996** Survey Date: **7/24/2006**

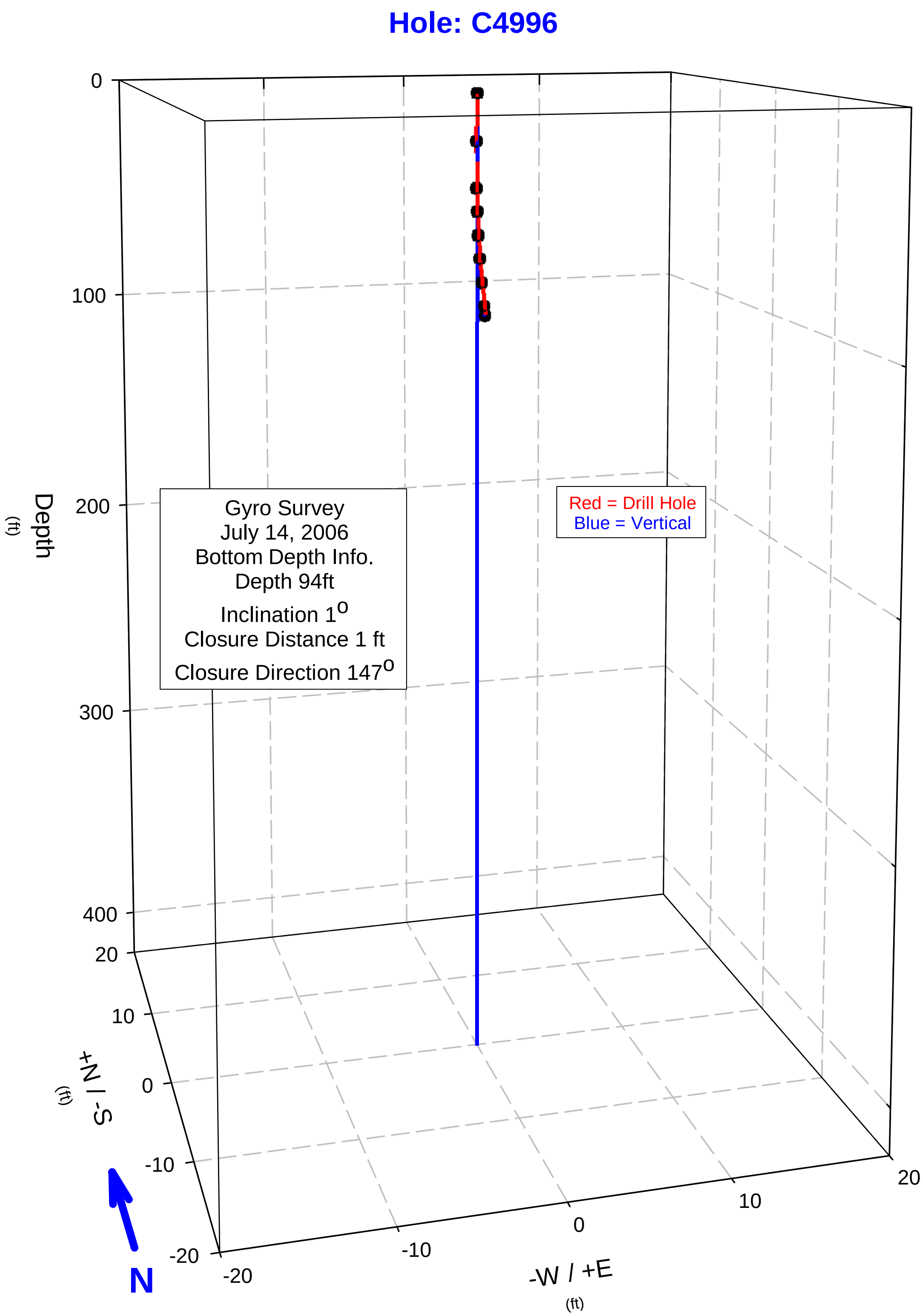
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
0	0	0.08	0	0	0	0	0
100	99.99	1.33	122.51	1.15	-0.62	0.97	1.4
200	199.93	2.66	117.79	4.62	-2.16	4.09	1.3
210	209.92	2.68	117.44	5.09	-2.35	4.52	0.7
220	219.91	2.7	117.17	5.56	-2.54	4.94	0.9
230	229.89	2.78	117.02	6.04	-2.74	5.38	0.7
240	239.88	2.81	116.86	6.52	-2.95	5.82	0.6
250	249.87	2.82	116.63	7.01	-3.14	6.27	0.8
260	259.86	2.77	116.45	7.5	-3.34	6.71	1.3
270	269.85	2.83	116.44	7.99	-3.56	7.15	1.2
280	279.83	2.84	116.49	8.48	-3.78	7.59	0.1
290	289.82	2.85	116.55	8.98	-4.01	8.03	0.2
294.5	294.32	2.9	116.59	9.2	-4.12	8.23	1.3



Hole: C4996
Gyro Survey
July 20, 2006
Bottom Depth Info.
Depth 244ft
Inclination 3.5°
Closure Distance 7 ft
Closure Direction 119°
Red = Drill Hole
Blue = Vertical
Depth
(ft)
0
100
200
300
400
+N / -S
(ft)
20
10
0
-10
-20
-W / +E
(ft)
-20
-10
0
10
20
N

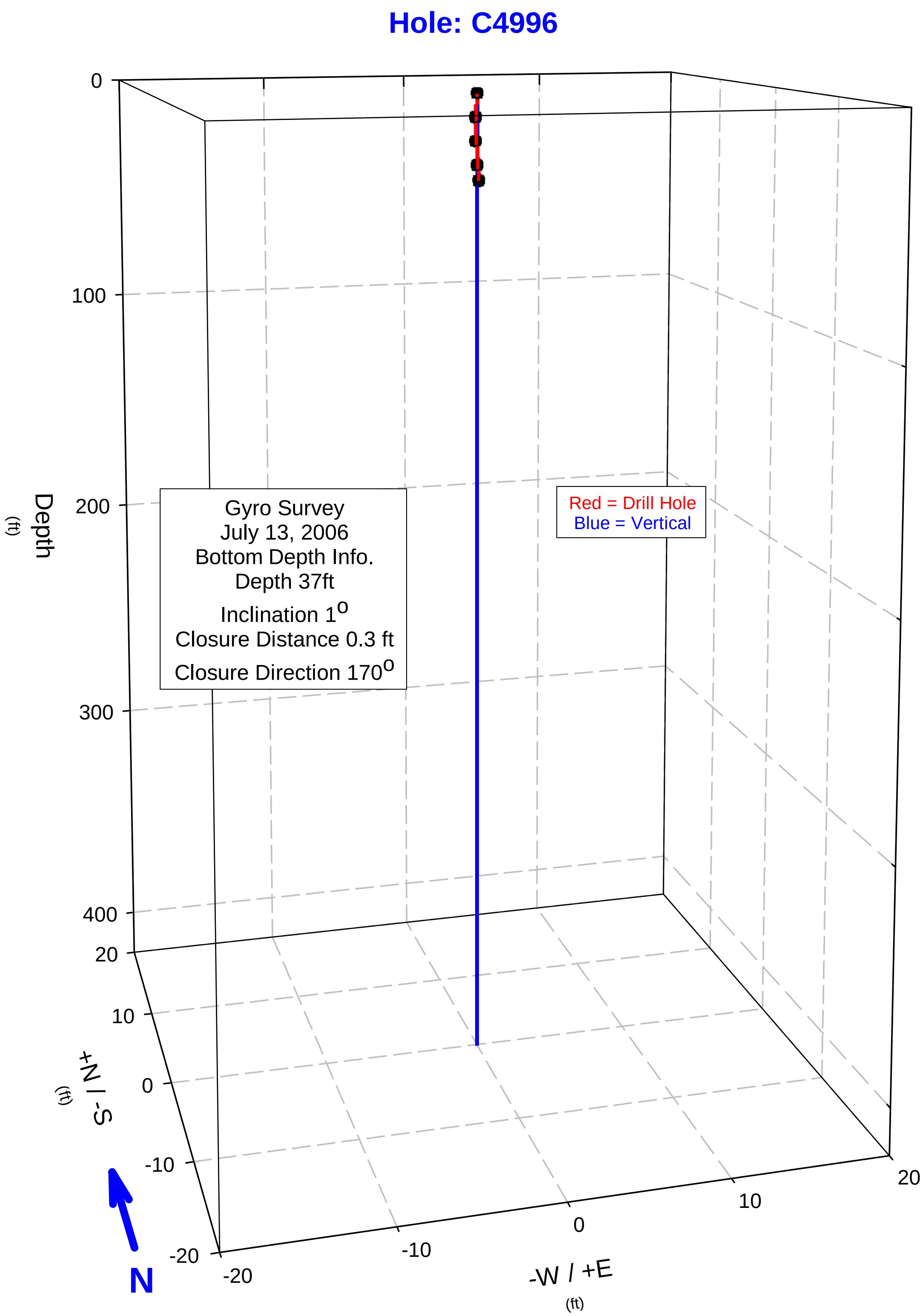
Hole: **C4996** Survey Date: **7/20/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
50	50	0.57	154.8	0.44	-0.4	0.19	0.5
100	99.99	1.2	139.56	1.18	-0.9	0.77	1.4
140	139.98	1.95	129.88	2.24	-1.44	1.72	2
150	149.97	2.22	127.83	2.6	-1.59	2.05	2.9
160	159.96	2.43	125.95	2.99	-1.76	2.42	2.1
170	169.95	2.59	124.46	3.42	-1.94	2.82	1.6
180	179.94	2.75	123.27	3.88	-2.13	3.24	1.7
190	189.93	2.87	122.26	4.36	-2.33	3.69	1.2
200	199.92	3	121.42	4.87	-2.54	4.16	1.4
210	209.9	3.04	120.65	5.4	-2.75	4.64	0.9
220	219.89	3.14	119.98	5.93	-2.96	5.14	1.1
230	229.87	3.22	119.47	6.48	-3.19	5.64	0.9
240	239.86	3.23	118.97	7.04	-3.41	6.16	1
244.4	244.25	3.49	118.75	7.3	-3.51	6.4	5.9


Hole: C4996
0
100
200
300
400
Depth
(ft)
Gyro Survey
July 14, 2006
Bottom Depth Info.
Depth 94ft
Inclination 1°
Closure Distance 1 ft
Closure Direction 147°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+N / -S
(ft)
-20
-10
0
10
20
-W / +E
(ft)
N

Hole: **C4996** Survey Date: **7/14/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
0	0	0.12	0	0	0	0	0
20	20	0.16	291.4	0.03	0.01	-0.03	1.2
40	40	0.35	214.27	0.07	-0.06	-0.04	1.8
50	50	0.52	185.08	0.13	-0.13	-0.01	2.4
60	60	0.63	168.44	0.22	-0.21	0.04	1.1
70	70	0.81	161.37	0.34	-0.32	0.11	1.9
80	80	1	155.5	0.49	-0.44	0.2	3.1
90	90	1.1	149.35	0.66	-0.57	0.34	1.5
94	93.99	1.12	147.67	0.73	-0.62	0.39	3.3

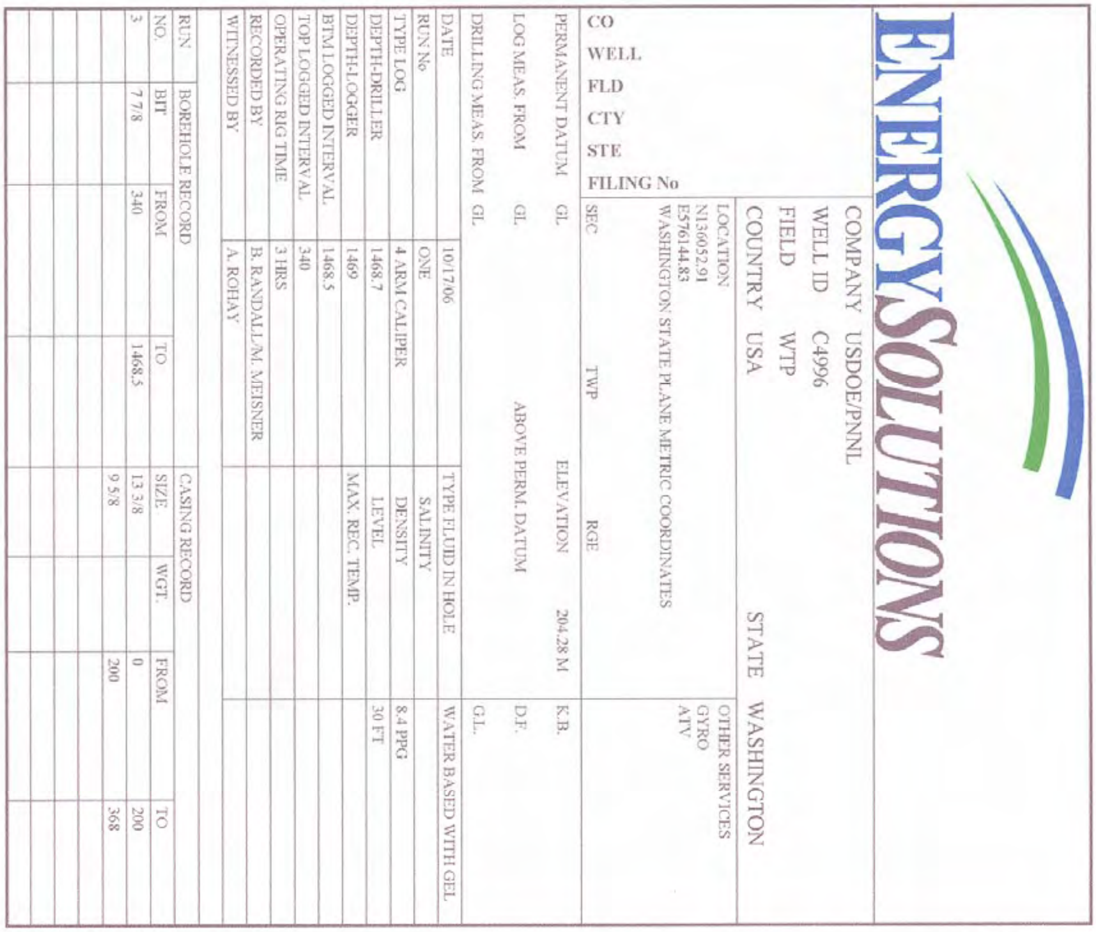


Hole: C4996
Gyro Survey
July 13, 2006
Bottom Depth Info.
Depth 37ft
Inclination 1°
Closure Distance 0.3 ft
Closure Direction 170°
Red = Drill Hole
Blue = Vertical
Depth (ft)
0
100
200
300
400
+N / -S (ft)
20
10
0
-10
-20
-W / +E (ft)
-20
-10
0
10
20
N

Hole: **C4996** Survey Date: **7/13/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
0	0	0.55	0	0	0	0	0
10	10	0.76	231.17	0.11	-0.07	-0.09	2.2
20	20	0.77	213.51	0.21	-0.18	-0.12	8.6
30	30	0.68	188.86	0.27	-0.27	-0.04	5.9
36.9	36.9	0.85	170.33	0.28	-0.28	0.05	5.7

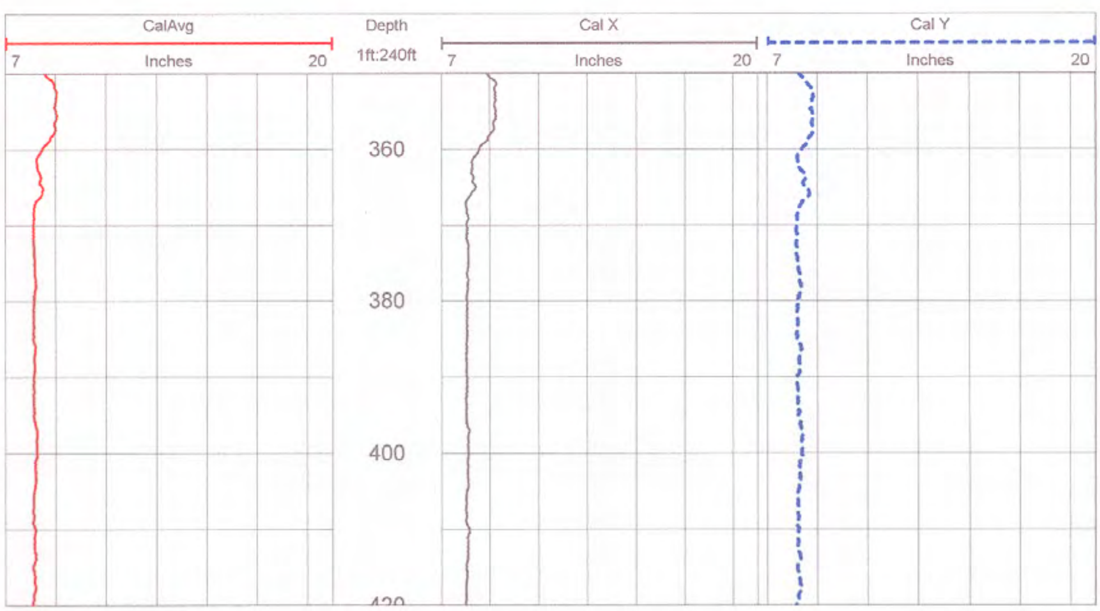
B1.2 ENERGY*SOLUTIONS* AND PACIFIC NORTHWEST GEOPHYSICS CALIPER LOGS

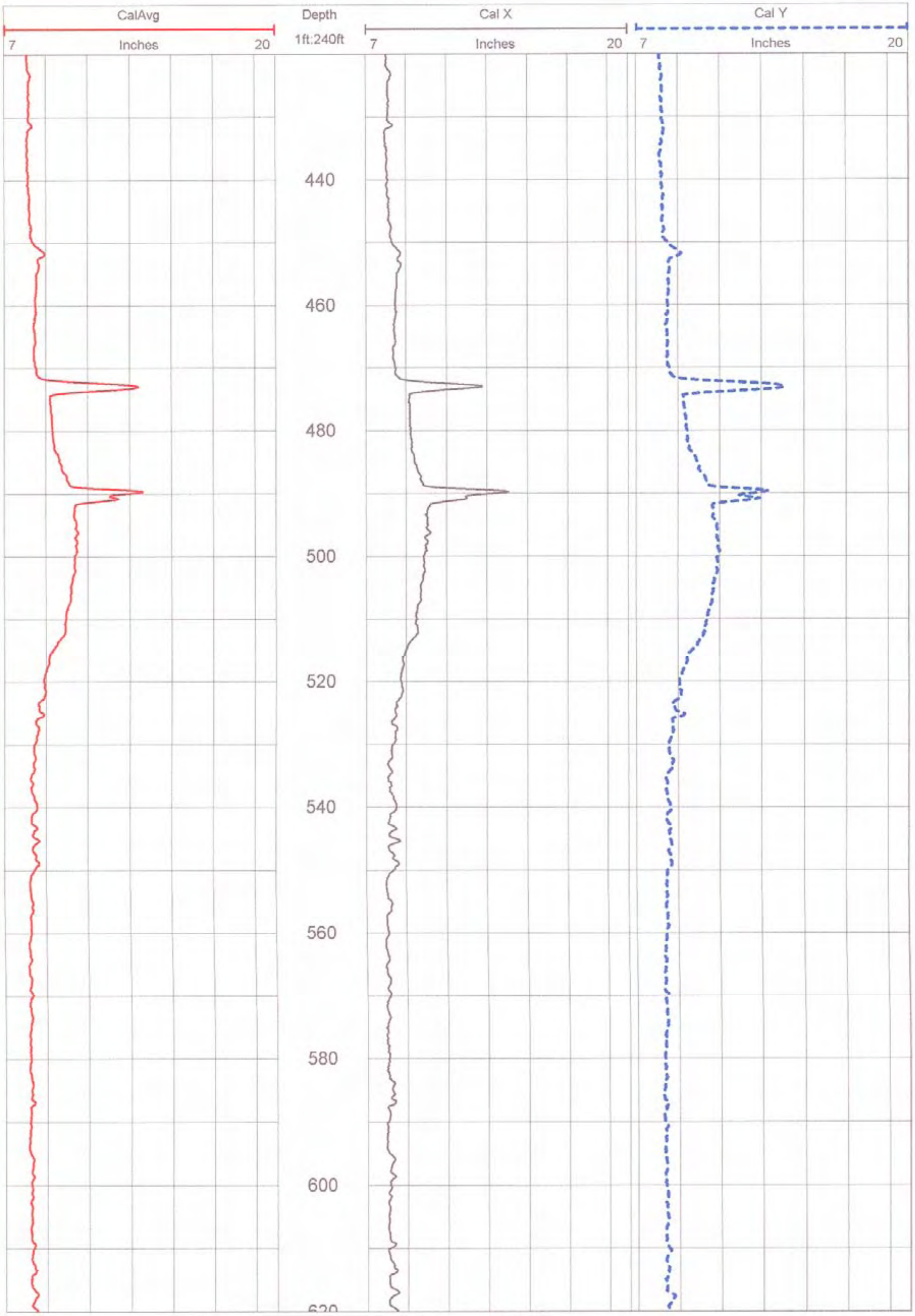


ENERGYSOLUTIONS

CO	COMPANY USDOE/PNNL		
WELL	WELL ID C4996		
FLD	FIELD WTP		
CTY	COUNTRY USA	STATE WASHINGTON	
STE	LOCATION N136052.91 E576144.83 WASHINGTON STATE PLANE METRIC COORDINATES		OTHER SERVICES GYRO ATV
FILING No	SEC	TWP	RGE
PERMANENT DATUM	GL	ELEVATION 204.28 M	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GL		G.L.
DATE	10/17/06	TYPE FLUID IN HOLE	WATER BASED WITH GEL
RUN No	ONE	SALINITY	
TYPE LOG	4 ARM CALIPER	DENSITY	8.4 PPG
DEPTH-DRILLER	1468.7	LEVEL	30 FT
DEPTH-LOGGER	1469	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	1468.5		
TOP LOGGED INTERVAL	340		
OPERATING RIG TIME	3 HRS		
RECORDED BY	B. RANDALL/M. MEISNER		
WITNESSED BY	A. ROHAY		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
3	7 7/8	340	1468.5	13 3/8		0	200
				9 5/8		200	368

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7
Inches
20
Depth
1ft:240ft
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500
520
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580
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620
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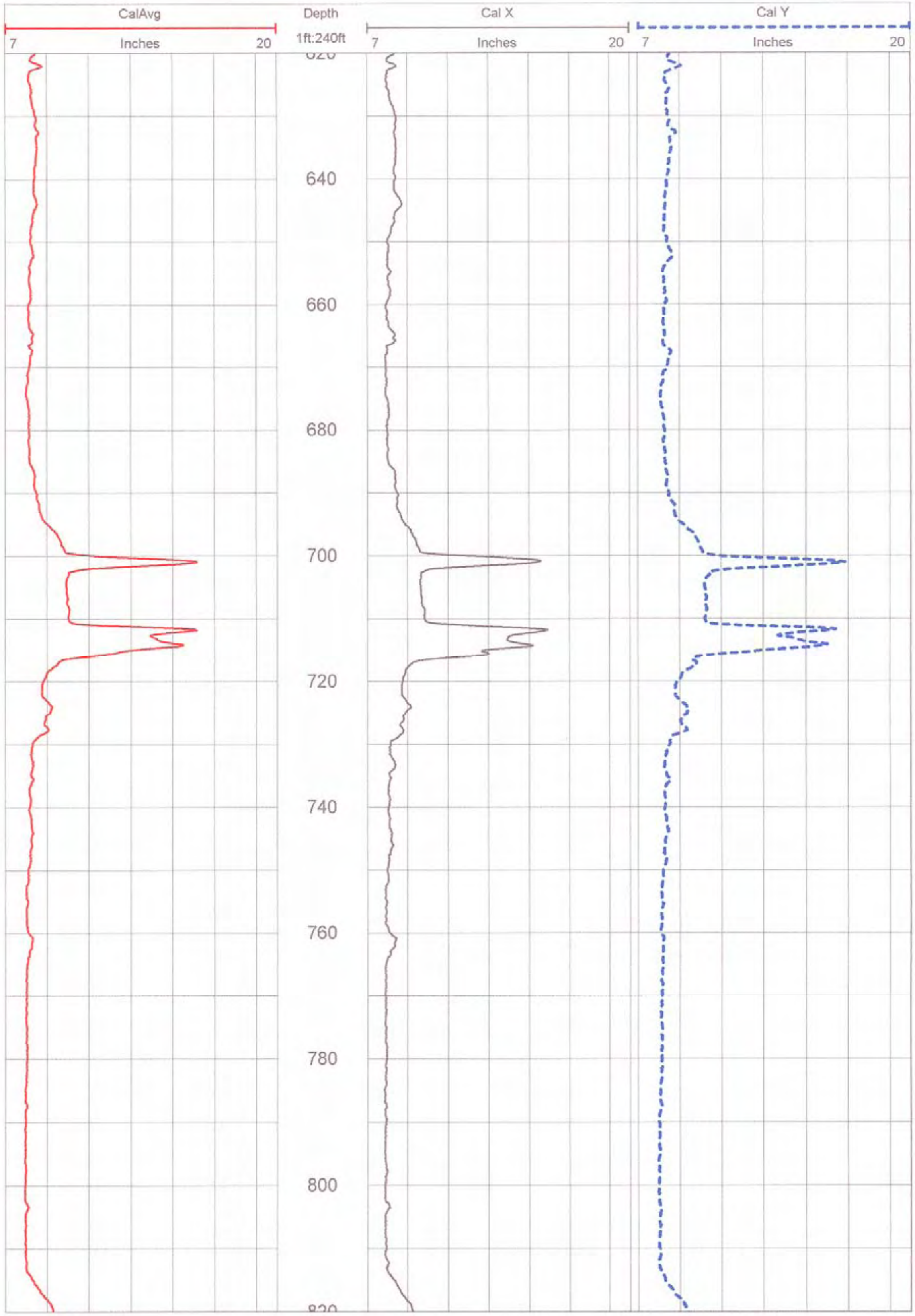
7
Inches
20
Cal Y
7
Inches
20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Inches
20
Depth
1ft:240ft
Cal X
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Inches
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Cal Y
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Inches
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740
760
780
800
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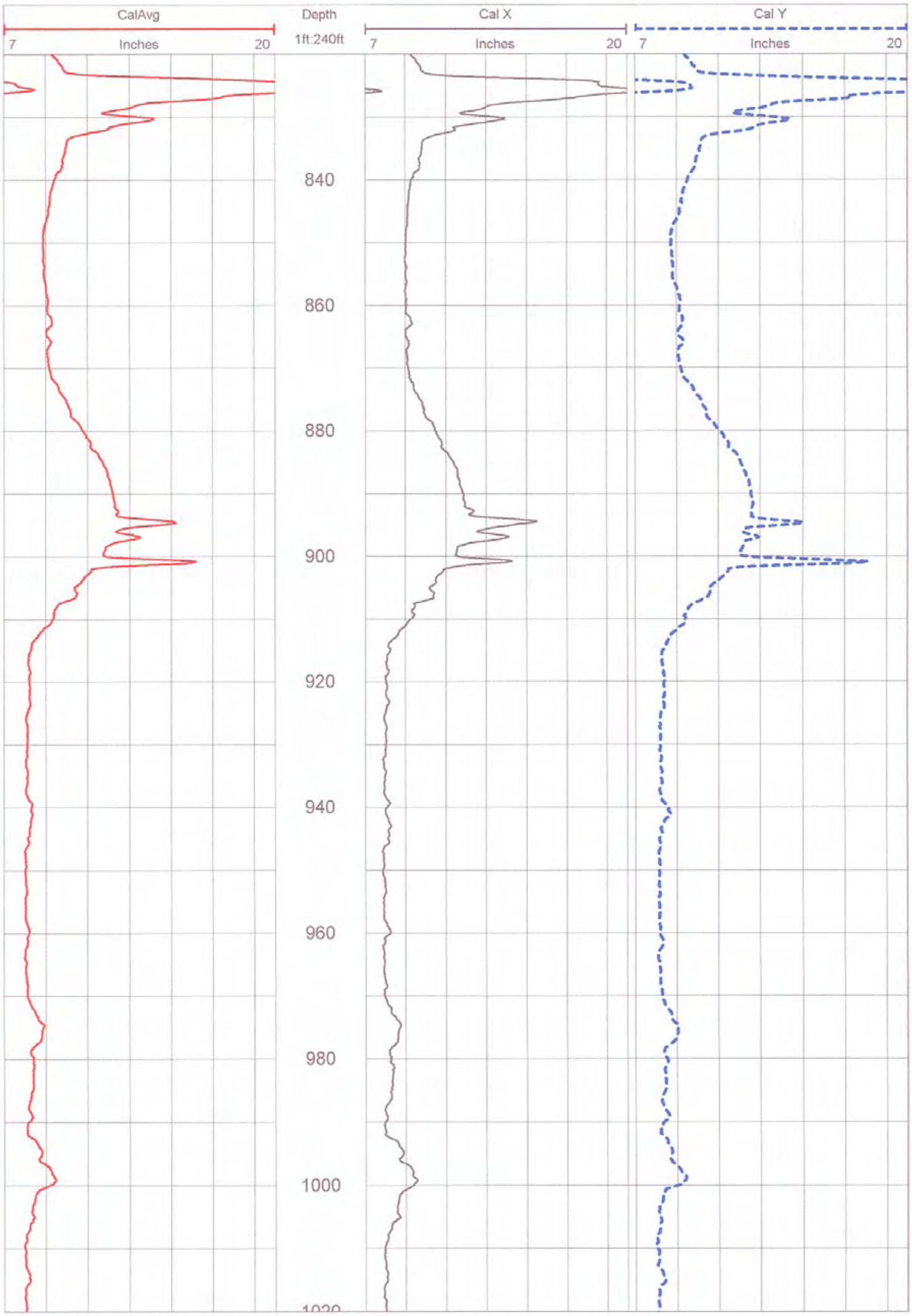
CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
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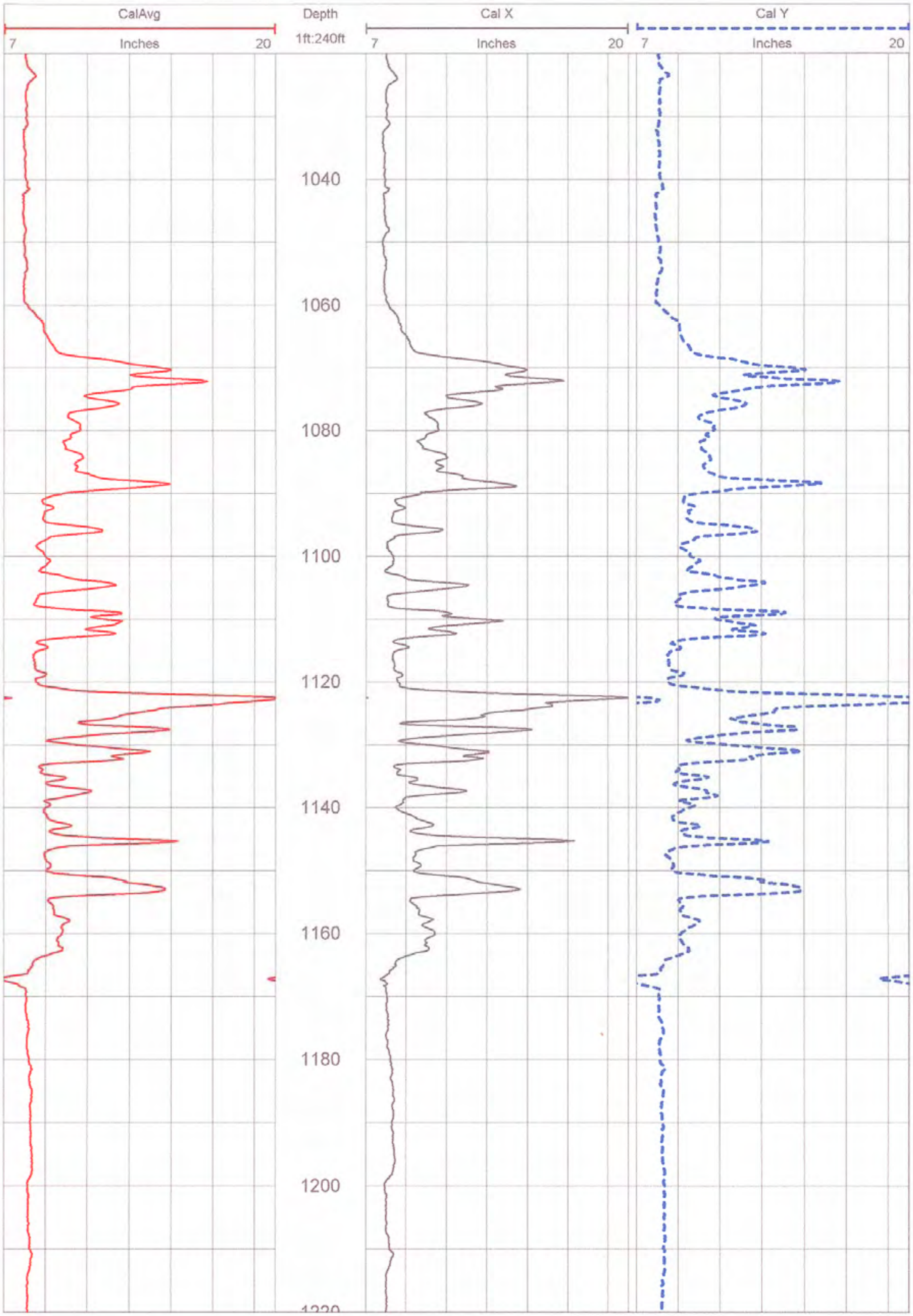
940
960
980
1000
1020


CalAvg
Depth
Cal X
Cal Y
7
Inches
20
1ft:240ft
7
Inches
20
7
Inches
20
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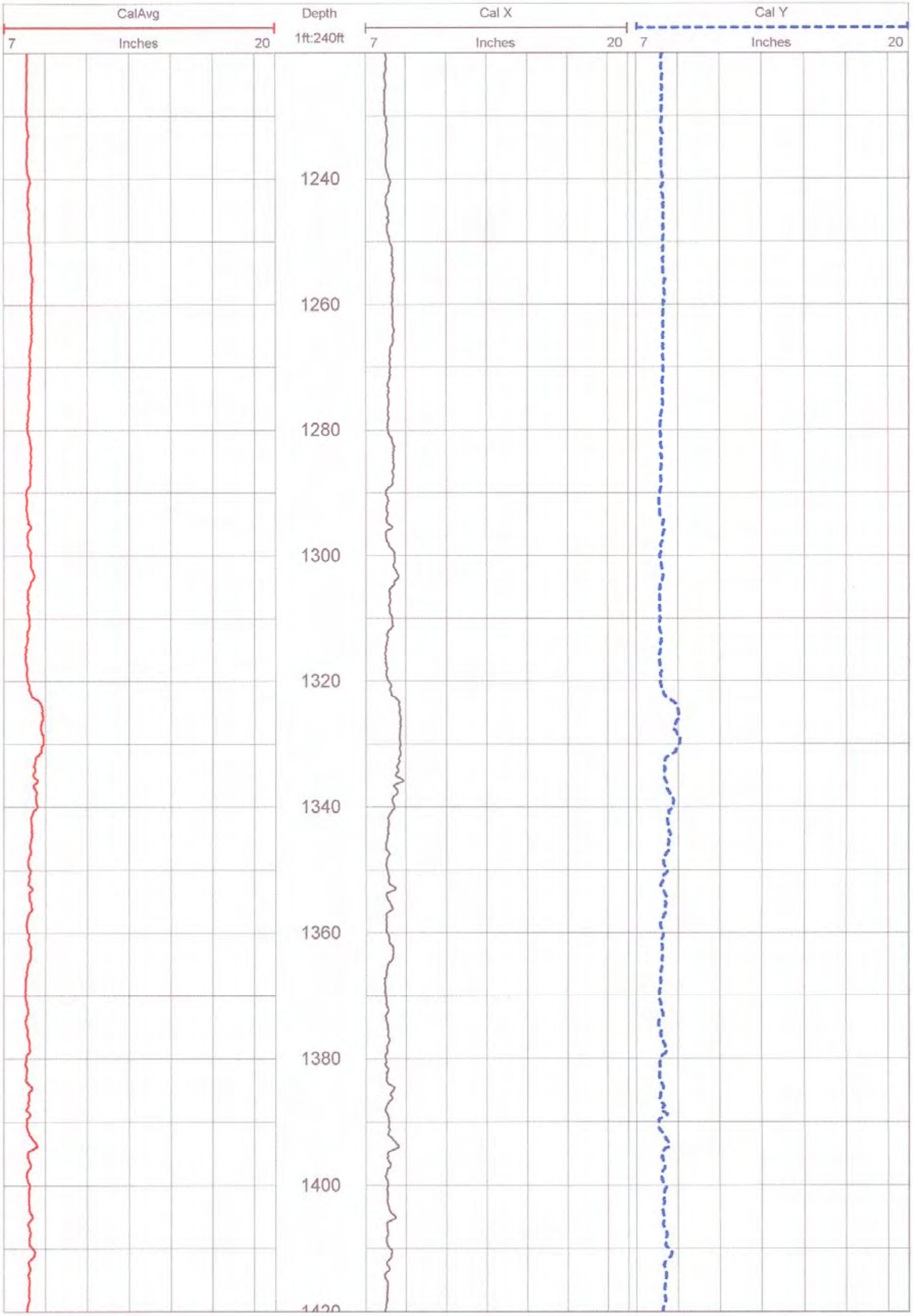
1140
1160
1180
1200


CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
1240
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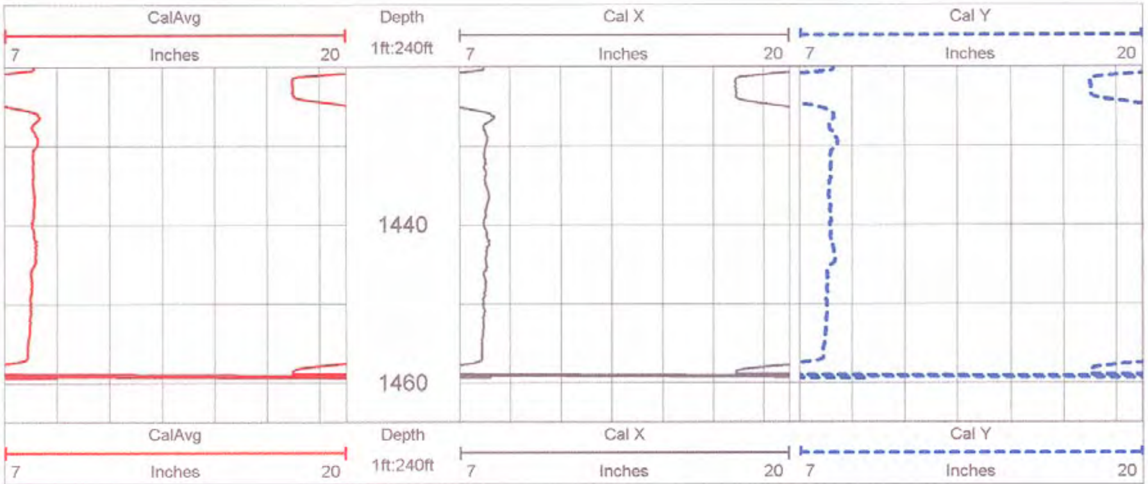
1360
1380
1400
1420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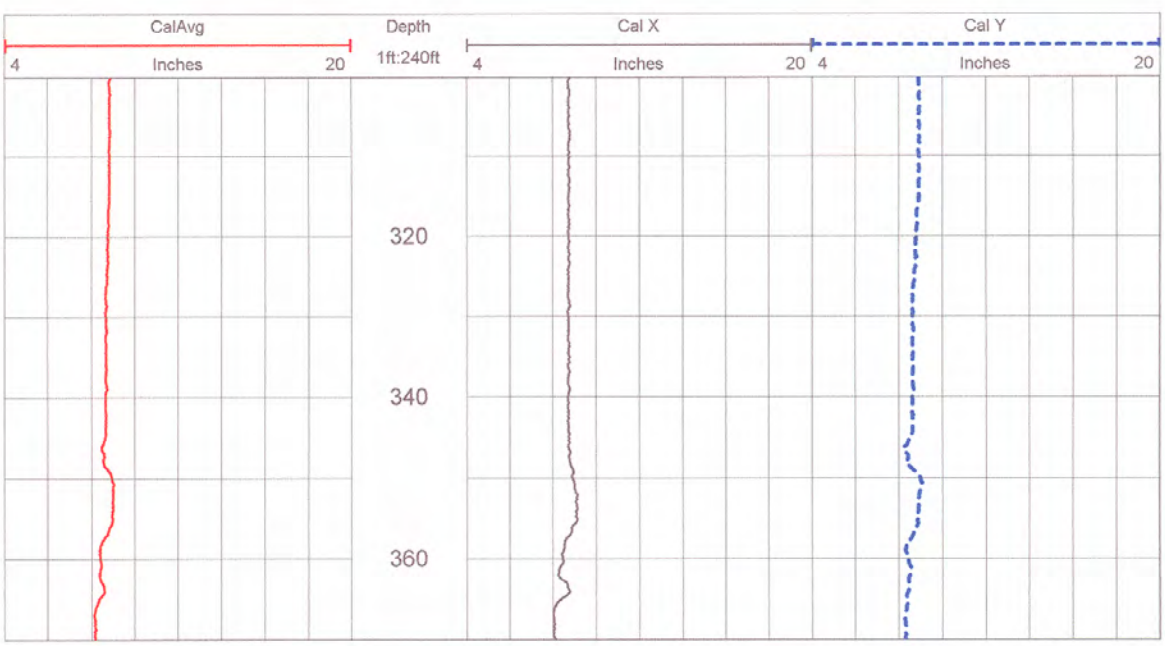
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
1440
1460
CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20

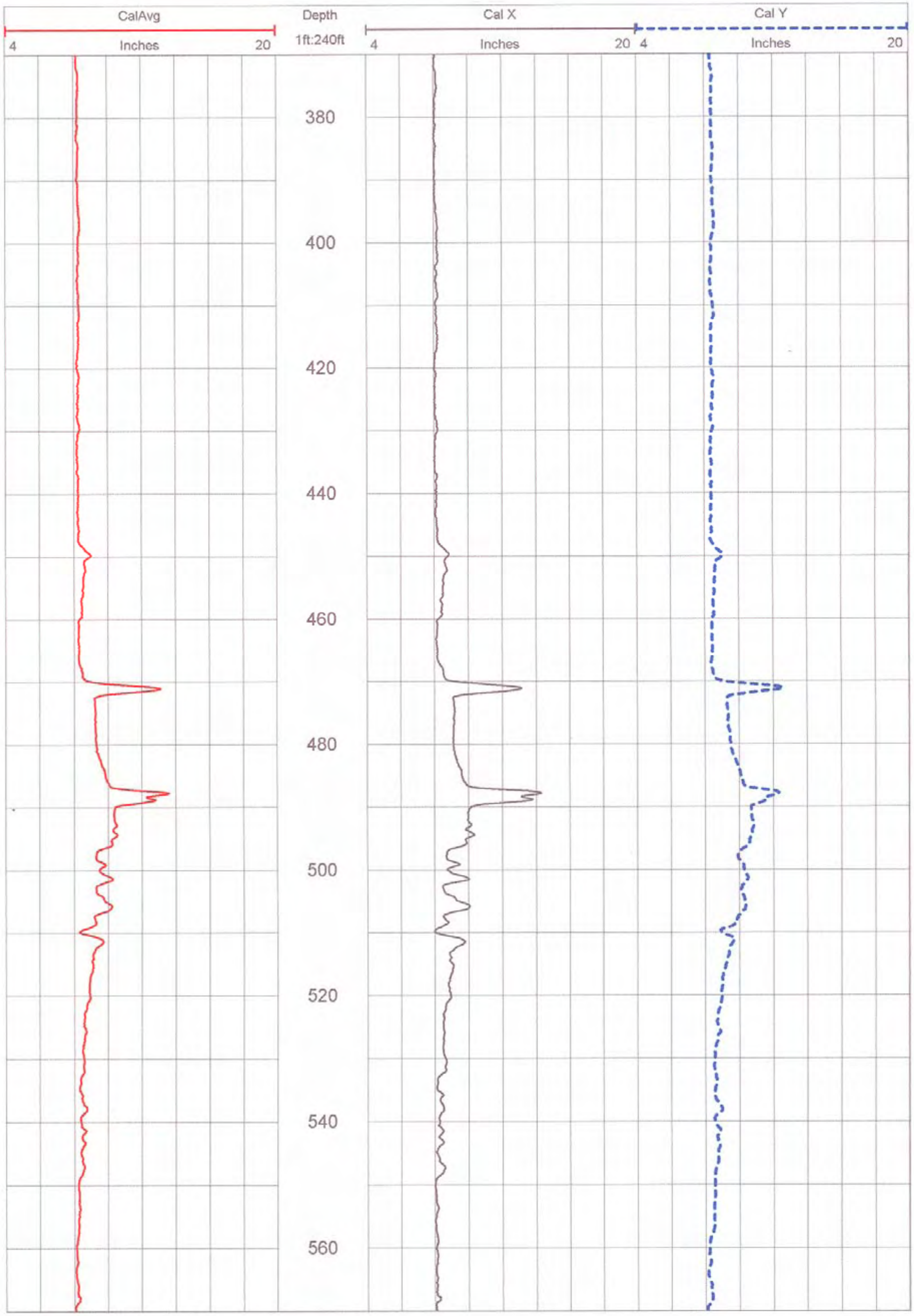
ENERGYSOLUTIONS

CO	COMPANY USDOE/PNNL		
WELL	WELL ID C4996		
FLD	FIELD WTP		
CTY	COUNTRY USA	STATE WASHINGTON	
STE	LOCATION N136052.91E E576144.83 WASHINGTON STATE PLANE METRIC COORDINATES		OTHER SERVICES GYRO ATV
FILING No	SEC	TWP	RGE
PERMANENT DATUM	GL	ELEVATION 204.28 M	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GL		G.L.

DATE	11/2/06	TYPE FLUID IN HOLE	WATER BASED WITH GEL
RUN No	TWO	SALINITY	
TYPE LOG	4 ARM CALIPER	DENSITY	8.4 PPG
DEPTH-DRILLER	1468.7	LEVEL	30 FT
DEPTH-LOGGER	1471	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	1470.8		
TOP LOGGED INTERVAL	349.8		
OPERATING RIG TIME	3 HRS		
RECORDED BY	B. RANDALL/M. MEISNER		
WITNESSED BY	A. ROHAY		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	7 7/8	370	1470.8	13 3/8		0	200
				9 5/8		200	368




CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
380
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420
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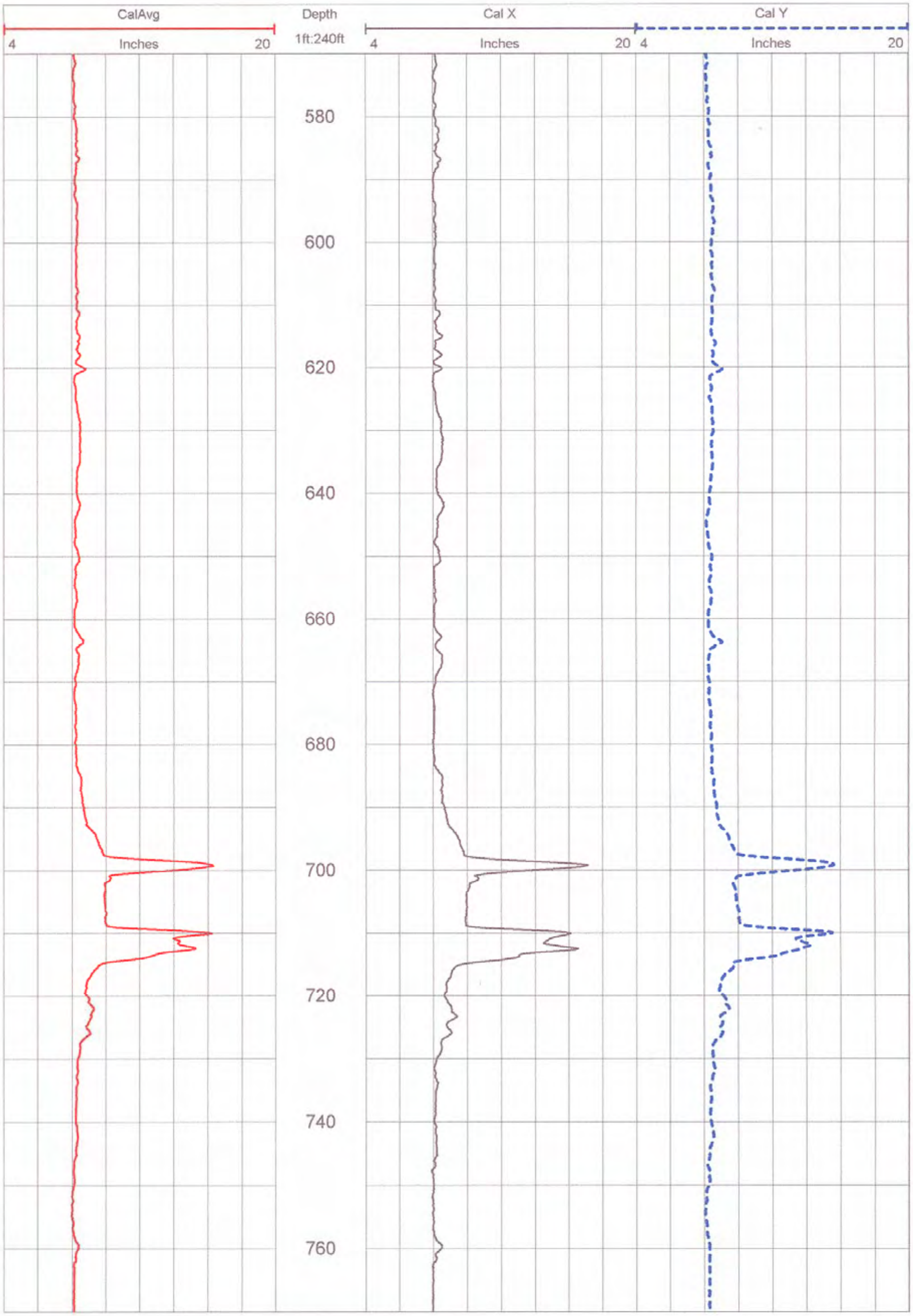
480
500
520
540
560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4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
580
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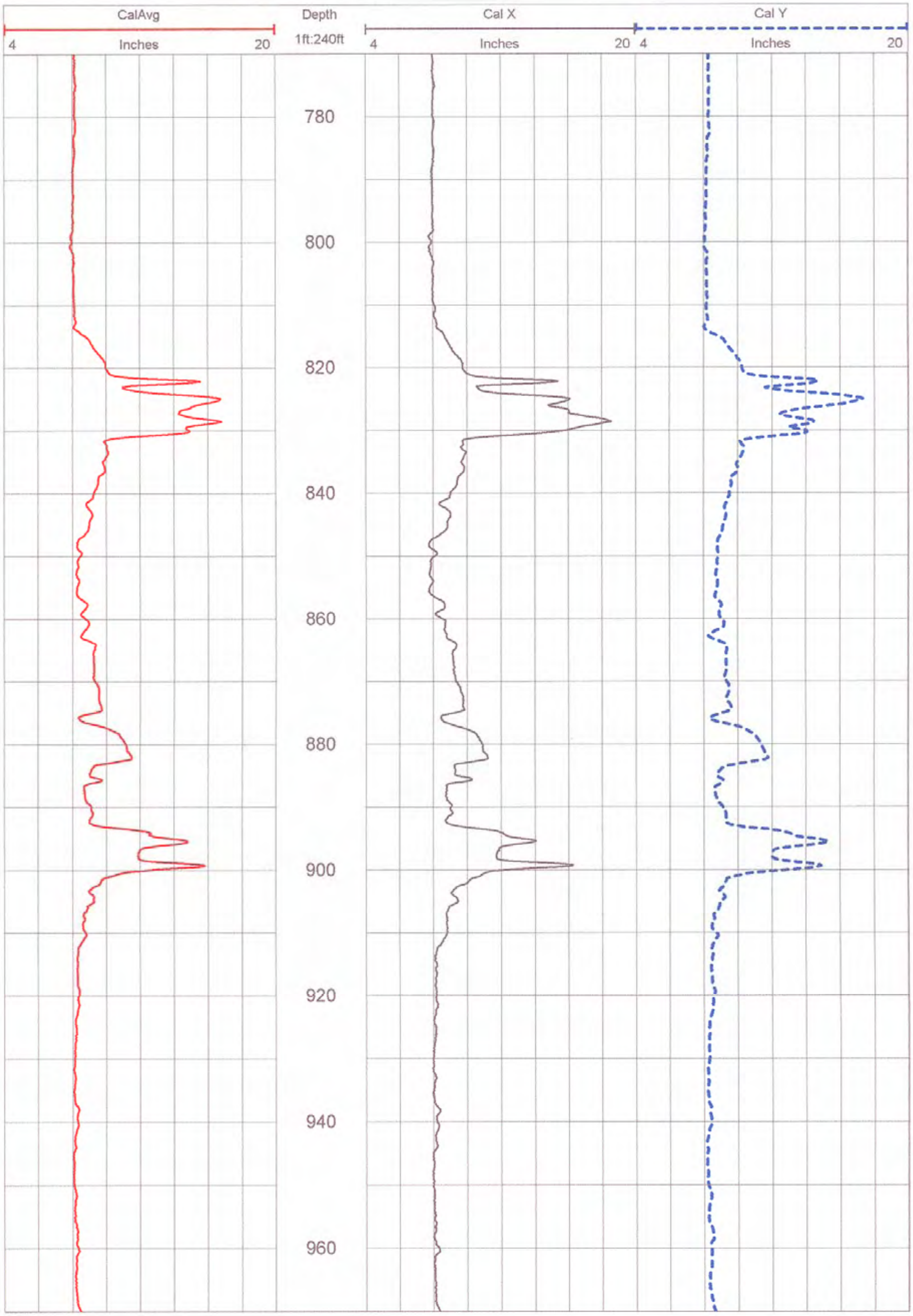
680
700
720
740
760


CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
780
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820
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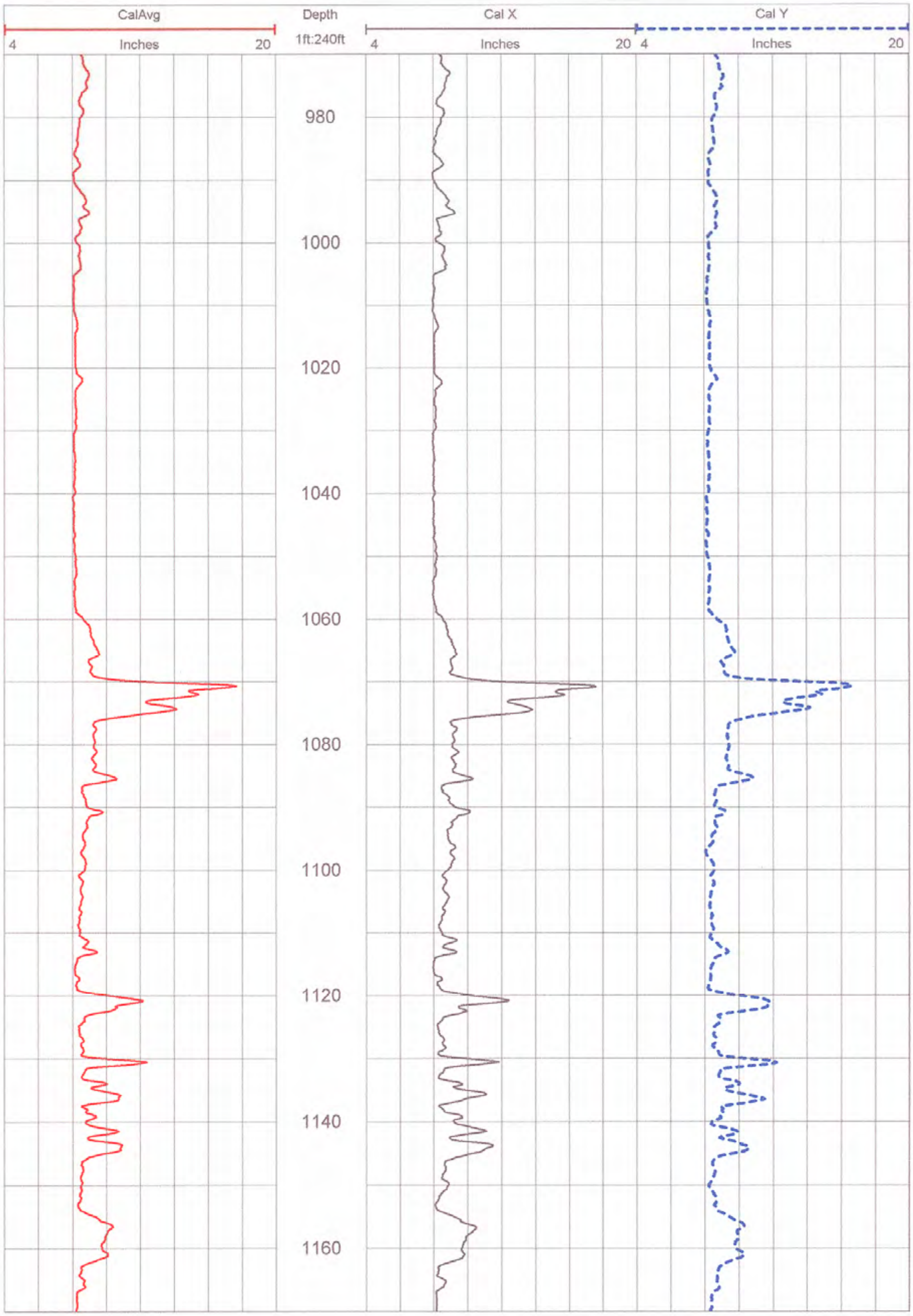
880
900
920
940
960


CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
980
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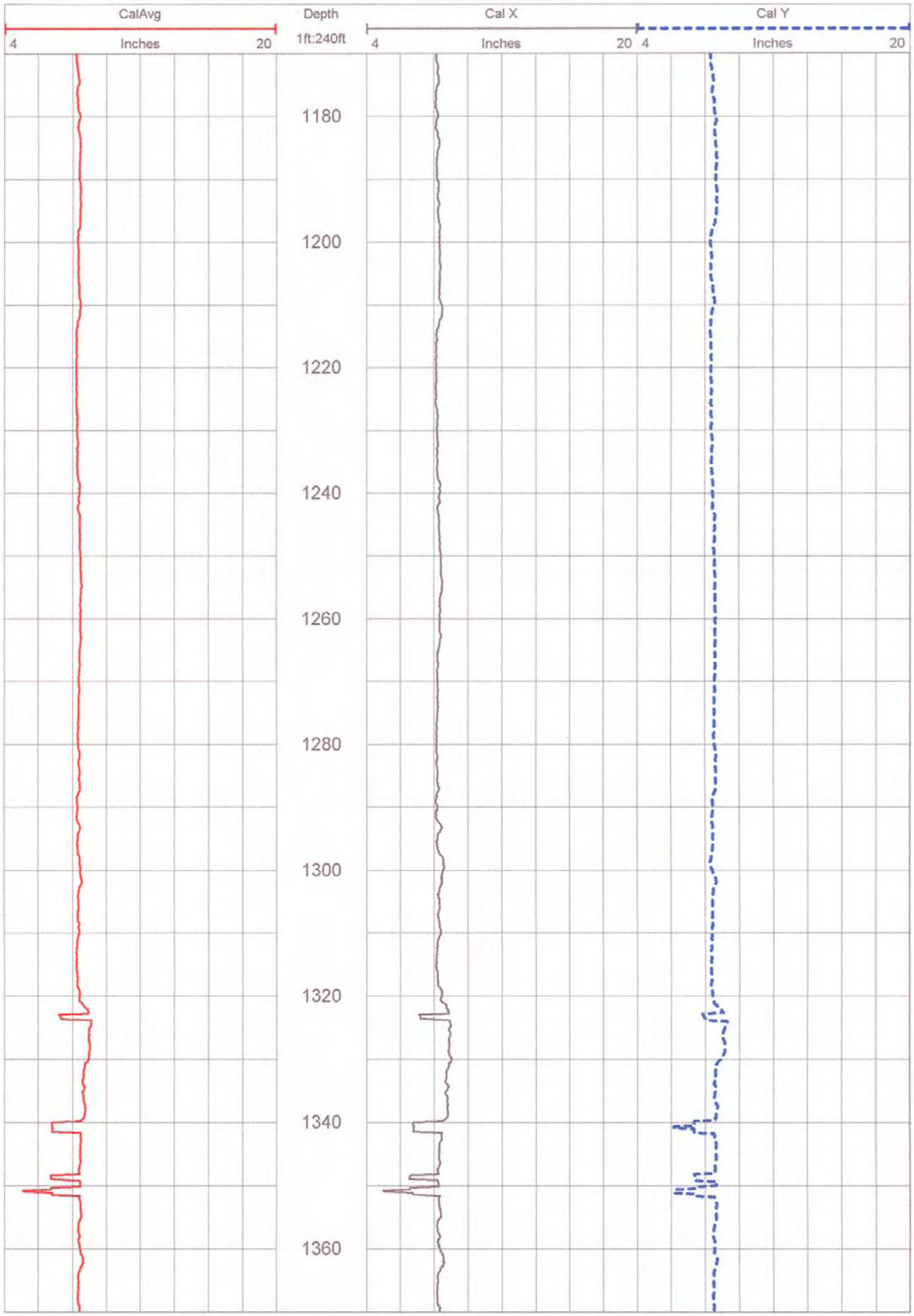
1100
1120
1140
1160


CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
1180
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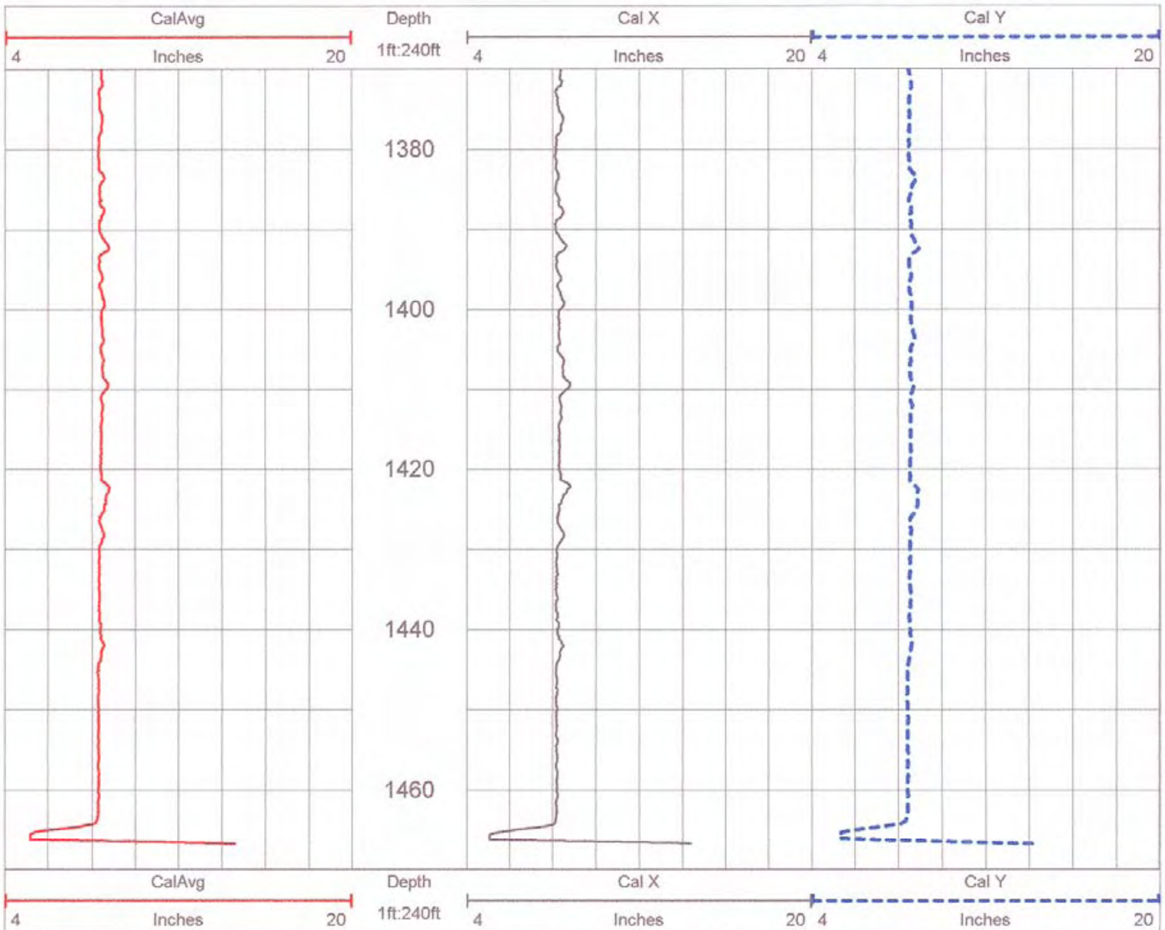
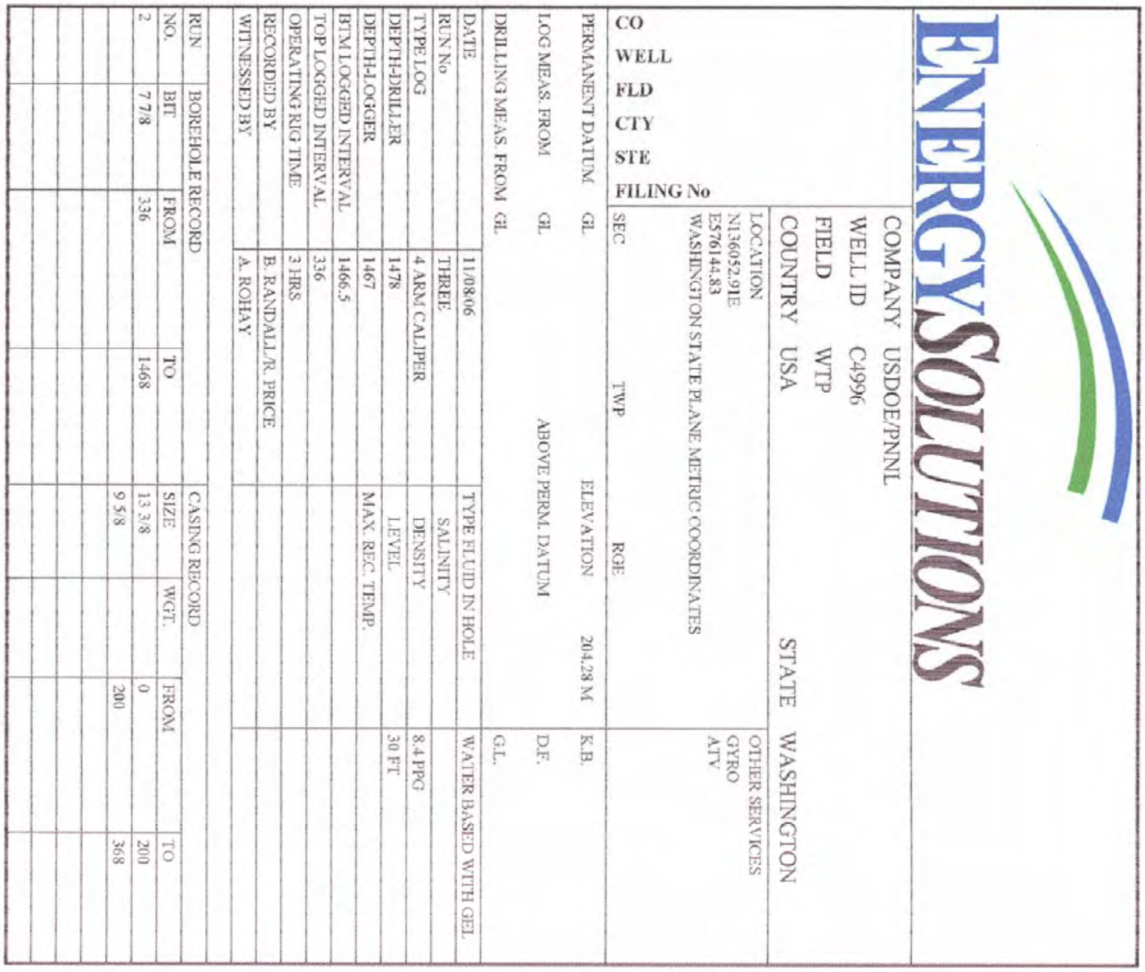
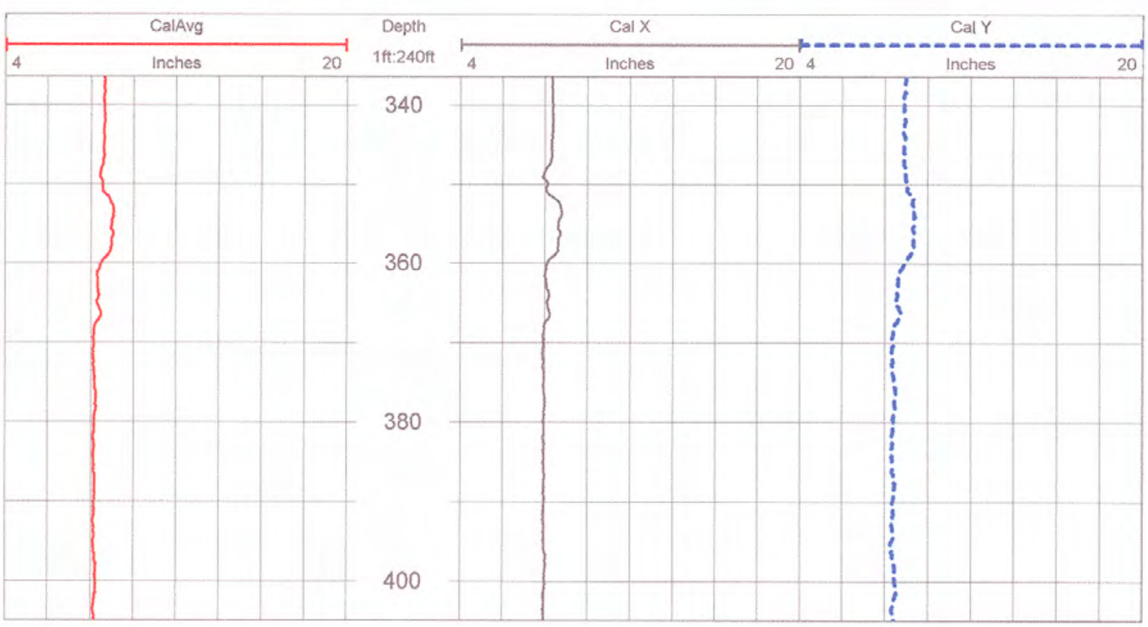
1300
1320
1340
1360


CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
1380
1400
1420
1440
1460
CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20


ENERGYSOLUTIONS
CO
WELL
FLD
CTY
STE
FILING No
COMPANY USDOE/PNNL
WELL ID C4996
FIELD WTP
COUNTRY USA
STATE WASHINGTON
LOCATION
N136052.91E
E576144.83
WASHINGTON STATE PLANE METRIC COORDINATES
OTHER SERVICES
GYRO
ATV
SEC
TWP
RGE
PERMANENT DATUM GL
ELEVATION 204.28 M
K.B.
LOG MEAS. FROM GL
ABOVE PERM. DATUM
D.F.
DRILLING MEAS FROM GL
G.L.
DATE 11/08/06
TYPE FLUID IN HOLE WATER BASED WITH GEL
RUN No THREE
SALINITY
TYPE LOG 4 ARM CALIPER
DENSITY 8.4 PPG
DEPTH-DRILLER 1478
LEVEL 30 FT
DEPTH-LOGGER 1467
MAX. REC. TEMP.
BTM LOGGED INTERVAL 1466.5
TOP LOGGED INTERVAL 336
OPERATING RIG TIME 3 HRS
RECORDED BY B. RANDALL/R. PRICE
WITNESSED BY A. ROHAY
RUN
BOREHOLE RECORD
NO.
BIT
FROM
TO
2
7 7/8
336
1468
CASING RECORD
SIZE
WGT.
FROM
TO
13 3/8
0
200
9 5/8
200
368


CalAvg
4
Inches
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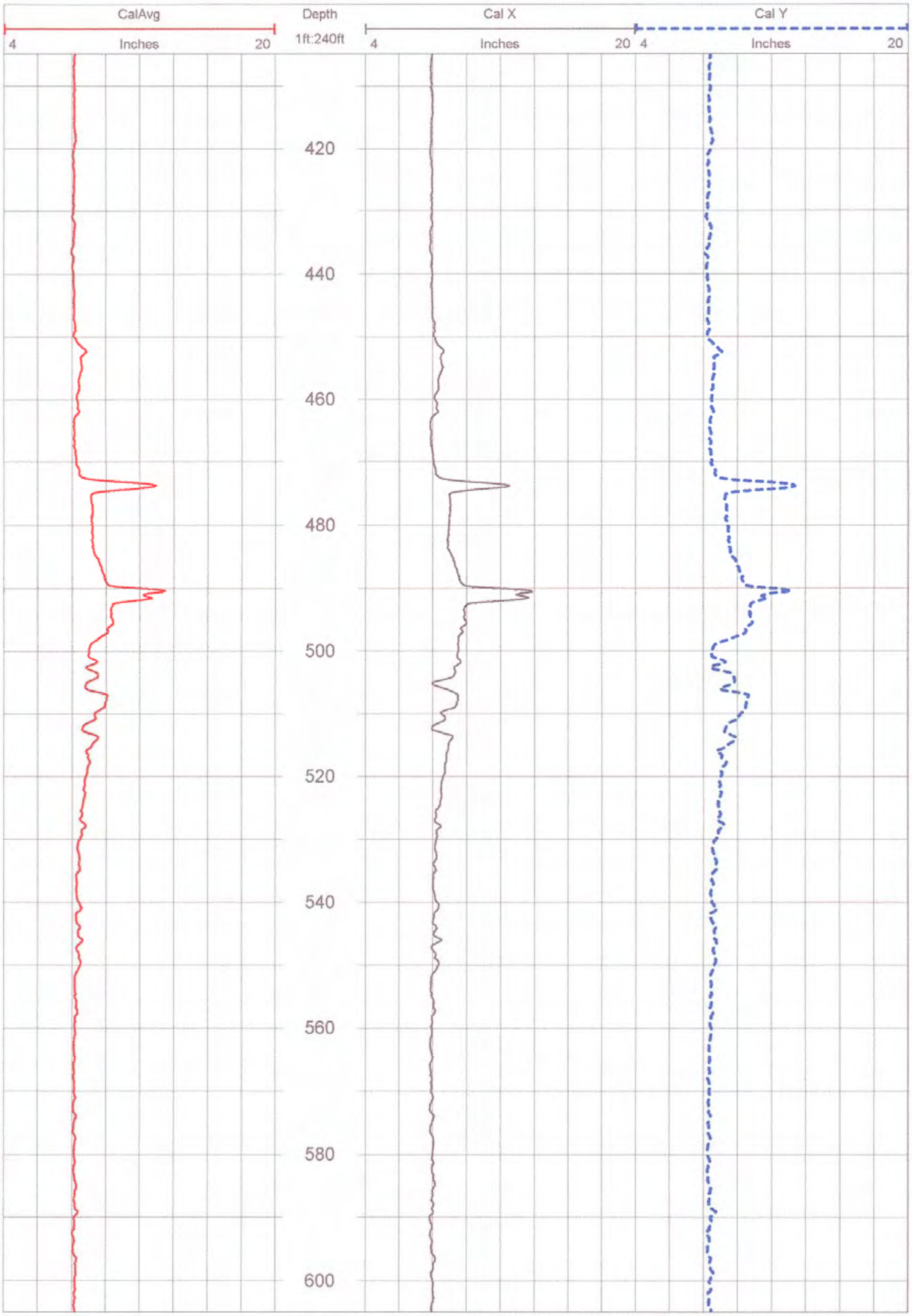
Depth
1ft:240ft
340
360
380
400
Cal X
4
Inches
20
Cal Y
4
Inches
20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4
Inches
20
Depth
1ft:240ft
Cal X
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Inches
20
Cal Y
4
Inches
20
420
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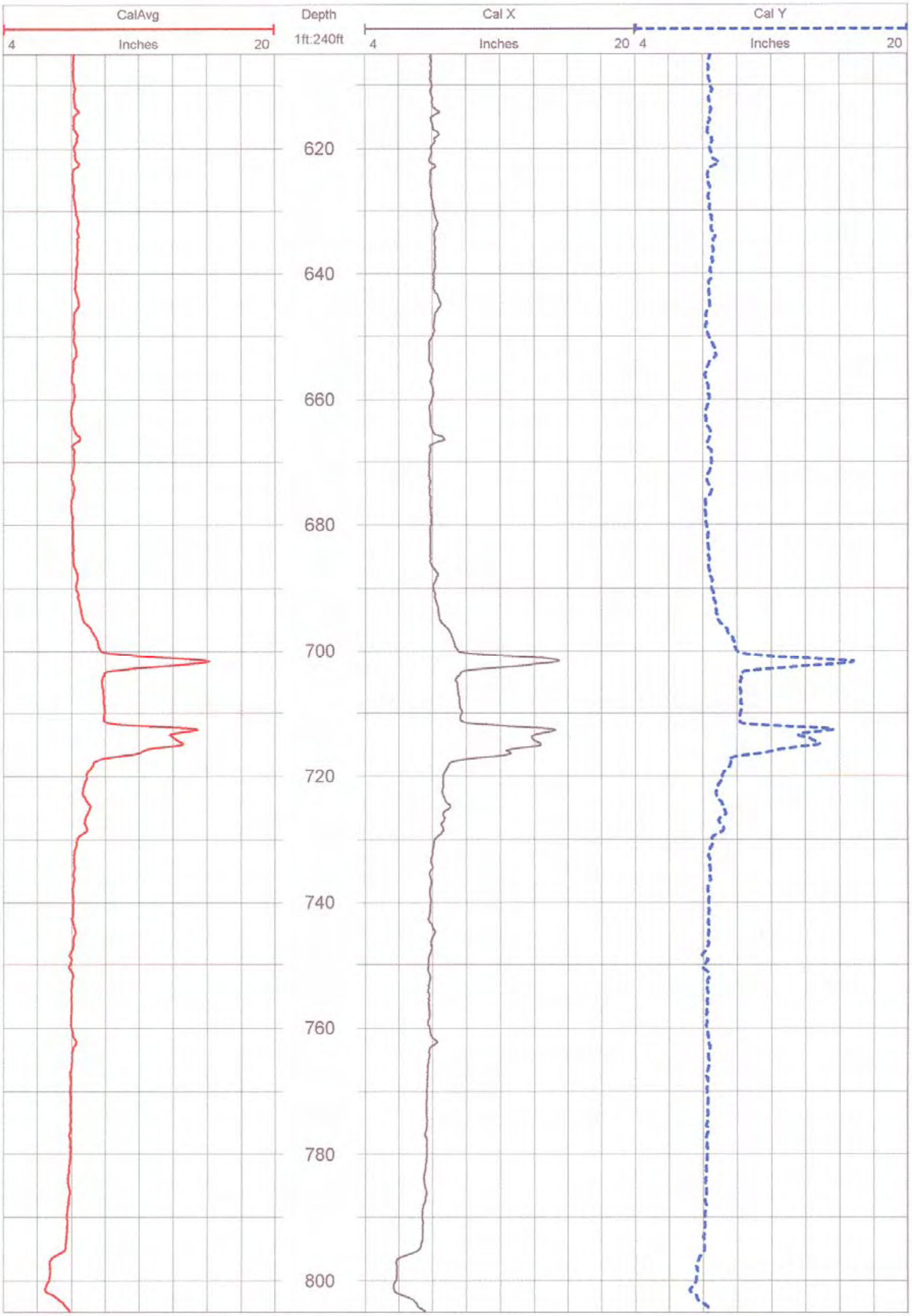
520
540
560
580
600


CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
620
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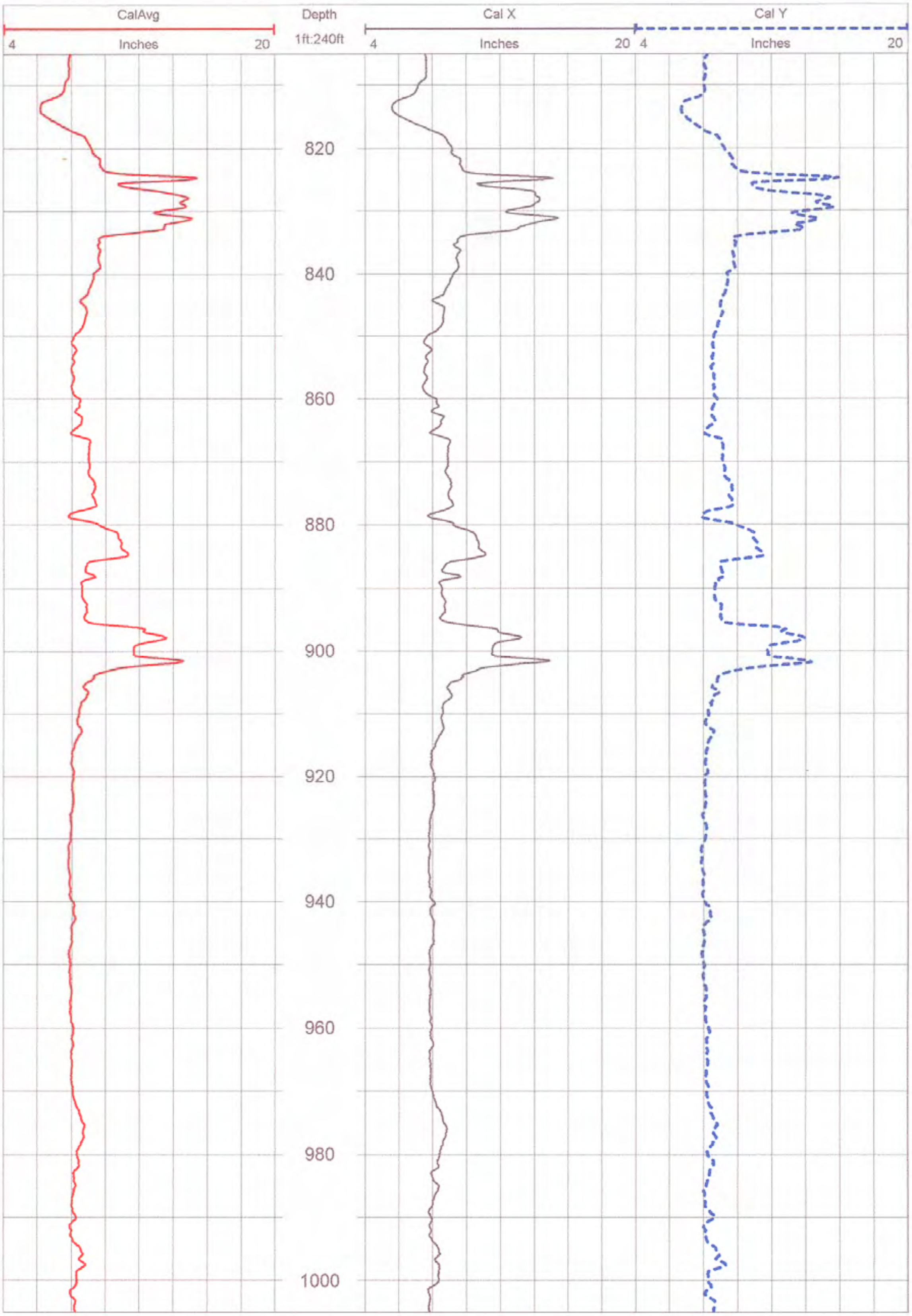
720
740
760
780
800


CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
820
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860
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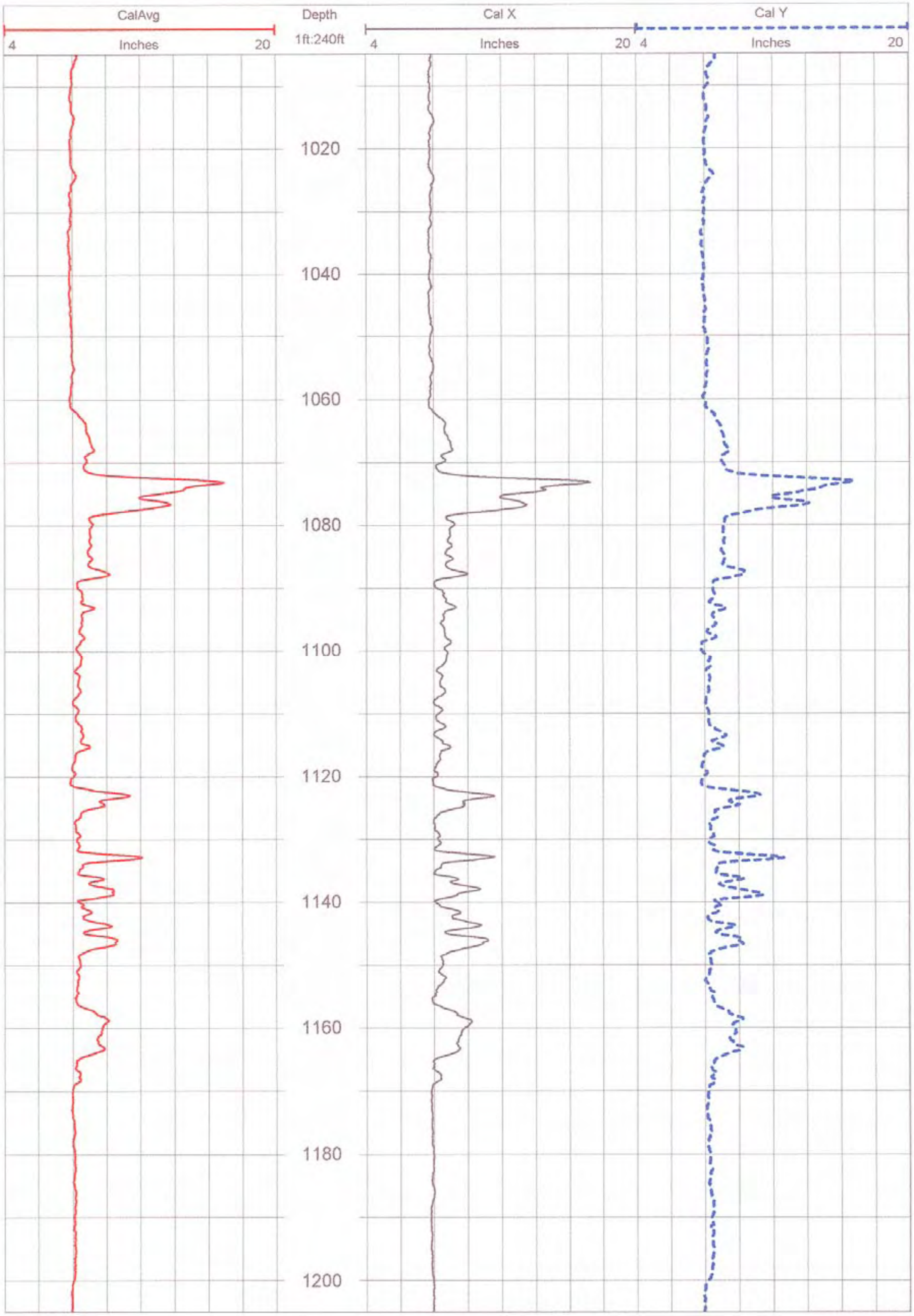
920
940
960
980
1000



CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
1020
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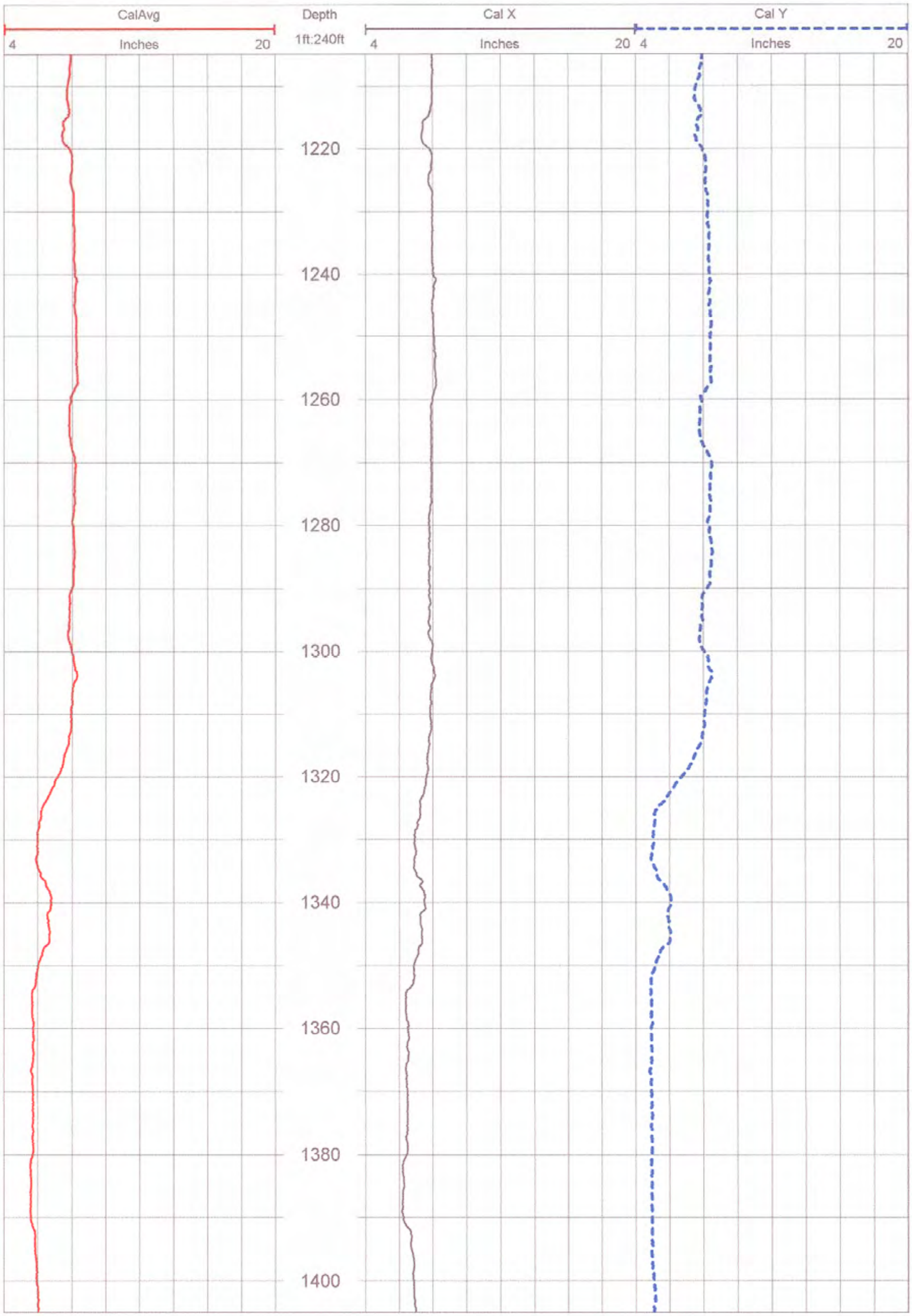
1140
1160
1180
1200


CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
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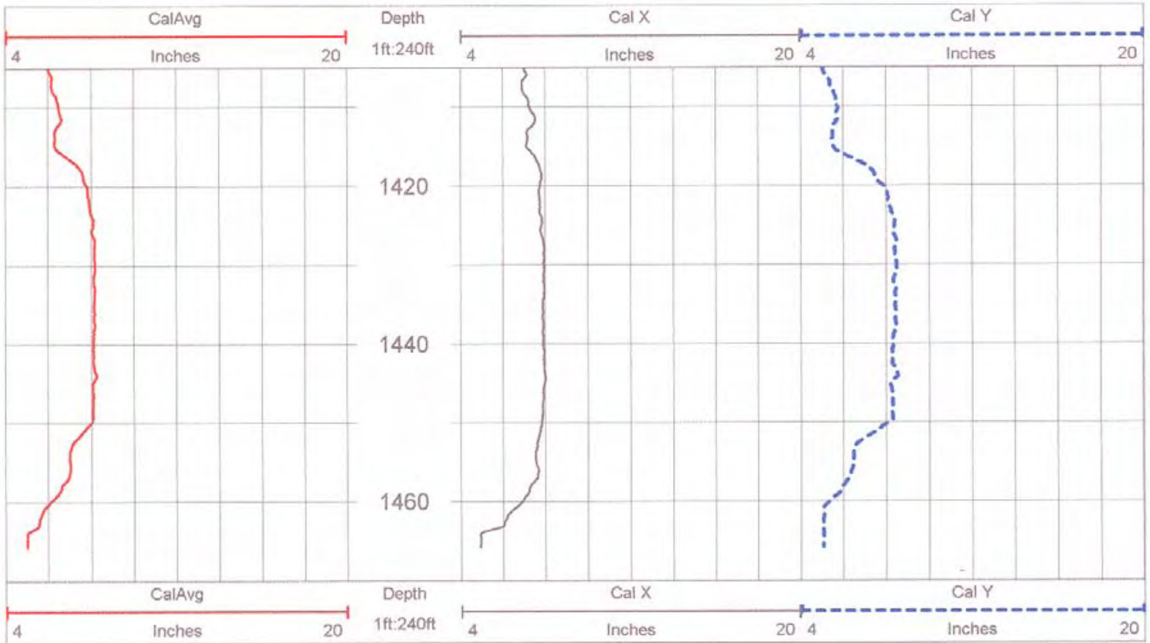
1360
1380
1400



CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
1420
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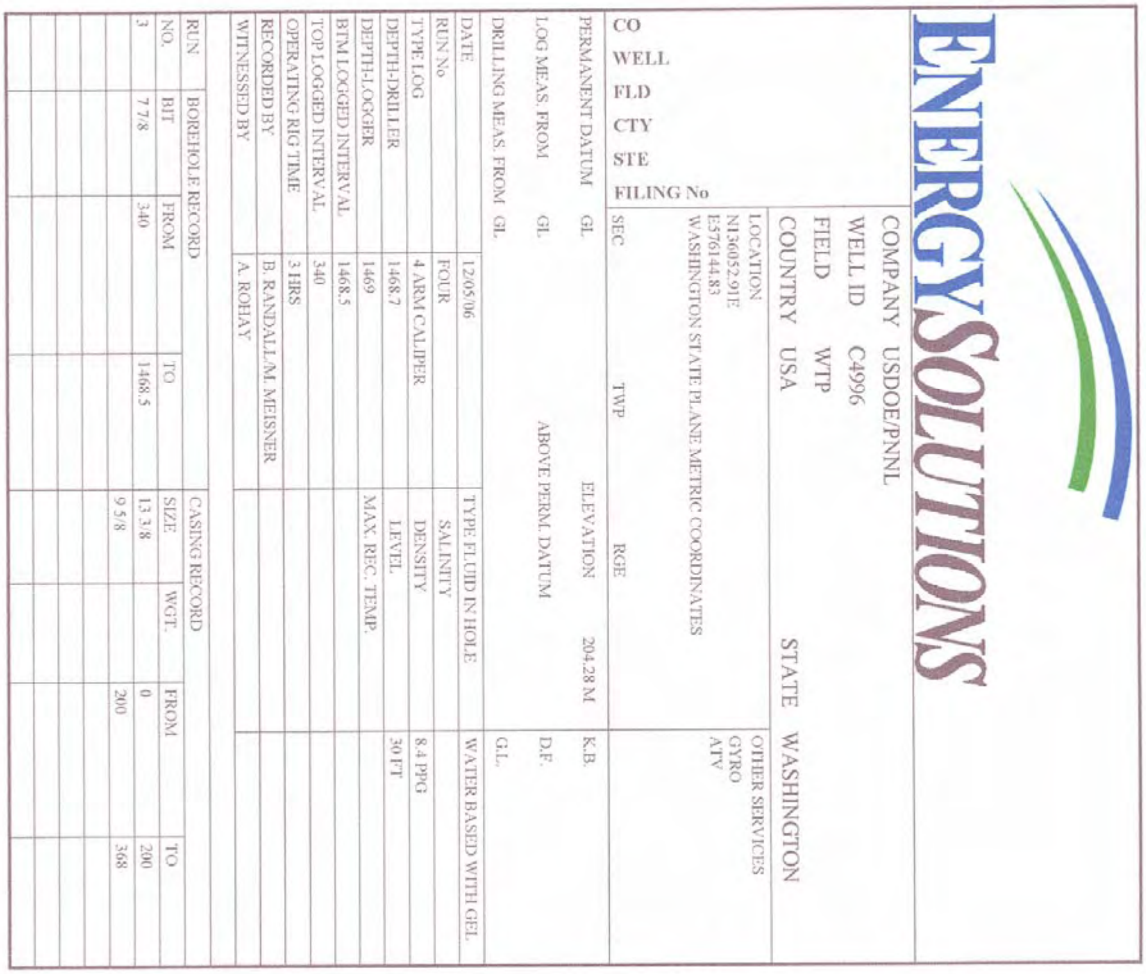
20
Cal Y
4
Inches
20



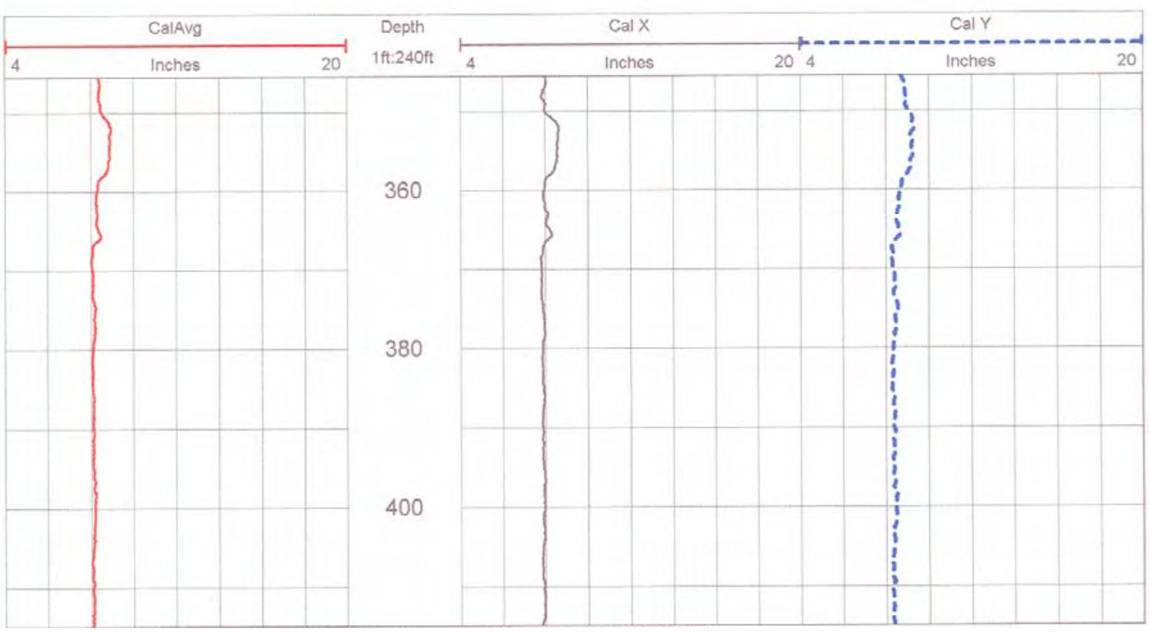
ENERGYSOLUTIONS

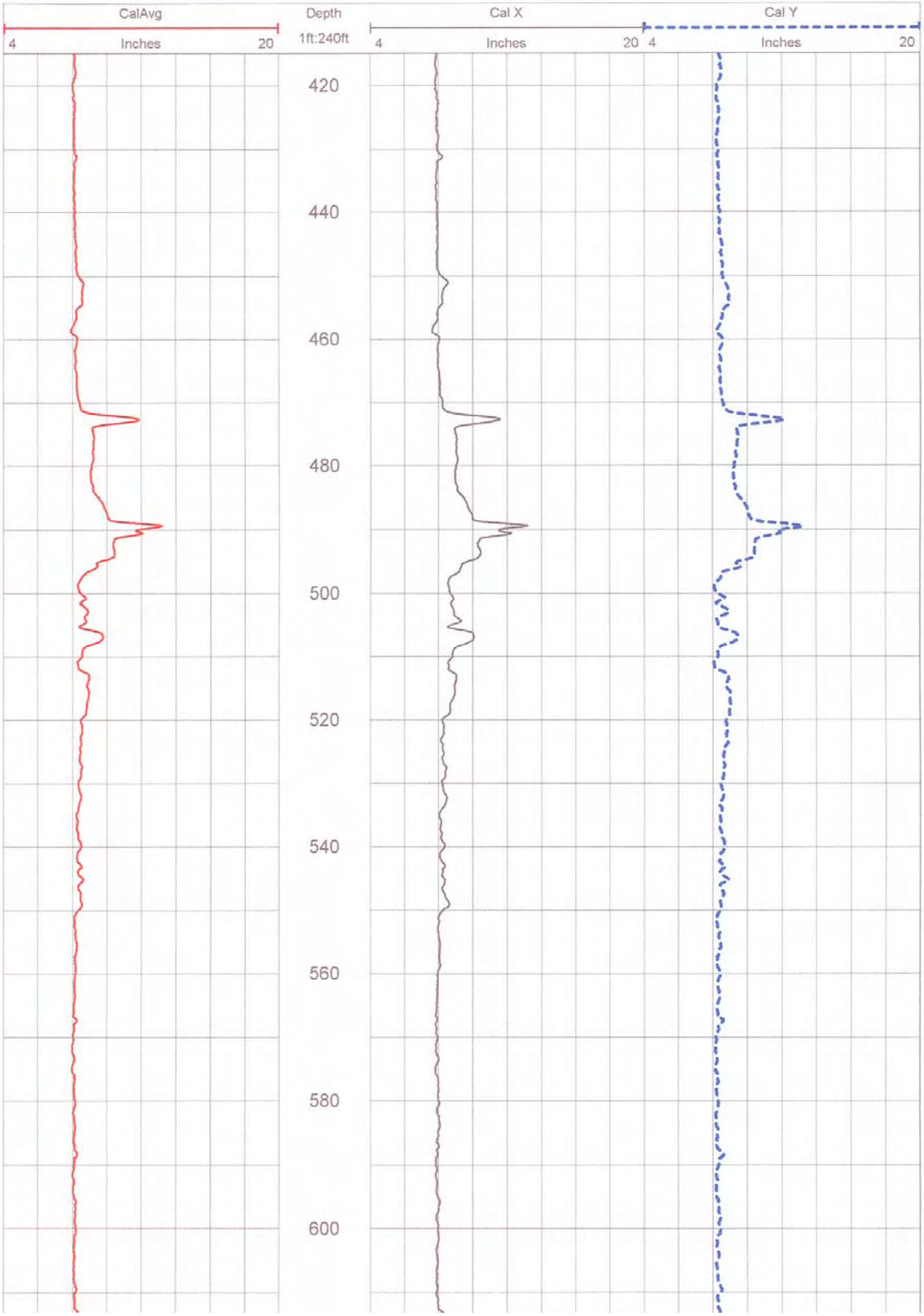
CO	COMPANY	USDOE/PNNL	
WELL	WELL ID	C4996	
FLD	FIELD	WTP	
CTY	COUNTRY	USA	STATE WASHINGTON
STE	LOCATION N136052.91E E576144.83 WASHINGTON STATE PLANE METRIC COORDINATES		OTHER SERVICES GYRO ATV
FILING No	SEC	TWP	RGE

PERMANENT DATUM	GL	ELEVATION	204.28 M	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM	GL			G.L.

DATE	12/05/06	TYPE FLUID IN HOLE	WATER BASED WITH GEL
RUN No	FOUR	SALINITY	
TYPE LOG	4 ARM CALIPER	DENSITY	8.4 PPG
DEPTH-DRILLER	1468.7	LEVEL	30 FT
DEPTH-LOGGER	1469	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	1468.5		
TOP LOGGED INTERVAL	340		
OPERATING RIG TIME	3 HRS		
RECORDED BY	B. RANDALL/M. MEISNER		
WITNESSED BY	A. ROHAY		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
3	7 7/8	340	1468.5	13 3/8		0	200
				9 5/8		200	368




CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
420
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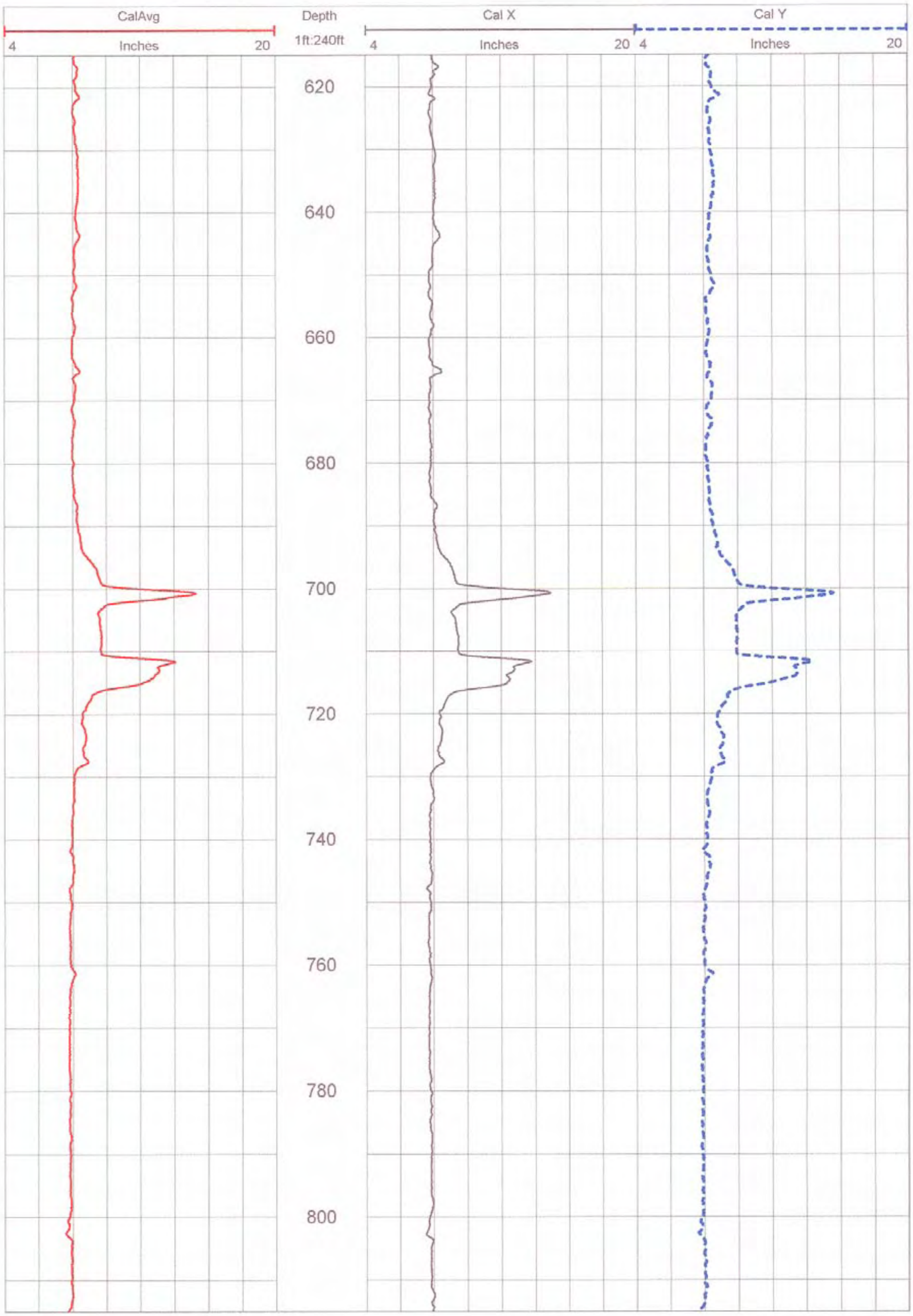
520
540
560
580
600


CalAvg
Depth
Cal X
Cal Y
4
Inches
20
1ft:240ft
4
Inches
20
4
Inches
20
620
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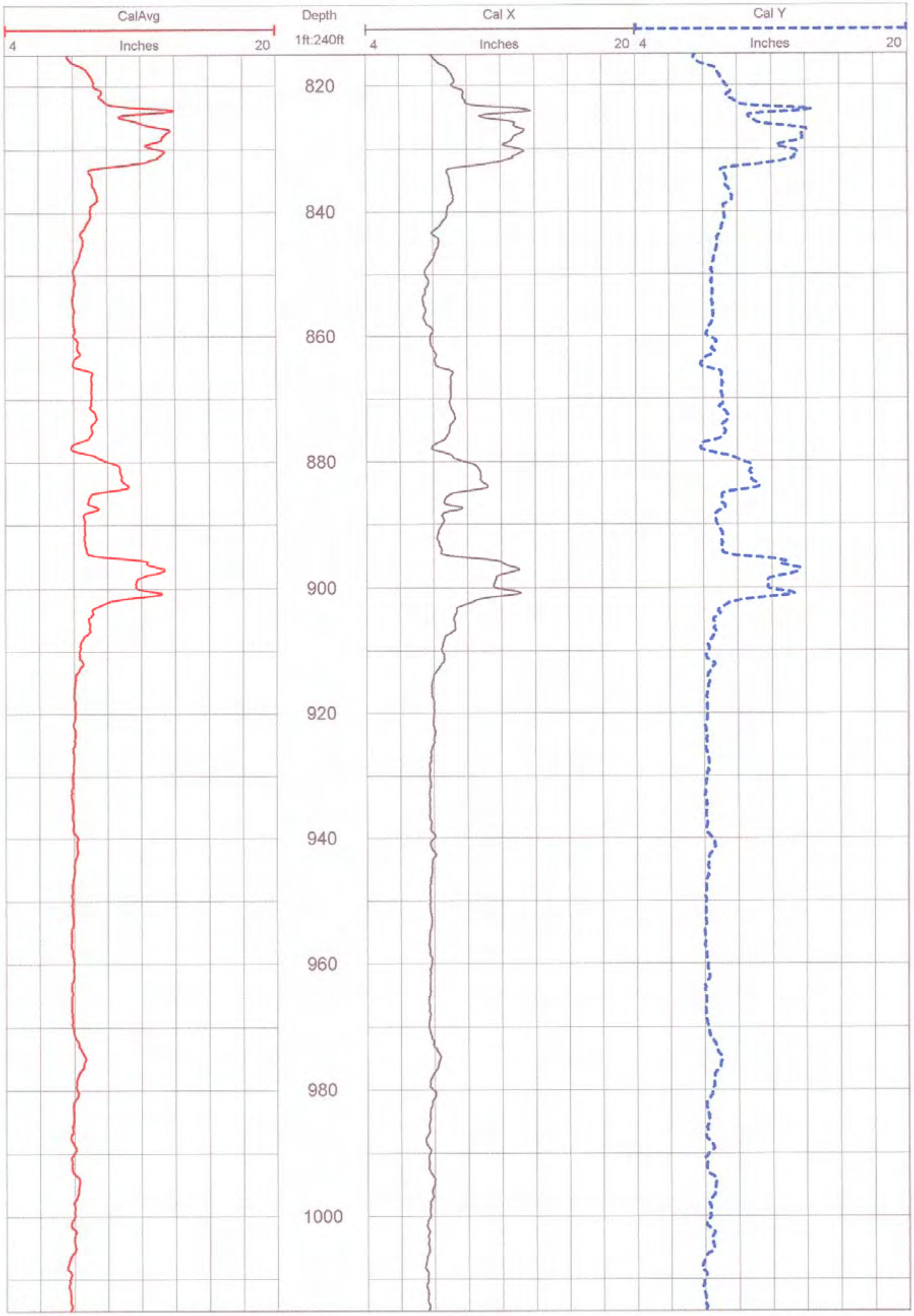
720
740
760
780
800


CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
820
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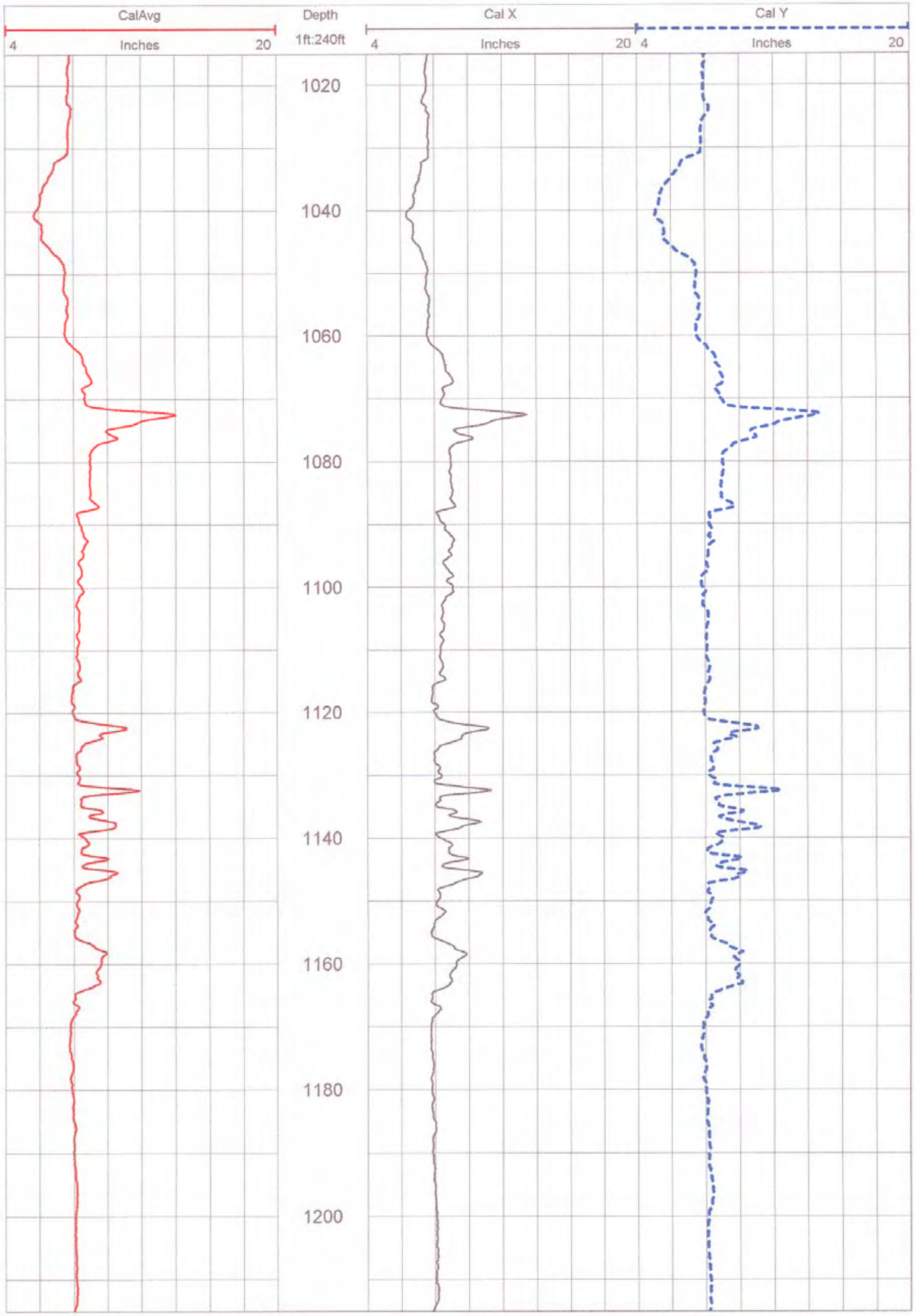
920
940
960
980
1000


CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20
1020
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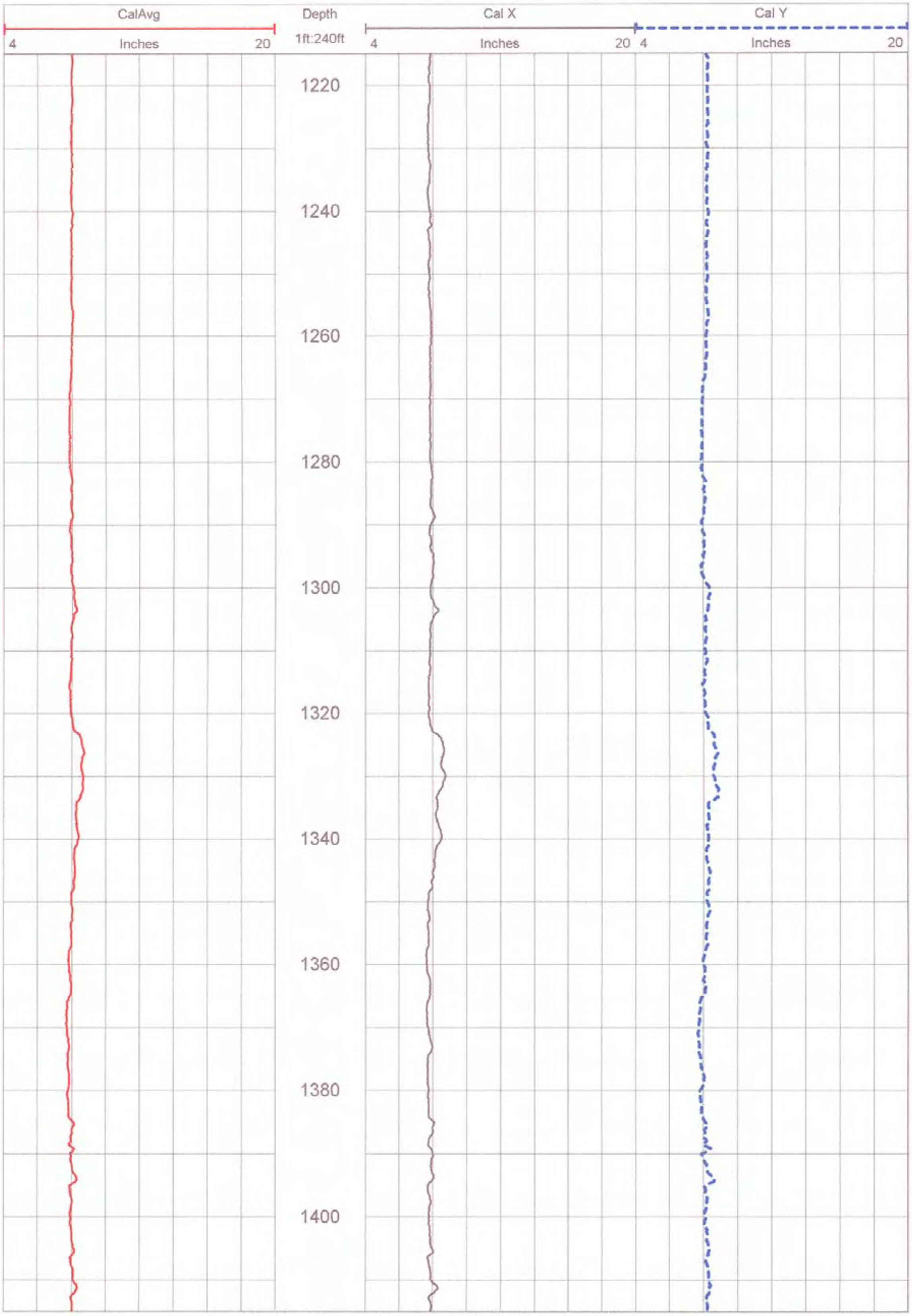
1140
1160
1180
1200


CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
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Inches
20
1220
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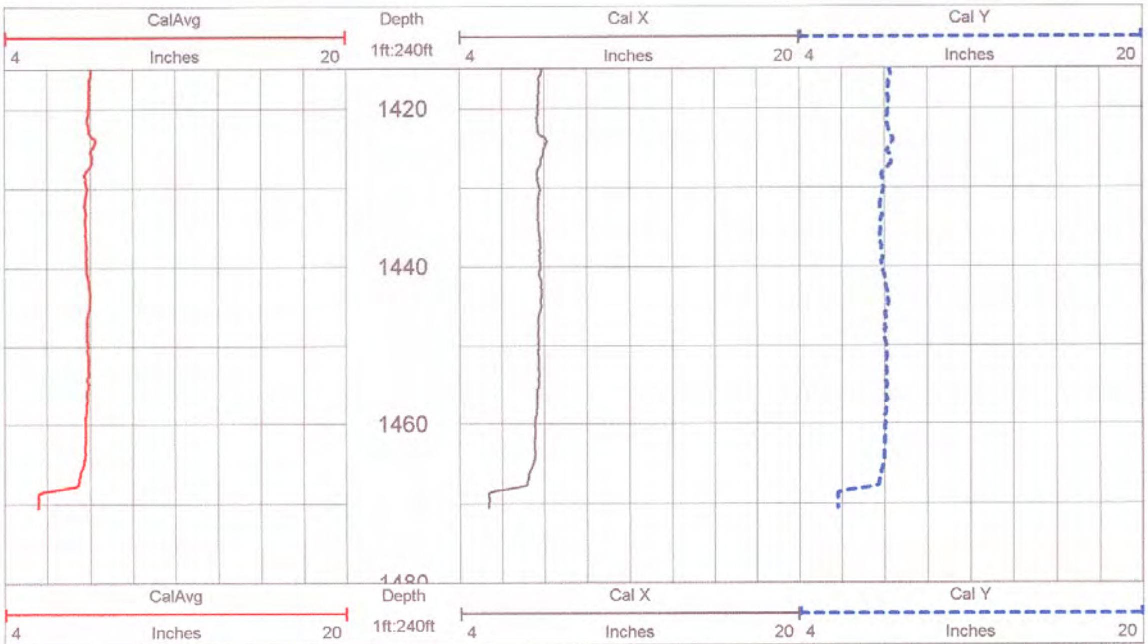
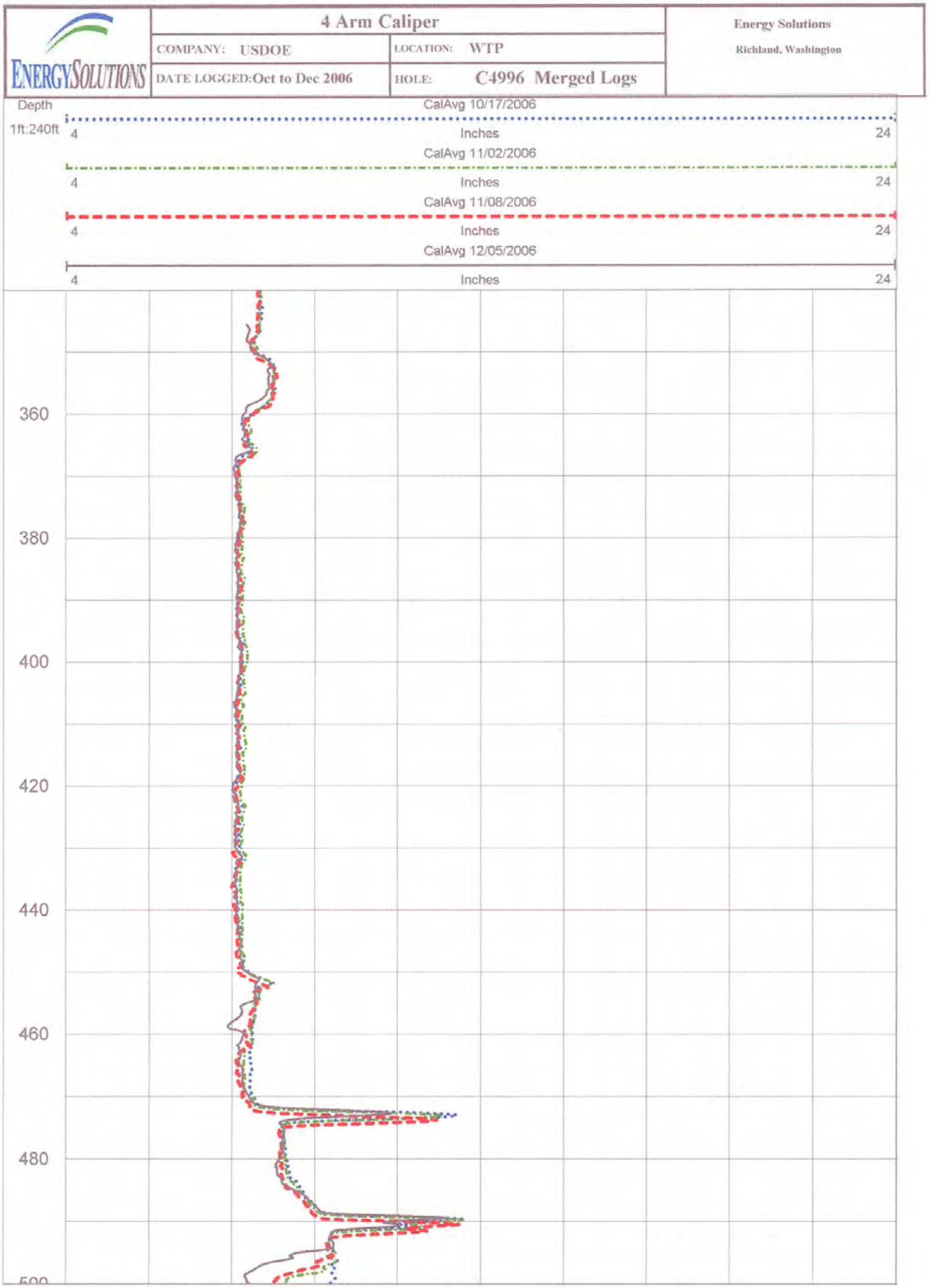
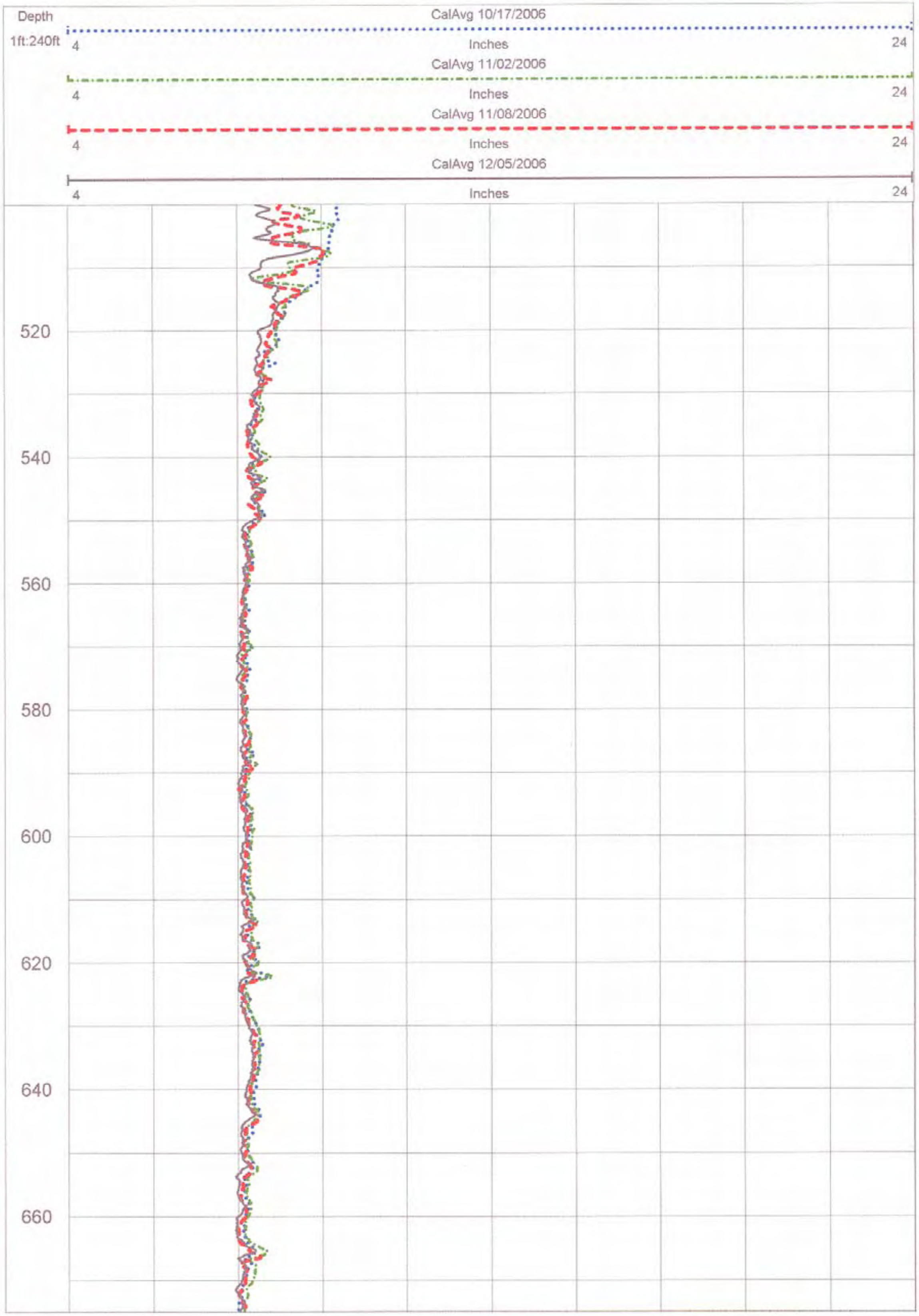
1340
1360
1380
1400


CalAvg
4
Inches
20
Depth
1ft:240ft
1420
1440
1460
1480
Cal X
4
Inches
20
Cal Y
4
Inches
20
CalAvg
4
Inches
20
Depth
1ft:240ft
Cal X
4
Inches
20
Cal Y
4
Inches
20



ENERGYSOLUTIONS
4 Arm Caliper
COMPANY: USDOE
LOCATION: WTP
DATE LOGGED:Oct to Dec 2006
HOLE: C4996 Merged Logs
Energy Solutions
Richland, Washington
Depth
1ft:240ft
CalAvg 10/17/2006
4 Inches 24
CalAvg 11/02/2006
4 Inches 24
CalAvg 11/08/2006
4 Inches 24
CalAvg 12/05/2006
4 Inches 24
360
380
400
420
440
460
480
500


Depth
1ft:240ft
CalAvg 10/17/2006
4
Inches
24
CalAvg 11/02/2006
4
Inches
24
CalAvg 11/08/2006
4
Inches
24
CalAvg 12/05/2006
4
Inches
24
520
540
560
580
600
620
640
660

Depth
1ft:240ft
CalAvg 10/17/2006
4
Inches
24
CalAvg 11/02/2006
4
Inches
24
CalAvg 11/08/2006
4
Inches
24
CalAvg 12/05/2006
4
Inches
24
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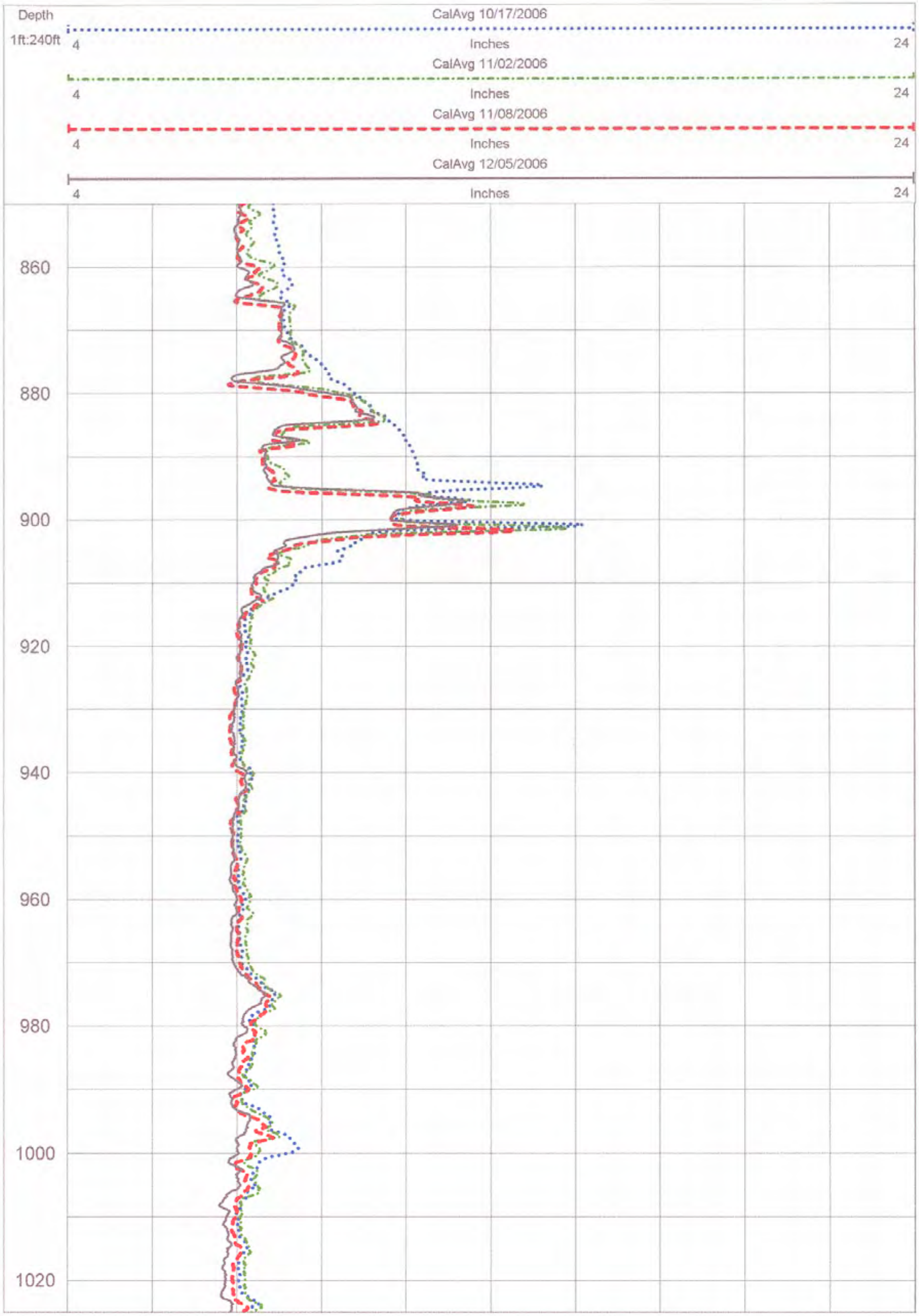
760
780
800
820
840


Depth
1ft:240ft
CalAvg 10/17/2006
4 Inches 24
CalAvg 11/02/2006
4 Inches 24
CalAvg 11/08/2006
4 Inches 24
CalAvg 12/05/2006
4 Inches 24
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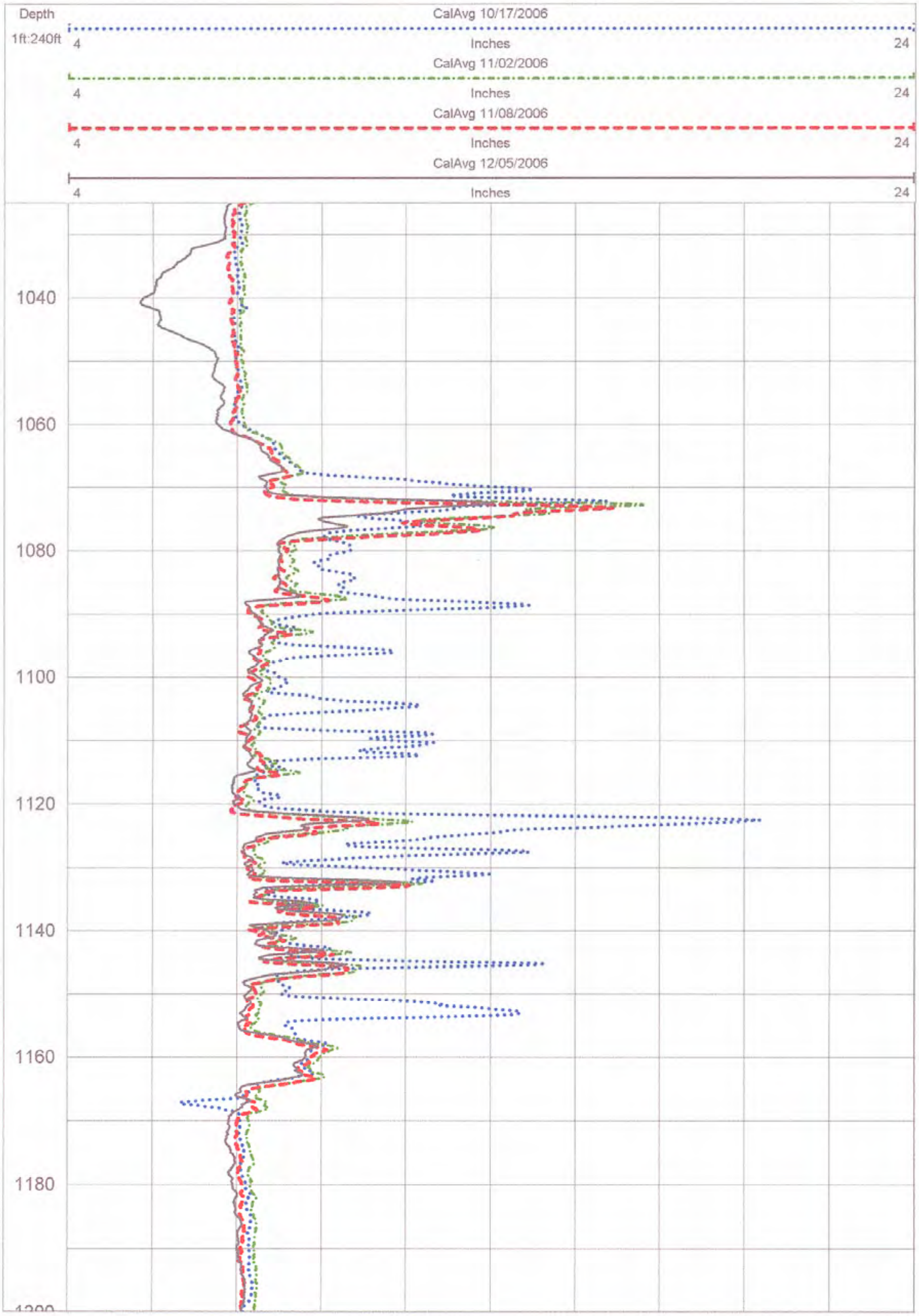
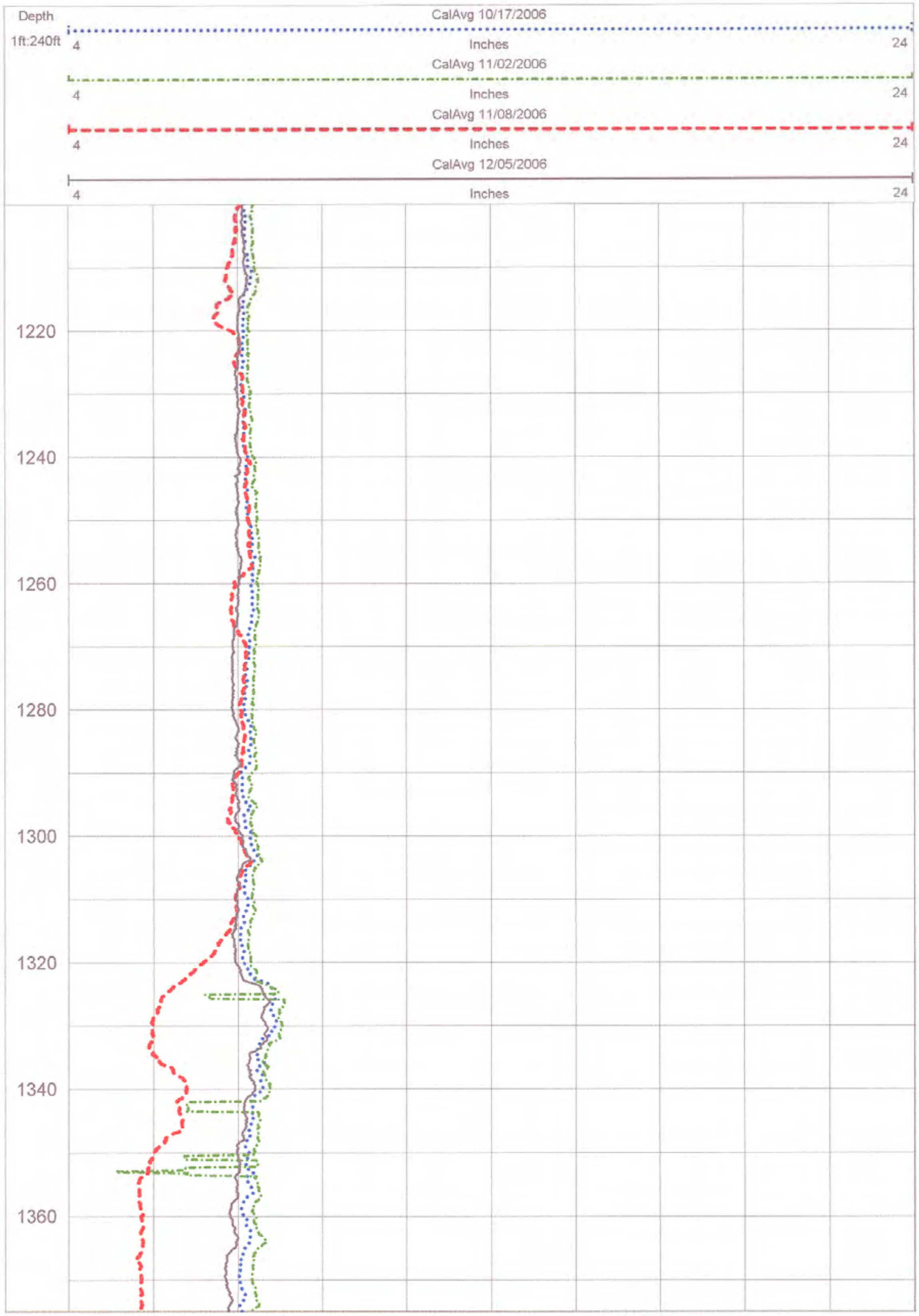
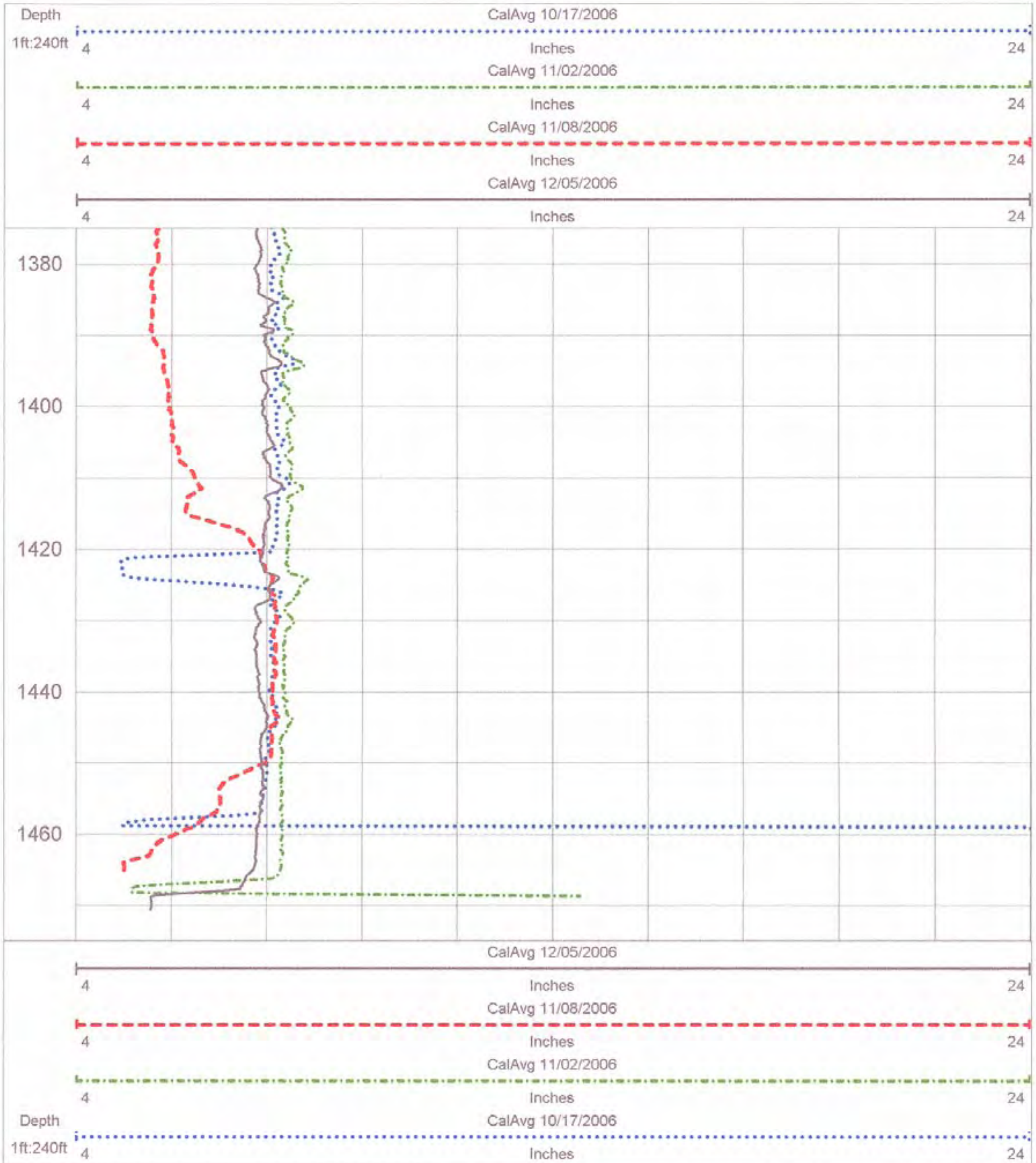
940
960
980
1000
1020



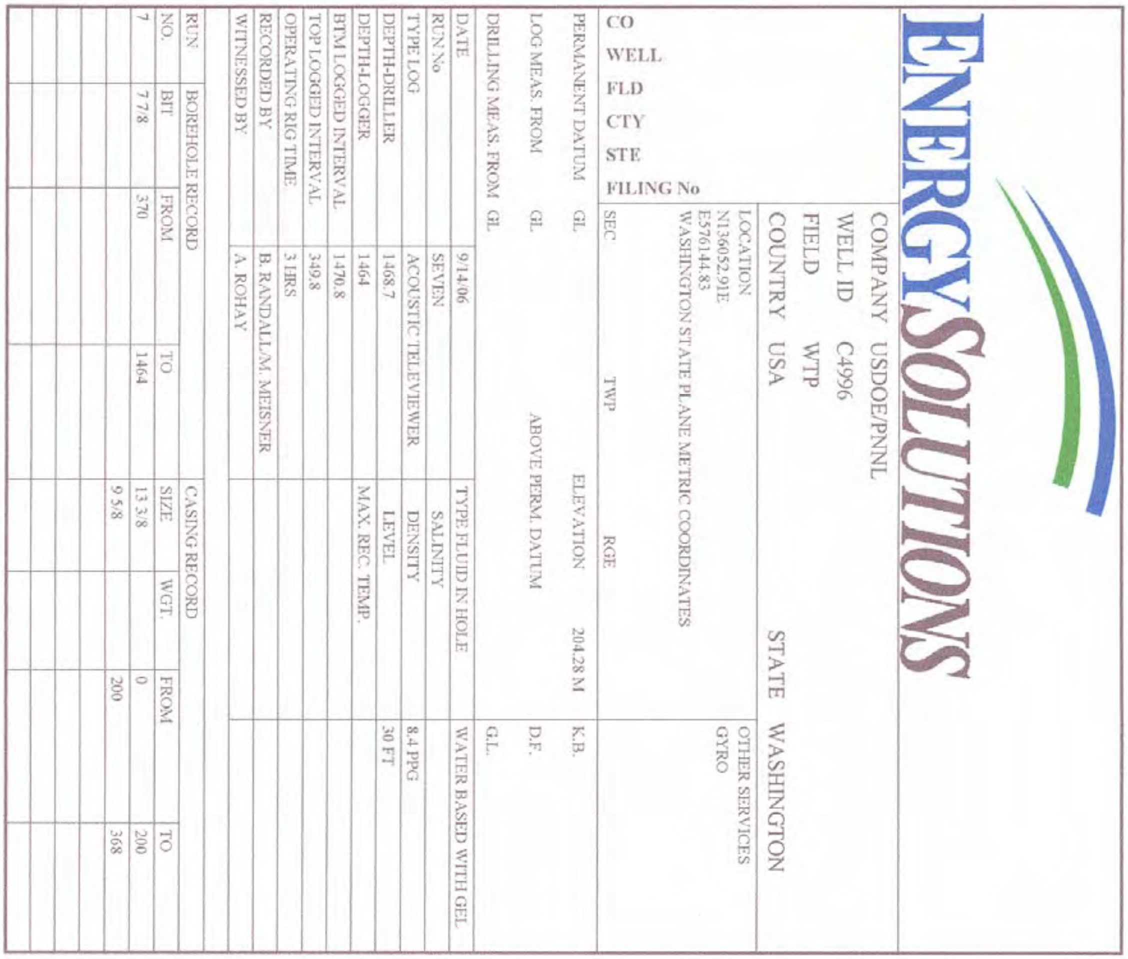
Depth
1ft:240ft
CalAvg 10/17/2006
4
Inches
24
CalAvg 11/02/2006
4
Inches
24
CalAvg 11/08/2006
4
Inches
24
CalAvg 12/05/2006
4
Inches
24
1040
1060
1080
1100
1120
1140
1160
1180


Depth
1ft:240ft
CalAvg 10/17/2006
4
Inches
24
CalAvg 11/02/2006
4
Inches
24
CalAvg 11/08/2006
4
Inches
24
CalAvg 12/05/2006
4
Inches
24
1220
1240
1260
1280
1300
1320
1340
1360



Depth
1ft:240ft
CalAvg 10/17/2006
4
Inches
24
CalAvg 11/02/2006
4
Inches
24
CalAvg 11/08/2006
4
Inches
24
CalAvg 12/05/2006
4
Inches
24
1380
1400
1420
1440
1460
CalAvg 12/05/2006
4
Inches
24
CalAvg 11/08/2006
4
Inches
24
CalAvg 11/02/2006
4
Inches
24
Depth
1ft:240ft
CalAvg 10/17/2006
4
Inches
24

B1.3 COLOG ACOUSTIC TELEVIEWER



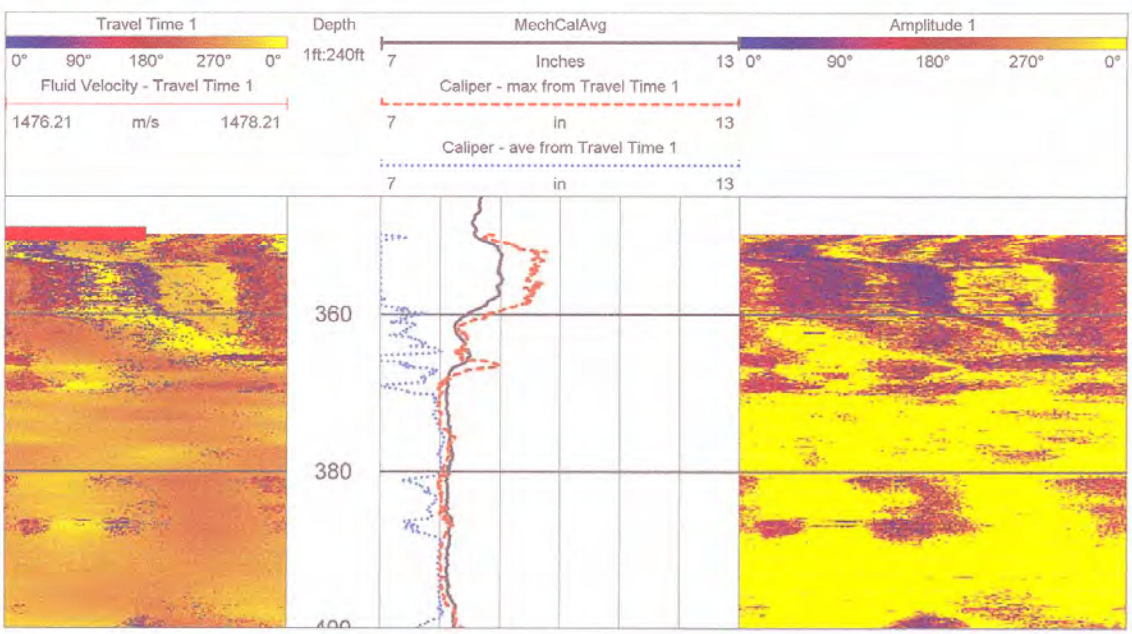
ENERGYSOLUTIONS

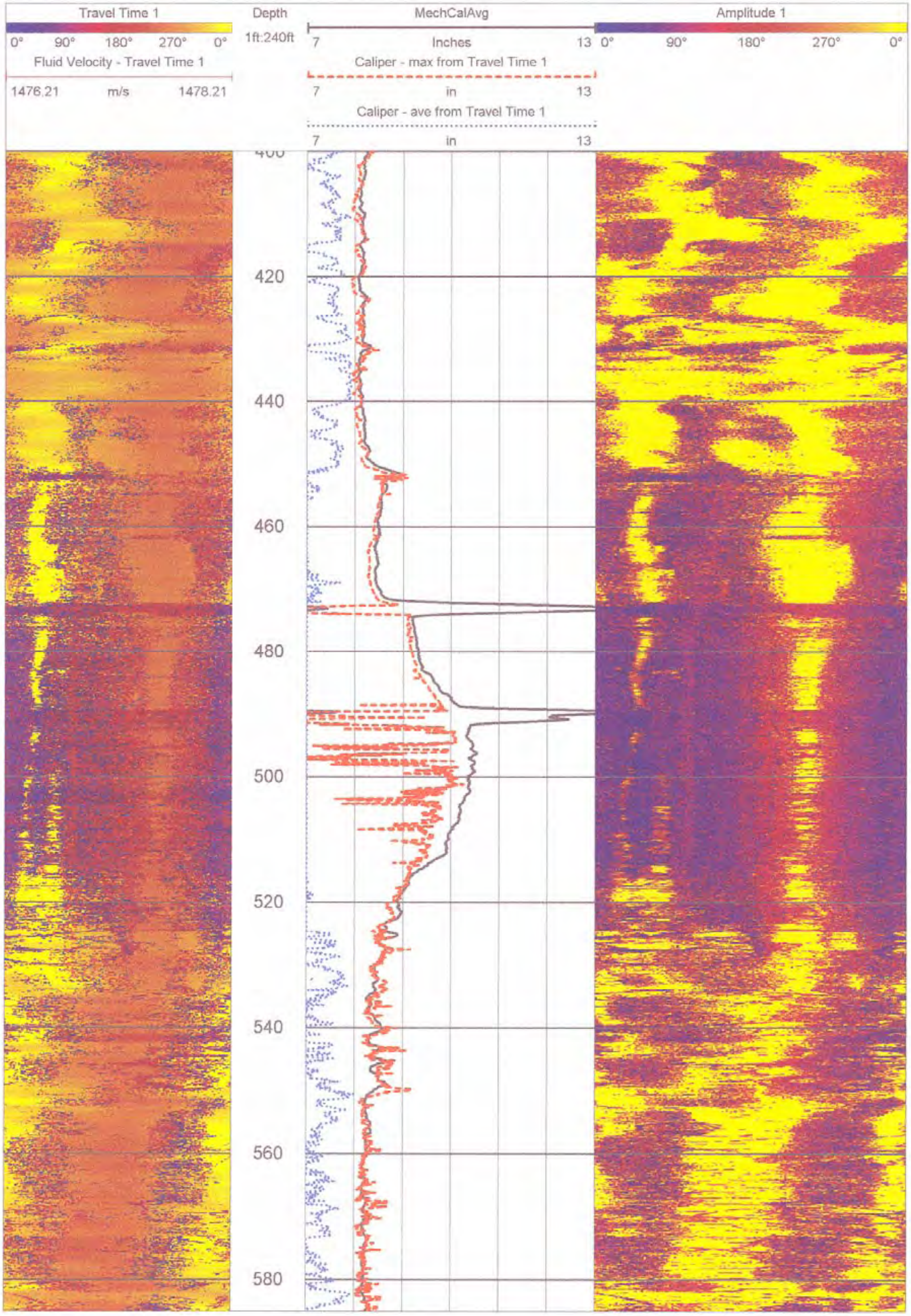
CO	COMPANY	USDOE/PNNL	
WELL	WELL ID	C4996	
FLD	FIELD	WTP	
CTY	COUNTRY	USA	STATE WASHINGTON
STE	LOCATION N136052.91E E576144.83 WASHINGTON STATE PLANE METRIC COORDINATES		OTHER SERVICES GYRO
FILING No	SEC	TWP	RGE

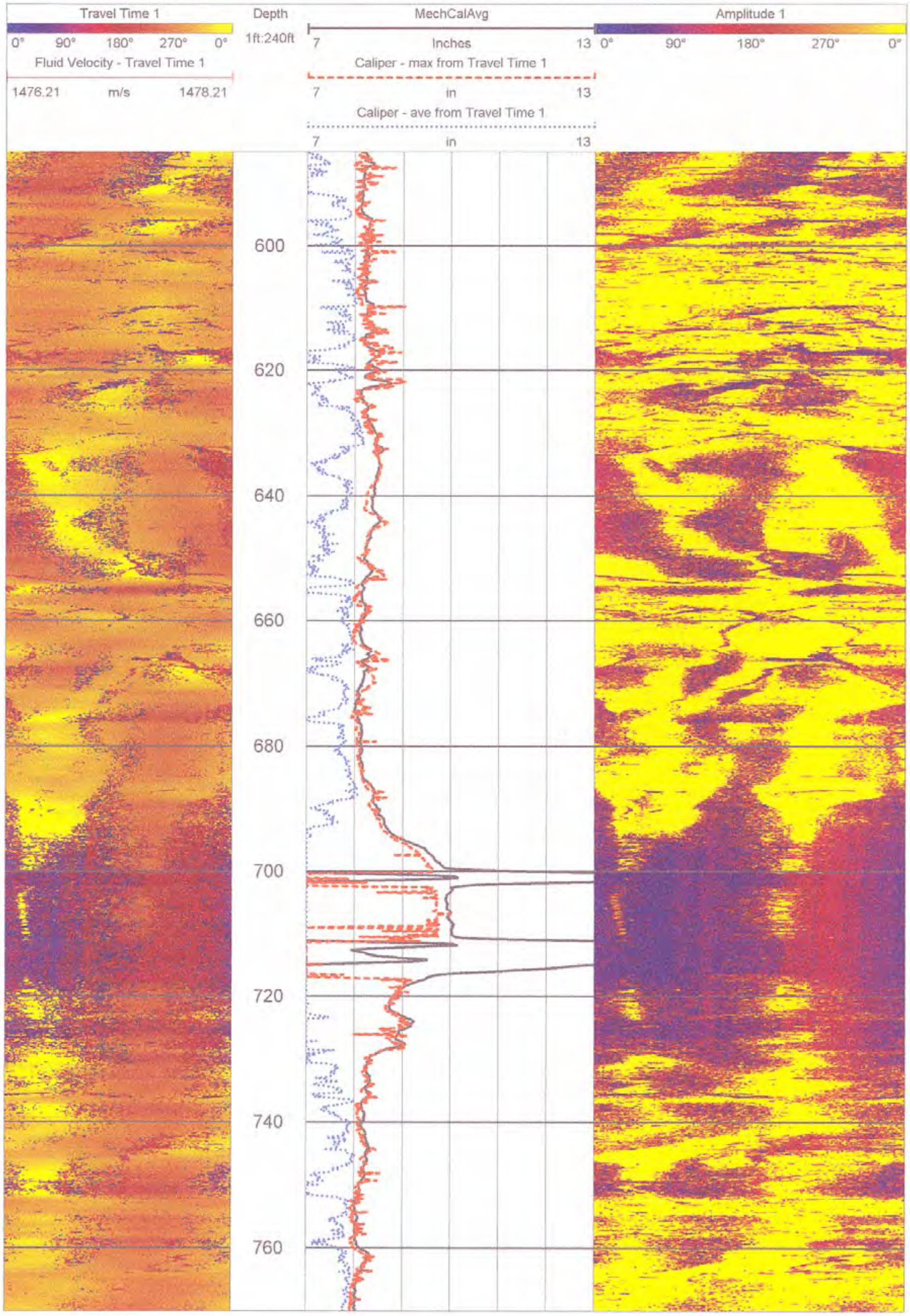
PERMANENT DATUM	GL	ELEVATION	204.28 M	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM	GL			G.L.

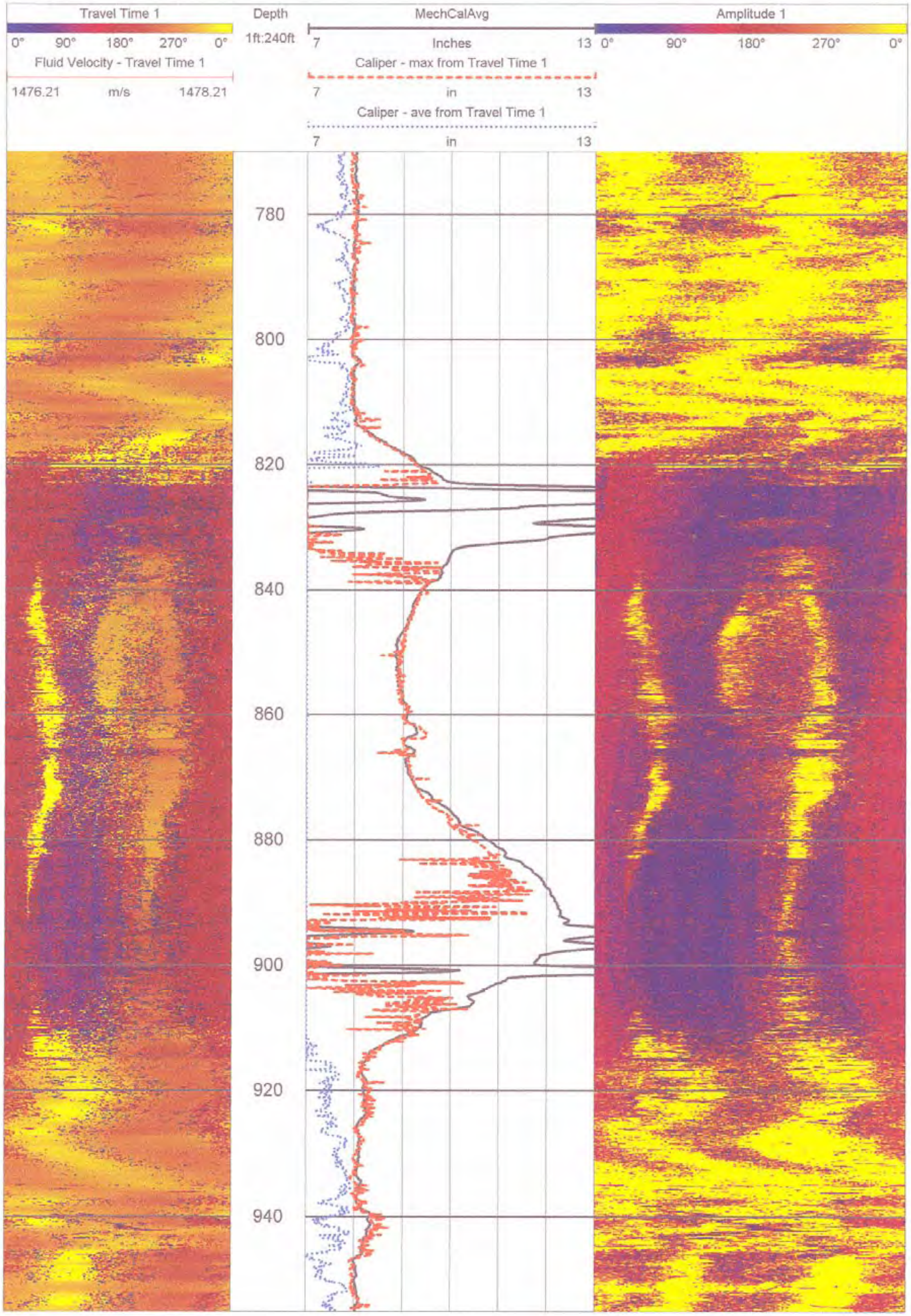
DATE	9/14/06	TYPE FLUID IN HOLE	WATER BASED WITH GEL
RUN No	SEVEN	SALINITY	
TYPE LOG	ACOUSTIC TELEVIEWER	DENSITY	8.4 PPG
DEPTH-DRILLER	1468.7	LEVEL	30 FT
DEPTH-LOGGER	1464	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	1470.8		
TOP LOGGED INTERVAL	349.8		
OPERATING RIG TIME	3 HRS		
RECORDED BY	B. RANDALL/M. MEISNER		
WITNESSED BY	A. ROHAY		

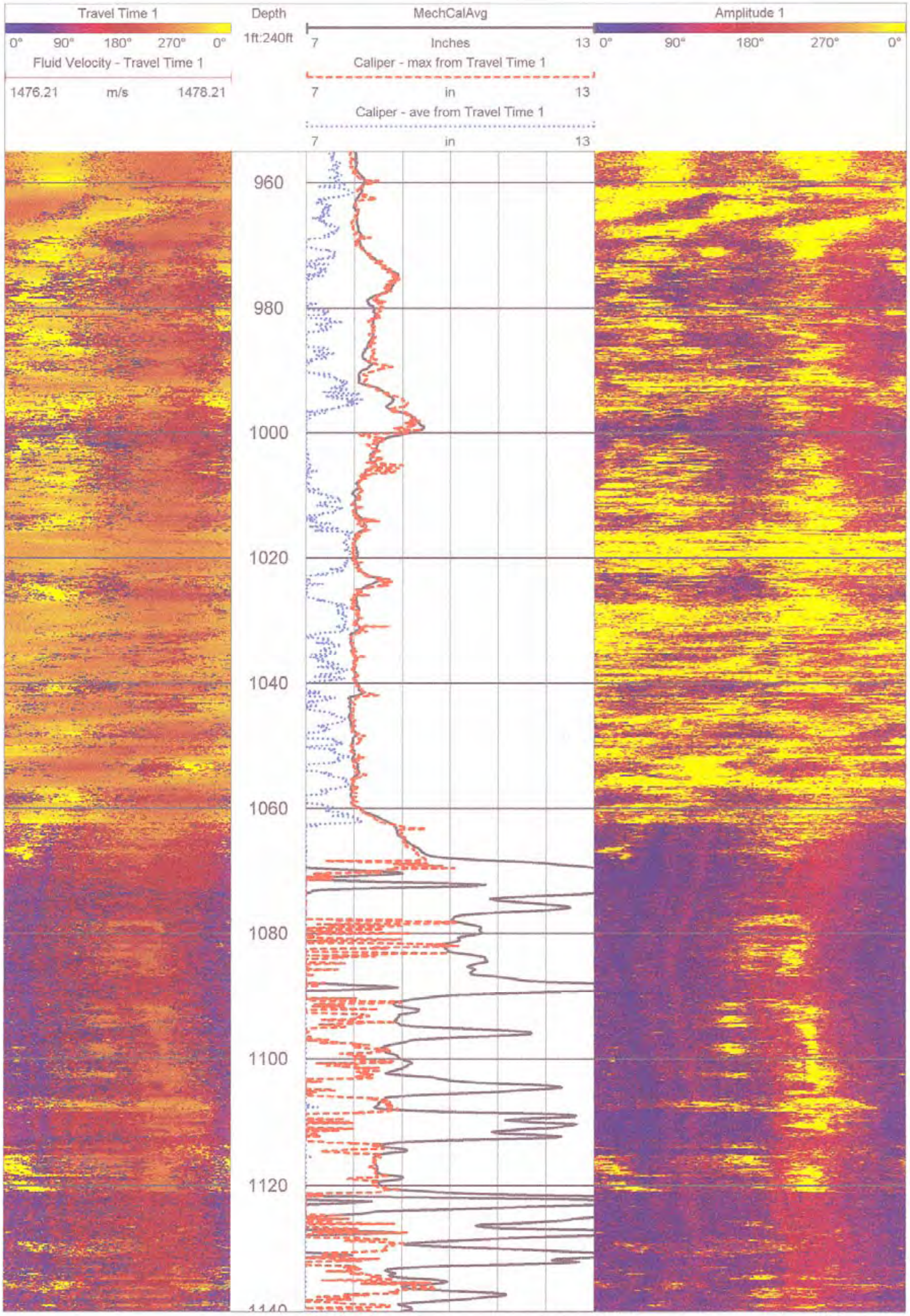
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
7	7 7/8	370	1464	13 3/8		0	200
				9 5/8		200	368

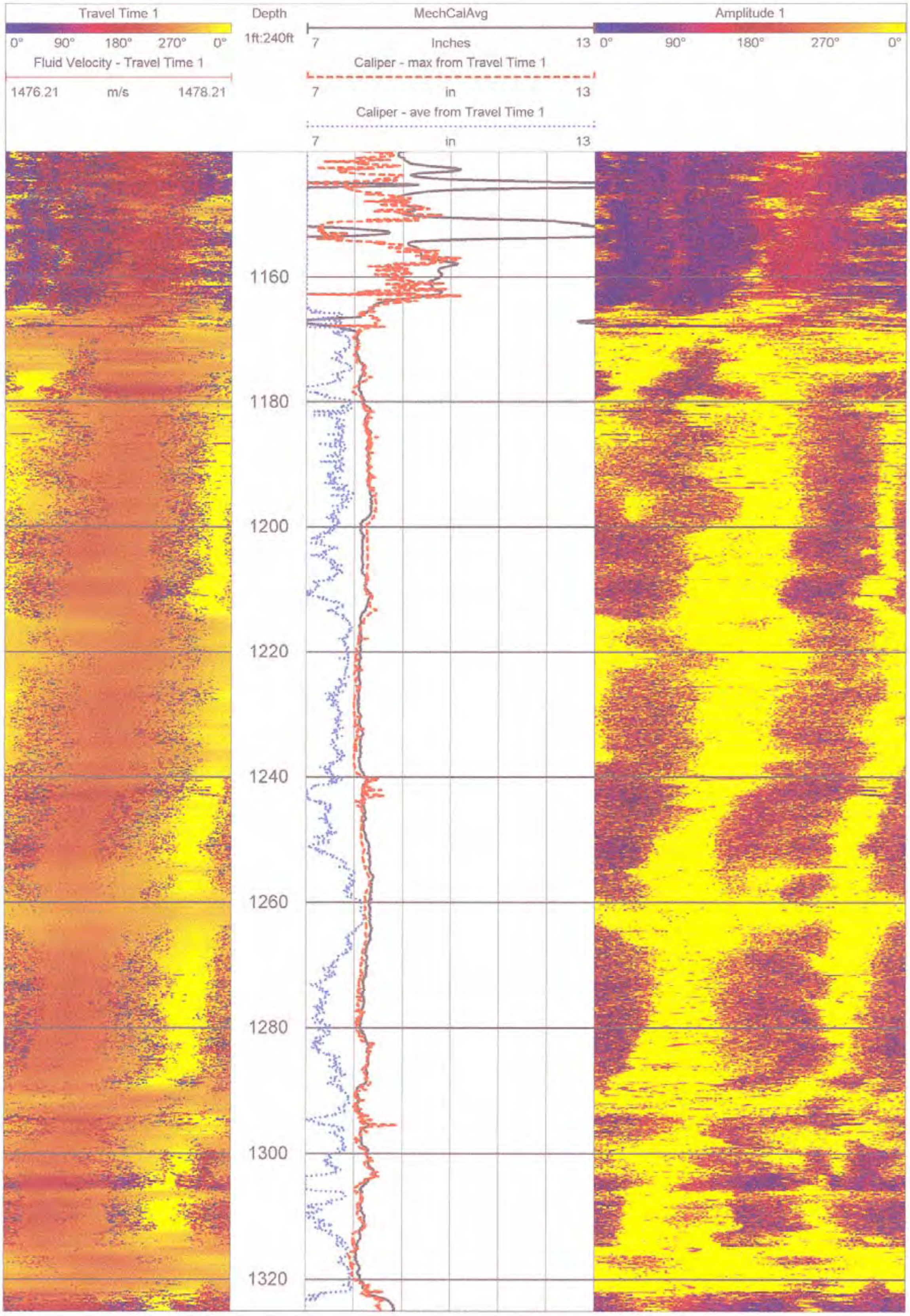


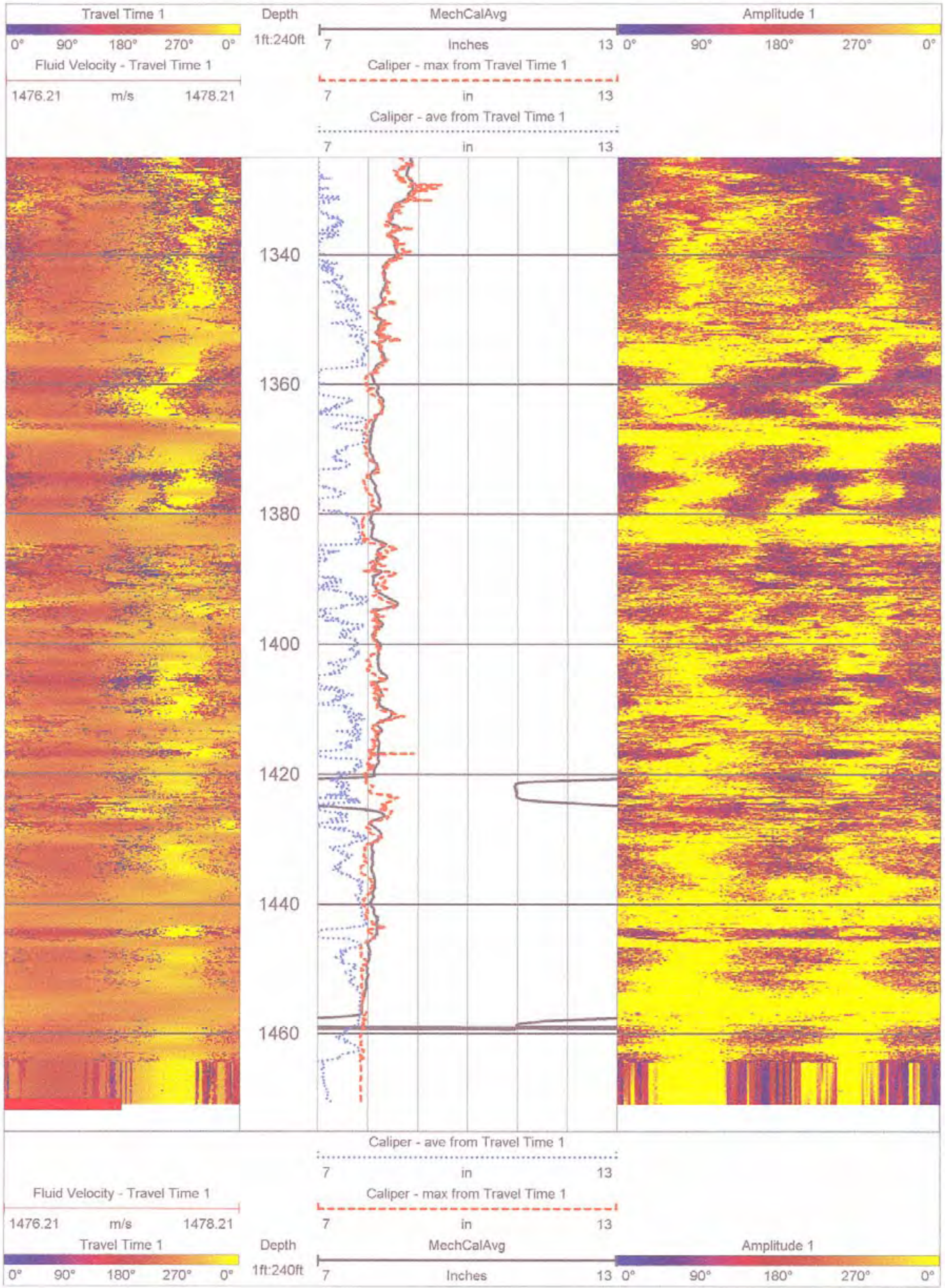

Travel Time 1
0° 90° 180° 270° 0°
Fluid Velocity - Travel Time 1
1476.21 m/s 1478.21
Depth
1ft:240ft
MechCalAvg
7 Inches 13
Caliper - max from Travel Time 1
7 in 13
Caliper - ave from Travel Time 1
7 in 13
Amplitude 1
0° 90° 180° 270° 0°
400
420
440
460
480
500
520
540
560
580


Travel Time 1
0° 90° 180° 270° 0°
Fluid Velocity - Travel Time 1
1476.21 m/s 1478.21
Depth
1ft:240ft
MechCalAvg
7 Inches 13
Caliper - max from Travel Time 1
7 in 13
Caliper - ave from Travel Time 1
7 in 13
Amplitude 1
0° 90° 180° 270° 0°
600
620
640
660
680
700
720
740
760

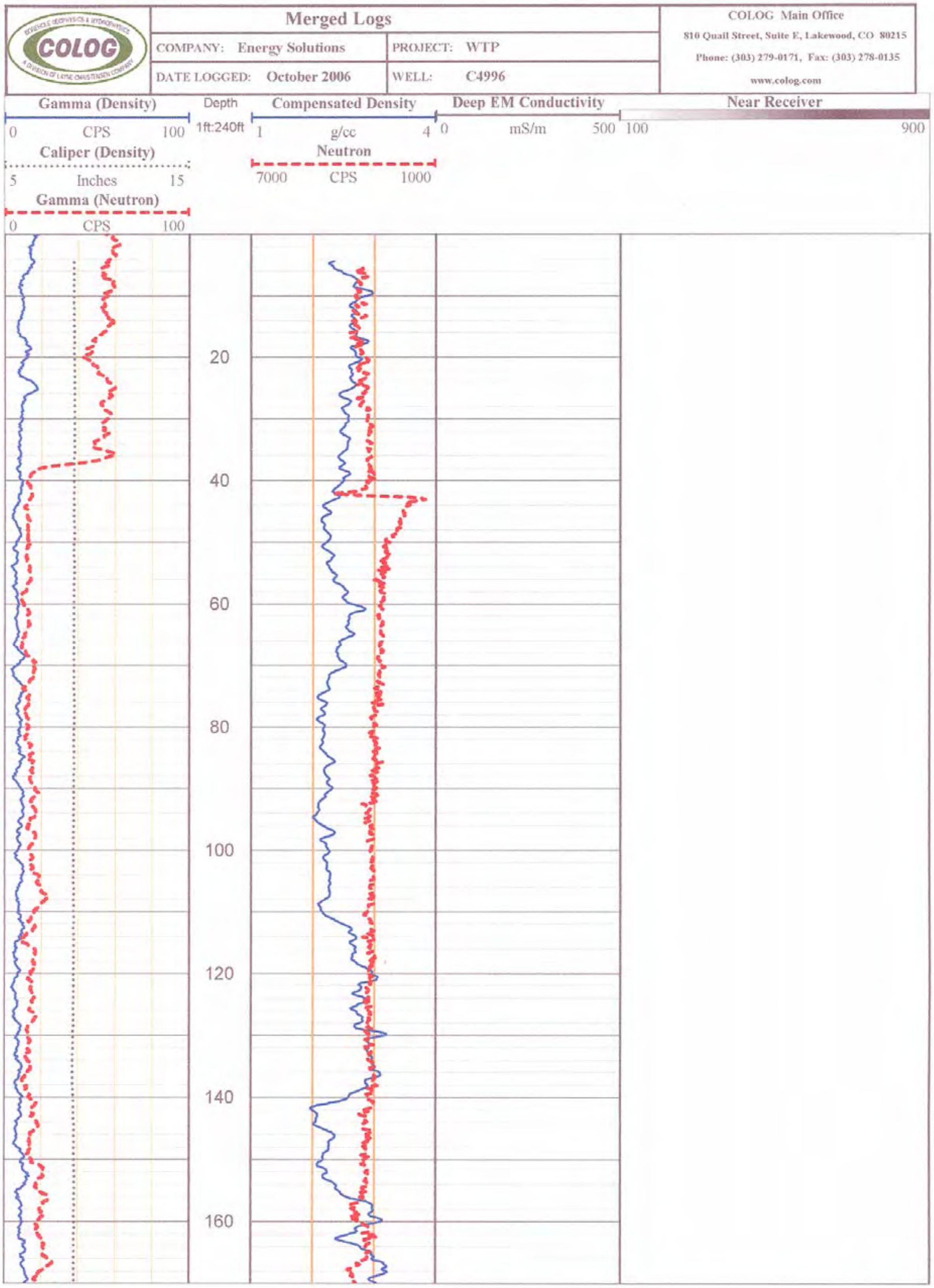

Travel Time 1
0° 90° 180° 270° 0°
Fluid Velocity - Travel Time 1
1476.21 m/s 1478.21
Depth
1ft:240ft
MechCalAvg
7 Inches 13
Caliper - max from Travel Time 1
7 in 13
Caliper - ave from Travel Time 1
7 in 13
Amplitude 1
0° 90° 180° 270° 0°
780
800
820
840
860
880
900
920
940

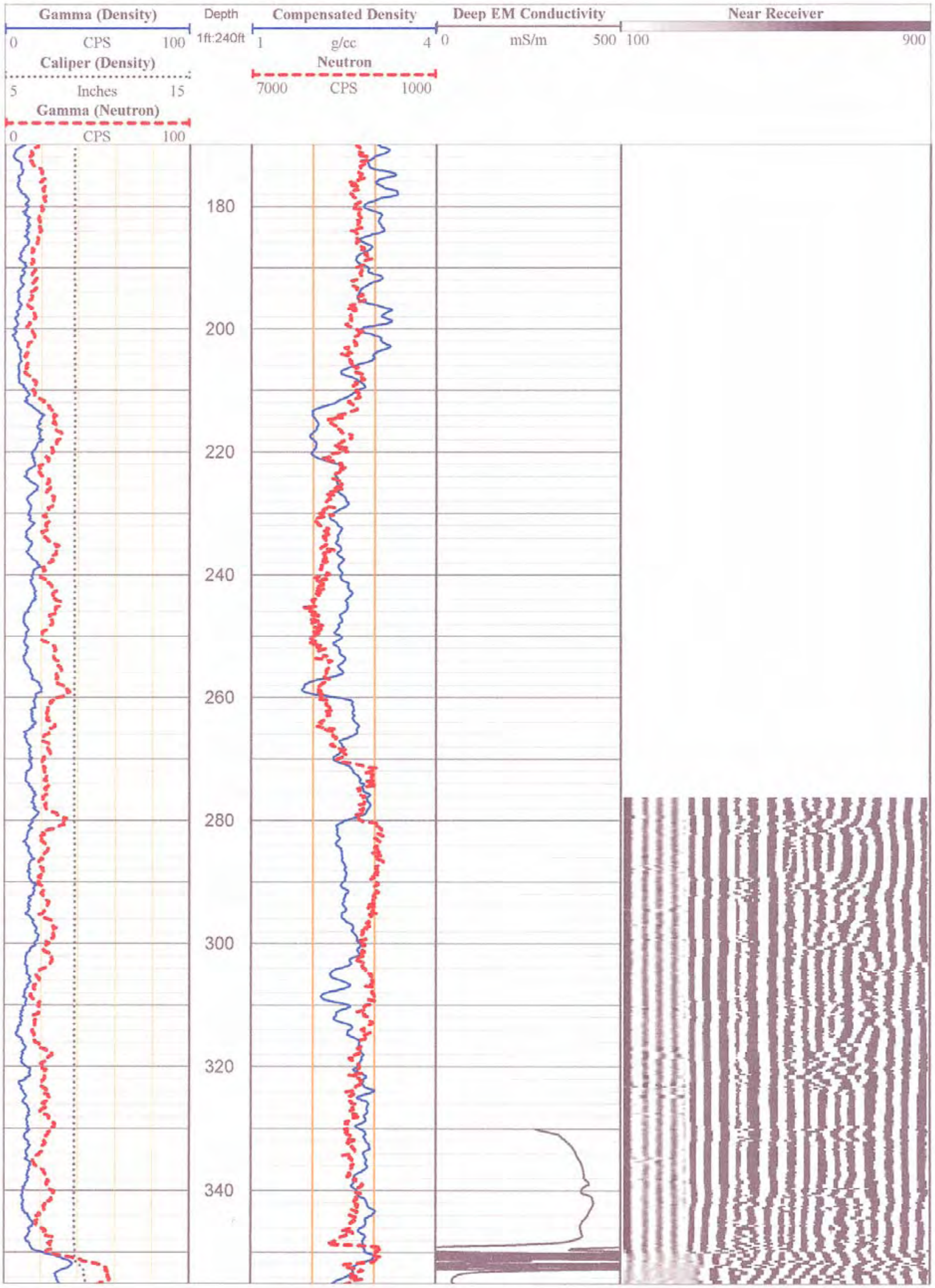

Travel Time 1
0° 90° 180° 270° 0°
Fluid Velocity - Travel Time 1
1476.21 m/s 1478.21
Depth
1ft:240ft
MechCalAvg
7 Inches 13
Caliper - max from Travel Time 1
7 in 13
Caliper - ave from Travel Time 1
7 in 13
Amplitude 1
0° 90° 180° 270° 0°
960
980
1000
1020
1040
1060
1080
1100
1120
1140

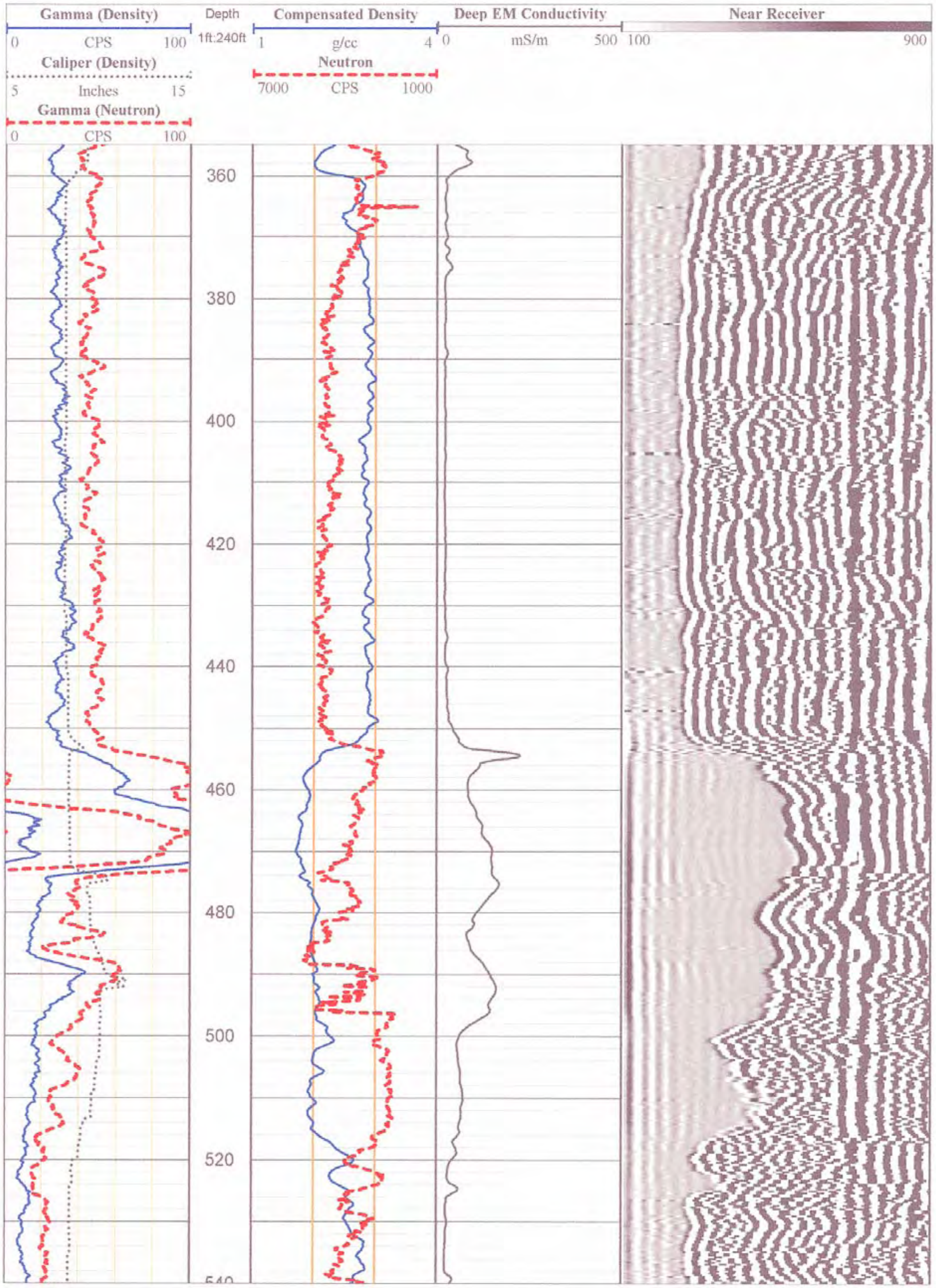

Travel Time 1
0° 90° 180° 270° 0°
Fluid Velocity - Travel Time 1
1476.21 m/s 1478.21
Depth
1ft:240ft
MechCalAvg
7 Inches 13
Caliper - max from Travel Time 1
7 in 13
Caliper - ave from Travel Time 1
7 in 13
Amplitude 1
0° 90° 180° 270° 0°
1160
1180
1200
1220
1240
1260
1280
1300
1320

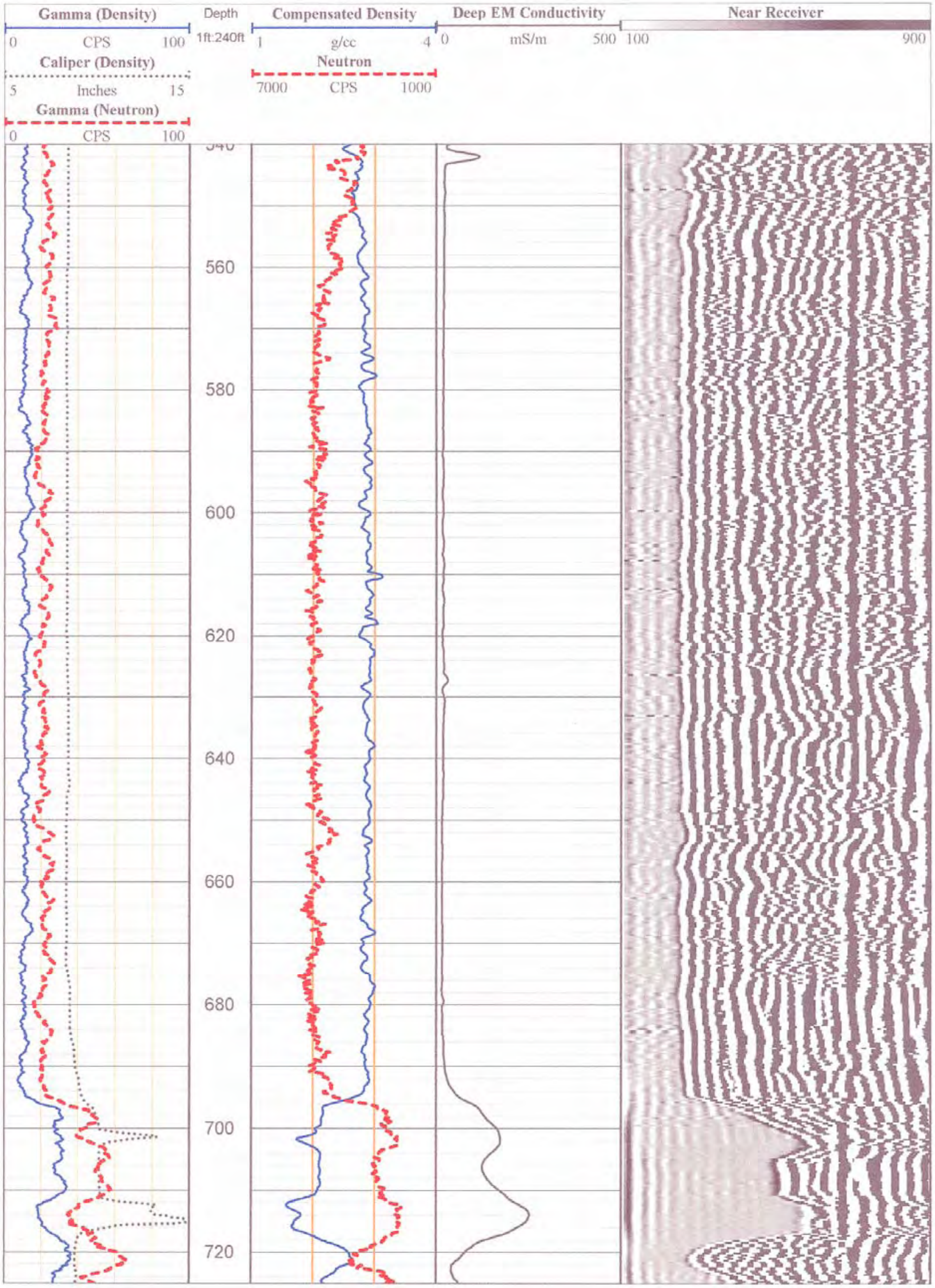

Travel Time 1
0° 90° 180° 270° 0°
Fluid Velocity - Travel Time 1
1476.21 m/s 1478.21
Depth
1ft:240ft
MechCalAvg
7 Inches 13
Caliper - max from Travel Time 1
7 in 13
Caliper - ave from Travel Time 1
7 in 13
Amplitude 1
0° 90° 180° 270° 0°
1340
1360
1380
1400
1420
1440
1460
Caliper - ave from Travel Time 1
7 in 13
Caliper - max from Travel Time 1
7 in 13
Fluid Velocity - Travel Time 1
1476.21 m/s 1478.21
Travel Time 1
0° 90° 180° 270° 0°
Depth
1ft:240ft
MechCalAvg
7 Inches 13
Amplitude 1
0° 90° 180° 270° 0°

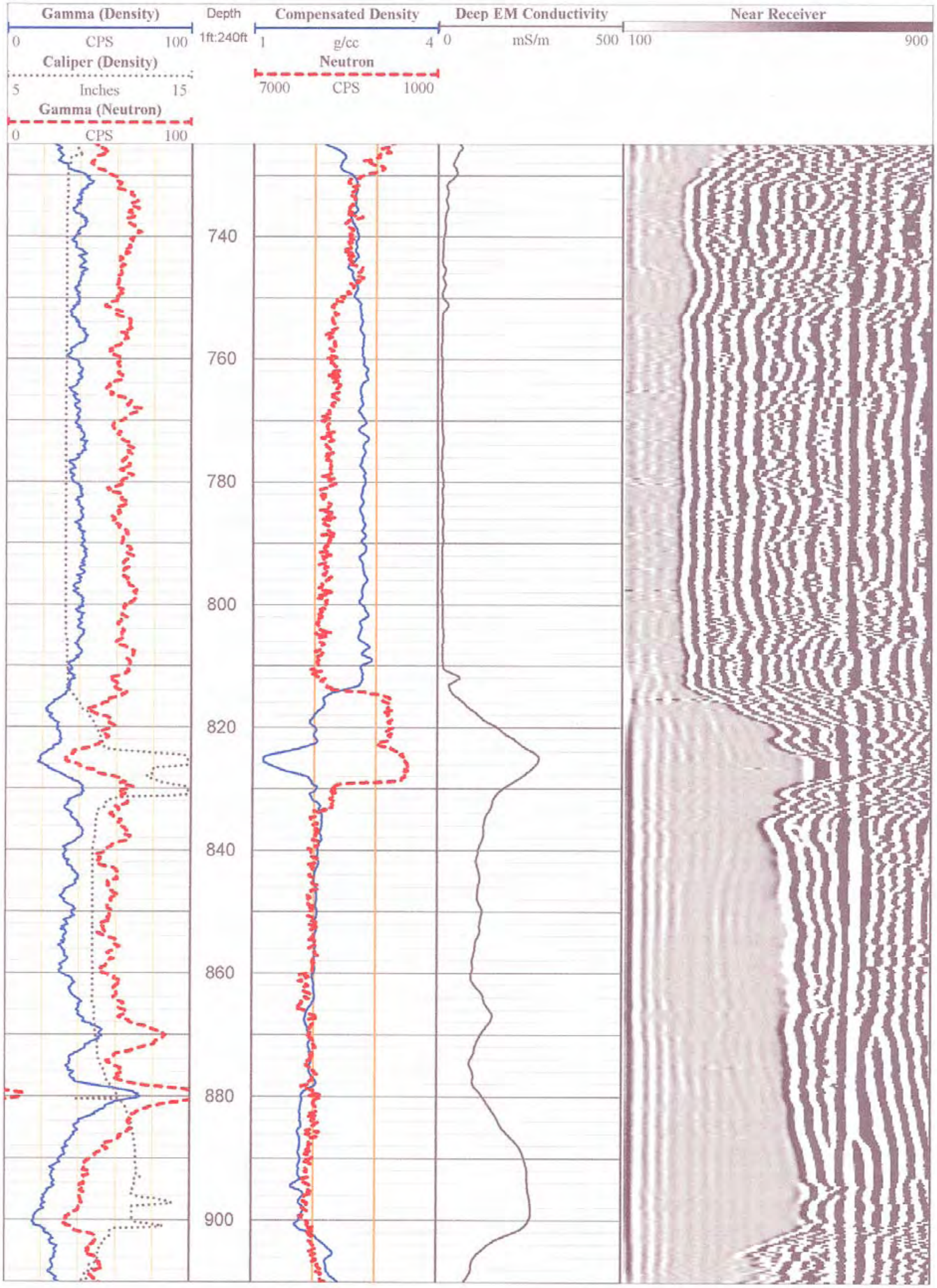
B1.4 COLOG MERGED LOG

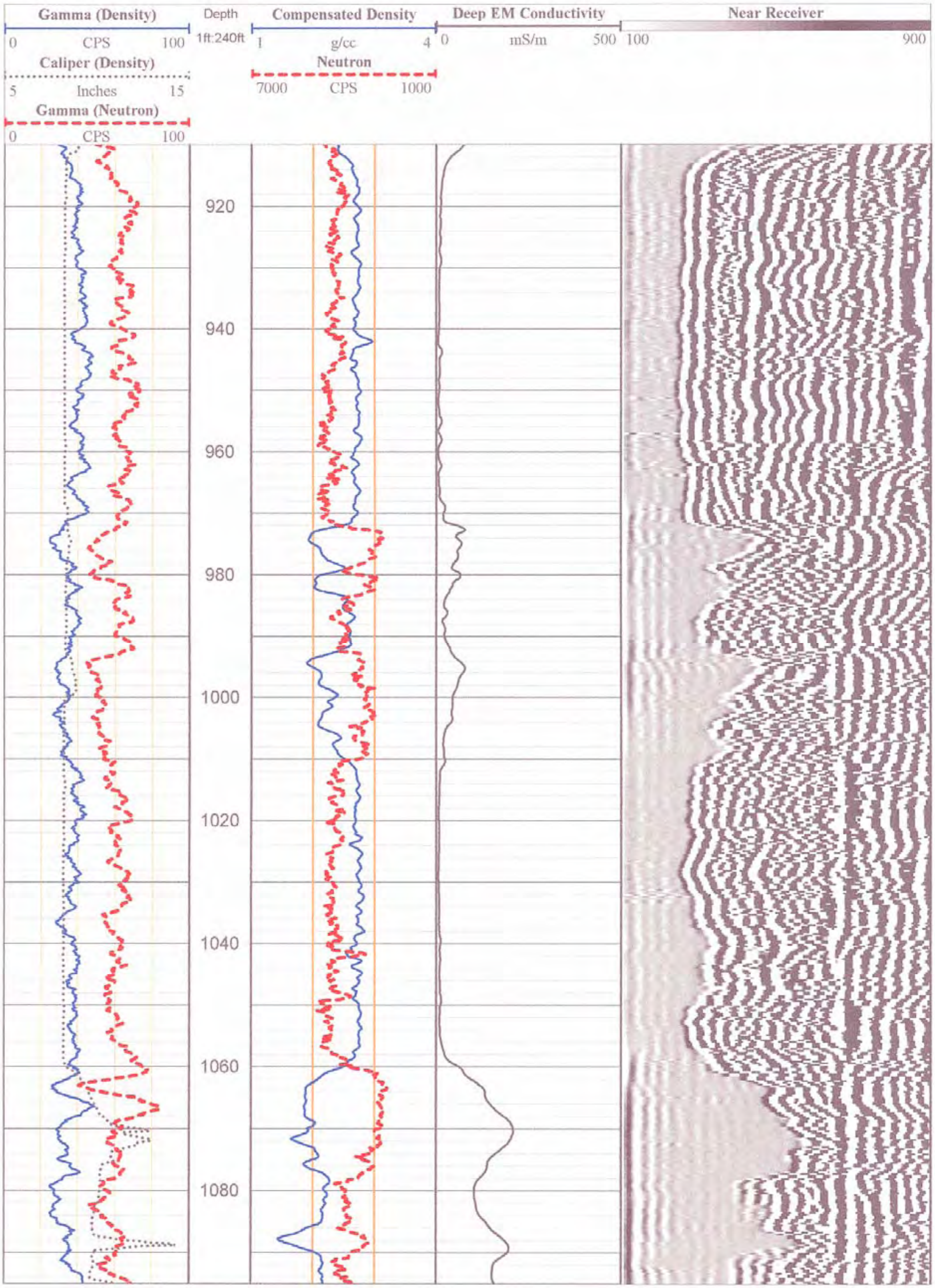


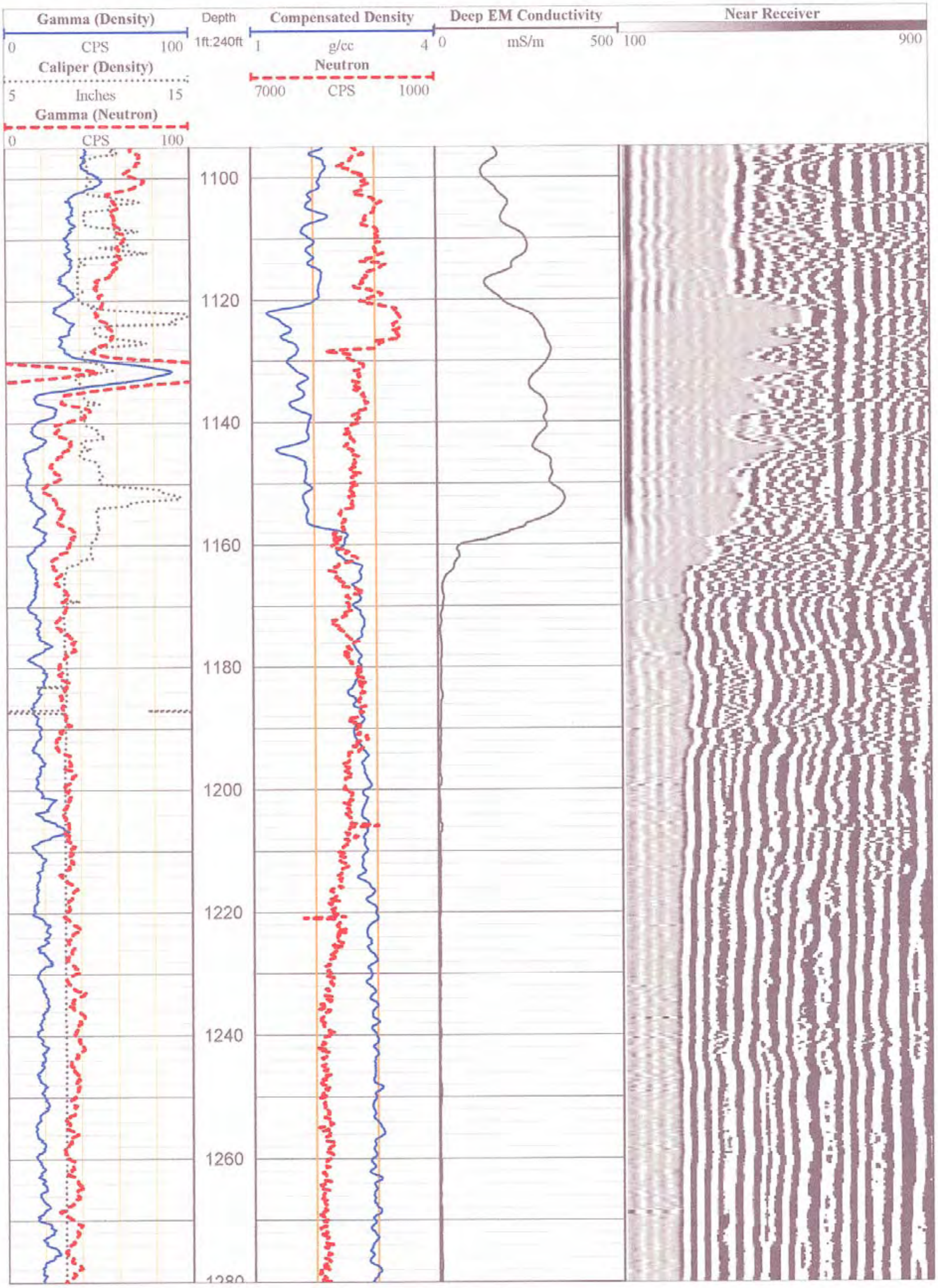

Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
180
200
220
240
260
280
300
320
340

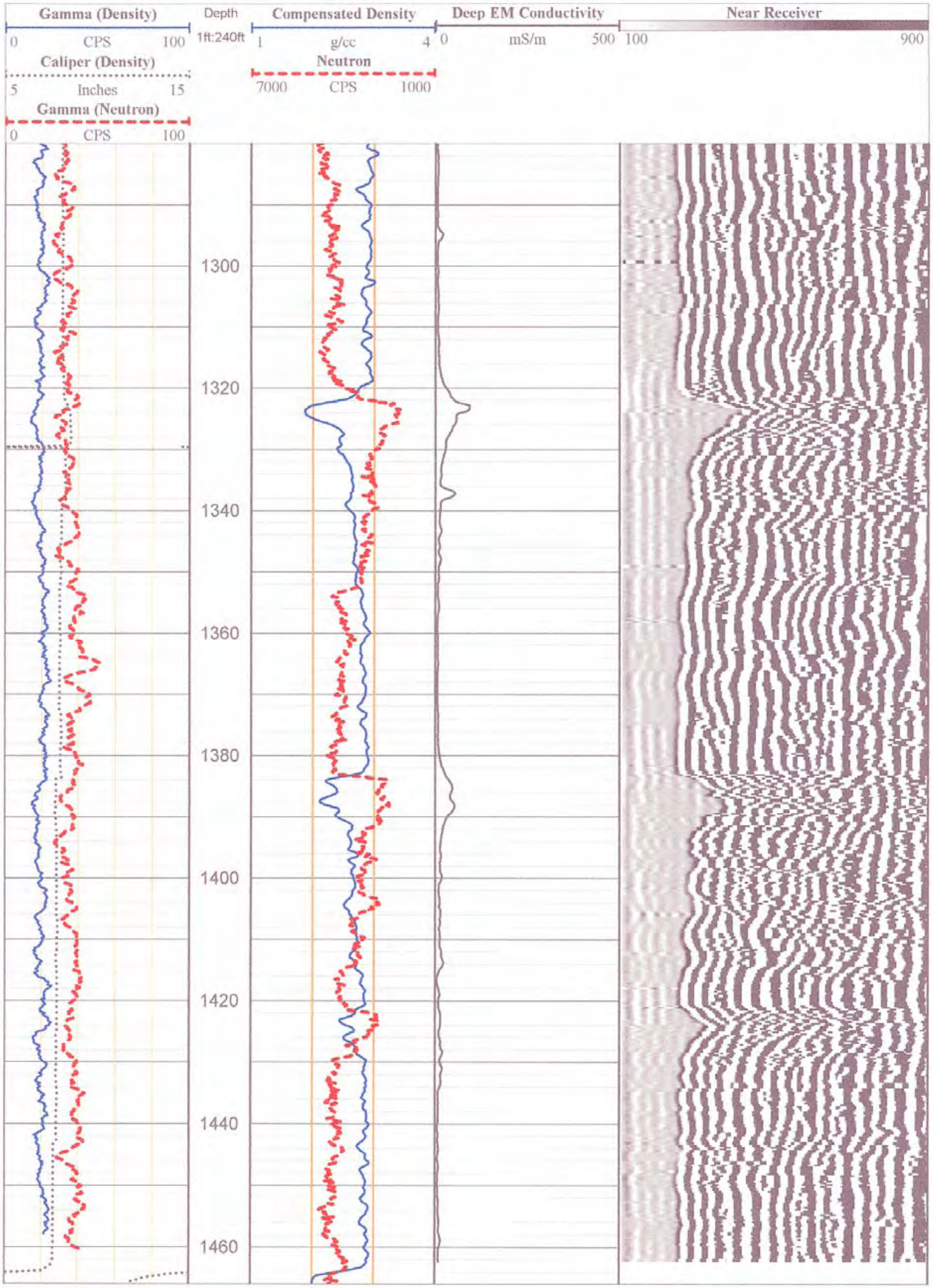

Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
360
380
400
420
440
460
480
500
520
540


Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
560
580
600
620
640
660
680
700
720

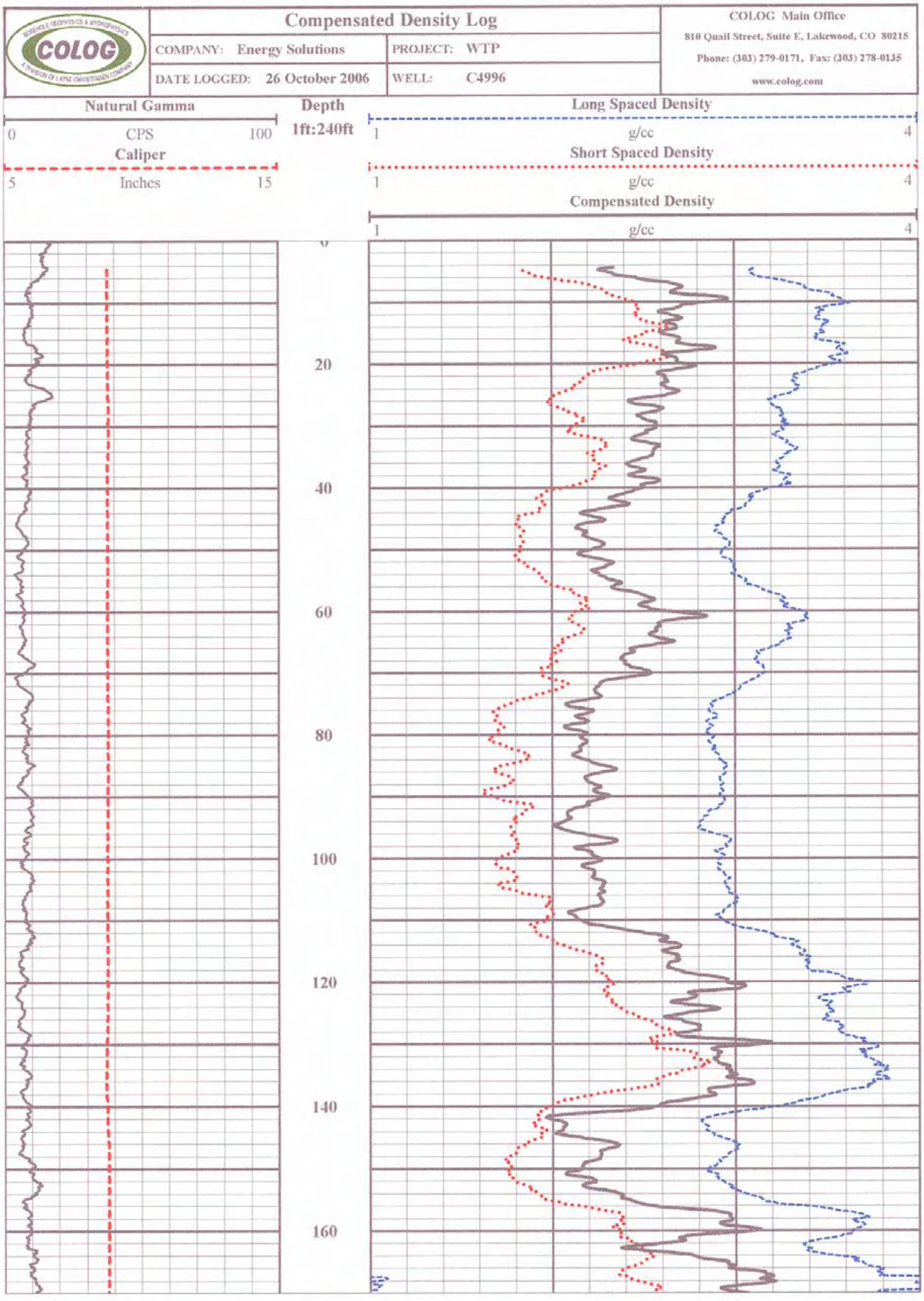

Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
740
760
780
800
820
840
860
880
900

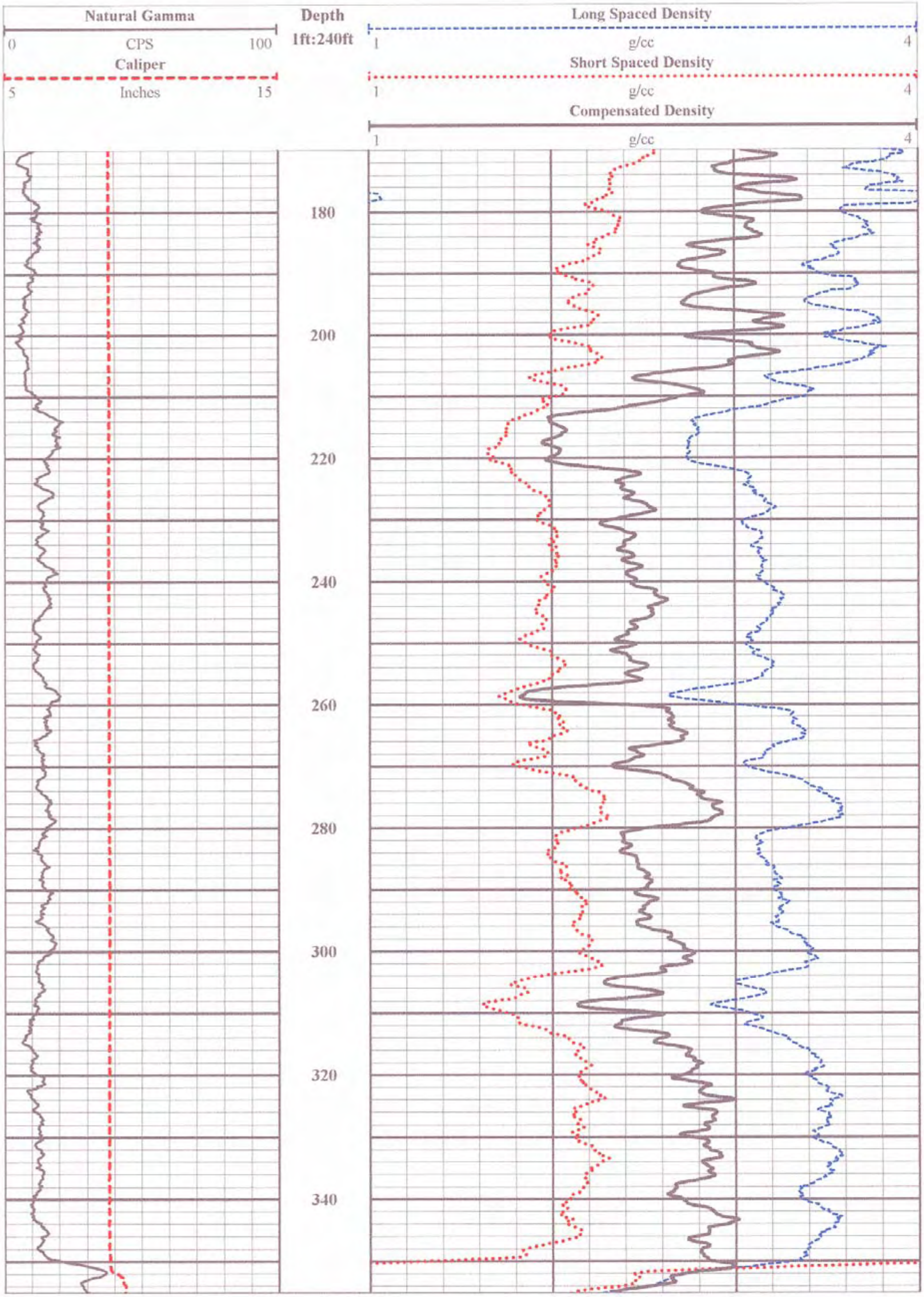

Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
920
940
960
980
1000
1020
1040
1060
1080
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900

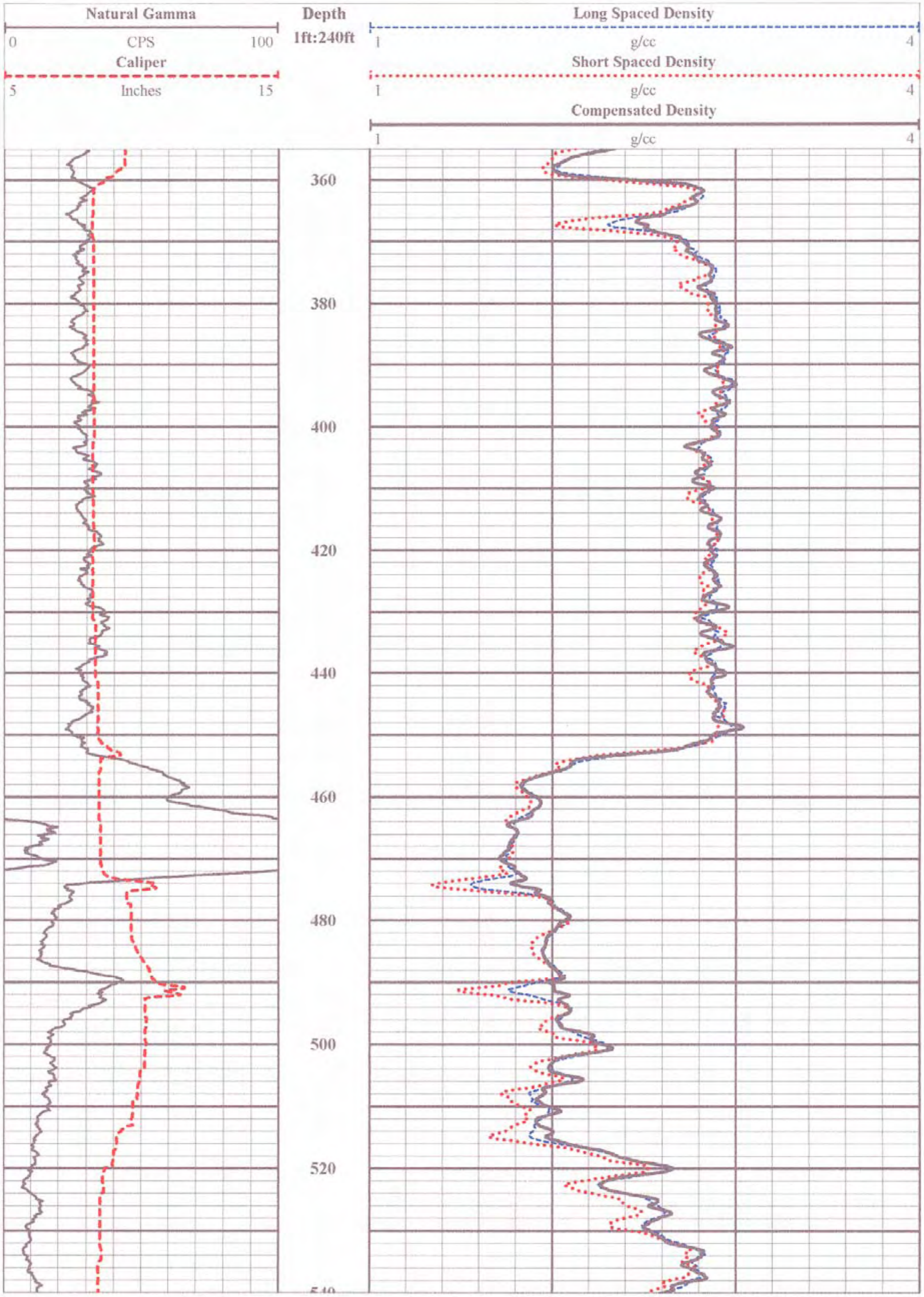

Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
1100
1120
1140
1160
1180
1200
1220
1240
1260
1280

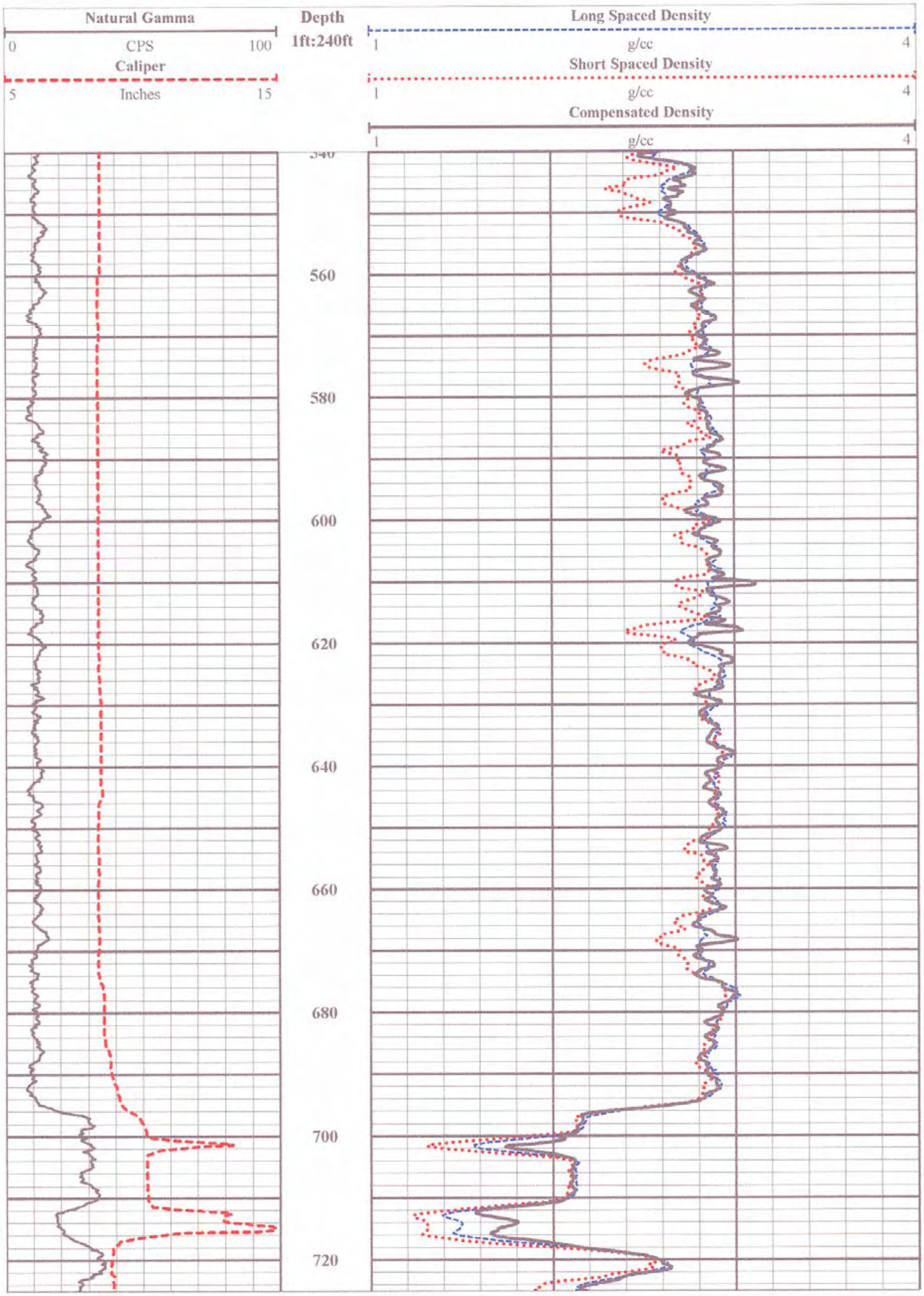

Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
1300
1320
1340
1360
1380
1400
1420
1440
1460

B1.5 COLOG COMPENSATED DENSITY LOG

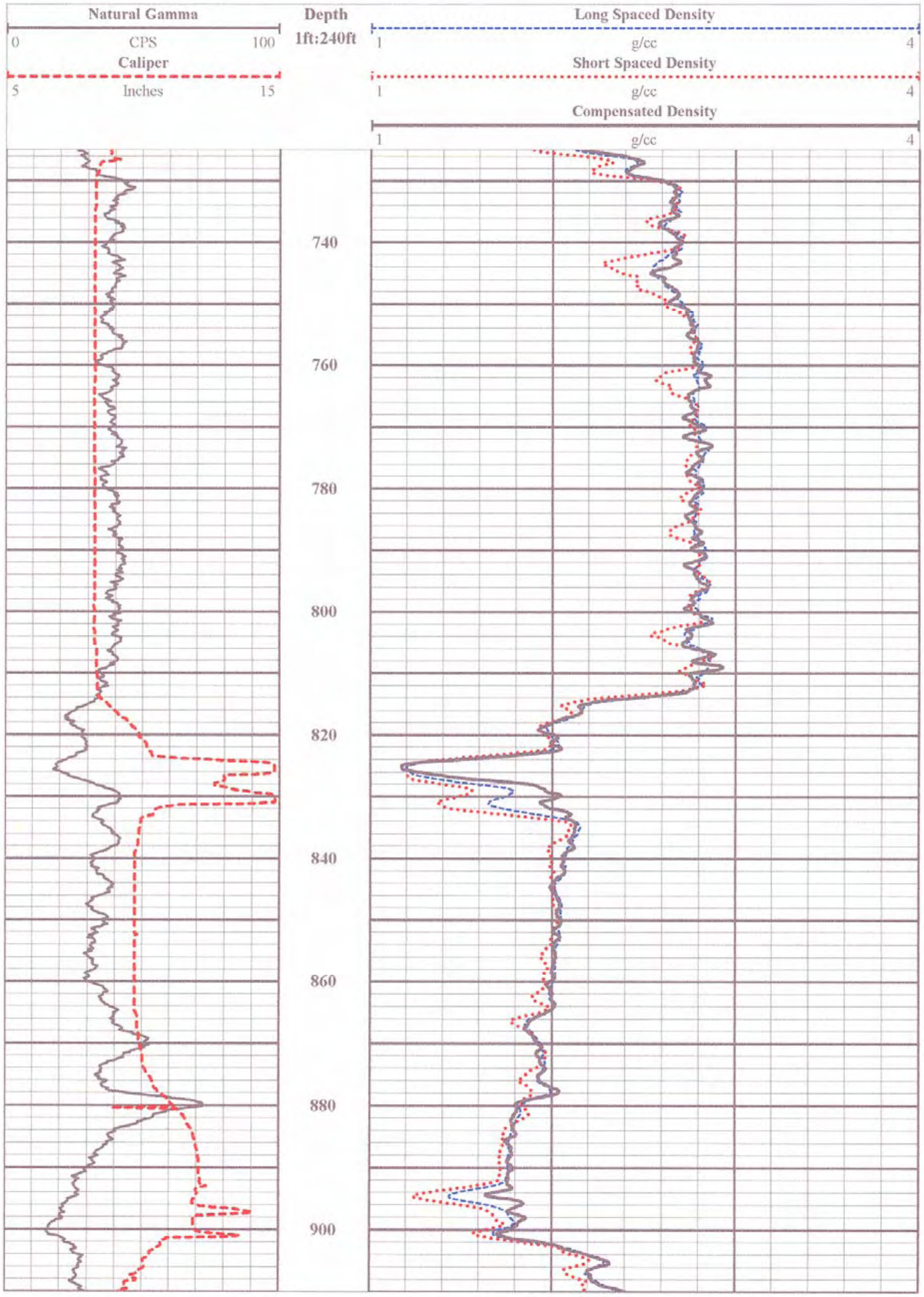


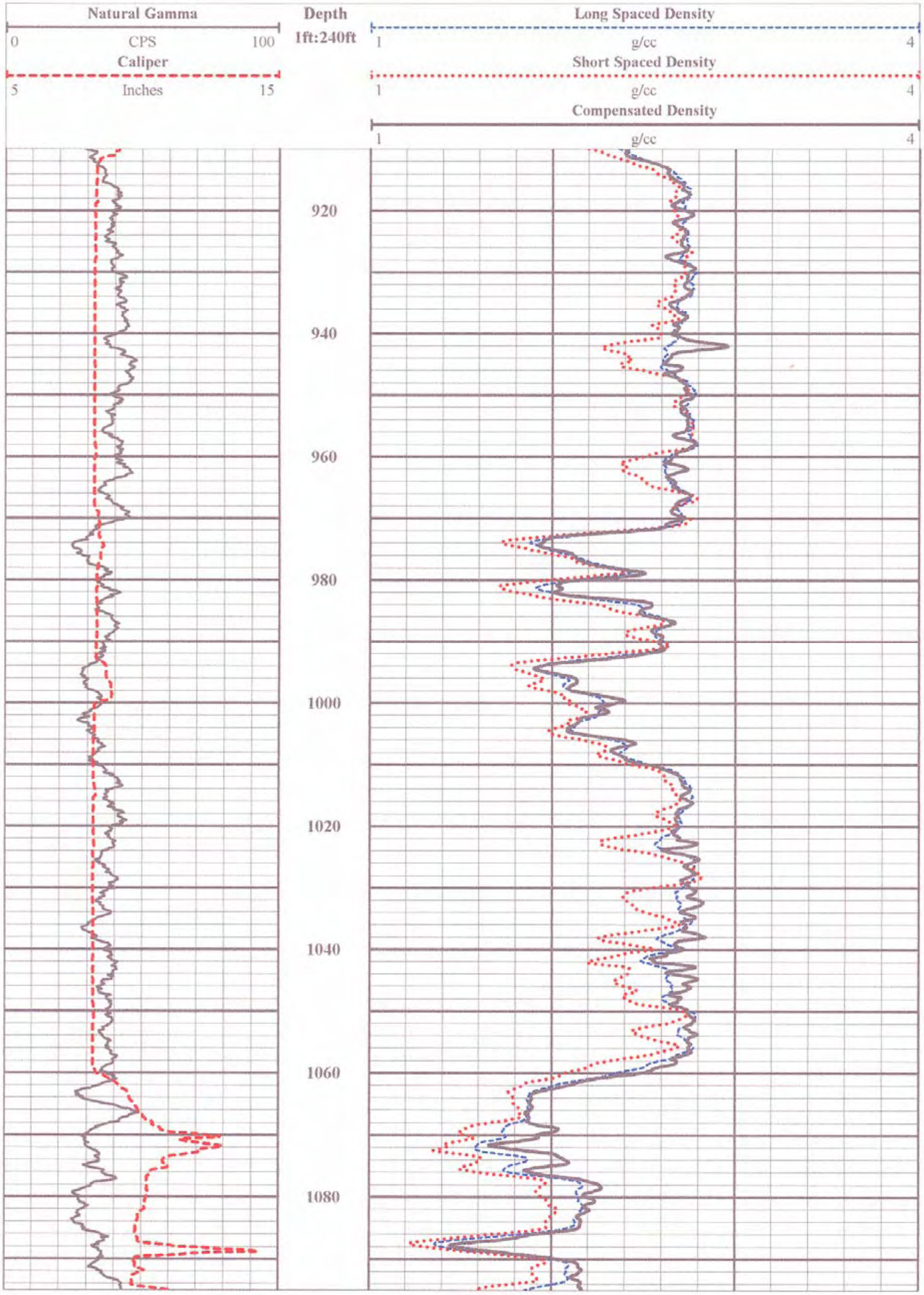

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4
180
200
220
240
260
280
300
320
340

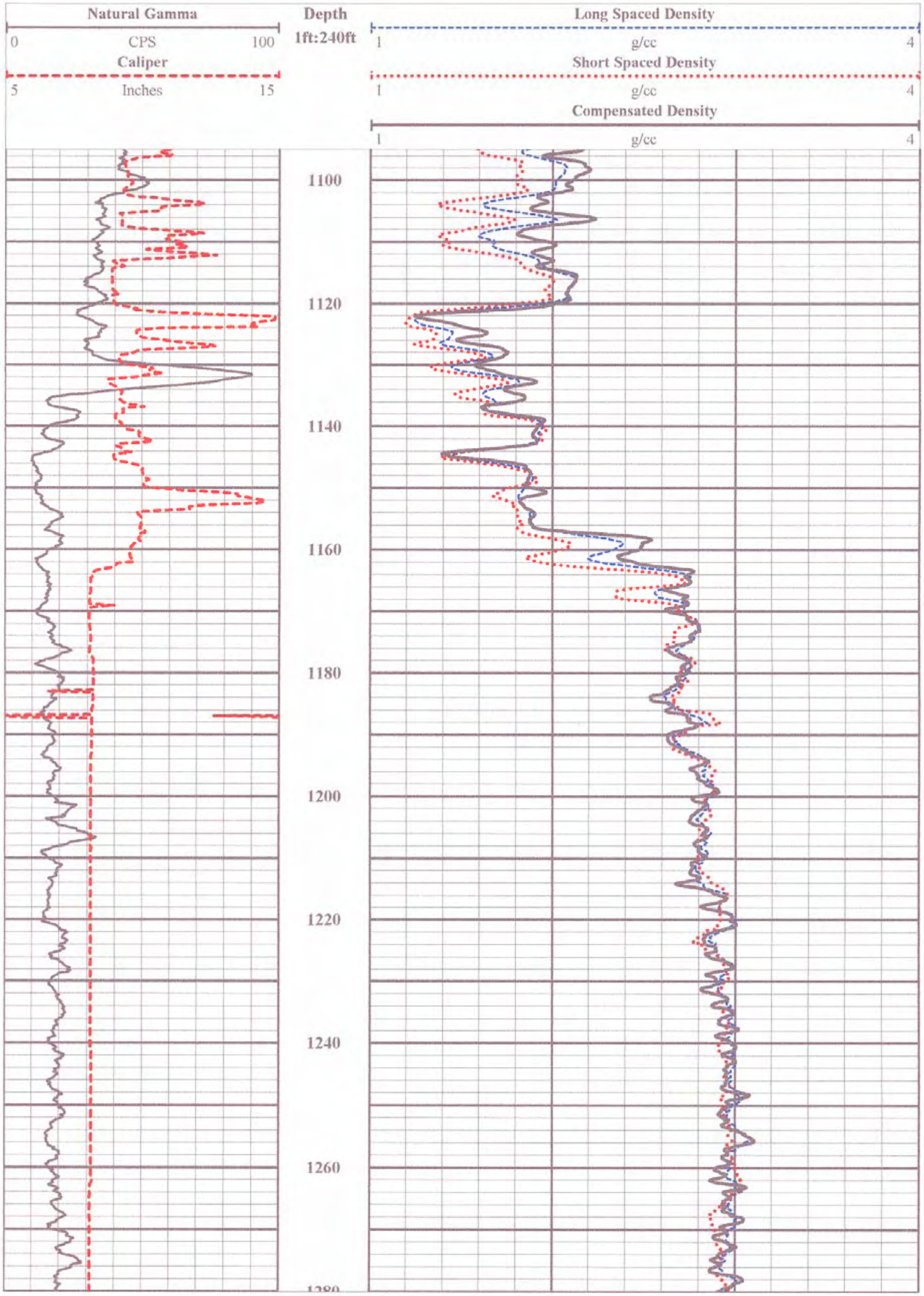

Natural Gamma
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Long Spaced Density
1 g/cc 4
Short Spaced Density
1 g/cc 4
Compensated Density
1 g/cc 4
360
380
400
420
440
460
480
500
520
540

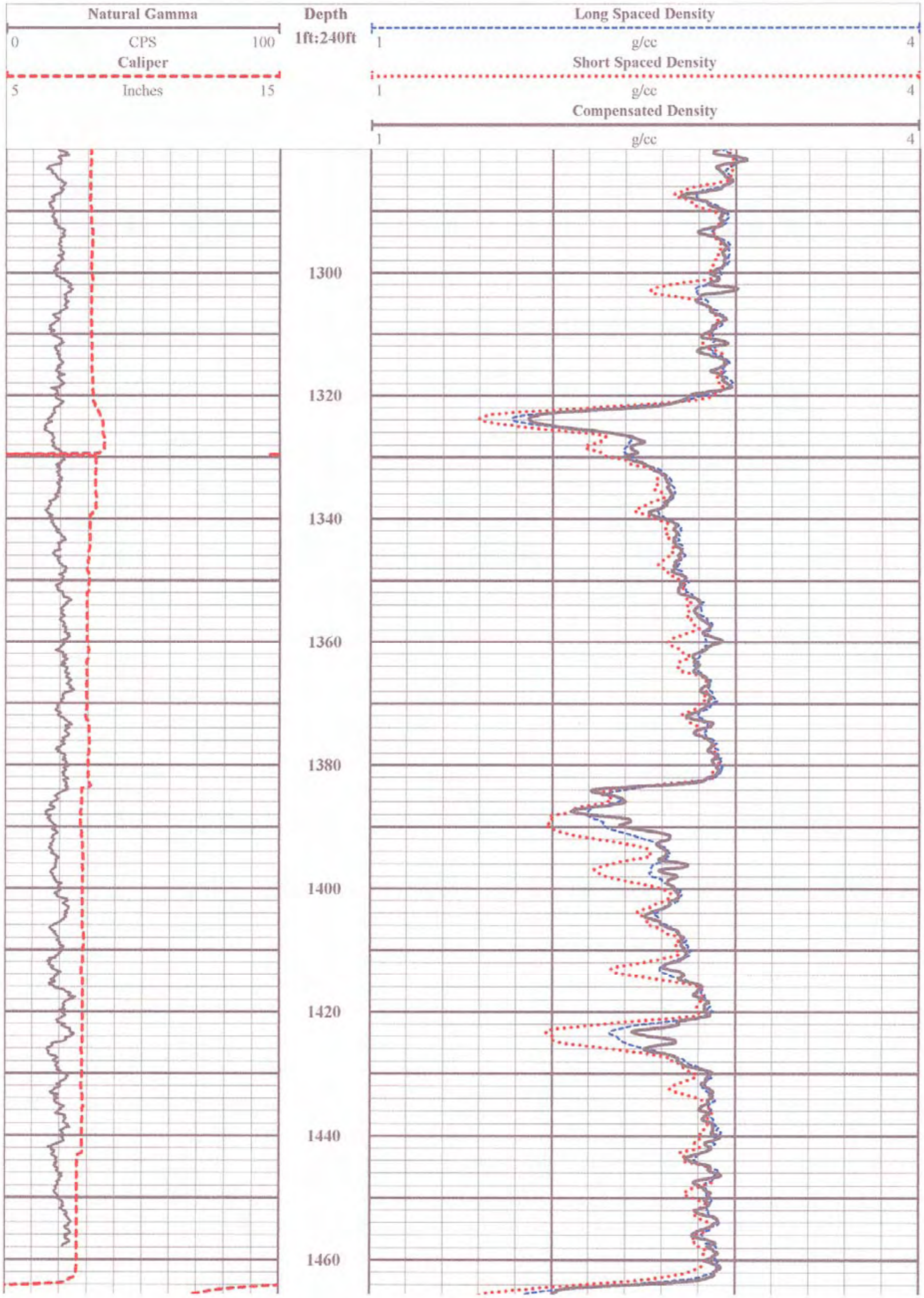


Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
540
560
580
600
620
640
660
680
700
720
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4

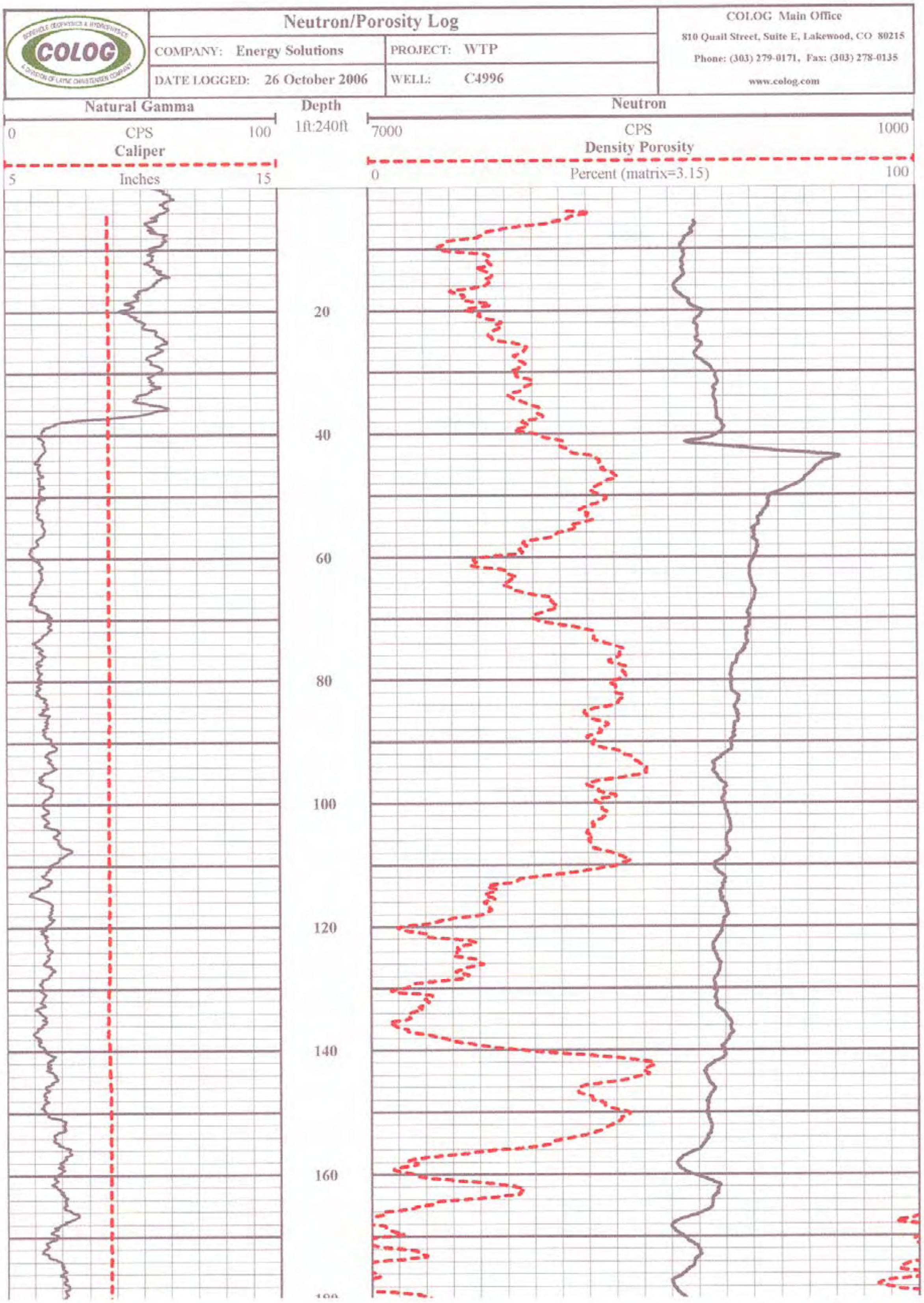

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
740
760
780
800
820
840
860
880
900
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4

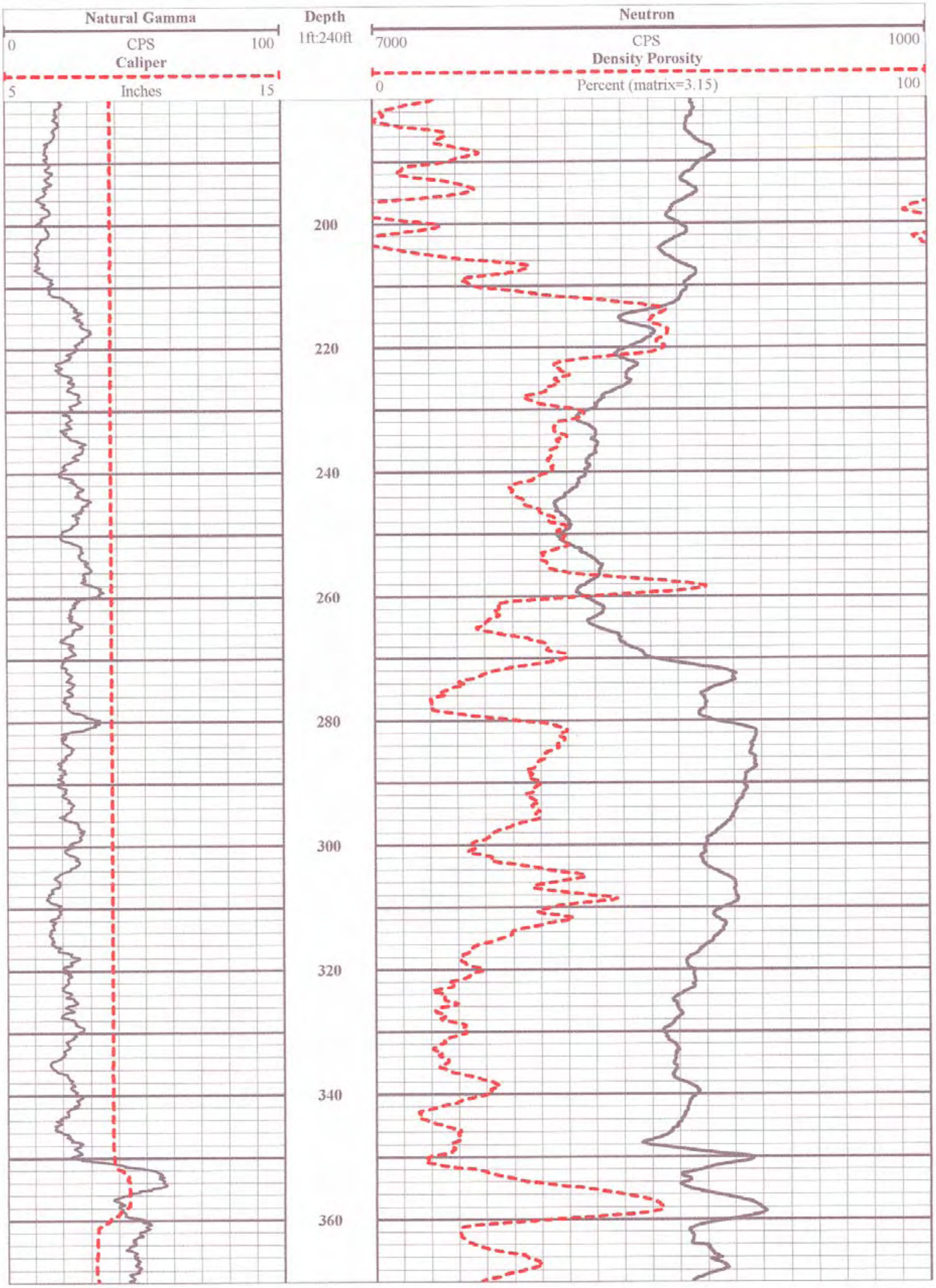

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
920
940
960
980
1000
1020
1040
1060
1080
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4

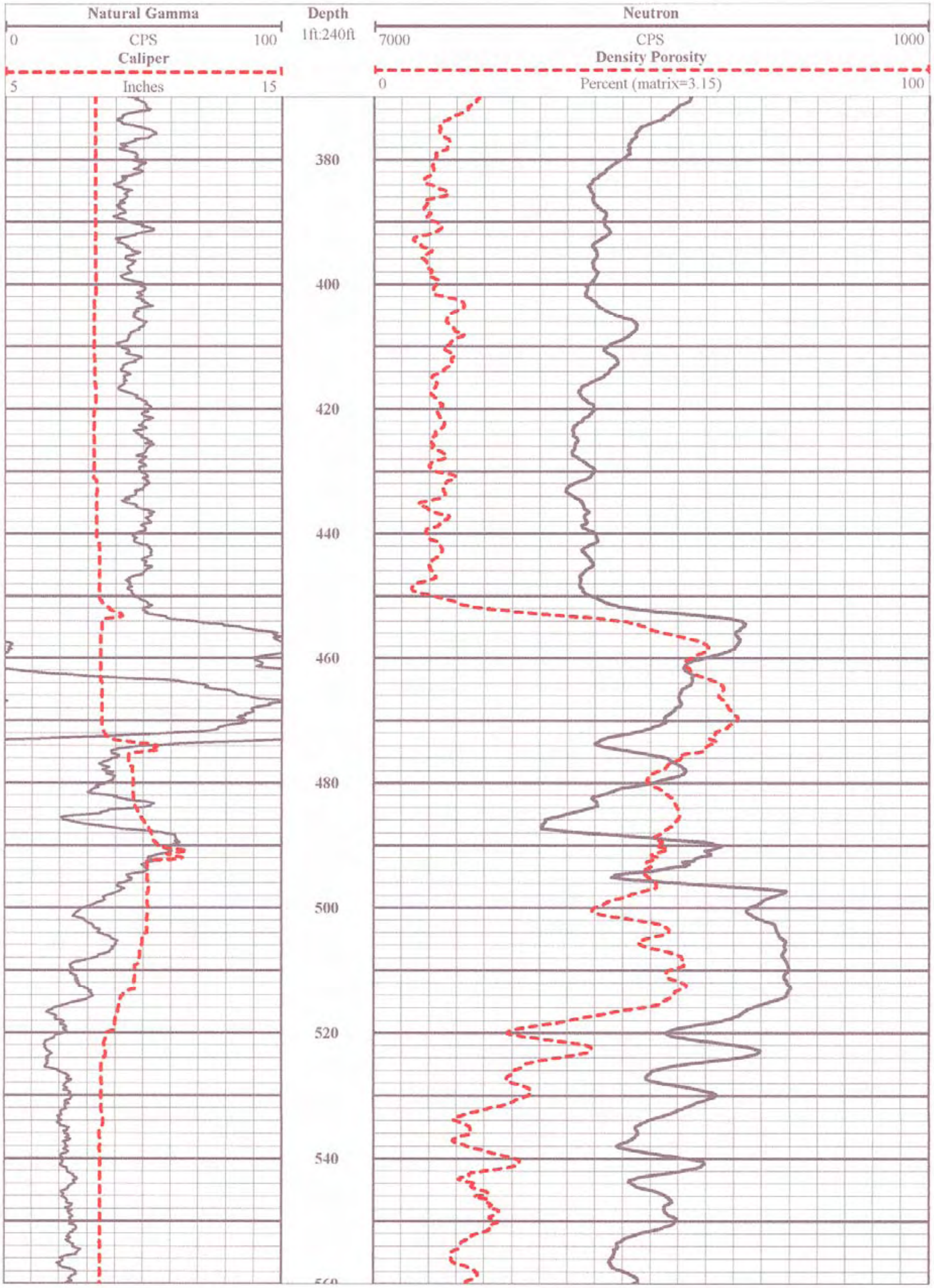

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
1100
1120
1140
1160
1180
1200
1220
1240
1260
1280
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4

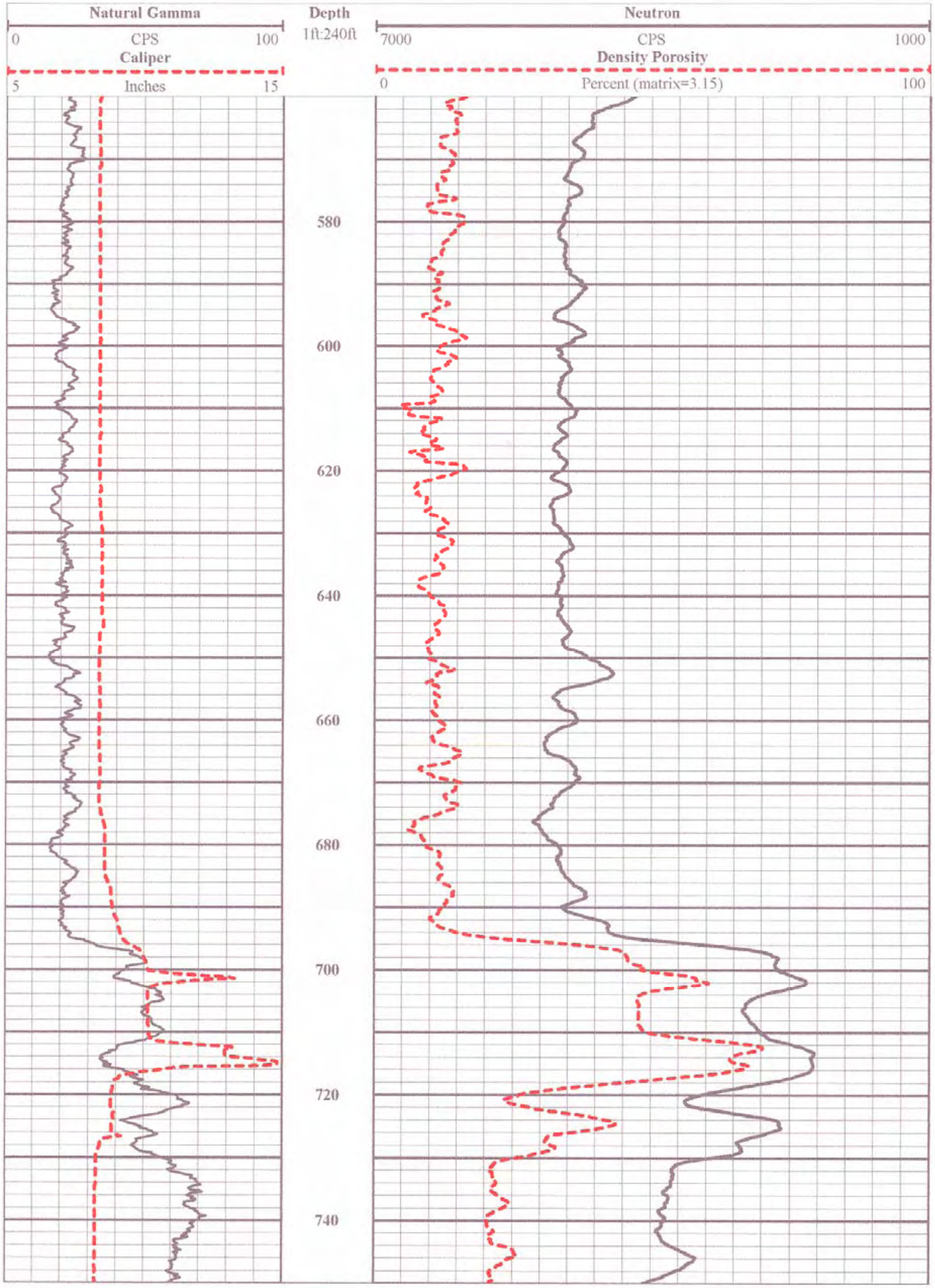

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4
1300
1320
1340
1360
1380
1400
1420
1440
1460

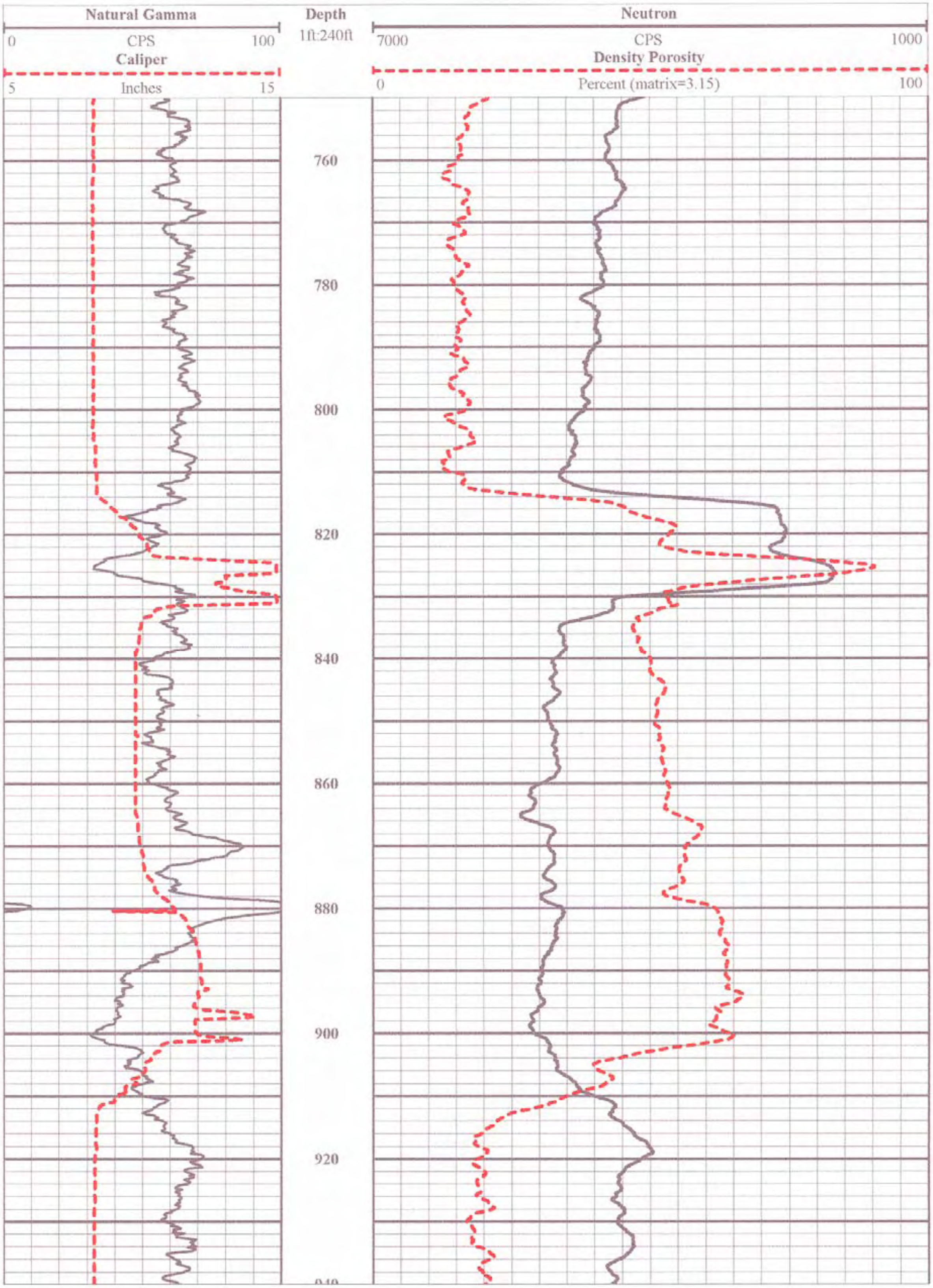
B1.6 COLOG NEUTRON/POROSITY LOG

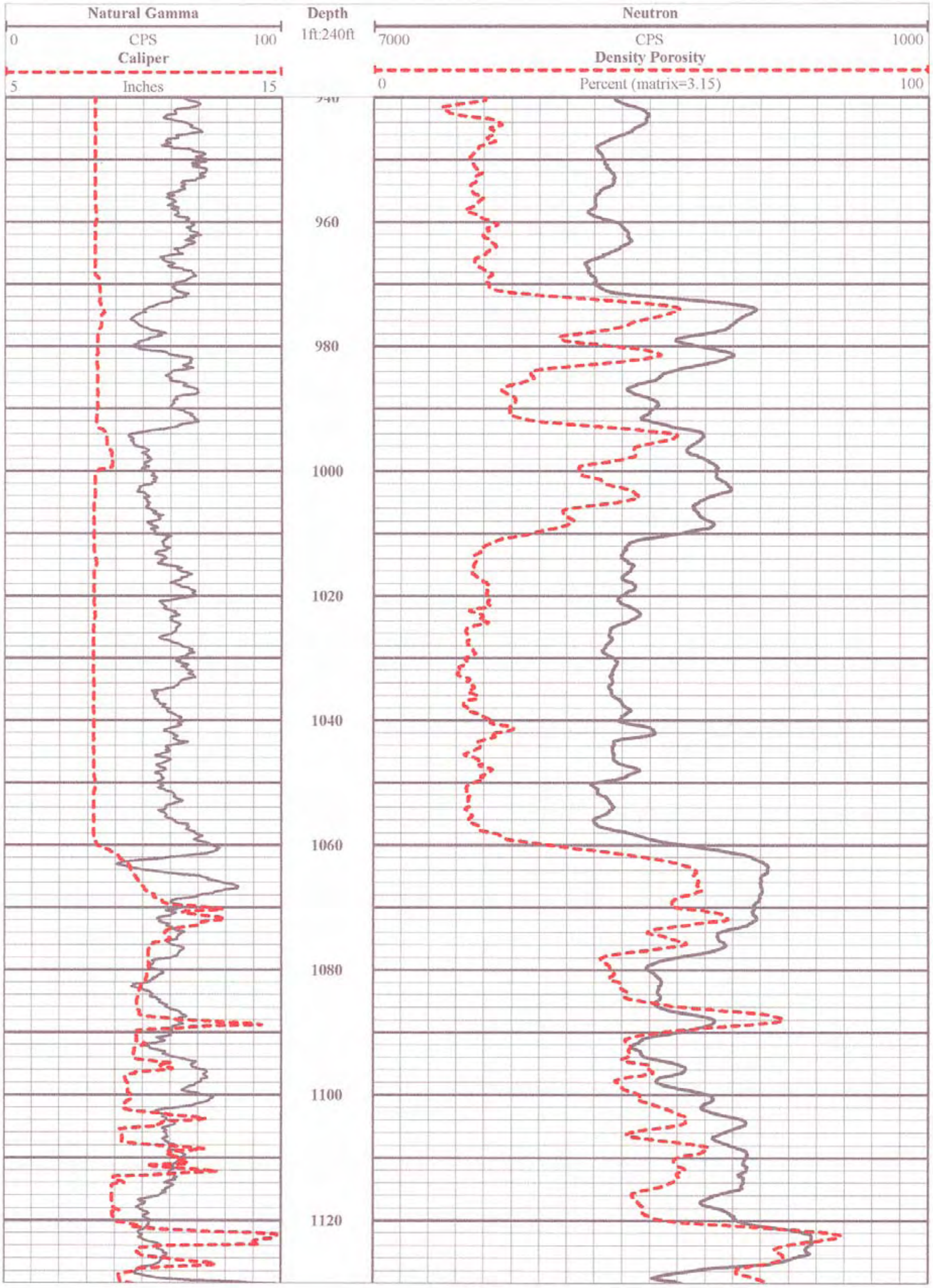


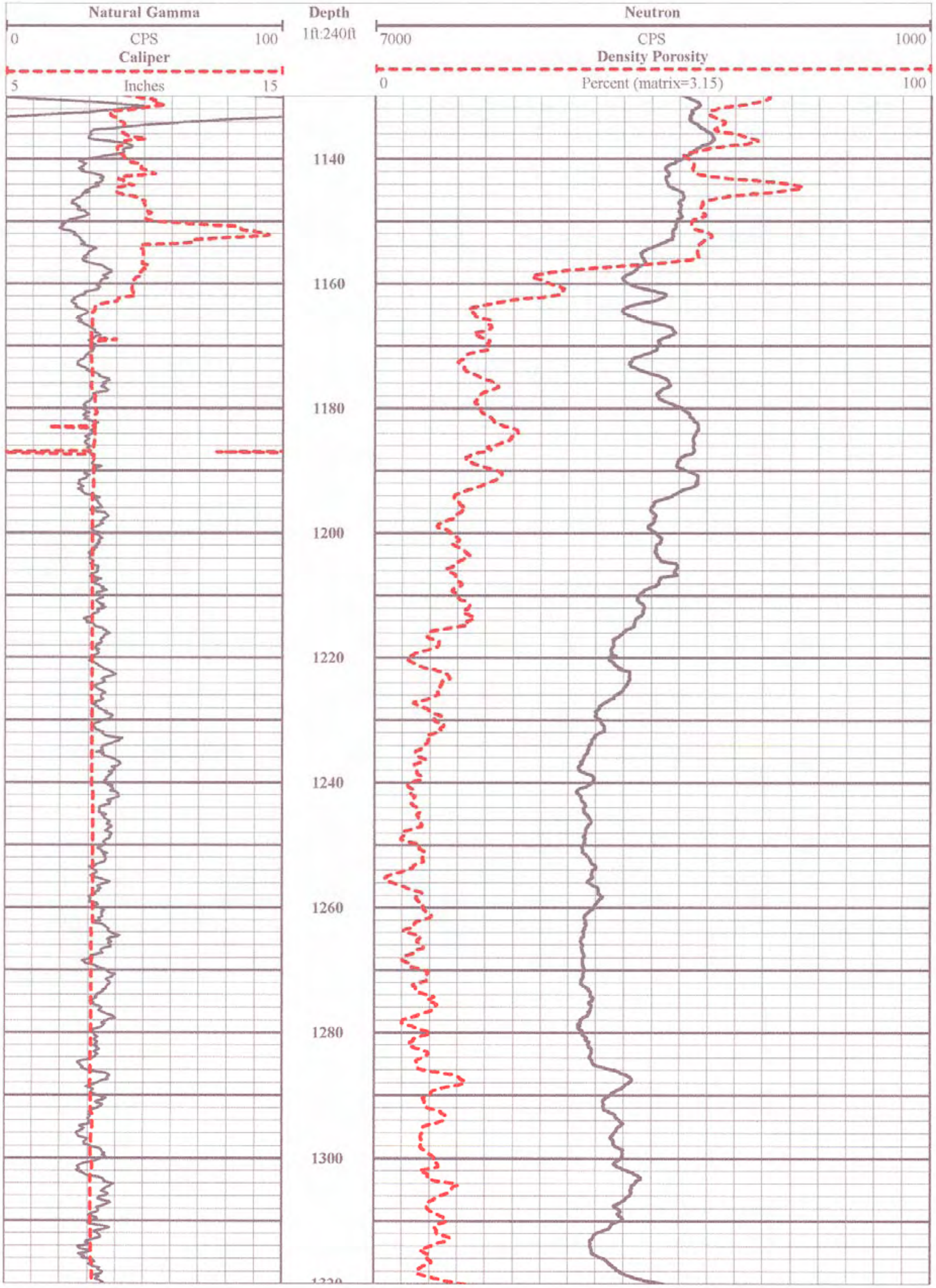

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
200
220
240
260
280
300
320
340
360
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100

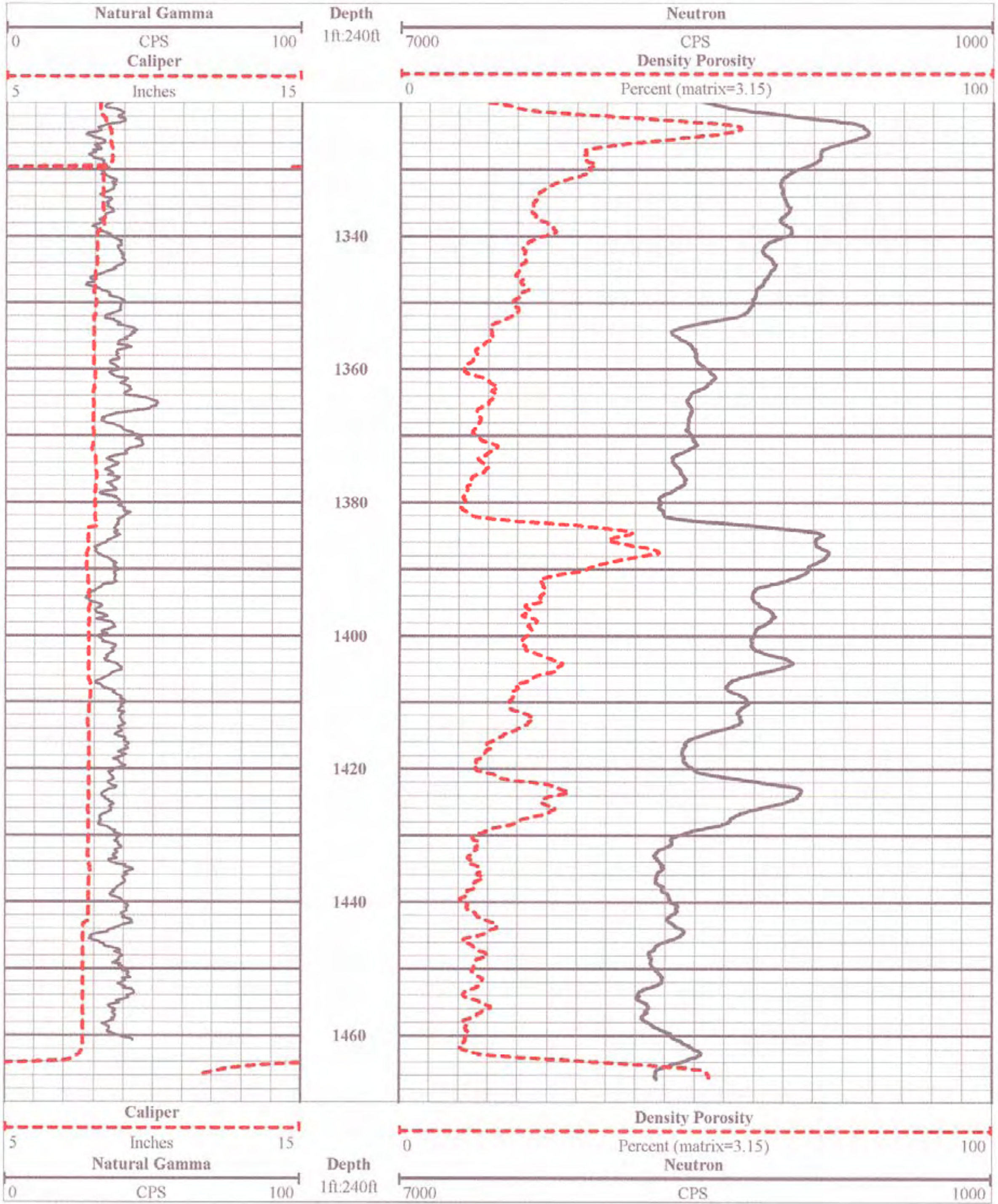

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
380
400
420
440
460
480
500
520
540
560
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100


Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
580
600
620
640
660
680
700
720
740
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100

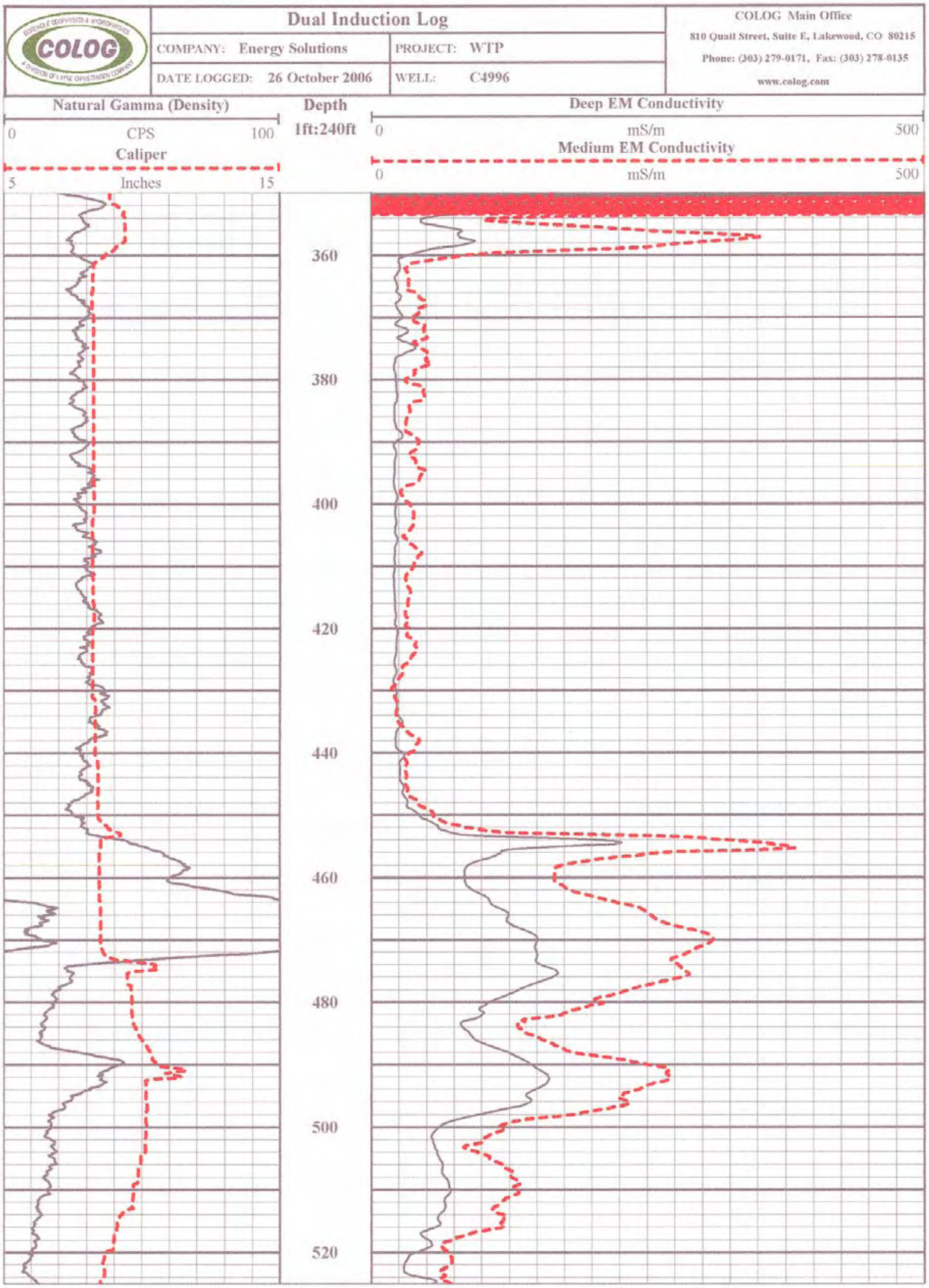

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100
760
780
800
820
840
860
880
900
920


Natural Gamma
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Neutron
7000 CPS 1000
Density Porosity
0 Percent (matrix=3.15) 100
960
980
1000
1020
1040
1060
1080
1100
1120

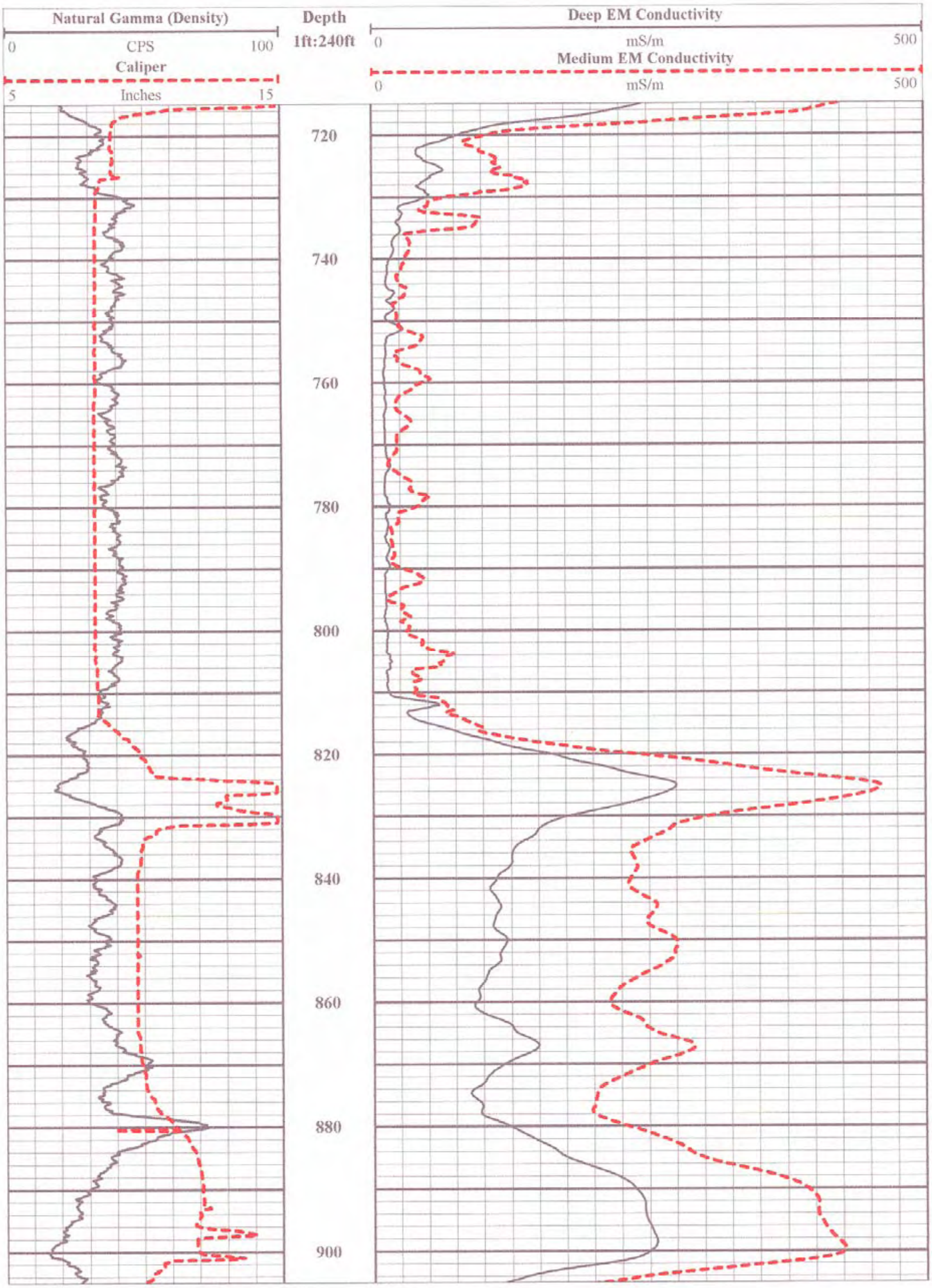

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
1140
1160
1180
1200
1220
1240
1260
1280
1300
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100

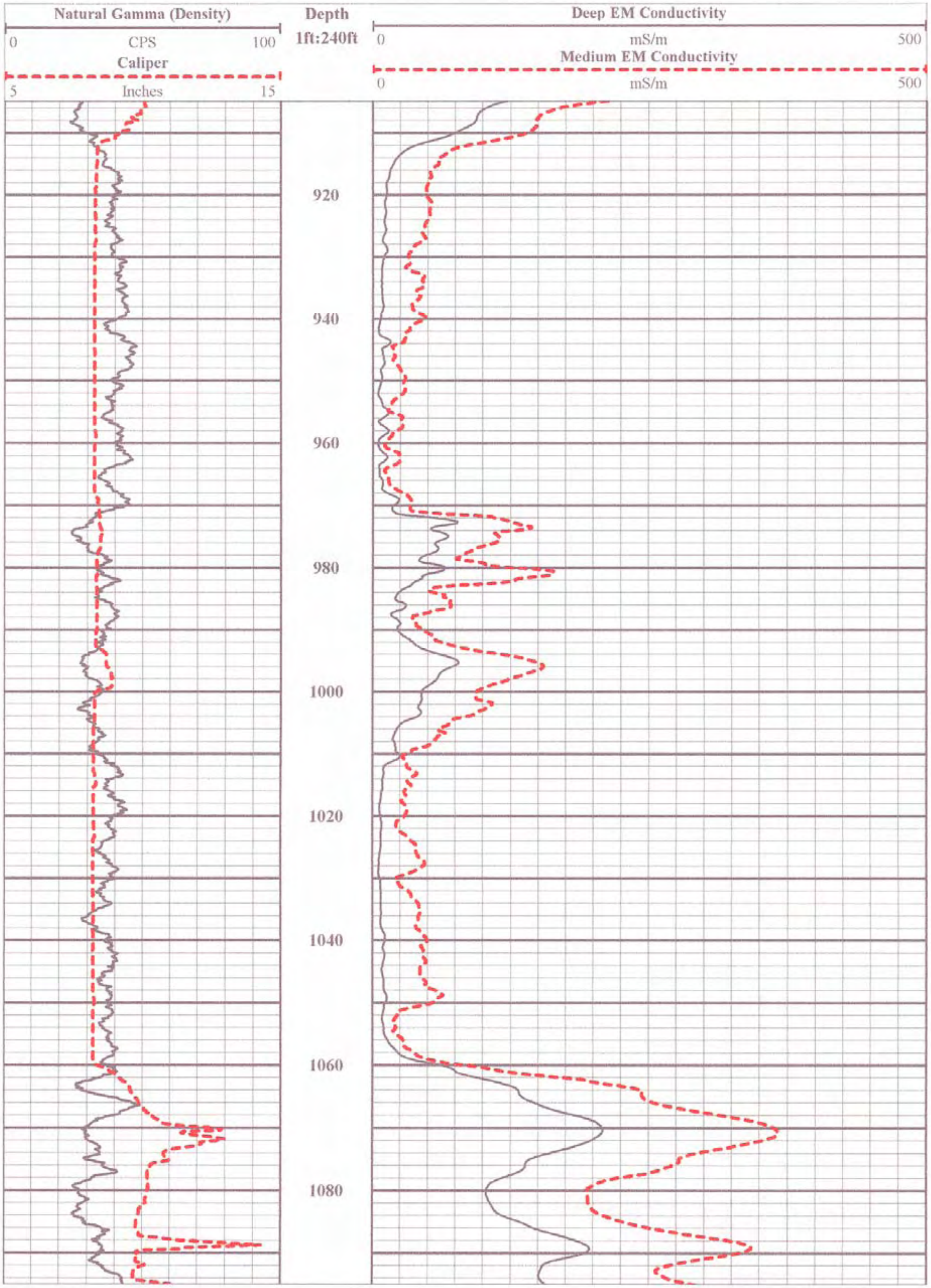

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100
1340
1360
1380
1400
1420
1440
1460
Caliper
5
Inches
15
Natural Gamma
0
CPS
100
Depth
1ft:240ft
Density Porosity
0
Percent (matrix=3.15)
100
Neutron
7000
CPS
1000

B1.7 COLOG DUAL INDUCTION LOG

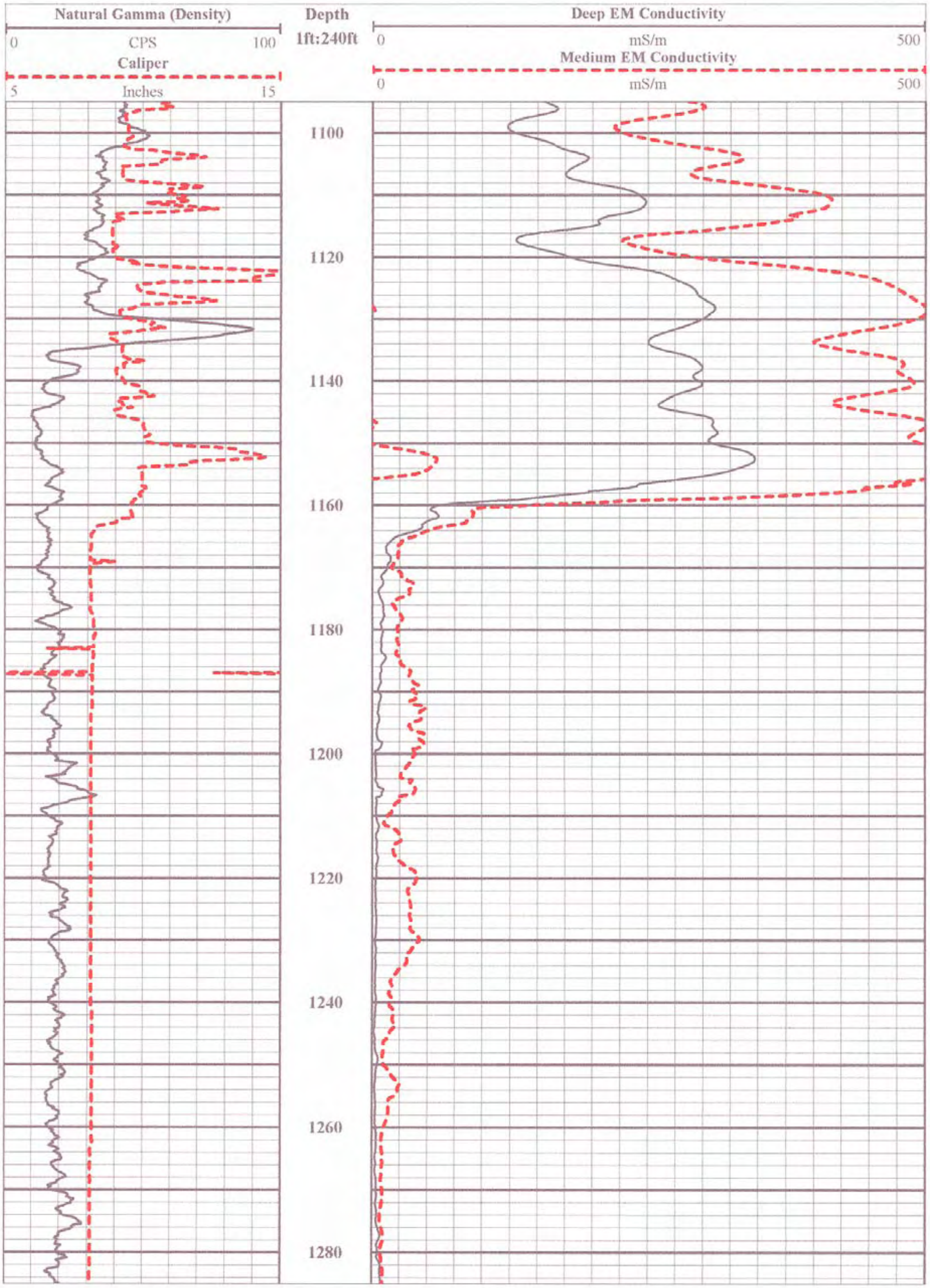


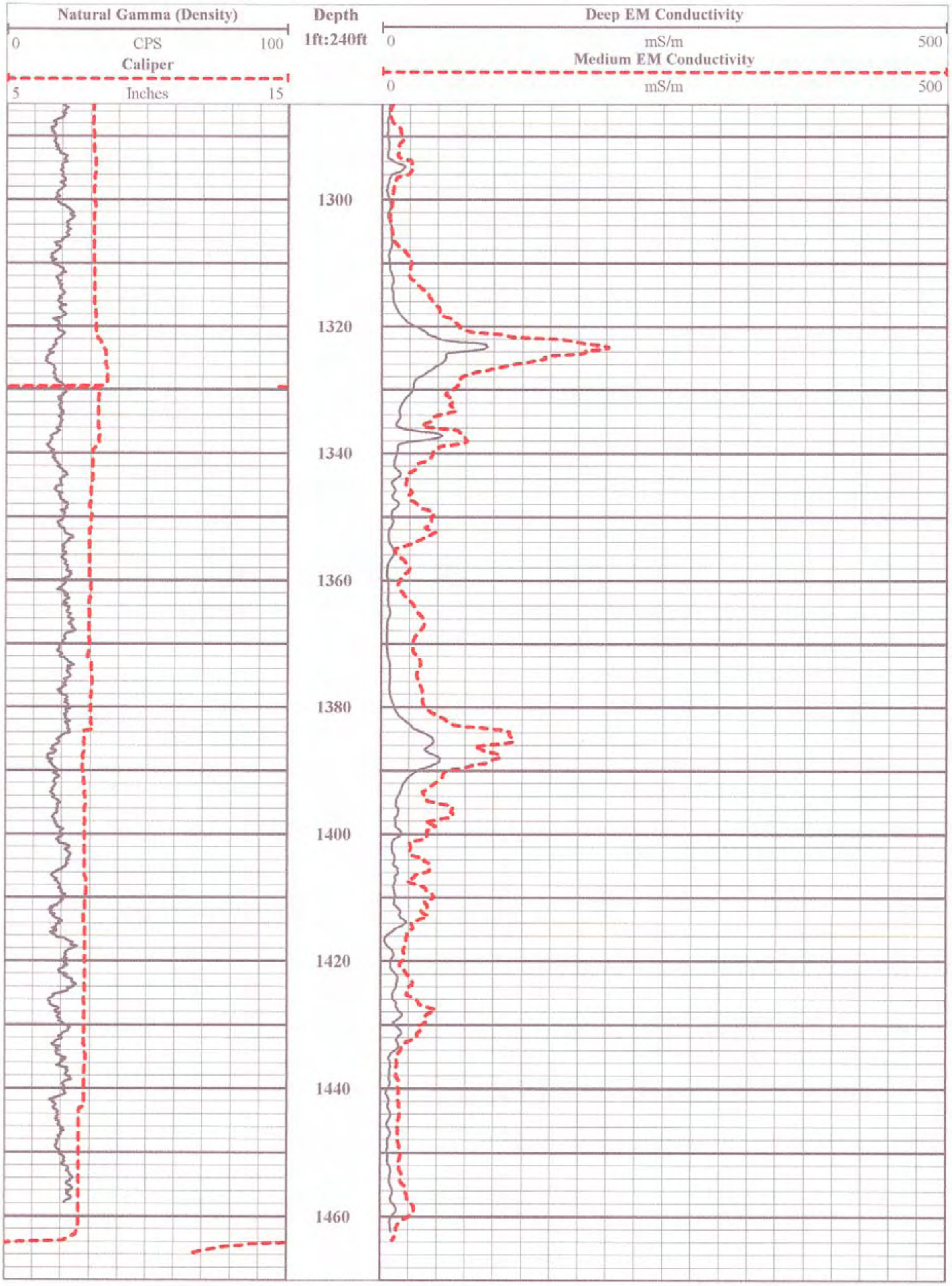

Natural Gamma (Density)
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
540
560
580
600
620
640
660
680
700
Deep EM Conductivity
0
mS/m
500
Medium EM Conductivity
0
mS/m
500


Natural Gamma (Density)
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
720
740
760
780
800
820
840
860
880
900
Deep EM Conductivity
0
mS/m
500
Medium EM Conductivity
0
mS/m
500

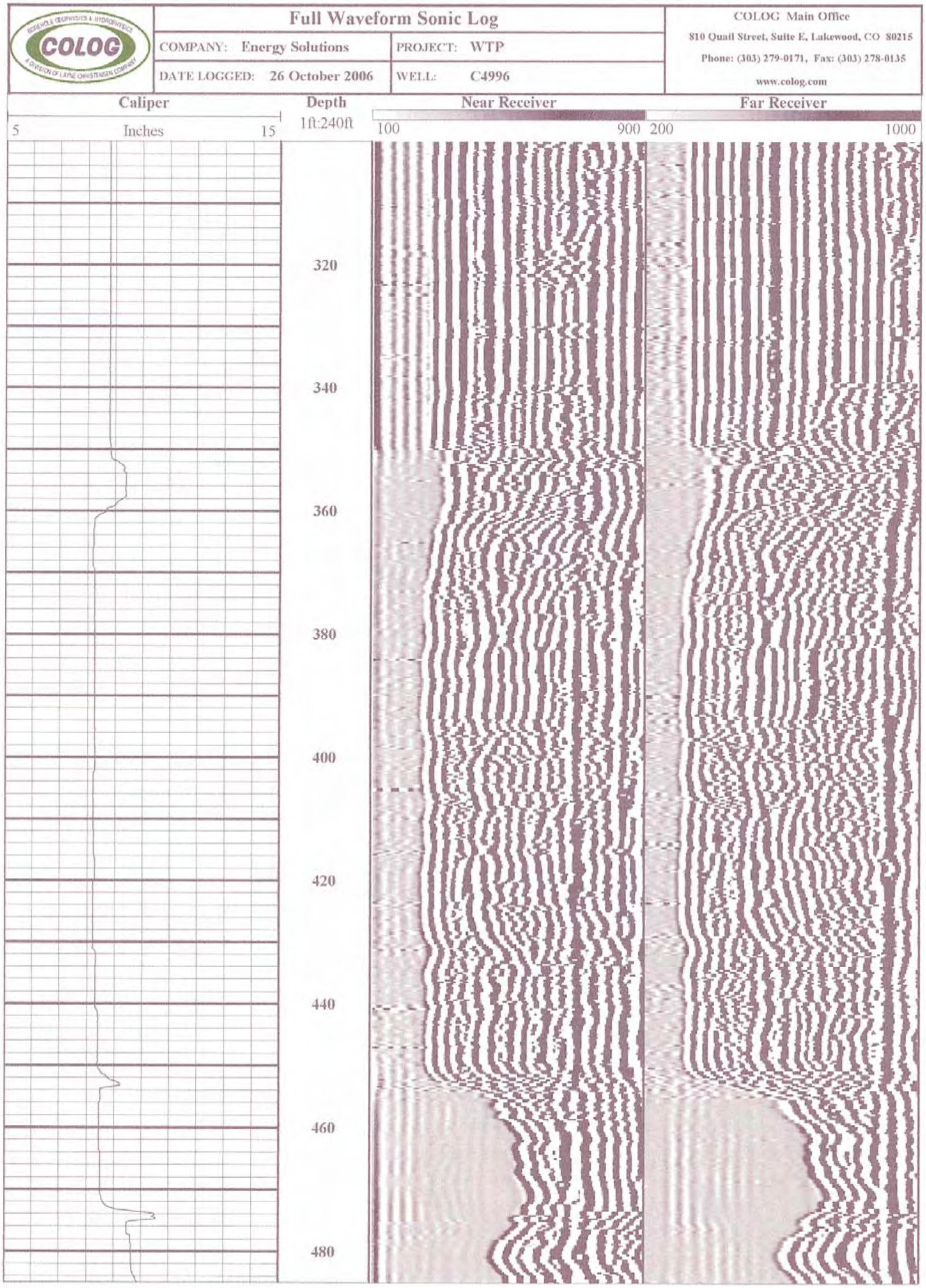


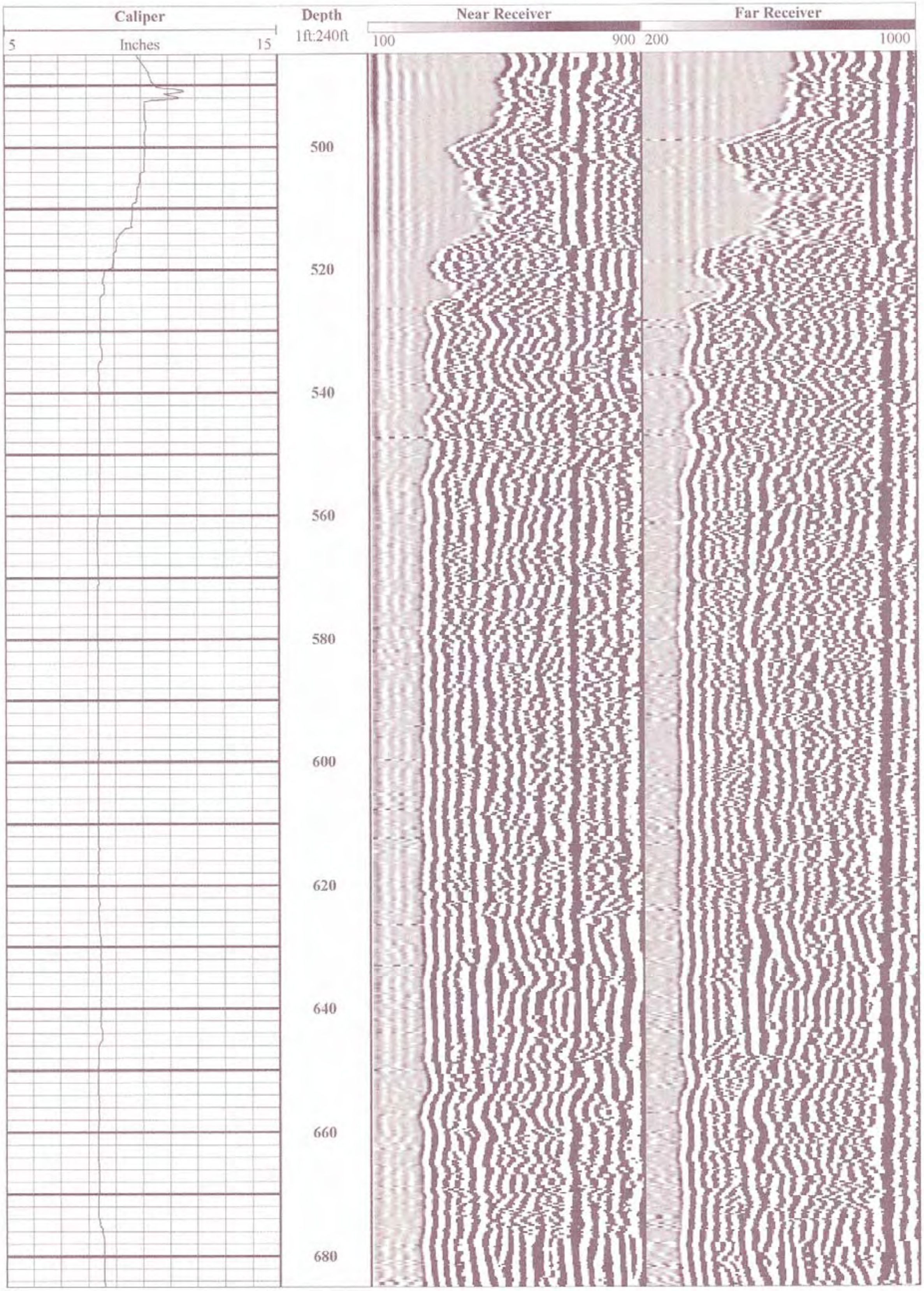
Natural Gamma (Density)
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
920
940
960
980
1000
1020
1040
1060
1080
Deep EM Conductivity
0
mS/m
500
Medium EM Conductivity
0
mS/m
500

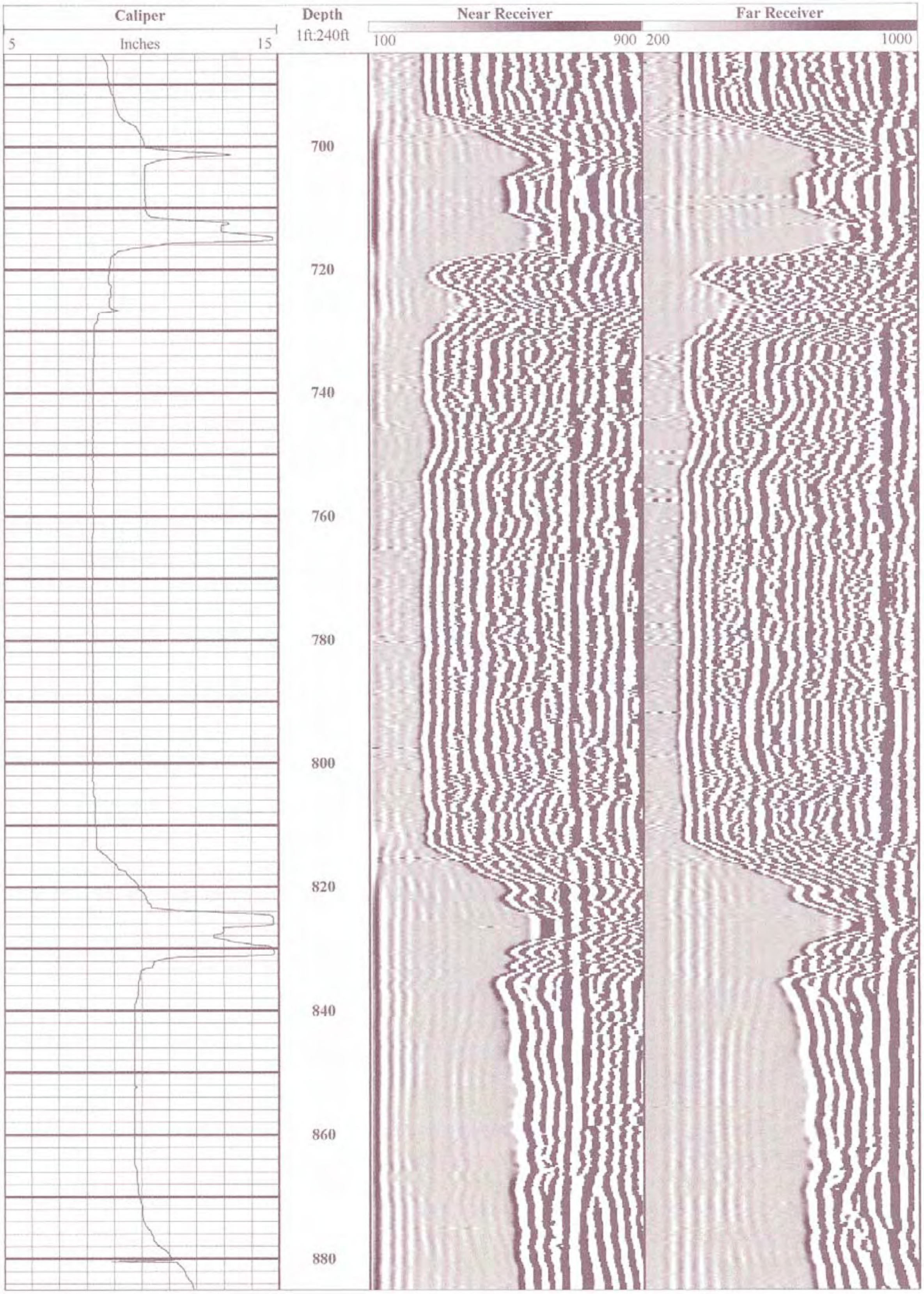

Natural Gamma (Density)
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Deep EM Conductivity
0 mS/m 500
Medium EM Conductivity
0 mS/m 500
1100
1120
1140
1160
1180
1200
1220
1240
1260
1280

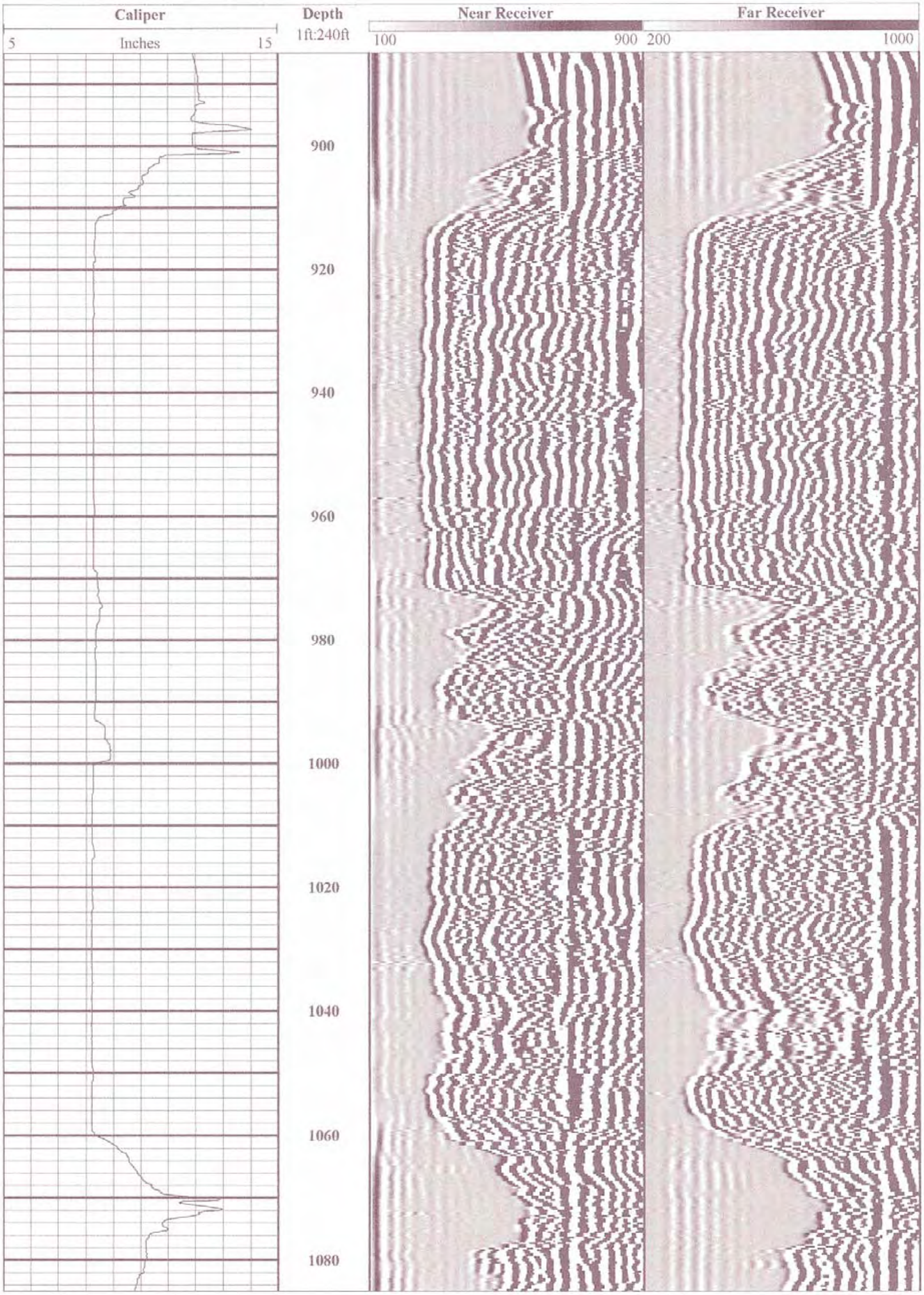

Natural Gamma (Density)
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
1300
1320
1340
1360
1380
1400
1420
1440
1460
Deep EM Conductivity
0
mS/m
500
Medium EM Conductivity
0
mS/m
500

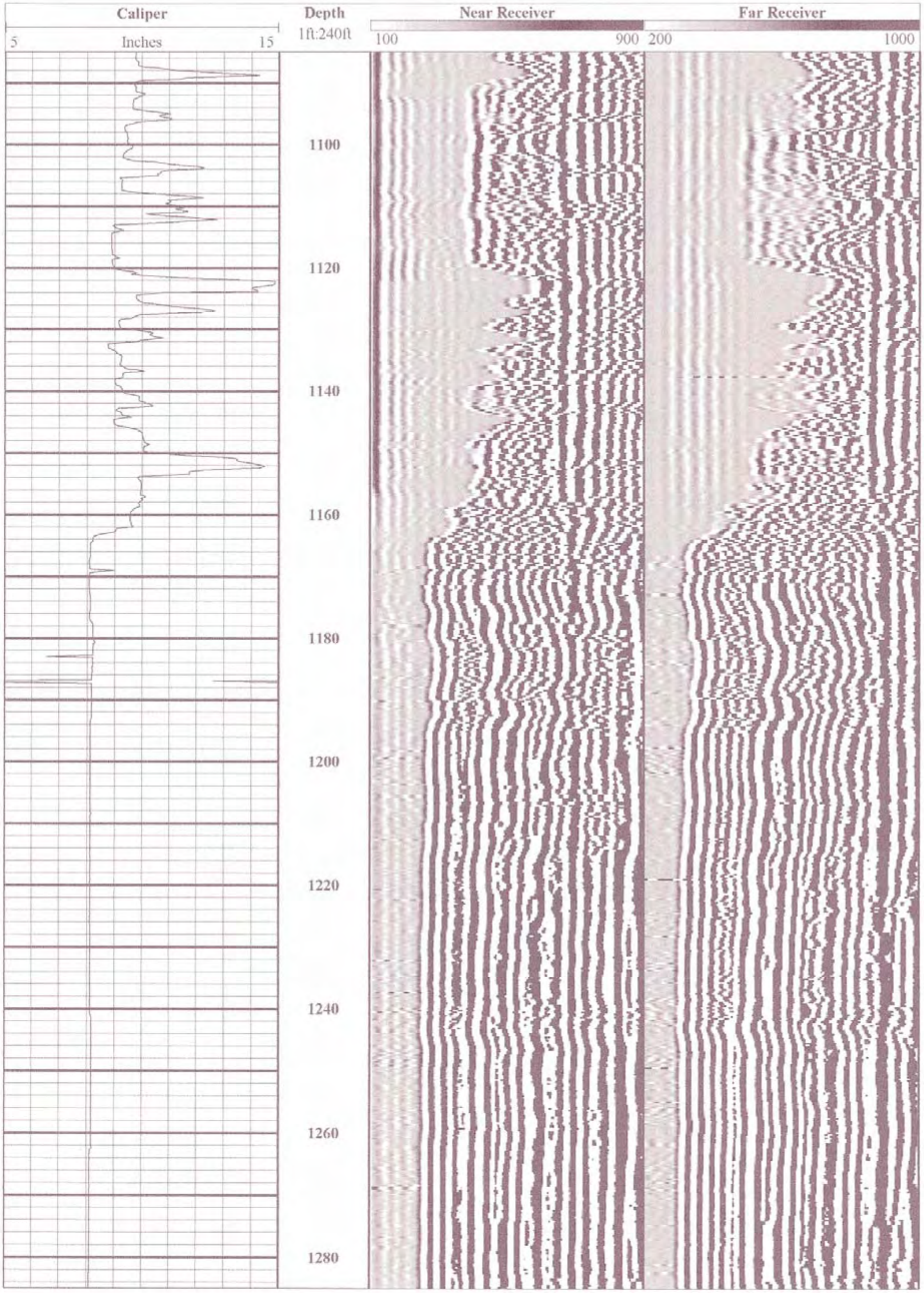
B1.8 COLOG FULL WAVEFORM SONIC LOG

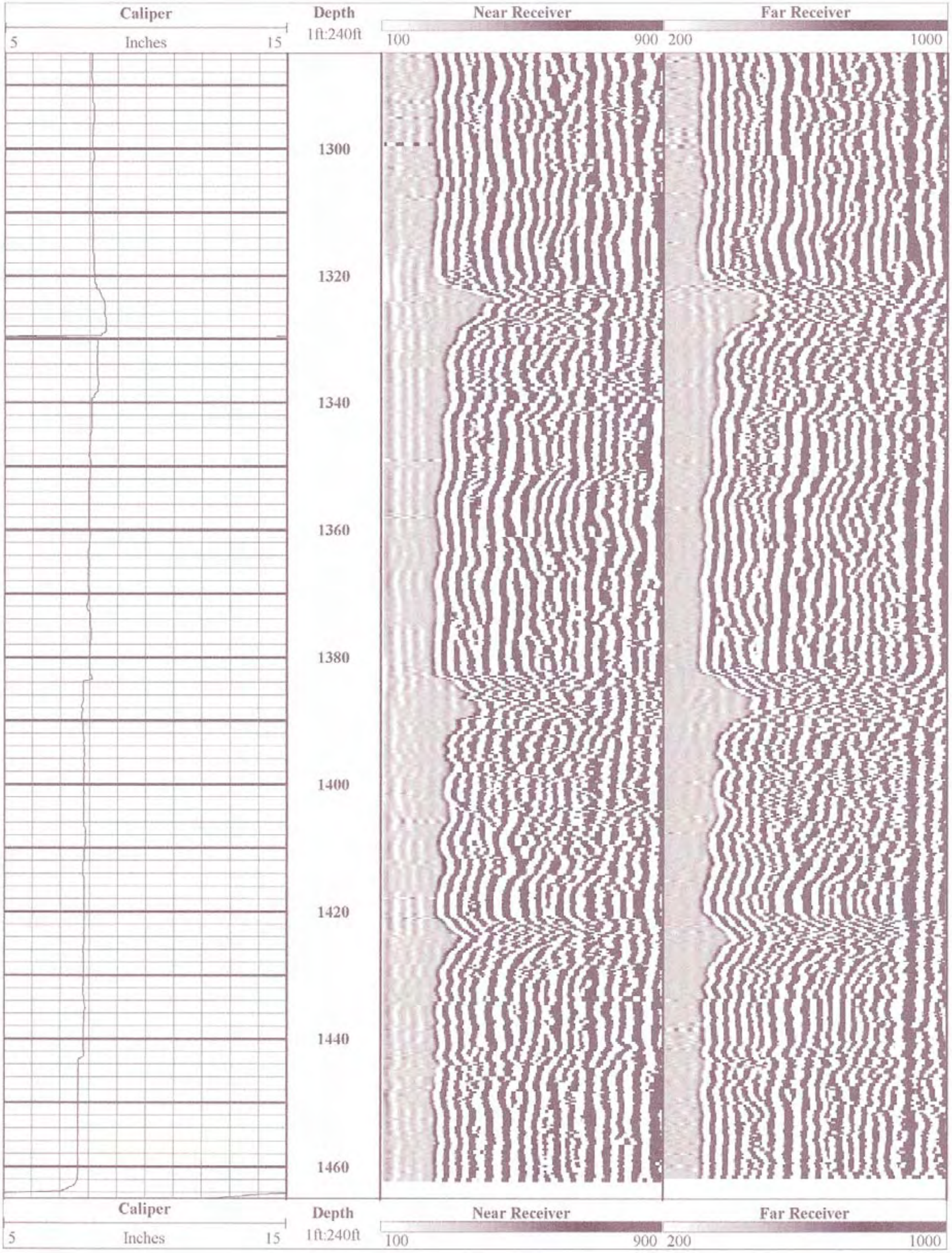



Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
500
520
540
560
580
600
620
640
660
680


Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
700
720
740
760
780
800
820
840
860
880


Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
900
920
940
960
980
1000
1020
1040
1060
1080


Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
1100
1120
1140
1160
1180
1200
1220
1240
1260
1280


Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
1300
1320
1340
1360
1380
1400
1420
1440
1460
Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000

B1.9 WELLBORE NAVIGATION, INC., EARTH'S MAGNETIC FIELD SURVEY

WELLBORE NAVIGATION, INC.
Tustin, California7

Earth's Magnetic Field Survey

For

Energy Solutions

Job Number: 48-0350-312

Well Name: C4996

Location: Hanford Site

Survey Date: September 28, 2006

Survey Engineer: Dawson/Adams

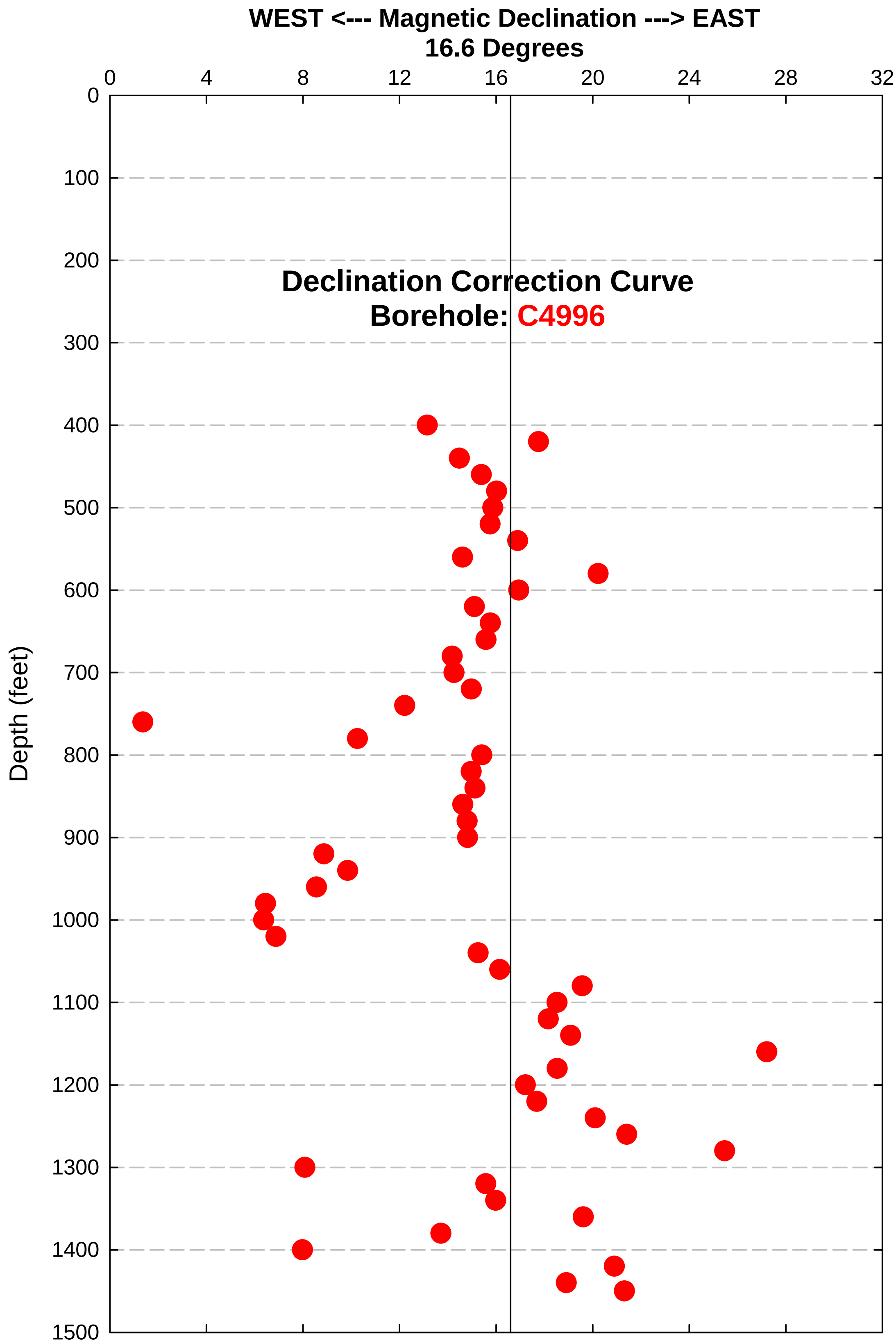
Magnetic Declination: 00.00E True North

Surface Y-Coordinate: 136052.905
Surface X-Coordinate: 576146.827
Surface Elevation: 204.284

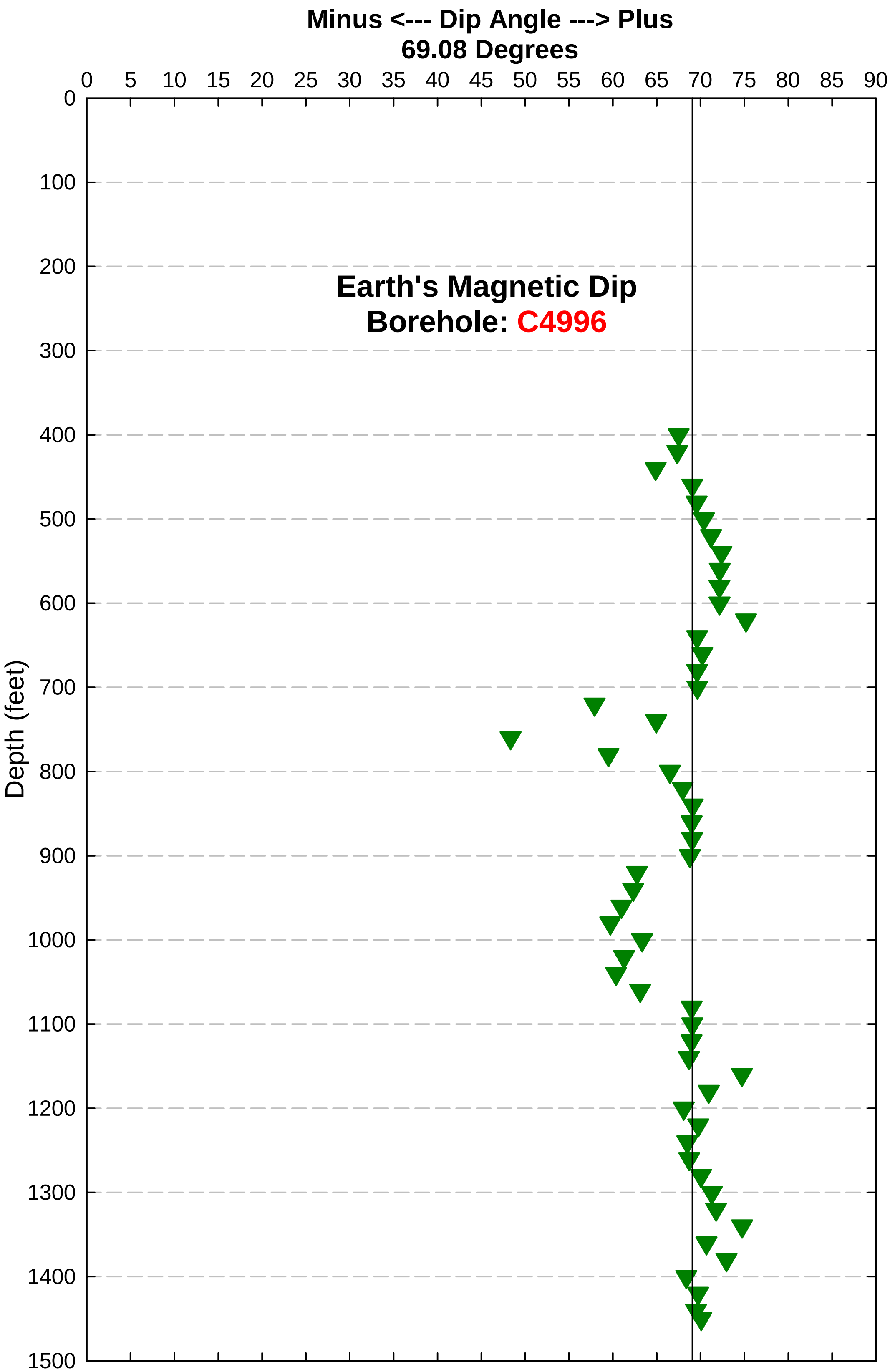
Depth Measured in FEET

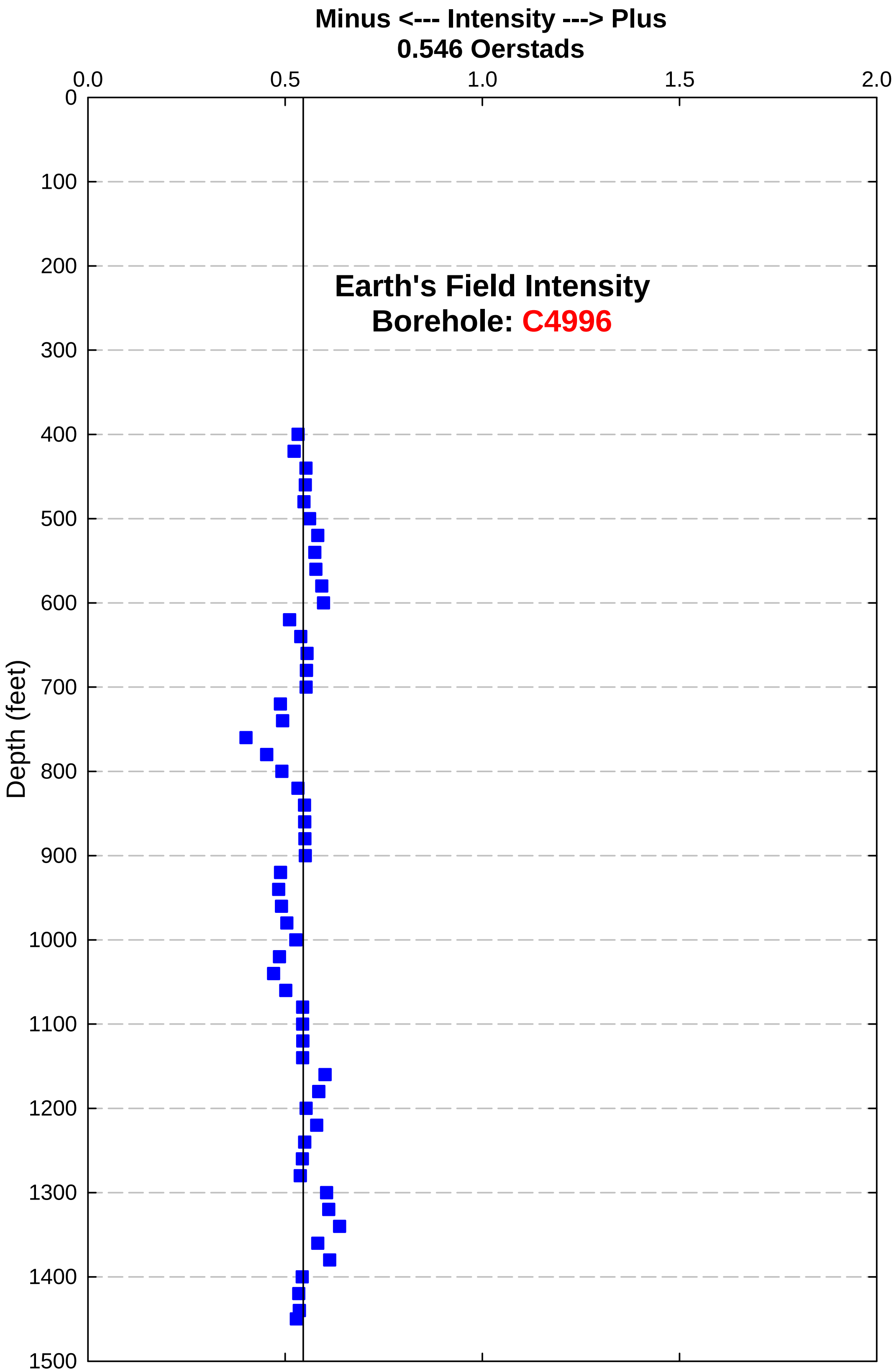
Comments: Surface Casing Depth 368 ft.
USGS: Dip=69.08 Degrees
Intensity= 0.54600 Oerstads
Declination= 16.60 Degrees

Hole ID	Measured Depth	Magnetic Declination	Magnetic Intensity	Magnetic Dip	HFS	X-HFS	Y-HFS	Z-HFS
C4996	400	13.14886	0.53293	67.5	0.20394	0.04639	0.1986	0.49236
C4996	420	17.75369	0.52286	67.34	0.20144	0.06142	0.19184	0.4825
C4996	440	14.4785	0.55297	64.88	0.23474	0.05869	0.22729	0.50067
C4996	460	15.38715	0.55158	69.06	0.19713	0.05231	0.19006	0.51515
C4996	480	16.02503	0.54774	69.55	0.19137	0.05283	0.18394	0.51322
C4996	500	15.86295	0.56213	70.39	0.18866	0.05157	0.18148	0.52953
C4996	520	15.75388	0.58305	71.2	0.1879	0.05102	0.18084	0.55194
C4996	540	16.89365	0.57538	72.39	0.17407	0.05059	0.16656	0.54842
C4996	560	14.60812	0.57823	72.19	0.17686	0.0446	0.17114	0.55052
C4996	580	20.2299	0.5928	72.15	0.18171	0.06283	0.1705	0.56426
C4996	600	16.93821	0.59722	72.17	0.18287	0.05328	0.17493	0.56854
C4996	620	15.10383	0.51151	75.17	0.13092	0.03411	0.1264	0.49447
C4996	640	15.75906	0.5398	69.62	0.18798	0.05105	0.18092	0.50601
C4996	660	15.57894	0.55591	70.21	0.18822	0.05055	0.1813	0.52308
C4996	680	14.1782	0.55428	69.62	0.19303	0.04728	0.18715	0.51958
C4996	700	14.25806	0.55352	69.63	0.19267	0.04745	0.18673	0.51891
C4996	720	14.97595	0.48807	57.91	0.25929	0.067	0.25048	0.4135
C4996	740	12.21576	0.49379	64.96	0.209	0.04422	0.20426	0.44738
C4996	760	1.365936	0.40099	48.34	0.26654	0.00635	0.26647	0.29958
C4996	780	10.2558	0.4534	59.5	0.23012	0.04097	0.22644	0.39066
C4996	800	15.40527	0.49162	66.5	0.19603	0.05208	0.18899	0.45085
C4996	820	14.96817	0.5324	67.96	0.19979	0.0516	0.19301	0.49349
C4996	840	15.12643	0.54942	69.11	0.19591	0.05112	0.18912	0.5133
C4996	860	14.62396	0.54967	68.98	0.19716	0.04978	0.19078	0.51309
C4996	880	14.80106	0.55028	69.03	0.19693	0.05031	0.1904	0.51383
C4996	900	14.81705	0.55153	68.79	0.19954	0.05103	0.1929	0.51417
C4996	920	8.869976	0.4885	62.76	0.2236	0.03448	0.22092	0.43432
C4996	940	9.852539	0.48397	62.32	0.22482	0.03847	0.2215	0.42858
C4996	960	8.559692	0.49096	61	0.23802	0.03543	0.23537	0.4294
C4996	980	6.445282	0.50478	59.72	0.25452	0.02857	0.25291	0.43591
C4996	1000	6.372803	0.52753	63.34	0.2367	0.02627	0.23524	0.47145
C4996	1020	6.883774	0.48582	61.29	0.23338	0.02797	0.23169	0.42609
C4996	1040	15.25523	0.47085	60.37	0.23279	0.06125	0.22458	0.40928
C4996	1060	16.1512	0.50165	63.12	0.22681	0.06309	0.21786	0.44745
C4996	1080	19.56986	0.54475	68.98	0.1954	0.06545	0.18411	0.5085
C4996	1100	18.52356	0.5445	69.06	0.1946	0.06182	0.18452	0.50854
C4996	1120	18.16028	0.54499	68.96	0.19566	0.06098	0.18592	0.50866
C4996	1140	19.0874	0.54469	68.68	0.19804	0.06476	0.18715	0.50741
C4996	1160	27.21414	0.60158	74.73	0.15844	0.07246	0.1409	0.58034
C4996	1180	18.53077	0.58539	70.93	0.19126	0.06079	0.18134	0.55326
C4996	1200	17.21326	0.5532	68.09	0.20643	0.06109	0.19718	0.51324
C4996	1220	17.68686	0.5802	69.74	0.20091	0.06104	0.19142	0.5443
C4996	1240	20.10511	0.5497	68.5	0.20147	0.06925	0.18919	0.51145
C4996	1260	21.41417	0.54365	68.71	0.19739	0.07207	0.18377	0.50655
C4996	1280	25.46976	0.53864	70.04	0.18387	0.07907	0.166	0.50628
C4996	1300	8.078034	0.60556	71.28	0.19435	0.02731	0.19242	0.57352
C4996	1320	15.57593	0.61044	71.77	0.19097	0.05128	0.18395	0.5798
C4996	1340	15.98691	0.63817	74.75	0.16786	0.04623	0.16137	0.6157
C4996	1360	19.6102	0.58309	70.67	0.19301	0.06478	0.18181	0.55022
C4996	1380	13.71393	0.61308	72.97	0.17955	0.04257	0.17444	0.5862
C4996	1400	7.977265	0.54348	68.38	0.20024	0.02779	0.19831	0.50525
C4996	1420	20.901	0.53476	69.72	0.18535	0.06613	0.17316	0.50161
C4996	1440	18.9102	0.53605	69.49	0.18782	0.06087	0.17768	0.50207
C4996	1450	21.3151	0.52865	70.08	0.18012	0.06547	0.16779	0.49702



WEST <--- Magnetic Declination ---> EAST
16.6 Degrees
Declination Correction Curve
Borehole: C4996
Depth (feet)
0
4
8
12
16
20
24
28
32
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500


Minus <--- Dip Angle ---> Plus
69.08 Degrees
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Earth's Magnetic Dip
Borehole: C4996
Depth (feet)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500


Minus <--- Intensity ---> Plus
0.546 Oerstads
0.0
0.5
1.0
1.5
2.0
Earth's Field Intensity
Borehole: C4996
Depth (feet)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500

APPENDIX C

BOREHOLE C4997

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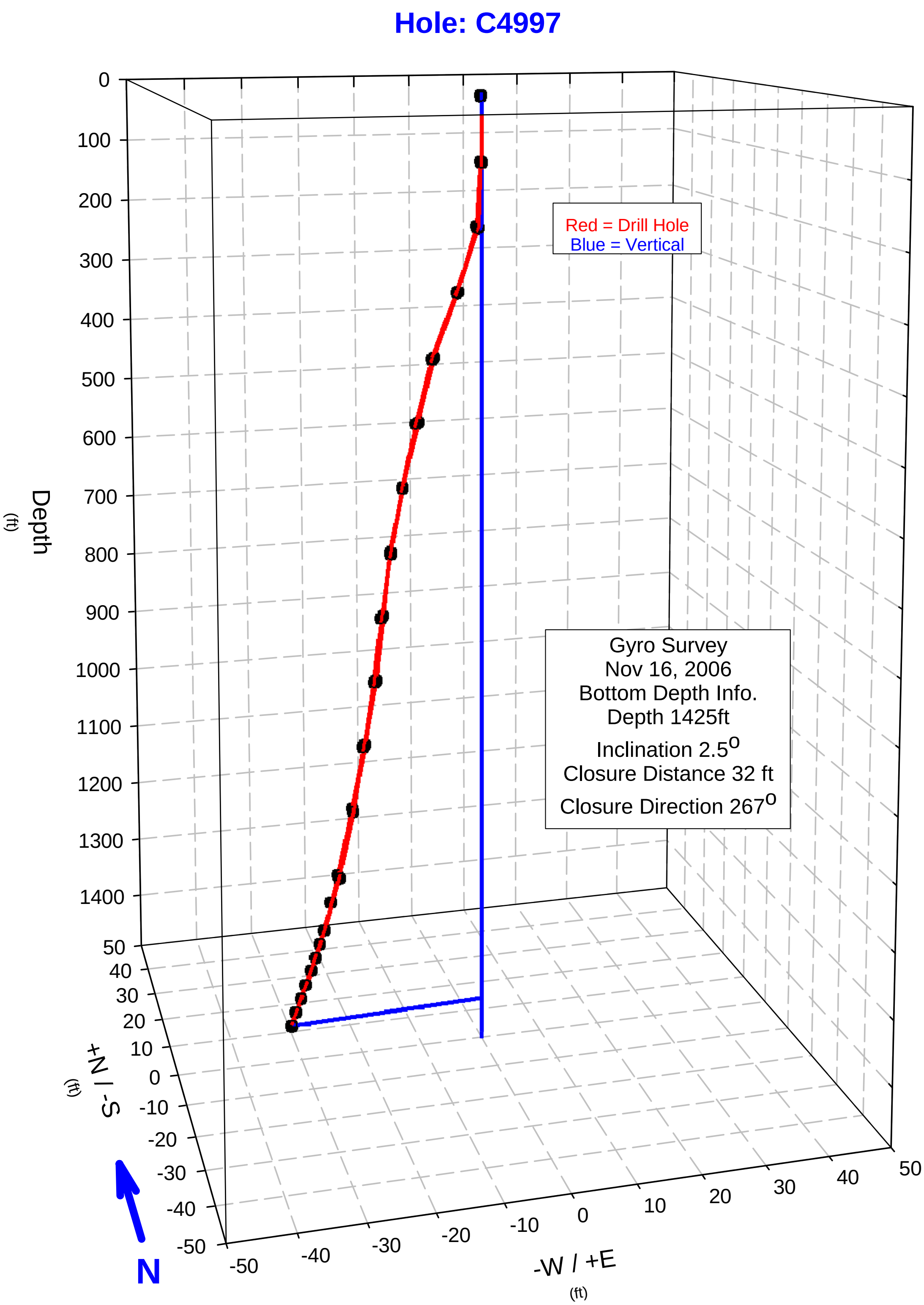
C1.0 BOREHOLE C4997

C1.1 ENERGY*SOLUTIONS* AND PACIFIC NORTHWEST GEOPHYSICS GYROSCOPIC LOGS

Hole: **C4997**

Survey Date	Survey Number	Maximum Depth (feet)	Inclination From Vertical (deg)	Closure Distance (feet)
11/16/2006	21*	1425	2.5	32
11/4/2006	20*	1261	2.6	26
10/8/2006	19*	1416	1.5	33
10/6/2006	18A*	1336	2.5	29
10/1/2006	17*	1237	1.3	23
9/27/2006	16*	1117	1.1	23
9/21/2006	14*	1033	1	21
9/17/2006	13*	956	1.5	19
9/12/2006	12*	958	1.0	20
9/5/2006	11	782	0.8	14
9/2/2006	10*	656	1.5	13
8/27/2006	9*	559	1.5	13
Casing	Cable-Tool			
8/17/2006	8	371	3.1	7
8/15/2006	7	336	2.1	5
8/9/2006	6*	270	1.9	3
8/8/2006	5	235	2.5	1
8/4/2006	4	197	1.3	1
8/3/2006	3	175	1	1
8/2/2006	2	130	0.5	1.5
8/1/2006	1	71	0.6	0.7

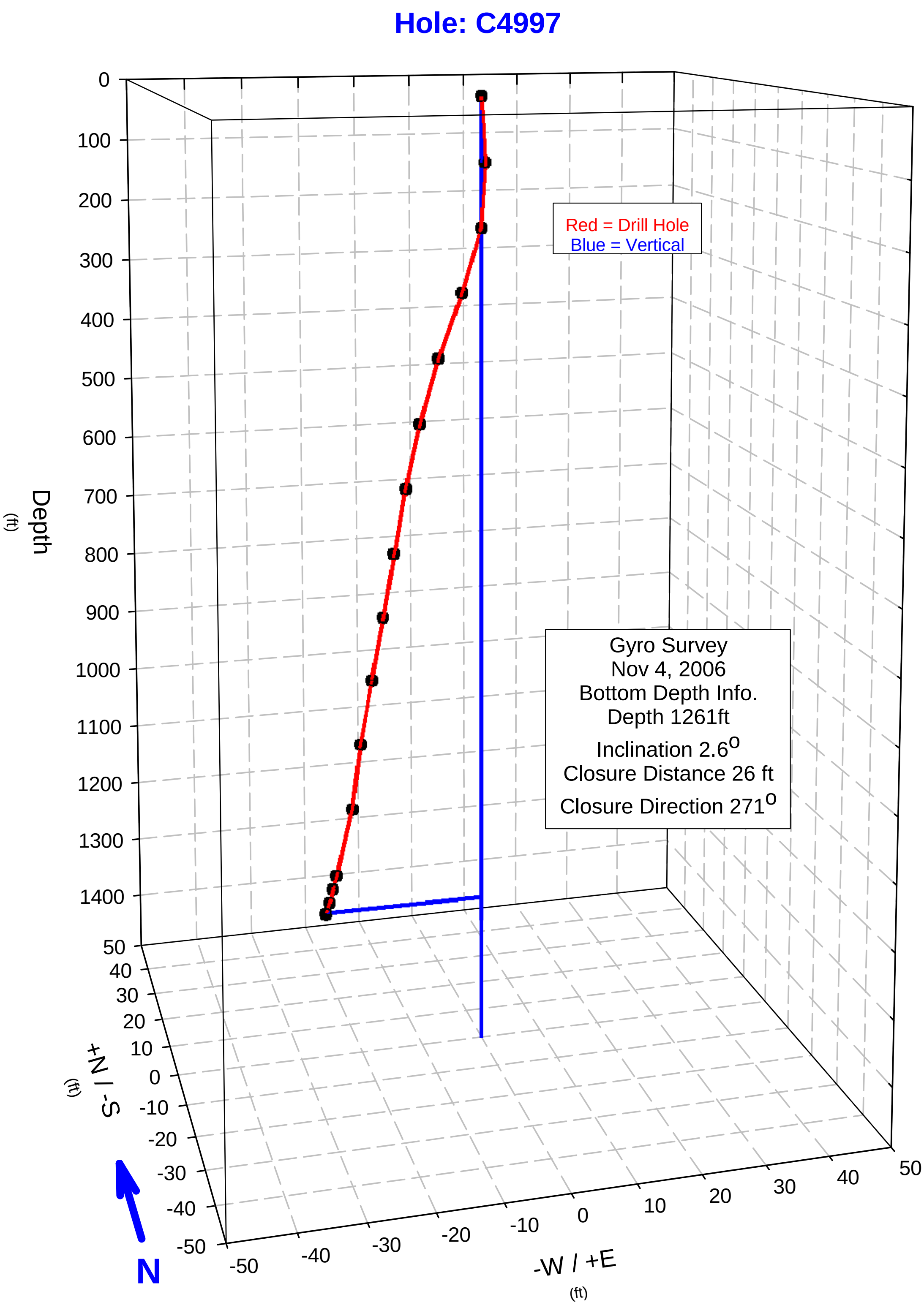
* = Gyro data includes Out-Run survey check-stations.



Hole: C4997
Red = Drill Hole
Blue = Vertical
Gyro Survey
Nov 16, 2006
Bottom Depth Info.
Depth 1425ft
Inclination 2.5°
Closure Distance 32 ft
Closure Direction 267°
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

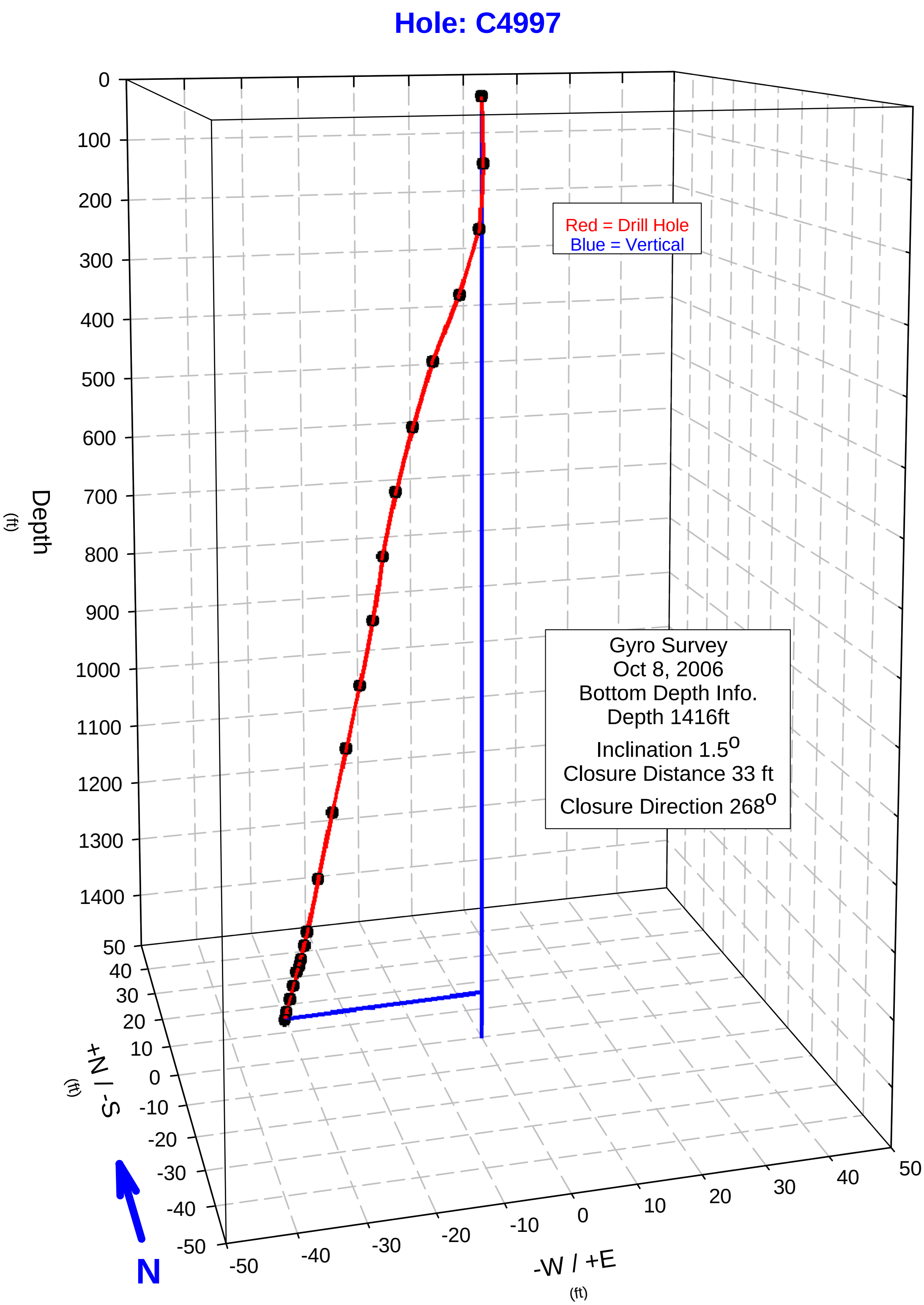
Hole: **C4997** Survey Date: **11/16/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
5	5	0.46	217.35	0.05	-0.04	-0.03	12.2
105	105	0.55	190.24	0.54	-0.53	-0.1	0.8
205	204.99	1.38	284.14	0.47	0.11	-0.45	1.9
305	304.92	2.91	293.4	3.94	1.56	-3.62	2.2
405	404.84	1.81	282.47	7.84	1.69	-7.66	1.4
505	504.8	1.34	279.49	10.46	1.72	-10.31	0.9
605	604.78	1.33	278.59	12.72	1.9	-12.57	0.6
705	704.75	1.1	275.93	14.74	1.52	-14.66	0.2
805	804.74	0.74	275.91	16.23	1.67	-16.14	0.8
905	904.73	0.81	275.94	17.45	1.81	-17.36	0.7
1005	1004.72	1.32	274.55	19.24	1.53	-19.18	0.6
1105	1104.7	1.03	272.57	21.09	0.94	-21.07	0.7
1205	1204.66	2.08	270.42	23.61	0.17	-23.61	1.3
1305	1304.6	1.8	269.18	26.95	-0.39	-26.94	0.3
1345	1344.57	2.68	268.52	28.48	-0.74	-28.47	2.2
1385	1384.53	2.67	267.5	30.26	-1.32	-30.24	1
1425	1424.49	2.54	266.69	32.02	-1.85	-31.96	1.4


Hole: C4997
Red = Drill Hole
Blue = Vertical
Gyro Survey
Nov 4, 2006
Bottom Depth Info.
Depth 1261ft
Inclination 2.6°
Closure Distance 26 ft
Closure Direction 271°
Depth
(ft)
+N / -S
(ft)
-W / +E
(ft)
N

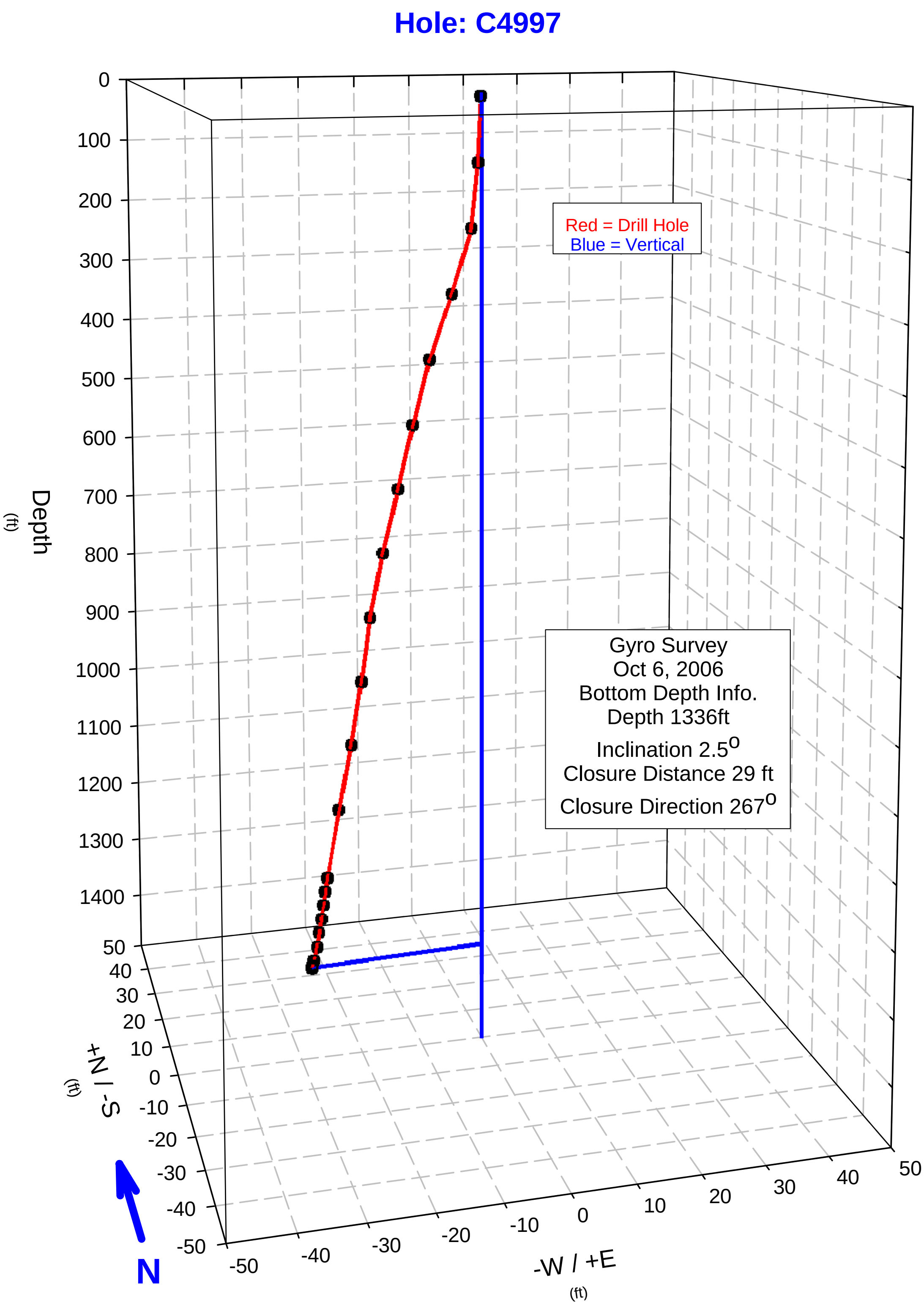
Hole: **C4997** Survey Date: **11/4/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
5	5	0.4	77.93	0.04	0.01	0.04	4.9
105	105	0.51	104.31	0.68	-0.17	0.66	0.5
205	204.99	1.45	20.88	0.53	0.5	0.19	2
305	304.94	2.44	299.43	3.13	1.54	-2.72	1.9
405	404.86	2.02	284.03	6.82	1.65	-6.62	0.4
505	504.81	1.5	281.14	9.86	1.9	-9.67	0.6
605	604.79	1.15	279.74	12.14	2.05	-11.97	0.4
705	704.77	1.13	277.64	14.07	1.87	-13.94	0.1
805	804.75	1.03	277.8	15.85	2.15	-15.71	0.7
905	904.73	1.24	278.46	17.77	2.61	-17.58	0.6
1005	1004.71	0.86	278.1	19.59	2.76	-19.4	0.4
1105	1104.7	1.32	275.79	21.13	2.13	-21.02	1
1205	1204.65	2.33	272.34	23.92	0.98	-23.9	1.3
1225	1224.64	1.82	271.76	24.59	0.76	-24.58	3.6
1245	1244.63	1.62	271.24	25.15	0.54	-25.14	1.9
1261.5	1261.11	2.57	270.92	25.73	0.41	-25.73	5.8


Hole: C4997
Red = Drill Hole
Blue = Vertical
Gyro Survey
Oct 8, 2006
Bottom Depth Info.
Depth 1416ft
Inclination 1.5°
Closure Distance 33 ft
Closure Direction 268°
Depth
(ft)
+N / -S
(ft)
-W / +E
(ft)
N
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
50
40
30
20
10
0
-10
-20
-30
-40
-50

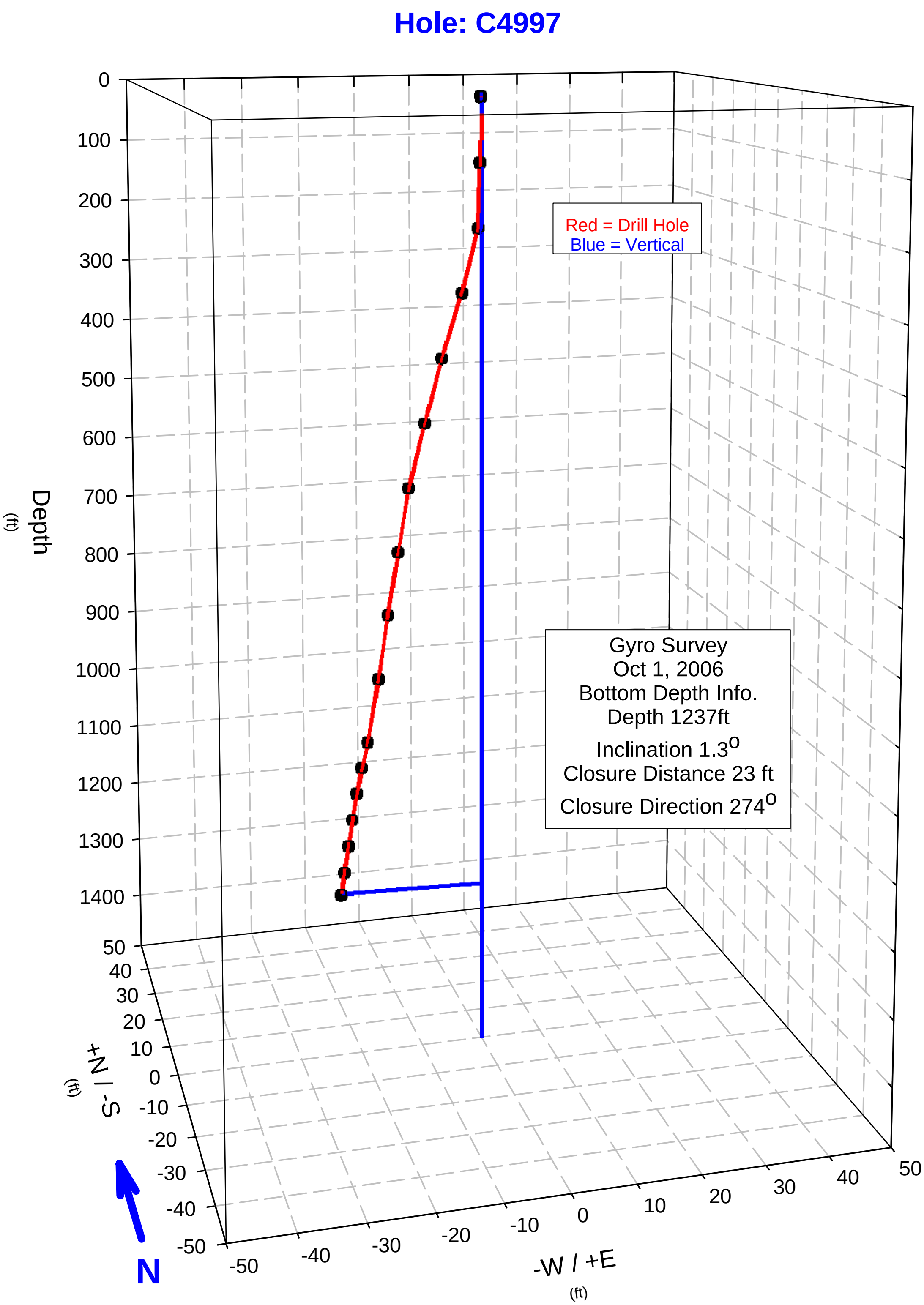
Hole: **C4997** Survey Date: **10/8/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.41	168.5	0.05	-0.05	0.01	12.7
105	105	0.58	175.8	0.88	-0.88	0.06	0.3
205	204.99	1.01	210.75	1.07	-0.92	-0.55	1.5
305	304.94	2.76	263.51	3.75	-0.42	-3.72	1.9
405	404.84	2.11	268.8	7.96	-0.17	-7.96	0.7
505	504.79	1.59	272.15	11.13	0.42	-11.12	0.6
605	604.75	1.64	273	13.9	0.73	-13.88	0.6
705	704.73	0.88	273.53	16.03	0.99	-16	1
805	804.72	1.09	273.71	17.66	1.14	-17.62	0.7
905	904.69	1.44	273.78	19.8	1.31	-19.76	0.7
1005	1004.67	1.16	274.98	22.03	1.91	-21.95	0.3
1105	1104.64	1.66	274.18	24.38	1.78	-24.32	0.9
1205	1204.6	1.47	271.87	26.91	0.88	-26.89	0.3
1285	1284.57	1.56	270.23	28.86	0.12	-28.86	0.2
1305	1304.56	1.85	269.86	29.43	-0.07	-29.43	1.5
1325	1324.55	1.86	269.49	30.05	-0.27	-30.04	0.1
1335	1334.55	2.04	269.3	30.37	-0.37	-30.37	1.8
1345	1344.54	2.03	269.12	30.71	-0.47	-30.71	0.4
1365	1364.53	1.83	268.8	31.36	-0.66	-31.36	1
1385	1384.52	1.76	268.56	31.98	-0.81	-31.97	0.7
1405	1404.51	1.64	268.41	32.56	-0.91	-32.55	0.9
1416	1415.51	1.46	268.3	32.85	-0.98	-32.84	3.7


Hole: C4997
Red = Drill Hole
Blue = Vertical
Gyro Survey
Oct 6, 2006
Bottom Depth Info.
Depth 1336ft
Inclination 2.5°
Closure Distance 29 ft
Closure Direction 267°
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

Hole: **C4997** Survey Date: **10/6/2006**

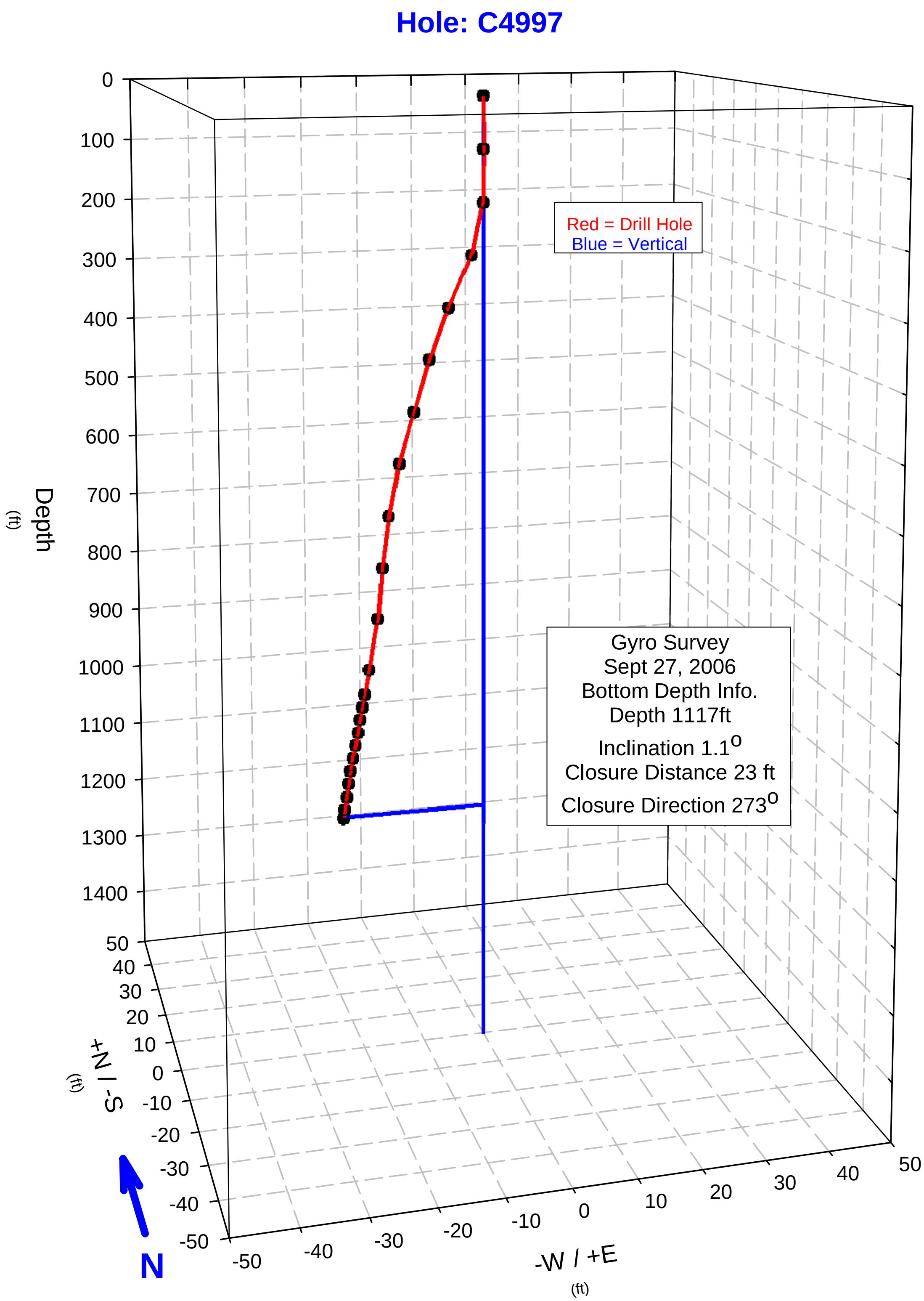
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.56	309.12	0.04	0.02	-0.03	8.9
105	105	0.59	241.84	0.67	-0.32	-0.59	0.9
205	204.99	1.46	273.54	1.58	0.1	-1.58	1.9
305	304.93	2.32	288.45	4.67	1.48	-4.43	1.3
405	404.87	1.93	281.49	8.23	1.64	-8.06	1
505	504.83	1.3	278.36	10.94	1.59	-10.82	0.9
605	604.8	1.5	279.63	13.36	2.23	-13.17	0.2
705	704.77	1.37	280.01	15.86	2.76	-15.62	0.3
805	804.74	1.16	278.61	18	2.7	-17.8	0.4
905	904.73	0.56	277.72	19.44	2.61	-19.27	0.7
1005	1004.72	1.38	278.33	21.12	3.06	-20.9	0.8
1105	1104.69	1.58	276.29	23.28	2.55	-23.14	1.4
1205	1204.64	1.81	271.61	25.46	0.72	-25.45	0.2
1225	1224.64	1.46	270.74	25.88	0.34	-25.88	2
1245	1244.63	1.68	269.94	26.28	-0.03	-26.28	1.6
1265	1264.62	1.5	269.19	26.71	-0.38	-26.71	1
1285	1284.61	1.48	268.48	27.11	-0.72	-27.1	0.2
1305	1304.61	1.85	267.76	27.58	-1.08	-27.56	1.9
1325	1324.59	2.03	267.04	28.16	-1.45	-28.12	1.3
1333	1332.59	2.43	266.81	28.45	-1.58	-28.4	7.5
1334	1333.59	2.45	266.78	28.49	-1.6	-28.44	2.6
1335	1334.59	2.49	266.76	28.53	-1.61	-28.48	6.2
1336	1335.59	2.48	266.73	28.57	-1.63	-28.52	0.9



Hole: C4997
Red = Drill Hole
Blue = Vertical
Gyro Survey
Oct 1, 2006
Bottom Depth Info.
Depth 1237ft
Inclination 1.3°
Closure Distance 23 ft
Closure Direction 274°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

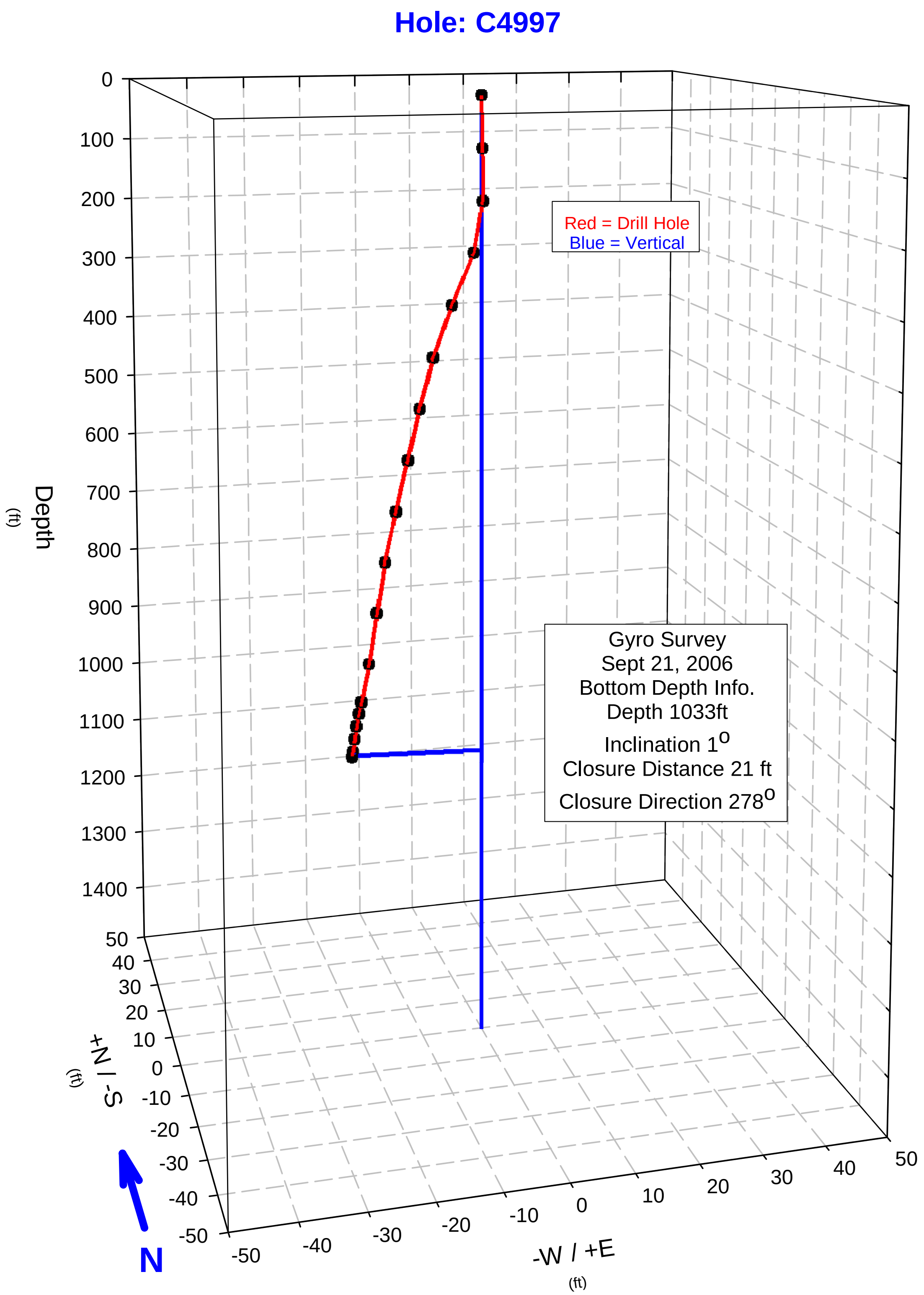
Hole: **C4997** Survey Date: **10/1/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.69	216.7	0.08	-0.06	-0.05	7.4
6	6	0.49	218.91	0.08	-0.07	-0.05	43.9
105	105	0.33	231.18	0.24	-0.15	-0.19	0.8
205	204.99	1.12	336.89	0.79	0.73	-0.31	1.3
305	304.95	2.34	302.22	3.26	1.74	-2.76	2.1
405	404.9	1.41	288.28	6.33	1.99	-6.01	0.9
505	504.86	1.78	283.88	9.06	2.17	-8.79	0.4
605	604.82	1.21	282.95	11.63	2.6	-11.33	0.8
705	704.81	0.81	282.73	13.35	2.94	-13.02	0.6
805	804.79	1.22	282.44	15.08	3.25	-14.72	0.6
905	904.78	0.7	281.71	16.64	3.38	-16.3	0.8
1005	1004.76	1.47	280.75	18.44	3.44	-18.12	1
1045	1044.75	1.21	280.84	19.38	3.64	-19.03	0.6
1085	1084.74	1.36	280.46	20.25	3.68	-19.91	1.2
1125	1124.73	1.44	278.95	21	3.27	-20.75	2.2
1165	1164.72	1.3	277.21	21.69	2.72	-21.52	1.1
1205	1204.71	1.71	275.36	22.44	2.1	-22.34	1.7
1237.5	1237.2	1.29	273.78	23.02	1.52	-22.97	1.4


Hole: C4997
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sept 27, 2006
Bottom Depth Info.
Depth 1117ft
Inclination 1.1°
Closure Distance 23 ft
Closure Direction 273°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

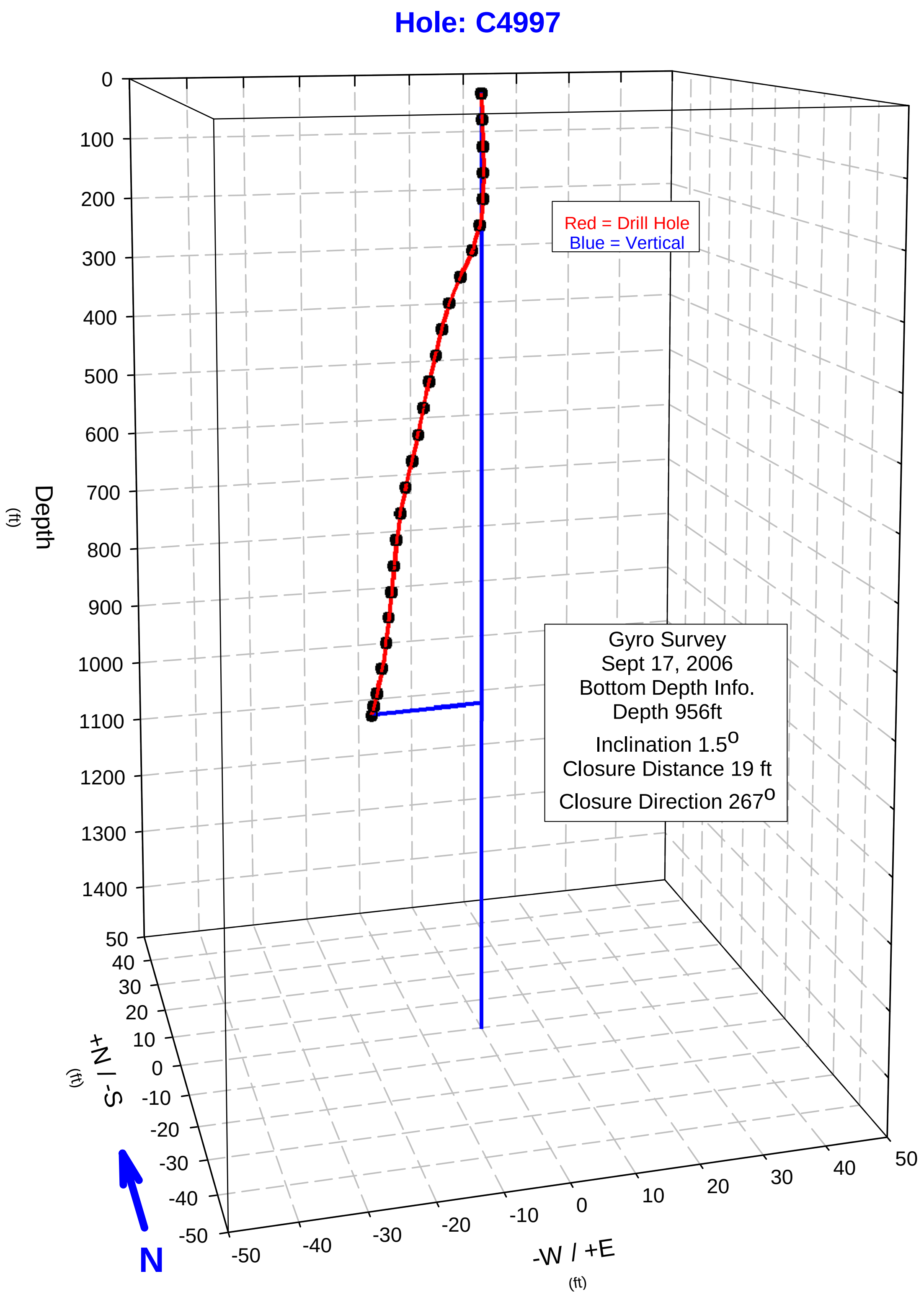
Hole: **C4997** Survey Date: **9/27/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.93	192.08	0.07	-0.07	-0.01	8.3
85	84.99	0.68	189.95	1.18	-1.16	-0.2	0.5
165	164.99	0.14	194.03	1.55	-1.5	-0.38	1
245	244.96	2.63	240.2	2.53	-1.26	-2.2	3.3
325	324.87	2.73	262.78	5.95	-0.75	-5.9	0.4
405	404.82	1.61	269.28	8.86	-0.11	-8.86	1.4
485	484.78	1.96	271.43	11.32	0.28	-11.32	0.5
565	564.74	1.53	271.37	13.75	0.33	-13.74	0.6
645	644.72	1.05	270.37	15.53	0.1	-15.53	0.6
725	724.71	0.61	269.56	16.67	-0.13	-16.67	0.6
805	804.71	0.67	270.18	17.48	0.05	-17.48	0.6
885	884.69	1.35	271.88	18.77	0.61	-18.76	0.9
925	924.69	0.84	272.64	19.49	0.9	-19.46	1.3
945	944.68	1.54	272.93	19.88	1.02	-19.86	3.9
965	964.68	0.99	272.95	20.32	1.05	-20.29	3.4
985	984.67	0.81	272.97	20.62	1.07	-20.6	2.1
1005	1004.67	1.41	273.11	21.01	1.14	-20.98	3.2
1025	1024.67	1.37	272.97	21.48	1.11	-21.45	2.5
1045	1044.66	0.92	272.66	21.86	1.01	-21.84	2.3
1065	1064.66	1.02	272.43	22.19	0.94	-22.17	0.7
1085	1084.65	1.2	272.18	22.56	0.86	-22.54	1
1105	1104.65	1	271.84	22.92	0.74	-22.91	1.3
1117.5	1117.15	1.1	271.58	23.12	0.64	-23.11	1.3


Hole: C4997
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sept 21, 2006
Bottom Depth Info.
Depth 1033ft
Inclination 1°
Closure Distance 21 ft
Closure Direction 278°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

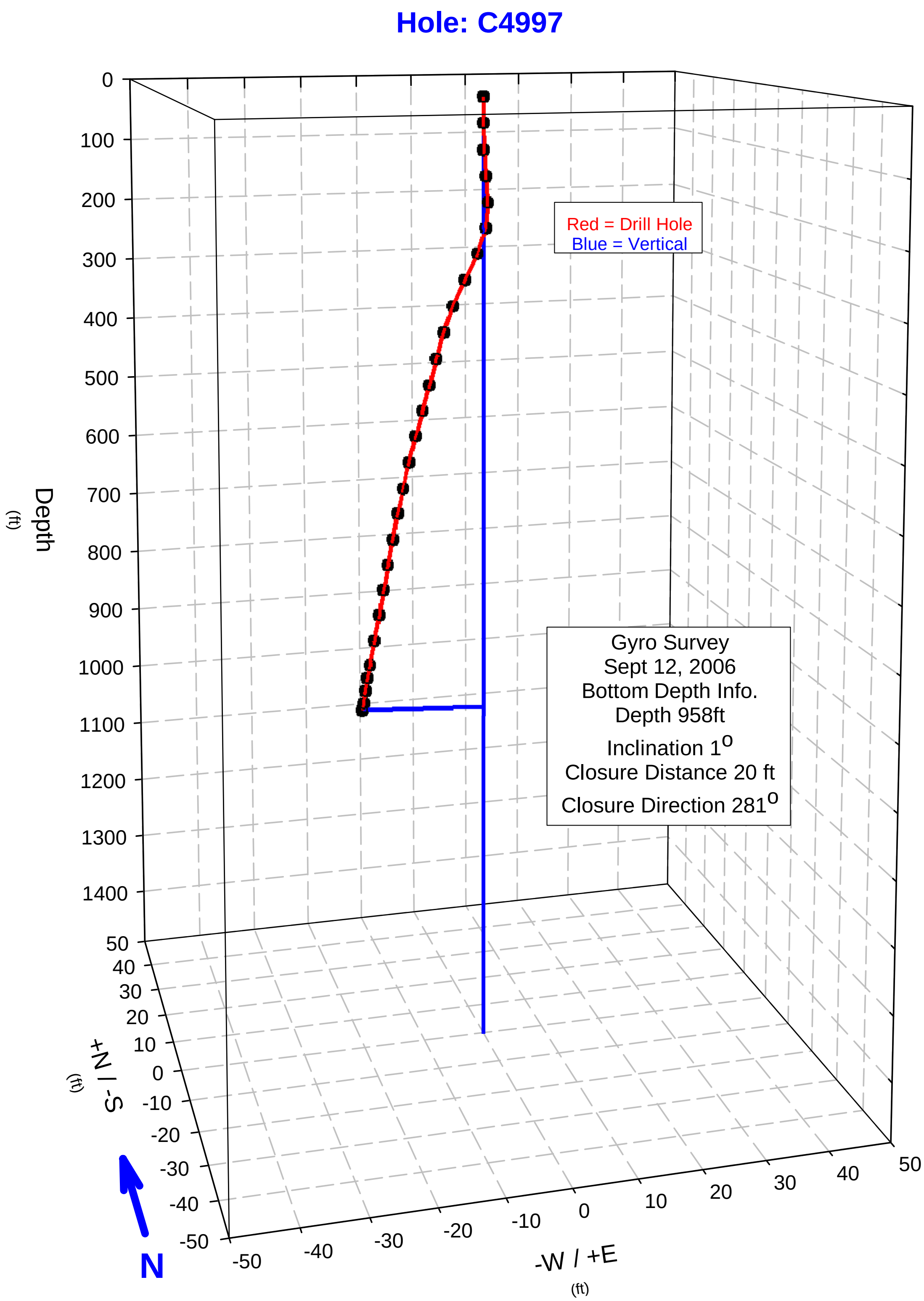
Hole: **C4997** Survey Date: **8/21/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.45	141.4	0.03	-0.03	0.02	12.6
85	85	0.4	174.52	0.46	-0.46	0.04	0.7
165	165	0.71	145.99	0.45	-0.37	0.25	1.4
245	244.97	2.61	270.38	1.18	0.01	-1.18	4
325	324.89	2.58	271.43	4.8	0.12	-4.8	0.1
405	404.83	1.77	272.62	7.83	0.36	-7.82	1.1
485	484.8	1.42	275.02	10.02	0.88	-9.98	0.5
565	564.78	1.38	275.52	11.93	1.15	-11.88	0.6
645	644.75	1.46	275.42	13.9	1.31	-13.83	0.4
725	724.73	1.12	276.82	15.65	1.86	-15.54	0.6
805	804.72	0.82	277.44	16.95	2.19	-16.81	0.7
885	884.71	1.1	276.79	18.28	2.16	-18.15	0.4
945	944.7	1.35	276.9	19.54	2.35	-19.4	0.8
965	964.69	1.31	277.18	20	2.5	-19.84	0.5
985	984.69	0.96	277.35	20.39	2.61	-20.22	2.1
1005	1004.69	0.81	277.37	20.69	2.65	-20.52	0.7
1025	1024.68	0.71	277.45	20.96	2.72	-20.78	0.9
1033	1032.68	0.96	277.48	21.07	2.74	-20.89	3.6


Hole: C4997
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sept 17, 2006
Bottom Depth Info.
Depth 956ft
Inclination 1.5°
Closure Distance 19 ft
Closure Direction 267°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

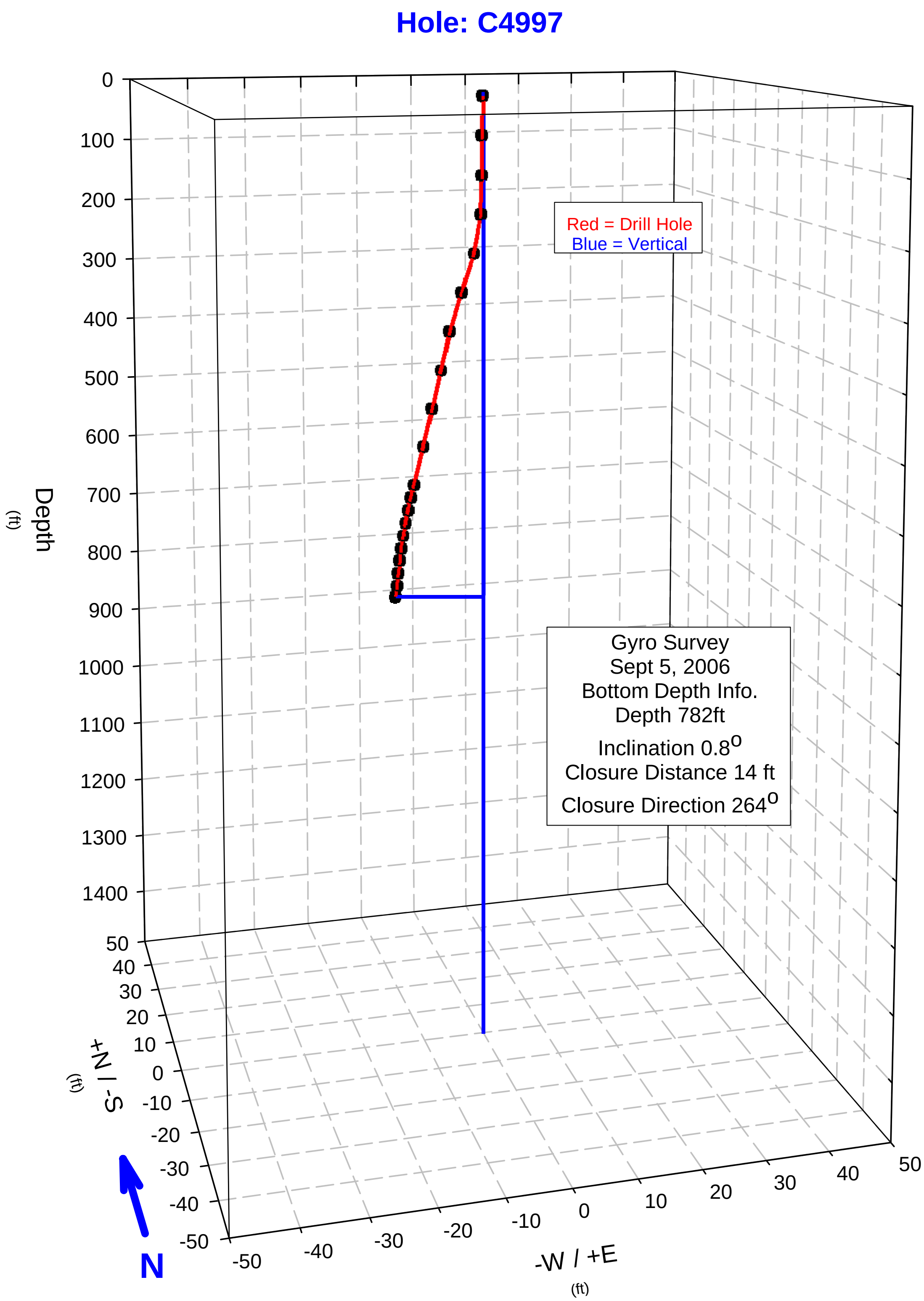
Hole: **C4997** Survey Date: **9/17/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
2	2	0.54	131.78	0.03	-0.02	0.02	33.7
42	42	0.61	169.65	0.41	-0.41	0.07	0.6
82	82	0.66	173.78	0.85	-0.85	0.09	0.3
122	121.99	0.51	177.41	1.24	-1.24	0.06	0.8
162	161.99	0.37	182.38	1.28	-1.28	-0.05	2.1
202	201.99	1.28	204.11	0.87	-0.79	-0.36	2.3
242	241.97	2.59	262.46	1.5	-0.2	-1.49	4.5
282	281.92	2.89	273.59	3.36	0.21	-3.35	1
322	321.88	2.23	275.35	5.14	0.48	-5.12	1.7
362	361.86	1.44	274.33	6.41	0.48	-6.39	2.4
402	401.84	1.8	271.57	7.48	0.21	-7.48	1
442	441.83	1.56	269.65	8.62	-0.05	-8.62	0.9
482	481.81	1.51	268.3	9.66	-0.29	-9.66	0.7
522	521.8	1.31	266.87	10.61	-0.58	-10.6	0.5
562	561.79	1.75	266.05	11.67	-0.8	-11.64	1.2
602	601.77	1.54	265.48	12.81	-1.01	-12.77	0.6
642	641.76	1.21	264.81	13.76	-1.24	-13.7	0.9
682	681.75	1.05	264.01	14.52	-1.52	-14.44	0.5
722	721.75	0.49	263.31	15.02	-1.75	-14.92	1.4
762	761.74	0.82	262.85	15.46	-1.92	-15.34	0.9
802	801.74	0.6	262.83	15.95	-1.99	-15.82	0.9
842	841.74	0.8	263.51	16.39	-1.85	-16.28	0.8
882	881.73	1.01	264.67	16.93	-1.57	-16.85	0.5
922	921.72	1.52	265.77	17.74	-1.31	-17.69	1.5
942	941.72	1.58	266.32	18.25	-1.17	-18.21	0.6
956.5	956.21	1.42	266.76	18.6	-1.05	-18.57	1.4


Hole: C4997
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sept 12, 2006
Bottom Depth Info.
Depth 958ft
Inclination 1°
Closure Distance 20 ft
Closure Direction 281°
Depth
(ft)
+N / -S
(ft)
-W / +E
(ft)
N
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
50
40
30
20
10
0
-10
-20
-30
-40
-50
-50
-40
-30
-20
-10
0
10
20
30
40
50

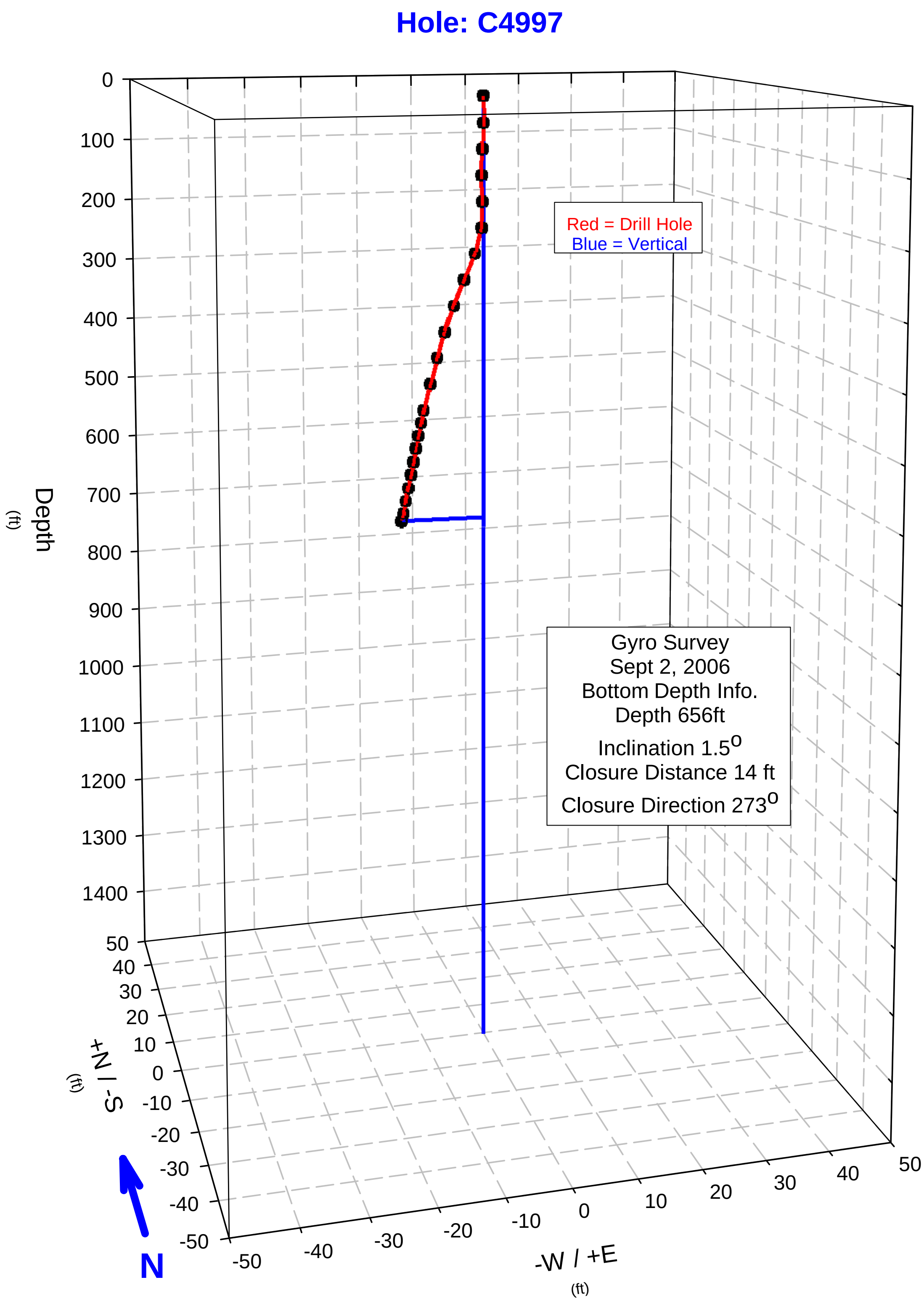
Hole: **C4997** Survey Date: **9/12/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
6	6	0.39	165.83	0.07	-0.06	0.02	11.2
46	46	0.62	185.23	0.33	-0.33	-0.03	1.7
86	86	0.66	186.43	0.72	-0.72	-0.08	1.6
126	125.99	0.5	169.07	0.95	-0.93	0.18	1.6
166	165.99	0.9	141.44	0.88	-0.69	0.55	1.8
206	205.98	1.5	90.59	0.45	0	0.45	3.7
246	245.96	2.66	313.31	1	0.69	-0.73	4.5
286	285.91	2.99	293.96	2.89	1.17	-2.64	0.9
326	325.86	2.71	287.05	4.81	1.41	-4.6	1.6
366	365.83	1.96	281.86	6.36	1.31	-6.22	2.2
406	405.81	1.72	278.03	7.56	1.06	-7.48	0.6
446	445.79	1.57	276.79	8.67	1.02	-8.61	1.8
486	485.78	1.56	277.63	9.75	1.29	-9.66	0.5
526	525.76	1.65	278.66	10.85	1.63	-10.73	0.2
566	565.74	1.71	278.35	12	1.74	-11.87	1.7
606	605.73	1.07	277.96	12.95	1.79	-12.82	2.1
646	645.72	1.38	278.52	13.79	2.04	-13.64	0.8
686	685.71	1.26	278.24	14.69	2.1	-14.54	1.5
726	725.71	0.99	278.09	15.44	2.17	-15.28	1.8
766	765.7	0.95	278.83	16.08	2.47	-15.89	0.2
806	805.69	1.25	279.41	16.82	2.75	-16.6	0.9
846	845.68	1.09	279.79	17.63	3	-17.38	0.4
886	885.68	1.06	279.98	18.38	3.18	-18.1	0.3
906	905.67	1.04	279.98	18.75	3.25	-18.47	0.2
926	925.67	1.01	280.18	19.1	3.37	-18.8	2.1
946	945.67	1	280.36	19.44	3.49	-19.12	2.1
958	957.67	0.96	280.52	19.62	3.58	-19.29	5.4


Hole: C4997
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sept 5, 2006
Bottom Depth Info.
Depth 782ft
Inclination 0.8°
Closure Distance 14 ft
Closure Direction 264°
Depth
(ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S
(ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E
(ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

Hole: **C4997** Survey Date: **9/5/2006**

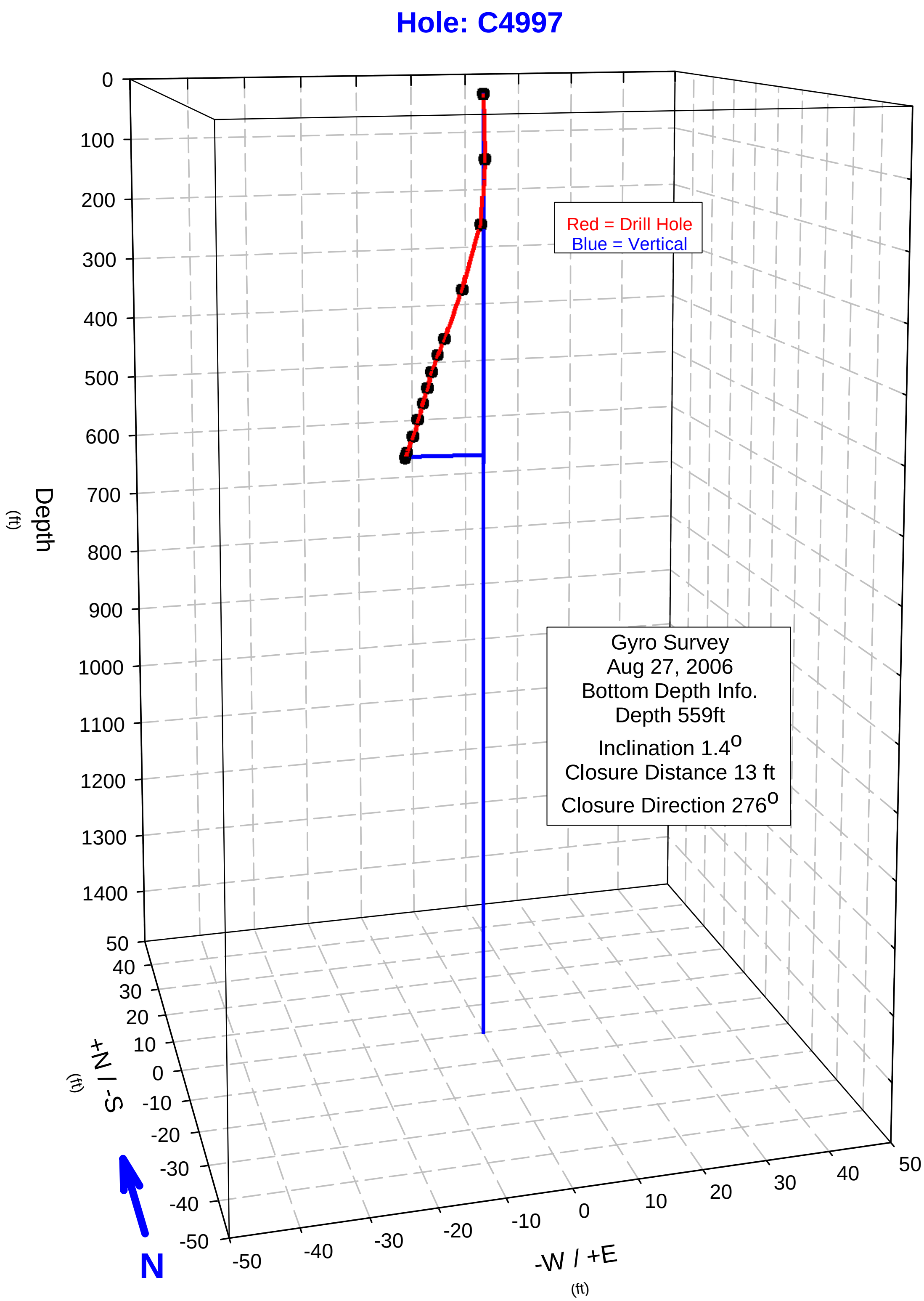
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.57	226.23	0.06	-0.04	-0.04	7.7
65	65	0.46	215.16	0.54	-0.44	-0.31	0.8
125	125	0.32	211.66	0.6	-0.51	-0.31	1.3
185	185	0.24	233.12	0.55	-0.33	-0.44	0.6
245	244.98	1.84	265.5	1.51	-0.12	-1.51	2.7
305	304.95	2.04	276.01	3.5	0.37	-3.48	0.4
365	364.92	1.47	279.72	5.32	0.9	-5.24	1
425	424.9	1.3	281.31	6.76	1.33	-6.63	0.3
485	484.89	1.48	282.18	8.21	1.73	-8.03	0.3
545	544.87	1.27	283.48	9.64	2.25	-9.37	0.5
605	604.85	1.69	284.51	11.18	2.8	-10.82	0.8
625	624.84	1.34	284.68	11.71	2.97	-11.32	1.8
645	644.84	1.25	284.91	12.15	3.13	-11.75	0.5
665	664.83	1.11	285.18	12.56	3.29	-12.12	0.7
685	684.83	0.96	285.42	12.92	3.44	-12.45	0.8
705	704.83	0.85	285.61	13.23	3.56	-12.74	0.6
725	724.82	0.74	285.68	13.51	3.65	-13	0.7
745	744.82	0.68	285.7	13.75	3.72	-13.24	0.3
765	764.82	0.57	285.71	13.97	3.78	-13.45	0.6
782	781.82	0.78	285.52	14.16	3.79	-13.65	1.9



Hole: C4997
Red = Drill Hole
Blue = Vertical
Gyro Survey
Sept 2, 2006
Bottom Depth Info.
Depth 656ft
Inclination 1.5°
Closure Distance 14 ft
Closure Direction 273°
Depth
(ft)
+N / -S
(ft)
-W / +E
(ft)
N
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
50
40
30
20
10
0
-10
-20
-30
-40
-50
-50
-40
-30
-20
-10
0
10
20
30
40
50

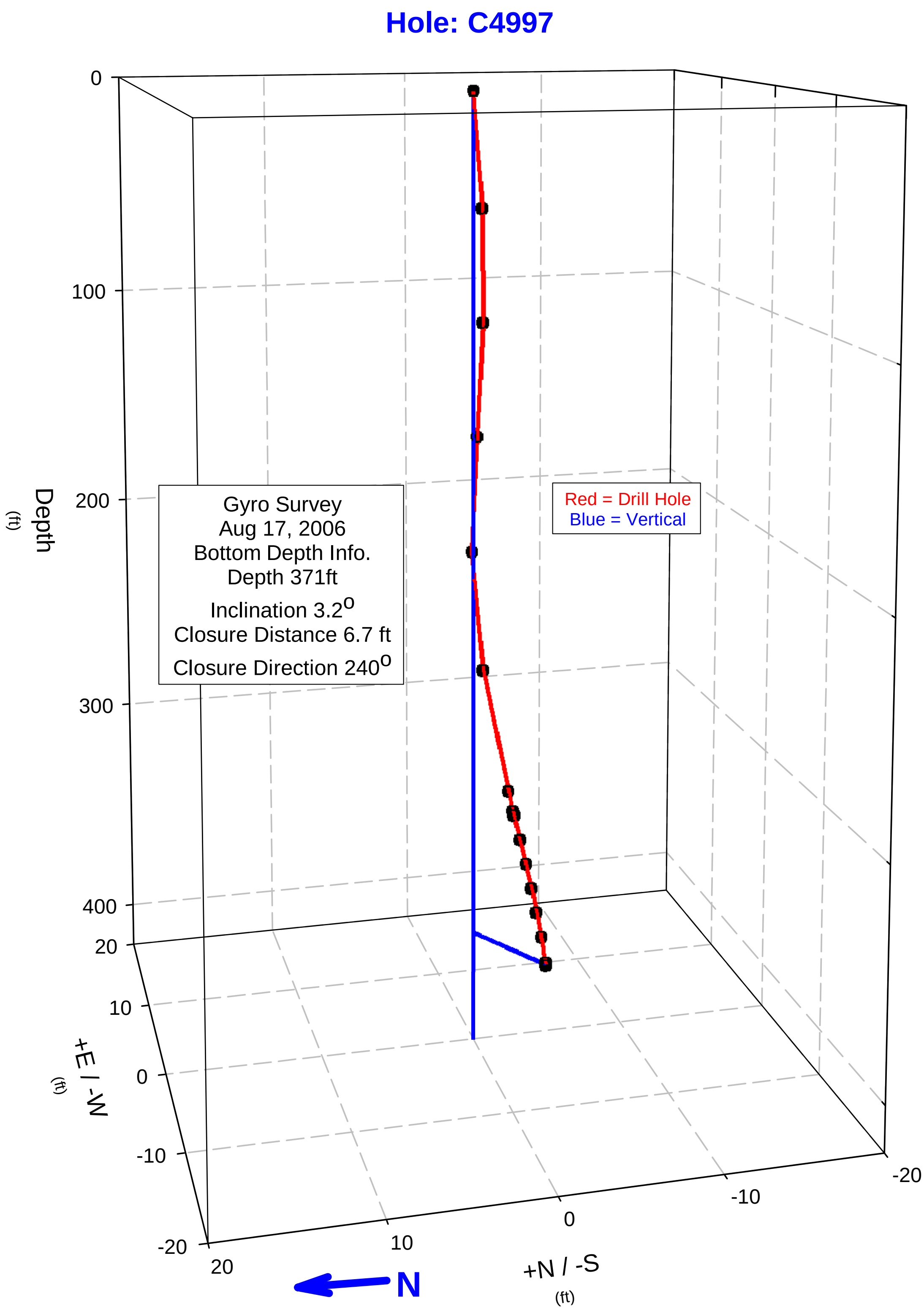
Hole: **C4997** Survey Date: **9/2/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
5	5	0.37	147.81	0.06	-0.05	0.03	19.4
45	45	0.5	171.8	0.22	-0.22	0.03	1.9
85	85	0.46	205.92	0.49	-0.44	-0.22	0.1
125	125	0.37	210.62	0.77	-0.66	-0.39	0.5
165	165	0.32	203.39	0.85	-0.78	-0.34	1.5
205	205	0.73	213.65	0.69	-0.58	-0.38	2.4
245	244.98	2.41	262.86	1.37	-0.17	-1.36	4.7
285	284.94	2.52	274.13	3.04	0.22	-3.04	0.3
325	324.9	2.44	277.26	4.76	0.6	-4.73	0.2
365	364.88	1.73	277.79	6.22	0.84	-6.16	2
405	404.86	1.61	277.18	7.38	0.92	-7.33	0.3
445	444.84	1.66	277.02	8.53	1.04	-8.46	0.3
485	484.83	1.42	276.82	9.6	1.14	-9.53	0.7
505	504.82	1.23	276.78	10.06	1.19	-9.99	1.5
525	524.82	1.2	276.73	10.49	1.23	-10.41	1.3
545	544.82	1.22	276.38	10.9	1.21	-10.84	0.4
565	564.81	1.23	275.91	11.32	1.17	-11.26	0.4
585	584.81	1.32	275.42	11.75	1.11	-11.7	0.5
605	604.8	1.41	274.86	12.22	1.04	-12.17	0.7
625	624.8	1.23	274.21	12.65	0.93	-12.62	1.1
645	644.79	1.13	273.63	13.05	0.83	-13.02	0.7
656.5	656.29	1.52	273.55	13.31	0.82	-13.28	5.4


Hole: C4997
Red = Drill Hole
Blue = Vertical
Gyro Survey
Aug 27, 2006
Bottom Depth Info.
Depth 559ft
Inclination 1.4°
Closure Distance 13 ft
Closure Direction 276°
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
+N / -S (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-W / +E (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
N

Hole: **C4997** Survey Date: **8/27/2006**

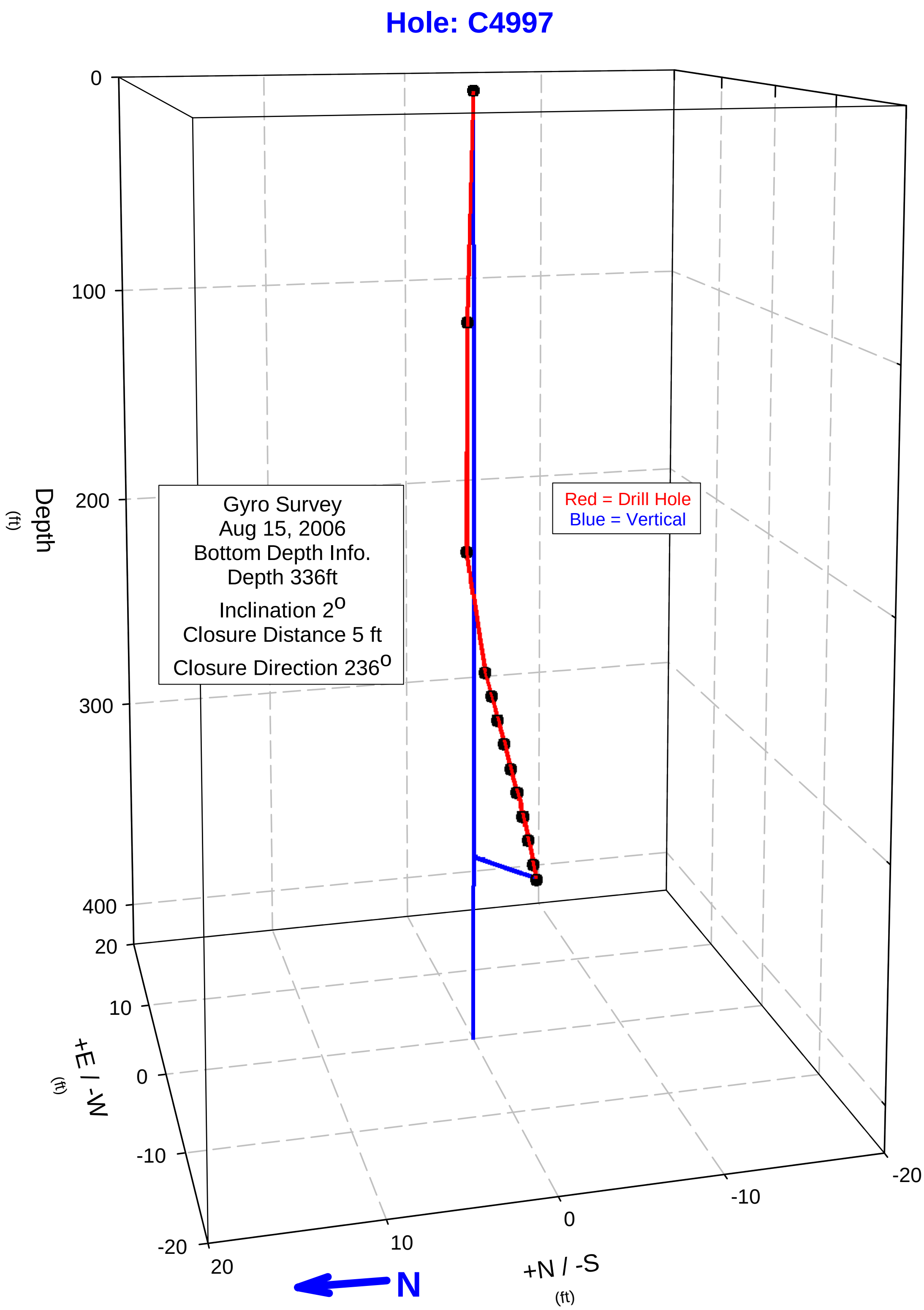
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
2	2	0.62	183.92	0.03	-0.03	0	16.6
100	99.99	0.57	176.99	1.04	-1.04	0.05	0.1
200	199.99	1.09	215.52	1.13	-0.92	-0.66	1.5
300	299.94	2.43	267.46	3.5	-0.16	-3.49	1.7
375	374.89	1.89	272.35	6.28	0.26	-6.28	0.9
400	399.86	3.15	272.78	7.37	0.36	-7.36	5.6
425	424.84	1.46	272.9	8.37	0.42	-8.36	7
450	449.84	1.56	274.13	8.99	0.65	-8.97	1.7
475	474.82	1.9	275.36	9.72	0.91	-9.67	2.1
500	499.81	1.55	275.64	10.46	1.03	-10.41	1.9
525	524.8	2.26	275.93	11.29	1.17	-11.23	3.2
550	549.78	2.14	276.39	12.24	1.36	-12.17	0.9
559	558.78	1.44	276.36	12.52	1.39	-12.44	8.4



Hole: C4997
Gyro Survey
Aug 17, 2006
Bottom Depth Info.
Depth 371ft
Inclination 3.2°
Closure Distance 6.7 ft
Closure Direction 240°
Red = Drill Hole
Blue = Vertical
Depth
(ft)
0
100
200
300
400
+E / -W
(ft)
20
10
0
-10
-20
+N / -S
(ft)
20
10
0
-10
-20
N

Hole: **C4997** Survey Date: **8/17/2006**

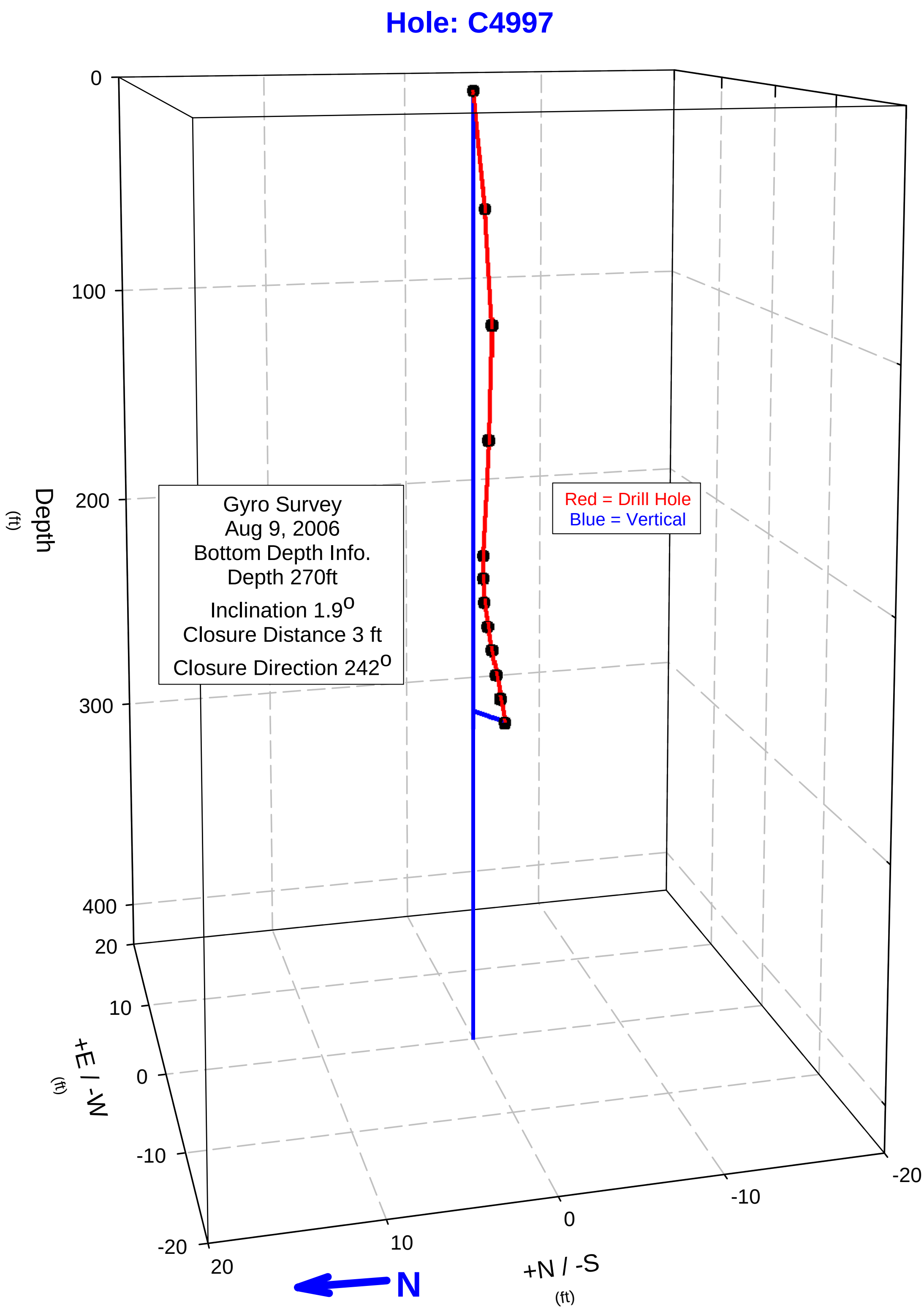
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
0	0	0.98	0	0	0	0	0
50	50	0.67	163.86	0.65	-0.63	0.18	1.5
100	99.99	0.54	142.56	1.03	-0.82	0.63	1
150	149.99	0.72	118.06	1.06	-0.5	0.94	1.5
200	199.98	1.32	91.82	0.47	-0.01	0.47	2.9
250	249.96	2.59	249.86	1.13	-0.39	-1.07	3.9
300	299.91	2.64	242.65	3.4	-1.56	-3.02	0.3
310	309.89	2.64	242.06	3.86	-1.81	-3.41	0
308	307.9	2.64	242.16	3.77	-1.76	-3.33	0.3
310	309.89	2.87	241.98	3.87	-1.82	-3.41	18.2
320	319.88	2.83	240.85	4.36	-2.12	-3.8	0.4
330	329.87	2.62	239.99	4.83	-2.41	-4.18	2
340	339.86	2.45	239.33	5.26	-2.69	-4.53	1.8
350	349.85	2.18	238.79	5.66	-2.94	-4.84	2.7
360	359.84	2.93	239.17	6.1	-3.13	-5.24	12.4
370	369.83	3.1	240.36	6.61	-3.27	-5.74	1.8
371	370.83	3.13	240.47	6.66	-3.28	-5.8	3.1



Hole: C4997
0
100
200
300
400
Depth
(ft)
Gyro Survey
Aug 15, 2006
Bottom Depth Info.
Depth 336ft
Inclination 2°
Closure Distance 5 ft
Closure Direction 236°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+E / -W
(ft)
20
10
0
-10
-20
+N / -S
(ft)
N

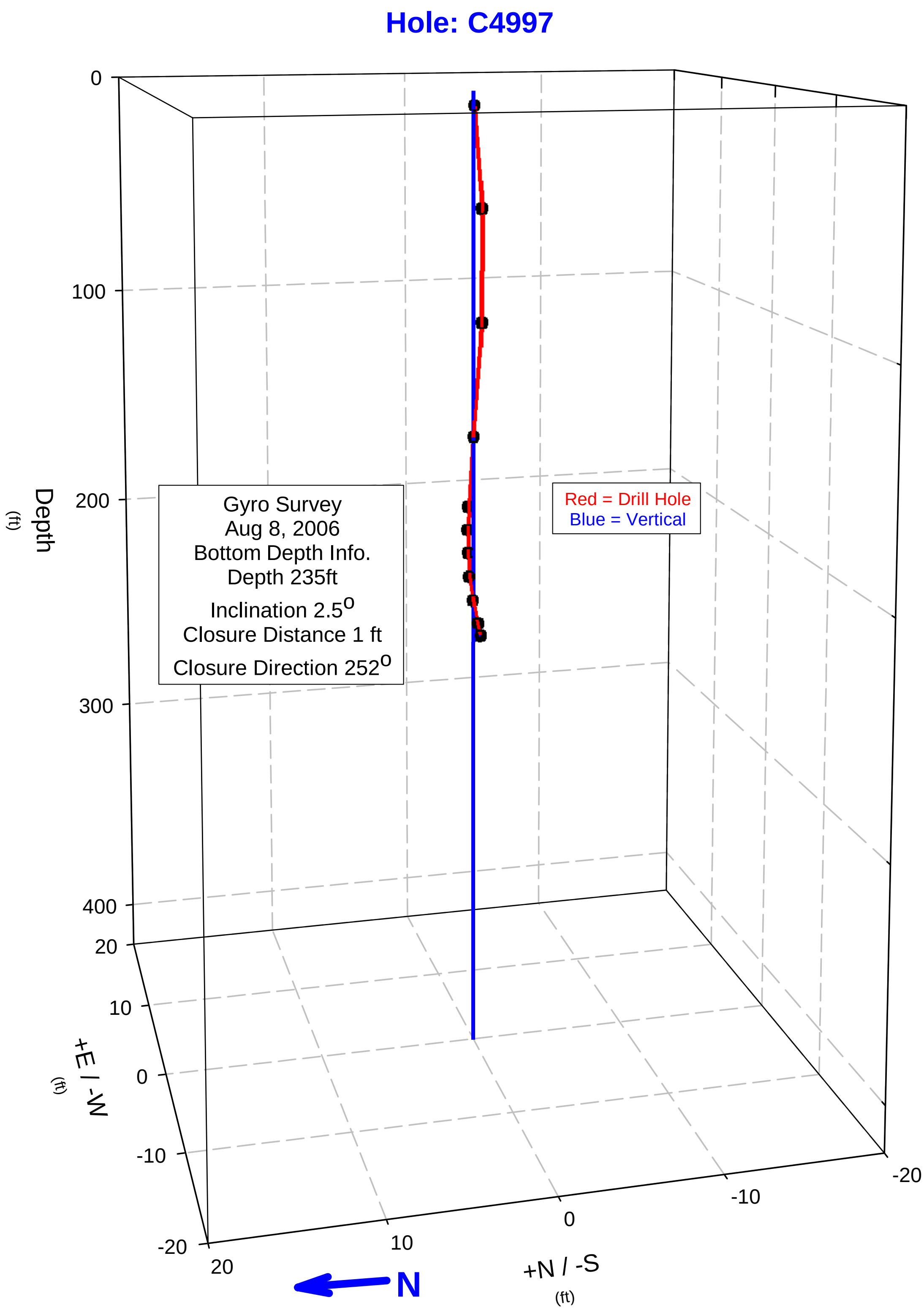
Hole: **C4997** Survey Date: **8/15/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
0	0	0.23	0	0	0	0	0
100	99.99	1.15	80.77	0.93	0.15	0.92	1.3
200	199.98	1.74	52.47	0.53	0.32	0.42	2.9
250	249.94	3.08	253.4	1.45	-0.41	-1.39	4.5
260	259.93	2.96	247.42	1.94	-0.75	-1.79	1.4
270	269.91	2.83	243.83	2.43	-1.07	-2.18	1.3
280	279.9	2.86	241.33	2.91	-1.4	-2.55	0.7
290	289.89	2.81	239.37	3.39	-1.73	-2.92	0.8
300	299.88	2.69	237.94	3.87	-2.05	-3.28	1.4
310	309.87	2.42	236.95	4.31	-2.35	-3.61	2.7
320	319.86	2.27	236.26	4.71	-2.62	-3.92	1.6
330	329.85	2.05	235.78	5.09	-2.86	-4.21	2.2
336.5	336.35	2.05	235.53	5.32	-3.01	-4.38	0.4


Hole: C4997
Gyro Survey
Aug 9, 2006
Bottom Depth Info.
Depth 270ft
Inclination 1.9°
Closure Distance 3 ft
Closure Direction 242°
Red = Drill Hole
Blue = Vertical
Depth (ft)
0
100
200
300
400
+E / -W (ft)
20
10
0
-10
-20
+N / -S (ft)
20
10
0
-10
-20
N

Hole: **C4997** Survey Date: **8/9/2006**

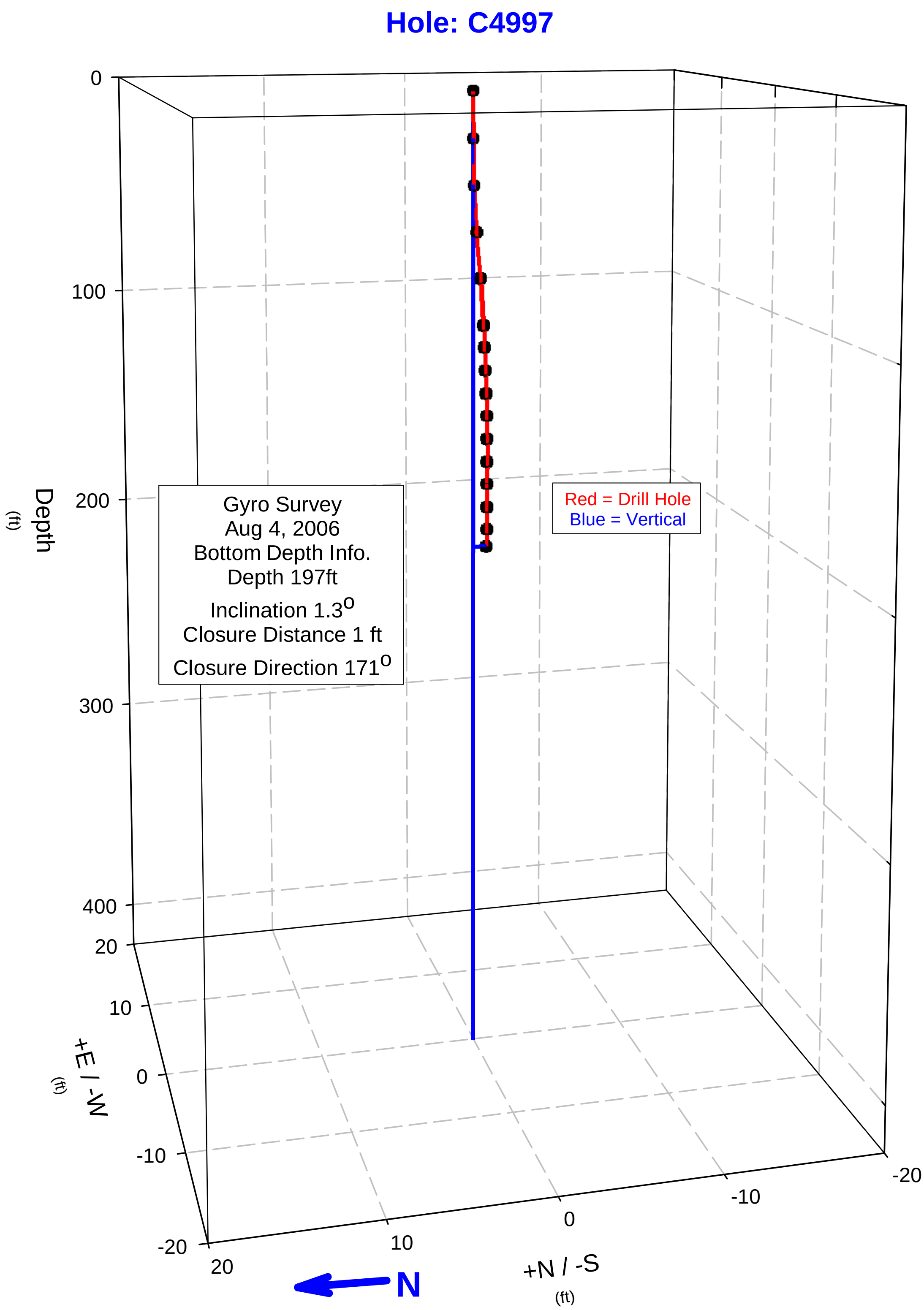
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
0	0	1.02	0	0	0	0	0
50	49.99	0.95	219.6	0.83	-0.64	-0.53	0.9
100	99.99	0.42	206.4	1.23	-1.1	-0.55	2.1
150	149.99	0.51	194.86	1.02	-0.99	-0.26	1.3
200	199.99	1.09	225	0.77	-0.55	-0.55	2.4
210	209.98	1.34	236.88	0.89	-0.49	-0.74	6
220	219.98	1.74	242.78	1.13	-0.52	-1.01	7.2
230	229.97	2.16	243.91	1.47	-0.65	-1.32	5.4
240	239.97	2.32	243.4	1.86	-0.83	-1.66	2
250	249.96	2.35	242.89	2.27	-1.03	-2.02	0.5
260	259.95	2.31	242.77	2.67	-1.22	-2.38	1
270.2	270.14	1.88	242.12	3.04	-1.42	-2.69	6.3



Hole: C4997
0
100
200
300
400
Depth
(ft)
Gyro Survey
Aug 8, 2006
Bottom Depth Info.
Depth 235ft
Inclination 2.5°
Closure Distance 1 ft
Closure Direction 252°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+E / -W
(ft)
20
10
0
-10
-20
+N / -S
(ft)
N

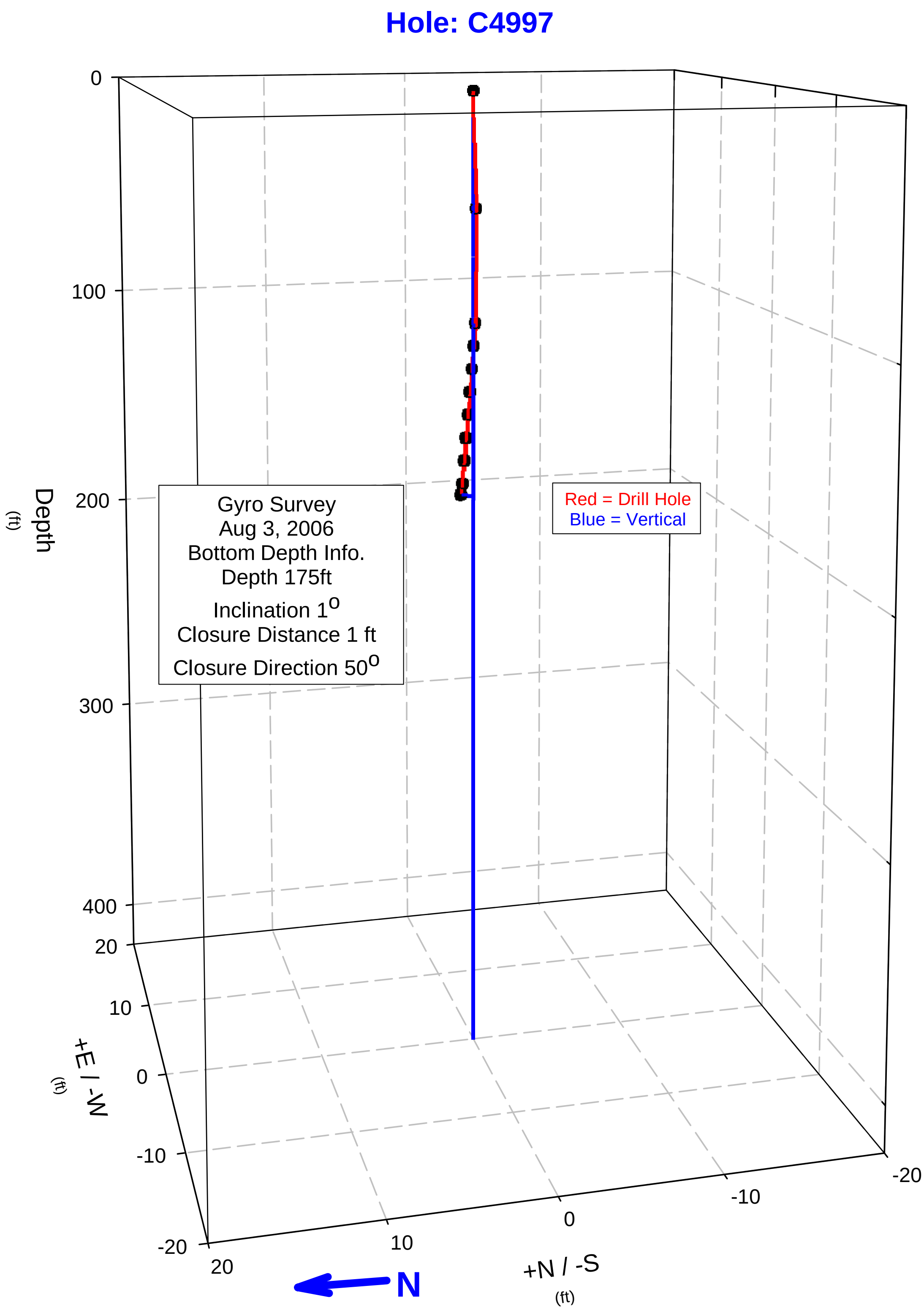
Hole: **C4997** Survey Date: **8/8/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
6.1	6.1	0.84	175.6	0.11	-0.11	0.01	11.3
50	50	0.73	168.89	0.64	-0.63	0.12	1.7
100	99.99	0.78	138.29	0.98	-0.73	0.65	1.8
150	149.99	0.9	104.34	0.88	-0.22	0.86	2.2
180	179.98	1.11	73.15	0.58	0.17	0.55	2.4
190	189.98	1.07	56.76	0.46	0.25	0.38	2.9
200	199.98	1.18	34.03	0.34	0.28	0.19	3.6
210	209.98	1.51	351.34	0.24	0.24	-0.04	5.8
220	219.97	2.15	286.89	0.34	0.1	-0.32	7.5
230	229.96	2.49	258.49	0.67	-0.13	-0.65	4.1
235	234.96	2.51	252.31	0.87	-0.26	-0.83	0.6


Hole: C4997
Gyro Survey
Aug 4, 2006
Bottom Depth Info.
Depth 197ft
Inclination 1.3°
Closure Distance 1 ft
Closure Direction 171°
Red = Drill Hole
Blue = Vertical
Depth
(ft)
0
100
200
300
400
+E / -W
(ft)
20
10
0
-10
-20
+N / -S
(ft)
20
10
0
-10
-20
N

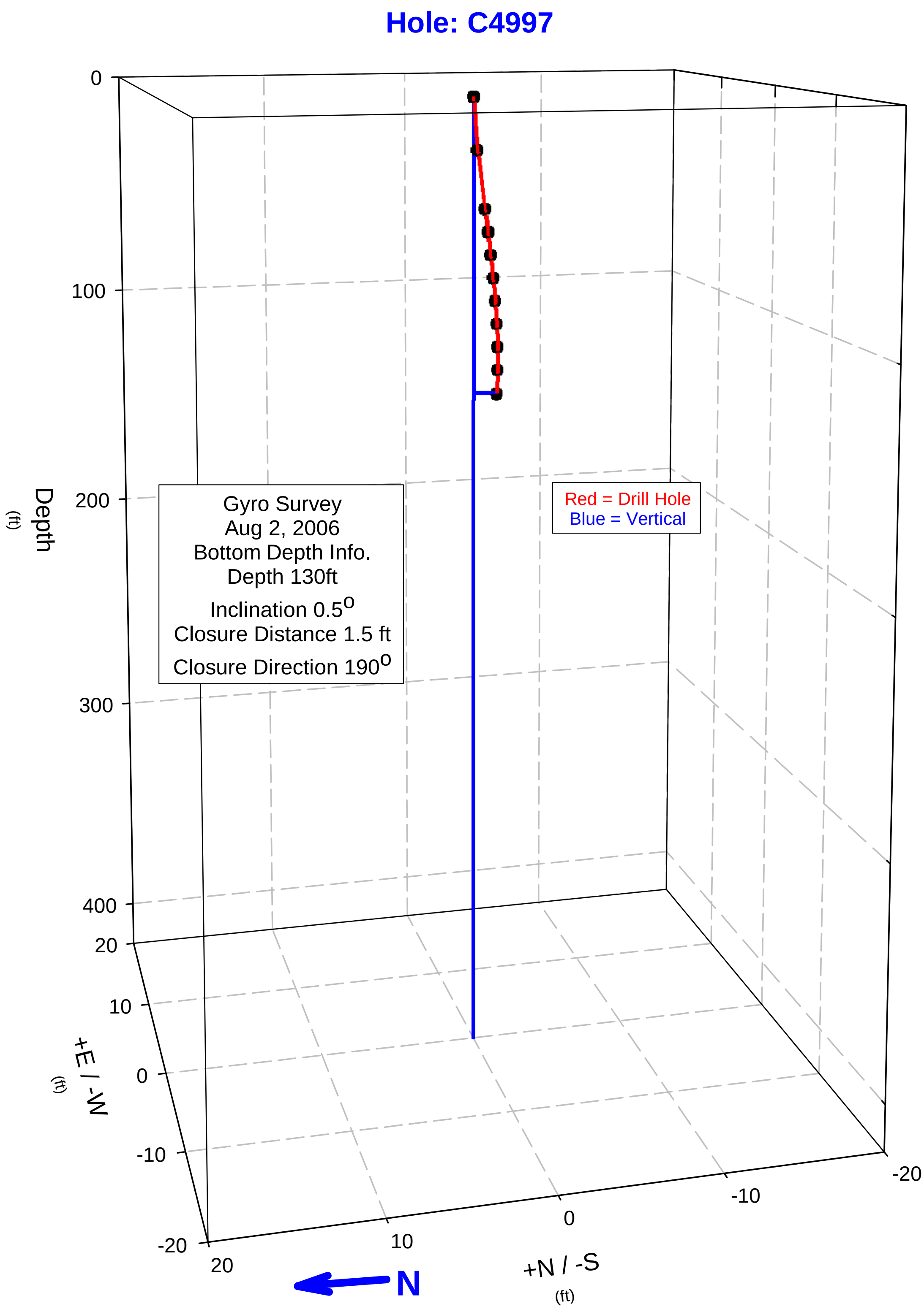
Hole: **C4997** Survey Date: **8/4/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
0	0	0.4	0	0	0	0	0
20	20	0.15	151.78	0.06	-0.06	0.03	2.4
40	40	0.36	181.56	0.07	-0.07	0	2.5
60	60	0.7	204.44	0.24	-0.22	-0.1	2.4
80	80	0.61	199.6	0.47	-0.44	-0.16	0.8
100	100	0.73	188.69	0.66	-0.65	-0.1	2.5
110	110	0.59	182.14	0.74	-0.74	-0.03	1.9
120	120	0.63	177.11	0.82	-0.82	0.04	1.1
130	129.99	0.46	173.57	0.9	-0.89	0.1	1.8
140	139.99	0.28	171.13	0.95	-0.94	0.15	2
150	149.99	0.33	169.14	0.99	-0.97	0.19	0.6
160	159.99	0.44	166.04	1.02	-0.99	0.25	3.3
170	169.99	0.12	163.39	1.03	-0.99	0.29	3.2
180	179.99	0.13	163.47	1.03	-0.99	0.29	2.5
190	189.99	0.52	166.32	1	-0.98	0.24	4
197.4	197.39	1.3	171.17	0.92	-0.91	0.14	11.7


Hole: C4997
0
100
200
300
400
Depth
(ft)
Gyro Survey
Aug 3, 2006
Bottom Depth Info.
Depth 175ft
Inclination 1°
Closure Distance 1 ft
Closure Direction 50°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+E / -W
(ft)
20
10
0
-10
-20
+N / -S
(ft)
N

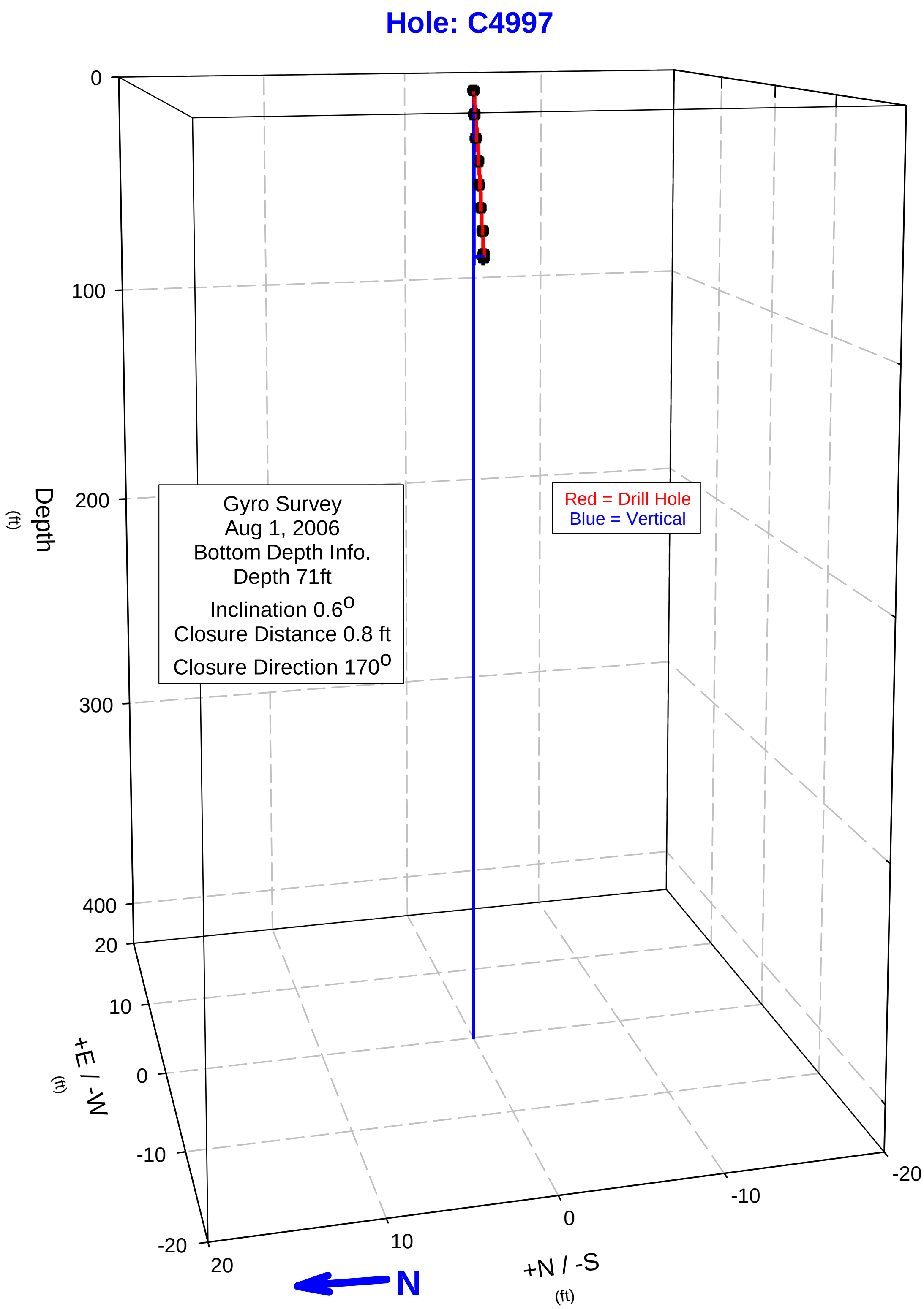
Hole: **C4997** Survey Date: **8/3/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
0	0	0.27	0	0	0	0	0
50	50	0.65	134.1	0.4	-0.28	0.29	0.8
100	100	0.65	114.6	0.81	-0.34	0.74	1.6
110	110	0.79	107.29	0.87	-0.26	0.83	2.5
120	119.99	0.68	99.89	0.93	-0.16	0.91	2
130	129.99	0.72	92.77	0.95	-0.05	0.94	3.7
140	139.99	0.87	84.39	0.94	0.09	0.94	1.8
150	149.99	0.79	75.63	0.93	0.23	0.9	2.4
160	159.99	0.98	66.06	0.91	0.37	0.84	2.1
170	169.99	1.02	55.16	0.93	0.53	0.76	0.8
175	174.99	1	49.98	0.95	0.61	0.73	1.6


Hole: C4997
0
100
200
300
400
Depth
(ft)
Gyro Survey
Aug 2, 2006
Bottom Depth Info.
Depth 130ft
Inclination 0.5°
Closure Distance 1.5 ft
Closure Direction 190°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+E / -W
(ft)
20
10
0
-10
-20
+N / -S
(ft)
N

Hole: **C4997** Survey Date: **8/2/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
2.4	2.4	0.69	258.07	0.03	-0.01	-0.03	7.5
25	25	1.03	230.82	0.32	-0.2	-0.25	4.1
50	49.99	1.15	206.19	0.73	-0.66	-0.32	2.2
60	59.99	1.16	199.27	0.91	-0.86	-0.3	1.2
70	69.99	1.02	194.28	1.08	-1.04	-0.27	1.4
80	79.99	1.06	190.45	1.24	-1.22	-0.23	0.8
90	89.99	0.8	187.93	1.39	-1.38	-0.19	2.8
100	99.99	0.43	187.24	1.5	-1.49	-0.19	4.1
110	109.99	0.17	187.35	1.55	-1.54	-0.2	2.6
120	119.99	0.39	188.44	1.55	-1.53	-0.23	5
130	129.99	0.45	190.73	1.5	-1.48	-0.28	0.9

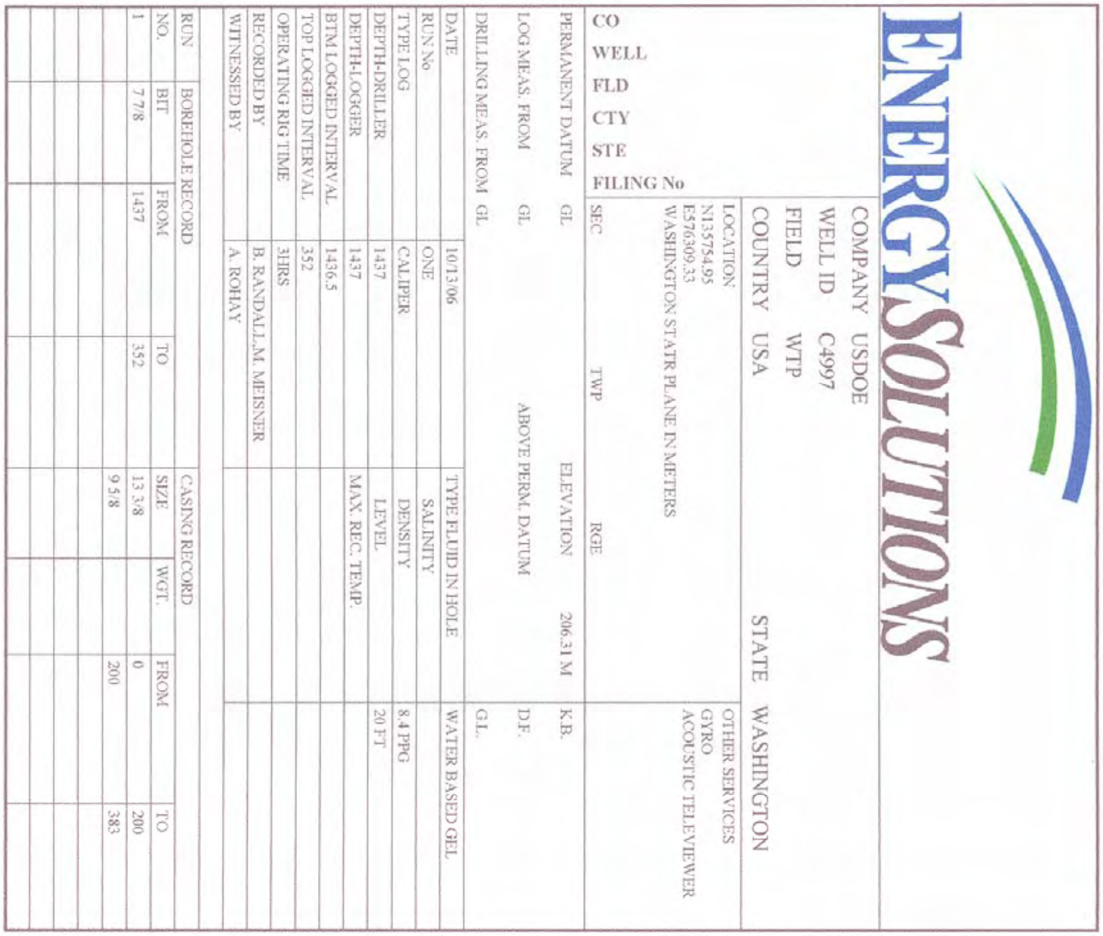


Hole: C4997
0
100
200
300
400
Depth
(ft)
Gyro Survey
Aug 1, 2006
Bottom Depth Info.
Depth 71ft
Inclination 0.6°
Closure Distance 0.8 ft
Closure Direction 170°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+E / -W
(ft)
20
10
0
-10
-20
+N / -S
(ft)
N

Hole: **C4997** Survey Date: **8/1/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
0	0	0.58	0	0	0	0	0
10	10	0.62	197.65	0.1	-0.1	-0.03	1.8
20	20	0.62	191.99	0.21	-0.21	-0.04	0.7
30	30	0.73	188.91	0.33	-0.32	-0.05	1.2
40	40	0.4	188.16	0.43	-0.42	-0.06	3.4
50	50	0.71	184.29	0.51	-0.51	-0.04	4.6
60	60	0.81	176.87	0.62	-0.62	0.03	1.8
70	70	0.67	170.8	0.73	-0.72	0.12	1.4
71.6	71.6	0.61	170.05	0.74	-0.73	0.13	4

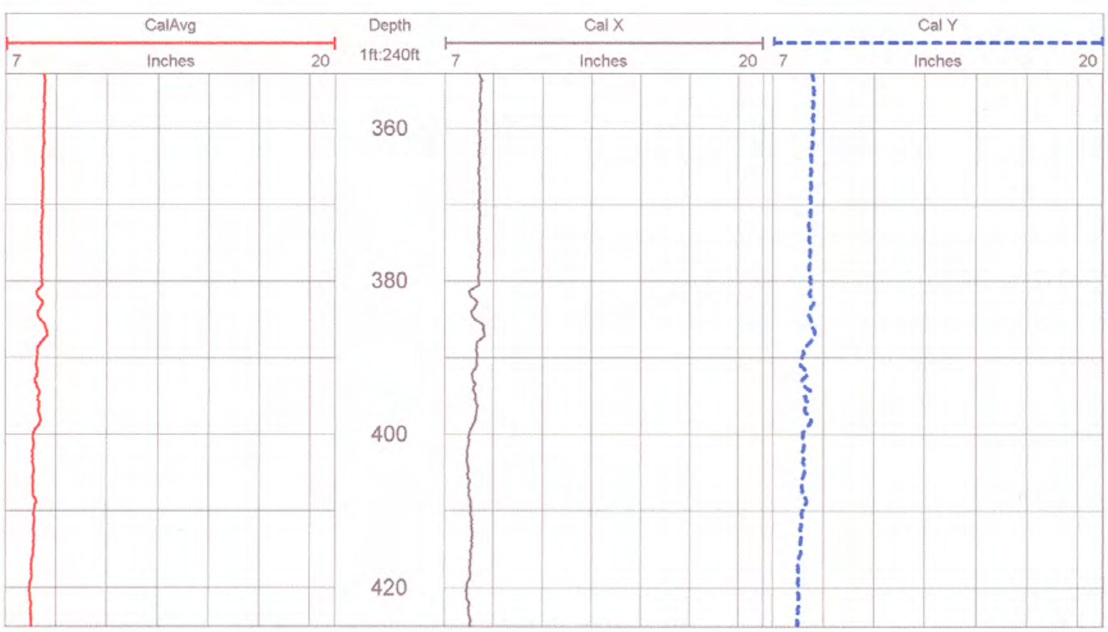
C1.2 ENERGY*SOLUTIONS* AND PACIFIC NORTHWEST GEOPHYSICS CALIPER LOGS

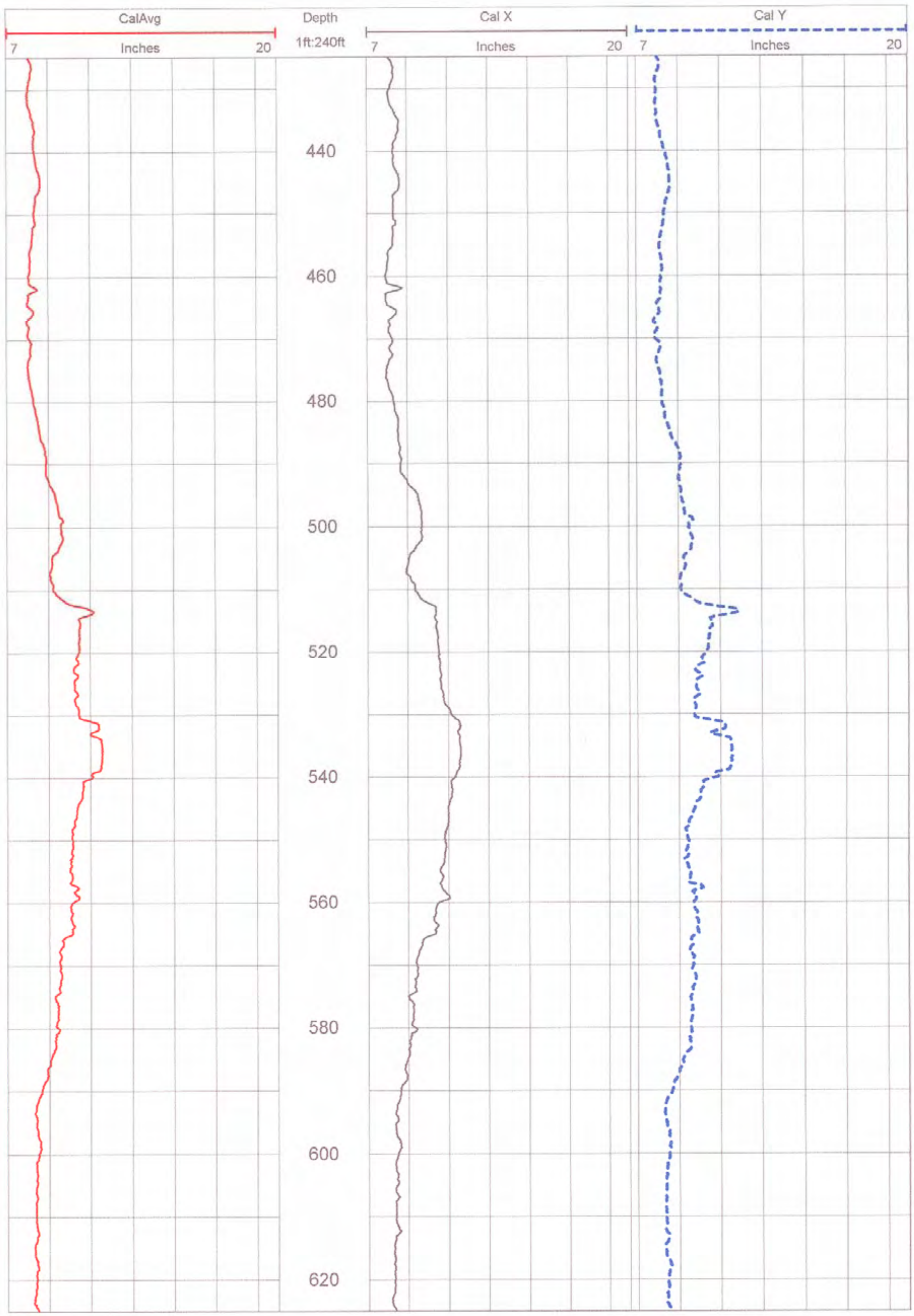

ENERGYSOLUTIONS

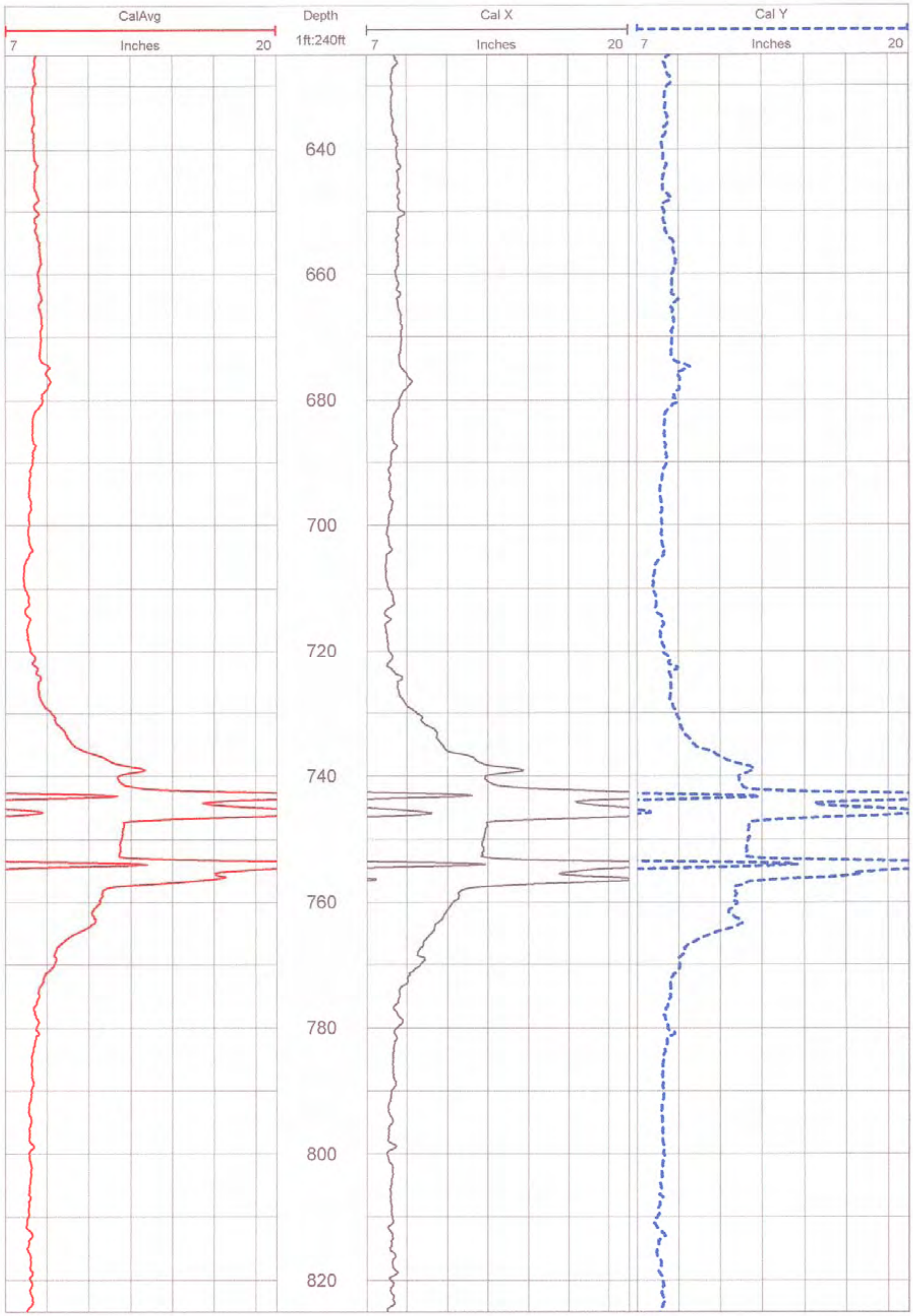
CO	COMPANY USDOE		
WELL	WELL ID C4997		
FLD	FIELD WTP		
CTY	COUNTRY USA	STATE WASHINGTON	
STE	LOCATION N135754.95 E576309.33 WASHINGTON STATE PLANE IN METERS		OTHER SERVICES GYRO ACOUSTIC TELEVIEWER
FILING No	SEC	TWP	RGE
PERMANENT DATUM	GL	ELEVATION 206.31 M	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GL		G.L.

DATE	10/13/06	TYPE FLUID IN HOLE	WATER BASED GEL
RUN No	ONE	SALINITY	
TYPE LOG	CALIPER	DENSITY	8.4 PPG
DEPTH-DRILLER	1437	LEVEL	20 FT
DEPTH-LOGGER	1437	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	1436.5		
TOP LOGGED INTERVAL	352		
OPERATING RIG TIME	3HRS		
RECORDED BY	B. RANDALL/M. MEISNER		
WITNESSED BY	A. ROHAY		

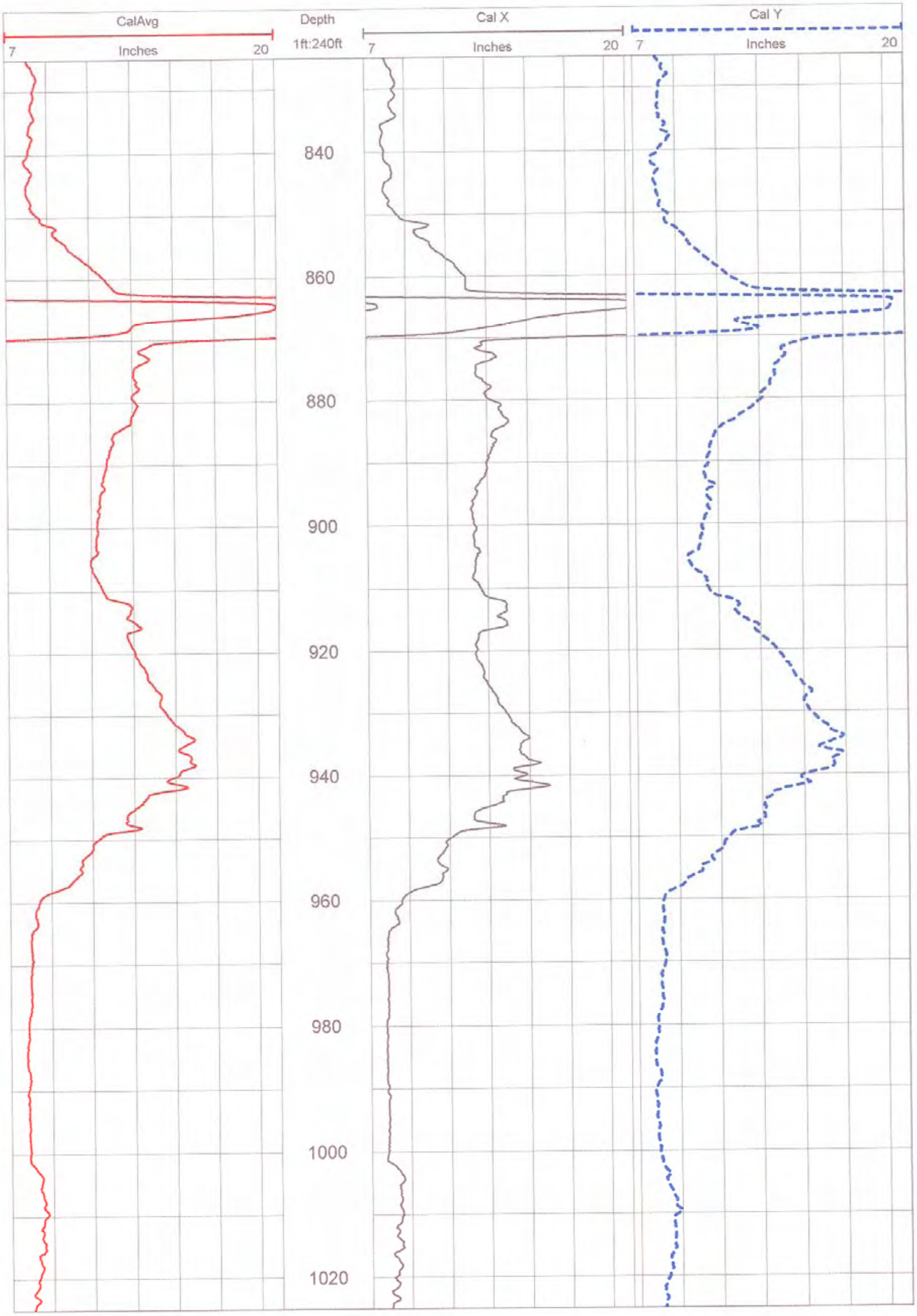
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	7 7/8	1437	352	13 3/8		0	200
				9 5/8		200	383

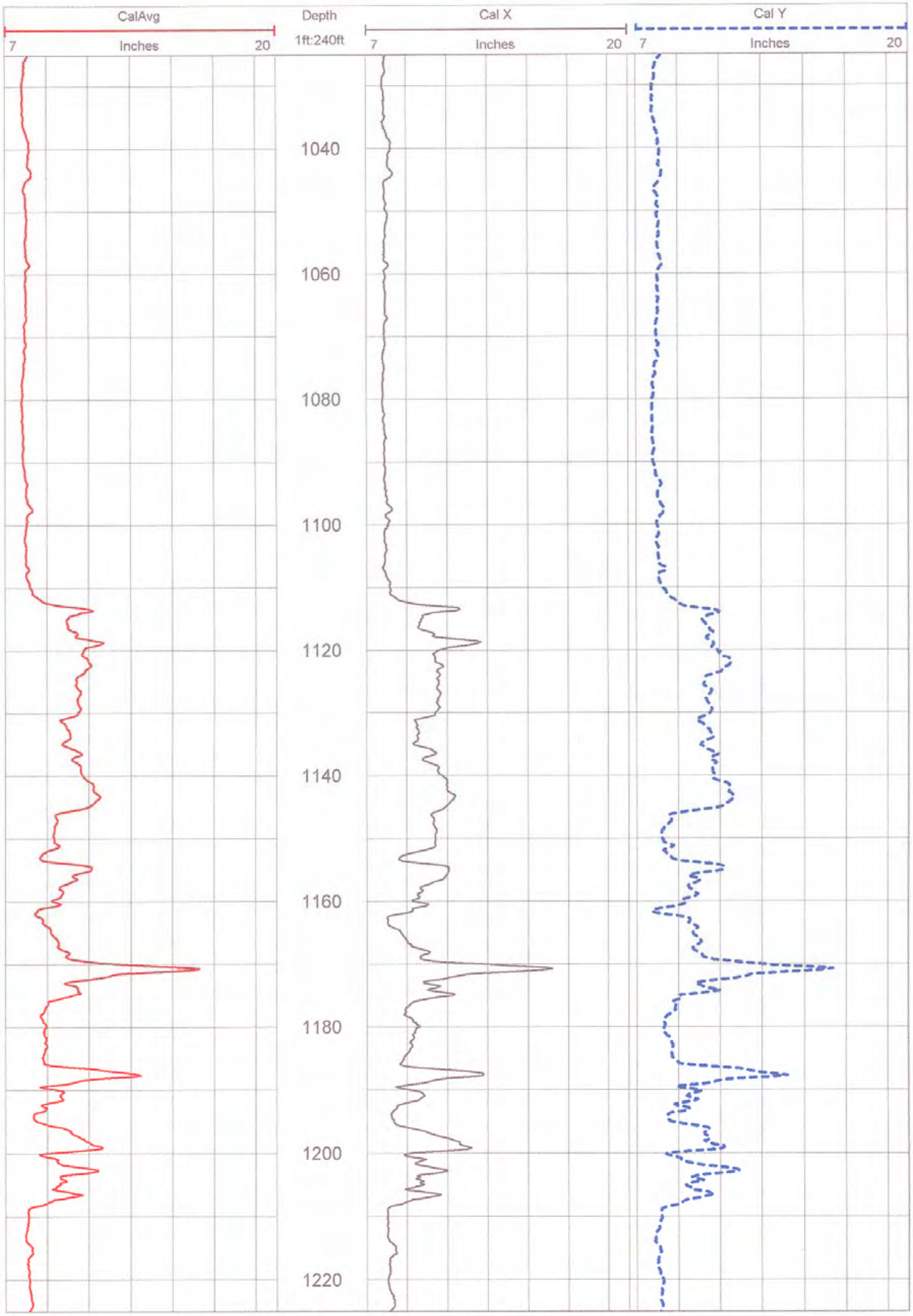


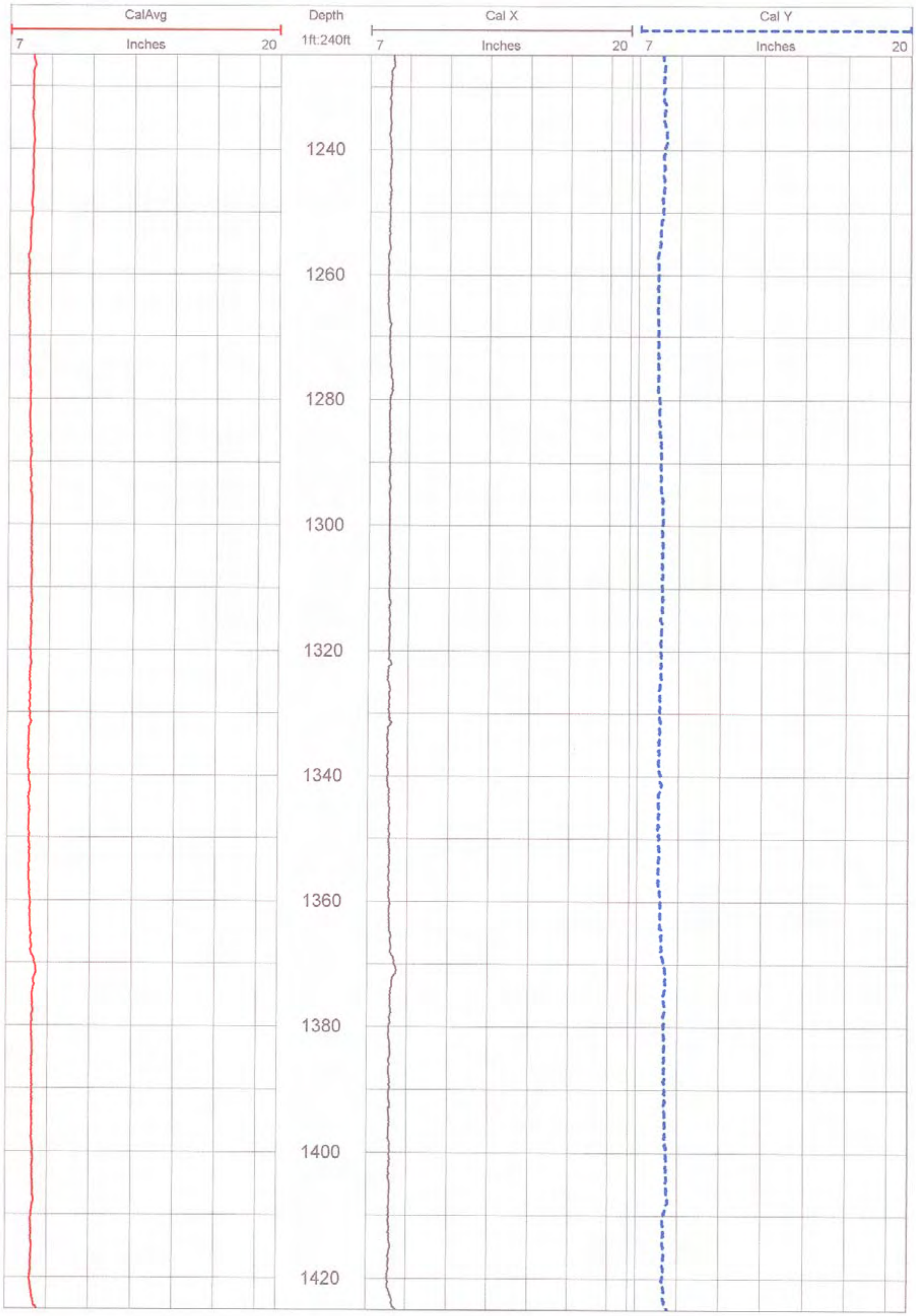

CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
440
460
480
500
520
540
560
580
600
620

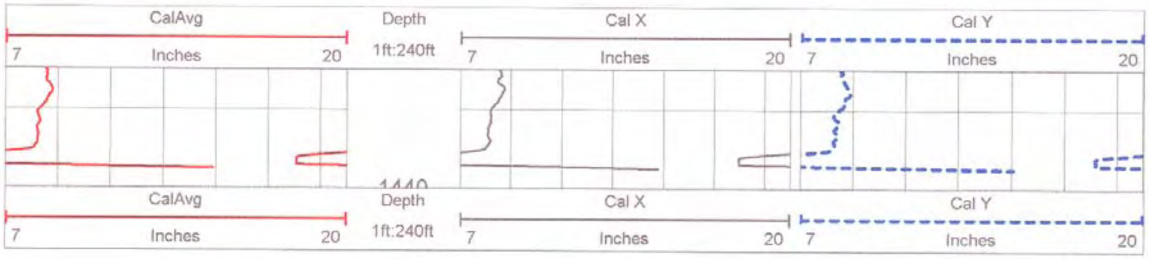


CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
640
660
680
700
720
740
760
780
800
820


CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
840
860
880
900
920
940
960
980
1000
1020


CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
1040
1060
1080
1100
1120
1140
1160
1180
1200
1220


CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
1240
1260
1280
1300
1320
1340
1360
1380
1400
1420


CalAvg
Depth
Cal X
Cal Y
7
Inches
20
1ft:240ft
1440

ENERGYSOLUTIONS

COMPANY	USDOE		
WELL ID	C4997		
FIELD	WTP		
COUNTRY	USA	STATE	WASHINGTON

CO / WELL / FLD / CTY / STE / FILING No

LOCATION
N135754.95
E576309.33
WASHINGTON STATR PLANE IN METERS

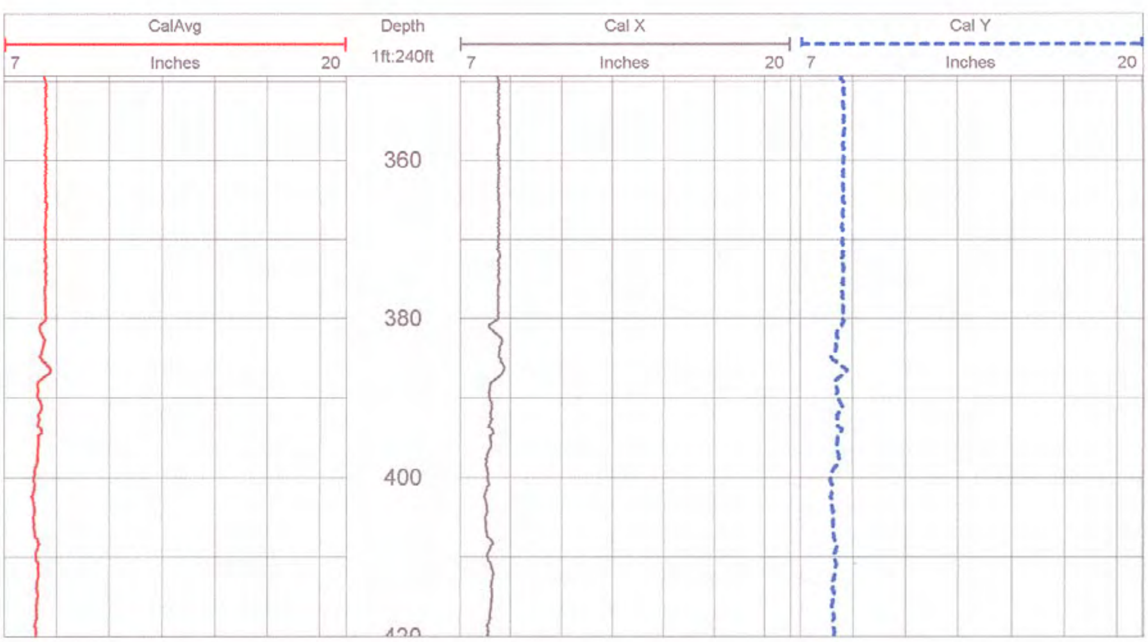
OTHER SERVICES
GYRO
ACOUSTIC TELEVIEWER

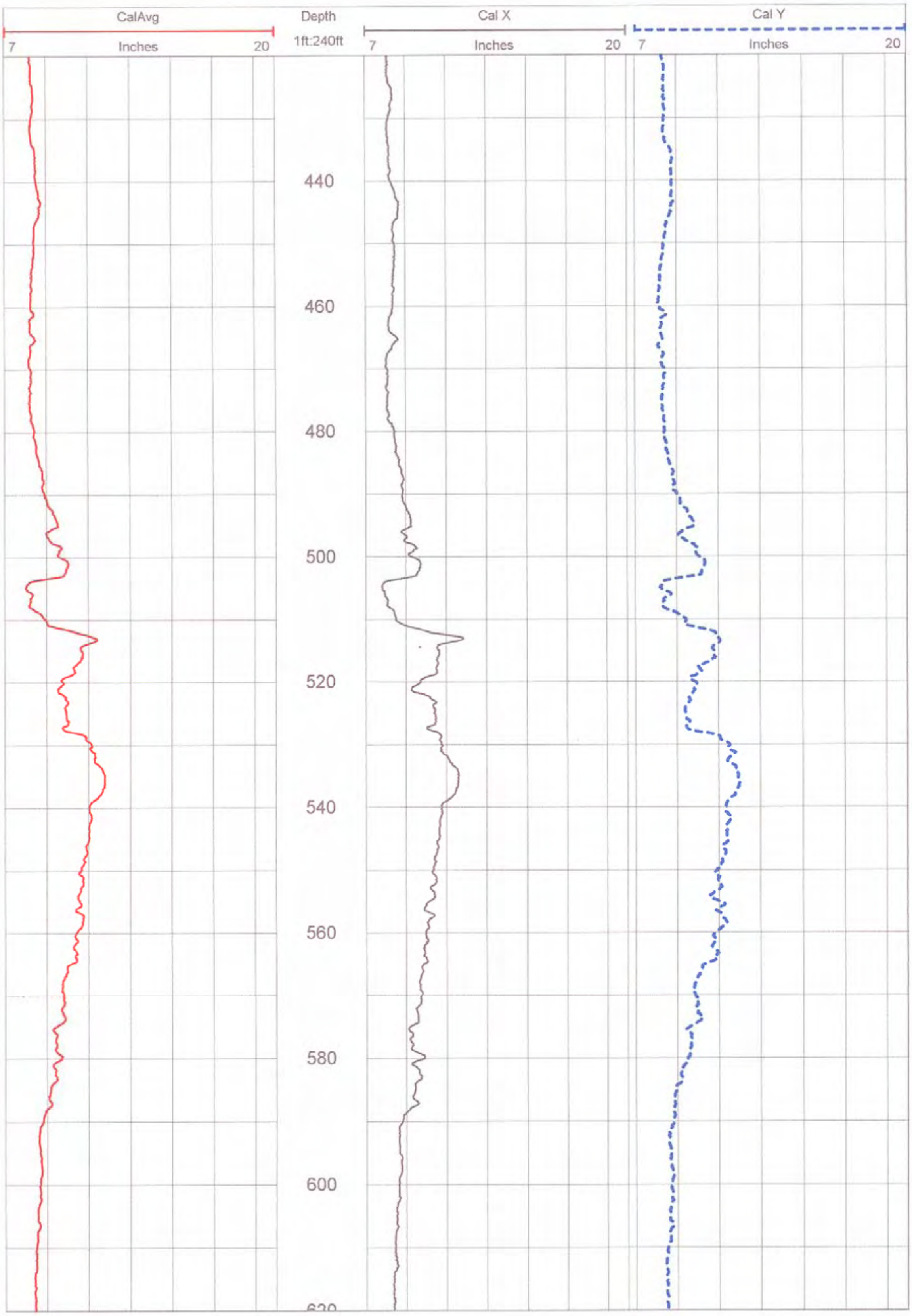
SEC TWP RGE

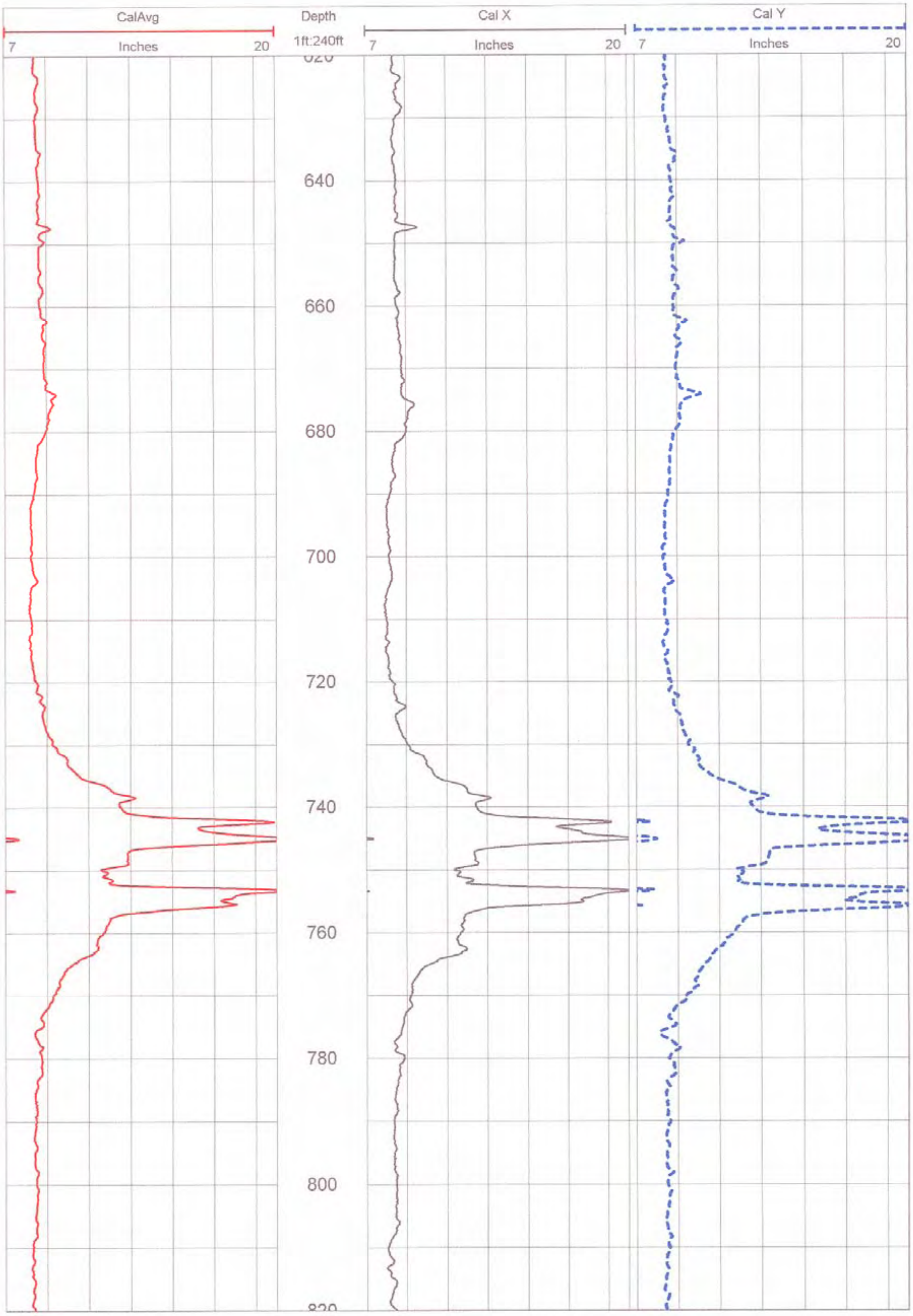
PERMANENT DATUM	GL	ELEVATION	206.31 M	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM	GL			G.L.

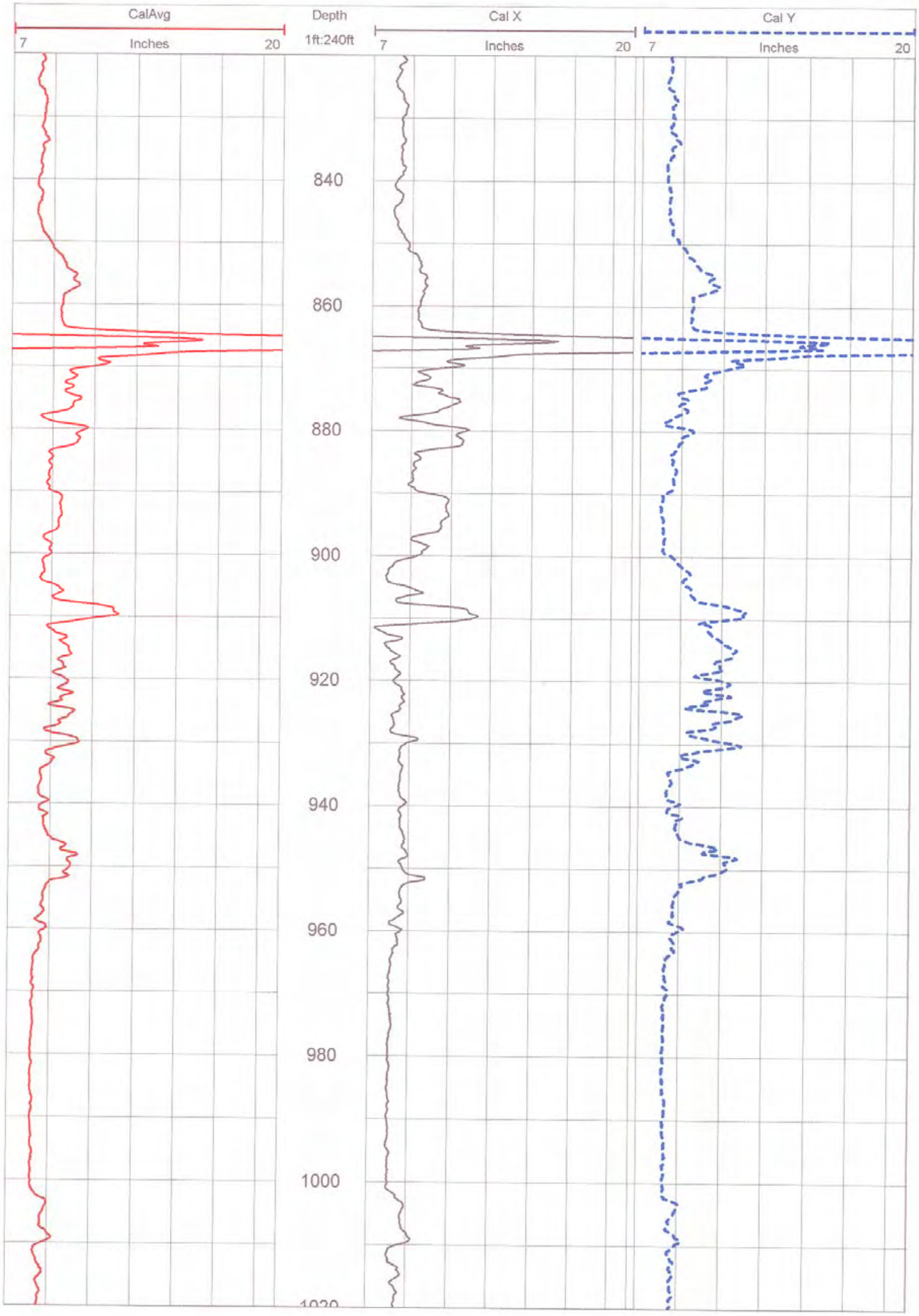
DATE	11/5/06	TYPE FLUID IN HOLE	WATER BASED GEL
RUN No	TWO	SALINITY	
TYPE LOG	4 ARM CALIPER	DENSITY	8.4 PPG
DEPTH-DRILLER	1437	LEVEL	20 FT
DEPTH-LOGGER	1437	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	1280		
TOP LOGGED INTERVAL	350		
OPERATING RIG TIME	3HRS		
RECORDED BY	J.MEISNER/M. MEISNER		
WITNESSED BY	A. ROHAY		

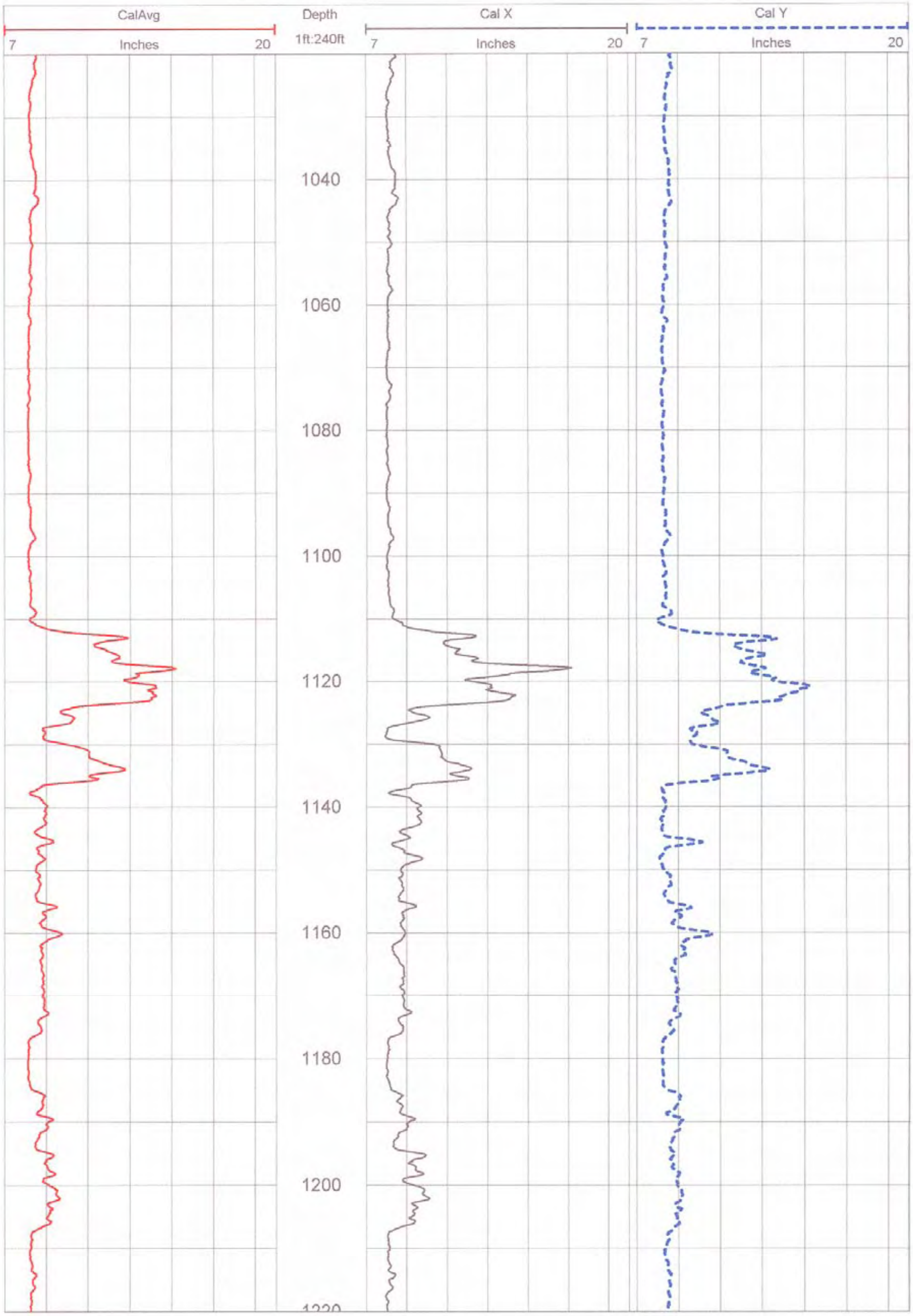
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	7 7/8	1437	352	13 3/8		0	200
				9 5/8		200	383

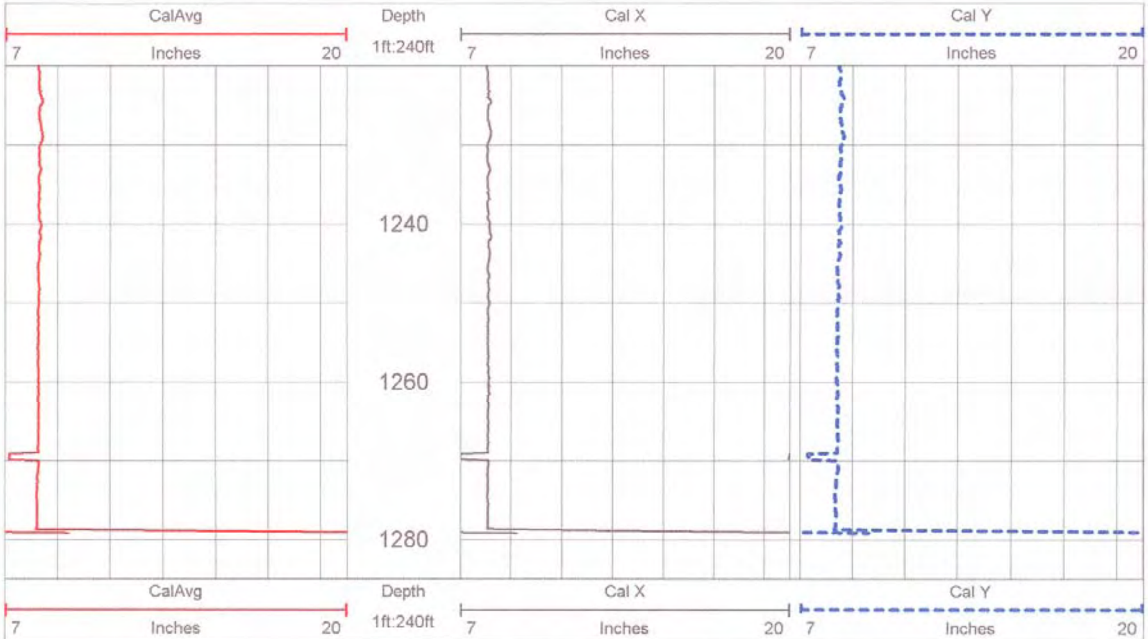



CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
440
460
480
500
520
540
560
580
600
620


CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
620
640
660
680
700
720
740
760
780
800
820


CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
840
860
880
900
920
940
960
980
1000
1020


CalAvg
7 Inches 20
Depth
1ft:240ft
Cal X
7 Inches 20
Cal Y
7 Inches 20
1040
1060
1080
1100
1120
1140
1160
1180
1200


CalAvg
Depth
Cal X
Cal Y
7
Inches
20
1ft:240ft
1240
1260
1280

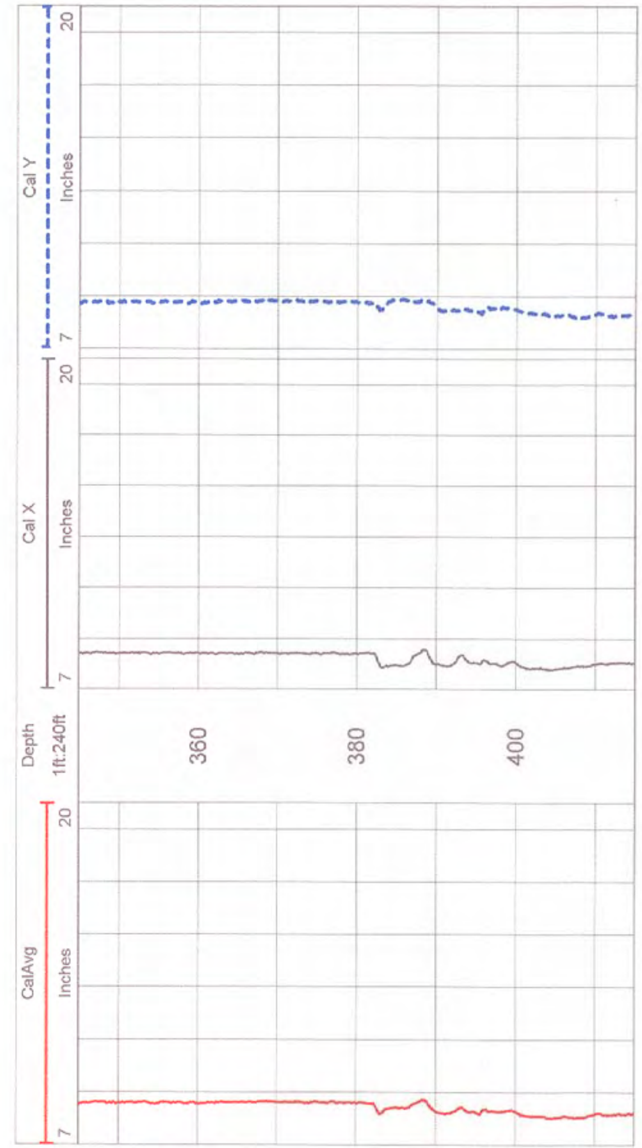
ENERGYSOLUTIONS

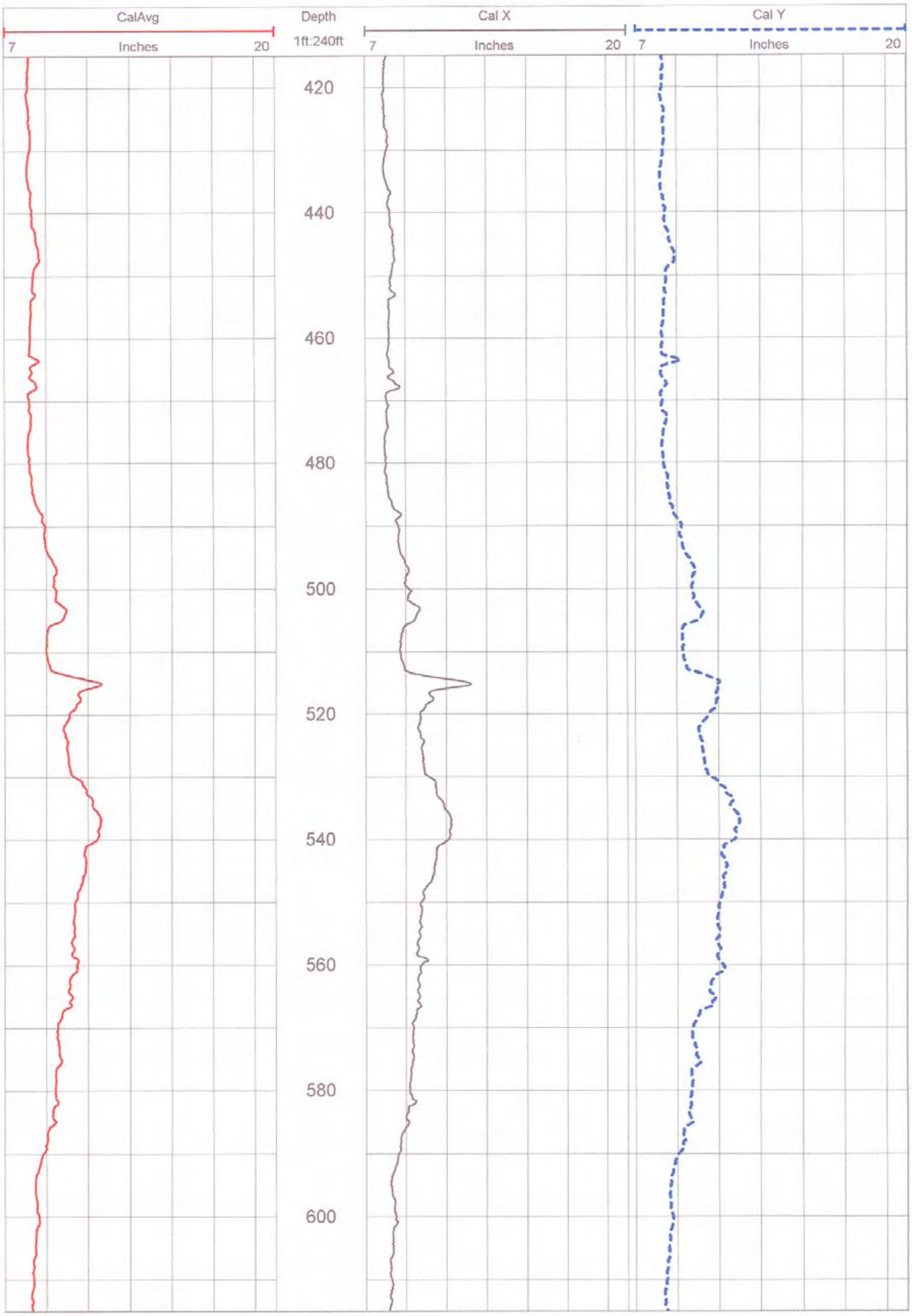
CO	COMPANY	USDOE	
WELL	WELL ID	C4997	
FLD	FIELD	WTP	
CTY	COUNTRY	USA	STATE WASHINGTON
STE	LOCATION N135754.95 E576309.33 WASHINGTON STATR PLANE IN METERS		OTHER SERVICES GYRO ACOUSTIC TELEVIEWER
FILING No	SEC	TWP	RGE

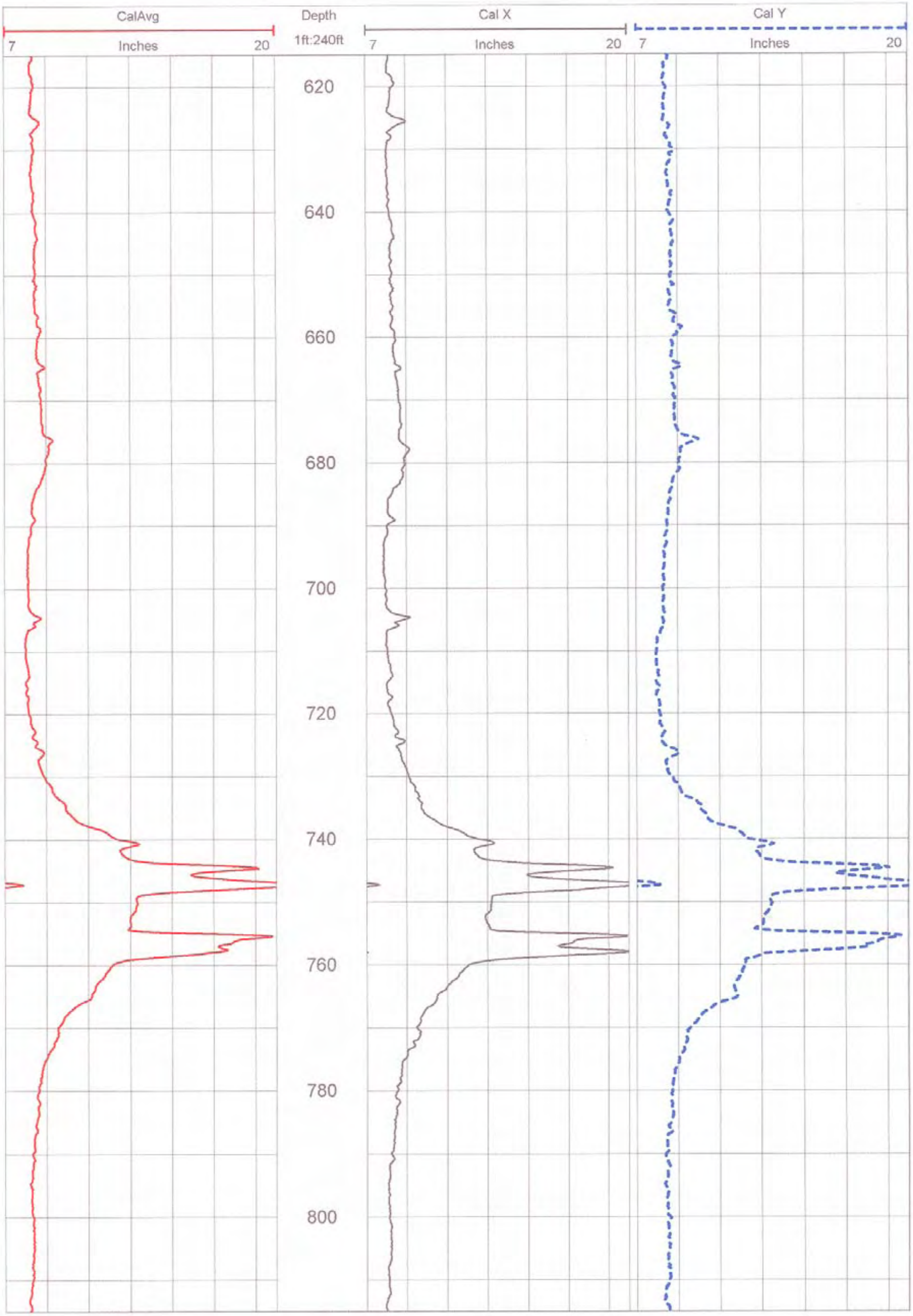
PERMANENT DATUM	GL	ELEVATION	206.31 M	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM	GL			G.L.

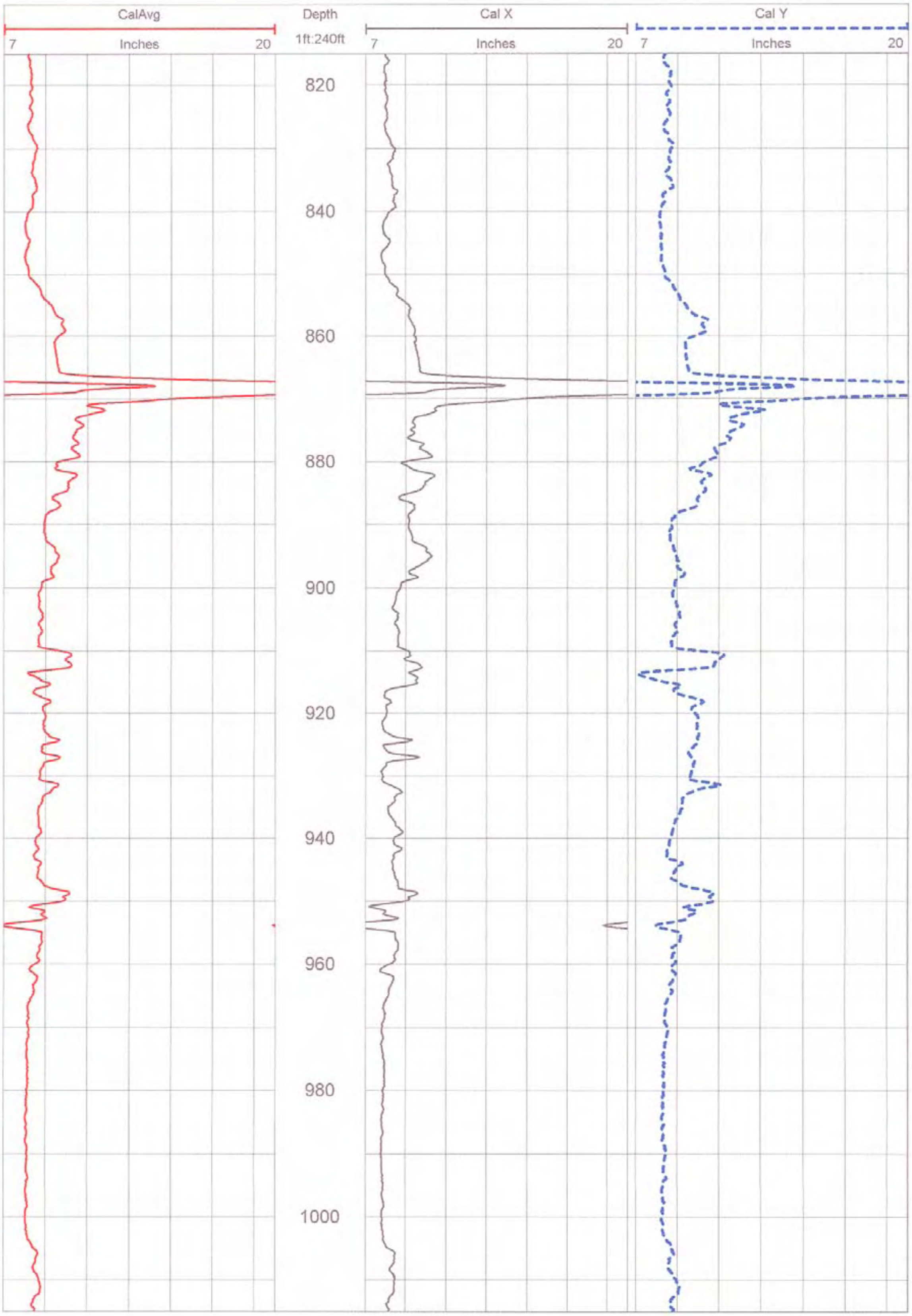
DATE	11/17/06	TYPE FLUID IN HOLE	WATER BASED GEL
RUN No	THREE	SALINITY	
TYPE LOG	4 ARM CALIPER	DENSITY	8.4 PPG
DEPTH-DRILLER	1437	LEVEL	20 FT
DEPTH-LOGGER	1437	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	1433		
TOP LOGGED INTERVAL	346		
OPERATING RIG TIME	3HRS		
RECORDED BY	B. RANDALL,M. MEISNER		
WITNESSED BY	A. ROHAY		

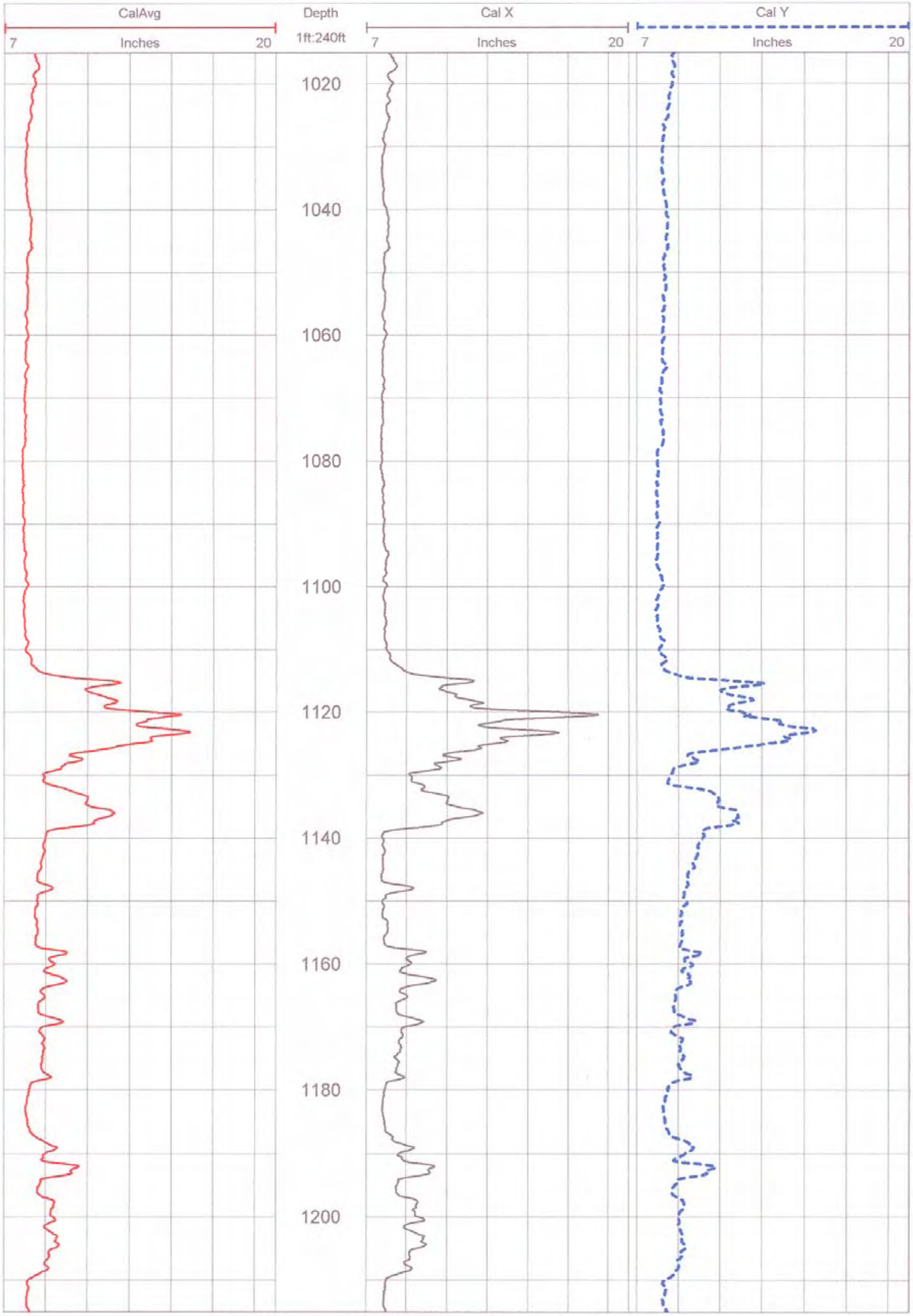
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	7 7/8	1437	352	13 3/8		0	200
				9 5/8		200	383

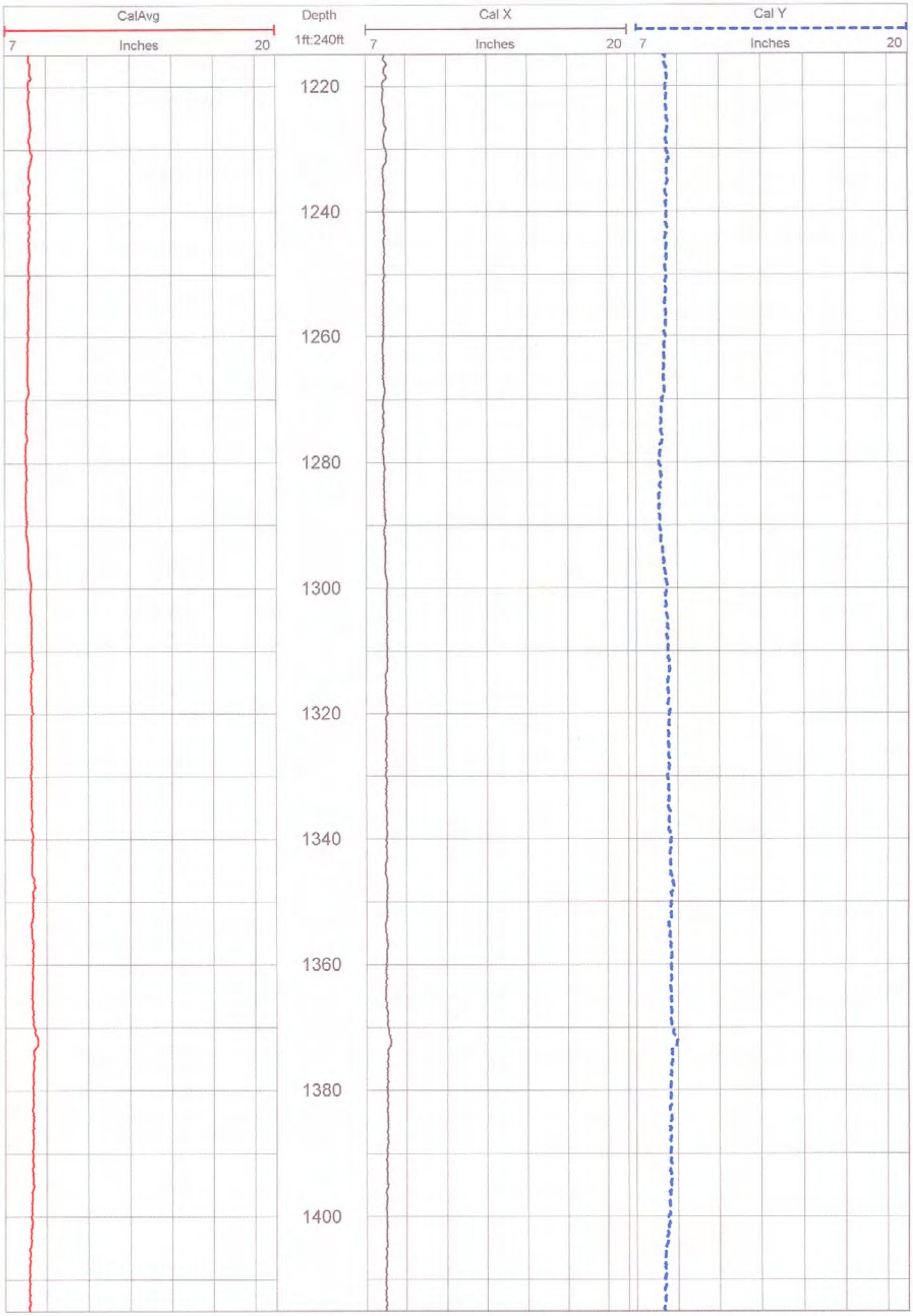


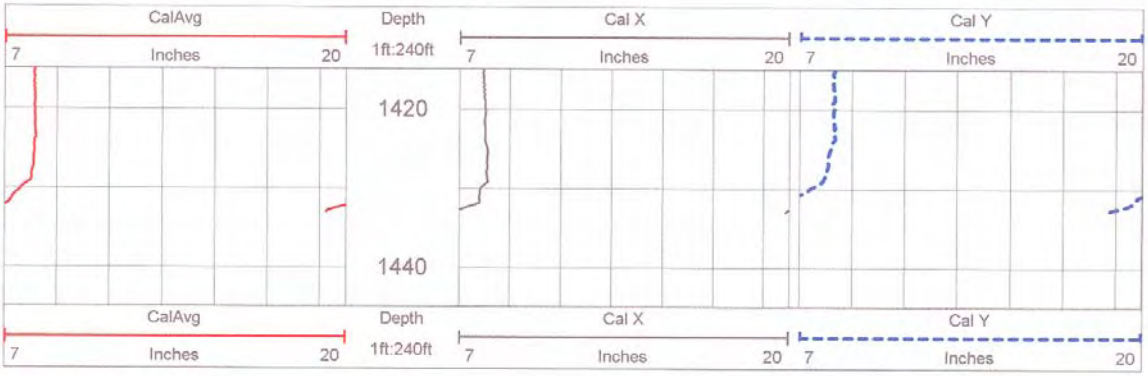

CalAvg
7
Inches
20
Depth
1ft:240ft
420
440
460
480
500
520
540
560
580
600
Cal X
7
Inches
20
Cal Y
7
Inches
20

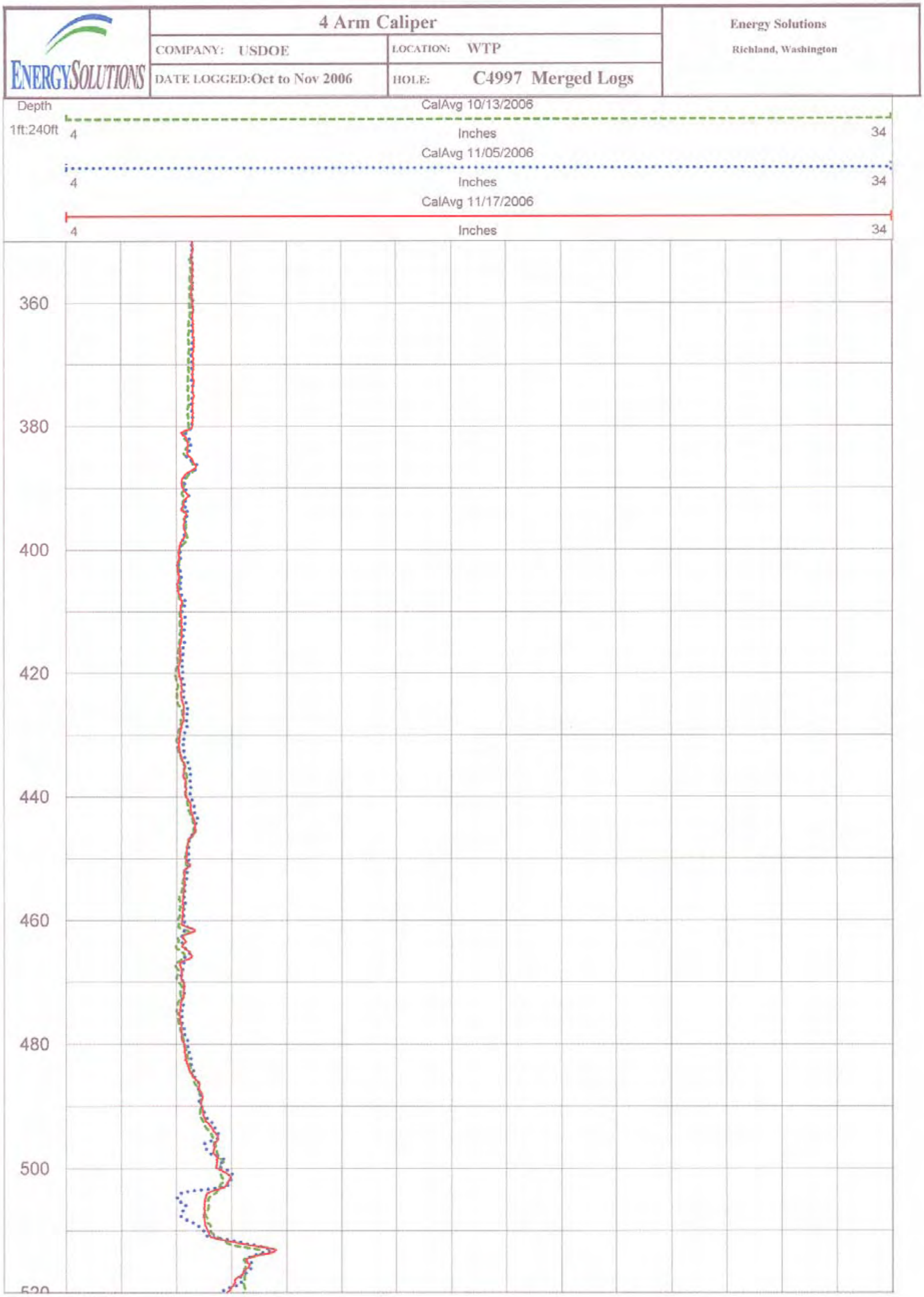

CalAvg
7
Inches
20
Depth
1ft:240ft
620
640
660
680
700
720
740
760
780
800
Cal X
7
Inches
20
Cal Y
7
Inches
20

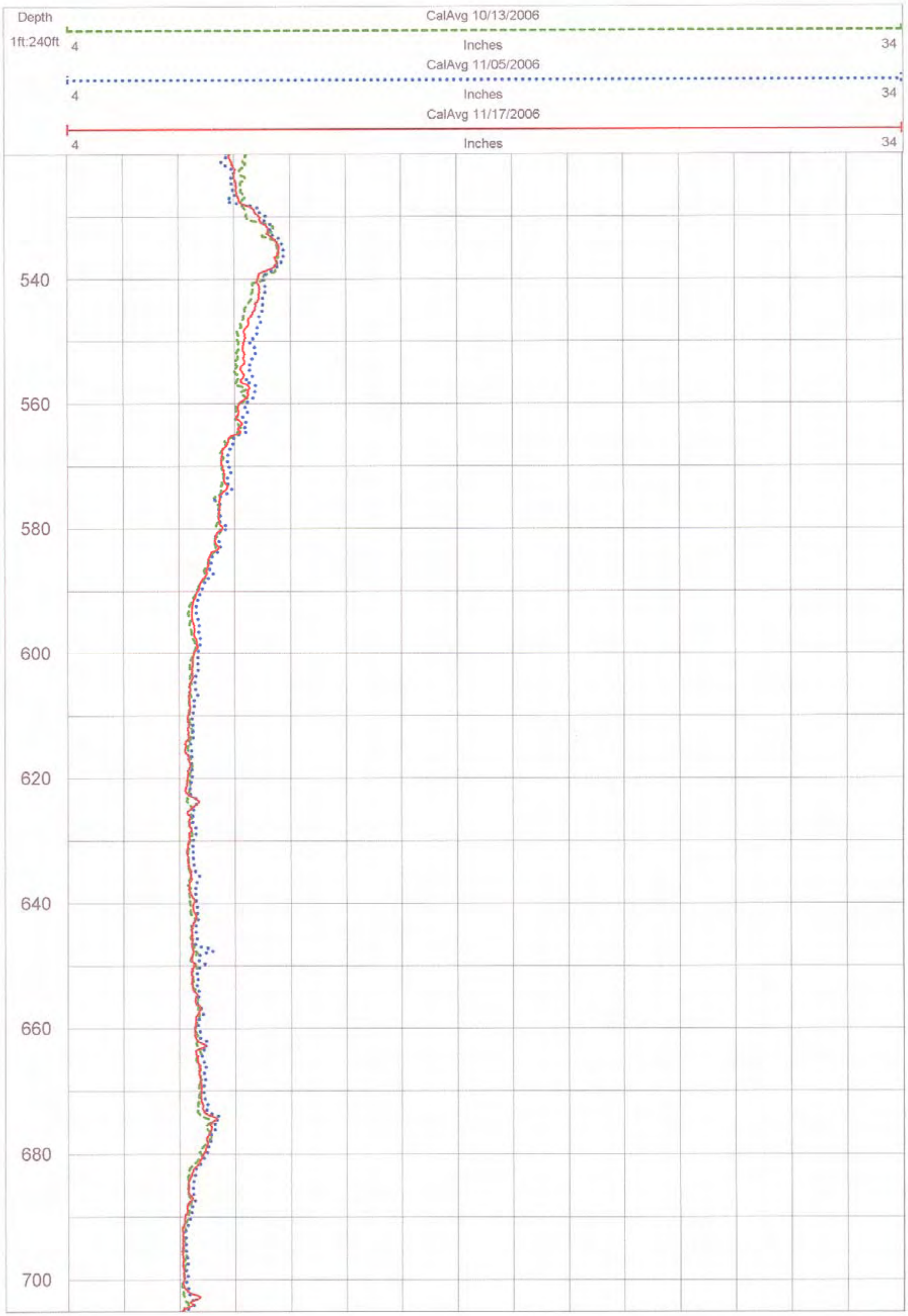

CalAvg
7 Inches 20
Depth
1ft:240ft
Cal X
7 Inches 20
Cal Y
7 Inches 20
820
840
860
880
900
920
940
960
980
1000


CalAvg
7
Inches
20
Depth
1ft:240ft
1020
1040
1060
1080
1100
1120
1140
1160
1180
1200
Cal X
7
Inches
20
Cal Y
7
Inches
20

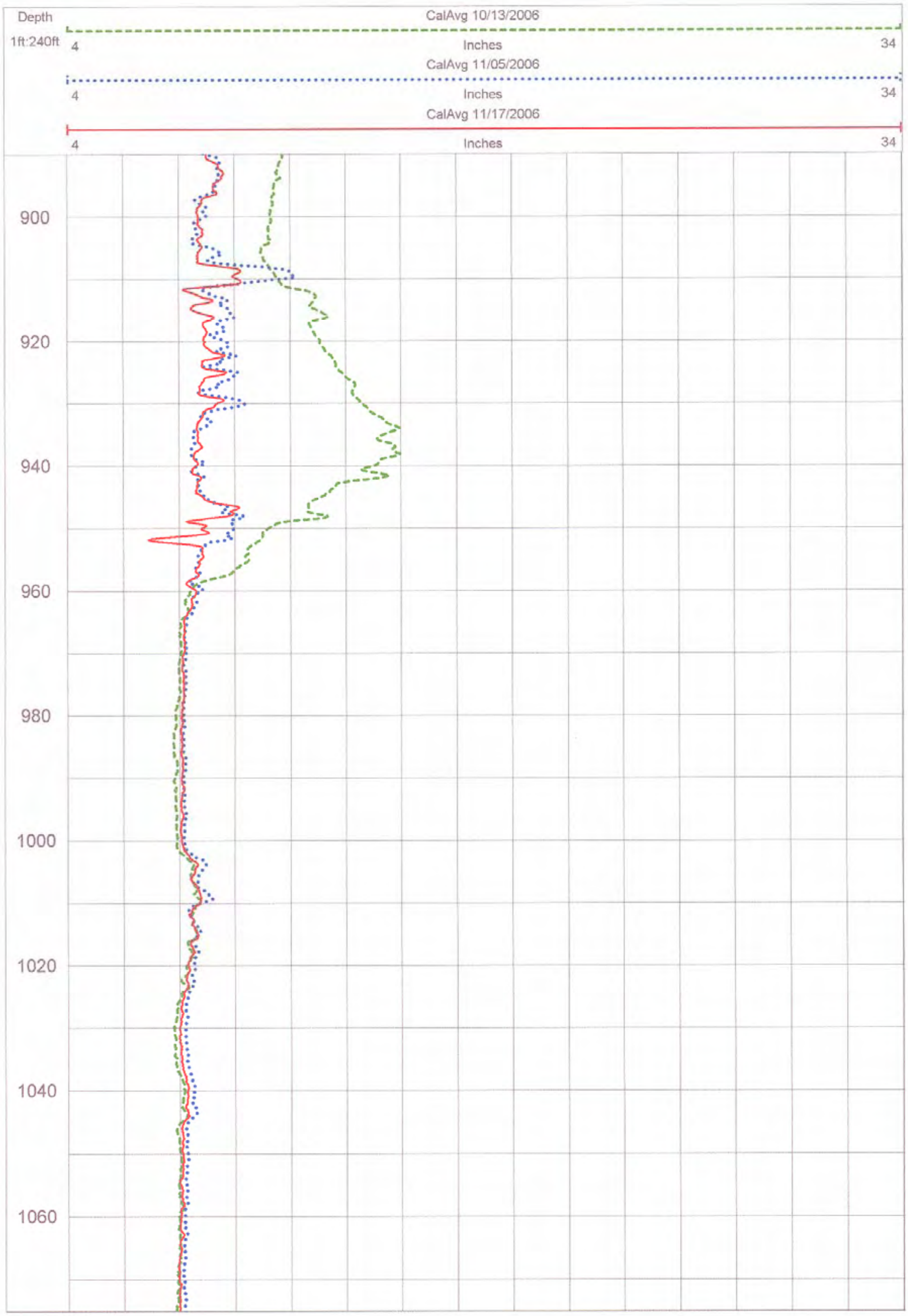

CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
1220
1240
1260
1280
1300
1320
1340
1360
1380
1400

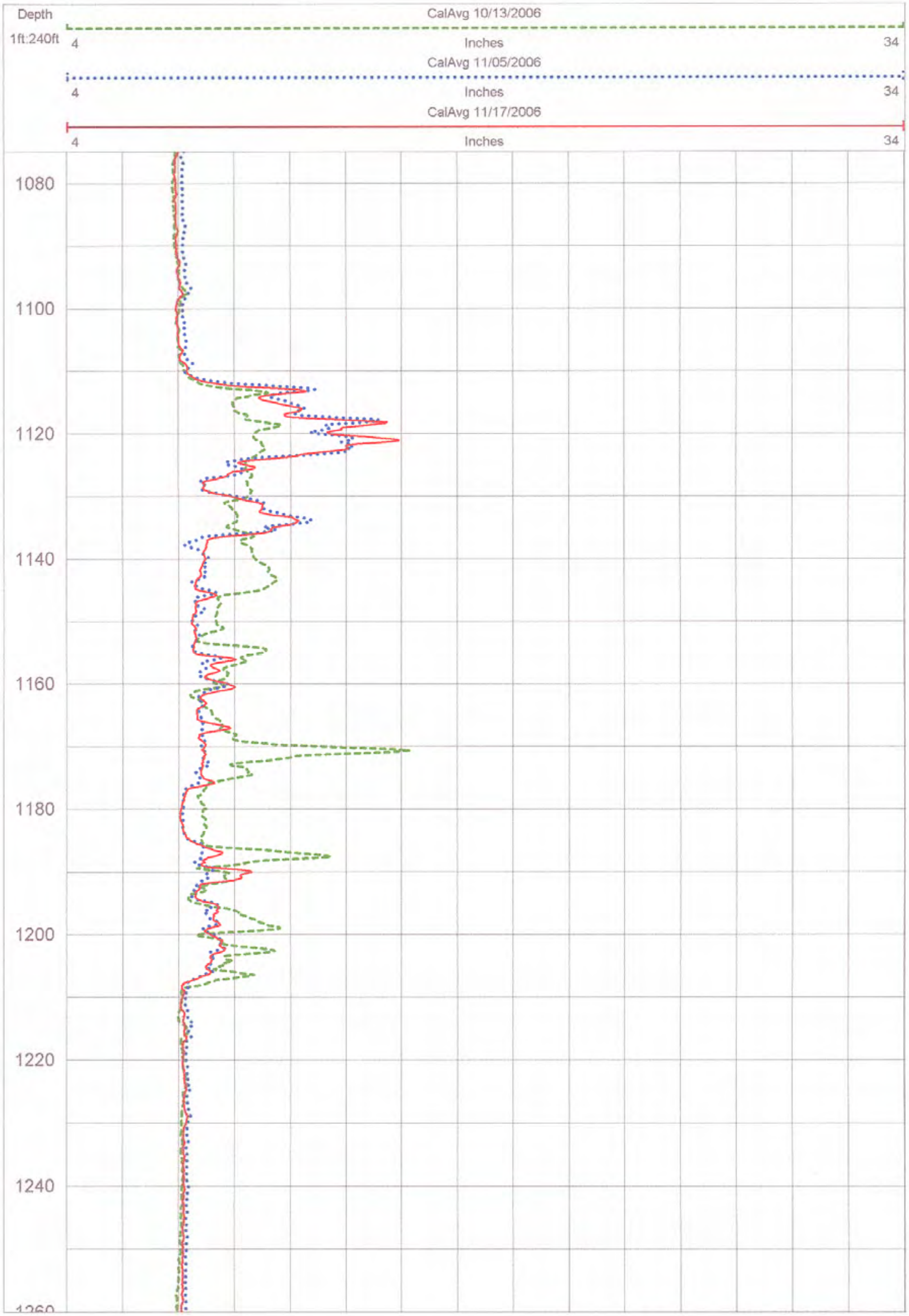

CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20
1420
1440
CalAvg
7
Inches
20
Depth
1ft:240ft
Cal X
7
Inches
20
Cal Y
7
Inches
20

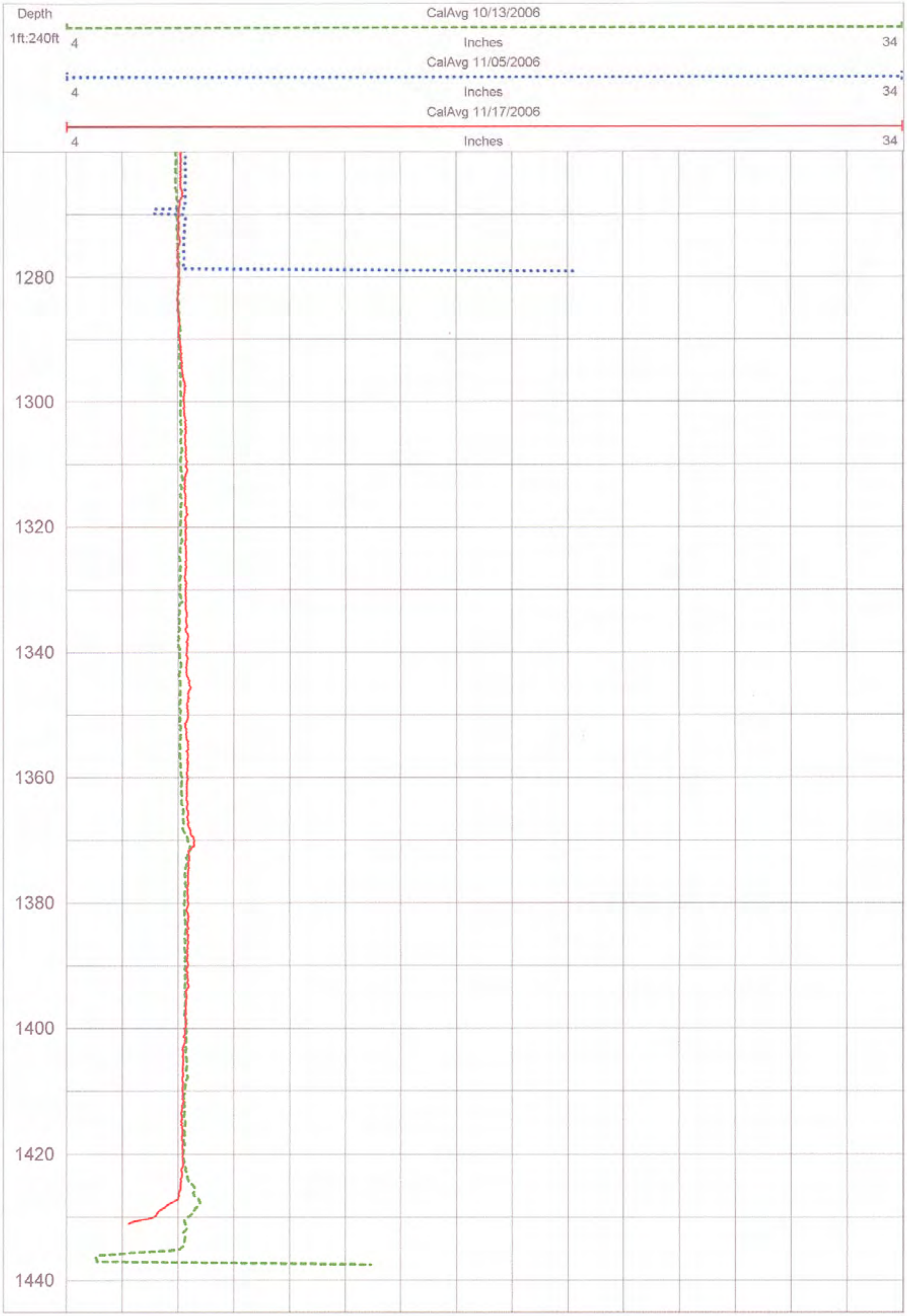

4 Arm Caliper
COMPANY: USDOE
LOCATION: WTP
Energy Solutions
Richland, Washington
DATE LOGGED:Oct to Nov 2006
HOLE: C4997 Merged Logs
Depth
1ft:240ft
CalAvg 10/13/2006
4 Inches 34
CalAvg 11/05/2006
4 Inches 34
CalAvg 11/17/2006
4 Inches 34
360
380
400
420
440
460
480
500
520


Depth
1ft:240ft
CalAvg 10/13/2006
4
Inches
34
CalAvg 11/05/2006
4
Inches
34
CalAvg 11/17/2006
4
Inches
34
540
560
580
600
620
640
660
680
700


Depth
1ft:240ft
CalAvg 10/13/2006
4
Inches
34
CalAvg 11/05/2006
4
Inches
34
CalAvg 11/17/2006
4
Inches
34
720
740
760
780
800
820
840
860
880

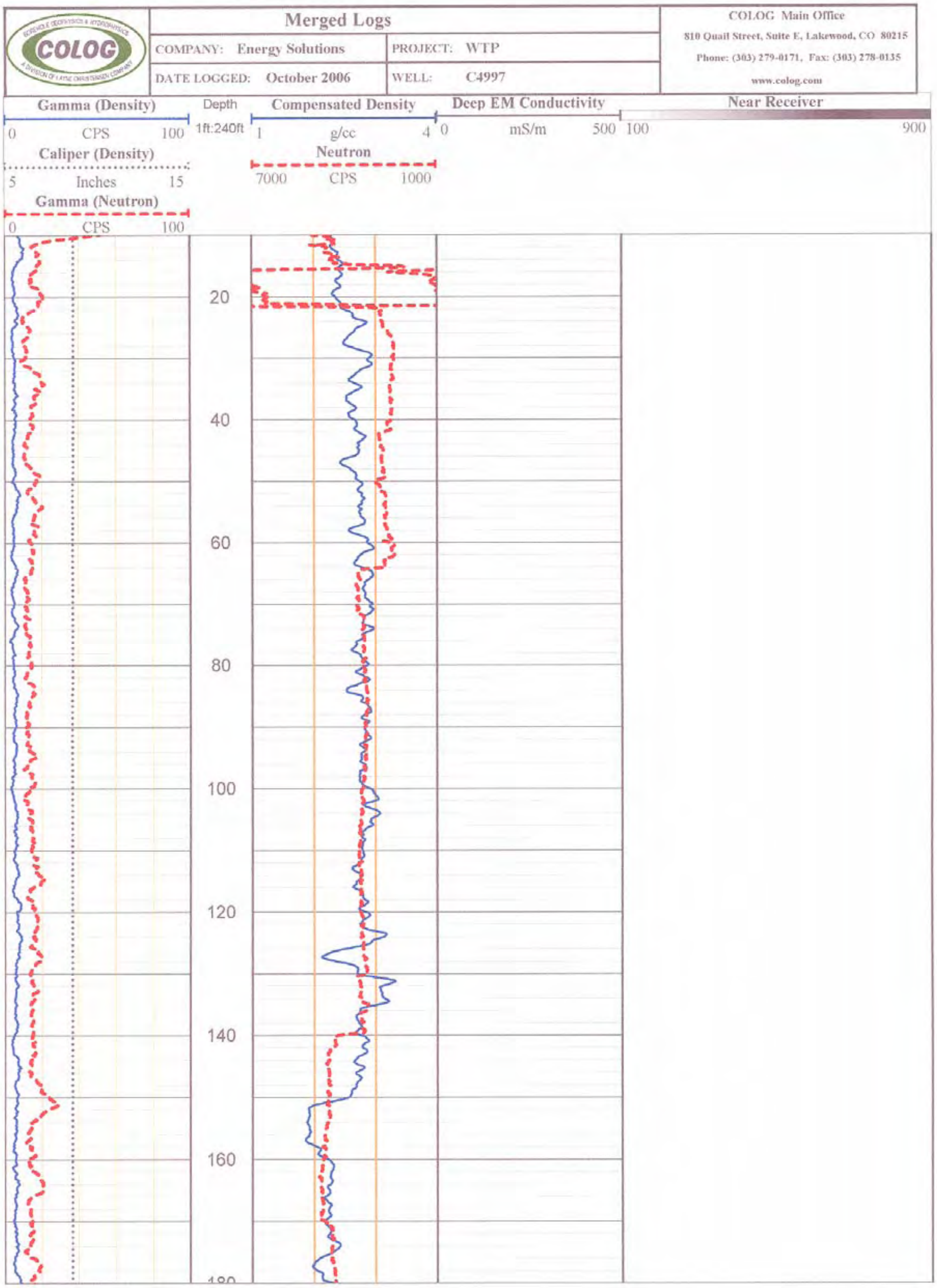

Depth
1ft:240ft
CalAvg 10/13/2006
4
Inches
34
CalAvg 11/05/2006
4
Inches
34
CalAvg 11/17/2006
4
Inches
34
900
920
940
960
980
1000
1020
1040
1060

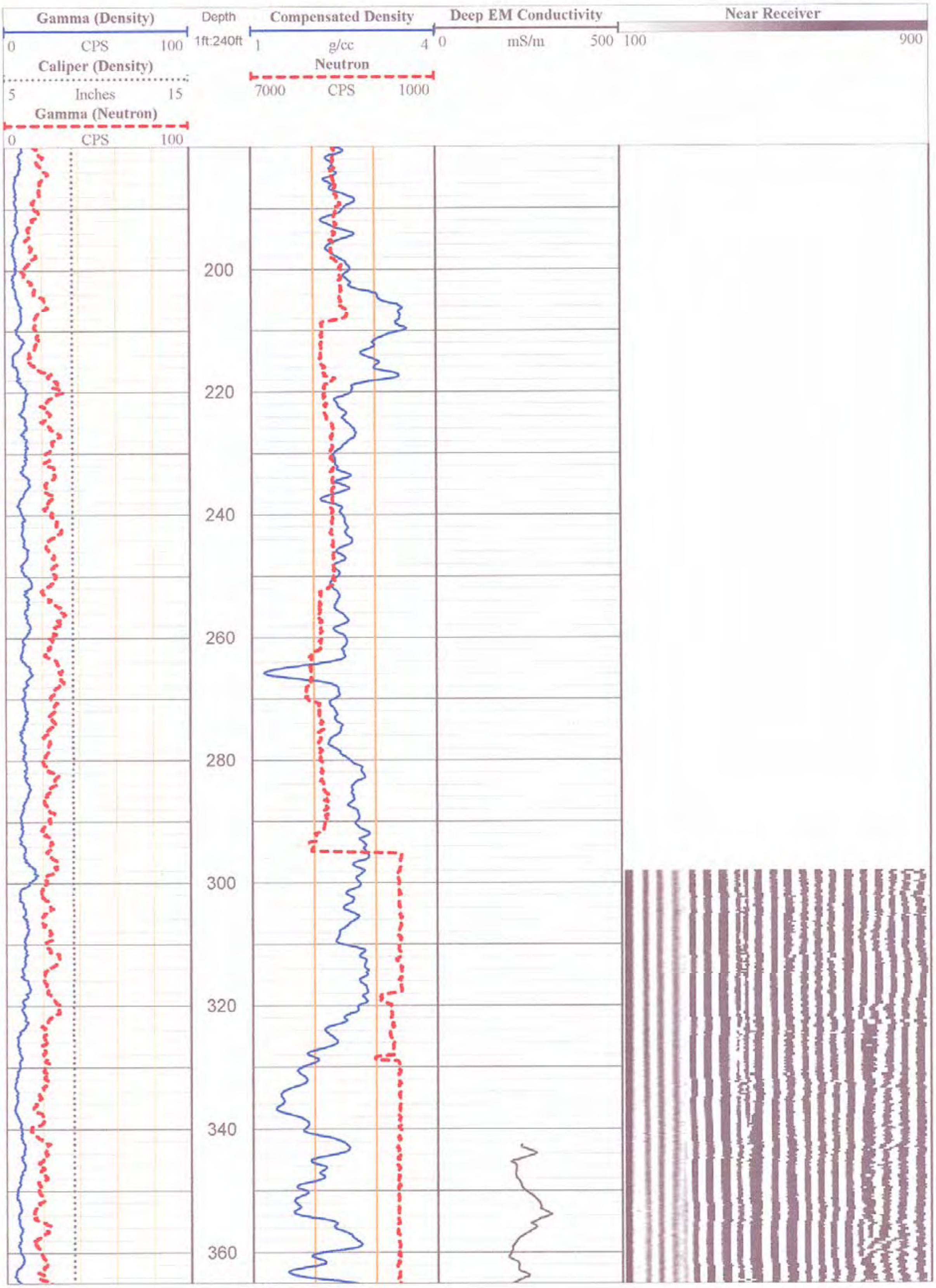

Depth
1ft:240ft
CalAvg 10/13/2006
4
Inches
34
CalAvg 11/05/2006
4
Inches
34
CalAvg 11/17/2006
4
Inches
34
1080
1100
1120
1140
1160
1180
1200
1220
1240
1260

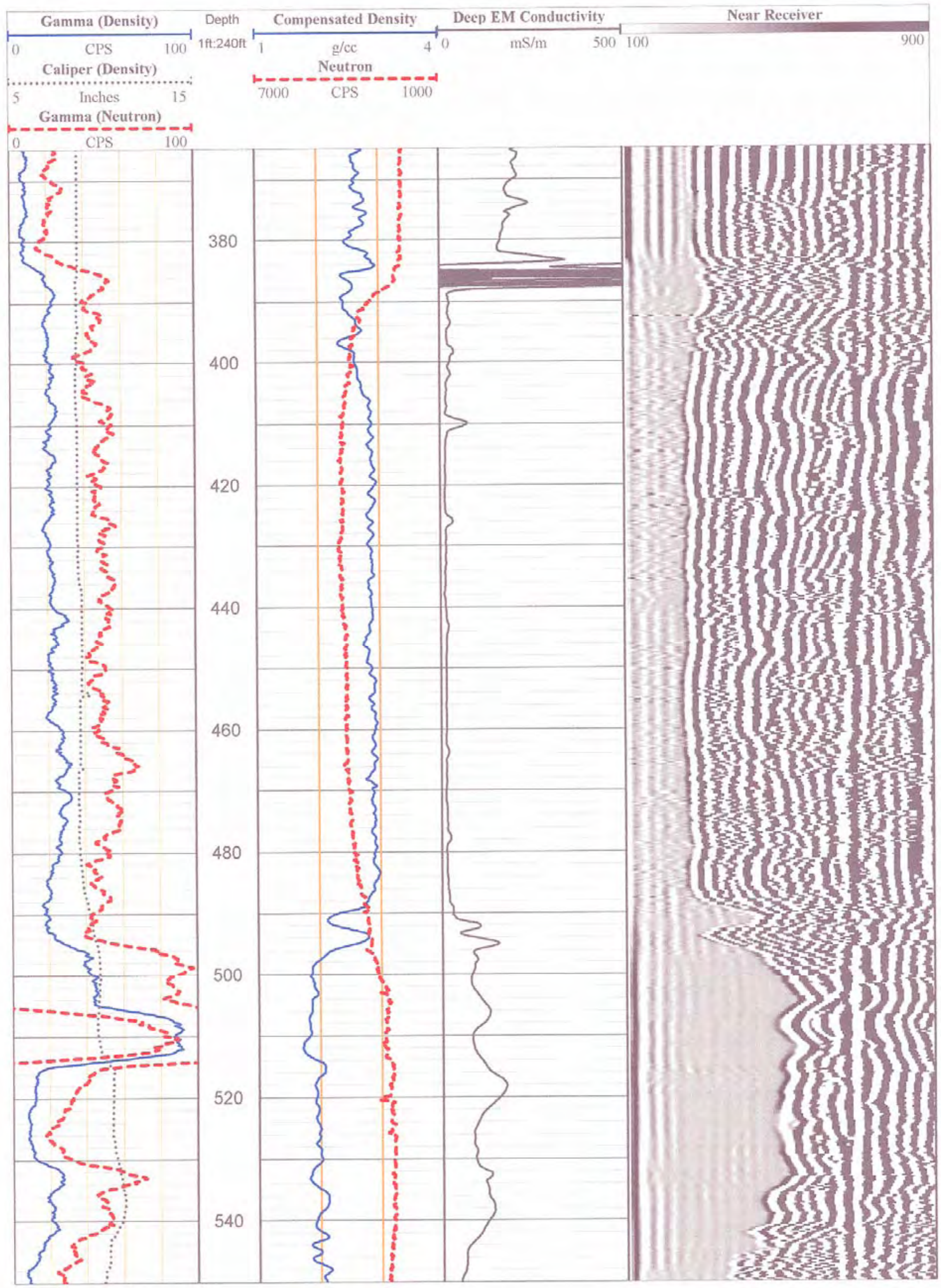


Depth
1ft:240ft
CalAvg 10/13/2006
4
Inches
34
CalAvg 11/05/2006
4
Inches
34
CalAvg 11/17/2006
4
Inches
34
1280
1300
1320
1340
1360
1380
1400
1420
1440

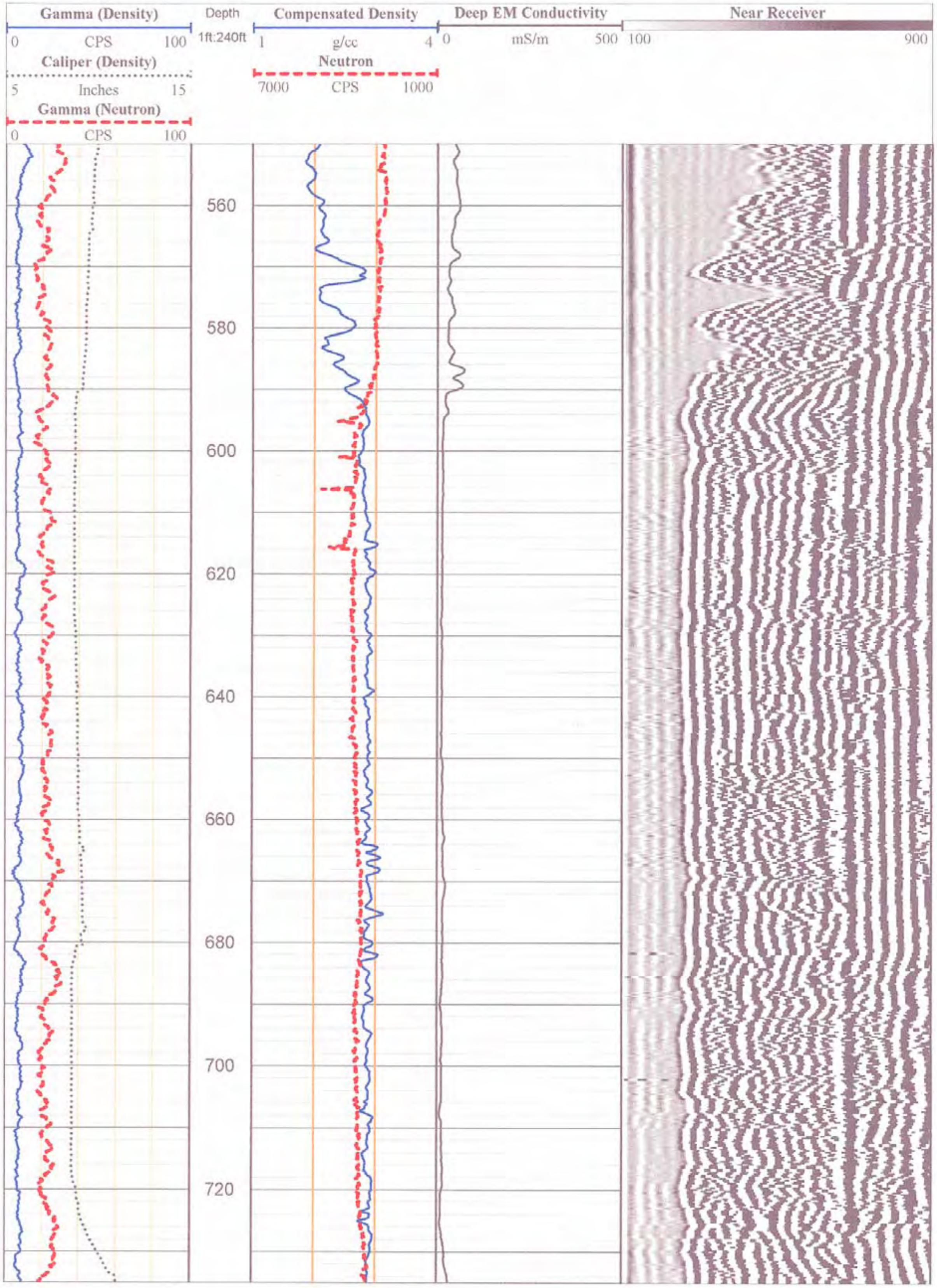
C1.3 COLOG MERGED LOGS

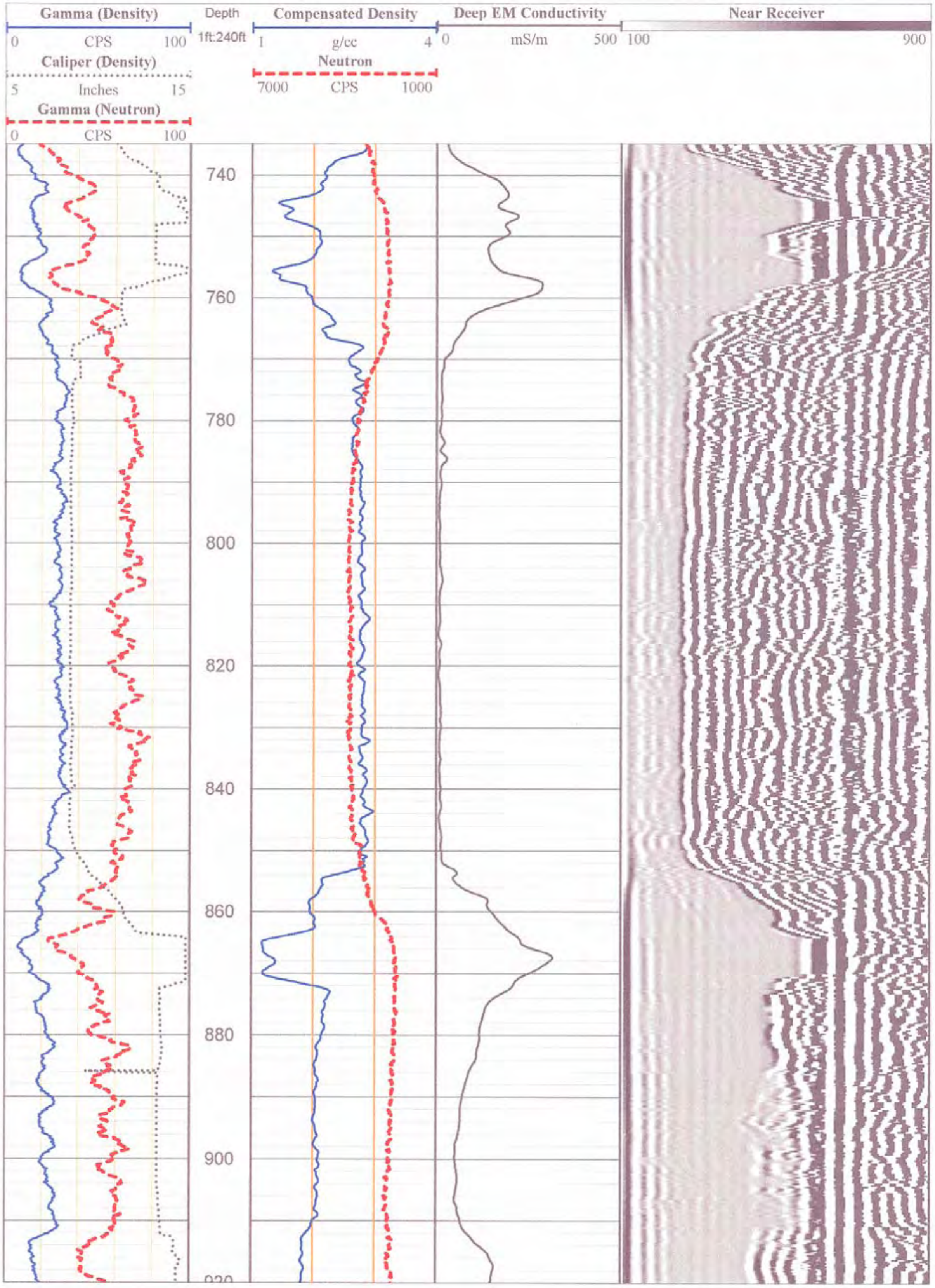



Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100
900
200
220
240
260
280
300
320
340
360

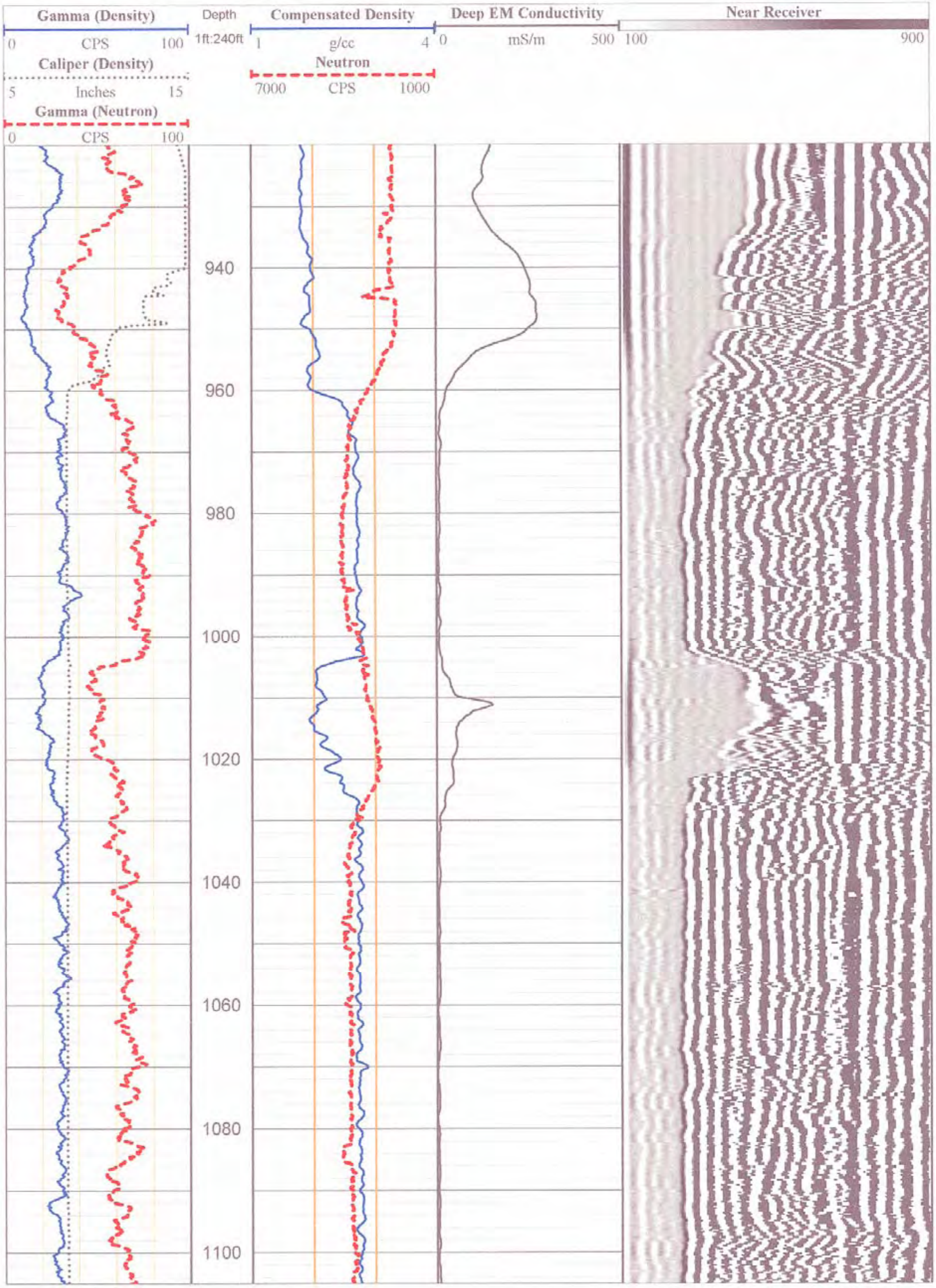


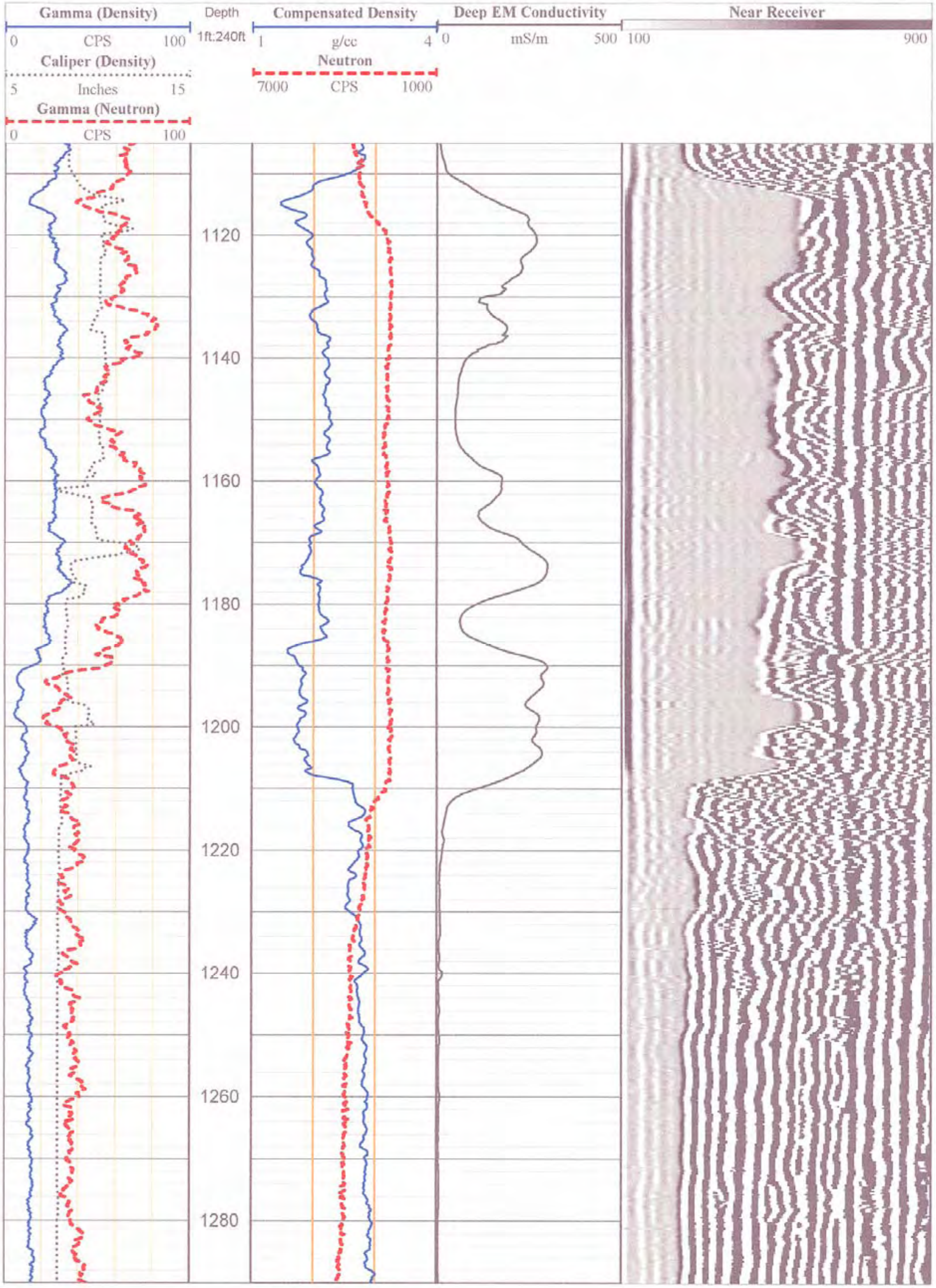
Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
380
400
420
440
460
480
500
520
540
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100
900

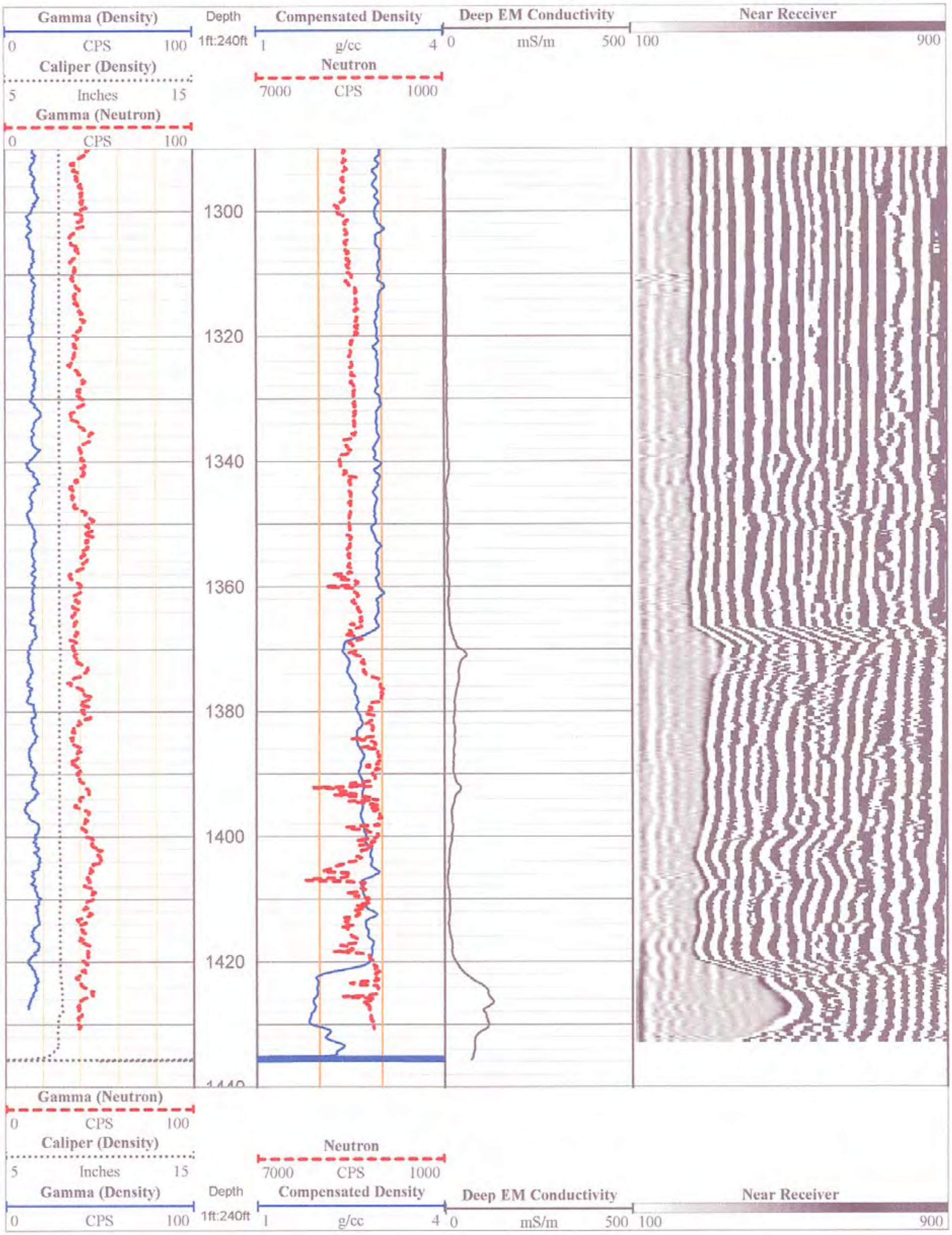

Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
560
580
600
620
640
660
680
700
720



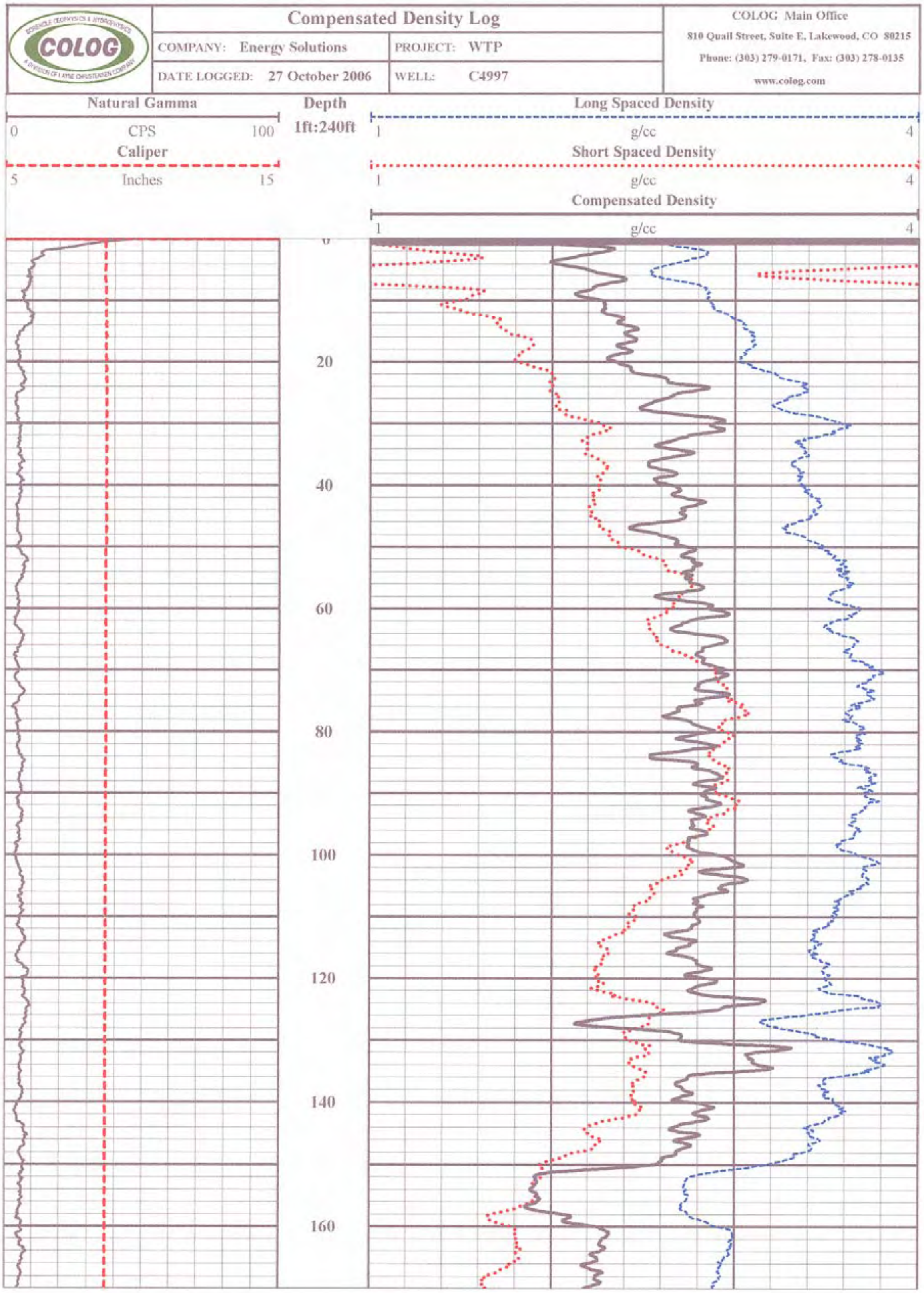
Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
740
760
780
800
820
840
860
880
900
920
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900

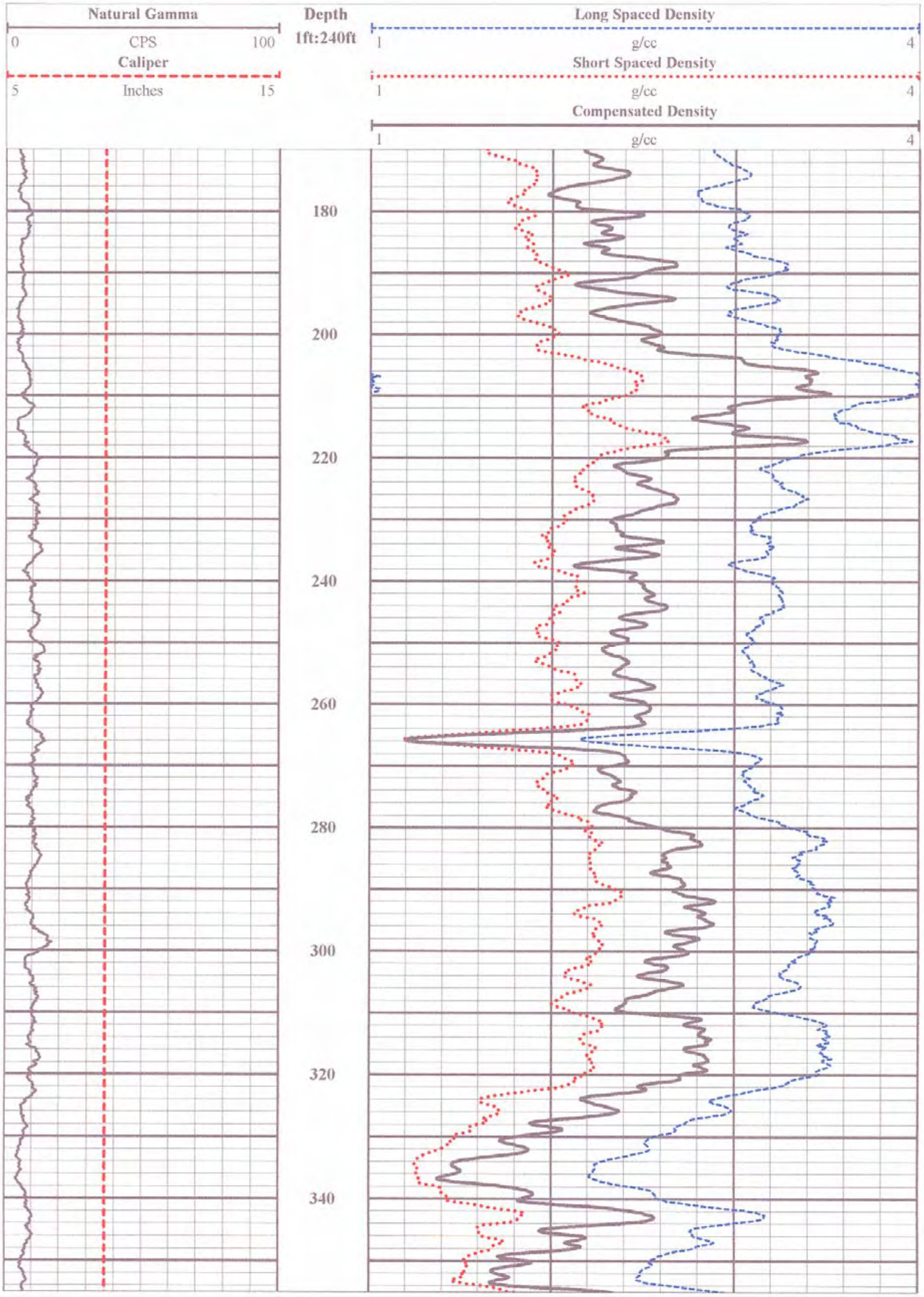

Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
940
960
980
1000
1020
1040
1060
1080
1100

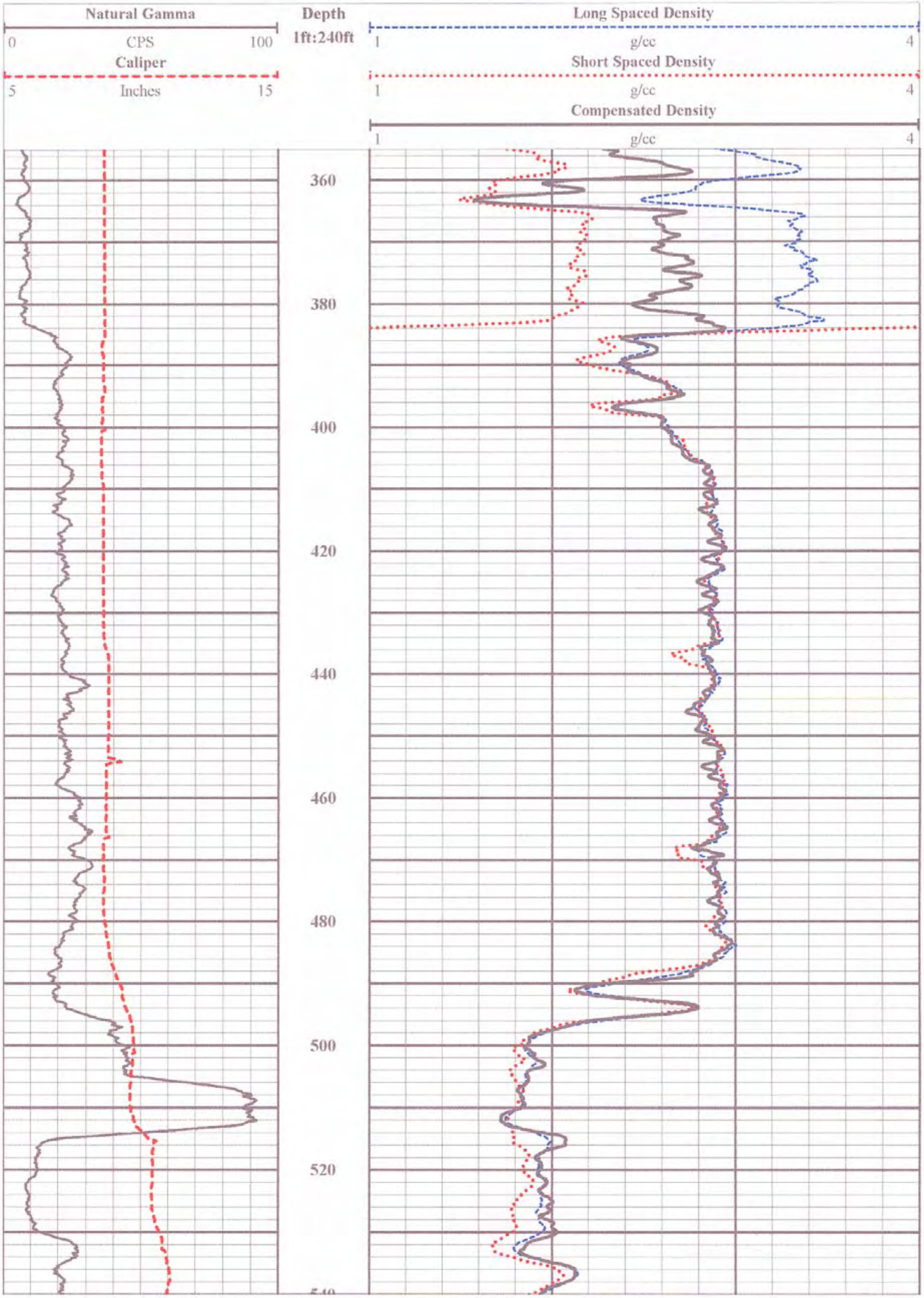

Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
1120
1140
1160
1180
1200
1220
1240
1260
1280

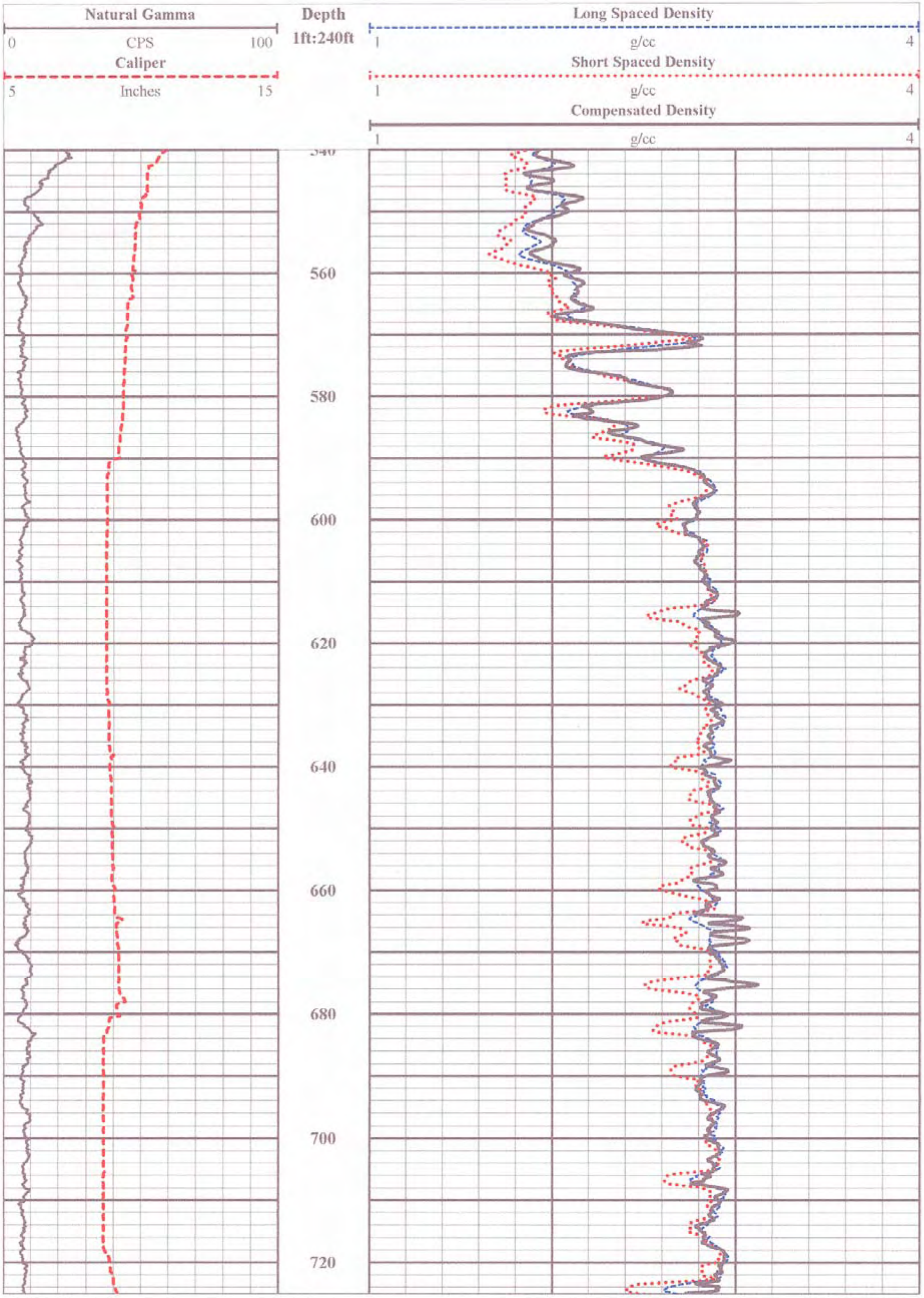

Gamma (Density)
0 CPS 100
Caliper (Density)
5 Inches 15
Gamma (Neutron)
0 CPS 100
Depth
1ft:240ft
Compensated Density
1 g/cc 4
Neutron
7000 CPS 1000
Deep EM Conductivity
0 mS/m 500
Near Receiver
100 900
1300
1320
1340
1360
1380
1400
1420
1440

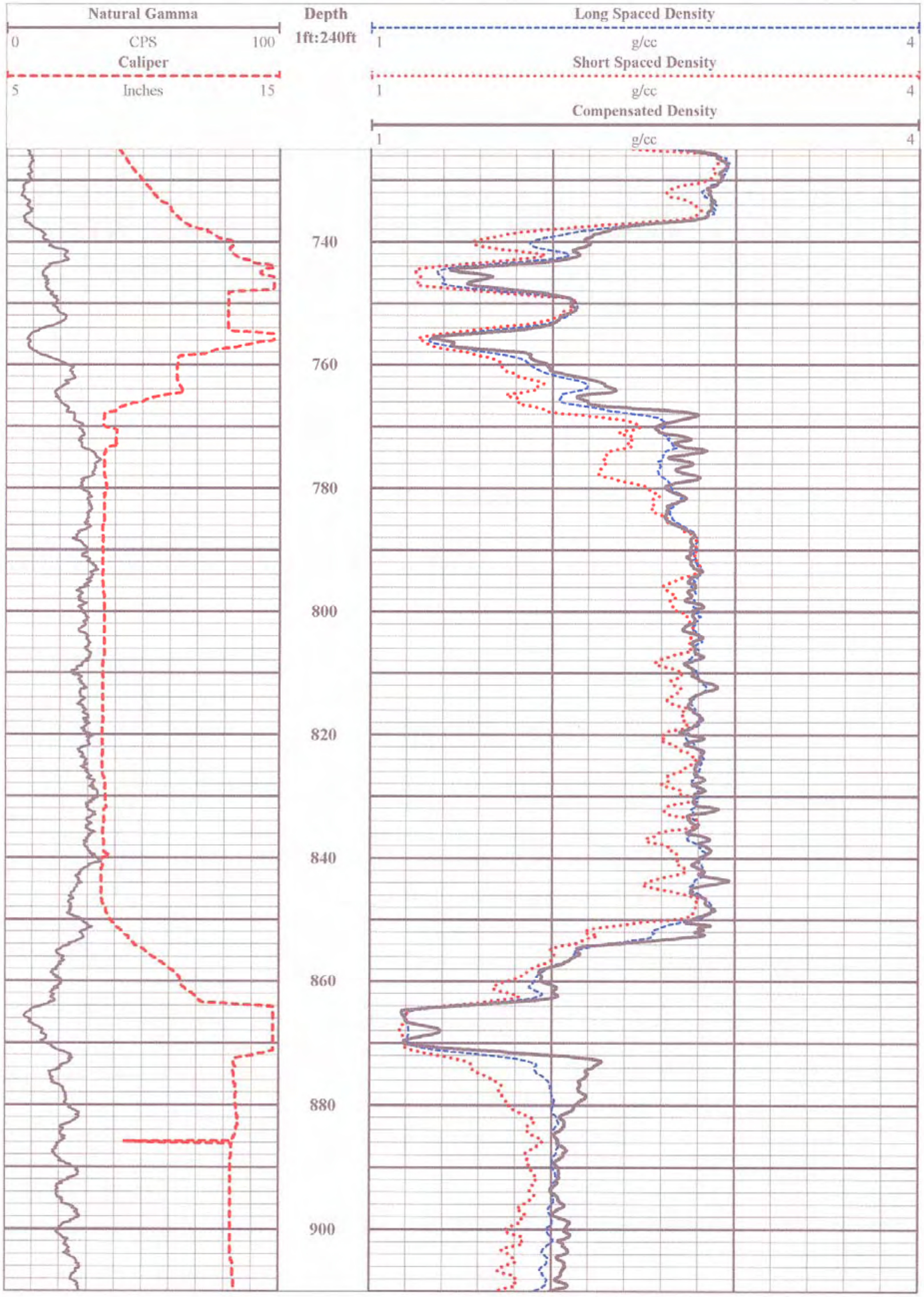
C1.4 COLOG COMPENSATED DENSITY LOGS

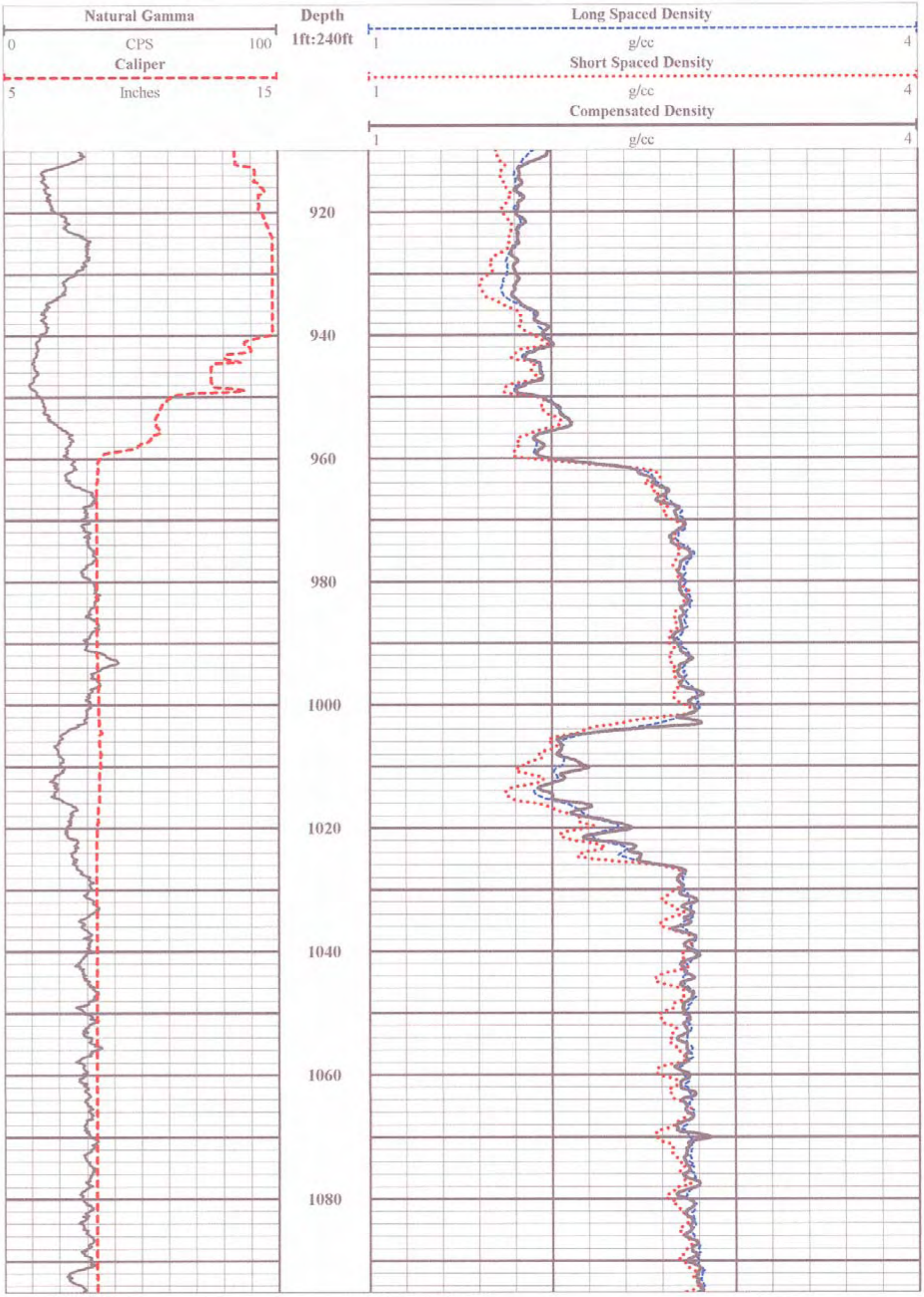


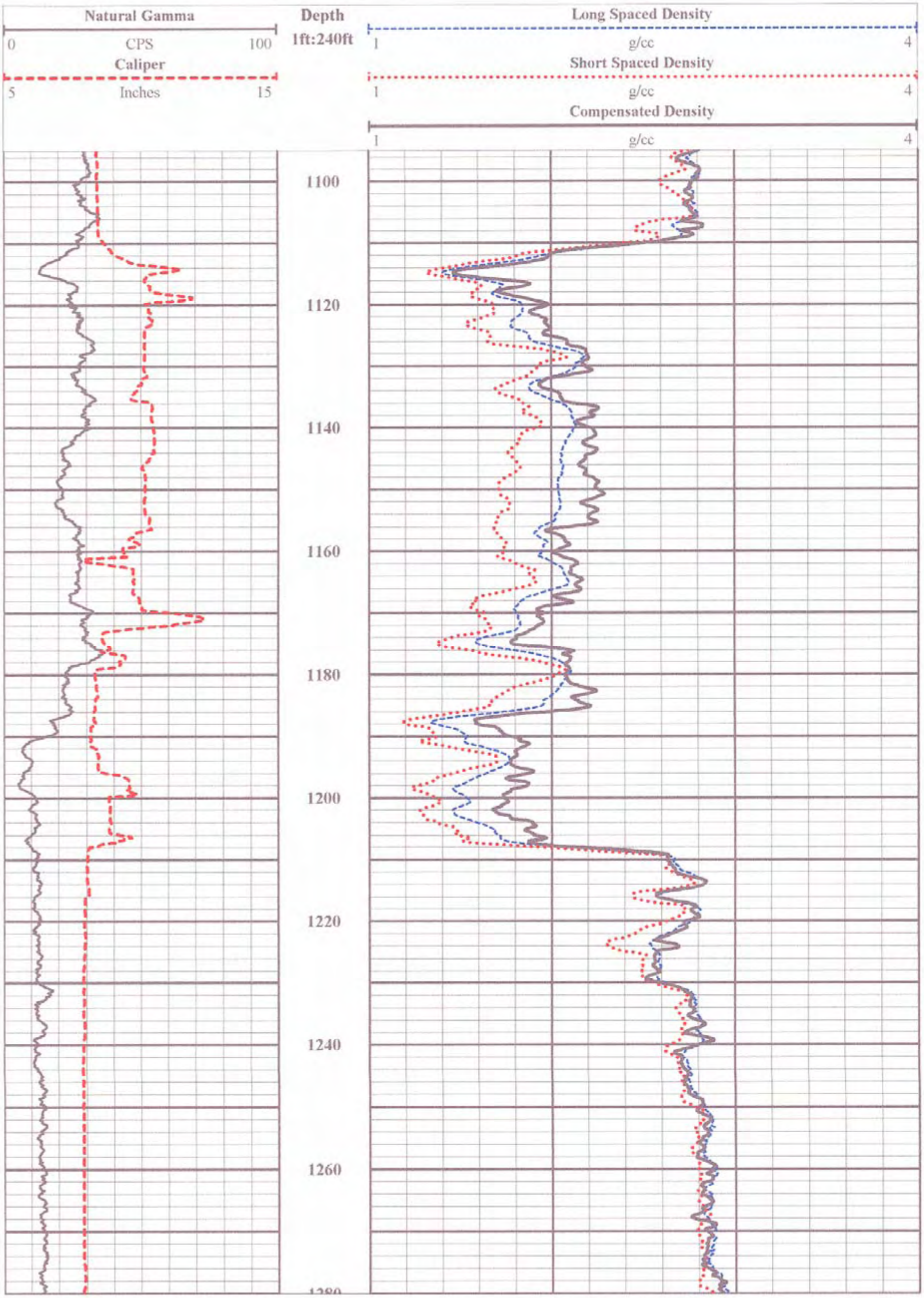

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4
180
200
220
240
260
280
300
320
340

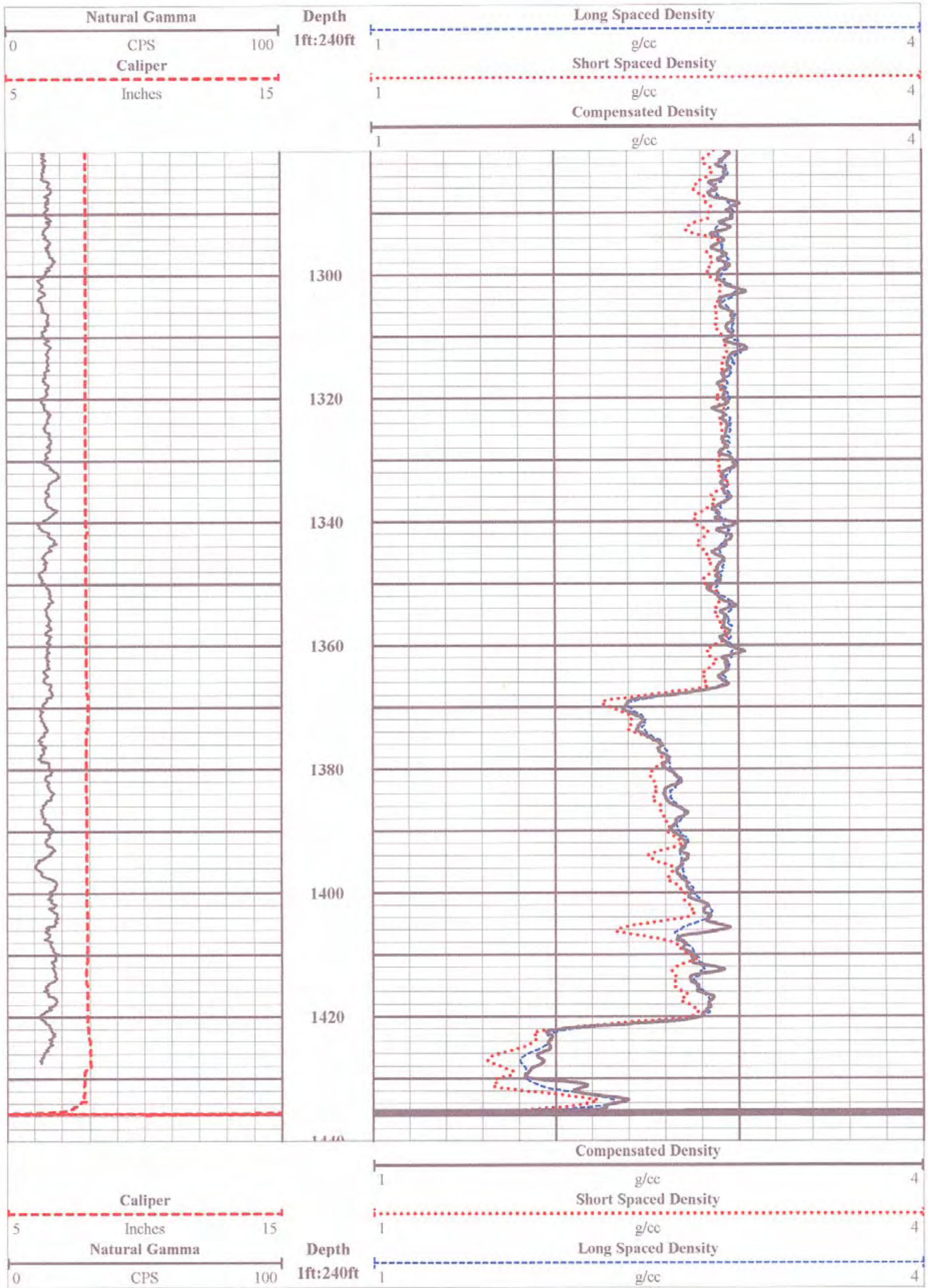

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4
360
380
400
420
440
460
480
500
520


Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4
540
560
580
600
620
640
660
680
700
720


Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4
740
760
780
800
820
840
860
880
900

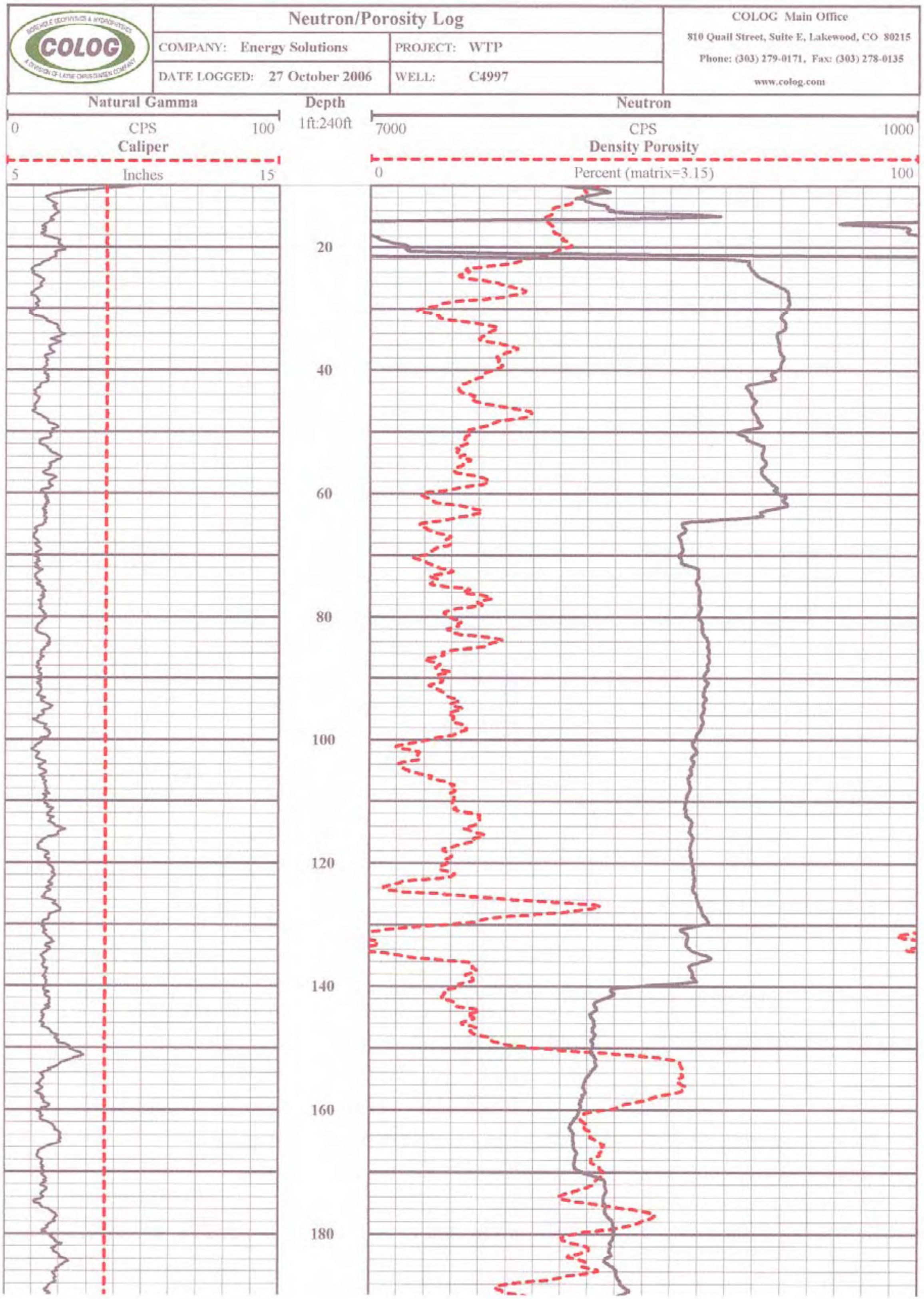

Natural Gamma
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Long Spaced Density
1 g/cc 4
Short Spaced Density
1 g/cc 4
Compensated Density
1 g/cc 4
920
940
960
980
1000
1020
1040
1060
1080

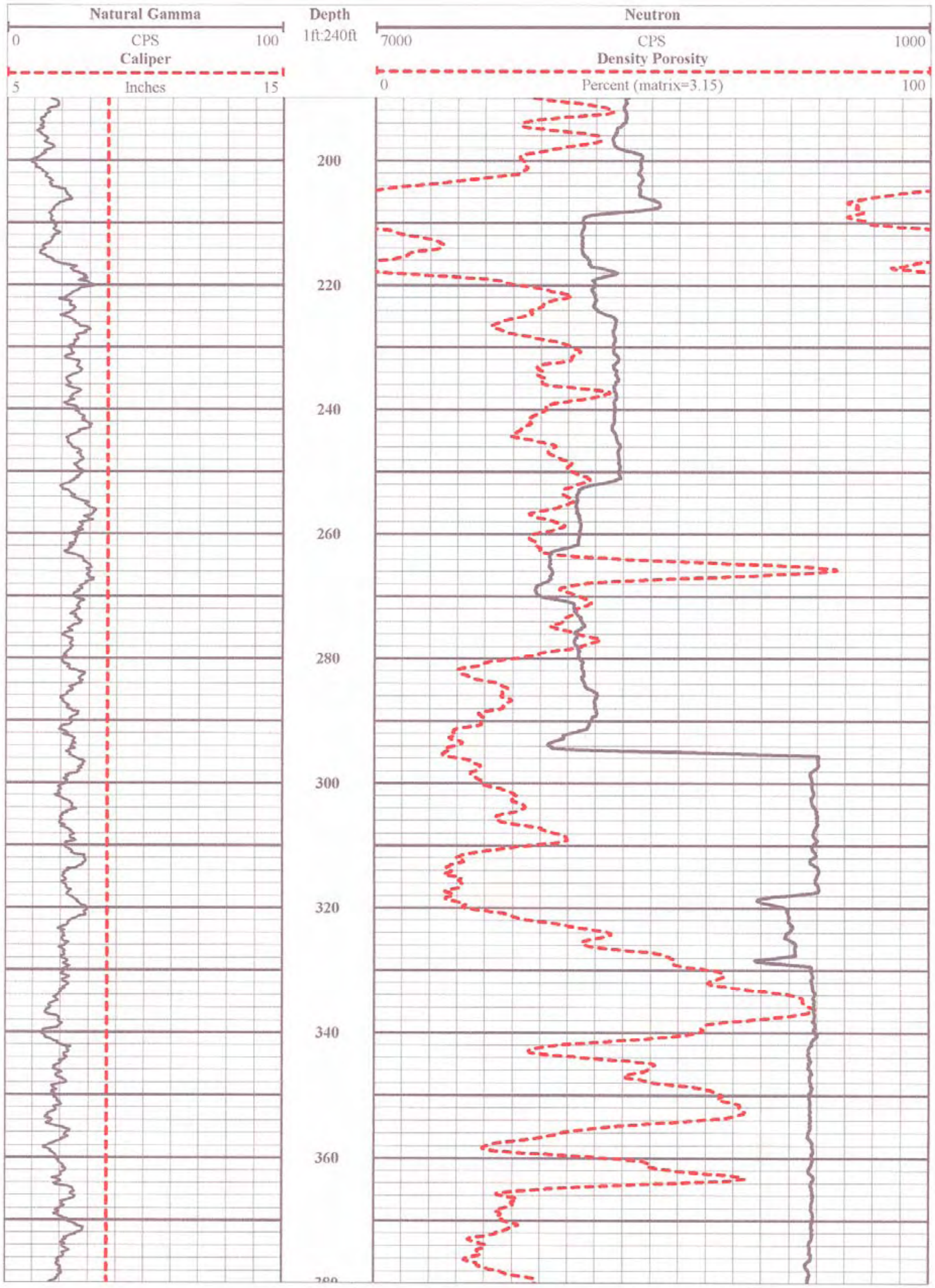

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Long Spaced Density
1
g/cc
4
Short Spaced Density
1
g/cc
4
Compensated Density
1
g/cc
4
1100
1120
1140
1160
1180
1200
1220
1240
1260

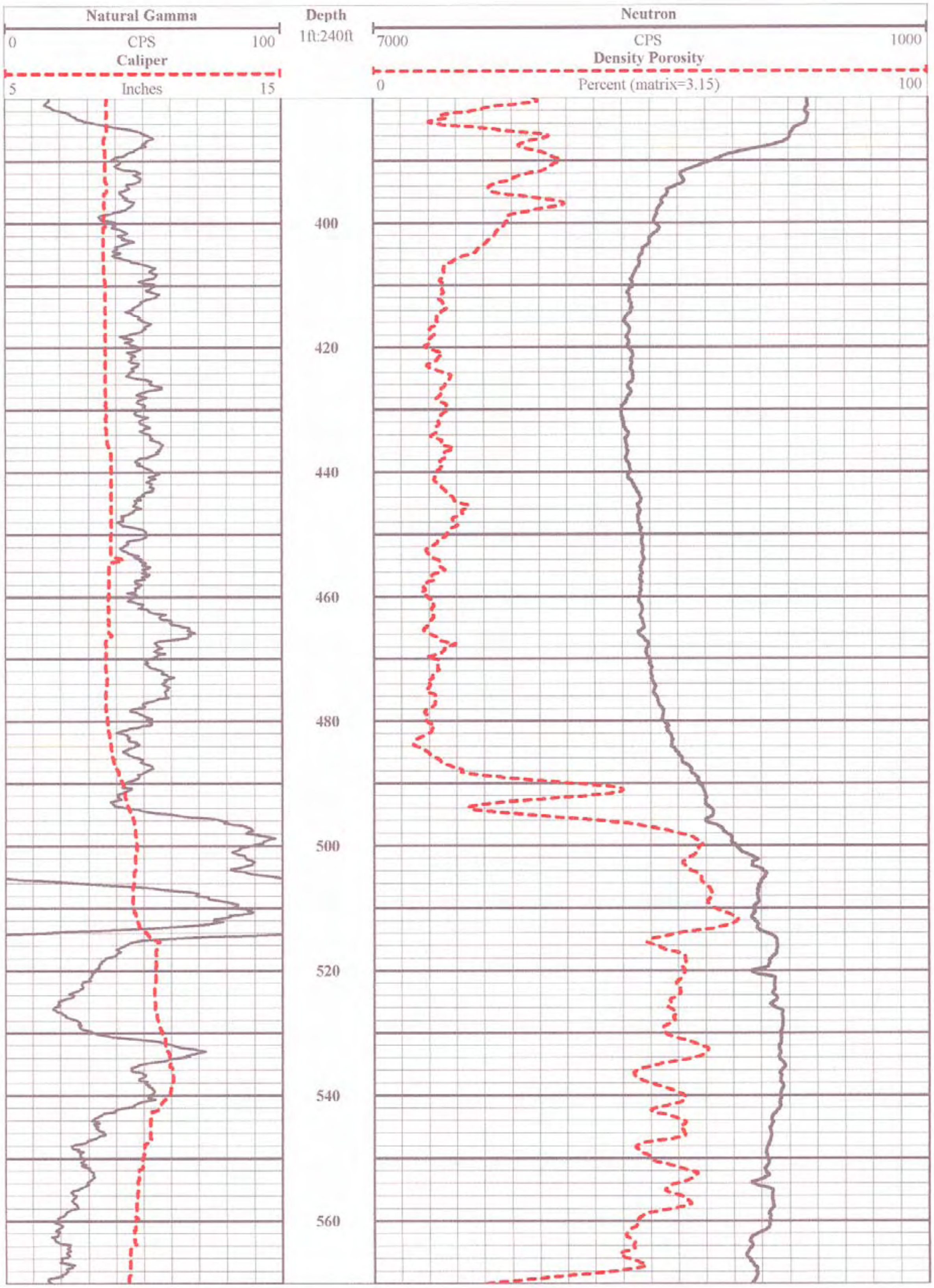


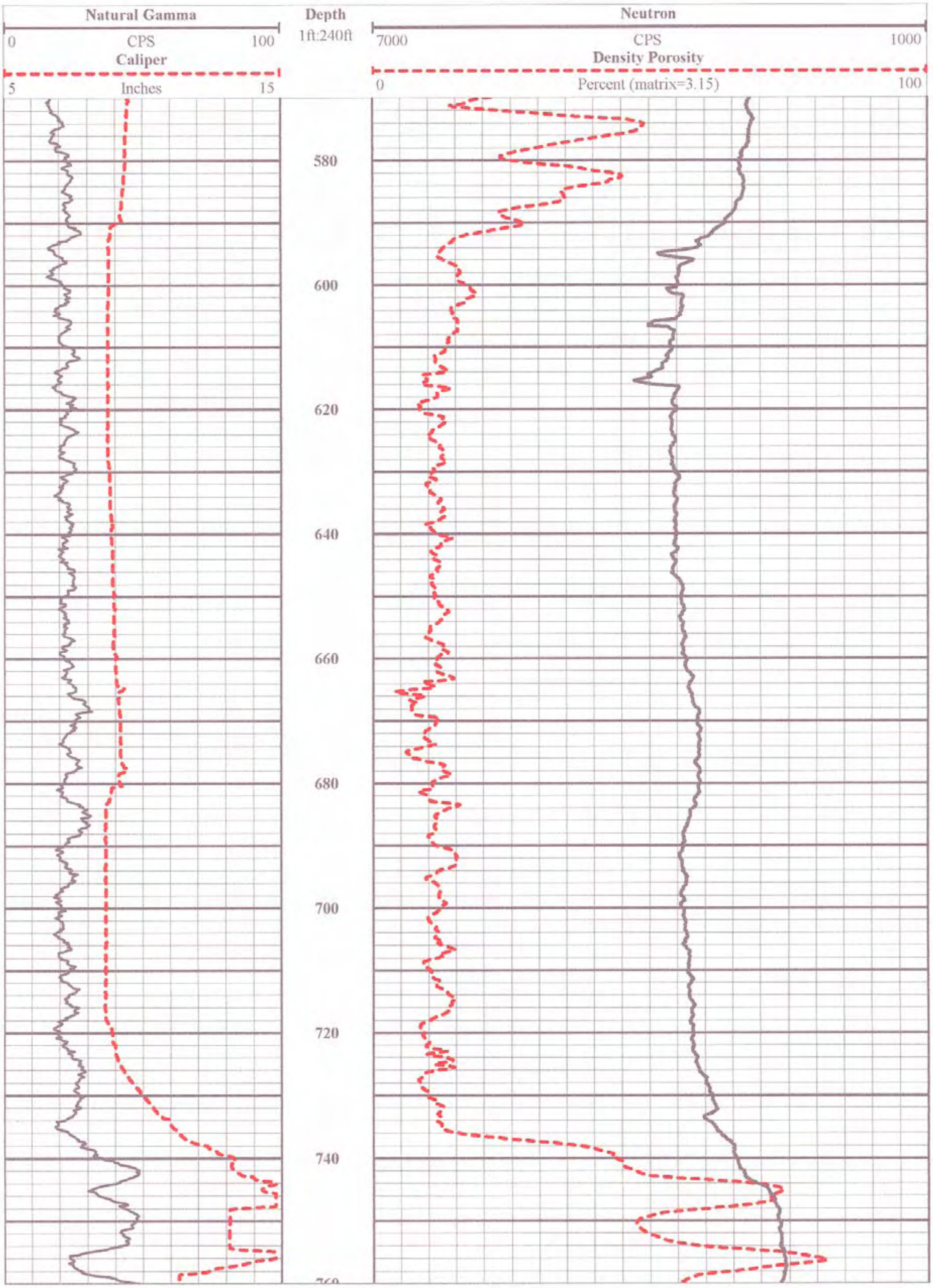
Natural Gamma
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Long Spaced Density
1 g/cc 4
Short Spaced Density
1 g/cc 4
Compensated Density
1 g/cc 4
1300
1320
1340
1360
1380
1400
1420
Compensated Density
1 g/cc 4
Short Spaced Density
1 g/cc 4
Long Spaced Density
1 g/cc 4
Caliper
5 Inches 15
Natural Gamma
0 CPS 100
Depth
1ft:240ft

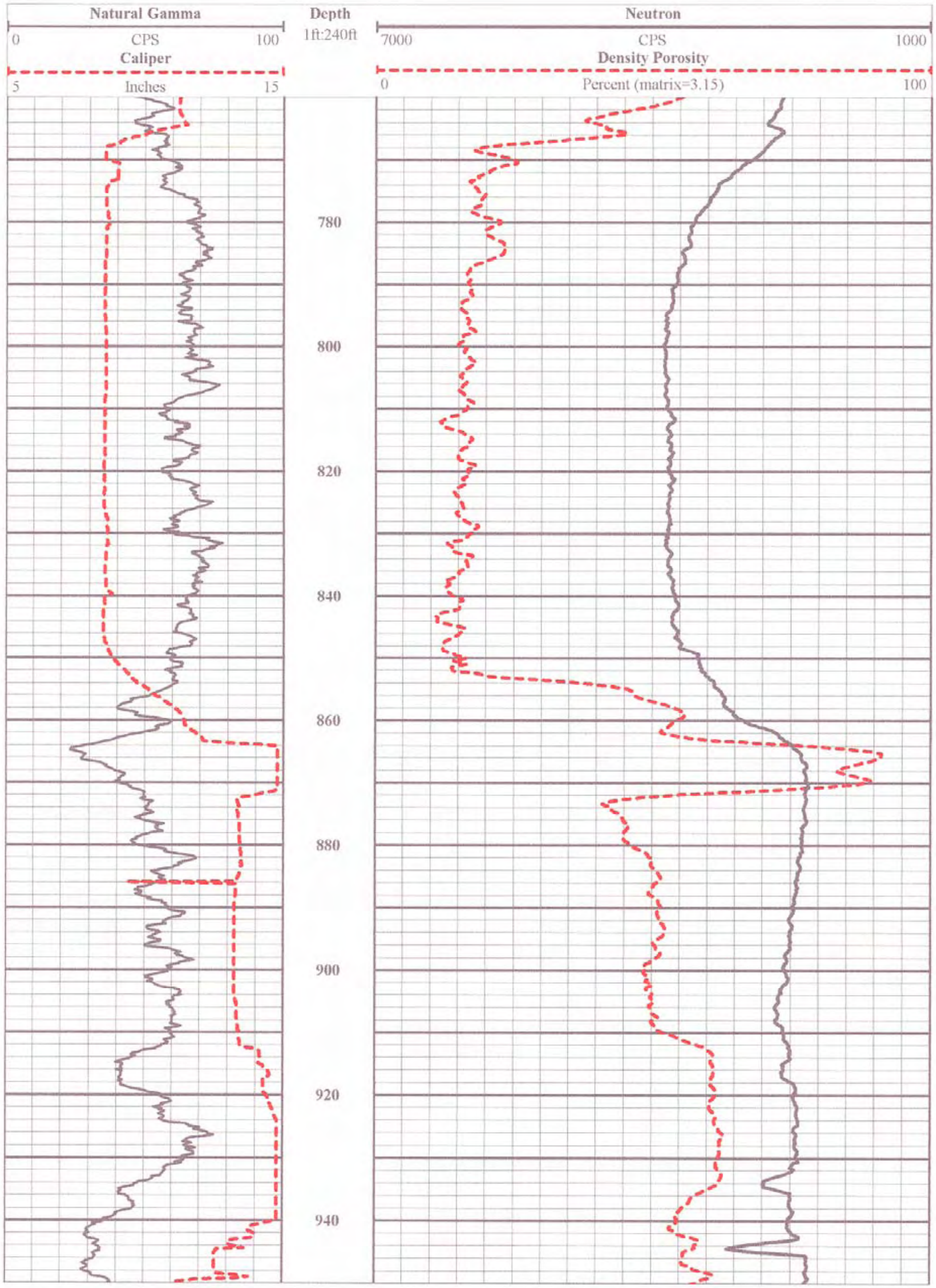
C1.5 COLOG NEUTRON/POROSITY LOGS

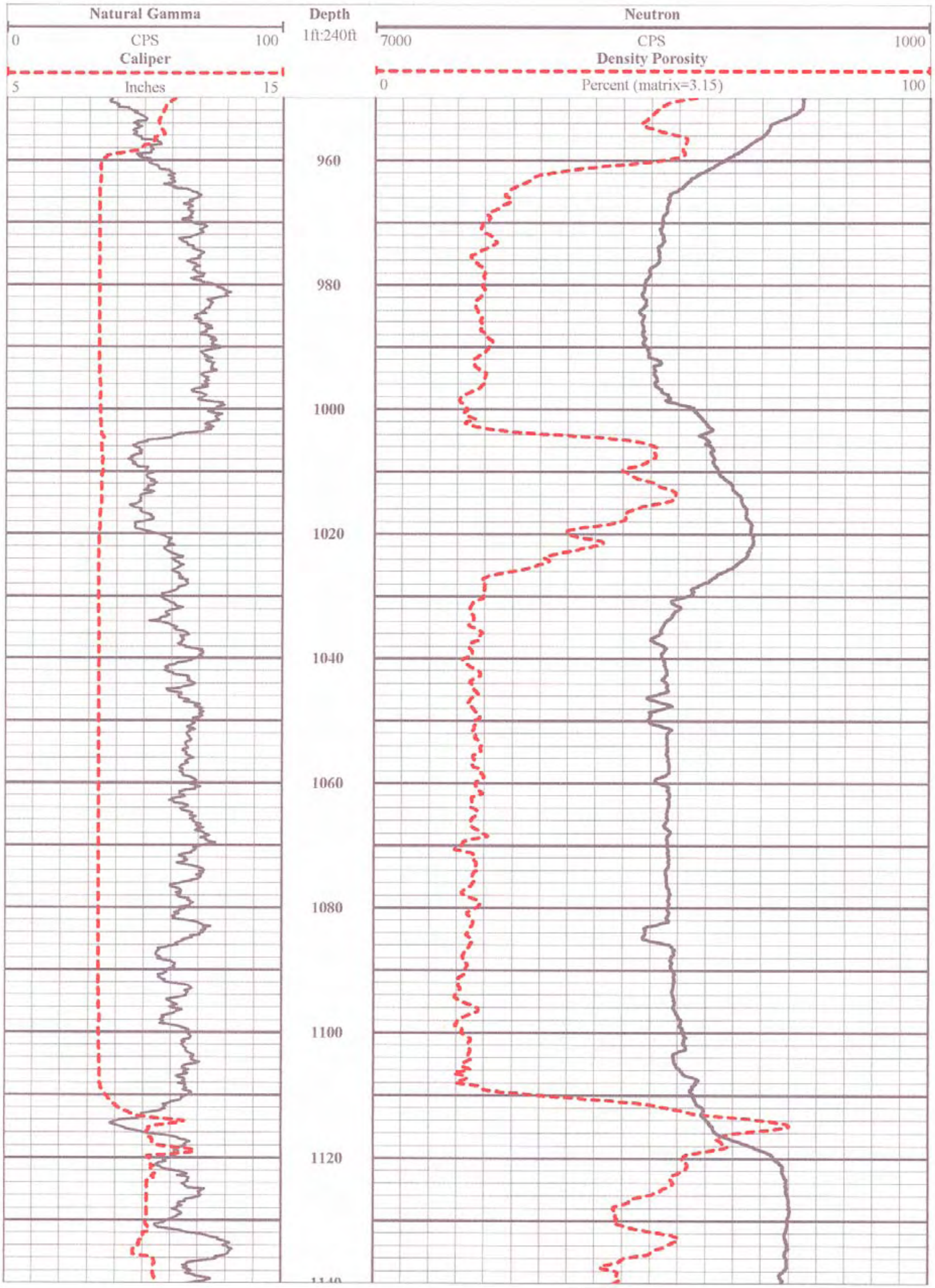


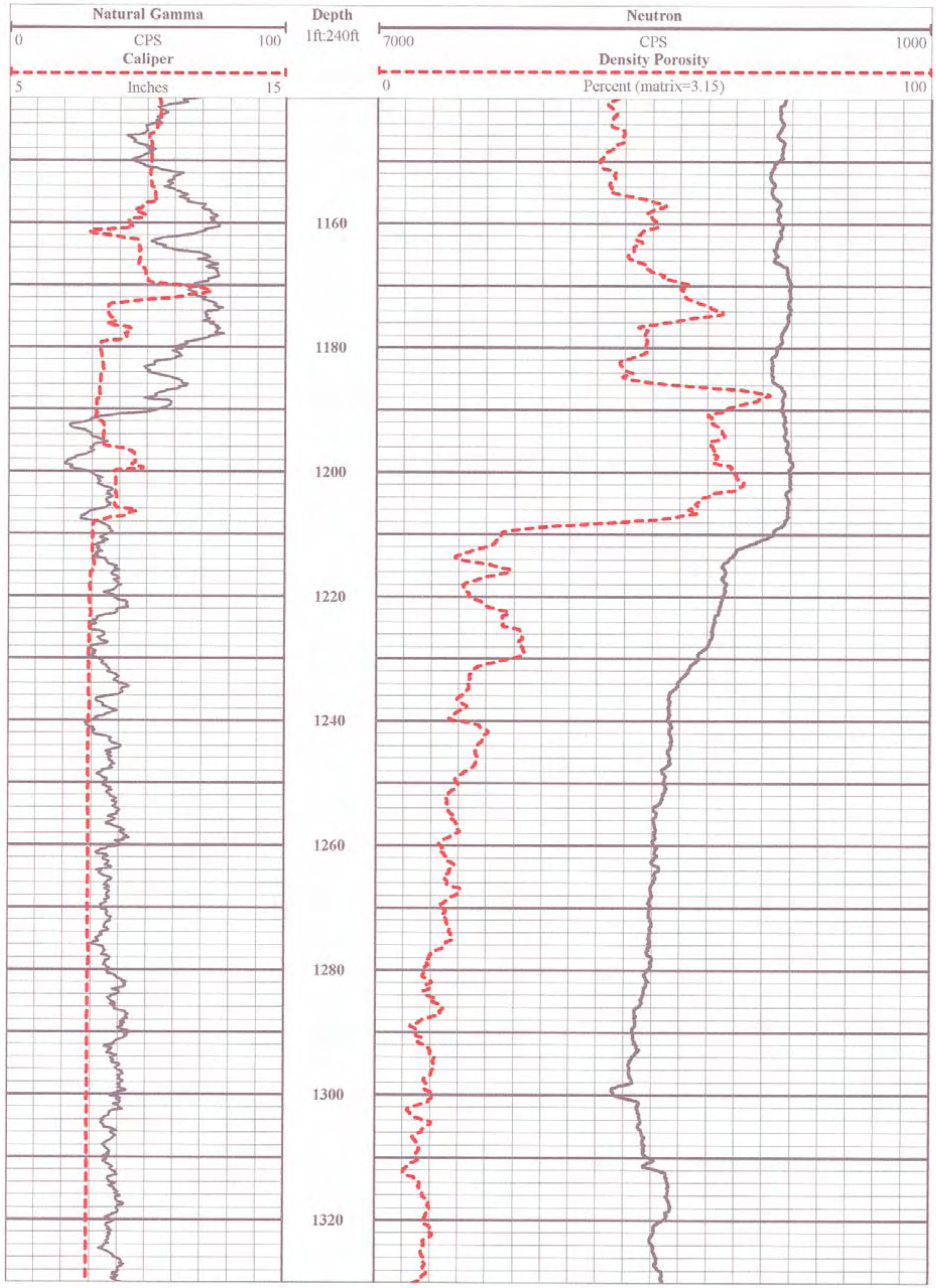

Natural Gamma
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
200
220
240
260
280
300
320
340
360
380
Neutron
7000 CPS 1000
Density Porosity
0 Percent (matrix=3.15) 100

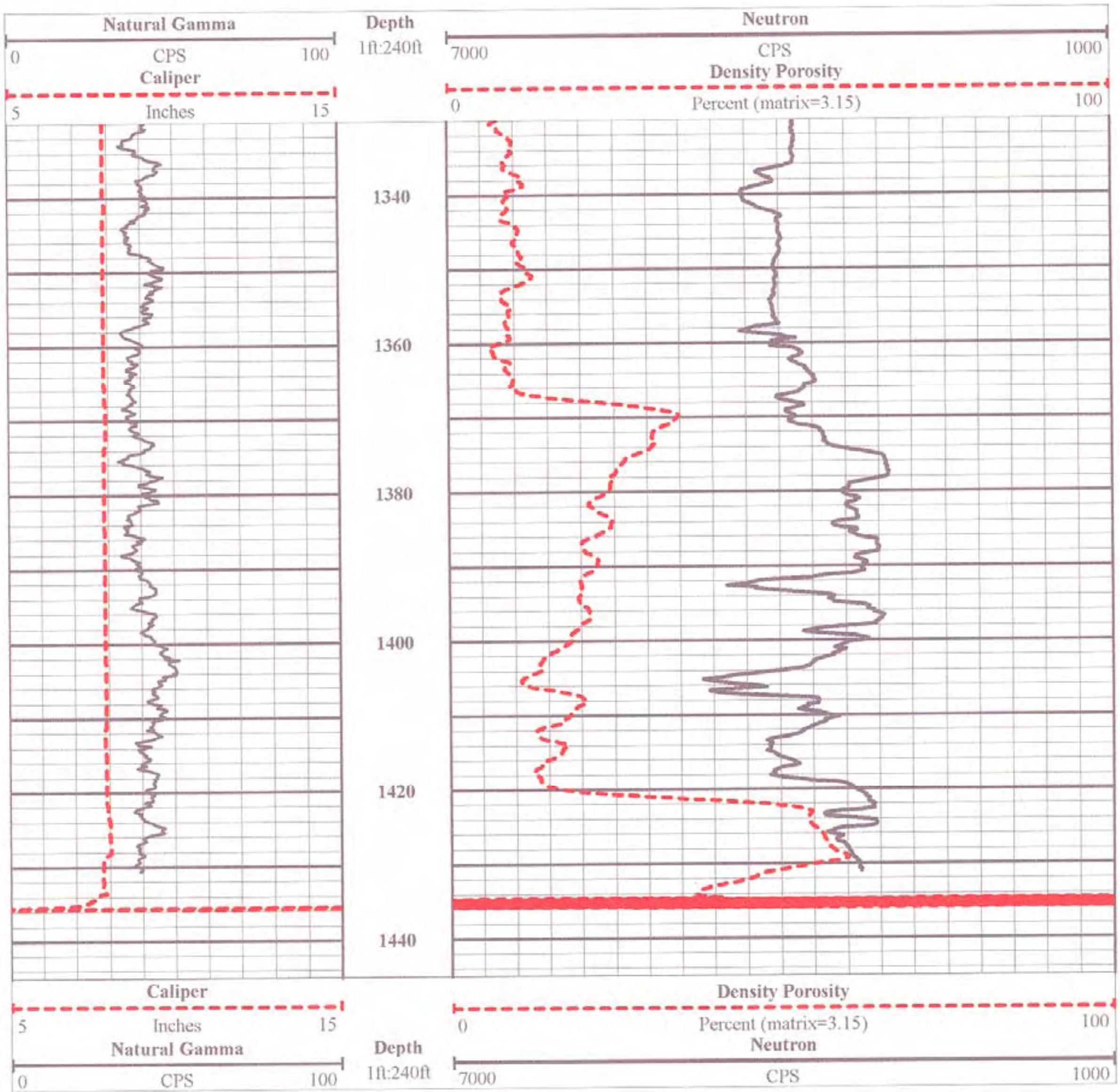

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
400
420
440
460
480
500
520
540
560
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100


Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
580
600
620
640
660
680
700
720
740
760
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100


Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
780
800
820
840
860
880
900
920
940
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100

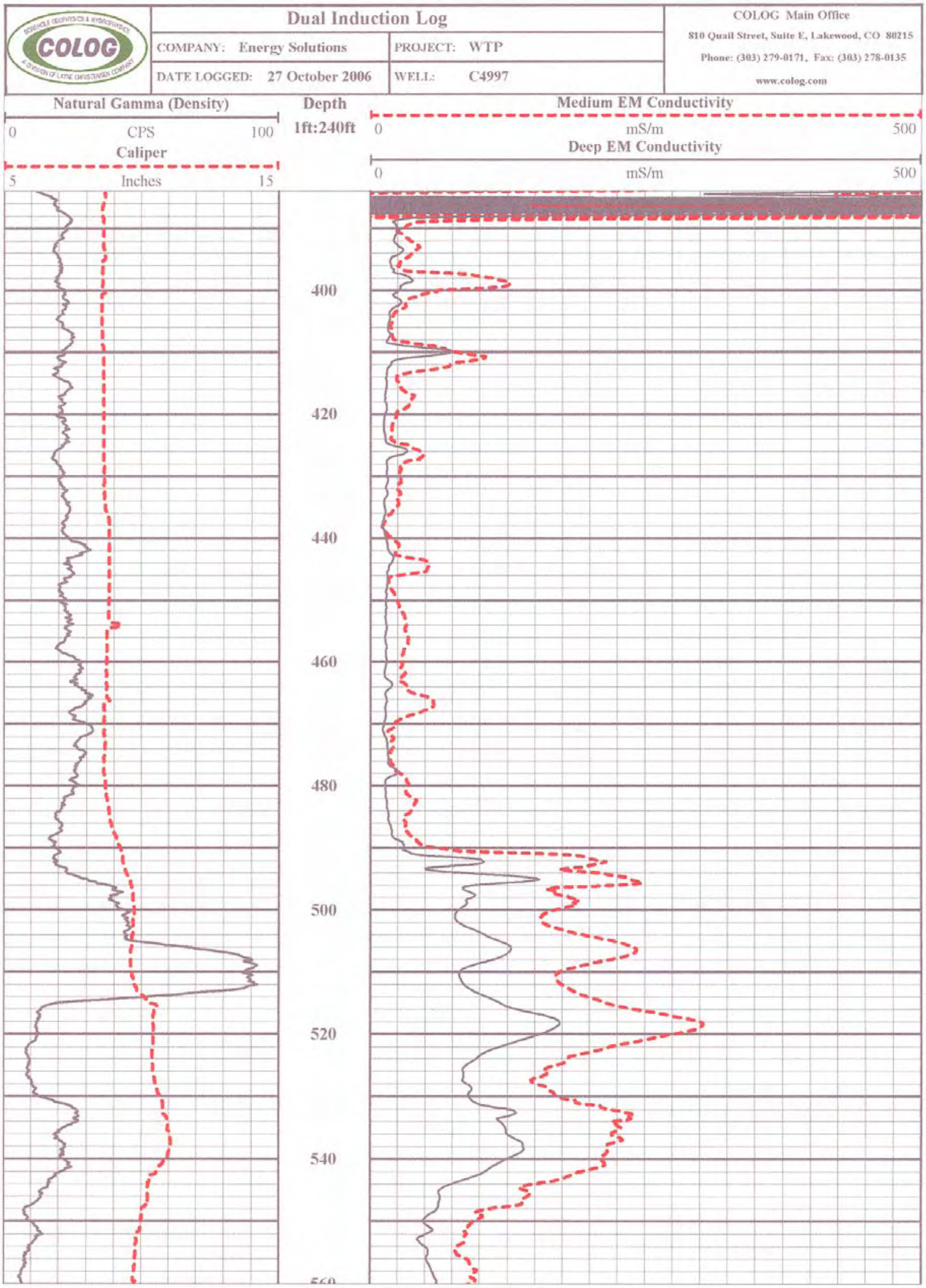

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
960
980
1000
1020
1040
1060
1080
1100
1120
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100

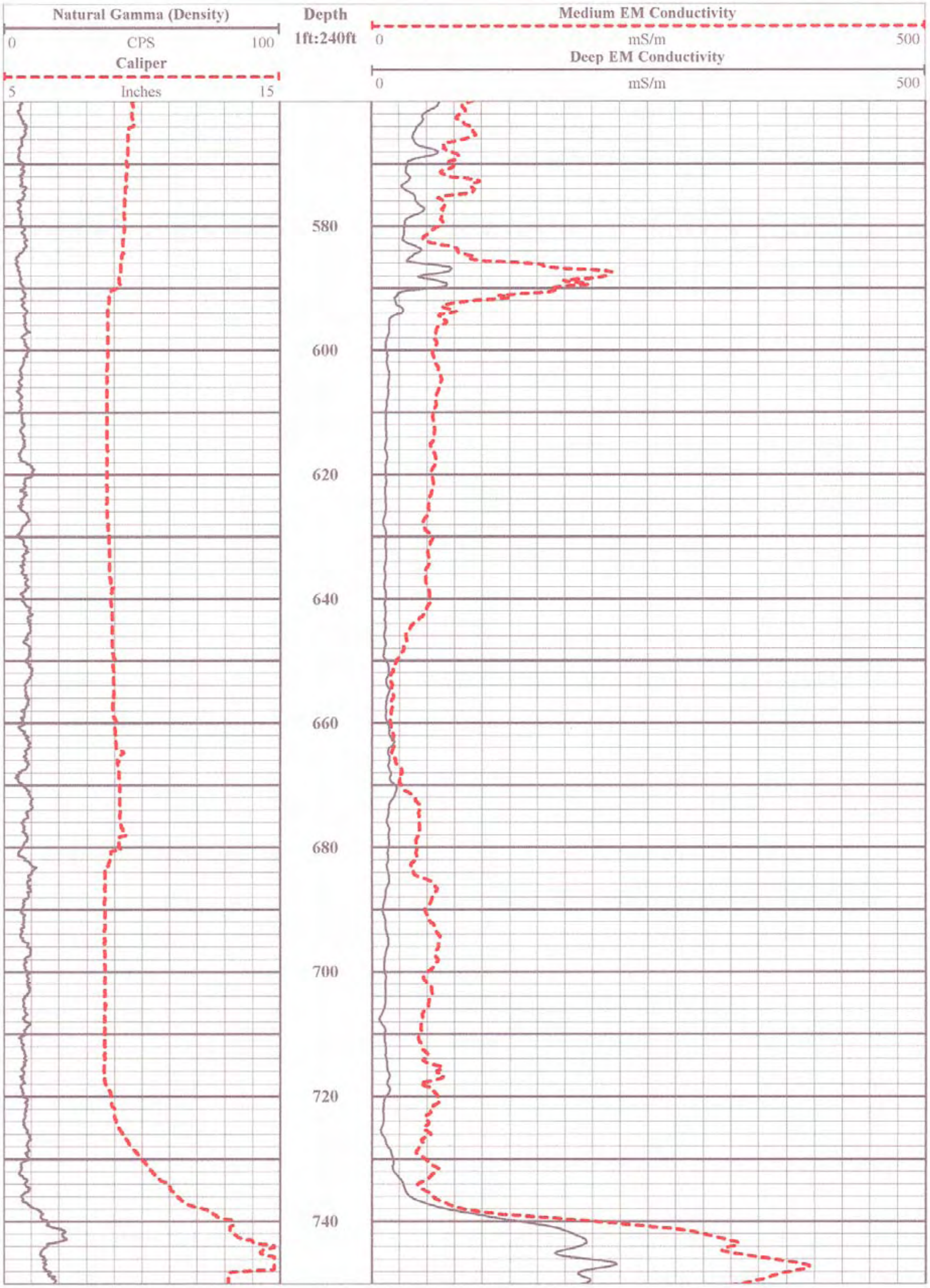

Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
1160
1180
1200
1220
1240
1260
1280
1300
1320
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100

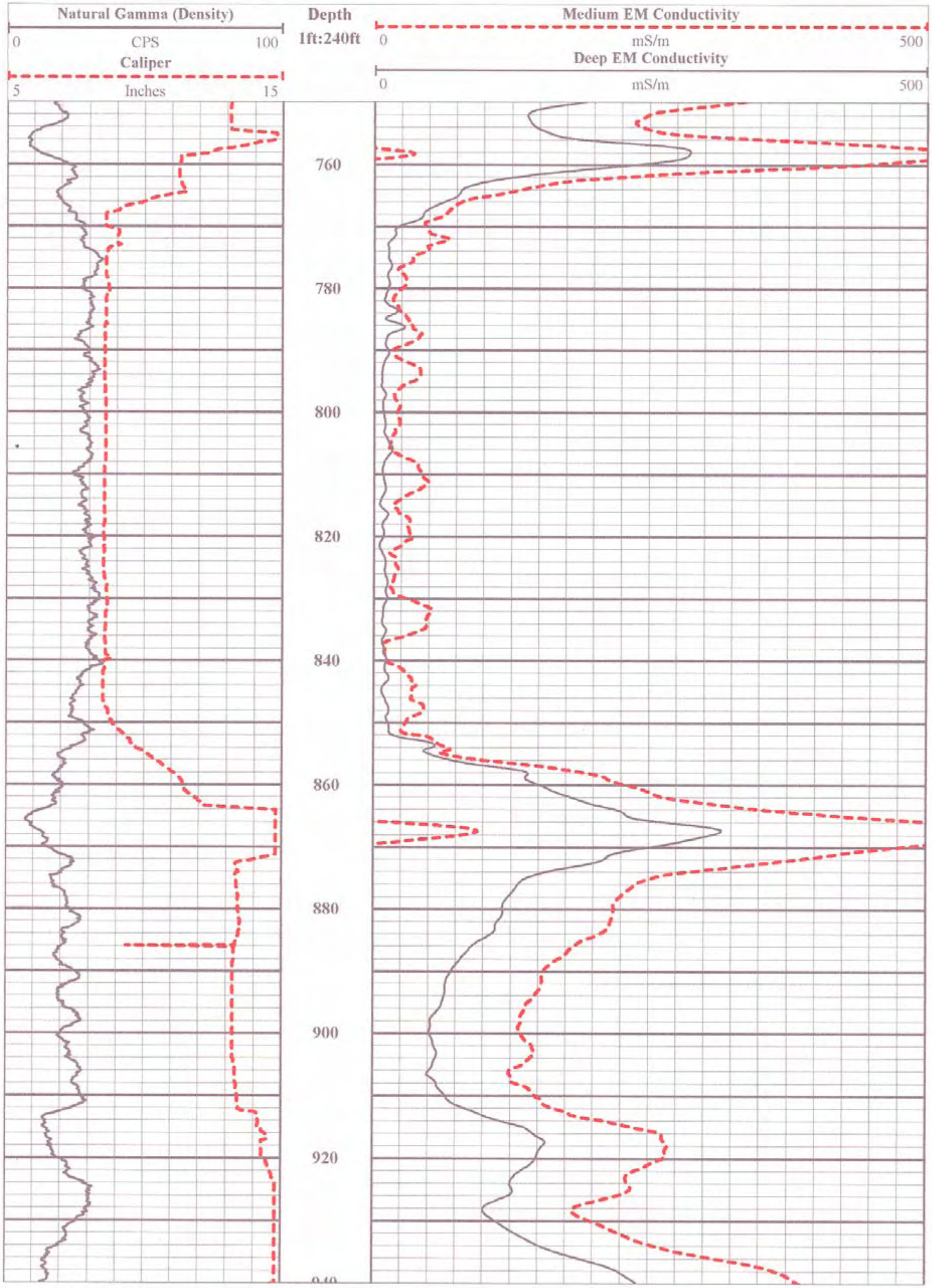


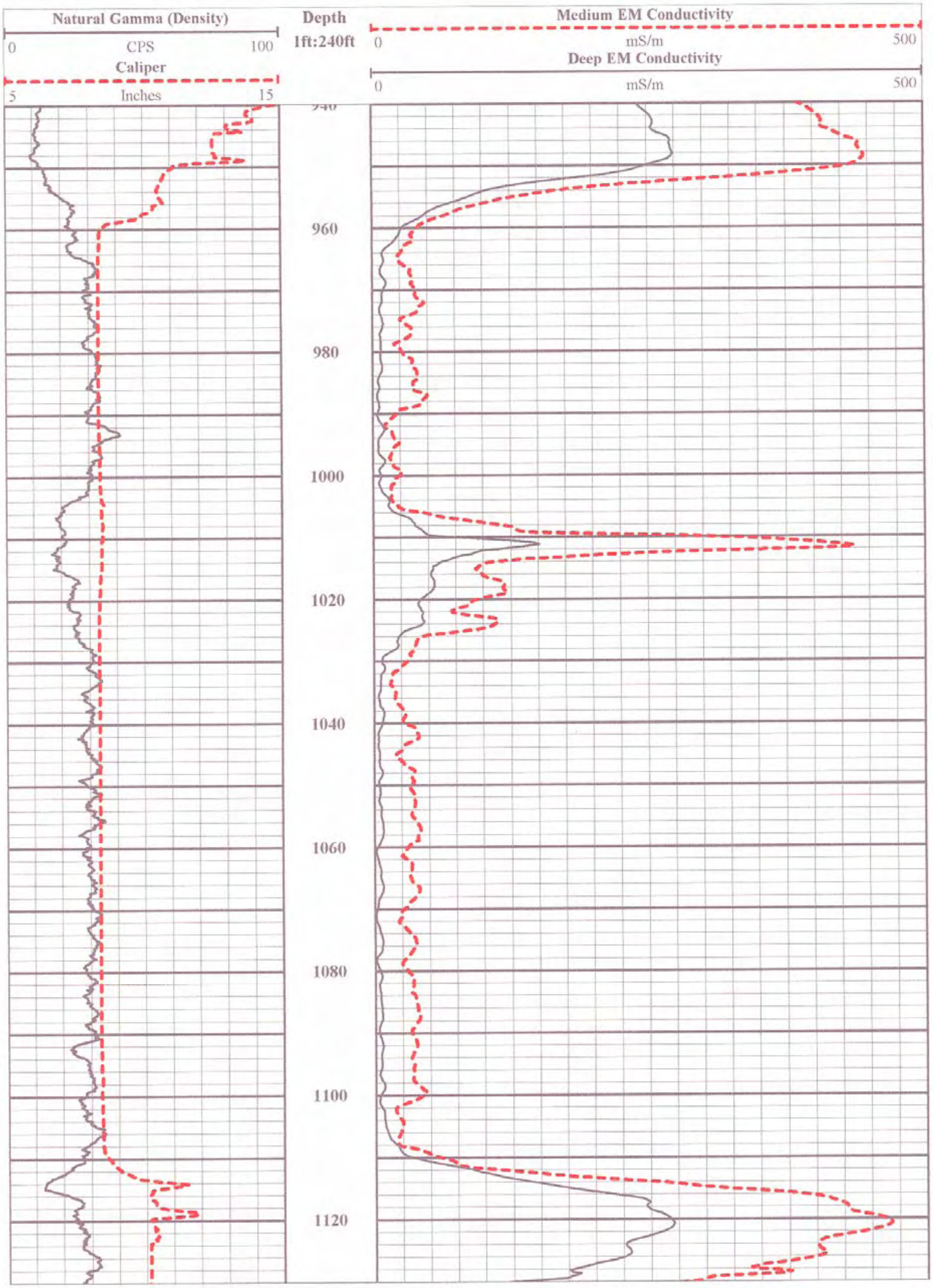
Natural Gamma
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Neutron
7000
CPS
1000
Density Porosity
0
Percent (matrix=3.15)
100
1340
1360
1380
1400
1420
1440
Caliper
5
Inches
15
Natural Gamma
0
CPS
100
Depth
1ft:240ft
Density Porosity
0
Percent (matrix=3.15)
100
Neutron
7000
CPS
1000

C1.6 COLOG DUAL INDUCTION LOG

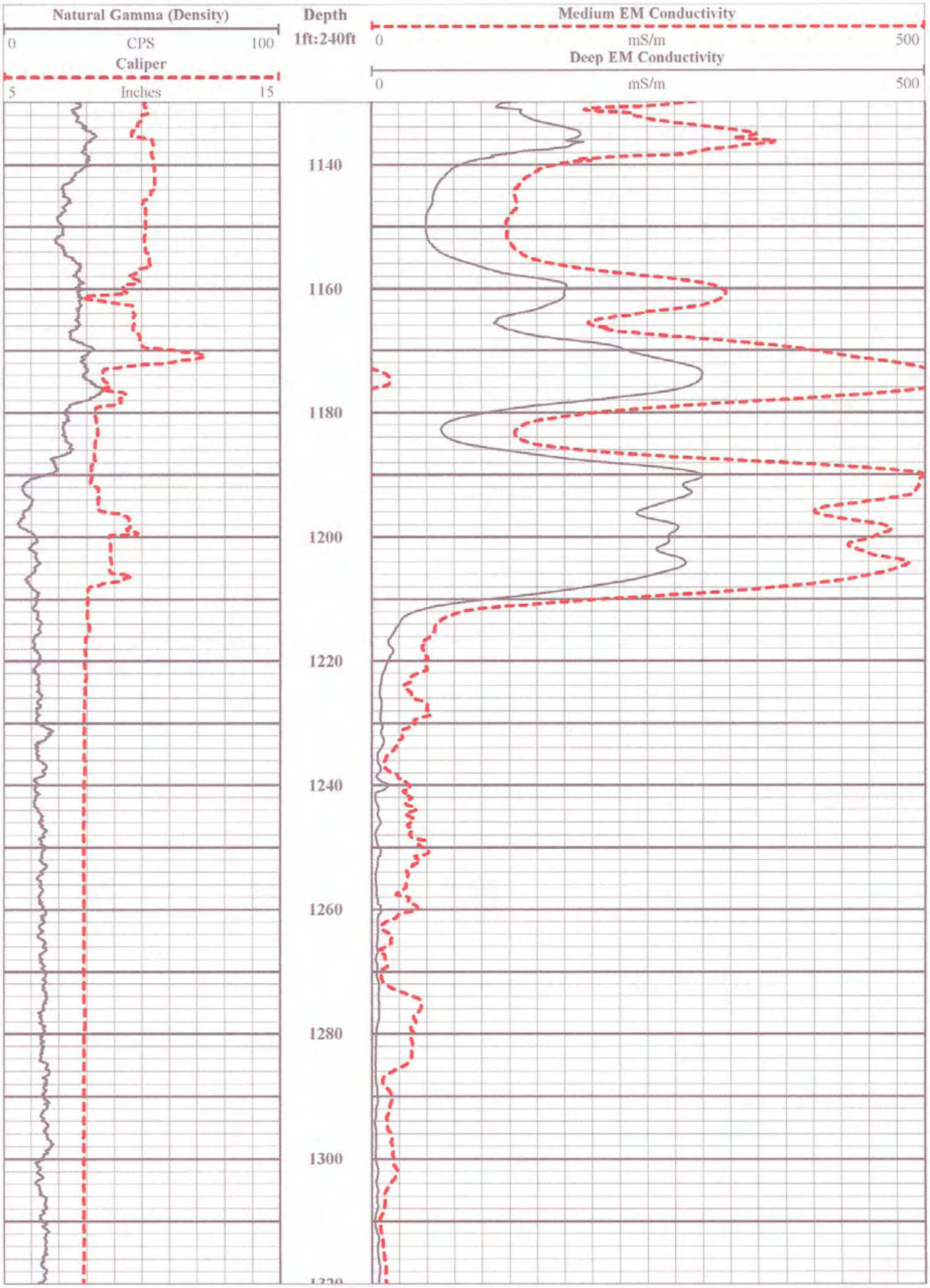


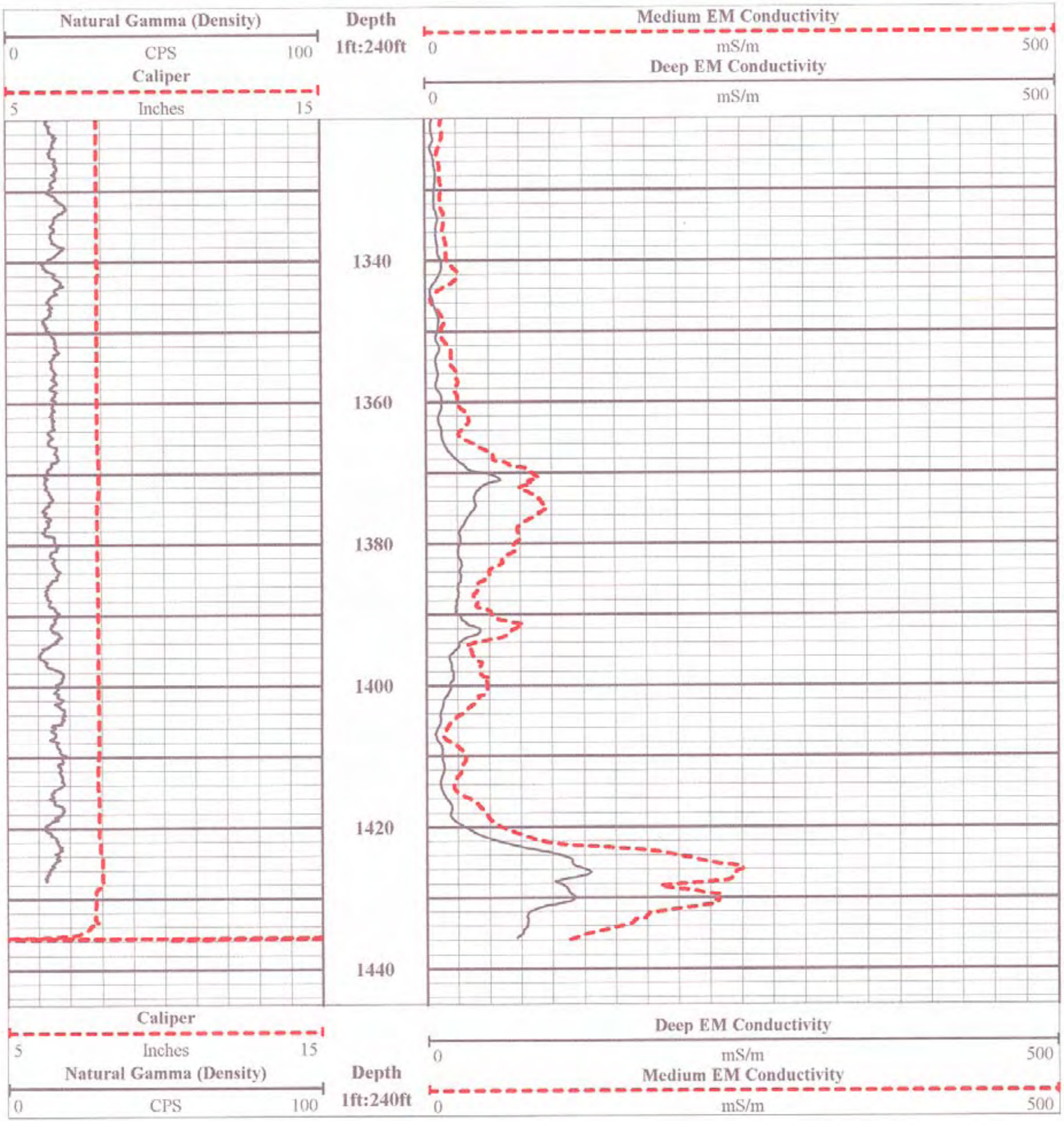

Natural Gamma (Density)
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
580
600
620
640
660
680
700
720
740
Medium EM Conductivity
0
mS/m
500
Deep EM Conductivity
0
mS/m
500


Natural Gamma (Density)
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Medium EM Conductivity
0 mS/m 500
Deep EM Conductivity
0 mS/m 500
760
780
800
820
840
860
880
900
920

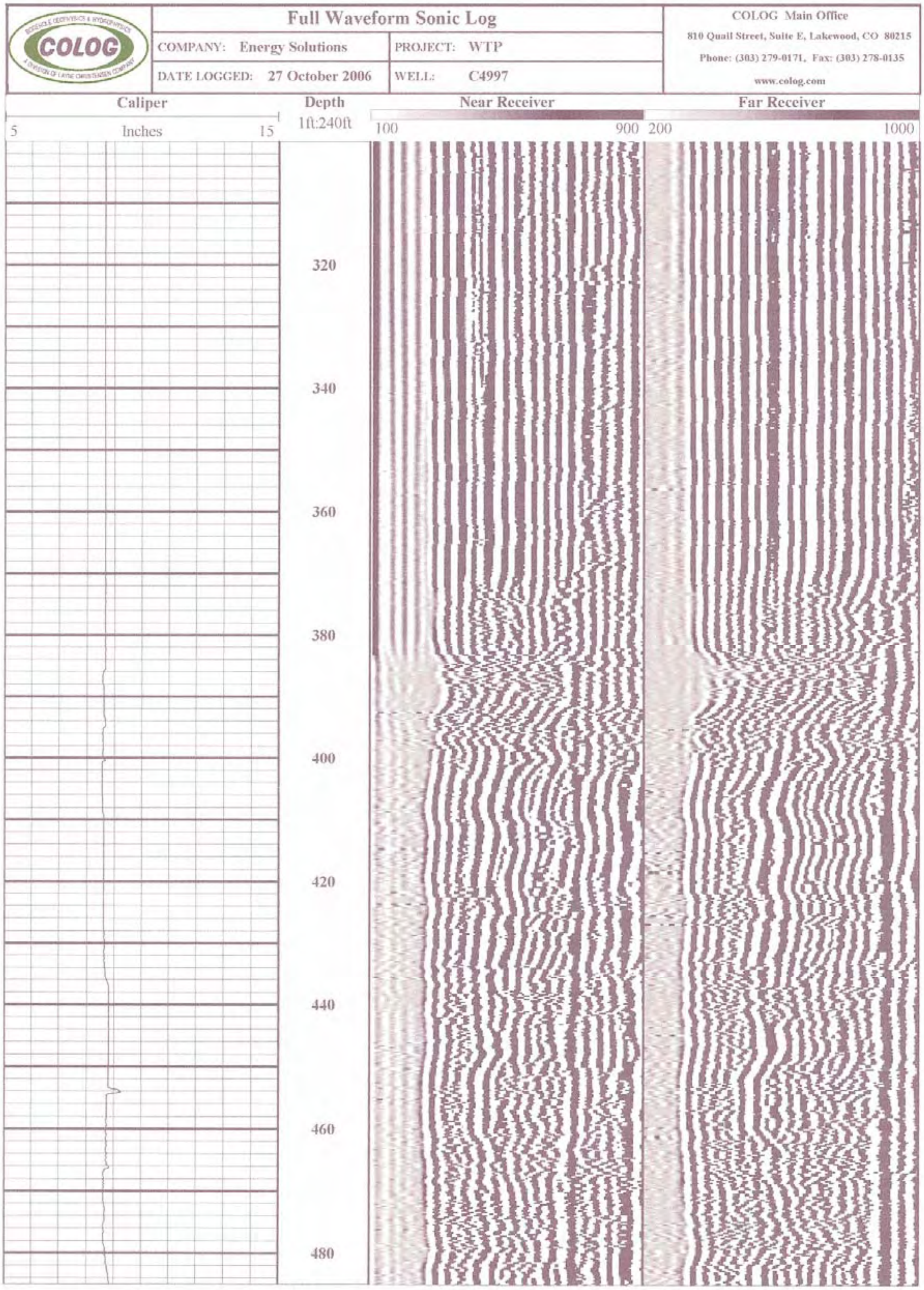


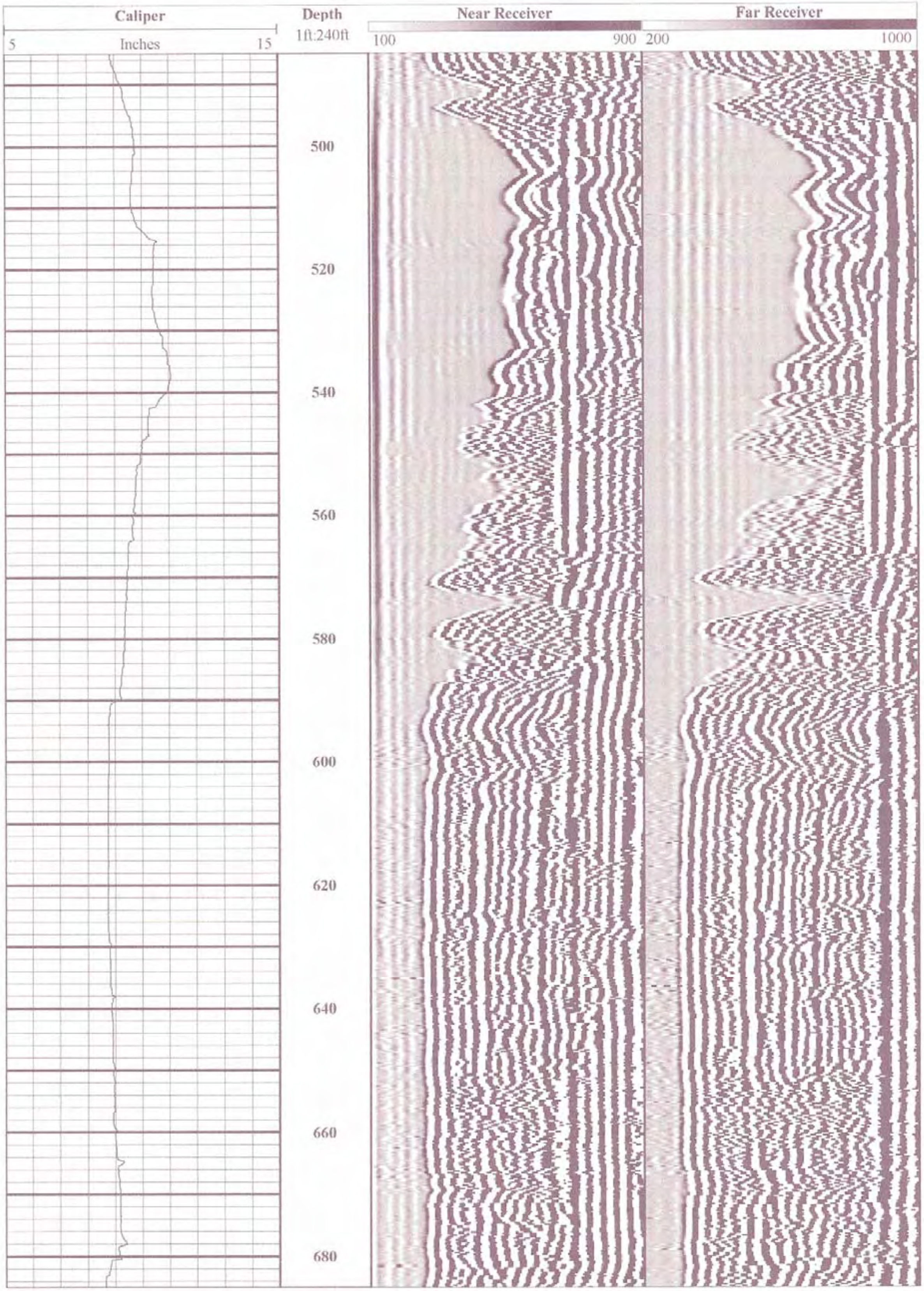
Natural Gamma (Density)
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Medium EM Conductivity
0
mS/m
500
Deep EM Conductivity
0
mS/m
500
960
980
1000
1020
1040
1060
1080
1100
1120

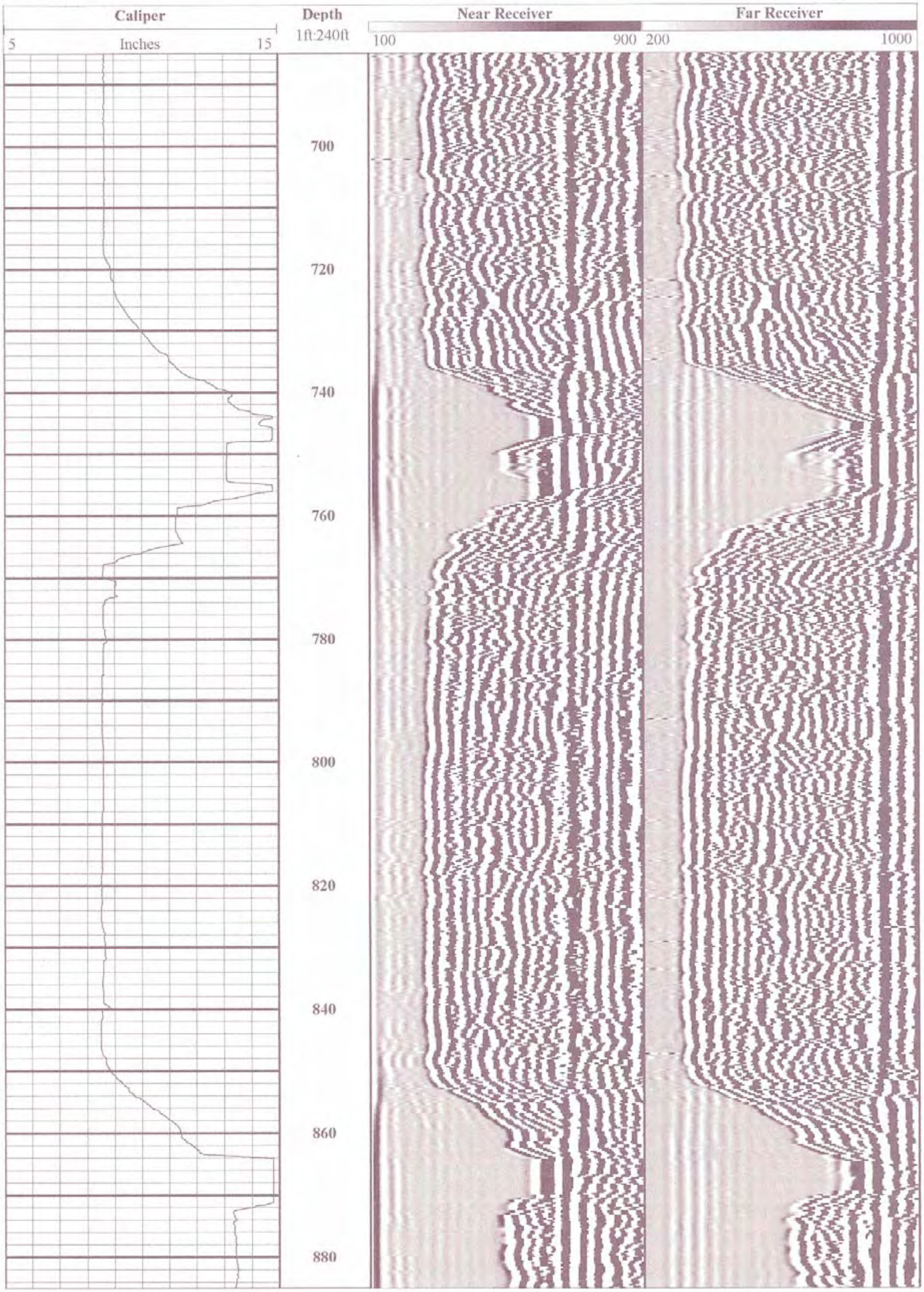

Natural Gamma (Density)
0 CPS 100
Caliper
5 Inches 15
Depth
1ft:240ft
Medium EM Conductivity
0 mS/m 500
Deep EM Conductivity
0 mS/m 500
1140
1160
1180
1200
1220
1240
1260
1280
1300

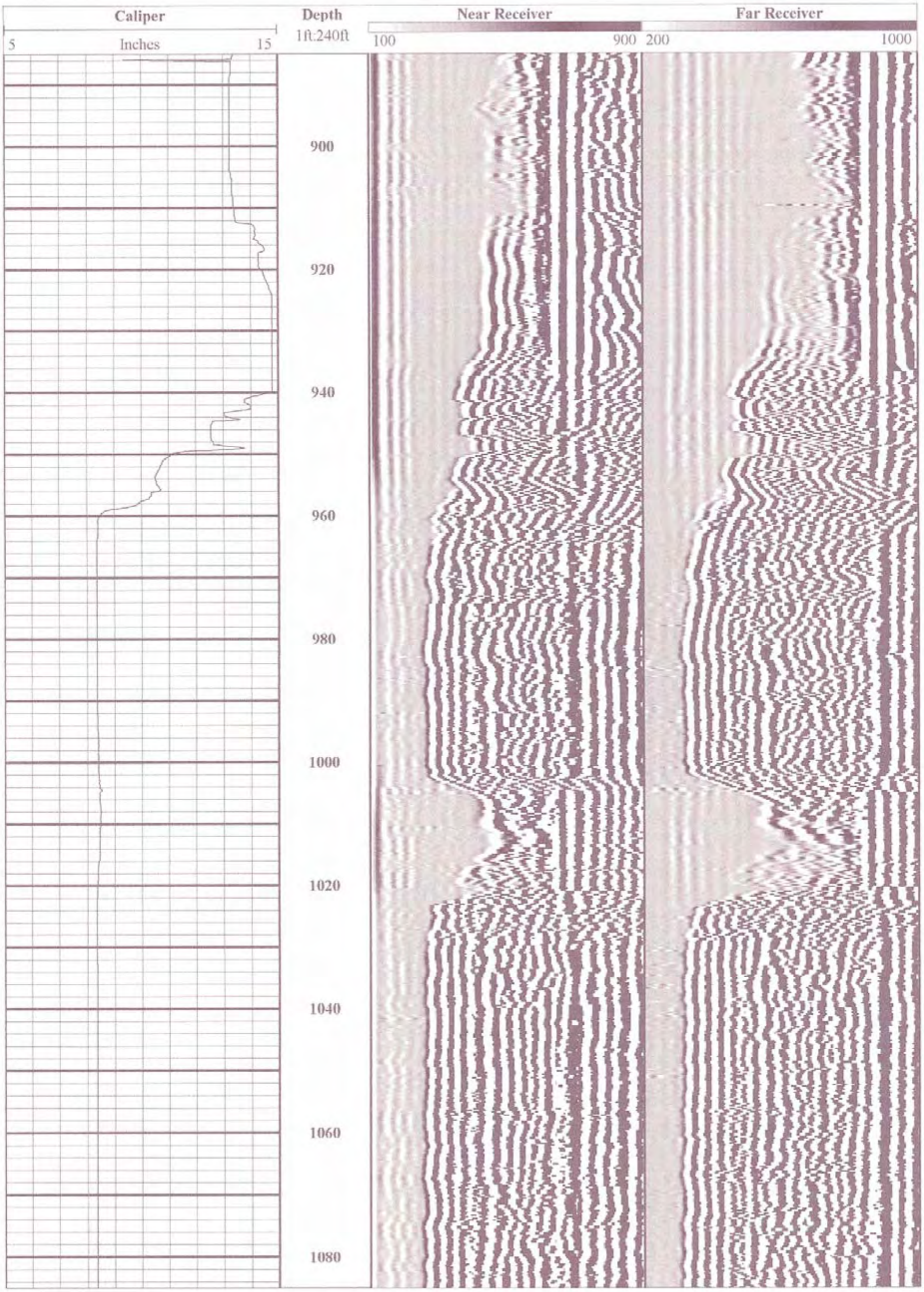

Natural Gamma (Density)
0
CPS
100
Caliper
5
Inches
15
Depth
1ft:240ft
Medium EM Conductivity
0
mS/m
500
Deep EM Conductivity
0
mS/m
500
1340
1360
1380
1400
1420
1440
Caliper
5
Inches
15
Natural Gamma (Density)
0
CPS
100
Depth
1ft:240ft
Deep EM Conductivity
0
mS/m
500
Medium EM Conductivity
0
mS/m
500

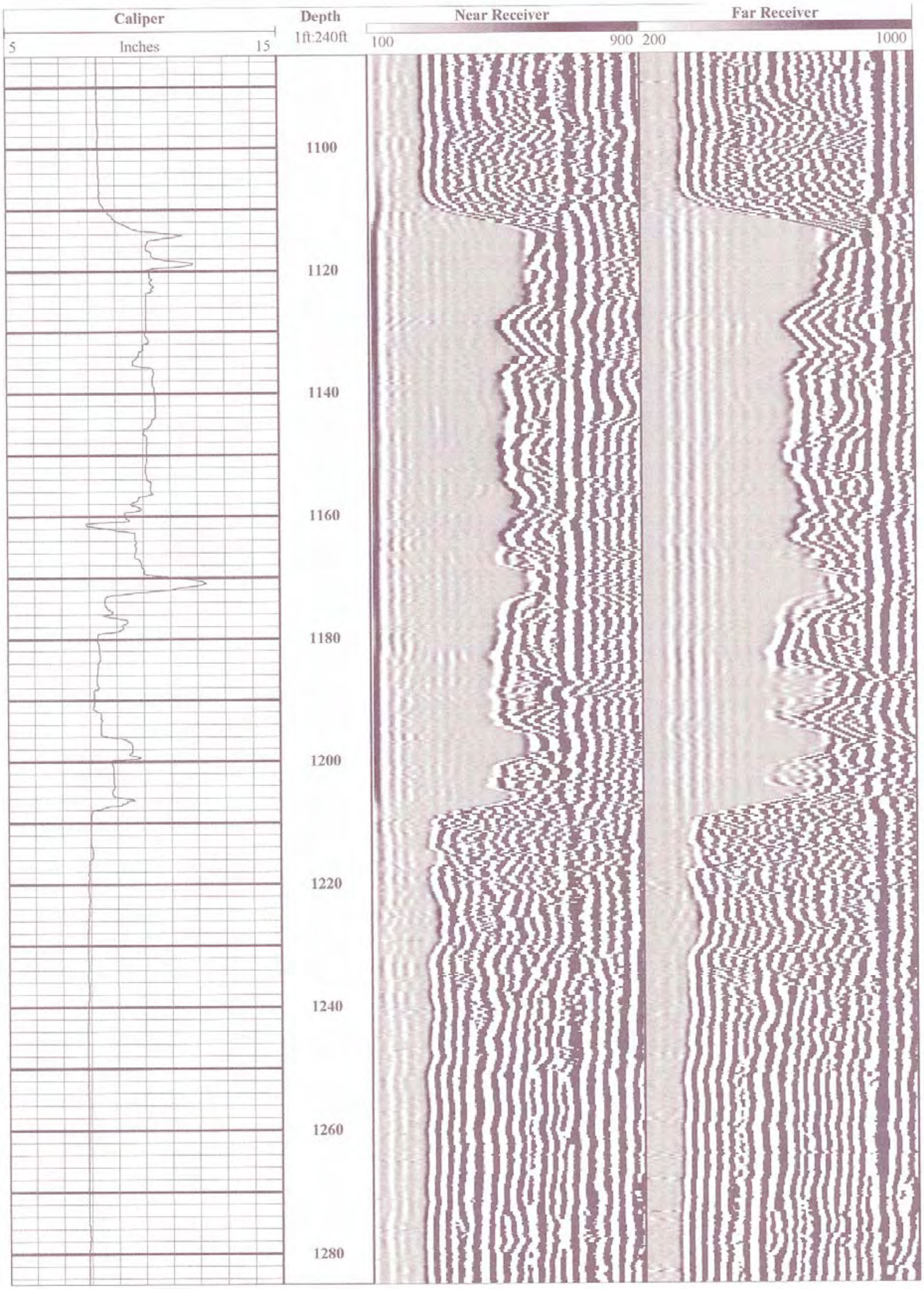
C1.7 COLOG FULL WAVEFORM SONIC LOG

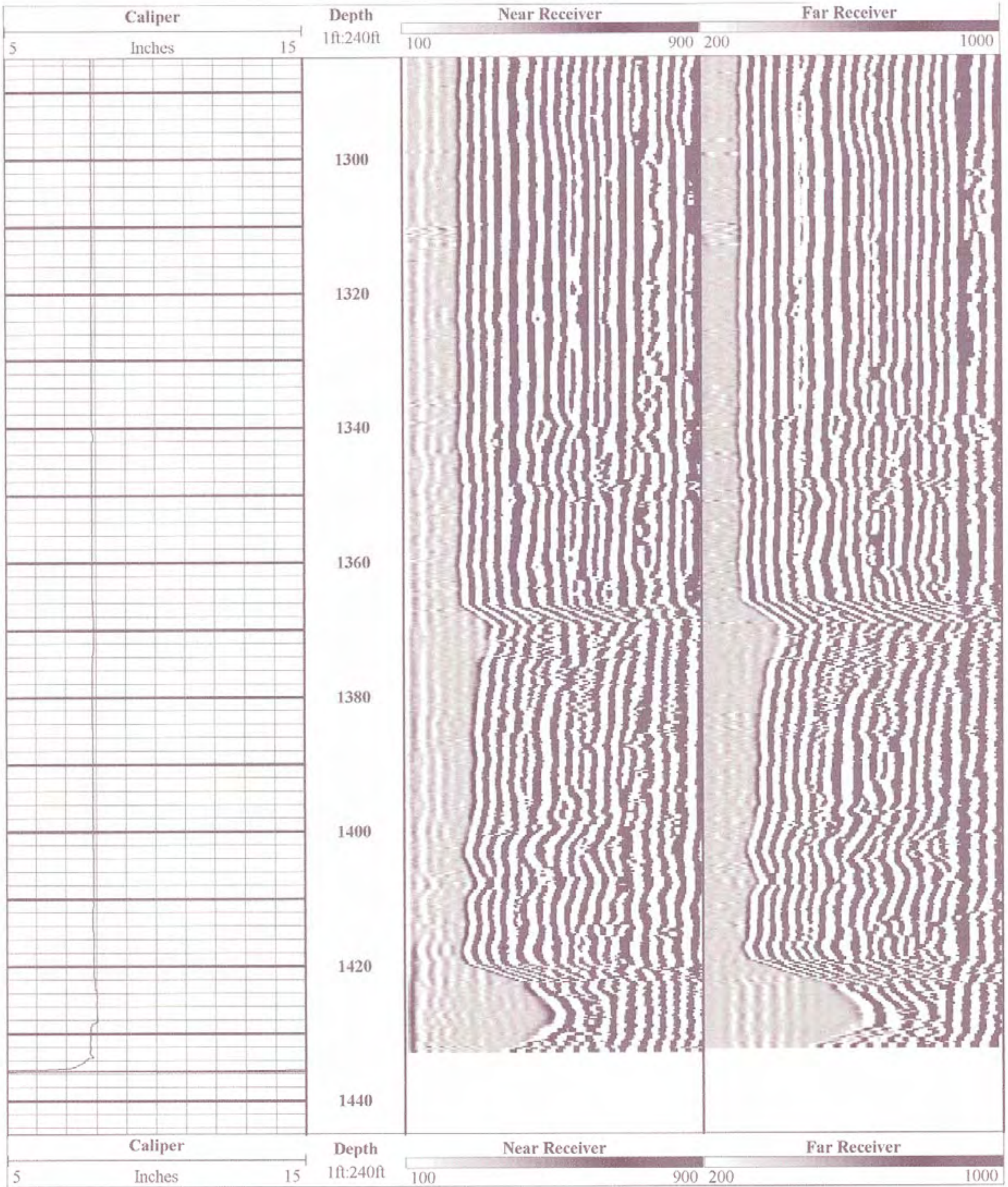



Caliper
5
Inches
15
Depth
1ft:240ft
500
520
540
560
580
600
620
640
660
680
Near Receiver
100
900
Far Receiver
200
1000


Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
700
720
740
760
780
800
820
840
860
880


Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
900
920
940
960
980
1000
1020
1040
1060
1080


Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
1100
1120
1140
1160
1180
1200
1220
1240
1260
1280


Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000
1300
1320
1340
1360
1380
1400
1420
1440
Caliper
5
Inches
15
Depth
1ft:240ft
Near Receiver
100
900
Far Receiver
200
1000

C1.8 WELLBORE NAVIGATION, INC., EARTH'S MAGNETIC FIELD SURVEY

WELLBORE NAVIGATION, INC.
Tustin, California

Earth's Magnetic Field Survey

For

Energy Solutions

Job Number: 48-0350-312

Well Name: C4997

Location: Hanford Site

Survey Date: October 24, 2006

Survey Engineer: Dawson/Adams

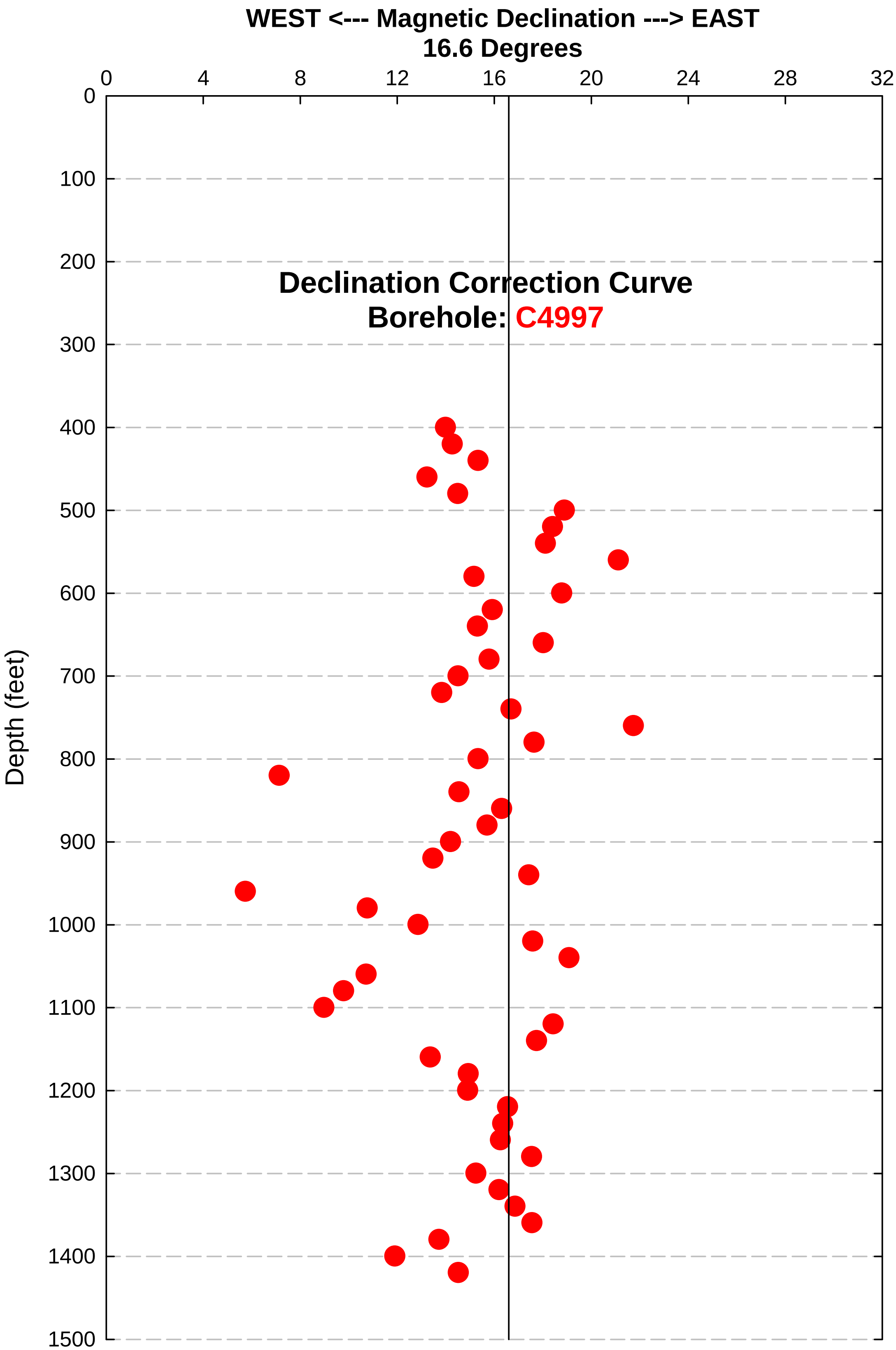
Magnetic Declination: 00.00E True North

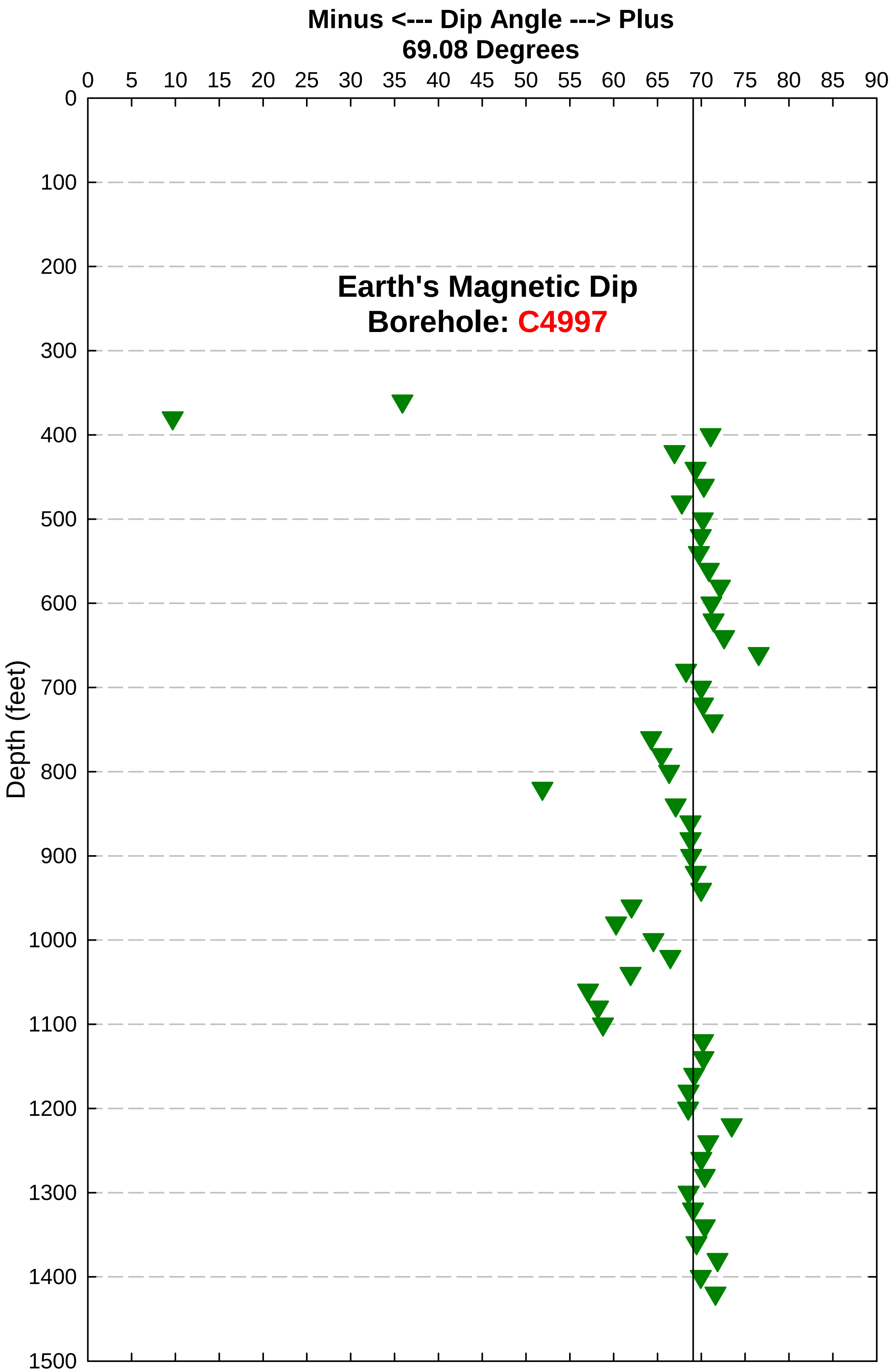
Surface Y-Coordinate: 135754.95
Surface X-Coordinate: 576309.33
Surface Elevation: 206.31

Depth Measured in FEET

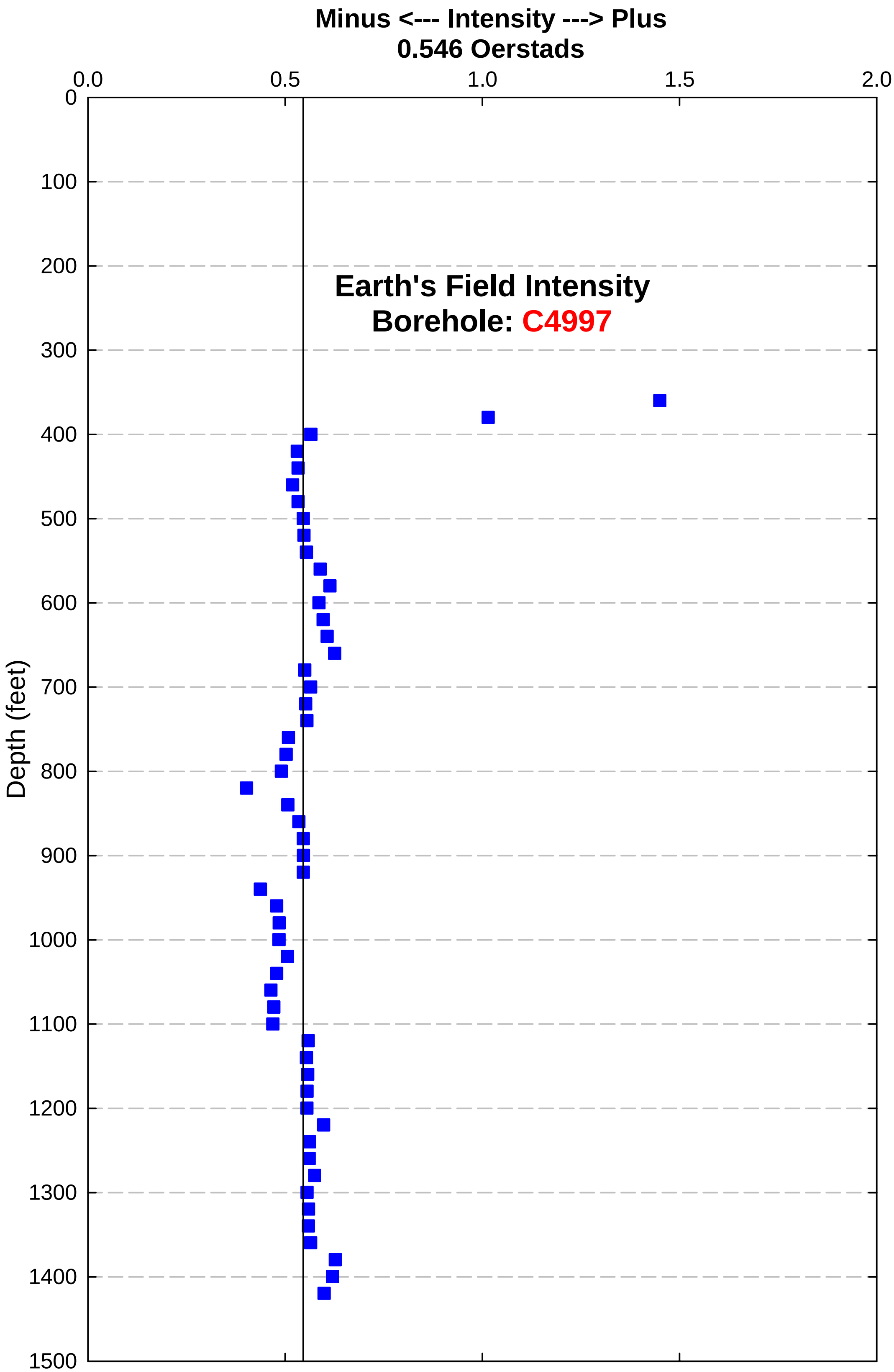
Comments: Surface Casing Depth 383 ft.
USGS: Dip=69.08 Degrees
Intensity= 0.54600 Oerstads
Declination= 16.60 Degrees

Hole ID	Measured Depth	Magnetic Declination	Magnetic Intensity	Magnetic Dip	HFS	X-HFS	Y-HFS	Z-HFS
C4997	360	163.046	1.45031	35.9	1.17481	0.34258	-1.12375	0.85042
C4997	380	257.777	1.01501	9.69	1.00053	-0.97785	-0.21183	0.17084
C4997	400	13.98435	0.5655	71.06	0.18355	0.04436	0.17811	0.53488
C4997	420	14.27173	0.53112	66.93	0.20812	0.05131	0.2017	0.48864
C4997	440	15.3306	0.53305	69.34	0.18807	0.04972	0.18138	0.49877
C4997	460	13.22662	0.51886	70.28	0.17508	0.04006	0.17043	0.48843
C4997	480	14.4913	0.53291	67.78	0.20153	0.05043	0.19512	0.49334
C4997	500	18.88808	0.54627	70.17	0.18531	0.05999	0.17533	0.51388
C4997	520	18.40216	0.54778	69.94	0.18789	0.05931	0.17828	0.51455
C4997	540	18.11105	0.55431	69.73	0.19204	0.0597	0.18252	0.51998
C4997	560	21.11438	0.58915	70.86	0.19317	0.06959	0.1802	0.55658
C4997	580	15.16221	0.61398	72.14	0.1883	0.04925	0.18175	0.58439
C4997	600	18.7808	0.58583	71.14	0.18937	0.06097	0.17929	0.55438
C4997	620	15.9222	0.59666	71.39	0.19041	0.05224	0.1831	0.56546
C4997	640	15.30343	0.60658	72.61	0.18129	0.04785	0.17486	0.57885
C4997	660	18.01677	0.62585	76.55	0.14557	0.04502	0.13843	0.60869
C4997	680	15.78565	0.54965	68.27	0.2035	0.05536	0.19582	0.51059
C4997	700	14.50858	0.56486	69.98	0.19338	0.04845	0.18721	0.53073
C4997	720	13.83206	0.5523	70.19	0.18718	0.04475	0.18175	0.51962
C4997	740	16.68556	0.55522	71.29	0.1781	0.05114	0.1706	0.52588
C4997	760	21.73694	0.50879	64.26	0.22096	0.08183	0.20525	0.4583
C4997	780	17.6445	0.50258	65.46	0.20874	0.06327	0.19892	0.45718
C4997	800	15.33085	0.49064	66.32	0.19705	0.0521	0.19004	0.44933
C4997	820	7.131653	0.40217	51.86	0.24837	0.03084	0.24645	0.31631
C4997	840	14.54573	0.50711	67.08	0.19749	0.0496	0.19116	0.46707
C4997	860	16.30135	0.53504	68.76	0.19383	0.05441	0.18604	0.4987
C4997	880	15.70038	0.54625	68.76	0.19789	0.05355	0.19051	0.50914
C4997	900	14.19806	0.54674	68.84	0.19736	0.04841	0.19133	0.50988
C4997	920	13.46695	0.54613	69.36	0.19251	0.04483	0.18722	0.51108
C4997	940	17.42268	0.43755	69.97	0.14987	0.04487	0.14299	0.41108
C4997	960	5.738295	0.47873	62.04	0.22445	0.02244	0.22333	0.42285
C4997	980	10.76254	0.48491	60.27	0.24047	0.04491	0.23624	0.42108
C4997	1000	12.85248	0.48468	64.53	0.20843	0.04636	0.20321	0.43757
C4997	1020	17.58212	0.50633	66.47	0.20214	0.06106	0.1927	0.46423
C4997	1040	19.08427	0.47845	61.93	0.22513	0.07361	0.21276	0.42217
C4997	1060	10.71945	0.46429	57.06	0.25246	0.04696	0.24806	0.38965
C4997	1080	9.786827	0.47128	58.22	0.2482	0.04219	0.24459	0.40062
C4997	1100	8.973358	0.46909	58.78	0.24314	0.03792	0.24017	0.40116
C4997	1120	18.42572	0.55842	70.19	0.18925	0.05982	0.17955	0.52537
C4997	1140	17.74608	0.55425	70.24	0.18738	0.05711	0.17847	0.52161
C4997	1160	13.35764	0.5573	69.18	0.19808	0.04576	0.19272	0.52091
C4997	1180	14.92804	0.55599	68.56	0.20323	0.05235	0.19637	0.51752
C4997	1200	14.90219	0.55528	68.5	0.20351	0.05234	0.19667	0.51664
C4997	1220	16.54583	0.59796	73.47	0.17013	0.04845	0.16309	0.57325
C4997	1240	16.35144	0.56203	70.79	0.18493	0.05206	0.17745	0.53074
C4997	1260	16.25079	0.56109	70	0.1919	0.0537	0.18424	0.52725
C4997	1280	17.53906	0.57493	70.38	0.19305	0.05818	0.18408	0.54155
C4997	1300	15.24263	0.55589	68.56	0.20319	0.05342	0.19604	0.51742
C4997	1320	16.19437	0.55958	69.05	0.20008	0.0558	0.19214	0.52259
C4997	1340	16.85475	0.55882	70.38	0.18764	0.05441	0.17958	0.52638
C4997	1360	17.55141	0.56508	69.46	0.19826	0.05979	0.18903	0.52916
C4997	1380	13.71987	0.62744	71.85	0.19545	0.04636	0.18987	0.59622
C4997	1400	11.90224	0.62019	69.94	0.21273	0.04387	0.20815	0.58257
C4997	1420	14.5152	0.59882	71.62	0.18882	0.04732	0.18279	0.56827


WEST <--- Magnetic Declination ---> EAST
16.6 Degrees
0
4
8
12
16
20
24
28
32
Declination Correction Curve
Borehole: C4997
Depth (feet)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500



Minus <--- Dip Angle ---> Plus
69.08 Degrees
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Depth (feet)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
Earth's Magnetic Dip
Borehole: C4997


Minus <--- Intensity ---> Plus
0.546 Oerstads
0.0
0.5
1.0
1.5
2.0
Earth's Field Intensity
Borehole: C4997
Depth (feet)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500

APPENDIX D

BOREHOLE C4998

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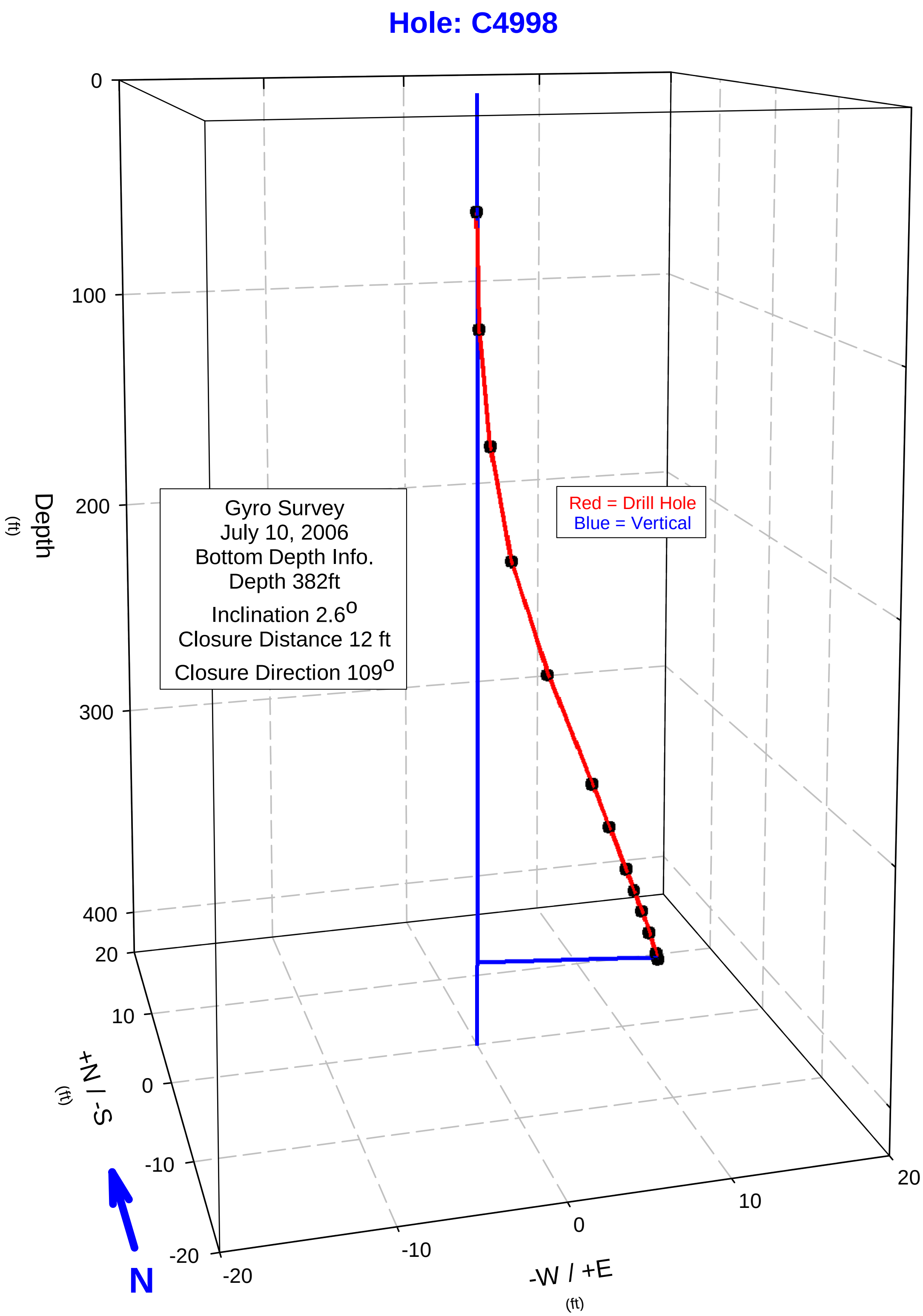
D1.0 COREHOLE C4998

D1.1 ENERGY*SOLUTIONS* AND PACIFIC NORTHWEST GEOPHYSICS GYROSCOPIC LOGS

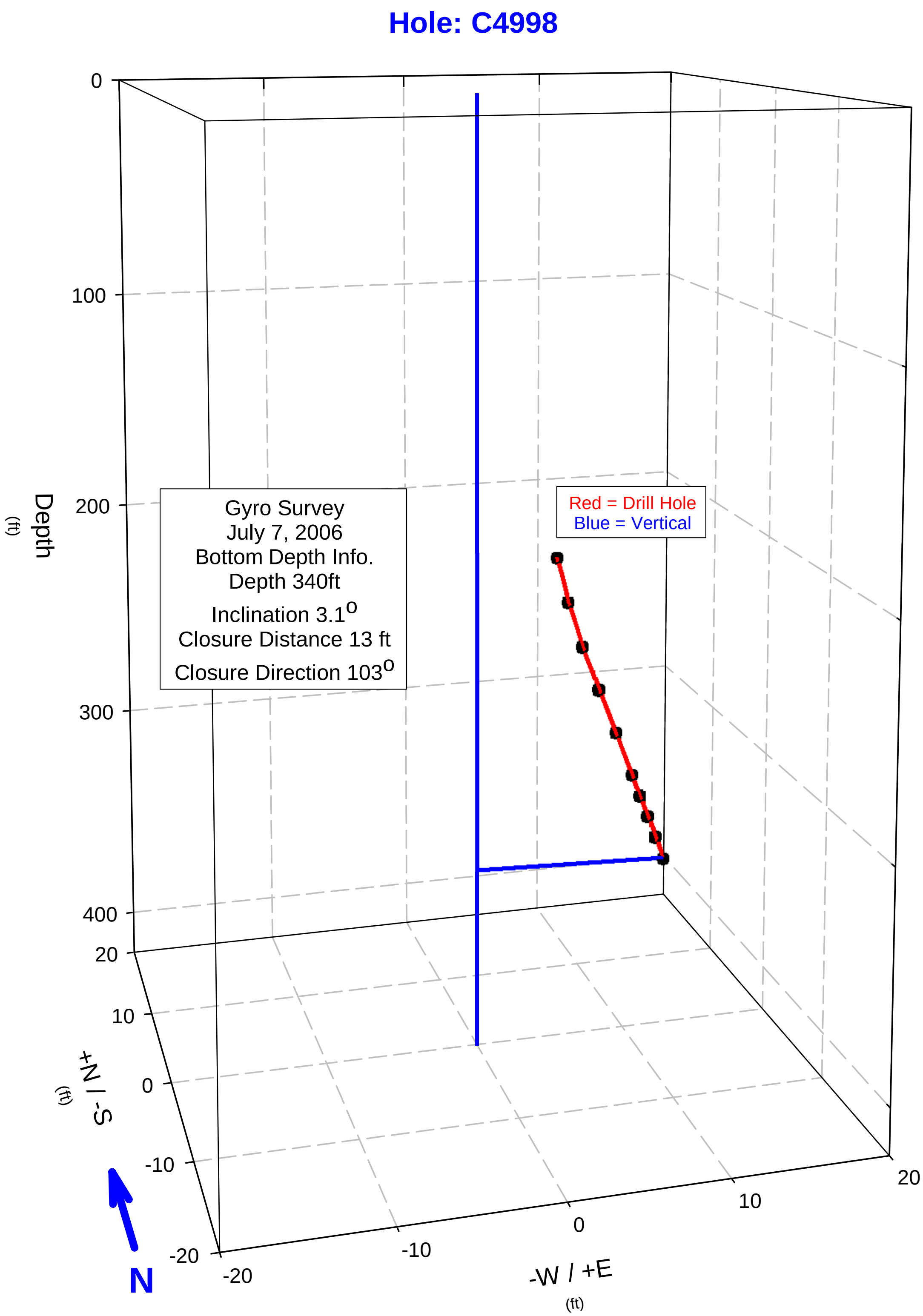
Hole: **C4998**

Survey Date	**Survey Number**	**Maximum Depth (feet)**	**Inclination From Vertical (deg)**	**Closure Distance (feet)**
Casing	Cable-Tool			
7/10/2006	8	382	2.6	12
7/7/2006	7	340	3.1	13
7/5/2006	6	313	3.7	8
6/28/2006	5	250	2.9	4.4
6/21/2006	4	191	0.7	1.8
6/19/2006	3	145	0.5	0.7
6/15/2006	2	101	0.5	0.2
6/14/2006	1	73	0.5	0.1


Hole: C4998
Gyro Survey
July 10, 2006
Bottom Depth Info.
Depth 382ft
Inclination 2.6°
Closure Distance 12 ft
Closure Direction 109°
Red = Drill Hole
Blue = Vertical
Depth
(ft)
0
100
200
300
400
20
10
0
-10
-20
+N / -S
(ft)
N
-20
-10
0
10
20
-W / +E
(ft)

Hole: **C4998** Survey Date: **7/10/2006**

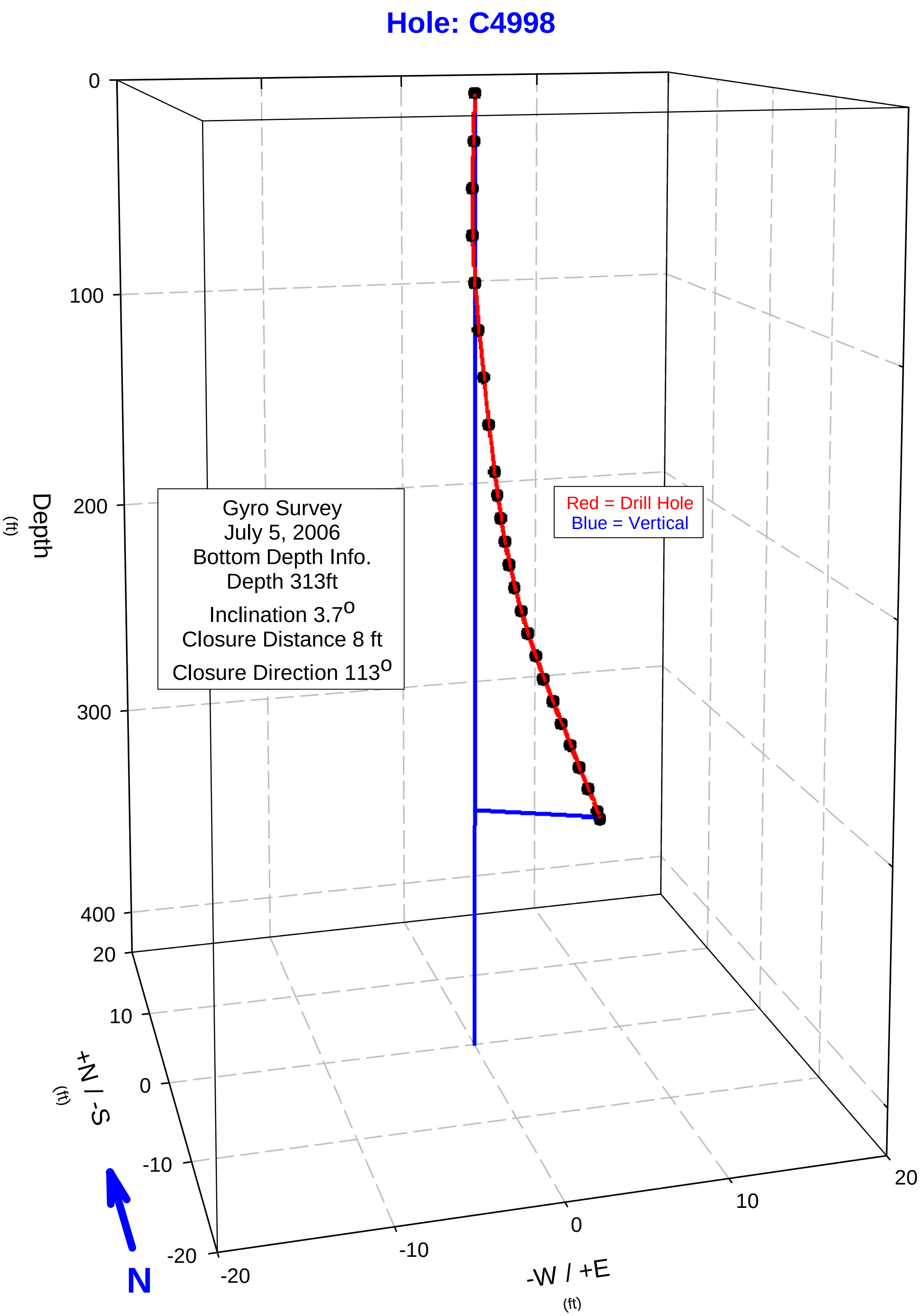
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
50	50	0.44	221.89	0.1	-0.07	-0.07	1.4
100	100	0.56	177.38	0.44	-0.44	0.02	1.1
150	149.99	1.21	146.92	1.11	-0.93	0.61	1.4
200	199.97	2	127.9	2.38	-1.46	1.88	2
250	249.92	3.4	114.11	4.6	-1.88	4.2	2.9
300	299.83	3.39	106.59	7.45	-2.13	7.14	0.6
320	319.79	3.34	104.71	8.59	-2.18	8.31	0.3
340	339.76	3.2	103.33	9.71	-2.24	9.45	0.7
350	349.75	3.2	102.73	10.26	-2.26	10.01	0.6
360	359.73	3.22	102.09	10.81	-2.26	10.57	1.5
370	369.72	2.99	101.51	11.34	-2.26	11.11	2.5
380	379.7	2.45	101.14	11.81	-2.28	11.58	5.5
382.6	382.3	2.59	101.09	11.92	-2.29	11.7	10.5



Hole: C4998
Gyro Survey
July 7, 2006
Bottom Depth Info.
Depth 340ft
Inclination 3.1o
Closure Distance 13 ft
Closure Direction 103o
Red = Drill Hole
Blue = Vertical
Depth
(ft)
0
100
200
300
400
+N / -S
(ft)
20
10
0
-10
-20
-W / +E
(ft)
-20
-10
0
10
20
N

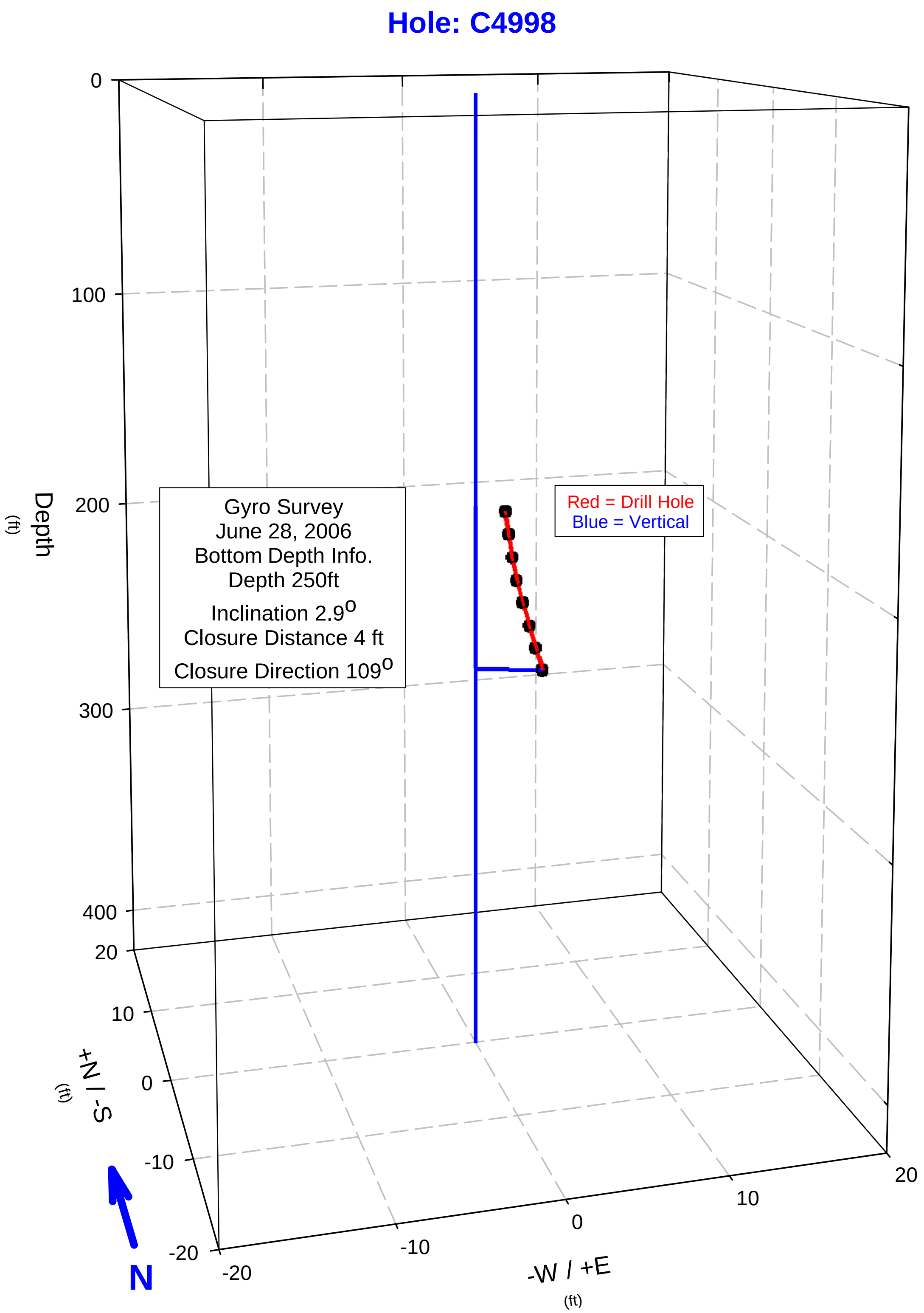
Hole: **C4998** Survey Date: **7/7/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
200	199.93	1.99	105.18	5.12	-1.34	4.94	0.6
220	219.92	2.41	103.83	5.88	-1.4	5.71	2.1
240	239.89	3.12	102.26	6.83	-1.45	6.67	3.7
260	259.86	3.41	100.53	7.94	-1.45	7.81	1.5
280	279.83	3.32	98.77	9.09	-1.38	8.98	1.4
300	299.79	3.35	97.23	10.22	-1.29	10.14	0.5
310	309.77	3.36	96.62	10.79	-1.24	10.72	0.1
320	319.76	3.29	96.05	11.36	-1.2	11.3	0.9
330	329.74	3.22	95.54	11.92	-1.15	11.87	0.8
340	339.73	3.1	95.12	12.47	-1.11	12.42	1.3


Hole: C4998
0
100
200
300
400
Depth
(ft)
Gyro Survey
July 5, 2006
Bottom Depth Info.
Depth 313ft
Inclination 3.7°
Closure Distance 8 ft
Closure Direction 113°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+N / -S
(ft)
N
-20
-10
0
10
20
-W / +E
(ft)

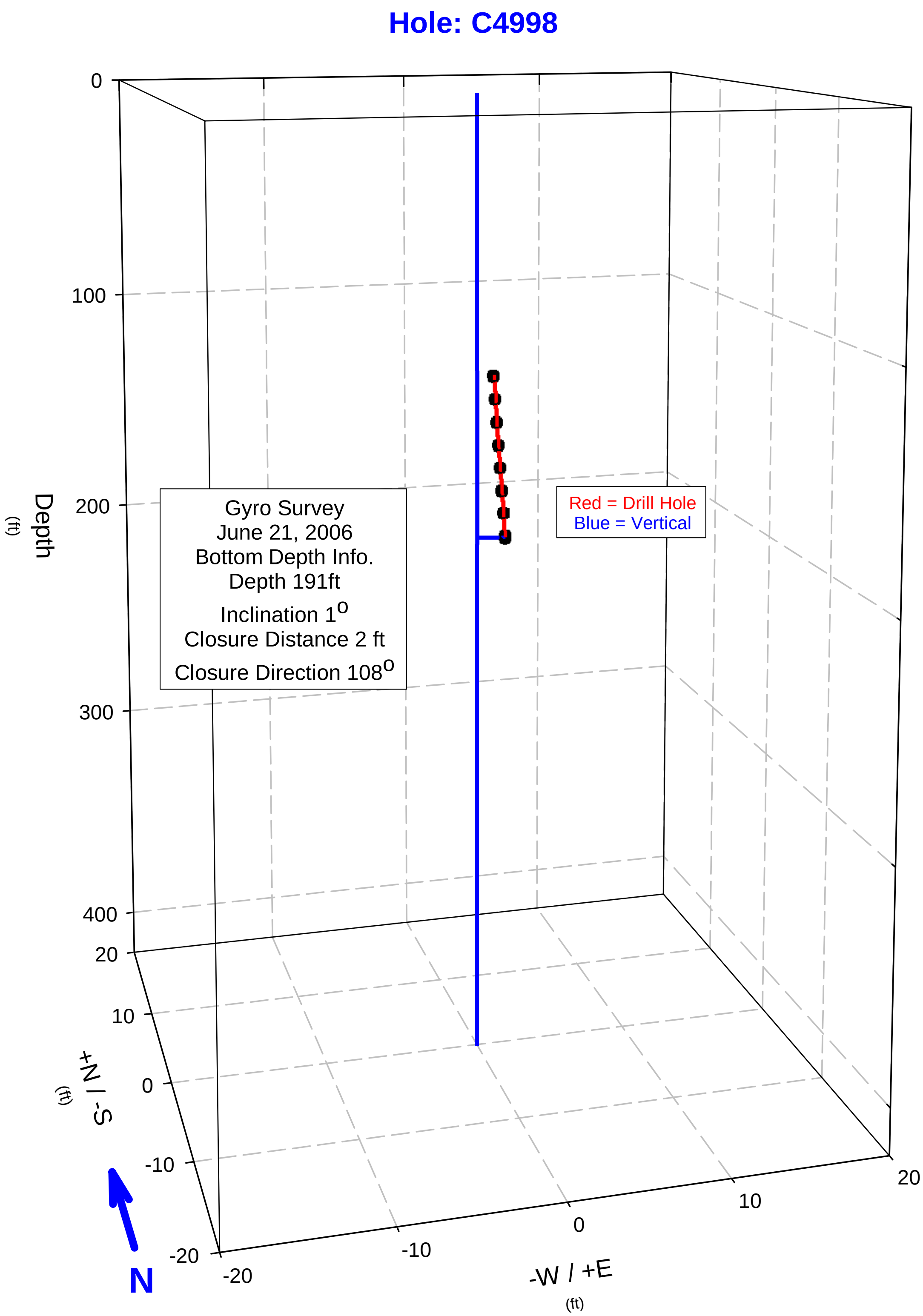
Hole: **C4998** Survey Date: **7/5/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
0	0	0.44	0	0	0	0	0
20	20	0.56	207.93	0.17	-0.15	-0.08	1.4
40	40	0.28	216.31	0.31	-0.25	-0.18	1.5
60	60	0.49	212.17	0.43	-0.36	-0.23	2
80	80	0.8	195.19	0.58	-0.56	-0.15	2.5
100	99.99	1.24	177.09	0.86	-0.86	0.04	2.2
120	119.99	1.1	167.22	1.23	-1.2	0.27	0.7
140	139.99	1.14	160.85	1.59	-1.5	0.52	0.9
160	159.98	1.12	154.99	1.93	-1.75	0.82	1.1
170	169.98	1.24	151.97	2.11	-1.86	0.99	1.6
180	179.98	1.43	148.71	2.31	-1.97	1.2	2.1
190	189.97	1.52	145.53	2.53	-2.08	1.43	1
200	199.97	1.78	142.4	2.78	-2.2	1.69	2.8
210	209.96	2.14	138.9	3.07	-2.31	2.02	4
220	219.96	2.39	135.24	3.4	-2.42	2.4	2.6
230	229.95	2.63	131.79	3.78	-2.52	2.82	2.6
240	239.93	2.97	128.5	4.22	-2.62	3.3	3.5
250	249.92	3.2	125.48	4.7	-2.73	3.83	2.3
260	259.9	3.37	122.82	5.22	-2.83	4.39	1.7
270	269.89	3.36	120.49	5.77	-2.93	4.97	1.1
280	279.87	3.25	118.38	6.3	-2.99	5.54	2
290	289.85	3.42	116.4	6.83	-3.04	6.12	2
300	299.84	3.42	114.71	7.39	-3.09	6.72	1.4
310	309.82	3.48	113.3	7.96	-3.15	7.31	0.7
313.5	313.31	3.7	112.82	8.17	-3.17	7.53	6.2


Hole: C4998
Gyro Survey
June 28, 2006
Bottom Depth Info.
Depth 250ft
Inclination 2.9°
Closure Distance 4 ft
Closure Direction 109°
Red = Drill Hole
Blue = Vertical
Depth (ft)
0
100
200
300
400
+N / -S (ft)
20
10
0
-10
-20
-W / +E (ft)
-20
-10
0
10
20
N

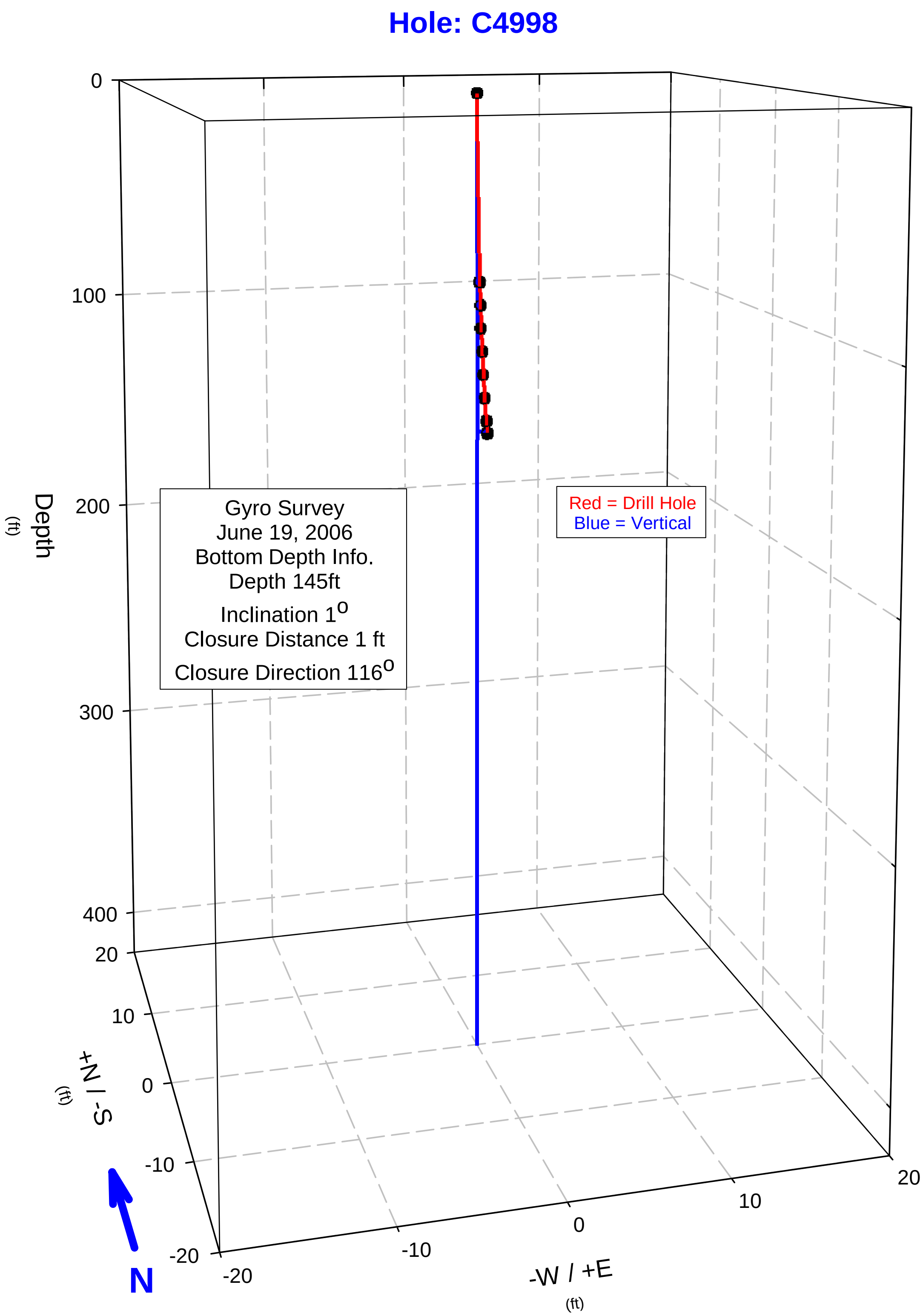
Hole: **C4998** Survey Date: **6/28/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
180	179.99	1.18	106.4	1.94	-0.55	1.86	0.7
190	189.98	1.31	108.51	2.14	-0.68	2.03	1.9
200	199.98	1.52	109.79	2.38	-0.81	2.24	2.7
210	209.98	1.94	110.19	2.68	-0.93	2.52	4.7
220	219.97	2.36	110.05	3.06	-1.05	2.87	4.2
230	229.96	2.51	109.7	3.48	-1.17	3.28	1.8
240	239.95	2.27	109.26	3.9	-1.29	3.68	2.5
250	249.94	2.92	109.05	4.35	-1.42	4.11	6.7


Hole: C4998
Depth
(ft)
0
100
200
300
400
Gyro Survey
June 21, 2006
Bottom Depth Info.
Depth 191ft
Inclination 1°
Closure Distance 2 ft
Closure Direction 108°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+N / -S
(ft)
N
-20
-10
0
10
20
-W / +E
(ft)

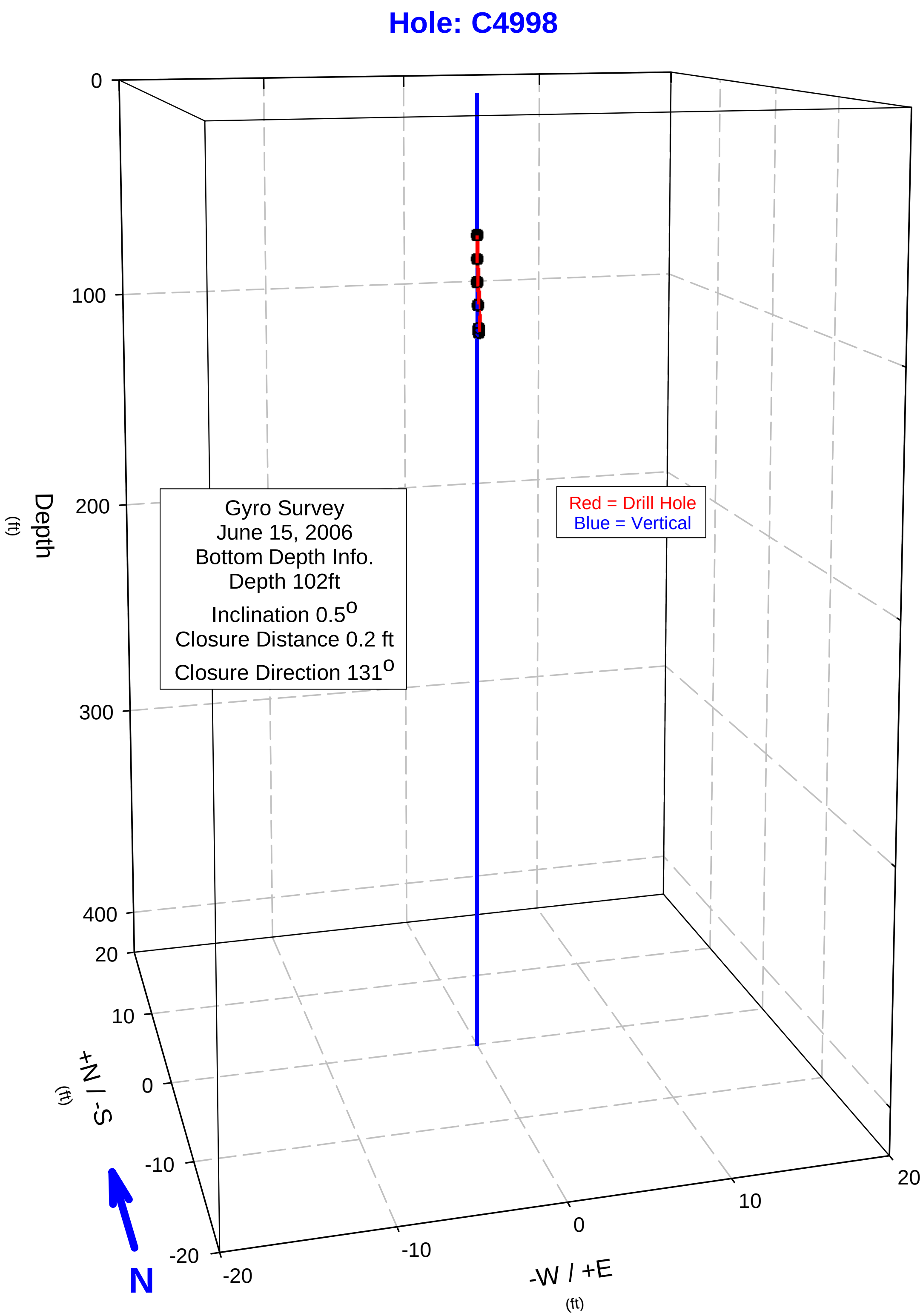
Hole: **C4998** Survey Date: **6/21/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
120	119.99	0.5	123.6	1.14	-0.63	0.95	0.3
130	129.99	0.57	122.41	1.23	-0.66	1.04	0.7
140	139.99	0.57	121.3	1.32	-0.69	1.13	0.1
150	149.99	0.62	119.52	1.42	-0.7	1.23	2.2
160	159.99	0.71	116.94	1.51	-0.69	1.35	1
170	169.99	0.7	114.39	1.61	-0.67	1.47	0
180	179.99	0.76	111.88	1.72	-0.64	1.6	0.9
190	189.99	0.89	108.56	1.82	-0.58	1.72	3.4
191	190.99	0.66	108.26	1.83	-0.57	1.73	35.8


Hole: C4998
0
100
200
300
400
Depth
(ft)
Gyro Survey
June 19, 2006
Bottom Depth Info.
Depth 145ft
Inclination 1°
Closure Distance 1 ft
Closure Direction 116°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+N / -S
(ft)
N
-20
-10
0
10
20
-W / +E
(ft)

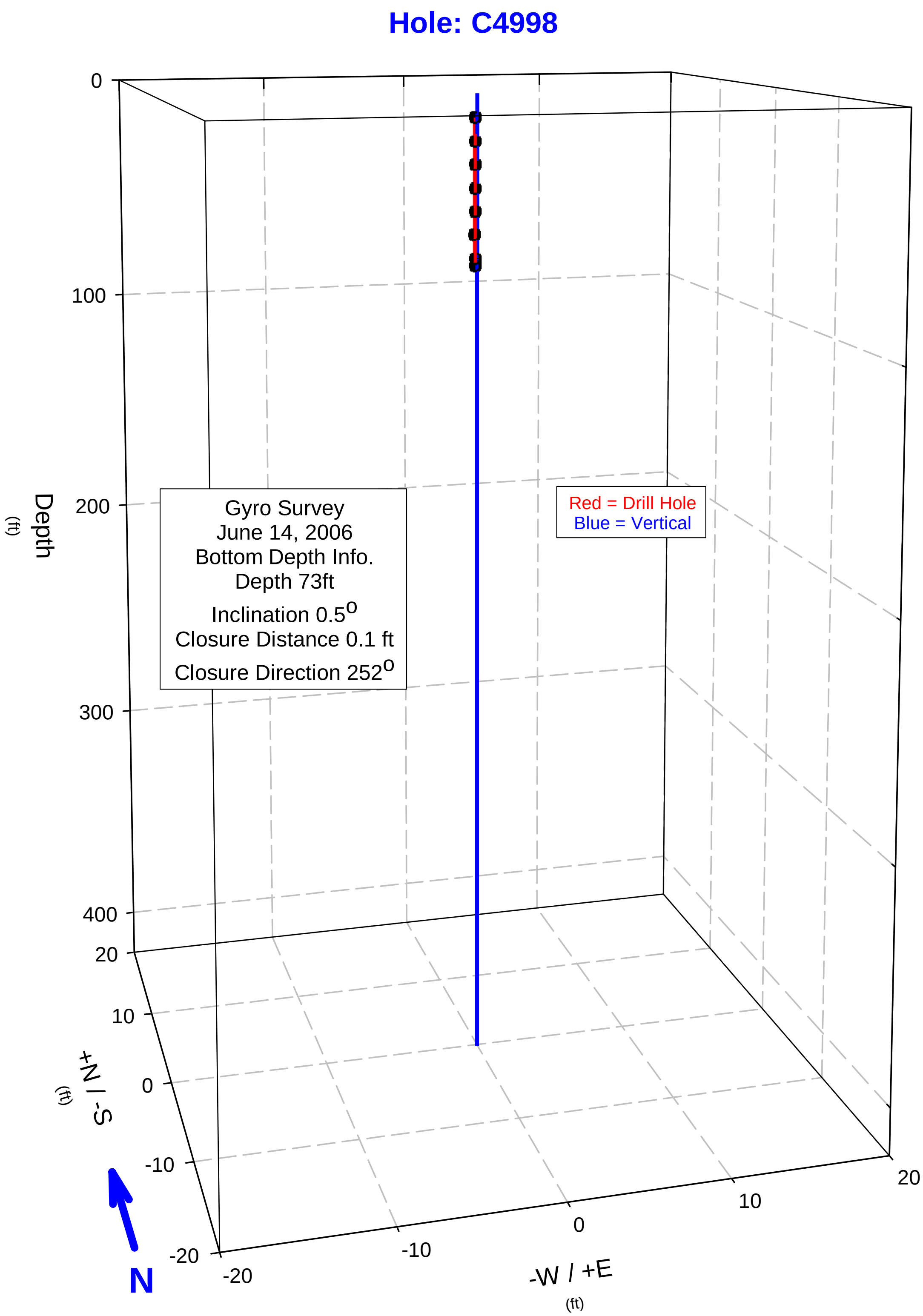
Hole: **C4998** Survey Date: **6/19/2006**

Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
0	0	0.09	0	0	0	0	0
80	80	0.25	108.43	0.18	-0.06	0.17	0.3
90	90	0.28	113.26	0.22	-0.09	0.21	0.5
100	100	0.33	115.67	0.28	-0.12	0.25	1.1
110	110	0.46	116.61	0.34	-0.15	0.31	1.3
120	120	0.45	117.29	0.42	-0.19	0.38	0.4
130	130	0.51	118.09	0.51	-0.24	0.45	1
140	140	0.91	117.12	0.63	-0.29	0.56	4.7
145.3	145.3	0.52	116.26	0.69	-0.31	0.62	7.4


Hole: C4998
Gyro Survey
June 15, 2006
Bottom Depth Info.
Depth 102ft
Inclination 0.5°
Closure Distance 0.2 ft
Closure Direction 131°
Red = Drill Hole
Blue = Vertical
Depth
(ft)
0
100
200
300
400
+N / -S
(ft)
20
10
0
-10
-20
-W / +E
(ft)
-20
-10
0
10
20
N

Hole: **C4998** Survey Date: **6/15/2006**

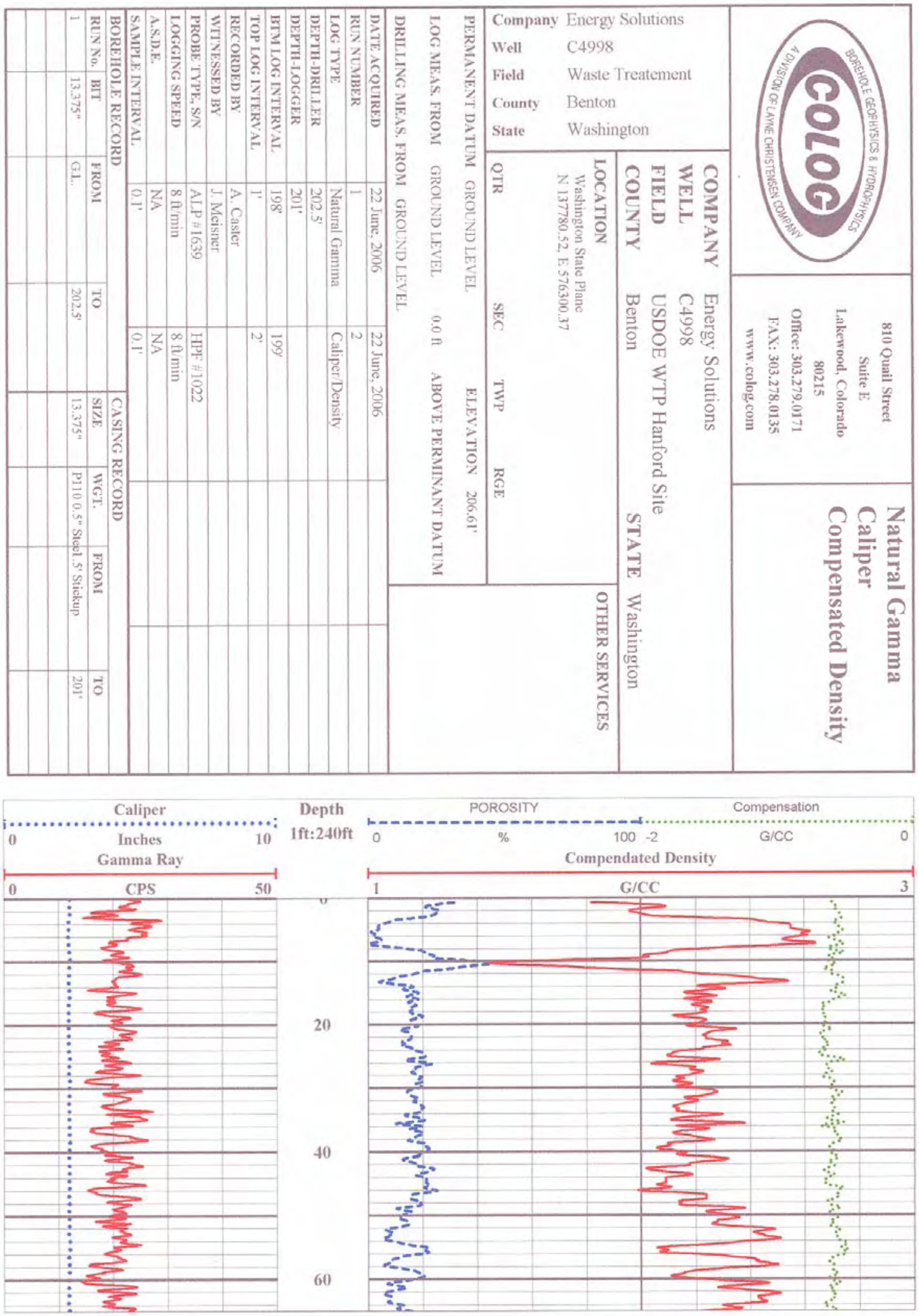
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity ^{o}/100-ft
60	60	0.06	181.91	0.08	-0.08	0	0.4
70	70	0.06	176.77	0.08	-0.08	0	0.9
80	80	0.28	159.67	0.09	-0.08	0.03	2.7
90	90	0.26	140.18	0.12	-0.09	0.07	1.5
100	100	0.32	133.15	0.16	-0.11	0.12	0.6
101.8	101.8	0.48	131.46	0.18	-0.12	0.13	10.4

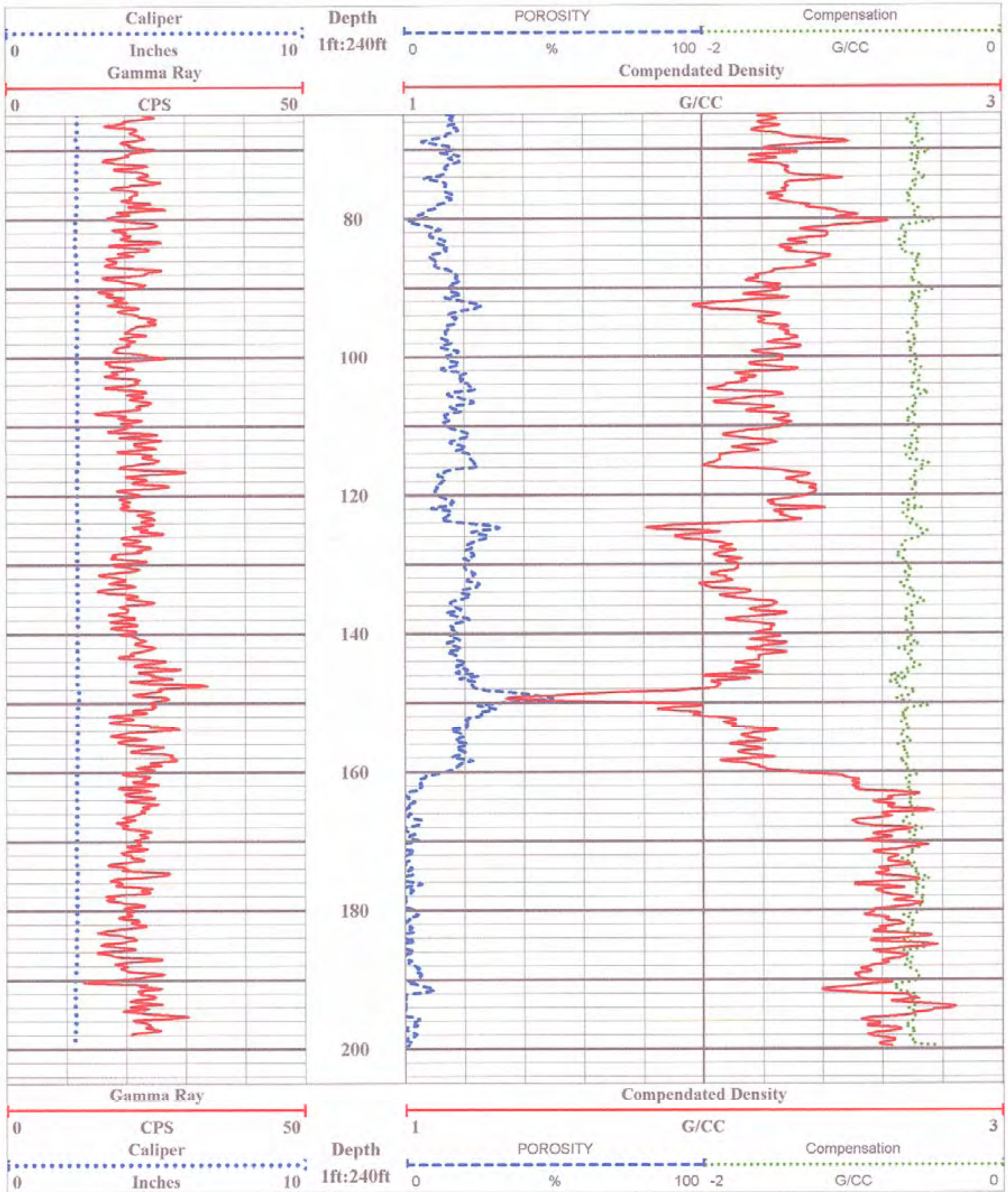

Hole: C4998
0
100
200
300
400
Depth
(ft)
Gyro Survey
June 14, 2006
Bottom Depth Info.
Depth 73ft
Inclination 0.5°
Closure Distance 0.1 ft
Closure Direction 252°
Red = Drill Hole
Blue = Vertical
20
10
0
-10
-20
+N / -S
(ft)
N
-20
-10
0
10
20
-W / +E
(ft)

Hole: **C4998** Survey Date: **6/14/2006**

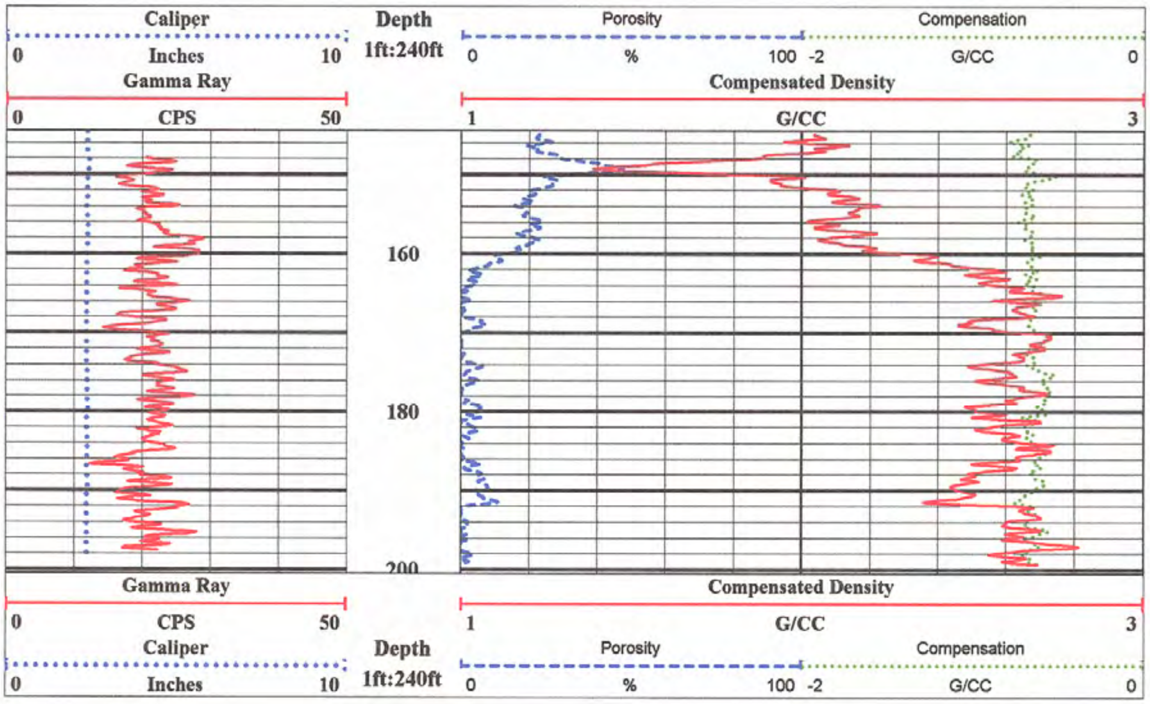
Measured Depth (feet)	TrueVert. Depth (feet)	Inclination from Vert. (deg)	Closure Direction (deg)	Closure Distance (feet)	Rectangular Coordinates +N/-S	Rectangular Coordinates +E/-W	Dog-Leg Severity °/100-ft
10	10	0.03	265.13	0.09	-0.01	-0.09	10.5
20	20	0	263.59	0.09	-0.01	-0.09	0.3
30	30	0.03	264.12	0.09	-0.01	-0.09	0.3
40	40	0.06	264.05	0.1	-0.01	-0.1	0.4
50	50	0.06	263.41	0.11	-0.01	-0.11	0.1
60	60	0.03	262.3	0.12	-0.02	-0.12	0.5
70	70	0.14	258.35	0.11	-0.02	-0.11	1.5
73	73	0.46	252.14	0.1	-0.03	-0.1	10.8

D1.2 COLOG COMPENSATED DENSITY LOGS





Caliper
0 Inches 10
Gamma Ray
0 CPS 50
Depth
1ft:240ft
POROSITY
0 % 100
Compensation
-2 G/CC 0
Compendated Density
1 G/CC 3
80
100
120
140
160
180
200
Gamma Ray
0 CPS 50
Caliper
0 Inches 10
Depth
1ft:240ft
Compendated Density
1 G/CC 3
POROSITY
0 % 100
Compensation
-2 G/CC 0


Caliper
0 Inches 10
Gamma Ray
0 CPS 50
Depth
1ft:240ft
160
180
200
Porosity
0 % 100
Compensation
-2 G/CC 0
Compensated Density
1 G/CC 3
Gamma Ray
0 CPS 50
Caliper
0 Inches 10
Depth
1ft:240ft
Compensated Density
1 G/CC 3
Porosity
0 % 100
Compensation
-2 G/CC 0

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80215
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FAX: 303.278.0135
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Natural Gamma
Caliper
Compensated Density
Long Spaced Density
Short Spaced Density

Company	Energy Solutions
Well	C4998
Field	Waste Treatement
County	Benton
State	Washington

COMPANY Energy Solutions
WELL C4998
FIELD USDOE WTP Hanford Site
COUNTY Benton STATE Washington

LOCATION
Washington State Plane
N 137780.52, E 576300.37

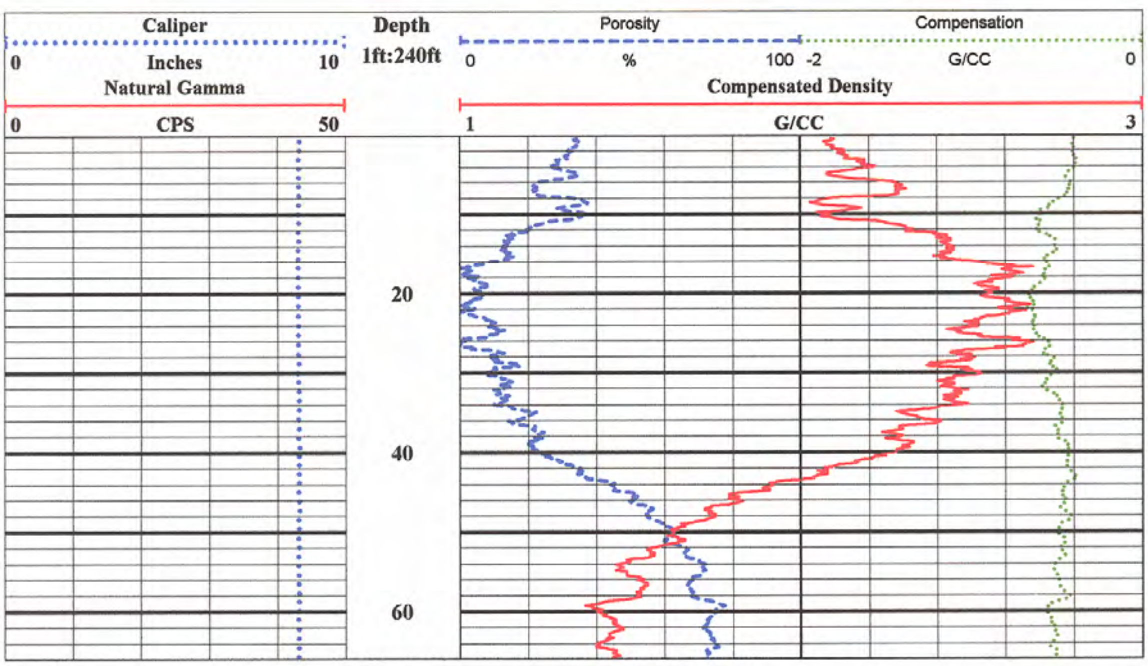
OTHER SERVICES

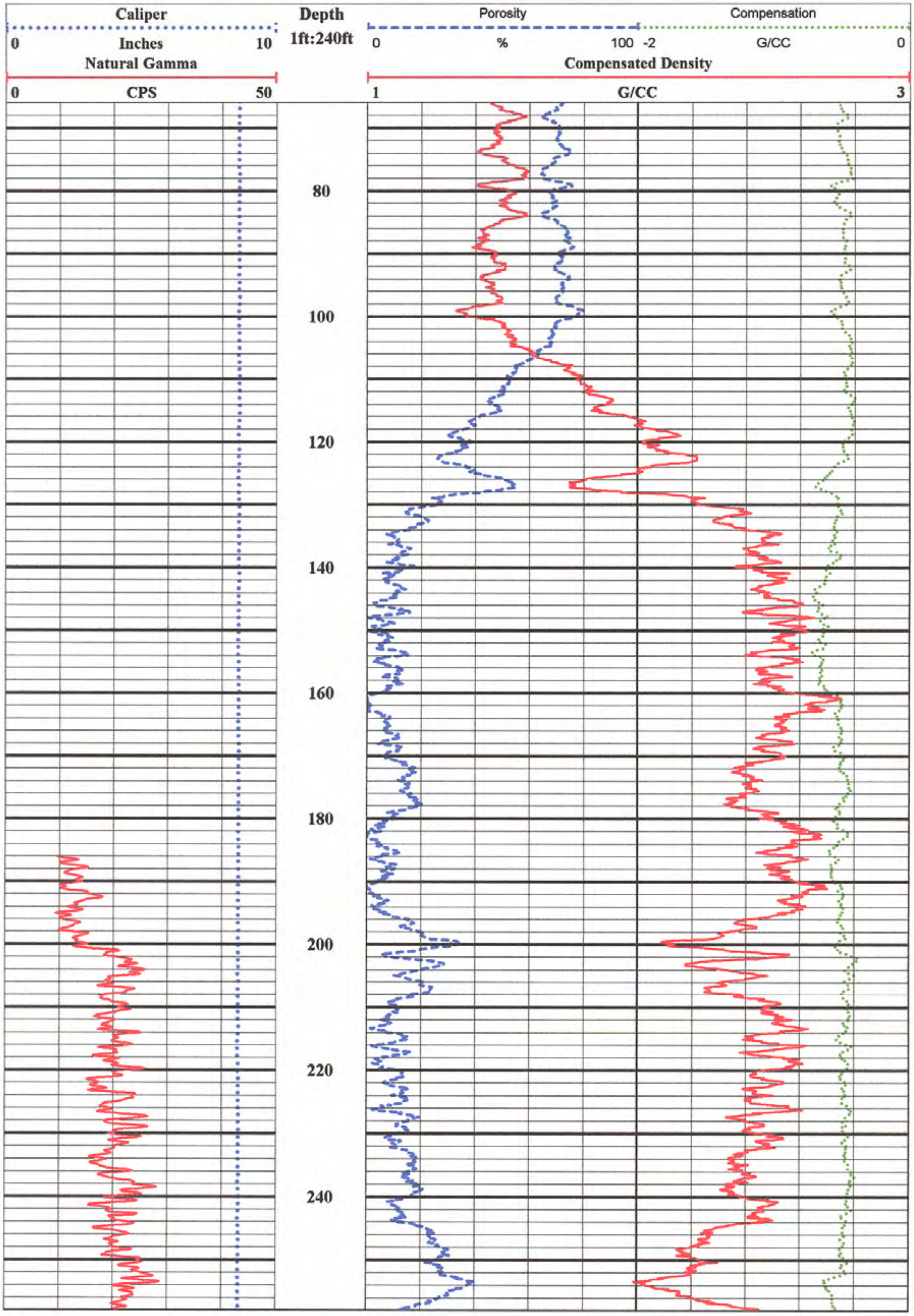
QTR SEC TWP RGE

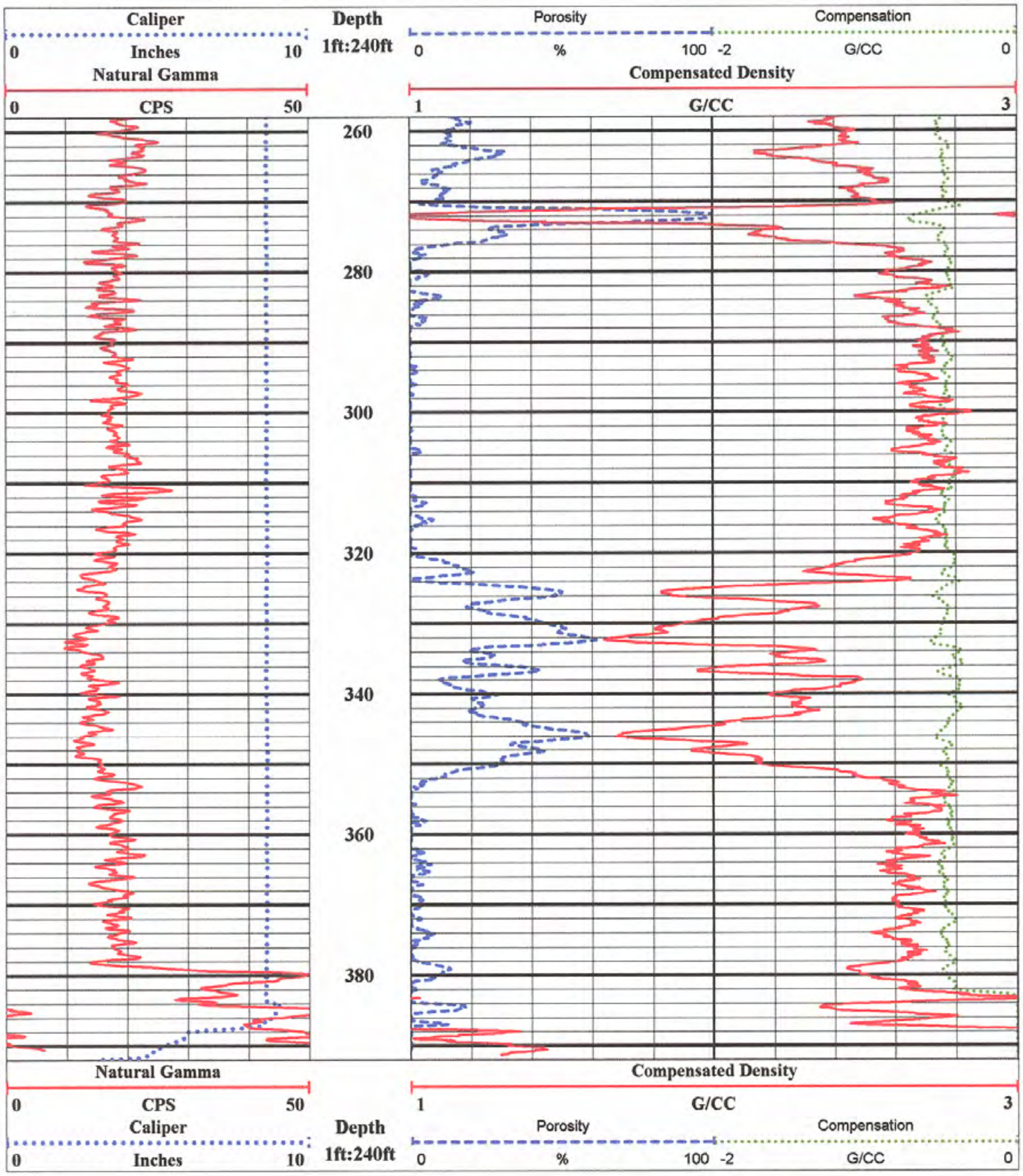
PERMANENT DATUM GROUND LEVEL ELEVATION 206.61'
LOG MEAS. FROM GROUND LEVEL 0.0 ft ABOVE PERMINANT DATUM
DRILLING MEAS. FROM GROUND LEVEL

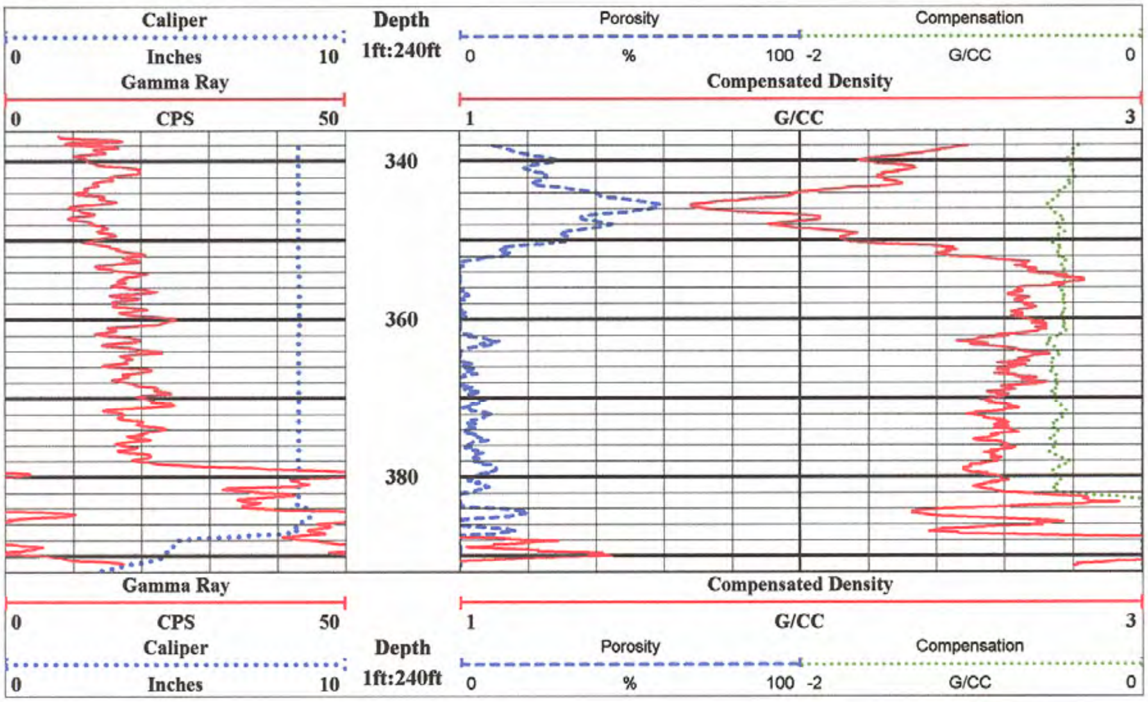
DATE ACQUIRED	10 July, 2006	10 Julu, 2006	
RUN NUMBER	1	2	
LOG TYPE	Natural Gamma	Caliper/Density	
DEPTH-DRILLER	395'		
DEPTH-LOGGER	393'		
BTM LOG INTERVAL	391'	392'	
TOP LOG INTERVAL	186'	1'	
RECORDED BY	A. Caster		
WITNESSED BY	J. Meisner		
PROBE TYPE, S/N	ALP #1639	HLP #1022	
LOGGING SPEED	8ft/min	8ft/min	
A.S.D.E.	NA	NA	
SAMPLE INTERVAL	0.1'	0.1'	

BOREHOLE RECORD				CASING RECORD			
RUN No.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	13.375"	G.L.	202.5'	13.375"	P110 0.5" Steel	1.5' Stickup	201'
2	9 3/4"	202.5	395'	9.625"	P110 0.5" Steel	Surface	384.5'




Caliper
0 Inches 10
Natural Gamma
0 CPS 50
Depth
1ft:240ft
80
100
120
140
160
180
200
220
240
Porosity
0 % 100
Compensation
-2 G/CC 0
Compensated Density
1 G/CC 3


Caliper
0 Inches 10
Natural Gamma
0 CPS 50
Depth
1ft:240ft
Porosity
0 % 100
Compensation
-2 G/CC 0
Compensated Density
1 G/CC 3
260
280
300
320
340
360
380
Natural Gamma
0 CPS 50
Caliper
0 Inches 10
Depth
1ft:240ft
Compensated Density
1 G/CC 3
Porosity
0 % 100
Compensation
-2 G/CC 0


Caliper
0 Inches 10
Gamma Ray
0 CPS 50
Depth
1ft:240ft
Porosity
0 % 100
Compensation
-2 G/CC 0
Compensated Density
1 G/CC 3
340
360
380
Gamma Ray
0 CPS 50
Caliper
0 Inches 10
Depth
1ft:240ft
Compensated Density
1 G/CC 3
Porosity
0 % 100
Compensation
-2 G/CC 0

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Natural Gamma
Caliper
Compensated Density
Long Spaced Density
Short Spaced Density

Company	Energy Solutions
Well	C4998
Field	Waste Treatement
County	Benton
State	Washington

COMPANY Energy Solutions
WELL C4998
FIELD USDOE WTP Hanford Site
COUNTY Benton **STATE** Washington

LOCATION
Washington State Plane
N 137780.52, E 576300.37

QTR **SEC** **TWP** **RGE**

OTHER SERVICES

PERMANENT DATUM GROUND LEVEL **ELEVATION** 206.61'
LOG MEAS. FROM GROUND LEVEL 0.0 ft **ABOVE PERMINANT DATUM**
DRILLING MEAS. FROM GROUND LEVEL

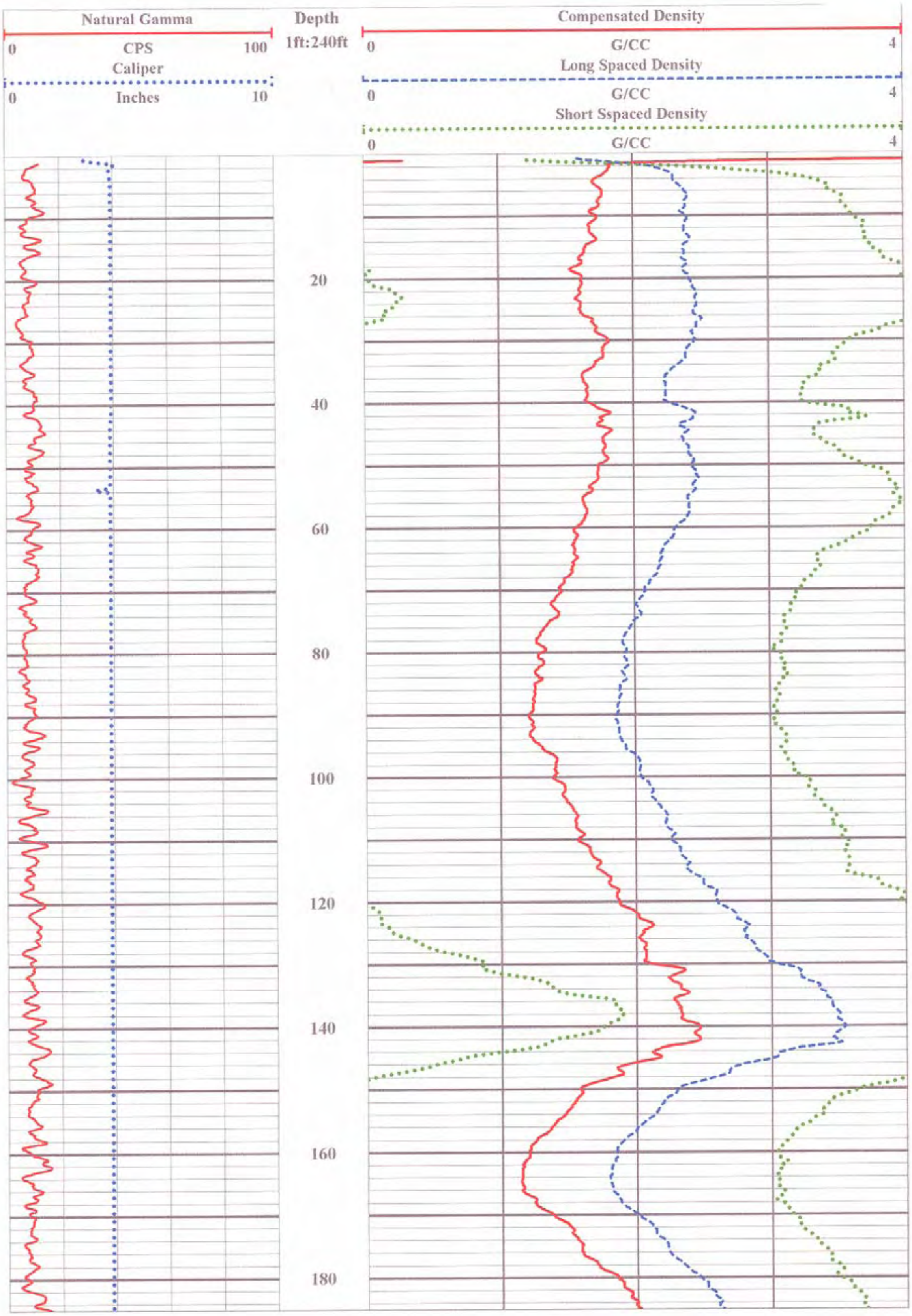
DATE ACQUIRED	15&18 Sept, 2006	15&18 Sept, 2006		
RUN NUMBER	1	2		
LOG TYPE	Natural Gamma	Caliper/Density		
DEPTH-DRILLER	1400'			
DEPTH-LOGGER	1397'			
BTM LOG INTERVAL	1393'	1396'		
TOP LOG INTERVAL	1'	2'		
RECORDED BY	A. Caster			
WITNESSED BY	J. Meisner			
PROBE TYPE, S/N	RAB 2019	HPF 1516		
LOGGING SPEED	15ft/min	12ft/min		
A.S.D.E.	NA	NA		
SAMPLE INTERVAL	0.1'	0.1'		

BOREHOLE RECORD				CASING RECORD			
RUN No.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	13.375"	G.L.	202.5'	13.375"	P110 0.5" Steel	.5' Stickup	201'
2	9 3/4"	202.5	395'	9.625"	P110 0.5" Steel	Surface	384.5'
3	HQ 3.8"	400'	1400'	4"	Steel	1' Stickup	400'

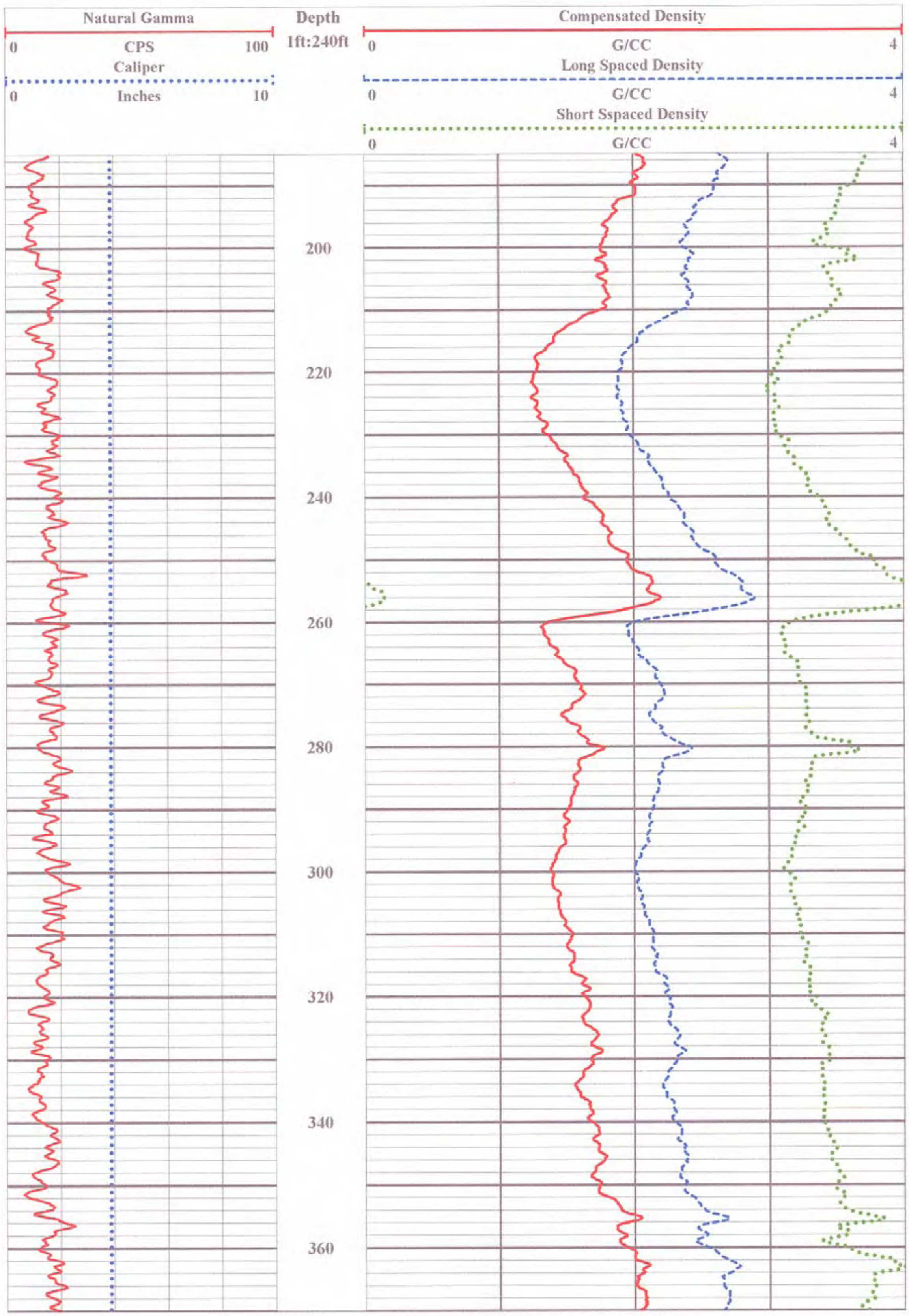
COMMENTS **NA - Not Available, N/A - Not Applicable**

Bottom log is repeat section, middle log was ran through HQ from 1215' to 1100'and openhole from 1396' to1215',

top log was ran openhole from 1170' to 400'.



Natural Gamma
0
CPS
100
Caliper
0
Inches
10
Depth
1ft:240ft
Compensated Density
0
G/CC
4
Long Spaced Density
0
G/CC
4
Short Sspaced Density
0
G/CC
4
20
40
60
80
100
120
140
160
180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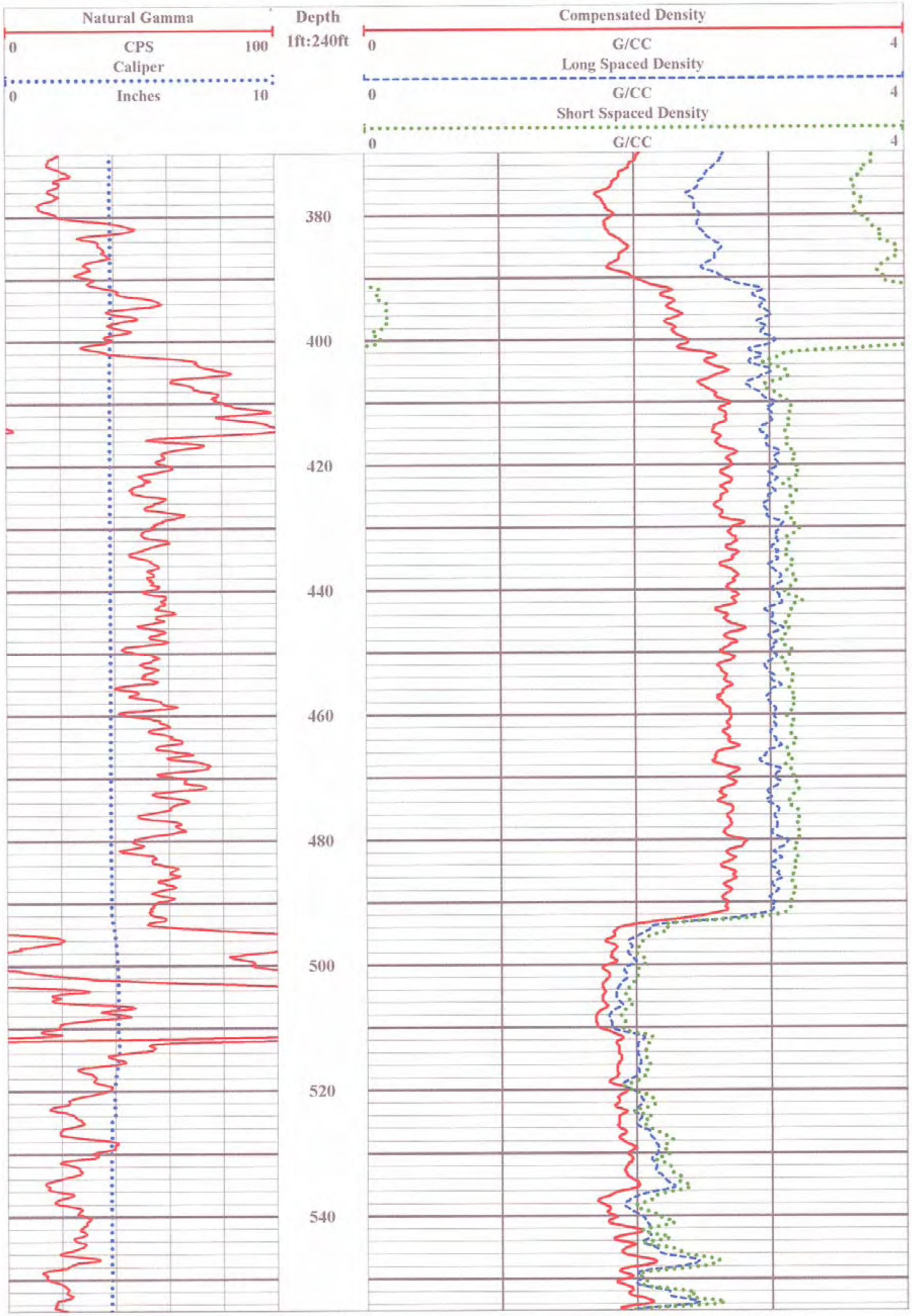
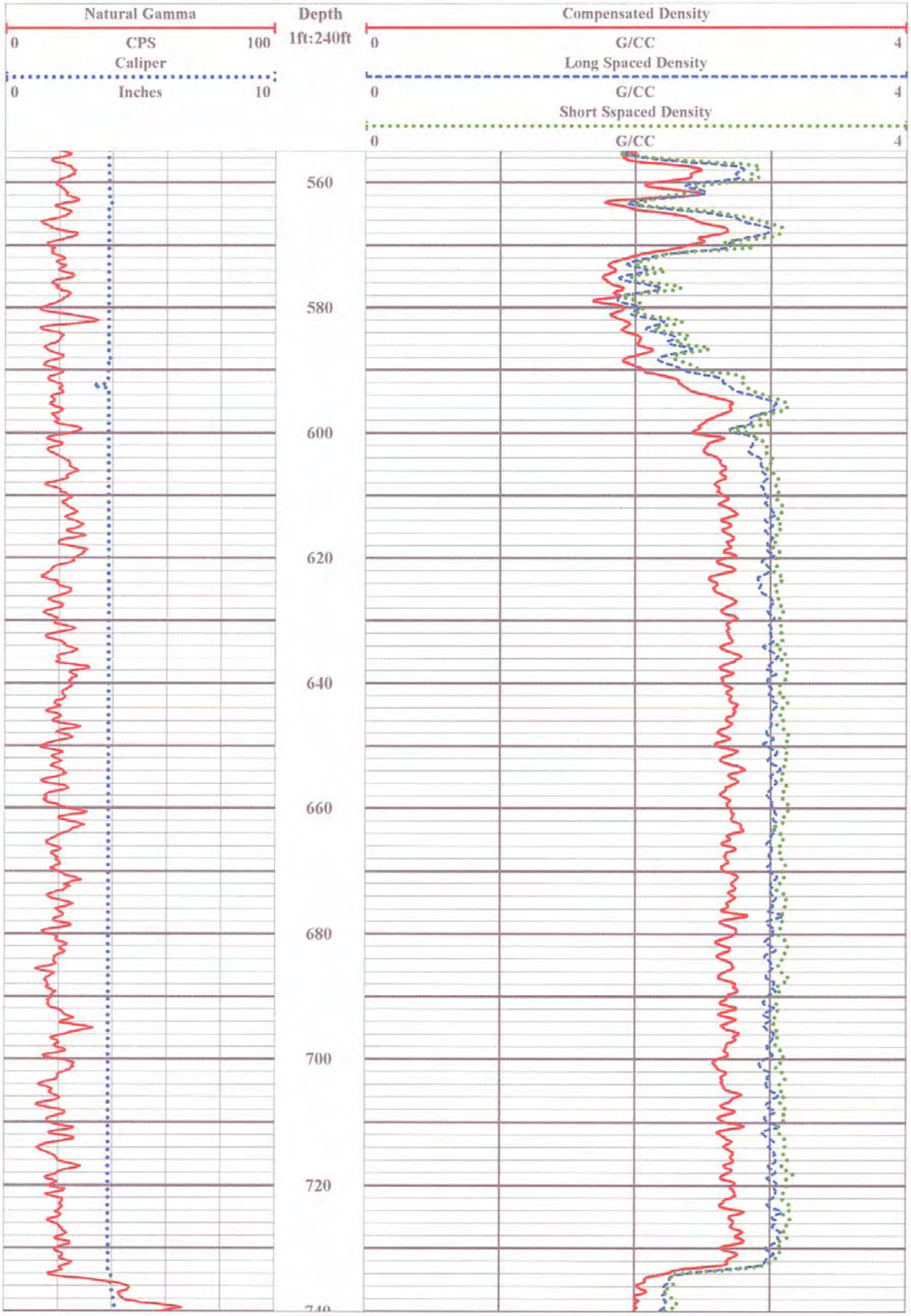
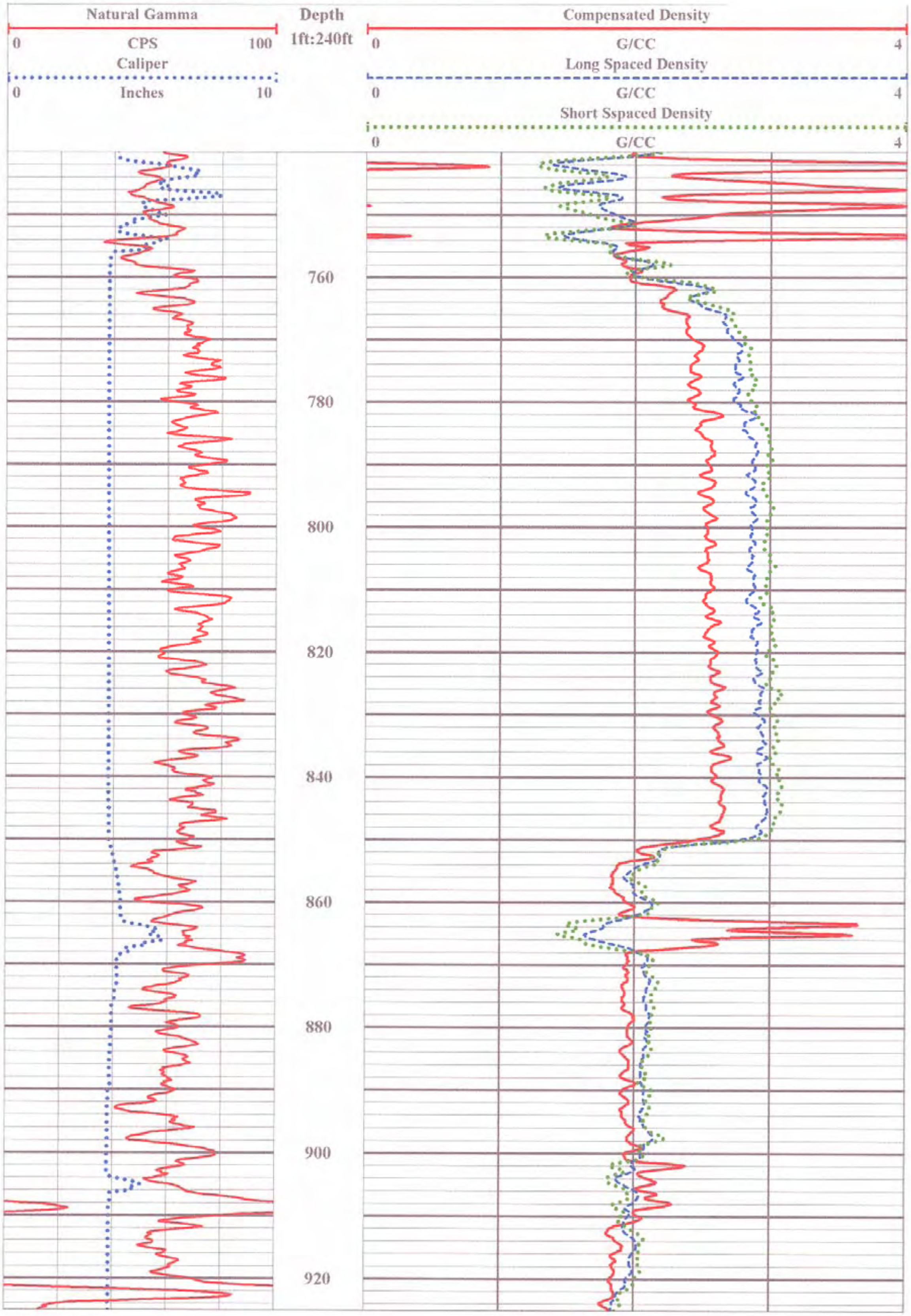
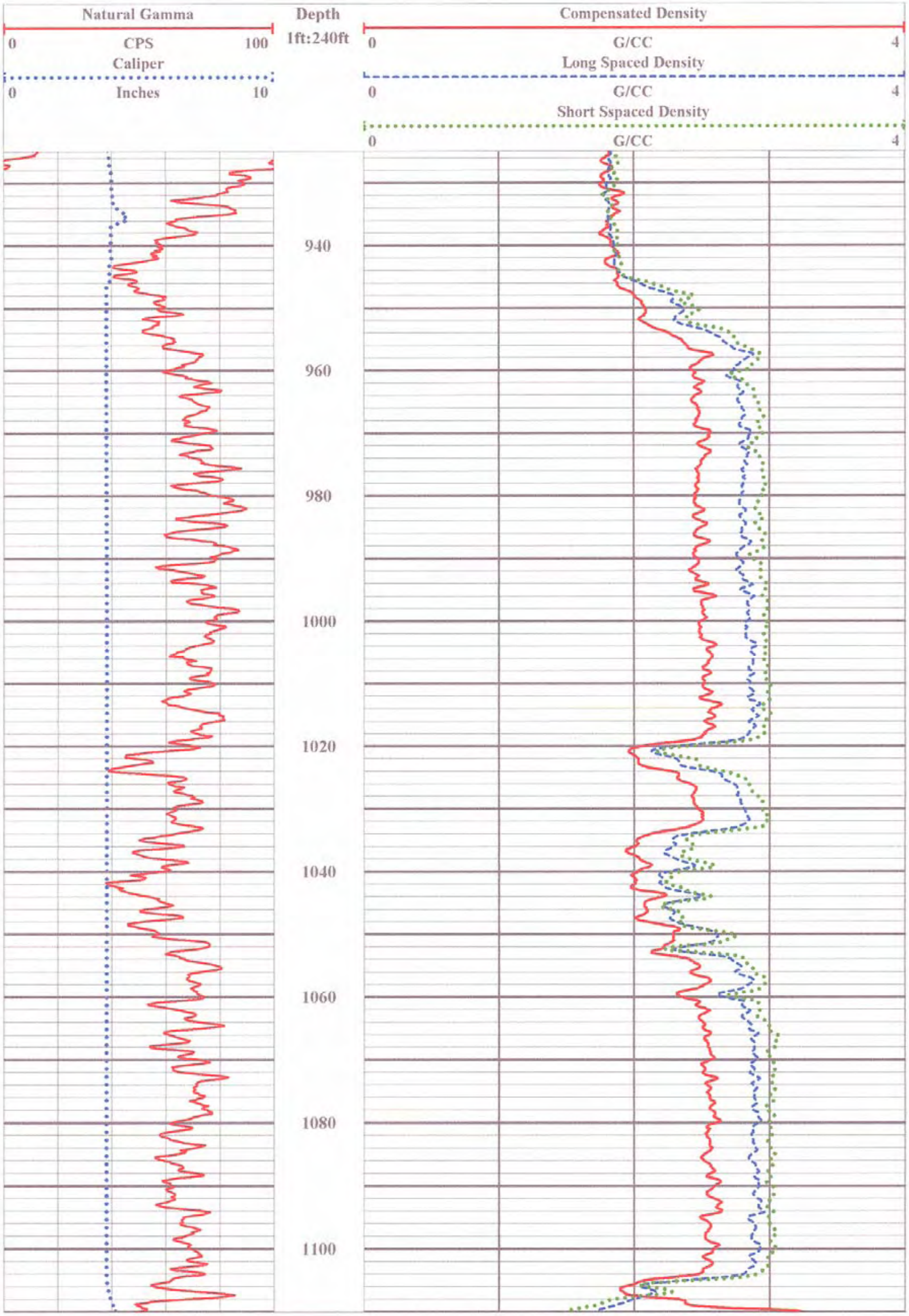
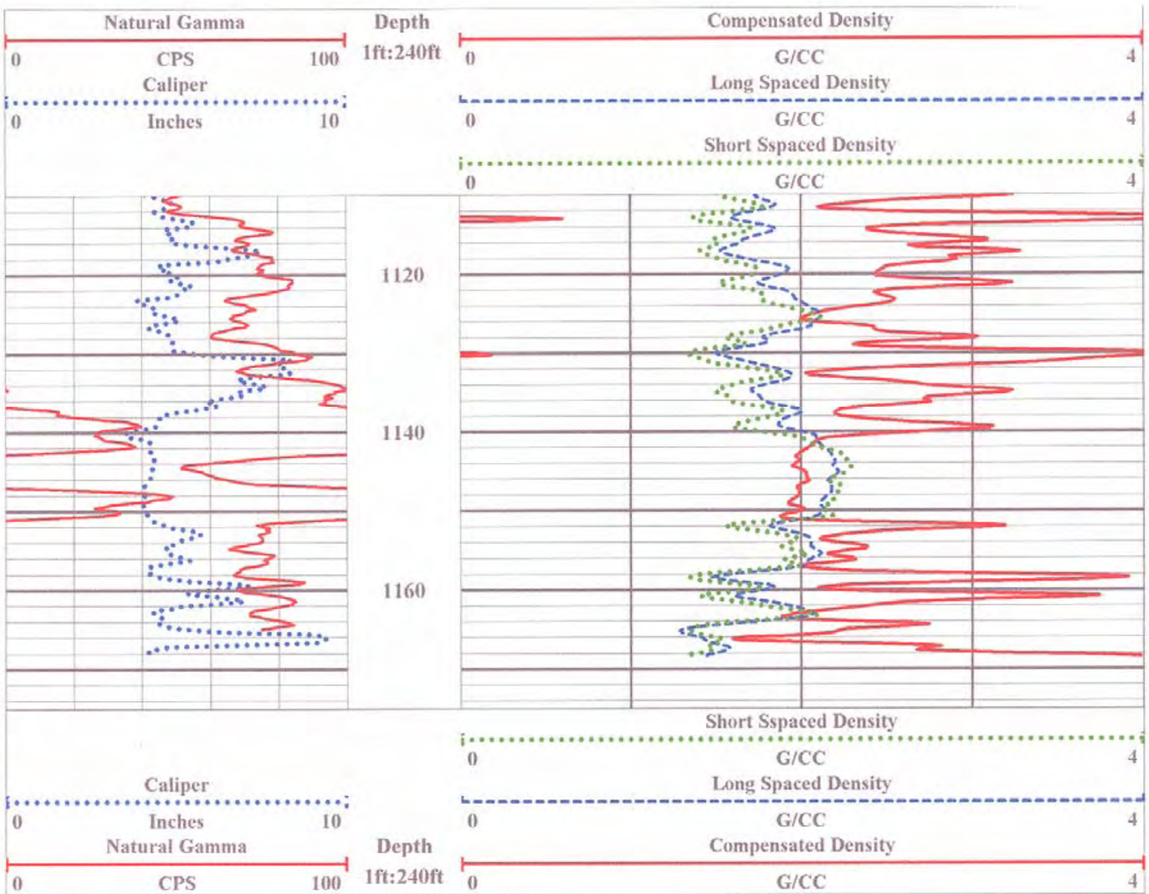
0
CPS
100
Caliper
0
Inches
10
Depth
1ft:240ft
200
220
240
260
280
300
320
340
360
Compensated Density
0
G/CC
4
Long Spaced Density
0
G/CC
4
Short Sspaced Density
0
G/CC
4

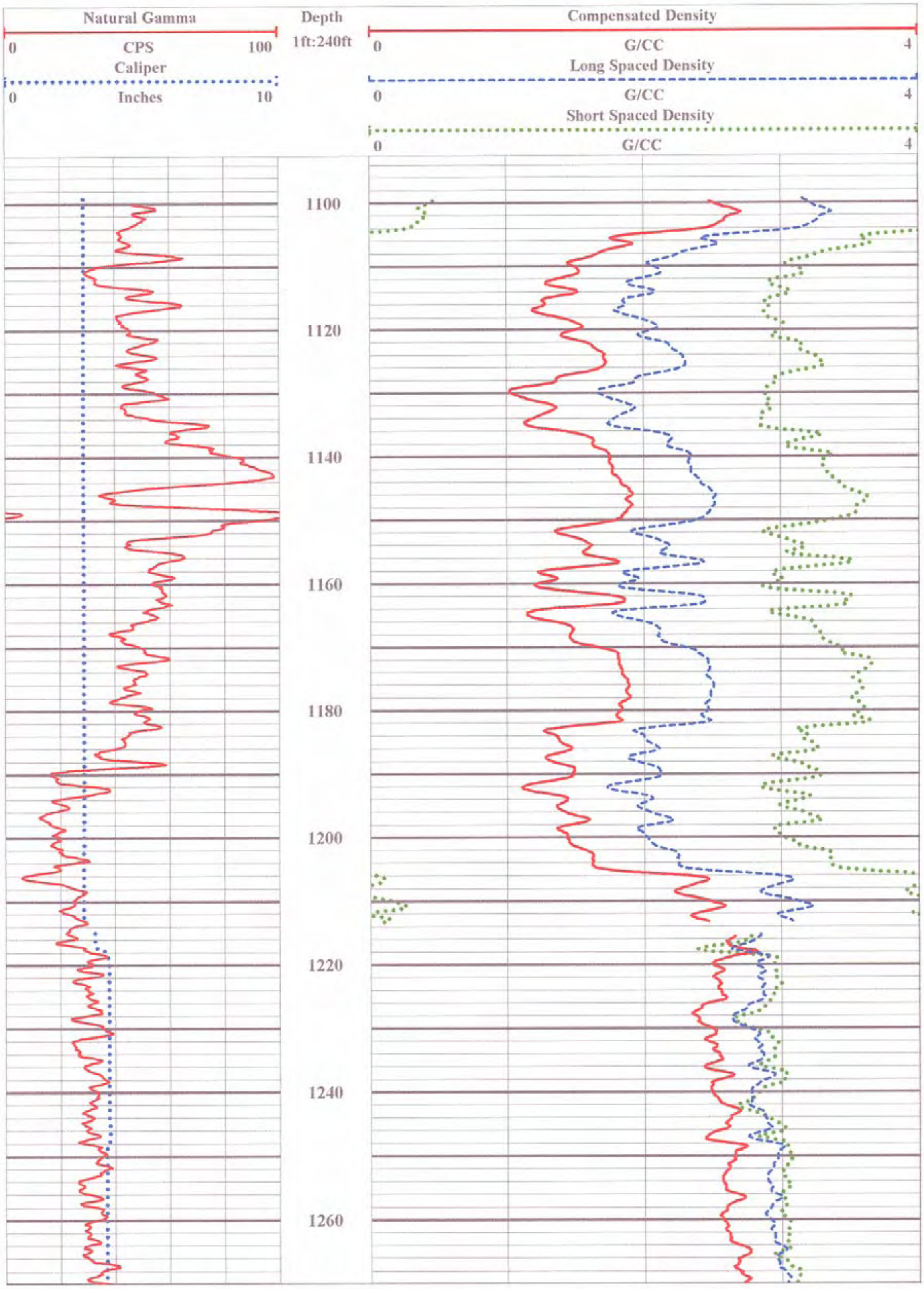

Natural Gamma
0
CPS
100
Caliper
0
Inches
10
Depth
1ft:240ft
380
400
420
440
460
480
500
520
540
Compensated Density
0
G/CC
4
Long Spaced Density
0
G/CC
4
Short Sspaced Density
0
G/CC
4


Natural Gamma
0
CPS
100
Caliper
0
Inches
10
Depth
1ft:240ft
Compensated Density
0
G/CC
4
Long Spaced Density
0
G/CC
4
Short Sspaced Density
0
G/CC
4
560
580
600
620
640
660
680
700
720

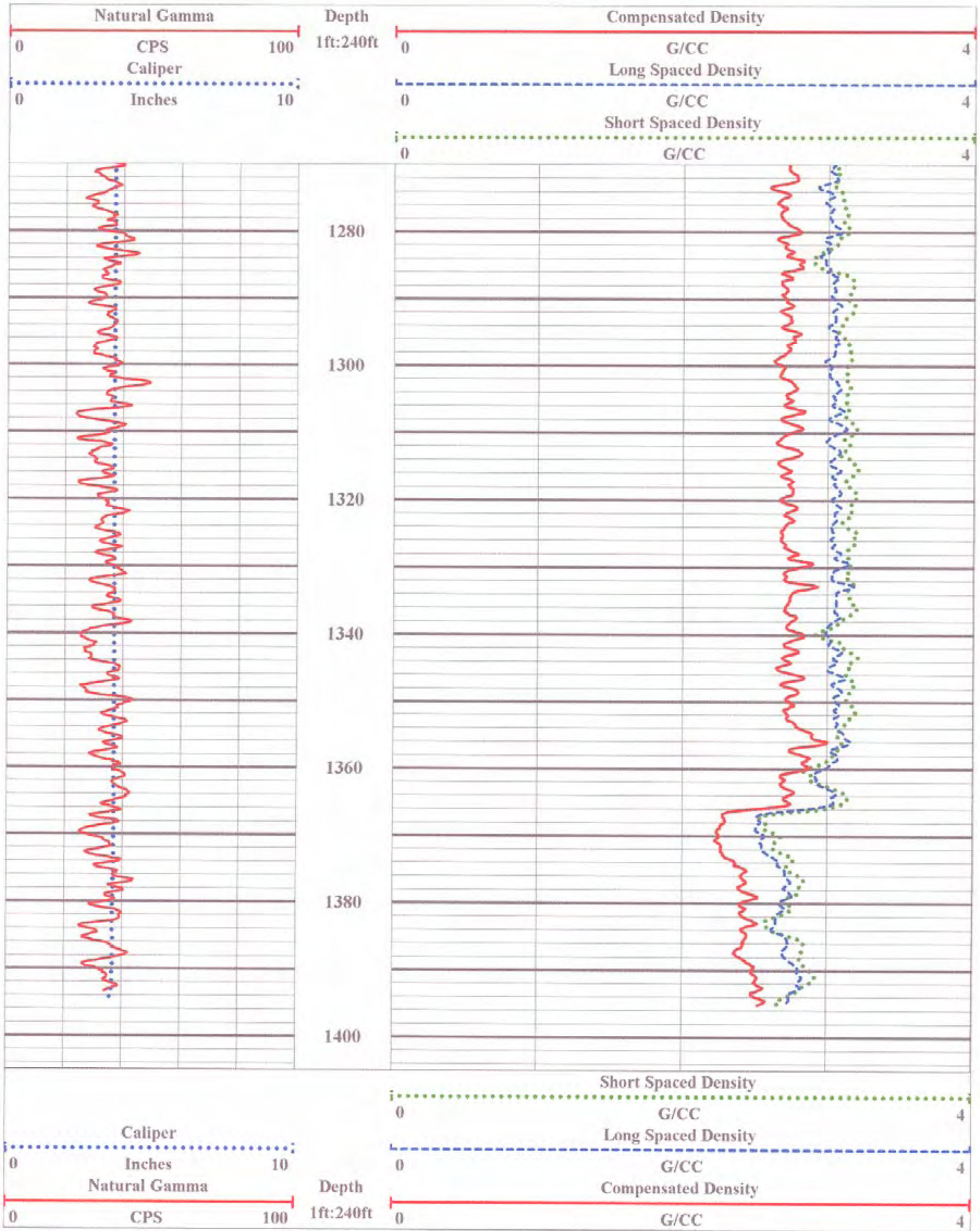

Natural Gamma
0
CPS
100
Caliper
0
Inches
10
Depth
1ft:240ft
Compensated Density
0
G/CC
4
Long Spaced Density
0
G/CC
4
Short Sspaced Density
0
G/CC
4
760
780
800
820
840
860
880
900
920

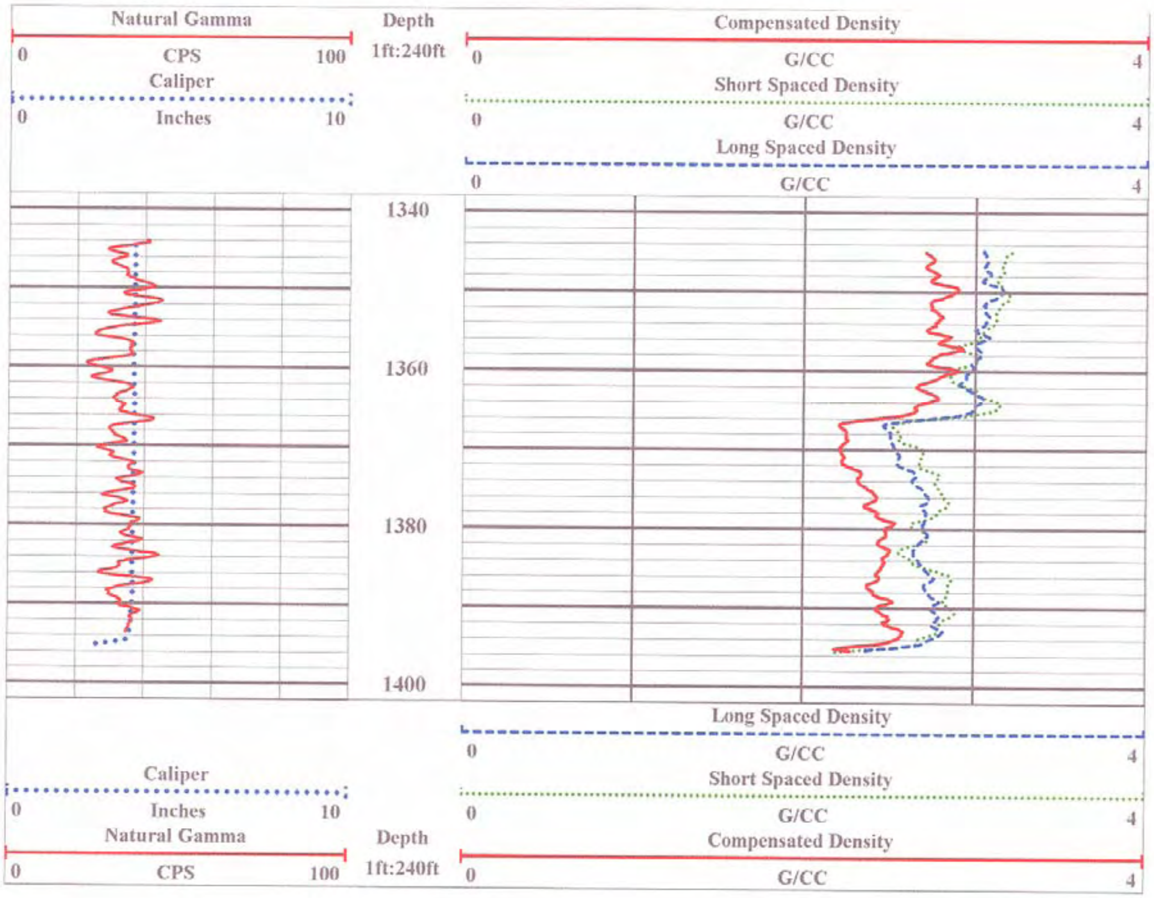

Natural Gamma
0 CPS 100
Caliper
0 Inches 10
Depth
1ft:240ft
Compensated Density
0 G/CC 4
Long Spaced Density
0 G/CC 4
Short Sspaced Density
0 G/CC 4
940
960
980
1000
1020
1040
1060
1080
1100


Natural Gamma
0 CPS 100
Caliper
0 Inches 10
Depth
1ft:240ft
Compensated Density
0 G/CC 4
Long Spaced Density
0 G/CC 4
Short Sspaced Density
0 G/CC 4
1120
1140
1160
Short Sspaced Density
0 G/CC 4
Long Spaced Density
0 G/CC 4
Compensated Density
0 G/CC 4
Caliper
0 Inches 10
Natural Gamma
0 CPS 100
Depth
1ft:240ft



Natural Gamma
0
CPS
100
Caliper
0
Inches
10
Depth
1ft:240ft
1100
1120
1140
1160
1180
1200
1220
1240
1260
Compensated Density
0
G/CC
4
Long Spaced Density
0
G/CC
4
Short Spaced Density
0
G/CC
4


Natural Gamma
0 CPS 100
Caliper
0 Inches 10
Depth
1ft:240ft
Compensated Density
0 G/CC 4
Long Spaced Density
0 G/CC 4
Short Spaced Density
0 G/CC 4
1280
1300
1320
1340
1360
1380
1400
Short Spaced Density
0 G/CC 4
Long Spaced Density
0 G/CC 4
Compensated Density
0 G/CC 4
Caliper
0 Inches 10
Natural Gamma
0 CPS 100
Depth
1ft:240ft


Natural Gamma
0 CPS 100
Caliper
0 Inches 10
Depth
1ft:240ft
Compensated Density
0 G/CC 4
Short Spaced Density
0 G/CC 4
Long Spaced Density
0 G/CC 4
1340
1360
1380
1400
Long Spaced Density
0 G/CC 4
Short Spaced Density
0 G/CC 4
Compensated Density
0 G/CC 4
Caliper
0 Inches 10
Natural Gamma
0 CPS 100
Depth
1ft:240ft

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