TRC0701

# Standard Penetration Hammer Efficiency for N-Value Correction

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Project Number TRC-0701

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# CHAPTER 1

# Introduction

## 1.1 General Overview

The Standard Penetration Test, commonly known as the SPT, has been performed by the Arkansas Highway and Transportation Department since the early 1960's. AHTD uses the results of the SPT to design foundations for bridge and other structures, evaluate retaining wall stability, evaluate liquefaction potential during potential future seismic events as well as to evaluate soil strength for other various purposes.

The SPT is performed by driving a split barrel sampler of standard dimensions into the ground using a 140 lb hammer with a "free" fall of 30 inches. The number of blows are counted for each of three 6" intervals. The total number of blows it takes to drive the sampler the last 12 inches is the SPT N-value. The first 6 inches of penetration is discarded as it is considered to be necessary to seat the sampler through potentially disturbed material in the bottom of the hole.

The SPT was developed in the late 1920's and is still the most popular way to obtain subsurface information. It is estimated that 85 to 90 percent of conventional foundation design in North and South America is made using the SPT (Bowles 1996). The method has been standardized as ASTM D 1586 since 1958 with periodic revisions to date. One reason for the SPT's popularity is the fact that a sample is obtained during the test that allows for classification and laboratory testing. Another advantage of this test is the vast amount of historical data and the many empirical correlations that have been developed based on that data. Undrained shear strength, friction angle, consistency, density, liquefaction potential, Young's modulus, shear modulus, settlement potential in sands, and bearing capacity are some of the geotechnical design parameters that have published correlations to the SPT N-value.

One problem with the SPT is the well documented variability in the resulting N-value for the same soil conditions. ASTM D 1586 allows various drilling methods, hammer types, sampling rods, and liners to be used in conjunction with the test. Each of these items as well as the operator's techniques and equipment's condition introduce some variability into the test. Of all the documented sources of variability in the energy delivered to the drill rods, the hammer type is considered to be the most influential. Energy efficiencies have been reported to vary between 30% and 100% depending on the type of hammer system used. ASTM D 1586 states that the variability in N-values produced by different drill rigs and operators may be reduced by measuring that part of the hammer energy delivered into the drill rods from the hammer and adjusting N on the basis of comparative energies. AHTD currently uses five different hammer systems. Four of these are Central Mine Equipment (CME) automatic hammers and one is a Dietrich automatic hammer.

## 1.2 Objective

The objective of this research project is to determine the most appropriate correction factor by which to adjust the N-value based on measurements of the energy imparted into the sampling rod by each of the five hammers currently in use by AHTD. This study consists of three tasks. The first task is the field testing. This task consisted of measuring the energy imparted into the drill rod during at least 5 SPT Tests for each of the five AHTD hammers. The second task is the data review. This task included the reduction of the data, evaluation of the data quality, and the analysis of the data. The third task is the development and presentation of the recommendations addressing how AHTD should correct the SPT N values and what correction factors are most appropriate for each hammer.

# CHAPTER 2

## Calculations, Equipment and Training for Energy Measurements

### 2.1 Energy Calculations

The method used to calculate the energy imparted by the SPT hammer into the drill rod for this project is known as the EFV method. This method uses the force and velocity measured in the sample rod just below the hammer to calculate the maximum energy. To obtain the force and velocity, an instrumented rod is attached as part of the rod just below the anvil. The product of the force and velocity is integrated with respect to time to obtain the energy:

$$E(t) = \int F du = \int FV dt = EFV$$

The EFV method does not require any correction factors and is not influenced by variances in the cross section or loose joints in the drill rod. This method requires that the velocity be calculated by integrating the acceleration. The acceleration is measured using accelerometers. For some time, the accelerometer technology wasn't capable of measuring accelerations imparted during the SPT test accurately due to the steel on steel hammer impact. For this reason, a method known as the EF2 was commonly used. The EF2 method relies only on the force measurement and the properties of the drill rod to calculate the energy. This EF2 method required correction factors and the calculation is only accurate in the absence of upward traveling waves which are common due to non uniform rods and joints. Because accelerometer technology now allows for accurate measurement of the acceleration of the drill rod from the SPT hammer impact, the EF2 method is effectively obsolete and will not be discussed further.

### 2.2 Equipment

#### 2.2.1 Instrumented Rod

Historically AHTD uses AWJ sampling rod to perform the SPT sampling on every rig except the CME-45 skid rig where AW rod is typically used. The only difference in AWJ and AW rod is the type of threads. The instrumented rod was manufactured by PDI, Inc. from a 2 foot piece of AWJ rod. The instrumented rod consists of a 2 foot section of AWJ drill rod with two strain gauges and 2 accelerometers mounted to it. The two strain gauges allow for the force to be calculated based on the cross sectional area of the rod and the elastic properties of the steel rod. Two accelerometers are bolted on opposite sides of the rod. The two accelerometers measure the acceleration and then the acceleration is integrated into velocity.

##### 2.2.1.1 Strain Gauges

The two strain gauges are foil strain gauges (350 ohm) and are glued directly onto the rod in a full Wheatstone bridge arrangement. The strain gauges are on opposite sides of the rod so that any influence of bending can be taken out. Each strain bridge is terminated in a short cable with a quick disconnect plug.

### 2.2.1.2 Accelerometers

Two accelerometers are bolted on opposite sides of the rod. The acceleration is immediately integrated into velocity. The accelerometers are mounted on rigid aluminum blocks and are terminated in a short cable with a quick disconnect plug. The aluminum blocks are bolted to the instrumented rod section on opposite sides. Figure C-4 in Appendix C is a photo of the accelerometers being mounted to the instrumented rod.

### 2.2.2 Connections

All four of the strain gauges and accelerometers are connected by the quick connector plugs to a short connection cable which accepts up to four individual sensors and combines them into a single main cable. The main cable is then connected to the SPT Analyzer.

### 2.2.3 SPT Analyzer

The SPT Analyzer is a small portable unit which serves as a signal conditioning and processing unit. It is powered by 12 volt DC, either from an internal battery or from a 120 Volt AC main. The SPT Analyzer uses a touch screen interface for entry of project and boring descriptions, user comments, and data control and review. The SPT Analyzer displays graphic data and test results on an LCD screen as the test proceeds. Fig. C-2 in Appendix C shows a picture of the SPT Analyzer screen.

## 2.3 Training

The training was conducted by Jorge Beim of PDI, inc. on October 3$^{rd}$ and 4$^{th}$ 2006. The training consisted of a morning of classroom training, an afternoon of field testing, and then the following morning of data review back in the classroom. The training was held in the Materials Division training room and at the primary testing site. Because the workload at the time permitted it, both drill crews as well as the majority of the technical personnel from the Geotechnical Section were able to attend the entire training.

# CHAPTER 3

## Field Testing Program

### 3.1 Testing Locations

The primary test site is located under the I-440 Arkansas River Bridge between the south bank of the river and the first bridge bent south of the bank. The site is just to the west of the Little Rock Port Authority and is accessed through the Port Authority. Figure 3.1 shows the location of the primary test site. Although some challenging drilling conditions were encountered at this site, the site was convenient to the Materials Division Building, within Department right of way, and void of underground utility lines. Also, the bridge provided shelter from the rain and sun. Boring logs for borings conducted with the Failing 1500, CME-750, CME-75, and CME-850 describe the subsurface conditions at the primary site. These boring logs are included in Appendix B.

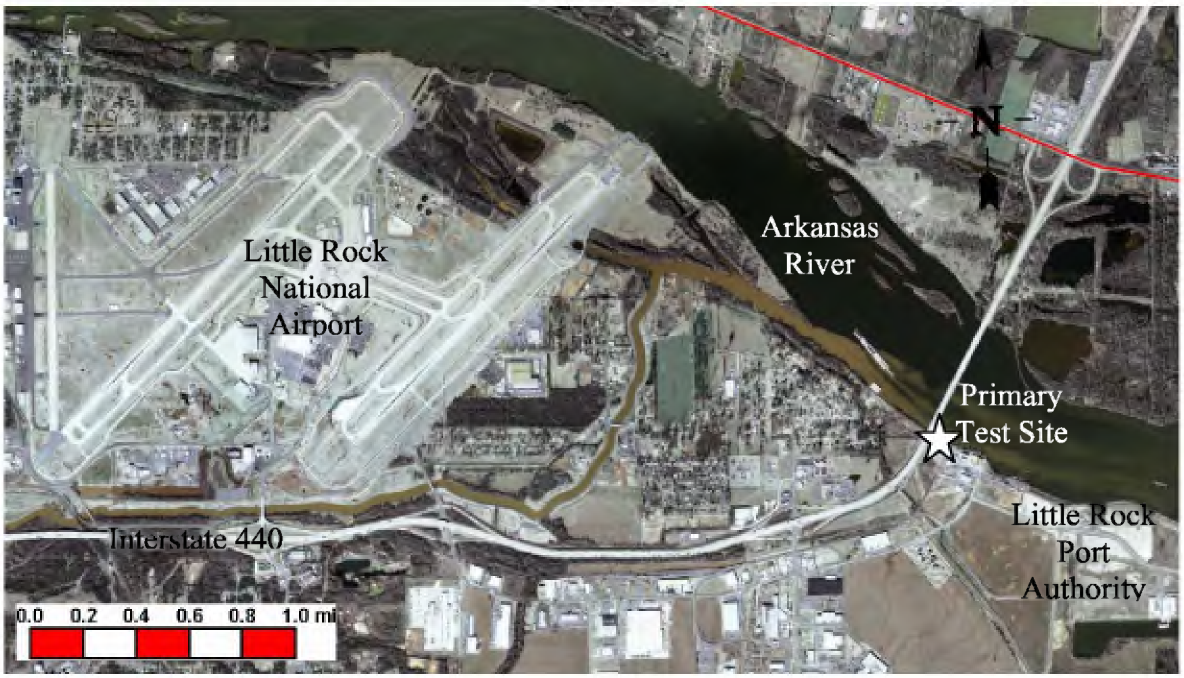



Figure 3.1 – Primary Test Site

A secondary site at the AHTD Equipment and Procurement (E&P) Annex was used for the testing of the CME-45 skid rig's hammer. This site is just east of the northeast corner of the gravel lot on the northeast corner of the E&P grounds. Figure 3.2 shows the location of the secondary test site. Although extremely convenient, this site had very limited overburden above the shale bedrock limiting the depth that testing could be performed to about 15 feet. Boring logs for borings CME-45-A and CME-45-B describe the subsurface conditions at the secondary site. These boring logs are included in Appendix B.


Figure 3.2 – Secondary Test Site

### 3.2 Field Testing – Phase I

Phase I of field testing was all performed at the primary test site. All components for the SPT energy measuring system had been purchased by AHTD from PDI, inc. However, at the time of the first phase of training, PDI, inc. had been delayed calibrating the strain gauges in new instrumented rods, so a temporary "loaner" rod was provided.

All 4 of the AHTD rigs that were in service at the time were tested. The CME 75 truck mounted drill rig had been ordered but had not been delivered at that time.

#### 3.2.1 October 3, 2006

The first day of field testing, the CME 850 and the CME 750 were tested under the direction of Jorge Beim of PDI, inc. Energy measurements were taken for the entire duration of SPT tests conducted at depths of 20, 40, 60, 80, and 100 feet below the existing ground surface. One problem that was noted in the field during this first day of testing was that the accelerometers which were bolted to the instrumented rod had a tendency to become loose. It was believed that the results would still be usable when the velocities from the loose accelerometer were discarded. Both rigs were drilling at the same time and the testing equipment was alternated between the two rigs. This required separate files to be created for each SPT test. The 5 files for the tests performed on each rig were later joined into one file.

### 3.2.2 October 5, 2006

On the second day of the Phase I testing, both the Failing 1500 and the CME 45 skid rig were tested. The Failing 1500 was tested at 20, 40, 60, 80, and 100 feet, but the CME-45 was tested at 10, 20 30, 40, and 50 feet below the existing ground surface. The CME 45 has much more limited capabilities and struggled to reach the 50 foot depth. This rig is typically only used for shallow solid flight and hollow stem auger holes.

To keep the accelerometers from backing off, lock washers were installed on the bolts. Care was taken to ensure that they were totally compressed and provided at least as much surface contact as the bolt heads had previously to the outside of the accelerometers. The Energy Transfer Ratios calculated from these energy measurements were well in excess of 100%. Also, the accelerometers were giving significantly different readings for each blow. Because these results were believed to be in error, they were emailed to Jorge Beim at PDI's home office in Cleveland, Ohio. Based on PDI Personnel's review of the data, the accelerometers were sent in and exchanged for a different model.

### 3.3 Field Testing – Phase II

When the new accelerometers arrived, they had a wider housing through which the bolts had to go before threading into the instrumented rod. When an attempt was made to mount the accelerometers to the rod, they did not lie flat against the rod. Upon closer inspection, it was discovered that the threaded holes in the rod were not perpendicular to the axis of the rod. This is probably also the reason that the bolts were so prone to backing off during Phase I. After conversations with PDI about machining new threaded holes in the rod, it was decided that Phase II would be delayed until the new instrumented rod ordered by AHTD could be delivered.

Upon delivery of the new instrumented rod purchased by AHTD, the testing was performed on the various rigs when most convenient between other projects. Unfortunately during this span of about 8 months, all of the subsurface investigations for roadway cuts, embankments, and bridge structures were being performed in Northwest Arkansas primarily for the Bella Vista Bypass where bedrock is relatively shallow. For this reason, no testing was incorporated into routine subsurface investigation projects. The testing performed for the hammers on each rig will be discussed separately. Table 4.1 presents a summary of the drill rigs, hammers, and test borings.

### 3.3.1 Failing 1500

On November 21, 2006 AHTD personnel measured the energy of the Dietrich automatic hammer mounted on the Failing 1500 during SPT tests at depths of 20, 40, 60, 80, and 100 feet at the primary test site. The AHTD drill crew used rotary wash techniques with a bentonite slurry to maintain hole stability. Casing was limited to a very short piece of surface casing only. During the testing at the 80 foot depth, it was noted that accelerometer #2 became loose.

### 3.3.2 CME 750 All Terrain Rig

On December 4, 2006, AHTD personnel measured the energy of the CME automatic hammer mounted on the CME 750 during SPT tests at depths of 20, 40, 60, 80, and 100 feet at the primary test site. The AHTD drill crew set 10 feet of Hollow Stem Augers to "case" the near surface soils. The crew then advanced the hole using rotary wash techniques with a bentonite slurry to maintain hole stability.

### 3.3.3 CME 75 Truck Mounted Rig

On February 22, 2007 AHTD personnel measured the energy of the CME automatic hammer mounted on the CME 75 during SPT tests at depths of 20, 22, 40, 60, 80, and 100 feet at the primary test site. The crew set 10 feet of Hollow Stem Augers to "case" the near surface soils. The AHTD drill crew then advanced the hole using rotary wash techniques with a bentonite slurry to maintain hole stability. This was the first hole performed using the new, recently delivered 2006 model rig. Kurt Jagar with CME was on site during the drilling and testing which also served as part of the training that was specified for the new drill rig. During the SPT test at 20 feet, the hydraulic chuck release mechanism was left engaged which reduces the flow of hydraulic fluid to the SPT hammer hydraulic motor. It was obvious at the time that the fall of the hammer was reduced so the SPT test was repeated at 22 feet to replace the erroneous data.

### 3.3.4 CME 45 Skid Rig

On March 5, 2007 AHTD personnel measured the energy of the CME automatic hammer mounted on the CME 45 during SPT tests at depths of 3, 8, and 13 feet at the AHTD Equipment and Procurement Annex site. The AHTD drill crew advanced the hole using hollow stem augers. Drilling was performed at this alternative site due to the difficulties encountered during Phase I while rotary wash drilling at the primary test site. The less powerful pump (Moyno 3L6) and smaller diameter augers used by this rig created problems flushing the gravels out of the hole. Also, the shallower depths of 3, 8 and 13 feet are more representative of the depths of typical SPT testing for this rig. Shale was encountered during the 13 foot SPT test in the first boring (CME-45-A). In order to have energy measurement data from the same number of SPT tests as the other rigs, another hole (CME-45-B) was drilled approximately 5 feet away from the first.

### 3.3.5 CME 850

On July 17, 2007 AHTD personnel measured the energy of the CME automatic hammer mounted on the CME 850 during SPT tests at depths of 22, 40, 60, 80, and 100 feet at the primary test site. The crew set 10 feet of Hollow Stem Augers to "case" the near surface soils. The AHTD drill crew then advanced the hole using rotary wash techniques with a bentonite slurry to maintain hole stability. During the SPT test at 20 feet, the SPT Analyzer was not set to record data. For this reason, an additional test was performed at 22 feet to replace the missing data.

| Drill Rig | Date Tested | Hammer Type | Sample Rod | Driller | Drilling Method | Slurry |
|---|---|---|---|---|---|---|
| FAILING 1500 (1975) | 11/21/2007 | Dietrich Automatic | AWJ | Donnie Thornton | Rotary Wash | Bentonite |
| CME-750 (1997) | 12/4/2006 | CME Automatic | AWJ | Daniel Dickerson | Rotary Wash | Bentonite |
| CME-75 (2006) | 2/22/2007 | CME Automatic | AWJ | Brian Casto | Rotary Wash | Bentonite |
| CME-45 (1986) | 3/5/2007 | CME Automatic | AWJ | Josh Higginbottom | Hollow Stem Auger | N/A (dry) |
| CME-850 (2001) | 7/17/2007 | CME Automatic | AWJ | Gary Brown | Rotary Wash | Bentonite |

Table 4.1 – Summary of Drill Rigs, Hammers, and Test Borings for Phase II

# CHAPTER 4

## Data Analysis

### 4.1 Data Quality Evaluation

All data was downloaded from the SPT Analyzer to an AHTD server. Each recorded blow was evaluated to determine if it was a full hammer blow. Frequently at the end of the SPT test, the driller shuts down the hammer late enough in the hammer cycle that a partial blow occurs. Additionally, if the data collection is begun before the hammer is placed on the anvil, the sensors may record this as a low energy blow. All of these "accidental" partial blows were deleted. Each remaining blow was evaluated for quality based on several factors. The agreement between the two velocities integrated from the accelerometers and the agreement between the two force measurements calculated from the two strain gauges was evaluated. Ideally, the value of both V1/V2 and F1/F2 are 1.00 indicating agreement between the accelerations measured in both accelerometers and the strain measurements in both strain gauges. With the second set of accelerometers, the ratios of V1/V2 and F1/F2 were typically well within an acceptable range indicating good consistency between the sensors. The only exceptions came during the 80 foot test with the Failing-1500. As this test was being performed, one of the Accelerometers, A2, became loose. This was documented during the field testing and clearly visible in the data. During these blows, Accelerometer 2 provided unusable data that had to be excluded. Only data from Accelerometer 1 was used for these blows to determine the velocity component of the energy calculation. Table 4.1 summarizes the values of these quality control parameters.

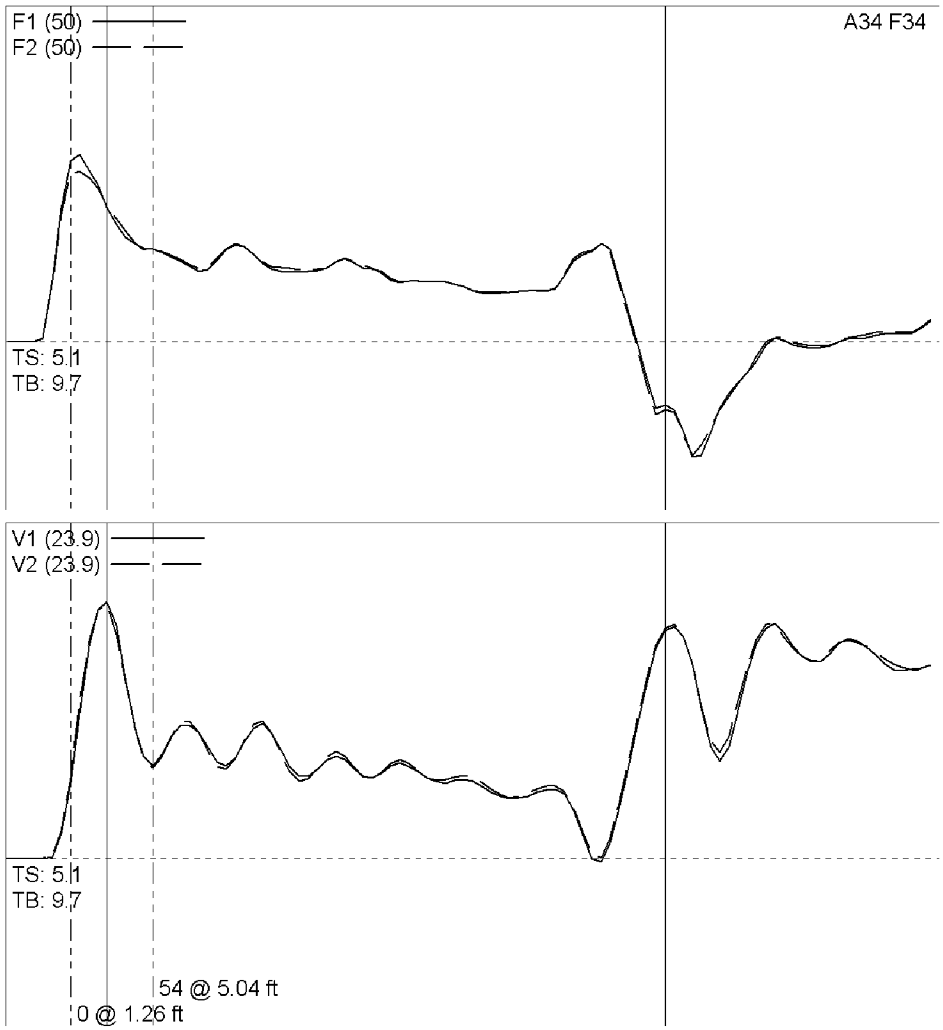
| | V1/V2 | | | | F1/F2 | | | |
|---|---|---|---|---|---|---|---|---|
| Drill Rig | Average | Max. | Min. | Standard Deviation | Average | Max. | Min. | Standard Deviation |
| Failing-1500 | 1.00 | 1.14 | 0.85 | 0.07 | 1.00 | 1.05 | 0.95 | 0.02 |
| CME-750 | 0.99 | 1.06 | 0.92 | 0.03 | 1.00 | 1.05 | 0.95 | 0.02 |
| CME-75 | 1.00 | 1.05 | 0.95 | 0.02 | 1.04 | 1.24 | 0.95 | 0.03 |
| CME-45 | 0.98 | 1.05 | 0.91 | 0.03 | 0.98 | 1.02 | 0.93 | 0.02 |
| CME-850 | 1.03 | 1.14 | 0.95 | 0.03 | 1.06 | 1.16 | 1.00 | 0.04 |

Table 4.1 – Data Quality Control Parameters

### 4.2 Data Adjustment

The peak in the velocity curve and the peak in the force curve should occur at the same time. One standard adjustment that is made in the data is for the velocity to be shifted relative to the force in time. Figure 4.1 shows the plot of a single blow before the velocity was shifted relative to the force in time, and Figure 4.2 shows the same blow after the velocity was shifted. The peaks in the force and velocity curves line up much better after the velocity was shifted.

TRC0701 CME850_2




*Project Information*
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PILE NAME: CME850_2
DESCR: ;CME850;
OPERATOR: DSR
FILE: CME850_2.W01
7/17/2007 11:14:19 AM
Blow Number 1

*Pile Properties*

| | |
|---|---|
| LE | 25.50 ft |
| AR | 1.17 in^2 |
| EM | 30000 ksi |
| SP | 0.492 k/ft3 |
| WS | 16807.7 f/s |
| EA/C | 2.1 ksec/ft |
| 2L/C | 3.03 ms |
| JC | 0.00 [] |
| LP | 20.00 ft |

*Quantity Results*

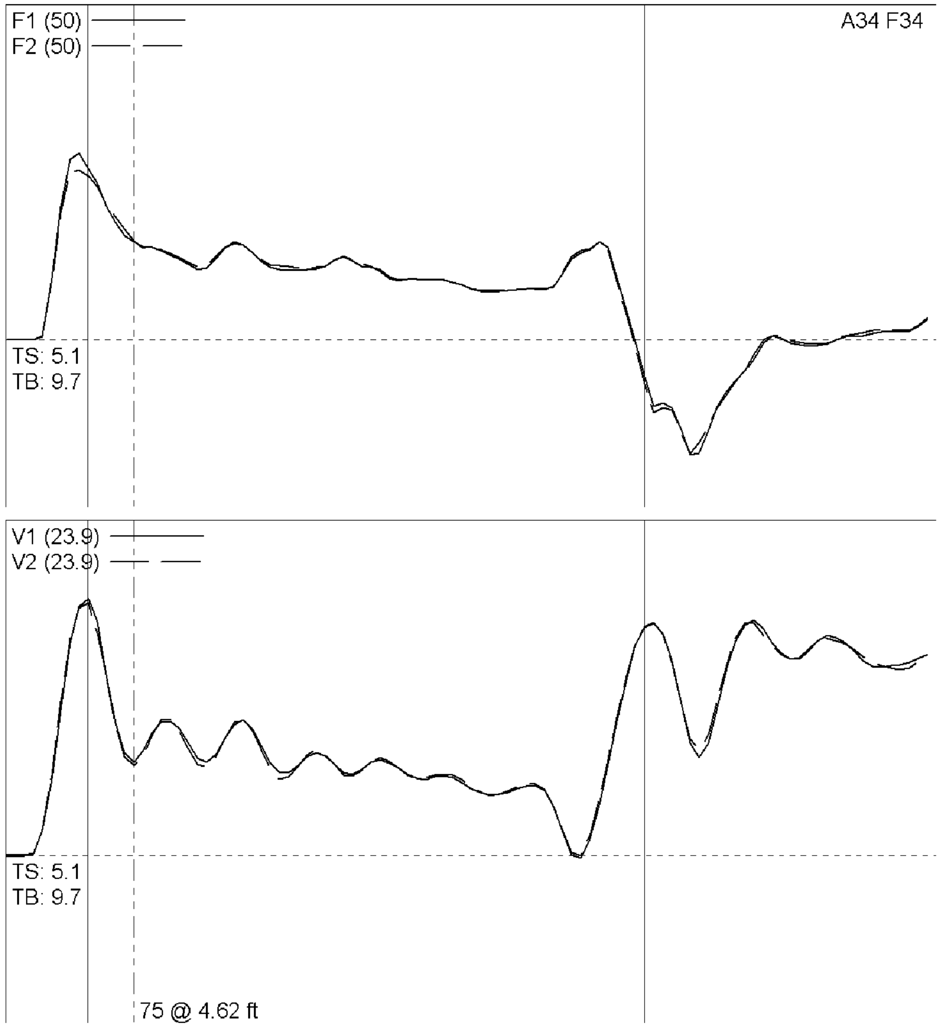
| | |
|---|---|
| FMX | 27 kips |
| VMX | 18.2 f/s |
| FVP | 0.5 [] |
| EFV | 0.287 k-ft |
| BPM | 0.0 bpm |
| ETR | 82.0 (%) |
| EMX | 0.287 k-ft |
| ER | 0.350 k-ft |
| QNV | 0.00 [] |

*Sensors*
F3: [F1] 218.16 (1)
F4: [F2] 219.18 (1)
A3: [A1] 282 mv/5000g's (1)
A4: [A2] 295 mv/5000g's (1)
CLIP: OK
F3/F4: OK 0.99
V3/V4: OK 1.01

Version 2005.096.007

Figure 4.1 – Plot of Representative Blow Prior to Velocity Shift

TRC0701 CME850_2




***Project Information***

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| EA/C | 2.1 ksec/ft |
| 2L/C | 3.03 ms |
| JC | 0.00 [] |
| LP | 20.00 ft |

***Quantity Results***

| | |
|---|---|
| FMX | 27 kips |
| VMX | 18.2 f/s |
| FVP | 0.7 [] |
| EFV | 0.309 k-ft |
| BPM | 0.0 bpm |
| ETR | 88.3 (%) |
| EMX | 0.309 k-ft |
| ER | 0.350 k-ft |
| QNV | 0.00 [] |

***Sensors***

F3: [F1] 218.16 (1)
F4: [F2] 219.18 (1)
A3: [A1] 282 mv/5000g's (1)
A4: [A2] 295 mv/5000g's (1)
CLIP: OK
F3/F4: OK 1.05
V3/V4: OK 1.02

Version 2005.096.007

Figure 4.2 – Plot of Representative Blow After Velocity Shift

This adjustment is commonly needed to reduce apparent phase shifts in the data and is recommended good practice (PDA-W). This adjustment should typically not exceed 2.0 time increments (SPT Analyzer). Table 4.2 gives the values by which the velocity was shifted for each of the hammers and the corresponding effect on the average maximum velocity (VMX), energy (EFV), and the energy transfer ratio (ETR).

| Hammer System | Velocity Shift | VMX | EFV | ETR |
|---|---|---|---|---|
| Failing-1500 | -1.8 | -0.175 | +0.020 | +5.69% |
| CME-750 | -1.8 | -0.200 | +0.010 | 2.55% |
| CME-75 | -0.5 | -0.246 | +0.002 | +0.59% |
| CME-45 | 0.0 | 0.000 | 0.000 | 0.00% |
| CME-850 | -2.0 | -0.0024 | +0.0197 | +5.61% |

Table 4.2 – Velocity Shift and Effect on Data

Another adjustment that was deemed appropriate involved the reduction of some of the velocities obtained from the accelerometers. For a uniform cross section, good data should have reasonable proportionality between the force and velocity at the first peak (PDA Help). Although the sample rod will not have a truly uniform cross section due to the joints present every 10 feet as well as small variations in the rod wall thickness, the velocity measurements for some of the hammers were considered to be disproportionably high when compared to the force measurements. For this reason the velocity replay factors RV1 and RV2 were adjusted until the proportionality was within acceptable limits. The default velocity replay factor is 1.0. The replay factor for the CME 750 data and much of the CME 45 data was kept at 1.0. However, the velocity replay factor for the remaining data was adjusted to values ranging from 0.8 to 0.9. The measured velocity for the hammer blow is simply multiplied by this replay factor. Since all adjusted replay factors are less than 1.0, both the velocities and the resulting calculated hammer efficiencies are reduced. Table 4.3 shows the replay factors applied to the velocities and the corresponding effect on the average maximum velocity (VMX), energy (EFV), and the energy transfer ratio (ETR).

| Hammer System | Velocity Replay Factor | VMX | EFV | ETR |
|---|---|---|---|---|
| Failing-1500 | 0.85 | -3.946 | -0.056 | -16.1% |
| CME-750 | 1.00 | 0.000 | 0.000 | 0.00% |
| CME-75 | 0.90 | -1.590 | -0.032 | -9.31% |
| CME-45 | 0.90* | -0.550 | -0.010 | -2.98% |
| CME-850 | 0.80 | -3.959 | -0.068 | -19.37% |

* Applied to last 2 SPT tests only

Table 4.3 – Velocity Replay Factor and Effect on Data

### 4.3 Correction Factors

Sixty percent is considered the standard energy transfer for the SPT test. The correction factor to standardize the SPT N-values to 60 percent energy is simply the ratio of the actual hammer energy transfer ratio to 60 percent, or:

$$CorrectionFactor = \frac{ETR(\%)}{60\%}$$

The uncorrected field SPT N-values ($N_f$) can then be corrected to the corresponding N-value at 60% energy ($N_{60}$) by multiplying by the Correction Factor:

$$N_{60} = N_f \times CorrectionFactor$$

The average ETR was calculated based on all the acceptable blows recorded for each hammer system. The blows occurring during the six inch seating interval as well as both six inch increments that would count toward the SPT N-value were used in the analysis. With the method of energy measurement being used, there is no reason the energy or energy measurements should be any different for the seating blows as compared to the other intervals. Using all the blows increases the data set, giving more confidence in the computed averages. This average ETR was used to calculate a correction factor for each hammer system. Table 5.3 provides the average ETR for each of the hammer systems, the standard deviation, and the corresponding correction factor.

| | | Average ETR | Standard Deviation | Correction Factor |
|---|---|---|---|---|
| FAILING 1500 (1975) | Dietrich Automatic | 79.1 | 6.56 | 1.32 |
| CME-750 (1997) | CME Automatic | 76.9 | 3.90 | 1.28 |
| CME-75 (2006) | CME Automatic | 83.0 | 2.23 | 1.38 |
| CME-45 (1986) | CME Automatic | 85.3 | 4.74 | 1.42 |
| CME-850 (2001) | CME Automatic | 77.5 | 1.84 | 1.29 |

Table 4.4 – Average ETR and Corresponding Correction Factor

### 4.4 Comparison of $N_{60}$'s

In theory, the $N_{60}$ values at each depth should be more consistent than the raw field N-values ($N_f$). This is based on the assumption that the subsurface stratigraphy is consistent across the site in both material type and density or consistency. Data from the CME-45 testing cannot be included in this comparison because it was performed at a different site. Also, at the primary testing site, the SPT testing at the 80 and 100 foot depths encountered varying amounts of gravel and varying degrees of cementation resulting in very high N-values and refusal. For this reason, only the test results from the 20, 40, and 60 foot depths are worthy of evaluation. Figure 4.3 and Figure 4.4 present the relationships between the field N-Values and between the $N_{60}$ values, respectively, for the AHTD hammers.

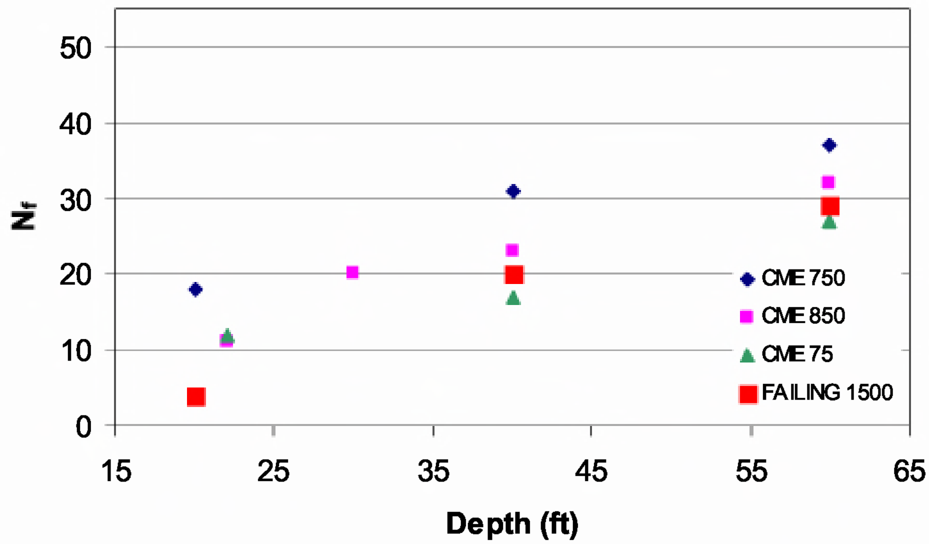



Figure 4.3 – Field N-Value ($N_f$) vs. Depth

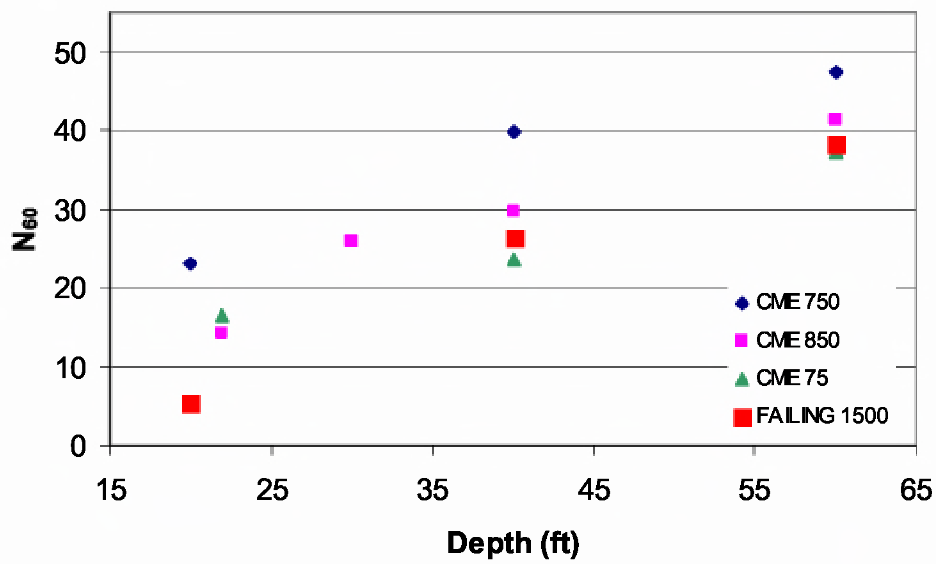



Figure 4.4 – Corrected N-Value ($N_{60}$) vs. Depth

Although all borings were performed in a relatively small area, the site was more variable between borings than desirable for this comparison. This is supported by the differences in field N-values between tests performed during Phase I and Phase II at the same depth using the same hammer. Figure 4.5 shows the field N-Values for the tests performed using the CME-750 hammer during Phase I and Phase II testing.

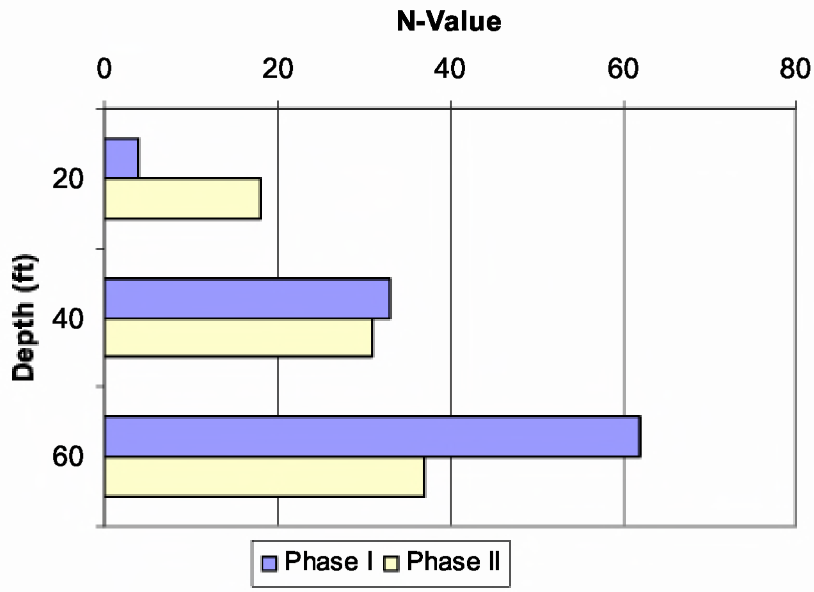



Figure 4.5 – Field N-Values for CME-750 during Phase I and Phase II

Even in a single boring performed by the CME-850, the N-values varied greatly between depths of 20.0 and 23.5 feet showing the high variability in the densities of the soils at the site with depth. Figure 4.6 presents the blows for each six inch increment for these depths.

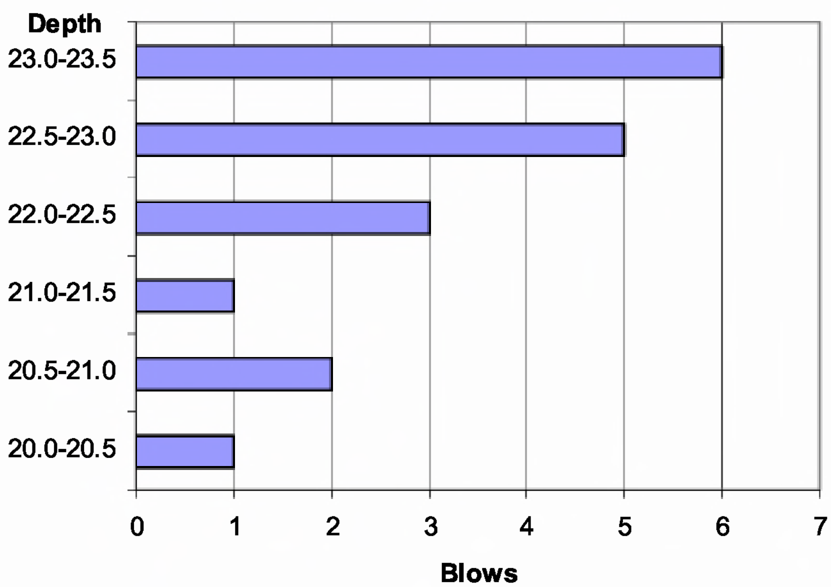



Figure 4.6 – Blows per 6 Inch Increment for CME-850

## 4.5 Comparison to Similar Hammers

Table 4.5 provides a summary of the reported energy transfer ratios for SPT hammers similar to those used by AHTD.

| Agency | Tested By | Hammer Type | Reported ETR's | | | Reported By | Comments |
|---|---|---|---|---|---|---|---|
| | | | Low | High | Average | | |
| Washington DOT | GRL | CME Automatics | * | * | 77% | Lamb (1997) | Multiple Hammers |
| Oregon DOT | GRL | CME Automatics | 78% | 82% | * | * | Multiple Hammers |
| Minnesota DOT | * | CME Automatic | 76% | 94% | 80% | Lamb (1997) | 1 Hammer |
| Florida DOT & Consultants | * | Automatics | * | * | 83.2% | Davidson et.al (1999) | Numerous Hammers |
| Maryland DOT | MD DOT | CME Automatic | 77.2% | 89.36 | 81.4% | Aggour and Radding (2001) | 1 Hammer |

* Data Not Available

Table 4.5 – Reported Energy Transfer Ratios of Automatic Hammers, per Aggour and Radding (2001)

The average energy transfer ratios reported in Table 4.4 appear very reasonable when compared to the energy transfer ratios in Table 4.5 reported for similar hammers in other states.

# CHAPTER 5

## Conclusions and Recommendations

### 5.1 Conclusions

Many different SPT equipment related factors introduce variability into the resulting N-value. One of the most influential factors is the hammer energy. Different types of hammers deliver different amounts of energy into the sampling rod. In order to standardize the N-value based on the hammer energy, the N-value can be corrected to $N_{60}$. $N_{60}$ is the N-value that would have occurred if the hammer had been transferring 60% of the maximum theoretical energy into the sample rod. The standard of 60% is used because researchers have come to relative agreement that this is the average amount of energy on which most of the correlations between the N-value and the engineering properties of soils are based.

The standardization to $N_{60}$ is achieved by multiplying the measured field N-value by a correction factor. The correction factor is the actual hammer efficiency in percent divided by 60. In order to obtain the actual hammer efficiencies of each of the 5 AHTD hammers, the energies of each of the hammers were measured using an SPT Analyzer purchased from Pile Dynamics, Inc. Five SPT's were performed with each of the rigs. With the exception of the CME-45, all rigs were tested at the same site at depths of approximately 20, 40, 60, 80, and 100 feet. The energy transmitted into the rod was measured on every blow during each of the five SPT's. Comparisons of field and corrected N-values at each depth are concluded to lack merit due to the variability of the site in gravel content and soil density. These two factors even had great influence on the N-values of the same hammer at small changes in depth and in the N value of the same hammer in different holes at the same depth.

Published correction factors for automatic hammers like the ones AHTD uses range from 0.8 to 1.67 (Aggour and Radding 2001). All of the correction factors calculated using the average measured efficiencies fall within this range of values. Automatic hammers are advantageous to other hammer types because the hydraulics lift the hammer making the hammer energy much less affected by the operator's technique and fatigue level than other hammer systems.

### 5.2 Recommendations

#### 5.2.1 Immediate Action

Of all the corrections that have been recommended for application to the SPT N-value, the correction for the energy of the hammer has the most significant impact on the N-value. By comparison, most of the other corrections are relatively minor. Because the correction for hammer energy has such a significant impact on the N-value, the following recommendations are considered appropriate for AHTD to implement immediately:

- The recommended correction factor as provided in Table 5.1 for the particular hammer used should be placed on each boring log. Figure 5.1 shows an example boring log with this information added. Also, an explanation of how to apply this correction factor should be added to the legend that accompanies the boring logs. Figure 5.2 shows the legend with this explanation added.
- The energy of each hammer should be measured periodically to ensure that the hammer's energy hasn't changed due to equipment wear or other factors. The frequency should depend upon the use of the hammer systems. Annual measurements would be recommended for equipment under frequent use.
- The energy of a hammer should be tested after the hammer has had any significant maintenance or repairs performed.

| Drill Rig | Hammer | Recommended Correction Factor |
|---|---|---|
| FAILING 1500 (1975) | Dietrich Automatic | 1.32 |
| CME-750 (1997) | CME Automatic | 1.28 |
| CME-75 (2006) | CME Automatic | 1.38 |
| CME-45 (1986) | CME Automatic | 1.42 |
| CME-850 (2001) | CME Automatic | 1.29 |

Table 5.1 – Correction Factors Recommended for Use

| ARKANSAS HWY. & TRANS. DEPARTMENT<br>MATERIALS DIVISION - GEOTECHNICAL SEC. | BORING NO. AR-R8-2<br>PAGE 1 OF αα |
|---|---|
| JOB NO. 090224 Benton Co<br>JOB NAME: Bella Vista - Pineville, M<br>U.S. 71<br>STATION: 881+15<br>LOCATION: 102' Left of Center Line of Median<br>LOGGED BY: Josh Higginbottom | DATE: May 1, 2007<br>TYPE OF DRILLING: Hollow Stem Auger<br>EQUIPMENT: CME 750 w/ CME Automatic Hammer<br>HAMMER CORRECTION FACTOR: 1.25 |
| COMPLETION DEPTH: 51.3 | |

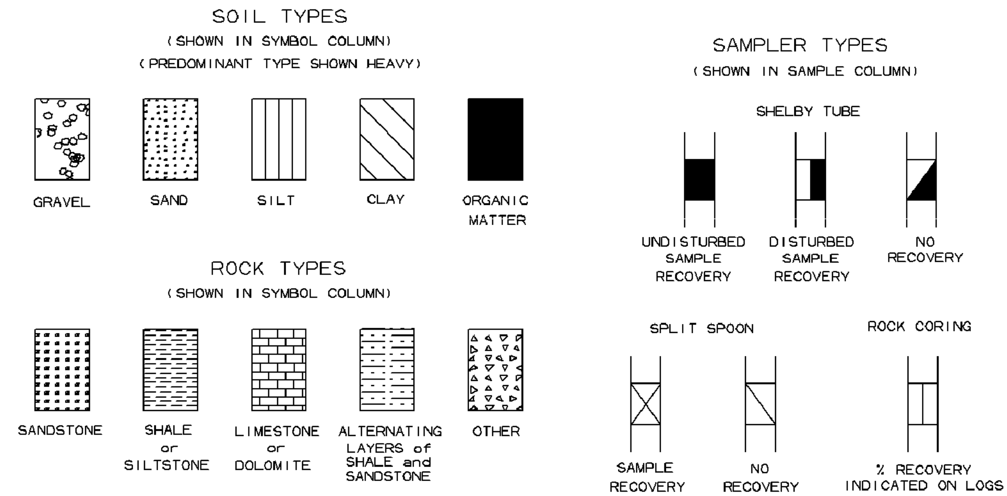
CORRECTION FACTOR

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: 1357.7 | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | X | Moist, Hard, Reddish Brown Gravelly (Chert Fragments) Clay | | | | | | 14<br>25-29 | | |
| 10 | | X | | | | | | | 29<br>34-19 | | |
| 15 | | X | Moist, Very Stiff, Reddish Brown Gravelly (Chert Fragments) Clay | | | | | | 9<br>10-8 | | |
| 20 | | X | Moist, Dense, Reddish Brown and Gray Clayey Gravel (Chert Fragments) | | | | | | 12<br>23-18 | | |
| 25 | | X | Moist, Stiff, Reddish Brown Gravelly (Chert Fragments) Clay | | | | | | 8<br>9-6 | | |
| 30 | | X | Moist, Medium Dense, Reddish Brown and Gray Clayey Gravel (Chert Fragments) | | | | | | 3<br>4-7 | | |
| 35 | | X | | | | | | | 3 | | |

REMARKS: * Drilling circulation fluid loss was encountered from 46.3' to 51.3'.

Figure 5.1 – Example Boring Log with Correction Factor

# LEGEND




TERMS DESCRIBING CONSISTENCY OR CONDITION

| GRANULAR SOIL | | CLAY | | CLAY-SHALE | | SHALE | |
|---|---|---|---|---|---|---|---|
| "N" Value | Density | "N" Value | Consistency | "N" Value | Consistency | "N" Value | Consistency |
| 0-4 | Very Loose | 0-1 | Very Soft | 0-1 | Very Soft | | |
| 5-10 | Loose | 2-4 | Soft | 2-4 | Soft | 31-60 | Soft |
| 11-30 | Medium Dense | 5-8 | Medium Stiff | 5-8 | Medium Stiff | Over 60 | |
| 31-50 | Dense | 9-15 | Stiff | 9-15 | Stiff | More than 2" Penetration in 60 Blows: | Medium Hard |
| Over 50 | Very Dense | 16-30 | Very Stiff | 16-30 | Very Stiff | | |
| | | 31-60 | Hard | 31-60 | Hard | | |
| | | Over 60 | Very Hard | Over 60 | Very Hard | Less than 2" Penetration in 60 Blows: | Hard |

1. Ground water elevations indicated on boring logs represent ground water elevations at date or time shown on boring log. Absence of water surface implies that no ground water data is available but does not necessarily mean that ground water will not be encountered at locations or within the vertical reaches of these borings.
2. Borings represent subsurface conditions at their respective locations for their respective depths. Variations in conditions between or adjacent to boring locations may be encountered.
3. Terms used for describing soils according to their texture or grain size distribution are in accordance with the Unified Soil Classification System.

Standard Penetration Test – Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. It is customary to drive the spoon 6.0 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and performing the test are recorded for each 6.0 inches of penetration on the drill log. The field "N" Value ($N_f$) can be obtained by adding the bottom two numbers for example: $\frac{6}{8-9} \Rightarrow 8+9=17 blows/ft$ The "N" Value corrected to 60% efficiency ($N_{60}$) can be obtained by multiplying $N_f$ by the hammer correction factor published on the boring log.

**EXPLANATION OF CORRECTION FACTOR**

Figure 5.2 – Legend with Explanation of Correction Factor

### 5.2.2 Potential Future Action

Several options for standardizing blow counts have been suggested in the literature. Table 5.2 gives three possible options and some of the advantages and disadvantages associated with each one.

| Options of Standardizing Blow Counts to N60 | Advantages | Disadvantages |
|---|---|---|
| Multipy N values by correction factors and showing corrected N values on final boring logs | No changes to equipment, data on final boring log is correct | Creates extra office work |
| Provide correction factor on boring logs and let users adjust N values | No changes to equipment, simple change to final boring log | Puts responsibility of correcting N values on boring log users |
| Calibrate hammer systems in field to provide average transferred energy efficiency of 60% | No changes to boring log, field data and final boring log data is correct | Not in compliance with current ASTM standard, change in equipment necessary |

Table 5.2 – Options for Correcting Blow Counts (Lamb 1997)

Although the option of altering the hammers to provide an average transferred energy efficiency of 60% is probably the simplest long term approach, it takes the SPT out of compliance with the current ASTM and AASHTO standards. Additionally, it may require further alterations to equipment or correction factors to account for future equipment wear. Due to these factors and its unproven nature, this approach is not recommended for AHTD at this time.

AHTD final boring logs currently show the number of blows for each of the three 6 inch increments. The last two must be added together to obtain the N-value. AHTD currently uses Logdraft software manufactured by Geosystems, inc. to generate the final boring logs. AHTD could leave the field blow counts on the logs and add another column where the corrected N-value ($N_{60}$) would be automatically generated by the software. For each subsurface investigation performed for a proposed bridge structure, another format of the boring logs and N-values are generated to be placed on the bridge layout in the final plans. The generation of these logs and N-values is currently automated. This process could be revised to provide the $N_{60}$ values. A standard note would then need to be placed on the layout sheet to explain that the values present have been corrected to 60% of the maximum theoretical energy. These slight adaptations in the software and process already in use could save AHTD personnel significant amounts of effort in the future while providing a more consistent representation of the conditions at the site.

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# Appendix A
# FIELD ENERGY MEASUREMENT DATA

| | | |
|---|---|---|
| 1.17 | inches^2 | Area |
| 0.492083 | kips/feet^3 | Specific Weight Density |
| 16807.7 | feet/secon | Wave Speed |
| 29999.6 | ksi | Elastic Modulus |

| DEPTH | N | AVE. ETR | STDEV |
|---|---|---|---|
| (ft) | (bpf) | (%) | of ETR |
| 20.0-21.5 | 4 | 72.9 | 4.3 |
| 40.0-41.5 | 20 | 80.2 | 1.8 |
| 60.0-61.5 | 29 | 78.4 | 2.7 |
| 80.0-81.0 | 60/6" | 78.4 | 9.5 |
| 100.0-100.8 | 52/4" | 80.0 | 4.8 |
| ALL BLOWS | | 79.1 | 6.56 |

| | | |
|---|---|---|
| F3 | F1 | 218.16 |
| F4 | F2 | 219.18 |
| A3 | A1 | 282 |
| A4 | A2 | 295 |

| | |
|---|---|
| PJ | TRC0701 |
| PN | Failing 1500 |
| PD | 1975 Failing 1500 (AHTD EQUIP #8569); Dietrich Automatic Hammer |
| OP | Driller - Donnie Thornton; SPT analyzer - David Ross |

| Date | Time | LP | DEPTH | N | BN | BPM | FMX | VMX | EFV | ETR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | feet | feet | bpf | | blows/min | kips | feet/second | kip-feet | (%) |
| 11/21/2006 | 10:07:20 | 23.5 | 20.0-20.5 | 4 | 2 | 0.0 | 28 | 15.2 | 0.244 | 69.8 |
| 11/21/2006 | 10:07:23 | 23.5 | 20.5-21.0 | 4 | 4 | 37.5 | 29 | 15.7 | 0.266 | 75.9 |
| 11/21/2006 | 11:06:23 | 43.5 | 40.0-40.5 | 20 | 2 | 0.0 | 29 | 16.0 | 0.280 | 80.1 |
| 11/21/2006 | 11:06:26 | 43.5 | 40.0-40.5 | 20 | 4 | 37.3 | 29 | 16.3 | 0.294 | 84.0 |
| 11/21/2006 | 11:06:29 | 43.5 | 40.0-40.5 | 20 | 6 | 37.3 | 28 | 15.8 | 0.293 | 83.7 |
| 11/21/2006 | 11:06:33 | 43.5 | 40.0-40.5 | 20 | 8 | 37.5 | 28 | 16.0 | 0.283 | 80.8 |
| 11/21/2006 | 11:06:36 | 43.5 | 40.5-41.0 | 20 | 10 | 37.3 | 28 | 16.3 | 0.286 | 81.6 |
| 11/21/2006 | 11:06:39 | 43.5 | 40.5-41.0 | 20 | 12 | 37.6 | 28 | 15.9 | 0.279 | 79.7 |
| 11/21/2006 | 11:06:42 | 43.5 | 40.5-41.0 | 20 | 14 | 37.5 | 28 | 15.7 | 0.276 | 78.9 |
| 11/21/2006 | 11:06:45 | 43.5 | 40.5-41.0 | 20 | 16 | 37.6 | 29 | 15.9 | 0.274 | 78.2 |
| 11/21/2006 | 11:06:48 | 43.5 | 41.0-41.5 | 20 | 18 | 37.6 | 28 | 16.1 | 0.276 | 78.9 |
| 11/21/2006 | 11:06:51 | 43.5 | 41.0-41.5 | 20 | 20 | 37.5 | 28 | 16.0 | 0.277 | 79.2 |
| 11/21/2006 | 11:06:55 | 43.5 | 41.0-41.5 | 20 | 22 | 37.6 | 28 | 15.9 | 0.277 | 79.2 |
| 11/21/2006 | 11:06:58 | 43.5 | 41.0-41.5 | 20 | 24 | 37.6 | 28 | 15.9 | 0.278 | 79.3 |
| 11/21/2006 | 11:07:01 | 43.5 | 41.0-41.5 | 20 | 26 | 37.4 | 28 | 15.7 | 0.277 | 79.1 |
| 11/21/2006 | 11:35:46 | 63.5 | 60.0-60.5 | 29 | 28 | 0.0 | 29 | 16.5 | 0.289 | 82.5 |
| 11/21/2006 | 11:35:50 | 63.5 | 60.0-60.5 | 29 | 30 | 38.1 | 31 | 15.7 | 0.295 | 84.4 |
| 11/21/2006 | 11:35:53 | 63.5 | 60.0-60.5 | 29 | 32 | 38.1 | 31 | 15.2 | 0.285 | 81.4 |
| 11/21/2006 | 11:35:56 | 63.5 | 60.0-60.5 | 29 | 34 | 37.8 | 30 | 14.6 | 0.276 | 79.0 |
| 11/21/2006 | 11:35:59 | 63.5 | 60.0-60.5 | 29 | 36 | 37.9 | 30 | 14.9 | 0.275 | 78.5 |
| 11/21/2006 | 11:36:02 | 63.5 | 60.5-61.0 | 29 | 38 | 38.2 | 30 | 15.1 | 0.271 | 77.4 |
| 11/21/2006 | 11:36:05 | 63.5 | 60.5-61.0 | 29 | 40 | 38.3 | 30 | 15.1 | 0.275 | 78.6 |
| 11/21/2006 | 11:36:08 | 63.5 | 60.5-61.0 | 29 | 42 | 38.3 | 30 | 15.2 | 0.279 | 79.6 |
| 11/21/2006 | 11:36:11 | 63.5 | 60.5-61.0 | 29 | 44 | 38.3 | 30 | 15.2 | 0.275 | 78.6 |
| 11/21/2006 | 11:36:14 | 63.5 | 60.5-61.0 | 29 | 46 | 38.2 | 29 | 15.3 | 0.268 | 76.7 |
| 11/21/2006 | 11:36:17 | 63.5 | 60.5-61.0 | 29 | 48 | 37.9 | 29 | 14.9 | 0.266 | 76.1 |
| 11/21/2006 | 11:36:20 | 63.5 | 60.5-61.0 | 29 | 50 | 38.2 | 30 | 15.0 | 0.271 | 77.4 |
| 11/21/2006 | 11:36:24 | 63.5 | 61.0-61.5 | 29 | 52 | 38.0 | 30 | 15.0 | 0.273 | 78.0 |
| 11/21/2006 | 11:36:27 | 63.5 | 61.0-61.5 | 29 | 54 | 38.4 | 30 | 15.0 | 0.263 | 75.3 |
| 11/21/2006 | 11:36:30 | 63.5 | 61.0-61.5 | 29 | 56 | 38.2 | 29 | 14.7 | 0.257 | 73.3 |
| 11/21/2006 | 11:36:33 | 63.5 | 61.0-61.5 | 29 | 58 | 38.1 | 30 | 15.5 | 0.274 | 78.3 |
| 11/21/2006 | 11:36:36 | 63.5 | 61.0-61.5 | 29 | 60 | 37.9 | 29 | 15.1 | 0.276 | 78.9 |
| 11/21/2006 | 11:36:39 | 63.5 | 61.0-61.5 | 29 | 62 | 38.1 | 29 | 15.3 | 0.272 | 77.6 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 11/21/2006 | 11:36:42 | 63.5 | 61.0-61.5 | 29 | 64 | 37.9 | 29 | 15.1 | 0.259 | 73.9 |
| 11/21/2006 | 11:36:45 | 63.5 | 61.0-61.5 | 29 | 66 | 38.2 | 30 | 15.2 | 0.287 | 81.9 |
| 11/21/2006 | 12:25:10 | 83.5 | 80.0-80.5 | 60/6" | 68 | 34.4 | 28 | 16.3 | 0.289 | 82.5 |
| 11/21/2006 | 12:25:13 | 83.5 | 80.0-80.5 | 60/6" | 70 | 37.9 | 29 | 16.4 | 0.302 | 86.2 |
| 11/21/2006 | 12:25:16 | 83.5 | 80.0-80.5 | 60/6" | 72 | 38.1 | 29 | 16.7 | 0.301 | 86.0 |
| 11/21/2006 | 12:25:19 | 83.5 | 80.0-80.5 | 60/6" | 74 | 38.1 | 29 | 17.0 | 0.309 | 88.4 |
| 11/21/2006 | 12:25:22 | 83.5 | 80.0-80.5 | 60/6" | 76 | 38.1 | 29 | 17.0 | 0.304 | 86.7 |
| 11/21/2006 | 12:25:25 | 83.5 | 80.0-80.5 | 60/6" | 78 | 38.1 | 28 | 16.4 | 0.288 | 82.2 |
| 11/21/2006 | 12:25:28 | 83.5 | 80.0-80.5 | 60/6" | 80 | 38.1 | 28 | 16.2 | 0.286 | 81.6 |
| 11/21/2006 | 12:25:31 | 83.5 | 80.0-80.5 | 60/6" | 82 | 38.5 | 29 | 17.1 | 0.302 | 86.2 |
| 11/21/2006 | 12:25:34 | 83.5 | 80.0-80.5 | 60/6" | 84 | 38.7 | 28 | 16.6 | 0.287 | 82.1 |
| 11/21/2006 | 12:25:37 | 83.5 | 80.0-80.5 | 60/6" | 86 | 38.5 | 29 | 17.4 | 0.302 | 86.3 |
| 11/21/2006 | 12:25:40 | 83.5 | 80.0-80.5 | 60/6" | 88 | 38.4 | 28 | 16.4 | 0.288 | 82.3 |
| 11/21/2006 | 12:25:44 | 83.5 | 80.0-80.5 | 60/6" | 90 | 38.5 | 28 | 16.6 | 0.288 | 82.2 |
| 11/21/2006 | 12:25:47 | 83.5 | 80.0-80.5 | 60/6" | 92 | 38.9 | 28 | 15.9 | 0.276 | 78.8 |
| 11/21/2006 | 12:25:50 | 83.5 | 80.5-81.0 | 60/6" | 94 | 39.0 | 29 | 16.2 | 0.291 | 83.0 |
| 11/21/2006 | 12:25:56 | 83.5 | 80.5-81.0 | 60/6" | 96 | 37.9 | 28 | 16.5 | 0.291 | 83.0 |
| 11/21/2006 | 12:25:59 | 83.5 | 80.5-81.0 | 60/6" | 98 | 37.5 | 28 | 15.7 | 0.283 | 80.9 |
| 11/21/2006 | 12:26:02 | 83.5 | 80.5-81.0 | 60/6" | 100 | 37.5 | 29 | 16.4 | 0.302 | 86.2 |
| 11/21/2006 | 12:26:05 | 83.5 | 80.5-81.0 | 60/6" | 102 | 37.6 | 29 | 16.7 | 0.305 | 87.0 |
| 11/21/2006 | 12:26:08 | 83.5 | 80.5-81.0 | 60/6" | 104 | 37.9 | 29 | 16.4 | 0.299 | 85.4 |
| 11/21/2006 | 12:26:11 | 83.5 | 80.5-81.0 | 60/6" | 106 | 38.2 | 29 | 16.6 | 0.309 | 88.3 |
| 11/21/2006 | 12:26:14 | 83.5 | 80.5-81.0 | 60/6" | 108 | 37.7 | 29 | 16.1 | 0.301 | 86.1 |
| 11/21/2006 | 12:26:18 | 83.5 | 80.5-81.0 | 60/6" | 110 | 38.1 | 30 | 16.9 | 0.325 | 92.9 |
| 11/21/2006 | 12:26:21 | 83.5 | 80.5-81.0 | 60/6" | 112 | 38.2 | 29 | 16.3 | 0.312 | 89.2 |
| 11/21/2006 | 12:26:24 | 83.5 | 80.5-81.0 | 60/6" | 114 | 38.2 | 29 | 16.4 | 0.308 | 88.1 |
| 11/21/2006 | 12:26:27 | 83.5 | 80.5-81.0 | 60/6" | 116 | 38.4 | 28 | 15.6 | 0.293 | 83.6 |
| 11/21/2006 | 12:26:30 | 83.5 | 80.5-81.0 | 60/6" | 118 | 38.1 | 27 | 14.8 | 0.276 | 78.9 |
| 11/21/2006 | 12:26:33 | 83.5 | 80.5-81.0 | 60/6" | 120 | 38.1 | 28 | 16.6 | 0.295 | 84.3 |
| 11/21/2006 | 12:26:36 | 83.5 | 80.5-81.0 | 60/6" | 122 | 39.3 | 26 | 17.0 | 0.270 | 77.2 |
| 11/21/2006 | 12:26:39 | 83.5 | 80.5-81.0 | 60/6" | 124 | 38.4 | 28 | 18.4 | 0.304 | 87.0 |
| 11/21/2006 | 12:26:42 | 83.5 | 80.5-81.0 | 60/6" | 126 | 38.3 | 28 | 11.9 | 0.254 | 72.6 |
| 11/21/2006 | 12:26:45 | 83.5 | 80.5-81.0 | 60/6" | 128 | 38.4 | 27 | 10.4 | 0.236 | 67.6 |
| 11/21/2006 | 12:26:48 | 83.5 | 80.5-81.0 | 60/6" | 130 | 39.2 | 27 | 9.6 | 0.225 | 64.1 |
| 11/21/2006 | 12:26:52 | 83.5 | 80.5-81.0 | 60/6" | 132 | 38.5 | 28 | 10.6 | 0.259 | 74.1 |
| 11/21/2006 | 12:26:55 | 83.5 | 80.5-81.0 | 60/6" | 134 | 38.5 | 28 | 10.9 | 0.260 | 74.3 |
| 11/21/2006 | 12:26:58 | 83.5 | 80.5-81.0 | 60/6" | 136 | 38.6 | 28 | 10.6 | 0.254 | 72.5 |
| 11/21/2006 | 12:27:01 | 83.5 | 80.5-81.0 | 60/6" | 138 | 38.5 | 28 | 10.4 | 0.242 | 69.1 |
| 11/21/2006 | 12:27:04 | 83.5 | 80.5-81.0 | 60/6" | 140 | 38.3 | 25 | 8.6 | 0.210 | 60.1 |
| 11/21/2006 | 12:27:07 | 83.5 | 80.5-81.0 | 60/6" | 142 | 38.2 | 27 | 9.7 | 0.230 | 65.6 |
| 11/21/2006 | 12:27:10 | 83.5 | 80.5-81.0 | 60/6" | 144 | 37.8 | 26 | 9.4 | 0.213 | 61.0 |
| 11/21/2006 | 12:27:13 | 83.5 | 80.5-81.0 | 60/6" | 146 | 37.8 | 26 | 9.4 | 0.216 | 61.7 |
| 11/21/2006 | 12:27:16 | 83.5 | 80.5-81.0 | 60/6" | 148 | 38.1 | 27 | 10.7 | 0.228 | 65.3 |
| 11/21/2006 | 12:27:19 | 83.5 | 80.5-81.0 | 60/6" | 150 | 38.3 | 27 | 10.1 | 0.215 | 61.6 |
| 11/21/2006 | 12:27:22 | 83.5 | 80.5-81.0 | 60/6" | 152 | 37.0 | 26 | 9.8 | 0.224 | 64.1 |
| 11/21/2006 | 12:27:26 | 83.5 | 80.5-81.0 | 60/6" | 154 | 38.3 | 27 | 9.9 | 0.226 | 64.7 |
| 11/21/2006 | 14:51:36 | 103.5 | 100.0-100.5 | 52/4" | 2 | 34.6 | 28 | 16.4 | 0.285 | 81.4 |
| 11/21/2006 | 14:51:39 | 103.5 | 100.0-100.5 | 52/4" | 4 | 37.7 | 28 | 16.8 | 0.296 | 84.6 |
| 11/21/2006 | 14:51:42 | 103.5 | 100.0-100.5 | 52/4" | 6 | 37.8 | 28 | 17.0 | 0.293 | 83.8 |
| 11/21/2006 | 14:51:45 | 103.5 | 100.0-100.5 | 52/4" | 8 | 38.0 | 28 | 17.0 | 0.290 | 82.9 |
| 11/21/2006 | 14:51:48 | 103.5 | 100.0-100.5 | 52/4" | 10 | 37.9 | 28 | 17.1 | 0.298 | 85.2 |
| 11/21/2006 | 14:51:51 | 103.5 | 100.0-100.5 | 52/4" | 12 | 37.9 | 28 | 16.9 | 0.286 | 81.7 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 11/21/2006 | 14:51:54 | 103.5 | 100.0-100.5 | 52/4" | 14 | 37.6 | 27 | 16.6 | 0.276 | 78.9 |
| 11/21/2006 | 14:51:58 | 103.5 | 100.0-100.5 | 52/4" | 16 | 38.2 | 28 | 17.5 | 0.294 | 84.0 |
| 11/21/2006 | 14:52:01 | 103.5 | 100.0-100.5 | 52/4" | 18 | 38.0 | 27 | 16.3 | 0.271 | 77.5 |
| 11/21/2006 | 14:52:04 | 103.5 | 100.0-100.5 | 52/4" | 20 | 38.4 | 28 | 16.9 | 0.287 | 81.9 |
| 11/21/2006 | 14:52:07 | 103.5 | 100.0-100.5 | 52/4" | 22 | 38.2 | 27 | 16.8 | 0.274 | 78.4 |
| 11/21/2006 | 14:52:10 | 103.5 | 100.0-100.5 | 52/4" | 24 | 38.1 | 27 | 15.9 | 0.274 | 78.3 |
| 11/21/2006 | 14:52:13 | 103.5 | 100.0-100.5 | 52/4" | 26 | 38.3 | 27 | 16.6 | 0.277 | 79.1 |
| 11/21/2006 | 14:52:16 | 103.5 | 100.0-100.5 | 52/4" | 28 | 38.2 | 28 | 16.4 | 0.278 | 79.5 |
| 11/21/2006 | 14:52:19 | 103.5 | 100.0-100.5 | 52/4" | 30 | 38.4 | 27 | 16.6 | 0.276 | 78.9 |
| 11/21/2006 | 14:52:22 | 103.5 | 100.0-100.5 | 52/4" | 32 | 38.1 | 27 | 16.6 | 0.279 | 79.7 |
| 11/21/2006 | 14:52:25 | 103.5 | 100.0-100.5 | 52/4" | 34 | 38.3 | 27 | 16.8 | 0.282 | 80.6 |
| 11/21/2006 | 14:52:28 | 103.5 | 100.0-100.5 | 52/4" | 36 | 38.3 | 26 | 16.3 | 0.266 | 76.0 |
| 11/21/2006 | 14:52:31 | 103.5 | 100.5-100.8 | 52/4" | 38 | 38.3 | 27 | 16.8 | 0.278 | 79.4 |
| 11/21/2006 | 14:52:34 | 103.5 | 100.5-100.8 | 52/4" | 40 | 38.6 | 27 | 16.4 | 0.277 | 79.0 |
| 11/21/2006 | 14:52:37 | 103.5 | 100.5-100.8 | 52/4" | 42 | 38.6 | 27 | 16.7 | 0.278 | 79.4 |
| 11/21/2006 | 14:52:41 | 103.5 | 100.5-100.8 | 52/4" | 44 | 38.5 | 26 | 16.6 | 0.266 | 76.0 |
| 11/21/2006 | 14:52:44 | 103.5 | 100.5-100.8 | 52/4" | 46 | 38.5 | 27 | 16.3 | 0.270 | 77.1 |
| 11/21/2006 | 14:52:47 | 103.5 | 100.5-100.8 | 52/4" | 48 | 38.4 | 26 | 15.9 | 0.255 | 73.0 |
| 11/21/2006 | 14:52:50 | 103.5 | 100.5-100.8 | 52/4" | 50 | 38.1 | 26 | 16.1 | 0.256 | 73.0 |
| 11/21/2006 | 14:52:53 | 103.5 | 100.5-100.8 | 52/4" | 52 | 38.2 | 27 | 15.8 | 0.263 | 75.0 |
| 11/21/2006 | 14:52:56 | 103.5 | 100.5-100.8 | 52/4" | 54 | 38.4 | 26 | 16.9 | 0.268 | 76.5 |
| 11/21/2006 | 14:52:59 | 103.5 | 100.5-100.8 | 52/4" | 56 | 38.5 | 27 | 15.2 | 0.243 | 69.6 |
| 11/21/2006 | 14:53:02 | 103.5 | 100.5-100.8 | 52/4" | 58 | 37.4 | 25 | 15.4 | 0.244 | 69.7 |
| 11/21/2006 | 14:53:05 | 103.5 | 100.5-100.8 | 52/4" | 60 | 37.7 | 25 | 15.7 | 0.247 | 70.5 |
| 11/21/2006 | 14:53:08 | 103.5 | 100.5-100.8 | 52/4" | 62 | 38.0 | 28 | 16.4 | 0.286 | 81.6 |
| 11/21/2006 | 14:53:11 | 103.5 | 100.5-100.8 | 52/4" | 64 | 37.9 | 27 | 17.2 | 0.280 | 80.1 |
| 11/21/2006 | 14:53:14 | 103.5 | 100.5-100.8 | 52/4" | 66 | 37.6 | 29 | 16.2 | 0.295 | 84.2 |
| 11/21/2006 | 14:53:18 | 103.5 | 100.5-100.8 | 52/4" | 68 | 37.5 | 29 | 16.9 | 0.300 | 85.7 |
| 11/21/2006 | 14:53:21 | 103.5 | 100.5-100.8 | 52/4" | 70 | 38.1 | 29 | 17.3 | 0.308 | 88.1 |
| 11/21/2006 | 14:53:24 | 103.5 | 100.5-100.8 | 52/4" | 72 | 38.0 | 30 | 16.6 | 0.304 | 86.7 |
| 11/21/2006 | 14:53:27 | 103.5 | 100.5-100.8 | 52/4" | 74 | 38.0 | 30 | 17.1 | 0.313 | 89.5 |
| 11/21/2006 | 14:53:30 | 103.5 | 100.5-100.8 | 52/4" | 76 | 38.0 | 29 | 17.6 | 0.301 | 86.1 |
| 11/21/2006 | 14:53:33 | 103.5 | 100.5-100.8 | 52/4" | 78 | 38.1 | 27 | 17.4 | 0.282 | 80.6 |
| 11/21/2006 | 14:53:36 | 103.5 | 100.5-100.8 | 52/4" | 80 | 38.0 | 26 | 16.6 | 0.259 | 74.1 |
| 11/21/2006 | 14:53:39 | 103.5 | 100.5-100.8 | 52/4" | 82 | 38.2 | 27 | 17.6 | 0.294 | 83.9 |
| 11/21/2006 | 14:53:43 | 103.5 | 100.5-100.8 | 52/4" | 84 | 38.3 | 28 | 17.4 | 0.294 | 84.0 |
| 11/21/2006 | 14:53:46 | 103.5 | 100.5-100.8 | 52/4" | 86 | 38.4 | 28 | 17.8 | 0.294 | 84.1 |

* Results based solely on V1 from Accelerometer #1 because Accelerometer #2 was loose

| | | |
|---|---|---|
| 1.17 | inches^2 | Area |
| 0.492083 | kips/feet^3 | Specific Weight Density |
| 16807.7 | feet/secon | Wave Speed |
| 29999.6 | ksi | Elastic Modulus |
| Strain Gauge Calibration Factors | | |
| F3 | F1 | 218.16 |
| F4 | F2 | 219.18 |
| Accelerometer Calibration Factors | | |
| A3 | A1 | 282 |
| A4 | A2 | 295 |

| DEPTH (ft) | N (bpf) | AVE. ETR (%) | STDEV of ETR |
|---|---|---|---|
| 20.0-21.5 | 18 | 73.3 | 5.44 |
| 40.0-41.5 | 31 | 76.9 | 4.17 |
| 60.0-61.5 | 37 | 76.8 | 2.90 |
| 80.0-80.8 | 28/3" | 75.7 | 3.96 |
| 100.0-100.4 | 60/5" | 79.2 | 2.45 |
| ALL BLOWS | | 76.9 | 3.90 |

| | |
|---|---|
| PJ | TRC0701 |
| PN | CME-AT2 |
| PD | 1997 CME-750 (AHTD EQUIP #2300); CME Automatic Hammer |
| OP | DRILLER - Daniel Dickerson; SPT Analyzer - David Ross |

| Date | Time | LP feet | DEPTH feet | N (bpf) | BN | BPM blows/min | FMX kips | VMX feet/seconc | EFV kip-feet | ETR (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 12/4/2006 | 15:12:07 | 25.5 | 20.0-20.5 | 18 | 2 | 59.9 | 25 | 14.50 | 0.244 | 69.7 |
| 12/4/2006 | 15:12:09 | 25.5 | 20.0-20.5 | 18 | 4 | 59.8 | 26 | 15.00 | 0.244 | 69.6 |
| 12/4/2006 | 15:12:11 | 25.5 | 20.5-21.0 | 18 | 6 | 58.4 | 23 | 14.20 | 0.217 | 62.0 |
| 12/4/2006 | 15:12:13 | 25.5 | 20.5-21.0 | 18 | 8 | 61.4 | 25 | 15.40 | 0.270 | 77.1 |
| 12/4/2006 | 15:12:15 | 25.5 | 20.5-21.0 | 18 | 10 | 59.9 | 25 | 14.80 | 0.248 | 70.9 |
| 12/4/2006 | 15:12:17 | 25.5 | 20.5-21.0 | 18 | 12 | 58.7 | 25 | 15.10 | 0.266 | 76.0 |
| 12/4/2006 | 15:12:19 | 25.5 | 21.0-21.5 | 18 | 14 | 59.0 | 25 | 15.20 | 0.258 | 73.8 |
| 12/4/2006 | 15:12:21 | 25.5 | 21.0-21.5 | 18 | 16 | 59.3 | 24 | 15.20 | 0.260 | 74.4 |
| 12/4/2006 | 15:12:23 | 25.5 | 21.0-21.5 | 18 | 18 | 58.7 | 25 | 15.00 | 0.275 | 78.6 |
| 12/4/2006 | 15:12:25 | 25.5 | 21.0-21.5 | 18 | 20 | 59.3 | 25 | 15.40 | 0.282 | 80.7 |
| 12/4/2006 | 15:26:44 | 45.5 | 40.0-40.5 | 31 | 24 | 61.1 | 26 | 15.30 | 0.274 | 78.2 |
| 12/4/2006 | 15:26:46 | 45.5 | 40.0-40.5 | 31 | 26 | 58.3 | 25 | 14.80 | 0.256 | 73.1 |
| 12/4/2006 | 15:26:48 | 45.5 | 40.0-40.5 | 31 | 28 | 58.4 | 25 | 14.90 | 0.254 | 72.6 |
| 12/4/2006 | 15:26:50 | 45.5 | 40.0-40.5 | 31 | 30 | 58.1 | 25 | 14.70 | 0.255 | 72.7 |
| 12/4/2006 | 15:26:52 | 45.5 | 40.5-41.0 | 31 | 32 | 58.6 | 23 | 14.10 | 0.247 | 70.6 |
| 12/4/2006 | 15:26:54 | 45.5 | 40.5-41.0 | 31 | 34 | 59.6 | 25 | 14.80 | 0.268 | 76.5 |
| 12/4/2006 | 15:26:56 | 45.5 | 40.5-41.0 | 31 | 36 | 59.3 | 27 | 15.70 | 0.288 | 82.2 |
| 12/4/2006 | 15:26:58 | 45.5 | 40.5-41.0 | 31 | 38 | 59.6 | 26 | 15.30 | 0.284 | 81.2 |
| 12/4/2006 | 15:27:00 | 45.5 | 40.5-41.0 | 31 | 40 | 59.4 | 25 | 15.30 | 0.272 | 77.9 |
| 12/4/2006 | 15:27:02 | 45.5 | 40.5-41.0 | 31 | 42 | 58.6 | 24 | 14.70 | 0.266 | 76.1 |
| 12/4/2006 | 15:27:04 | 45.5 | 40.5-41.0 | 31 | 44 | 59.1 | 26 | 15.60 | 0.284 | 81.2 |
| 12/4/2006 | 15:27:06 | 45.5 | 41.0-41.5 | 31 | 46 | 59.3 | 25 | 14.60 | 0.256 | 73.0 |
| 12/4/2006 | 15:27:08 | 45.5 | 41.0-41.5 | 31 | 48 | 58.7 | 26 | 15.50 | 0.284 | 81.1 |
| 12/4/2006 | 15:27:10 | 45.5 | 41.0-41.5 | 31 | 50 | 58.9 | 26 | 15.60 | 0.282 | 80.4 |
| 12/4/2006 | 15:27:12 | 45.5 | 41.0-41.5 | 31 | 52 | 59.3 | 24 | 14.50 | 0.248 | 70.8 |
| 12/4/2006 | 15:27:14 | 45.5 | 41.0-41.5 | 31 | 54 | 58.9 | 26 | 15.10 | 0.275 | 78.5 |
| 12/4/2006 | 15:27:16 | 45.5 | 41.0-41.5 | 31 | 56 | 58.9 | 26 | 15.40 | 0.274 | 78.4 |
| 12/4/2006 | 15:27:18 | 45.5 | 41.0-41.5 | 31 | 58 | 59.2 | 24 | 14.50 | 0.248 | 70.7 |
| 12/4/2006 | 15:27:20 | 45.5 | 41.0-41.5 | 31 | 60 | 59.3 | 27 | 15.60 | 0.285 | 81.5 |
| 12/4/2006 | 15:27:22 | 45.5 | 41.0-41.5 | 31 | 62 | 59.0 | 27 | 15.60 | 0.287 | 81.9 |
| 12/4/2006 | 15:47:16 | 65.5 | 60.0-60.5 | 37 | 64 | 59.5 | 25 | 15.00 | 0.258 | 73.8 |
| 12/4/2006 | 15:47:18 | 65.5 | 60.0-60.5 | 37 | 66 | 58.5 | 25 | 14.90 | 0.253 | 72.3 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 12/4/2006 | 15:47:20 | 65.5 | 60.0-60.5 | 37 | 68 | 59.0 | 24 | 14.60 | 0.257 | 73.5 |
| 12/4/2006 | 15:47:22 | 65.5 | 60.0-60.5 | 37 | 70 | 59.5 | 25 | 14.90 | 0.261 | 74.5 |
| 12/4/2006 | 15:47:24 | 65.5 | 60.0-60.5 | 37 | 72 | 58.7 | 25 | 15.00 | 0.264 | 75.6 |
| 12/4/2006 | 15:47:26 | 65.5 | 60.0-60.5 | 37 | 74 | 59.3 | 24 | 14.80 | 0.260 | 74.3 |
| 12/4/2006 | 15:47:28 | 65.5 | 60.5-61.0 | 37 | 76 | 59.0 | 25 | 15.20 | 0.268 | 76.4 |
| 12/4/2006 | 15:47:30 | 65.5 | 60.5-61.0 | 37 | 78 | 58.8 | 24 | 14.90 | 0.264 | 75.5 |
| 12/4/2006 | 15:47:32 | 65.5 | 60.5-61.0 | 37 | 80 | 58.9 | 25 | 15.30 | 0.268 | 76.5 |
| 12/4/2006 | 15:47:34 | 65.5 | 60.5-61.0 | 37 | 82 | 58.7 | 25 | 15.00 | 0.270 | 77.1 |
| 12/4/2006 | 15:47:36 | 65.5 | 60.5-61.0 | 37 | 84 | 58.8 | 25 | 15.00 | 0.265 | 75.8 |
| 12/4/2006 | 15:47:38 | 65.5 | 60.5-61.0 | 37 | 86 | 59.3 | 26 | 15.30 | 0.276 | 79.0 |
| 12/4/2006 | 15:47:40 | 65.5 | 60.5-61.0 | 37 | 88 | 58.9 | 25 | 15.30 | 0.268 | 76.7 |
| 12/4/2006 | 15:47:42 | 65.5 | 60.5-61.0 | 37 | 90 | 58.8 | 25 | 15.10 | 0.268 | 76.6 |
| 12/4/2006 | 15:47:44 | 65.5 | 61.0-61.5 | 37 | 92 | 59.1 | 26 | 15.30 | 0.279 | 79.6 |
| 12/4/2006 | 15:47:46 | 65.5 | 61.0-61.5 | 37 | 94 | 59.0 | 26 | 15.50 | 0.278 | 79.3 |
| 12/4/2006 | 15:47:48 | 65.5 | 61.0-61.5 | 37 | 96 | 58.9 | 26 | 15.60 | 0.270 | 77.1 |
| 12/4/2006 | 15:47:50 | 65.5 | 61.0-61.5 | 37 | 98 | 58.5 | 25 | 15.30 | 0.261 | 74.5 |
| 12/4/2006 | 15:47:52 | 65.5 | 61.0-61.5 | 37 | 100 | 58.3 | 25 | 15.10 | 0.254 | 72.7 |
| 12/4/2006 | 15:47:54 | 65.5 | 61.0-61.5 | 37 | 102 | 58.8 | 26 | 16.10 | 0.285 | 81.3 |
| 12/4/2006 | 15:47:56 | 65.5 | 61.0-61.5 | 37 | 104 | 58.8 | 26 | 15.50 | 0.281 | 80.2 |
| 12/4/2006 | 15:47:58 | 65.5 | 61.0-61.5 | 37 | 106 | 59.1 | 26 | 15.90 | 0.291 | 83.0 |
| 12/4/2006 | 15:48:00 | 65.5 | 61.0-61.5 | 37 | 108 | 58.9 | 26 | 15.90 | 0.283 | 81.0 |
| 12/4/2006 | 16:18:10 | 85.5 | 80.0-80.5 | 28=3" | 112 | 0.0 | 24 | 15.50 | 0.284 | 81.1 |
| 12/4/2006 | 16:18:12 | 85.5 | 80.0-80.5 | 28=3" | 114 | 59.5 | 25 | 15.10 | 0.266 | 76.1 |
| 12/4/2006 | 16:18:14 | 85.5 | 80.0-80.5 | 28=3" | 116 | 59.4 | 25 | 15.30 | 0.277 | 79.0 |
| 12/4/2006 | 16:18:16 | 85.5 | 80.0-80.5 | 28=3" | 118 | 59.1 | 26 | 15.50 | 0.278 | 79.4 |
| 12/4/2006 | 16:18:18 | 85.5 | 80.0-80.5 | 28=3" | 120 | 58.8 | 24 | 14.40 | 0.239 | 68.4 |
| 12/4/2006 | 16:18:20 | 85.5 | 80.0-80.5 | 28=3" | 122 | 58.6 | 24 | 14.20 | 0.232 | 66.4 |
| 12/4/2006 | 16:18:22 | 85.5 | 80.0-80.5 | 28=3" | 124 | 59.0 | 25 | 14.80 | 0.251 | 71.7 |
| 12/4/2006 | 16:18:24 | 85.5 | 80.0-80.5 | 28=3" | 126 | 58.9 | 25 | 15.10 | 0.272 | 77.6 |
| 12/4/2006 | 16:18:26 | 85.5 | 80.0-80.5 | 28=3" | 128 | 59.0 | 26 | 15.40 | 0.281 | 80.4 |
| 12/4/2006 | 16:18:28 | 85.5 | 80.0-80.5 | 28=3" | 130 | 59.1 | 26 | 15.80 | 0.280 | 80.1 |
| 12/4/2006 | 16:18:30 | 85.5 | 80.0-80.5 | 28=3" | 132 | 59.0 | 26 | 15.50 | 0.282 | 80.6 |
| 12/4/2006 | 16:18:32 | 85.5 | 80.5-81.0 | 28=3" | 134 | 59.2 | 25 | 14.70 | 0.261 | 74.6 |
| 12/4/2006 | 16:18:34 | 85.5 | 80.5-81.0 | 28=3" | 136 | 59.1 | 25 | 14.70 | 0.255 | 72.8 |
| 12/4/2006 | 16:18:36 | 85.5 | 80.5-81.0 | 28=3" | 138 | 58.8 | 25 | 14.70 | 0.254 | 72.5 |
| 12/4/2006 | 16:18:38 | 85.5 | 80.5-81.0 | 28=3" | 140 | 58.9 | 25 | 14.80 | 0.257 | 73.5 |
| 12/4/2006 | 16:18:40 | 85.5 | 80.5-81.0 | 28=3" | 142 | 58.9 | 25 | 14.70 | 0.257 | 73.4 |
| 12/4/2006 | 16:18:42 | 85.5 | 80.5-81.0 | 28=3" | 144 | 59.2 | 25 | 14.90 | 0.256 | 73.1 |
| 12/4/2006 | 16:18:44 | 85.5 | 80.5-81.0 | 28=3" | 146 | 58.9 | 26 | 15.10 | 0.271 | 77.3 |
| 12/4/2006 | 16:18:46 | 85.5 | 80.5-81.0 | 28=3" | 148 | 59.0 | 25 | 15.00 | 0.257 | 73.4 |
| 12/4/2006 | 16:18:48 | 85.5 | 80.5-81.0 | 28=3" | 150 | 59.1 | 26 | 15.10 | 0.268 | 76.5 |
| 12/4/2006 | 16:18:50 | 85.5 | 80.5-81.0 | 28=3" | 152 | 59.1 | 25 | 15.10 | 0.266 | 75.9 |
| 12/4/2006 | 16:18:52 | 85.5 | 80.5-81.0 | 28=3" | 154 | 59.2 | 27 | 15.80 | 0.286 | 81.7 |
| 12/4/2006 | 16:18:54 | 85.5 | 80.5-81.0 | 28=3" | 156 | 59.2 | 25 | 14.70 | 0.263 | 75.1 |
| 12/4/2006 | 16:18:56 | 85.5 | 80.5-81.0 | 28=3" | 158 | 58.9 | 25 | 15.10 | 0.263 | 75.0 |
| 12/4/2006 | 16:47:41 | 105.5 | 100-100.5 | 60=5" | 164 | 59.5 | 25 | 15.40 | 0.281 | 80.4 |
| 12/4/2006 | 16:47:43 | 105.5 | 100-100.5 | 60=5" | 166 | 59.1 | 25 | 14.90 | 0.260 | 74.2 |
| 12/4/2006 | 16:47:45 | 105.5 | 100-100.5 | 60=5" | 168 | 59.0 | 25 | 15.10 | 0.268 | 76.7 |
| 12/4/2006 | 16:47:47 | 105.5 | 100-100.5 | 60=5" | 170 | 59.0 | 25 | 15.00 | 0.267 | 76.2 |
| 12/4/2006 | 16:47:49 | 105.5 | 100-100.5 | 60=5" | 172 | 59.3 | 27 | 16.00 | 0.286 | 81.7 |
| 12/4/2006 | 16:47:51 | 105.5 | 100-100.5 | 60=5" | 174 | 58.7 | 25 | 15.00 | 0.267 | 76.1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 12/4/2006 | 16:47:53 | 105.5 | 100-100.5 | 60=5" | 176 | 58.5 | 25 | 14.90 | 0.264 | 75.3 |
| 12/4/2006 | 16:47:55 | 105.5 | 100-100.5 | 60=5" | 178 | 58.9 | 26 | 15.30 | 0.281 | 80.3 |
| 12/4/2006 | 16:47:57 | 105.5 | 100-100.5 | 60=5" | 180 | 59.0 | 27 | 15.70 | 0.281 | 80.4 |
| 12/4/2006 | 16:47:59 | 105.5 | 100-100.5 | 60=5" | 182 | 59.2 | 26 | 15.60 | 0.278 | 79.5 |
| 12/4/2006 | 16:48:01 | 105.5 | 100-100.5 | 60=5" | 184 | 58.9 | 26 | 15.80 | 0.282 | 80.7 |
| 12/4/2006 | 16:48:03 | 105.5 | 100-100.5 | 60=5" | 186 | 58.7 | 27 | 15.80 | 0.285 | 81.3 |
| 12/4/2006 | 16:48:05 | 105.5 | 100-100.5 | 60=5" | 188 | 58.7 | 26 | 15.40 | 0.269 | 76.9 |
| 12/4/2006 | 16:48:07 | 105.5 | 100-100.5 | 60=5" | 190 | 58.6 | 26 | 15.30 | 0.271 | 77.3 |
| 12/4/2006 | 16:48:09 | 105.5 | 100-100.5 | 60=5" | 192 | 59.3 | 26 | 15.80 | 0.284 | 81.1 |
| 12/4/2006 | 16:48:11 | 105.5 | 100-100.5 | 60=5" | 194 | 58.7 | 26 | 15.20 | 0.264 | 75.3 |
| 12/4/2006 | 16:48:13 | 105.5 | 100-100.5 | 60=5" | 196 | 58.8 | 27 | 15.70 | 0.280 | 80.0 |
| 12/4/2006 | 16:48:15 | 105.5 | 100-100.5 | 60=5" | 198 | 58.9 | 27 | 16.20 | 0.289 | 82.7 |
| 12/4/2006 | 16:48:17 | 105.5 | 100-100.5 | 60=5" | 200 | 59.0 | 27 | 15.80 | 0.281 | 80.4 |
| 12/4/2006 | 16:48:19 | 105.5 | 100-100.5 | 60=5" | 202 | 58.8 | 26 | 15.10 | 0.278 | 79.3 |
| 12/4/2006 | 16:48:21 | 105.5 | 100-100.5 | 60=5" | 204 | 58.6 | 26 | 15.40 | 0.270 | 77.0 |
| 12/4/2006 | 16:48:23 | 105.5 | 100-100.5 | 60=5" | 206 | 59.0 | 26 | 15.20 | 0.278 | 79.4 |
| 12/4/2006 | 16:48:25 | 105.5 | 100-100.5 | 60=5" | 208 | 58.7 | 28 | 16.00 | 0.289 | 82.5 |
| 12/4/2006 | 16:48:27 | 105.5 | 100-100.5 | 60=5" | 210 | 59.0 | 26 | 15.50 | 0.285 | 81.3 |
| 12/4/2006 | 16:48:29 | 105.5 | 100-100.5 | 60=5" | 212 | 58.9 | 27 | 15.50 | 0.281 | 80.2 |
| 12/4/2006 | 16:48:31 | 105.5 | 100-100.5 | 60=5" | 214 | 58.9 | 27 | 15.90 | 0.286 | 81.7 |
| 12/4/2006 | 16:48:33 | 105.5 | 100-100.5 | 60=5" | 216 | 58.4 | 27 | 15.50 | 0.278 | 79.5 |
| 12/4/2006 | 16:48:35 | 105.5 | 100-100.5 | 60=5" | 218 | 58.5 | 26 | 15.30 | 0.265 | 75.8 |
| 12/4/2006 | 16:48:37 | 105.5 | 100-100.5 | 60=5" | 220 | 58.3 | 26 | 15.60 | 0.280 | 79.9 |
| 12/4/2006 | 16:48:39 | 105.5 | 100-100.5 | 60=5" | 222 | 58.8 | 27 | 15.70 | 0.288 | 82.4 |

| | | |
|---|---|---|
| 1.17 | inches^2 | Area |
| 0.492083 | kips/feet^3 | Specific Weight Density |
| 16807.7 | feet/secon | Wave Speed |
| 29999.6 | ksi | Elastic Modulus |

| DEPTH (ft) | N (bpf) | AVE. ETR (%) | STDEV of ETR |
|---|---|---|---|
| 20.0-21.5 | 7 | *67.4 | *2.23 |
| 22.0-23.5 | 12 | 79.6 | 2.76 |
| 40.0-41.5 | 17 | 83.4 | 0.73 |
| 60.0-61.5 | 27 | 84.2 | 0.56 |
| 80.0-80.8 | 37 | 82.5 | 2.97 |
| 100.0-100.8 | 11/2" | 83.7 | 0.76 |
| ALL BLOWS | | **83.0 | **2.23 |

*Equipment malfunction, hydraulic chuck release mechanism engaged reducing flow to SPT hammer hydraulic motor

** Excluding 20.0 to 21.5 SPT Test

| | | |
|---|---|---|
| F3 | F1 | 218.16 |
| F4 | F2 | 219.18 |
| A3 | A1 | 282 |
| A4 | A2 | 295 |

| | |
|---|---|
| PJ | TRC0701 |
| PN | CME-75 |
| PD | 2006 CME-75 (AHTD EQUIP #8400); CME Automatic Hammer |
| OP | Driller - Brian Casto; SPT Analyzer - David Ross |

| Date | Time | LP feet | DEPTH feet | N bpf | BN | BPM blows/minut | FMX kips | VMX feet/second | EFV kip-feet | ETR (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2/22/2007 | 13:15:53 | 24 | 20.0-20.5 | 7 | 1 | 0 | 26 | 14.3 | 0.225 | 64.3 |
| 2/22/2007 | 13:15:58 | 24 | 20.5-21.0 | 7 | 3 | 0 | 27 | 14.5 | 0.233 | 66.5 |
| 2/22/2007 | 13:16:01 | 24 | 20.5-21.0 | 7 | 4 | 26.1 | 27 | 14.4 | 0.233 | 66.4 |
| 2/22/2007 | 13:16:03 | 24 | 21.0-21.5 | 7 | 5 | 26.5 | 27 | 14.7 | 0.232 | 66.4 |
| 2/22/2007 | 13:16:05 | 24 | 21.0-21.5 | 7 | 6 | 26.7 | 27 | 14.8 | 0.234 | 66.9 |
| 2/22/2007 | 13:16:07 | 24 | 21.0-21.5 | 7 | 7 | 26.7 | 27 | 14.8 | 0.235 | 67.1 |
| 2/22/2007 | 13:16:09 | 24 | 21.0-21.5 | 7 | 8 | 27 | 27 | 15.0 | 0.250 | 71.5 |
| 2/22/2007 | 13:16:12 | 24 | 21.0-21.5 | 7 | 9 | 27.1 | 27 | 15.0 | 0.244 | 69.7 |
| 2/22/2007 | 15:08:01 | 26 | 22.0-22.5 | 12 | 3 | 45.7 | 29 | 14.7 | 0.286 | 81.8 |
| 2/22/2007 | 15:08:02 | 26 | 22.0-22.5 | 12 | 4 | 56.8 | 29 | 14.2 | 0.279 | 79.8 |
| 2/22/2007 | 15:08:04 | 26 | 22.0-22.5 | 12 | 5 | 56.2 | 29 | 14.3 | 0.281 | 80.3 |
| 2/22/2007 | 15:08:05 | 26 | 22.0-22.5 | 12 | 6 | 56.1 | 29 | 14.5 | 0.285 | 81.4 |
| 2/22/2007 | 15:08:06 | 26 | 22.5-23.0 | 12 | 7 | 56.2 | 29 | 14.5 | 0.279 | 79.7 |
| 2/22/2007 | 15:08:07 | 26 | 22.5-23.0 | 12 | 8 | 56.1 | 29 | 14.5 | 0.285 | 81.4 |
| 2/22/2007 | 15:08:08 | 26 | 22.5-23.0 | 12 | 9 | 56.1 | 29 | 14.7 | 0.278 | 79.3 |
| 2/22/2007 | 15:08:09 | 26 | 22.5-23.0 | 12 | 10 | 56.1 | 29 | 14.4 | 0.280 | 79.9 |
| 2/22/2007 | 15:08:10 | 26 | 22.5-23.0 | 12 | 11 | 56.1 | 29 | 14.5 | 0.280 | 80.0 |
| 2/22/2007 | 15:08:11 | 26 | 23.0-23.5 | 12 | 12 | 56 | 29 | 14.6 | 0.280 | 79.9 |
| 2/22/2007 | 15:08:12 | 26 | 23.0-23.5 | 12 | 13 | 56 | 29 | 14.6 | 0.277 | 79.2 |
| 2/22/2007 | 15:08:13 | 26 | 23.0-23.5 | 12 | 14 | 56.1 | 29 | 14.3 | 0.278 | 79.6 |
| 2/22/2007 | 15:08:14 | 26 | 23.0-23.5 | 12 | 15 | 56 | 29 | 14.5 | 0.282 | 80.6 |
| 2/22/2007 | 15:08:21 | 26 | 23.0-23.5 | 12 | 16 | 0 | 29 | 14.6 | 0.282 | 80.5 |
| 2/22/2007 | 15:08:22 | 26 | 23.0-23.5 | 12 | 17 | 56.8 | 29 | 14.5 | 0.283 | 80.9 |
| 2/22/2007 | 15:08:23 | 26 | 23.0-23.5 | 12 | 18 | 56.1 | 29 | 14.8 | 0.288 | 82.2 |
| 2/22/2007 | 15:40:23 | 46 | 40.0-40.5 | 17 | 19 | 0 | 29 | 14.6 | 0.296 | 84.7 |
| 2/22/2007 | 15:40:24 | 46 | 40.0-40.5 | 17 | 20 | 56.8 | 29 | 14.8 | 0.296 | 84.7 |
| 2/22/2007 | 15:40:25 | 46 | 40.0-40.5 | 17 | 21 | 55.9 | 29 | 14.5 | 0.293 | 83.8 |
| 2/22/2007 | 15:40:26 | 46 | 40.0-40.5 | 17 | 22 | 55.9 | 28 | 14.2 | 0.287 | 82.0 |
| 2/22/2007 | 15:40:28 | 46 | 40.0-40.5 | 17 | 23 | 55.9 | 28 | 14.1 | 0.289 | 82.6 |
| 2/22/2007 | 15:40:29 | 46 | 40.0-40.5 | 17 | 24 | 55.7 | 29 | 14.2 | 0.292 | 83.3 |
| 2/22/2007 | 15:40:30 | 46 | 40.0-40.5 | 17 | 25 | 55.7 | 29 | 14.3 | 0.294 | 84.0 |
| 2/22/2007 | 15:40:31 | 46 | 40.5-41.0 | 17 | 26 | 55.7 | 29 | 14.2 | 0.289 | 82.6 |
| 2/22/2007 | 15:40:32 | 46 | 40.5-41.0 | 17 | 27 | 55.8 | 28 | 14.0 | 0.290 | 82.9 |

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|---|---|---|---|---|---|---|---|---|---|---|
| 2/22/2007 | 15:40:33 | 46 | 40.5-41.0 | 17 | 28 | 55.7 | 29 | 14.2 | 0.290 | 83.0 |
| 2/22/2007 | 15:40:34 | 46 | 40.5-41.0 | 17 | 29 | 55.8 | 29 | 14.0 | 0.293 | 83.7 |
| 2/22/2007 | 15:40:35 | 46 | 40.5-41.0 | 17 | 30 | 55.6 | 28 | 14.2 | 0.290 | 82.7 |
| 2/22/2007 | 15:40:36 | 46 | 40.5-41.0 | 17 | 31 | 55.8 | 29 | 14.2 | 0.295 | 84.3 |
| 2/22/2007 | 15:40:37 | 46 | 40.5-41.0 | 17 | 32 | 55.7 | 29 | 14.2 | 0.291 | 83.3 |
| 2/22/2007 | 15:40:38 | 46 | 41.0-41.5 | 17 | 33 | 55.7 | 28 | 14.2 | 0.289 | 82.6 |
| 2/22/2007 | 15:40:39 | 46 | 41.0-41.5 | 17 | 34 | 55.8 | 28 | 14.3 | 0.292 | 83.4 |
| 2/22/2007 | 15:40:40 | 46 | 41.0-41.5 | 17 | 35 | 55.7 | 29 | 14.3 | 0.291 | 83.1 |
| 2/22/2007 | 15:40:41 | 46 | 41.0-41.5 | 17 | 36 | 55.5 | 29 | 14.1 | 0.293 | 83.7 |
| 2/22/2007 | 15:40:42 | 46 | 41.0-41.5 | 17 | 37 | 55.7 | 29 | 14.1 | 0.296 | 84.6 |
| 2/22/2007 | 15:40:43 | 46 | 41.0-41.5 | 17 | 38 | 55.7 | 29 | 14.2 | 0.292 | 83.4 |
| 2/22/2007 | 15:40:44 | 46 | 41.0-41.5 | 17 | 39 | 55.6 | 29 | 14.3 | 0.294 | 83.9 |
| 2/22/2007 | 15:40:45 | 46 | 41.0-41.5 | 17 | 40 | 55.6 | 28 | 14.4 | 0.291 | 83.3 |
| 2/22/2007 | 15:40:47 | 46 | 41.0-41.5 | 17 | 41 | 55.7 | 29 | 14.4 | 0.292 | 83.5 |
| 2/22/2007 | 15:40:48 | 46 | 41.0-41.5 | 27 | 42 | 55.7 | 28 | 14.4 | 0.291 | 83.2 |
| 2/22/2007 | 15:40:49 | 46 | 41.0-41.5 | 27 | 43 | 55.6 | 29 | 14.3 | 0.292 | 83.4 |
| 2/22/2007 | 16:14:20 | 66 | 60.0-60.5 | 27 | 44 | 0 | 29 | 14.1 | 0.297 | 84.8 |
| 2/22/2007 | 16:14:21 | 66 | 60.0-60.5 | 27 | 45 | 57 | 29 | 14.2 | 0.295 | 84.2 |
| 2/22/2007 | 16:14:22 | 66 | 60.0-60.5 | 27 | 46 | 55.8 | 29 | 14.1 | 0.299 | 85.4 |
| 2/22/2007 | 16:14:23 | 66 | 60.0-60.5 | 27 | 47 | 55.8 | 29 | 14.0 | 0.295 | 84.2 |
| 2/22/2007 | 16:14:24 | 66 | 60.0-60.5 | 27 | 48 | 55.8 | 29 | 14.1 | 0.296 | 84.5 |
| 2/22/2007 | 16:14:25 | 66 | 60.0-60.5 | 27 | 49 | 55.7 | 29 | 13.9 | 0.296 | 84.6 |
| 2/22/2007 | 16:14:26 | 66 | 60.0-60.5 | 27 | 50 | 55.7 | 29 | 14.0 | 0.291 | 83.3 |
| 2/22/2007 | 16:14:27 | 66 | 60.0-60.5 | 27 | 51 | 55.6 | 29 | 14.0 | 0.292 | 83.5 |
| 2/22/2007 | 16:14:29 | 66 | 60.5-61.0 | 27 | 52 | 55.8 | 29 | 14.0 | 0.292 | 83.5 |
| 2/22/2007 | 16:14:30 | 66 | 60.5-61.0 | 27 | 53 | 55.7 | 29 | 14.3 | 0.296 | 84.5 |
| 2/22/2007 | 16:14:31 | 66 | 60.5-61.0 | 27 | 54 | 55.6 | 29 | 14.3 | 0.292 | 83.4 |
| 2/22/2007 | 16:14:32 | 66 | 60.5-61.0 | 27 | 55 | 55.5 | 29 | 14.3 | 0.292 | 83.5 |
| 2/22/2007 | 16:14:33 | 66 | 60.5-61.0 | 27 | 56 | 55.6 | 29 | 14.5 | 0.292 | 83.3 |
| 2/22/2007 | 16:14:34 | 66 | 60.5-61.0 | 27 | 57 | 55.5 | 29 | 14.2 | 0.295 | 84.2 |
| 2/22/2007 | 16:14:35 | 66 | 60.5-61.0 | 27 | 58 | 55.5 | 29 | 14.7 | 0.292 | 83.5 |
| 2/22/2007 | 16:14:36 | 66 | 60.5-61.0 | 27 | 59 | 55.4 | 29 | 14.5 | 0.295 | 84.4 |
| 2/22/2007 | 16:14:37 | 66 | 60.5-61.0 | 27 | 60 | 55.6 | 29 | 14.2 | 0.294 | 83.9 |
| 2/22/2007 | 16:14:38 | 66 | 60.5-61.0 | 27 | 61 | 55.7 | 29 | 14.3 | 0.296 | 84.6 |
| 2/22/2007 | 16:14:39 | 66 | 60.5-61.0 | 27 | 62 | 55.7 | 29 | 14.4 | 0.294 | 83.9 |
| 2/22/2007 | 16:14:40 | 66 | 60.5-61.0 | 27 | 63 | 55.5 | 29 | 14.4 | 0.295 | 84.2 |
| 2/22/2007 | 16:14:41 | 66 | 60.5-61.0 | 27 | 64 | 55.7 | 29 | 14.4 | 0.297 | 84.9 |
| 2/22/2007 | 16:14:42 | 66 | 61.0-61.5 | 27 | 65 | 55.5 | 29 | 14.4 | 0.295 | 84.4 |
| 2/22/2007 | 16:14:43 | 66 | 61.0-61.5 | 27 | 66 | 55.6 | 29 | 14.1 | 0.296 | 84.6 |
| 2/22/2007 | 16:14:44 | 66 | 61.0-61.5 | 27 | 67 | 55.6 | 29 | 14.2 | 0.295 | 84.4 |
| 2/22/2007 | 16:14:45 | 66 | 61.0-61.5 | 27 | 68 | 55.5 | 29 | 14.1 | 0.295 | 84.4 |
| 2/22/2007 | 16:14:47 | 66 | 61.0-61.5 | 27 | 69 | 55.5 | 29 | 14.5 | 0.296 | 84.5 |
| 2/22/2007 | 16:14:48 | 66 | 61.0-61.5 | 27 | 70 | 55.4 | 29 | 14.3 | 0.296 | 84.7 |
| 2/22/2007 | 16:14:49 | 66 | 61.0-61.5 | 27 | 71 | 55.7 | 29 | 14.4 | 0.292 | 83.5 |
| 2/22/2007 | 16:14:50 | 66 | 61.0-61.5 | 27 | 72 | 55.6 | 29 | 14.2 | 0.291 | 83.3 |
| 2/22/2007 | 16:14:51 | 66 | 61.0-61.5 | 27 | 73 | 55.5 | 29 | 14.3 | 0.297 | 84.8 |
| 2/22/2007 | 16:14:52 | 66 | 61.0-61.5 | 27 | 74 | 55.5 | 29 | 14.4 | 0.297 | 84.8 |
| 2/22/2007 | 16:14:53 | 66 | 61.0-61.5 | 27 | 75 | 55.6 | 29 | 14.3 | 0.297 | 84.7 |
| 2/22/2007 | 16:14:54 | 66 | 61.0-61.5 | 27 | 76 | 55.4 | 29 | 14.4 | 0.294 | 84.0 |
| 2/22/2007 | 16:14:55 | 66 | 61.0-61.5 | 27 | 77 | 55.6 | 29 | 14.3 | 0.295 | 84.3 |
| 2/22/2007 | 16:14:56 | 66 | 61.0-61.5 | 27 | 78 | 55.6 | 29 | 14.3 | 0.293 | 83.9 |
| 2/22/2007 | 16:14:57 | 66 | 61.0-61.5 | 27 | 79 | 55.5 | 29 | 14.3 | 0.295 | 84.2 |

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|---|---|---|---|---|---|---|---|---|---|---|
| 2/26/2007 | 15:20:00 | 86 | 80.0-80.5 | 37 | 1 | 0 | 29 | 13.8 | 0.275 | 78.5 |
| 2/26/2007 | 15:20:01 | 86 | 80.0-80.5 | 37 | 2 | 41.9 | 29 | 13.8 | 0.274 | 78.2 |
| 2/26/2007 | 15:20:03 | 86 | 80.0-80.5 | 37 | 3 | 41.9 | 29 | 13.9 | 0.272 | 77.7 |
| 2/26/2007 | 15:20:04 | 86 | 80.0-80.5 | 37 | 4 | 41.9 | 29 | 14.1 | 0.271 | 77.3 |
| 2/26/2007 | 15:20:05 | 86 | 80.0-80.5 | 37 | 5 | 41.9 | 29 | 14.2 | 0.273 | 77.9 |
| 2/26/2007 | 15:20:07 | 86 | 80.0-80.5 | 37 | 6 | 41.9 | 29 | 14.1 | 0.275 | 78.6 |
| 2/26/2007 | 15:20:08 | 86 | 80.5-81.0 | 37 | 7 | 41.9 | 29 | 13.7 | 0.270 | 77.2 |
| 2/26/2007 | 15:20:10 | 86 | 80.5-81.0 | 37 | 8 | 42 | 29 | 13.9 | 0.273 | 78.1 |
| 2/26/2007 | 15:20:11 | 86 | 80.5-81.0 | 37 | 9 | 42 | 29 | 14.2 | 0.271 | 77.3 |
| 2/26/2007 | 15:20:12 | 86 | 80.5-81.0 | 37 | 10 | 41.9 | 29 | 14.5 | 0.274 | 78.3 |
| 2/26/2007 | 15:20:14 | 86 | 80.5-81.0 | 37 | 11 | 42 | 29 | 14.4 | 0.274 | 78.2 |
| 2/26/2007 | 15:20:15 | 86 | 80.5-81.0 | 37 | 12 | 42 | 29 | 13.9 | 0.271 | 77.5 |
| 2/26/2007 | 15:20:17 | 86 | 80.5-81.0 | 37 | 13 | 43 | 29 | 14.3 | 0.282 | 80.6 |
| 2/26/2007 | 15:20:18 | 86 | 80.5-81.0 | 37 | 14 | 45.8 | 30 | 14.5 | 0.280 | 80.1 |
| 2/26/2007 | 15:20:19 | 86 | 80.5-81.0 | 37 | 15 | 49.5 | 29 | 14.3 | 0.285 | 81.4 |
| 2/26/2007 | 15:20:20 | 86 | 80.5-81.0 | 37 | 16 | 52.1 | 31 | 15.0 | 0.290 | 83.0 |
| 2/26/2007 | 15:20:21 | 86 | 80.5-81.0 | 37 | 17 | 53.4 | 30 | 14.7 | 0.290 | 82.8 |
| 2/26/2007 | 15:20:22 | 86 | 80.5-81.0 | 37 | 18 | 53.5 | 30 | 14.9 | 0.288 | 82.2 |
| 2/26/2007 | 15:20:23 | 86 | 80.5-81.0 | 37 | 19 | 53.4 | 30 | 15.0 | 0.292 | 83.3 |
| 2/26/2007 | 15:20:25 | 86 | 80.5-81.0 | 37 | 20 | 53.4 | 30 | 15.1 | 0.290 | 82.8 |
| 2/26/2007 | 15:20:26 | 86 | 80.5-81.0 | 37 | 21 | 53.4 | 30 | 14.9 | 0.289 | 82.7 |
| 2/26/2007 | 15:20:27 | 86 | 81.0-81.5 | 37 | 22 | 53.4 | 30 | 14.5 | 0.288 | 82.4 |
| 2/26/2007 | 15:20:28 | 86 | 81.0-81.5 | 37 | 23 | 53.1 | 30 | 15.2 | 0.294 | 84.1 |
| 2/26/2007 | 15:20:29 | 86 | 81.0-81.5 | 37 | 24 | 56.3 | 30 | 14.8 | 0.297 | 84.8 |
| 2/26/2007 | 15:20:30 | 86 | 81.0-81.5 | 37 | 25 | 55.6 | 30 | 15.3 | 0.293 | 83.8 |
| 2/26/2007 | 15:20:31 | 86 | 81.0-81.5 | 37 | 26 | 55.7 | 30 | 15.2 | 0.296 | 84.5 |
| 2/26/2007 | 15:20:32 | 86 | 81.0-81.5 | 37 | 27 | 55.6 | 30 | 14.7 | 0.293 | 83.8 |
| 2/26/2007 | 15:20:33 | 86 | 81.0-81.5 | 37 | 28 | 55.6 | 30 | 15.0 | 0.298 | 85.0 |
| 2/26/2007 | 15:20:34 | 86 | 81.0-81.5 | 37 | 29 | 55.6 | 30 | 15.5 | 0.298 | 85.2 |
| 2/26/2007 | 15:20:35 | 86 | 81.0-81.5 | 37 | 30 | 55.7 | 30 | 14.9 | 0.298 | 85.1 |
| 2/26/2007 | 15:20:36 | 86 | 81.0-81.5 | 37 | 31 | 55.7 | 30 | 14.9 | 0.297 | 84.9 |
| 2/26/2007 | 15:20:37 | 86 | 81.0-81.5 | 37 | 32 | 55.6 | 30 | 15.0 | 0.294 | 84.1 |
| 2/26/2007 | 15:20:38 | 86 | 81.0-81.5 | 37 | 33 | 55.5 | 30 | 14.9 | 0.295 | 84.3 |
| 2/26/2007 | 15:20:40 | 86 | 81.0-81.5 | 37 | 34 | 55.6 | 30 | 14.4 | 0.297 | 85.0 |
| 2/26/2007 | 15:20:41 | 86 | 81.0-81.5 | 37 | 35 | 55.6 | 30 | 15.2 | 0.298 | 85.2 |
| 2/26/2007 | 15:20:42 | 86 | 81.0-81.5 | 37 | 36 | 55.6 | 30 | 14.7 | 0.294 | 84.1 |
| 2/26/2007 | 15:20:43 | 86 | 81.0-81.5 | 37 | 37 | 55.5 | 30 | 14.8 | 0.299 | 85.4 |
| 2/26/2007 | 15:20:44 | 86 | 81.0-81.5 | 37 | 38 | 55.6 | 30 | 14.7 | 0.297 | 84.7 |
| 2/26/2007 | 15:20:45 | 86 | 81.0-81.5 | 37 | 39 | 55.5 | 30 | 14.4 | 0.301 | 85.9 |
| 2/26/2007 | 15:20:46 | 86 | 81.0-81.5 | 37 | 40 | 55.7 | 30 | 14.7 | 0.295 | 84.2 |
| 2/26/2007 | 15:20:47 | 86 | 81.0-81.5 | 37 | 41 | 55.4 | 30 | 14.4 | 0.299 | 85.5 |
| 2/26/2007 | 15:20:48 | 86 | 81.0-81.5 | 37 | 42 | 55.5 | 30 | 14.7 | 0.298 | 85.2 |
| 2/26/2007 | 15:20:49 | 86 | 81.0-81.5 | 37 | 43 | 55.6 | 30 | 15.1 | 0.297 | 84.9 |
| 2/26/2007 | 15:20:50 | 86 | 81.0-81.5 | 37 | 44 | 55.6 | 30 | 14.3 | 0.301 | 85.9 |
| 2/26/2007 | 15:20:51 | 86 | 81.0-81.5 | 37 | 45 | 55.6 | 30 | 14.6 | 0.296 | 84.5 |
| 2/26/2007 | 15:20:52 | 86 | 81.0-81.5 | 37 | 46 | 55.5 | 30 | 14.4 | 0.297 | 84.7 |
| 2/26/2007 | 17:23:50 | 106 | 100.0-100.5 | 11/2" | 47 | 0 | 30 | 14.0 | 0.291 | 83.1 |
| 2/26/2007 | 17:23:51 | 106 | 100.0-100.5 | 11/2" | 48 | 56.3 | 30 | 14.0 | 0.293 | 83.8 |
| 2/26/2007 | 17:23:52 | 106 | 100.0-100.5 | 11/2" | 49 | 55.7 | 30 | 14.1 | 0.294 | 83.9 |
| 2/26/2007 | 17:23:53 | 106 | 100.0-100.5 | 11/2" | 50 | 55.6 | 30 | 14.0 | 0.290 | 82.8 |
| 2/26/2007 | 17:23:54 | 106 | 100.0-100.5 | 11/2" | 51 | 55.6 | 30 | 14.1 | 0.295 | 84.4 |
| 2/26/2007 | 17:23:55 | 106 | 100.0-100.5 | 11/2" | 52 | 55.7 | 30 | 14.0 | 0.292 | 83.4 |

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|---|---|---|---|---|---|---|---|---|---|---|
| 2/26/2007 | 17:23:56 | 106 | 100.0-100.5 | 11/2" | 53 | 55.6 | 30 | 14.2 | 0.294 | 84.0 |
| 2/26/2007 | 17:23:57 | 106 | 100.0-100.5 | 11/2" | 54 | 55.7 | 30 | 14.2 | 0.291 | 83.2 |
| 2/26/2007 | 17:23:58 | 106 | 100.0-100.5 | 11/2" | 55 | 55.6 | 30 | 14.2 | 0.291 | 83.1 |
| 2/26/2007 | 17:23:59 | 106 | 100.0-100.5 | 11/2" | 56 | 55.6 | 30 | 14.4 | 0.292 | 83.5 |
| 2/26/2007 | 17:24:01 | 106 | 100.0-100.5 | 11/2" | 57 | 55.5 | 30 | 14.1 | 0.295 | 84.3 |
| 2/26/2007 | 17:24:02 | 106 | 100.0-100.5 | 11/2" | 58 | 55.5 | 30 | 14.2 | 0.291 | 83.2 |
| 2/26/2007 | 17:24:03 | 106 | 100.0-100.5 | 11/2" | 59 | 55.5 | 30 | 14.2 | 0.295 | 84.3 |
| 2/26/2007 | 17:24:04 | 106 | 100.0-100.5 | 11/2" | 60 | 55.6 | 30 | 14.2 | 0.292 | 83.4 |
| 2/26/2007 | 17:24:05 | 106 | 100.0-100.5 | 11/2" | 61 | 55.5 | 30 | 14.4 | 0.297 | 84.9 |
| 2/26/2007 | 17:24:06 | 106 | 100.0-100.5 | 11/2" | 62 | 55.6 | 29 | 14.2 | 0.287 | 82.0 |
| 2/26/2007 | 17:24:07 | 106 | 100.0-100.5 | 11/2" | 63 | 55.7 | 30 | 14.4 | 0.294 | 83.9 |
| 2/26/2007 | 17:24:08 | 106 | 100.0-100.5 | 11/2" | 64 | 55.6 | 30 | 14.3 | 0.294 | 84.0 |
| 2/26/2007 | 17:24:09 | 106 | 100.0-100.5 | 11/2" | 65 | 55.7 | 30 | 14.3 | 0.292 | 83.5 |
| 2/26/2007 | 17:24:10 | 106 | 100.0-100.5 | 11/2" | 66 | 55.5 | 29 | 14.4 | 0.294 | 84.0 |
| 2/26/2007 | 17:24:11 | 106 | 100.0-100.5 | 11/2" | 67 | 55.6 | 30 | 14.3 | 0.294 | 84.1 |
| 2/26/2007 | 17:24:12 | 106 | 100.0-100.5 | 11/2" | 68 | 55.6 | 29 | 14.6 | 0.293 | 83.7 |
| 2/26/2007 | 17:24:13 | 106 | 100.0-100.5 | 11/2" | 69 | 55.5 | 30 | 13.9 | 0.293 | 83.8 |
| 2/26/2007 | 17:24:14 | 106 | 100.0-100.5 | 11/2" | 70 | 55.6 | 30 | 14.1 | 0.290 | 82.8 |
| 2/26/2007 | 17:24:15 | 106 | 100.0-100.5 | 11/2" | 71 | 55.7 | 30 | 14.5 | 0.296 | 84.5 |
| 2/26/2007 | 17:24:16 | 106 | 100.0-100.5 | 11/2" | 72 | 55.5 | 29 | 14.2 | 0.289 | 82.6 |
| 2/26/2007 | 17:24:17 | 106 | 100.0-100.5 | 11/2" | 73 | 55.5 | 29 | 14.3 | 0.292 | 83.4 |
| 2/26/2007 | 17:24:19 | 106 | 100.0-100.5 | 11/2" | 74 | 55.6 | 30 | 14.4 | 0.291 | 83.1 |
| 2/26/2007 | 17:24:20 | 106 | 100.0-100.5 | 11/2" | 75 | 55.5 | 30 | 14.0 | 0.289 | 82.4 |
| 2/26/2007 | 17:24:21 | 106 | 100.0-100.5 | 11/2" | 76 | 55.5 | 30 | 14.1 | 0.291 | 83.1 |
| 2/26/2007 | 17:24:22 | 106 | 100.0-100.5 | 11/2" | 77 | 55.6 | 29 | 14.4 | 0.292 | 83.5 |
| 2/26/2007 | 17:24:23 | 106 | 100.0-100.5 | 11/2" | 78 | 55.5 | 29 | 14.2 | 0.289 | 82.5 |
| 2/26/2007 | 17:24:24 | 106 | 100.0-100.5 | 11/2" | 79 | 55.5 | 30 | 14.4 | 0.292 | 83.5 |
| 2/26/2007 | 17:24:25 | 106 | 100.0-100.5 | 11/2" | 80 | 55.6 | 29 | 14.3 | 0.291 | 83.1 |
| 2/26/2007 | 17:24:26 | 106 | 100.5-100.8 | 11/2" | 81 | 55.4 | 30 | 14.3 | 0.293 | 83.7 |
| 2/26/2007 | 17:24:27 | 106 | 100.5-100.8 | 11/2" | 82 | 55.5 | 30 | 14.4 | 0.295 | 84.4 |
| 2/26/2007 | 17:24:28 | 106 | 100.5-100.8 | 11/2" | 83 | 55.5 | 30 | 14.4 | 0.299 | 85.5 |
| 2/26/2007 | 17:24:29 | 106 | 100.5-100.8 | 11/2" | 84 | 55.4 | 30 | 13.8 | 0.296 | 84.7 |
| 2/26/2007 | 17:24:30 | 106 | 100.5-100.8 | 11/2" | 85 | 55.4 | 30 | 14.5 | 0.292 | 83.5 |
| 2/26/2007 | 17:24:31 | 106 | 100.5-100.8 | 11/2" | 86 | 55.5 | 30 | 14.3 | 0.294 | 84.1 |
| 2/26/2007 | 17:24:32 | 106 | 100.5-100.8 | 11/2" | 87 | 55.4 | 30 | 14.4 | 0.293 | 83.6 |
| 2/26/2007 | 17:24:33 | 106 | 100.5-100.8 | 11/2" | 88 | 55.4 | 30 | 14.2 | 0.291 | 83.2 |
| 2/26/2007 | 17:24:34 | 106 | 100.5-100.8 | 11/2" | 89 | 55.5 | 30 | 14.7 | 0.297 | 84.9 |
| 2/26/2007 | 17:24:36 | 106 | 100.5-100.8 | 11/2" | 90 | 55.4 | 30 | 14.5 | 0.296 | 84.6 |
| 2/26/2007 | 17:24:37 | 106 | 100.5-100.8 | 11/2" | 91 | 55.5 | 30 | 14.5 | 0.299 | 85.3 |

*Equipment malfunction, hydraulic chuck release mechanism was engaged reducing flow to SPT hammer hydraulic motor

| | | |
|---|---|---|
| 1.17 | inches^2 | Area |
| 0.492083 | kips/feet^3 | Specific Weight Density |
| 16807.7 | feet/secon( | Wave Speed |
| 29999.6 | ksi | Elastic Modulus |

| | | |
|---|---|---|
| F3 | F1 | 218.2 |
| F4 | F2 | 219.2 |
| A3 | A1 | 282 |
| A4 | A2 | 295 |

| DEPTH | N | AVE. ETR | STDEV |
|---|---|---|---|
| (ft) | (bpf) | (%) | of ETR |
| 3.0-4.5 | 8 | 82.0 | 12.47 |
| 8.0-9.5 | 32 | 83.7 | 1.58 |
| 13.5-13.8 | 22/3" | 88.8 | 2.40 |
| 3.0-4.5 | 5 | 78.9 | 10.04 |
| 8.0-9.5 | 25 | 86.3 | 1.28 |
| ALL BLOWS | | 85.3 | 4.74 |

| | |
|---|---|
| PJ | TRC0701 |
| PN | CME-45 |
| PD | 1986 CME-45 Skid Mounted Rig (AHTD EQUIP #1002); CME Automatic Hammer |
| OP | Driller- Josh Higginbottom; SPT Analyzer - David Ross |

| Date | Time | LP | DEPTH | N | BN | BPM | FMX | VMX | EFV | ETR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | feet | feet | bpf | | blows/min. | kips | feet/second | kip-feet | (%) |
| 3/5/2007 | 10:26:50 | 8.8 | 3.0-3.5 | 8 | 1 | 0 | 28 | 16.3 | 0.215 | 61.5 |
| 3/5/2007 | 10:26:57 | 8.8 | 3.0-3.5 | 8 | 2 | 0 | 28 | 16.2 | 0.228 | 65.0 |
| 3/5/2007 | 10:26:59 | 8.8 | 3.0-3.5 | 8 | 3 | 52.8 | 28 | 16.8 | 0.331 | 94.5 |
| 3/5/2007 | 10:27:00 | 8.8 | 3.5-4.0 | 8 | 4 | 52.7 | 28 | 16.9 | 0.316 | 90.2 |
| 3/5/2007 | 10:27:01 | 8.8 | 3.5-4.0 | 8 | 5 | 53.7 | 28 | 16.4 | 0.297 | 84.9 |
| 3/5/2007 | 10:27:02 | 8.8 | 3.5-4.0 | 8 | 6 | 52.6 | 28 | 16.0 | 0.278 | 79.4 |
| 3/5/2007 | 10:27:03 | 8.8 | 3.5-4.0 | 8 | 7 | 53.3 | 28 | 16.0 | 0.314 | 89.7 |
| 3/5/2007 | 10:27:04 | 8.8 | 4.0-4.5 | 8 | 8 | 52.9 | 29 | 16.4 | 0.318 | 91.0 |
| 3/5/2007 | 11:11:10 | 13.8 | 8.0-8.5 | 32 | 9 | 0 | 28 | 16.0 | 0.274 | 78.4 |
| 3/5/2007 | 11:11:11 | 13.8 | 8.0-8.5 | 32 | 10 | 50.4 | 28 | 15.2 | 0.285 | 81.4 |
| 3/5/2007 | 11:11:13 | 13.8 | 8.0-8.5 | 32 | 11 | 50.2 | 29 | 15.2 | 0.286 | 81.8 |
| 3/5/2007 | 11:11:14 | 13.8 | 8.0-8.5 | 32 | 12 | 50.7 | 29 | 15.2 | 0.287 | 81.9 |
| 3/5/2007 | 11:11:15 | 13.8 | 8.0-8.5 | 32 | 13 | 51.2 | 29 | 15.4 | 0.284 | 81.1 |
| 3/5/2007 | 11:11:16 | 13.8 | 8.0-8.5 | 32 | 14 | 51.6 | 29 | 15.5 | 0.292 | 83.3 |
| 3/5/2007 | 11:11:17 | 13.8 | 8.0-8.5 | 32 | 15 | 52.2 | 29 | 15.4 | 0.284 | 81.1 |
| 3/5/2007 | 11:11:18 | 13.8 | 8.0-8.5 | 32 | 16 | 52.1 | 29 | 15.2 | 0.292 | 83.4 |
| 3/5/2007 | 11:11:19 | 13.8 | 8.0-8.5 | 32 | 17 | 52.2 | 29 | 15.5 | 0.293 | 83.7 |
| 3/5/2007 | 11:11:21 | 13.8 | 8.0-8.5 | 32 | 18 | 52.1 | 29 | 15.5 | 0.291 | 83.0 |
| 3/5/2007 | 11:11:22 | 13.8 | 8.0-8.5 | 32 | 19 | 52.2 | 29 | 15.4 | 0.289 | 82.5 |
| 3/5/2007 | 11:11:23 | 13.8 | 8.0-8.5 | 32 | 20 | 52.1 | 29 | 15.3 | 0.294 | 84.1 |
| 3/5/2007 | 11:11:24 | 13.8 | 8.5-9.0 | 32 | 21 | 52.3 | 29 | 15.4 | 0.295 | 84.2 |
| 3/5/2007 | 11:11:25 | 13.8 | 8.5-9.0 | 32 | 22 | 52.4 | 29 | 15.5 | 0.295 | 84.3 |
| 3/5/2007 | 11:11:26 | 13.8 | 8.5-9.0 | 32 | 23 | 52.1 | 29 | 15.4 | 0.293 | 83.6 |
| 3/5/2007 | 11:11:27 | 13.8 | 8.5-9.0 | 32 | 24 | 52.5 | 29 | 15.5 | 0.296 | 84.7 |
| 3/5/2007 | 11:11:28 | 13.8 | 8.5-9.0 | 32 | 25 | 52.2 | 29 | 15.3 | 0.296 | 84.6 |
| 3/5/2007 | 11:11:30 | 13.8 | 8.5-9.0 | 32 | 26 | 51.9 | 29 | 15.6 | 0.292 | 83.3 |
| 3/5/2007 | 11:11:31 | 13.8 | 8.5-9.0 | 32 | 27 | 52.4 | 29 | 15.5 | 0.290 | 82.8 |
| 3/5/2007 | 11:11:32 | 13.8 | 8.5-9.0 | 32 | 28 | 52.2 | 29 | 15.5 | 0.293 | 83.8 |
| 3/5/2007 | 11:11:33 | 13.8 | 8.5-9.0 | 32 | 29 | 52.5 | 29 | 15.5 | 0.292 | 83.4 |
| 3/5/2007 | 11:11:34 | 13.8 | 8.5-9.0 | 32 | 30 | 52.1 | 29 | 15.3 | 0.296 | 84.7 |
| 3/5/2007 | 11:11:35 | 13.8 | 8.5-9.0 | 32 | 31 | 52.6 | 29 | 15.5 | 0.293 | 83.6 |
| 3/5/2007 | 11:11:36 | 13.8 | 8.5-9.0 | 32 | 32 | 52.4 | 29 | 15.4 | 0.299 | 85.5 |
| 3/5/2007 | 11:11:37 | 13.8 | 8.5-9.0 | 32 | 33 | 52.4 | 29 | 15.5 | 0.299 | 85.4 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3/5/2007 | 11:11:39 | 13.8 | 8.5-9.0 | 32 | 34 | 52.4 | 29 | 15.4 | 0.302 | 86.2 |
| 3/5/2007 | 11:11:40 | 13.8 | 8.5-9.0 | 32 | 35 | 52.1 | 29 | 15.8 | 0.301 | 86.1 |
| 3/5/2007 | 11:11:41 | 13.8 | 8.5-9.0 | 32 | 36 | 52.4 | 29 | 15.4 | 0.299 | 85.5 |
| 3/5/2007 | 11:11:42 | 13.8 | 9.0-9.5 | 32 | 37 | 52.1 | 29 | 15.4 | 0.303 | 86.5 |
| 3/5/2007 | 11:11:43 | 13.8 | 9.0-9.5 | 32 | 38 | 52.8 | 29 | 15.5 | 0.301 | 85.9 |
| 3/5/2007 | 11:11:44 | 13.8 | 9.0-9.5 | 32 | 39 | 52.1 | 29 | 15.6 | 0.298 | 85.2 |
| 3/5/2007 | 11:11:45 | 13.8 | 9.0-9.5 | 32 | 40 | 52.6 | 29 | 15.6 | 0.299 | 85.5 |
| 3/5/2007 | 11:11:47 | 13.8 | 9.0-9.5 | 32 | 41 | 52 | 29 | 15.5 | 0.294 | 84.0 |
| 3/5/2007 | 11:11:48 | 13.8 | 9.0-9.5 | 32 | 42 | 52.7 | 29 | 15.3 | 0.294 | 84.0 |
| 3/5/2007 | 11:11:49 | 13.8 | 9.0-9.5 | 32 | 43 | 52.3 | 29 | 15.6 | 0.292 | 83.4 |
| 3/5/2007 | 11:11:50 | 13.8 | 9.0-9.5 | 32 | 44 | 52.5 | 29 | 15.6 | 0.296 | 84.5 |
| 3/5/2007 | 11:11:51 | 13.8 | 9.0-9.5 | 32 | 45 | 52.7 | 29 | 15.5 | 0.290 | 82.9 |
| 3/5/2007 | 11:11:52 | 13.8 | 9.0-9.5 | 32 | 46 | 52.4 | 29 | 15.5 | 0.292 | 83.3 |
| 3/5/2007 | 11:11:53 | 13.8 | 9.0-9.5 | 32 | 47 | 52.9 | 29 | 15.2 | 0.286 | 81.8 |
| 3/5/2007 | 11:11:54 | 13.8 | 9.0-9.5 | 32 | 48 | 52.4 | 29 | 15.5 | 0.290 | 83.0 |
| 3/5/2007 | 11:11:55 | 13.8 | 9.0-9.5 | 32 | 49 | 52.8 | 29 | 15.6 | 0.294 | 84.0 |
| 3/5/2007 | 11:11:57 | 13.8 | 9.0-9.5 | 32 | 50 | 52.5 | 29 | 15.7 | 0.292 | 83.4 |
| 3/5/2007 | 11:11:58 | 13.8 | 9.0-9.5 | 32 | 51 | 52.3 | 29 | 15.7 | 0.298 | 85.1 |
| 3/5/2007 | 11:11:59 | 13.8 | 9.0-9.5 | 32 | 52 | 52.9 | 29 | 15.7 | 0.296 | 84.5 |
| 3/5/2007 | 11:12:00 | 13.8 | 9.0-9.5 | 32 | 53 | 52.8 | 29 | 15.6 | 0.291 | 83.0 |
| 3/5/2007 | 11:40:01 | 18.8 | 13.0-13.5 | 22/3" | 54 | 0 | 29 | 16.5 | 0.272 | 77.8 |
| 3/5/2007 | 11:40:02 | 18.8 | 13.0-13.5 | 22/3" | 55 | 53.4 | 29 | 16.7 | 0.300 | 85.7 |
| 3/5/2007 | 11:40:04 | 18.8 | 13.0-13.5 | 22/3" | 56 | 54 | 29 | 16.3 | 0.309 | 88.4 |
| 3/5/2007 | 11:40:05 | 18.8 | 13.0-13.5 | 22/3" | 57 | 54.3 | 29 | 16.5 | 0.313 | 89.4 |
| 3/5/2007 | 11:40:06 | 18.8 | 13.0-13.5 | 22/3" | 58 | 54.6 | 29 | 16.5 | 0.310 | 88.6 |
| 3/5/2007 | 11:40:07 | 18.8 | 13.0-13.5 | 22/3" | 59 | 53.8 | 30 | 16.5 | 0.311 | 88.9 |
| 3/5/2007 | 11:40:08 | 18.8 | 13.0-13.5 | 22/3" | 60 | 53.9 | 30 | 16.6 | 0.306 | 87.6 |
| 3/5/2007 | 11:40:09 | 18.8 | 13.0-13.5 | 22/3" | 61 | 55 | 29 | 16.6 | 0.308 | 88.0 |
| 3/5/2007 | 11:40:10 | 18.8 | 13.0-13.5 | 22/3" | 62 | 54.4 | 29 | 16.5 | 0.304 | 86.8 |
| 3/5/2007 | 11:40:11 | 18.8 | 13.0-13.5 | 22/3" | 63 | 54.3 | 30 | 16.5 | 0.312 | 89.2 |
| 3/5/2007 | 11:40:12 | 18.8 | 13.5-13.8 | 22/3" | 64 | 53.7 | 30 | 16.7 | 0.315 | 90.0 |
| 3/5/2007 | 11:40:13 | 18.8 | 13.5-13.8 | 22/3" | 65 | 54.7 | 30 | 16.6 | 0.310 | 88.5 |
| 3/5/2007 | 11:40:14 | 18.8 | 13.5-13.8 | 22/3" | 66 | 54.1 | 30 | 16.5 | 0.310 | 88.6 |
| 3/5/2007 | 11:40:15 | 18.8 | 13.5-13.8 | 22/3" | 67 | 54 | 30 | 16.6 | 0.313 | 89.5 |
| 3/5/2007 | 11:40:17 | 18.8 | 13.5-13.8 | 22/3" | 68 | 54.9 | 30 | 16.4 | 0.307 | 87.8 |
| 3/5/2007 | 11:40:18 | 18.8 | 13.5-13.8 | 22/3" | 69 | 53.8 | 30 | 16.5 | 0.314 | 89.6 |
| 3/5/2007 | 11:40:19 | 18.8 | 13.5-13.8 | 22/3" | 70 | 54.2 | 30 | 16.4 | 0.318 | 90.9 |
| 3/5/2007 | 11:40:20 | 18.8 | 13.5-13.8 | 22/3" | 71 | 54 | 30 | 16.4 | 0.319 | 91.2 |
| 3/5/2007 | 11:40:21 | 18.8 | 13.5-13.8 | 22/3" | 72 | 54.5 | 30 | 16.4 | 0.311 | 88.8 |
| 3/5/2007 | 11:40:22 | 18.8 | 13.5-13.8 | 22/3" | 73 | 54.1 | 30 | 16.2 | 0.316 | 90.2 |
| 3/5/2007 | 11:40:23 | 18.8 | 13.5-13.8 | 22/3" | 74 | 54.4 | 30 | 16.4 | 0.315 | 90.0 |
| 3/5/2007 | 11:40:24 | 18.8 | 13.5-13.8 | 22/3" | 75 | 54 | 30 | 16.3 | 0.320 | 91.4 |
| 3/5/2007 | 11:40:25 | 18.8 | 13.5-13.8 | 22/3" | 76 | 54.8 | 30 | 16.4 | 0.310 | 88.7 |
| 3/5/2007 | 11:40:26 | 18.8 | 13.5-13.8 | 22/3" | 77 | 54.1 | 30 | 16.5 | 0.316 | 90.4 |
| 3/5/2007 | 11:40:27 | 18.8 | 13.5-13.8 | 22/3" | 78 | 54.3 | 30 | 16.4 | 0.316 | 90.2 |
| 3/5/2007 | 11:40:29 | 18.8 | 13.5-13.8 | 22/3" | 79 | 54.5 | 30 | 16.5 | 0.317 | 90.4 |
| 3/5/2007 | 11:40:30 | 18.8 | 13.5-13.8 | 22/3" | 80 | 54.4 | 30 | 16.2 | 0.308 | 87.9 |
| 3/5/2007 | 11:40:31 | 18.8 | 13.5-13.8 | 22/3" | 81 | 54.1 | 30 | 16.5 | 0.315 | 90.1 |
| 3/5/2007 | 11:40:32 | 18.8 | 13.5-13.8 | 22/3" | 82 | 54.3 | 30 | 16.3 | 0.310 | 88.5 |
| 3/5/2007 | 11:40:33 | 18.8 | 13.5-13.8 | 22/3" | 83 | 54.6 | 30 | 16.5 | 0.315 | 89.9 |
| 3/5/2007 | 11:40:34 | 18.8 | 13.5-13.8 | 22/3" | 84 | 54.3 | 30 | 16.5 | 0.312 | 89.1 |
| 3/5/2007 | 14:39:34 | 8.8 | 3.0-3.5 | 5 | 1 | 0 | 29 | 18.9 | 0.207 | 59.3 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3/5/2007 | 14:39:35 | 8.8 | 3.0-3.5 | 5 | 2 | 53.8 | 29 | 18.8 | 0.269 | 76.9 |
| 3/5/2007 | 14:39:37 | 8.8 | 3.5-4.0 | 5 | 3 | 53.8 | 30 | 18.7 | 0.295 | 84.2 |
| 3/5/2007 | 14:39:38 | 8.8 | 3.5-4.0 | 5 | 4 | 54.1 | 29 | 18.8 | 0.288 | 82.2 |
| 3/5/2007 | 14:39:39 | 8.8 | 4.0-4.5 | 5 | 5 | 54.3 | 30 | 18.7 | 0.306 | 87.4 |
| 3/5/2007 | 14:39:40 | 8.8 | 4.0-4.5 | 5 | 6 | 54.4 | 30 | 18.7 | 0.308 | 88.1 |
| 3/5/2007 | 14:39:41 | 8.8 | 4.0-4.5 | 5 | 7 | 54.3 | 30 | 18.8 | 0.260 | 74.3 |
| 3/5/2007 | 15:06:33 | 13.8 | 8.0-8.5 | 25 | 8 | 0 | 29 | 16.0 | 0.289 | 82.5 |
| 3/5/2007 | 15:06:34 | 13.8 | 8.0-8.5 | 25 | 9 | 54.4 | 30 | 15.6 | 0.302 | 86.3 |
| 3/5/2007 | 15:06:35 | 13.8 | 8.0-8.5 | 25 | 10 | 53.7 | 30 | 15.7 | 0.296 | 84.5 |
| 3/5/2007 | 15:06:36 | 13.8 | 8.0-8.5 | 25 | 11 | 53.9 | 31 | 15.9 | 0.299 | 85.5 |
| 3/5/2007 | 15:06:37 | 13.8 | 8.0-8.5 | 25 | 12 | 54.6 | 30 | 16.0 | 0.296 | 84.7 |
| 3/5/2007 | 15:06:38 | 13.8 | 8.0-8.5 | 25 | 13 | 54.1 | 30 | 15.9 | 0.305 | 87.1 |
| 3/5/2007 | 15:06:39 | 13.8 | 8.0-8.5 | 25 | 14 | 54.3 | 30 | 16.0 | 0.297 | 84.9 |
| 3/5/2007 | 15:06:40 | 13.8 | 8.0-8.5 | 25 | 15 | 54.4 | 31 | 15.8 | 0.303 | 86.6 |
| 3/5/2007 | 15:06:42 | 13.8 | 8.0-8.5 | 25 | 16 | 54.7 | 30 | 16.0 | 0.298 | 85.3 |
| 3/5/2007 | 15:06:43 | 13.8 | 8.0-8.5 | 25 | 17 | 54.4 | 31 | 16.0 | 0.305 | 87.2 |
| 3/5/2007 | 15:06:44 | 13.8 | 8.0-8.5 | 25 | 18 | 54.2 | 30 | 16.0 | 0.304 | 86.9 |
| 3/5/2007 | 15:06:45 | 13.8 | 8.0-8.5 | 25 | 19 | 54.5 | 31 | 16.0 | 0.307 | 87.6 |
| 3/5/2007 | 15:06:46 | 13.8 | 8.0-8.5 | 25 | 20 | 54.2 | 31 | 16.0 | 0.298 | 85.2 |
| 3/5/2007 | 15:06:47 | 13.8 | 8.0-8.5 | 25 | 21 | 54.4 | 31 | 16.0 | 0.304 | 86.9 |
| 3/5/2007 | 15:06:48 | 13.8 | 8.0-8.5 | 25 | 22 | 54.5 | 31 | 16.0 | 0.302 | 86.2 |
| 3/5/2007 | 15:06:49 | 13.8 | 8.5-9.0 | 25 | 23 | 54.3 | 31 | 16.1 | 0.305 | 87.1 |
| 3/5/2007 | 15:06:50 | 13.8 | 8.5-9.0 | 25 | 24 | 54.8 | 31 | 16.0 | 0.302 | 86.3 |
| 3/5/2007 | 15:06:51 | 13.8 | 8.5-9.0 | 25 | 25 | 54.3 | 31 | 16.0 | 0.311 | 88.9 |
| 3/5/2007 | 15:06:52 | 13.8 | 8.5-9.0 | 25 | 26 | 54.5 | 30 | 16.0 | 0.299 | 85.4 |
| 3/5/2007 | 15:06:53 | 13.8 | 8.5-9.0 | 25 | 27 | 54.7 | 31 | 15.9 | 0.303 | 86.6 |
| 3/5/2007 | 15:06:55 | 13.8 | 8.5-9.0 | 25 | 28 | 54.3 | 30 | 16.1 | 0.298 | 85.2 |
| 3/5/2007 | 15:06:56 | 13.8 | 8.5-9.0 | 25 | 29 | 54.3 | 31 | 16.0 | 0.305 | 87.0 |
| 3/5/2007 | 15:06:57 | 13.8 | 8.5-9.0 | 25 | 30 | 54.2 | 31 | 16.1 | 0.302 | 86.1 |
| 3/5/2007 | 15:06:58 | 13.8 | 8.5-9.0 | 25 | 31 | 54.6 | 31 | 16.1 | 0.309 | 88.3 |
| 3/5/2007 | 15:06:59 | 13.8 | 8.5-9.0 | 25 | 32 | 54.4 | 31 | 16.2 | 0.303 | 86.6 |
| 3/5/2007 | 15:07:00 | 13.8 | 8.5-9.0 | 25 | 33 | 54.4 | 31 | 16.2 | 0.303 | 86.6 |
| 3/5/2007 | 15:07:01 | 13.8 | 8.5-9.0 | 25 | 34 | 54.3 | 31 | 16.2 | 0.306 | 87.4 |
| 3/5/2007 | 15:07:02 | 13.8 | 8.5-9.0 | 25 | 35 | 54.4 | 31 | 16.1 | 0.309 | 88.3 |
| 3/5/2007 | 15:07:03 | 13.8 | 9.0-9.5 | 25 | 36 | 54.1 | 31 | 15.9 | 0.302 | 86.2 |
| 3/5/2007 | 15:07:04 | 13.8 | 9.0-9.5 | 25 | 37 | 54.6 | 31 | 16.1 | 0.305 | 87.3 |
| 3/5/2007 | 15:07:05 | 13.8 | 9.0-9.5 | 25 | 38 | 54.2 | 31 | 16.0 | 0.302 | 86.4 |
| 3/5/2007 | 15:07:06 | 13.8 | 9.0-9.5 | 25 | 39 | 54.3 | 31 | 16.1 | 0.306 | 87.4 |
| 3/5/2007 | 15:07:08 | 13.8 | 9.0-9.5 | 25 | 40 | 54.5 | 31 | 16.1 | 0.301 | 86.0 |
| 3/5/2007 | 15:07:09 | 13.8 | 9.0-9.5 | 25 | 41 | 54.6 | 31 | 16.1 | 0.308 | 88.0 |
| 3/5/2007 | 15:07:10 | 13.8 | 9.0-9.5 | 25 | 42 | 54.5 | 31 | 16.2 | 0.297 | 84.8 |
| 3/5/2007 | 15:07:11 | 13.8 | 9.0-9.5 | 25 | 43 | 54.4 | 31 | 16.0 | 0.305 | 87.1 |
| 3/5/2007 | 15:07:12 | 13.8 | 9.0-9.5 | 25 | 44 | 54.4 | 31 | 15.9 | 0.298 | 85.2 |
| 3/5/2007 | 15:07:13 | 13.8 | 9.0-9.5 | 25 | 45 | 54.7 | 31 | 15.9 | 0.301 | 86.0 |
| 3/5/2007 | 15:07:14 | 13.8 | 9.0-9.5 | 25 | 46 | 54.3 | 31 | 16.1 | 0.299 | 85.3 |
| 3/5/2007 | 15:07:15 | 13.8 | 9.0-9.5 | 25 | 47 | 54.3 | 31 | 16.1 | 0.303 | 86.6 |
| 3/5/2007 | 15:07:16 | 13.8 | 9.0-9.5 | 25 | 48 | 54.7 | 31 | 16.1 | 0.293 | 83.7 |

| | | |
|---|---|---|
| 1.17 | inches^2 | Area |
| 0.492083 | kips/feet^3 | Specific Weight Density |
| 16807.7 | feet/second | Wave Speed |
| 29999.6 | ksi | Elastic Modulus |

| | | |
|---|---|---|
| F3 | F1 | 218.16 |
| F4 | F2 | 219.18 |
| A3 | A1 | 282 |
| A4 | A2 | 295 |

| DEPTH (ft) | N (bpf) | AVE. ETR (%) | STDEV of ETR |
|---|---|---|---|
| 22.0-23.5 | 11 | 73.0 | 1.86 |
| 30.0-31.5 | 20 | 76.4 | 1.20 |
| 40.0-41.5 | 23 | 76.3 | 0.83 |
| 60.0-61.5 | 32 | 78.2 | 1.65 |
| 80.0-81.5 | *49=8" | 78.5 | 0.96 |
| 100.0-100.5 | *33=4" | 78.4 | 0.73 |
| ALL BLOWS | | 77.5 | 1.84 |

* SPT Test halted to reduce wear on SPT energy measuring equipment

| | |
|---|---|
| PJ | TRC0701 |
| PN | CME850_2 |
| PD | 2001 CME-850; CME Automatic Hammer |
| OP | DRILLER - Gary Brown; SPT Analyzer - David Ross |

| Date | Time | LP feet | DEPTH feet | N (bpf) | BN | BPM blows/min | FMX kips | VMX feet/second | EFV kip-feet | ETR (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 7/17/2007 | 11:14:19 | 25.5 | 22.0-22.5 | 11 | 1 | 0 | 27 | 14.6 | 0.247 | 70.6 |
| 7/17/2007 | 11:14:20 | 25.5 | 22.0-22.5 | 11 | 2 | 55 | 26 | 14.8 | 0.243 | 69.4 |
| 7/17/2007 | 11:14:21 | 25.5 | 22.0-22.5 | 11 | 3 | 53.7 | 27 | 14.9 | 0.261 | 74.5 |
| 7/17/2007 | 11:14:22 | 25.5 | 22.5-23.0 | 11 | 4 | 53.4 | 27 | 14.7 | 0.249 | 71.0 |
| 7/17/2007 | 11:14:23 | 25.5 | 22.5-23.0 | 11 | 5 | 53.5 | 27 | 14.8 | 0.258 | 73.6 |
| 7/17/2007 | 11:14:24 | 25.5 | 22.5-23.0 | 11 | 6 | 53.5 | 27 | 14.7 | 0.255 | 72.9 |
| 7/17/2007 | 11:14:25 | 25.5 | 22.5-23.0 | 11 | 7 | 53 | 27 | 15.0 | 0.261 | 74.6 |
| 7/17/2007 | 11:14:26 | 25.5 | 22.5-23.0 | 11 | 8 | 53.8 | 27 | 15.1 | 0.255 | 72.8 |
| 7/17/2007 | 11:14:27 | 25.5 | 23.0-23.5 | 11 | 9 | 53.1 | 27 | 15.0 | 0.261 | 74.5 |
| 7/17/2007 | 11:14:29 | 25.5 | 23.0-23.5 | 11 | 10 | 53.3 | 27 | 15.0 | 0.248 | 70.8 |
| 7/17/2007 | 11:14:30 | 25.5 | 23.0-23.5 | 11 | 11 | 53.3 | 27 | 15.0 | 0.258 | 73.8 |
| 7/17/2007 | 11:14:31 | 25.5 | 23.0-23.5 | 11 | 12 | 53.5 | 27 | 15.1 | 0.258 | 73.6 |
| 7/17/2007 | 11:14:32 | 25.5 | 23.0-23.5 | 11 | 13 | 53.2 | 27 | 15.0 | 0.261 | 74.7 |
| 7/17/2007 | 11:14:33 | 25.5 | 23.0-23.5 | 11 | 14 | 53.2 | 27 | 15.1 | 0.264 | 75.5 |
| 7/17/2007 | 12:19:52 | 35.5 | 30.0-30.5 | 20 | 1 | 0 | 26 | 15.4 | 0.271 | 77.5 |
| 7/17/2007 | 12:19:53 | 35.5 | 30.0-30.5 | 20 | 2 | 55.6 | 27 | 15.6 | 0.266 | 75.9 |
| 7/17/2007 | 12:19:54 | 35.5 | 30.0-30.5 | 20 | 3 | 52.8 | 27 | 15.5 | 0.267 | 76.3 |
| 7/17/2007 | 12:19:55 | 35.5 | 30.0-30.5 | 20 | 4 | 53.5 | 26 | 15.4 | 0.259 | 74.1 |
| 7/17/2007 | 12:19:56 | 35.5 | 30.0-30.5 | 20 | 5 | 53.2 | 27 | 15.5 | 0.271 | 77.3 |
| 7/17/2007 | 12:19:57 | 35.5 | 30.0-30.5 | 20 | 6 | 52.9 | 27 | 15.4 | 0.264 | 75.4 |
| 7/17/2007 | 12:19:58 | 35.5 | 30.0-30.5 | 20 | 7 | 53.2 | 27 | 15.4 | 0.268 | 76.6 |
| 7/17/2007 | 12:20:00 | 35.5 | 30.0-30.5 | 20 | 8 | 53.4 | 27 | 15.5 | 0.268 | 76.6 |
| 7/17/2007 | 12:20:01 | 35.5 | 30.0-30.5 | 20 | 9 | 53.2 | 27 | 15.4 | 0.272 | 77.8 |
| 7/17/2007 | 12:20:02 | 35.5 | 30.5-31.0 | 20 | 10 | 53.6 | 27 | 15.5 | 0.265 | 75.6 |
| 7/17/2007 | 12:20:03 | 35.5 | 30.5-31.0 | 20 | 11 | 53 | 27 | 15.3 | 0.271 | 77.4 |
| 7/17/2007 | 12:20:04 | 35.5 | 30.5-31.0 | 20 | 12 | 52.8 | 27 | 15.4 | 0.260 | 74.4 |
| 7/17/2007 | 12:20:05 | 35.5 | 30.5-31.0 | 20 | 13 | 53.1 | 27 | 15.5 | 0.270 | 77.3 |
| 7/17/2007 | 12:20:06 | 35.5 | 30.5-31.0 | 20 | 14 | 53.2 | 27 | 15.5 | 0.264 | 75.4 |
| 7/17/2007 | 12:20:07 | 35.5 | 30.5-31.0 | 20 | 15 | 53.2 | 27 | 15.4 | 0.276 | 78.9 |
| 7/17/2007 | 12:20:08 | 35.5 | 30.5-31.0 | 20 | 16 | 53 | 27 | 15.5 | 0.262 | 74.9 |
| 7/17/2007 | 12:20:09 | 35.5 | 30.5-31.0 | 20 | 17 | 53.1 | 27 | 15.4 | 0.273 | 78.0 |

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|---|---|---|---|---|---|---|---|---|---|---|
| 7/17/2007 | 12:20:11 | 35.5 | 30.5-31.0 | 20 | 18 | 53.3 | 27 | 15.3 | 0.263 | 75.0 |
| 7/17/2007 | 12:20:12 | 35.5 | 31.0-31.5 | 20 | 19 | 52.8 | 27 | 15.5 | 0.267 | 76.4 |
| 7/17/2007 | 12:20:13 | 35.5 | 31.0-31.5 | 20 | 20 | 53.3 | 27 | 15.5 | 0.264 | 75.3 |
| 7/17/2007 | 12:20:14 | 35.5 | 31.0-31.5 | 20 | 21 | 53.1 | 27 | 15.4 | 0.268 | 76.7 |
| 7/17/2007 | 12:20:15 | 35.5 | 31.0-31.5 | 20 | 22 | 53 | 27 | 15.4 | 0.264 | 75.5 |
| 7/17/2007 | 12:20:16 | 35.5 | 31.0-31.5 | 20 | 23 | 53.1 | 27 | 15.5 | 0.272 | 77.9 |
| 7/17/2007 | 12:20:17 | 35.5 | 31.0-31.5 | 20 | 24 | 53.1 | 27 | 15.5 | 0.265 | 75.6 |
| 7/17/2007 | 12:20:18 | 35.5 | 31.0-31.5 | 20 | 25 | 53.1 | 27 | 15.5 | 0.271 | 77.4 |
| 7/17/2007 | 12:20:19 | 35.5 | 31.0-31.5 | 20 | 26 | 53.1 | 27 | 15.7 | 0.266 | 75.9 |
| 7/17/2007 | 12:20:21 | 35.5 | 31.0-31.5 | 20 | 27 | 53.1 | 27 | 15.5 | 0.267 | 76.4 |
| 7/17/2007 | 12:20:22 | 35.5 | 31.0-31.5 | 20 | 28 | 53 | 27 | 15.6 | 0.266 | 76.1 |
| 7/17/2007 | 12:20:23 | 35.5 | 31.0-31.5 | 20 | 29 | 53.3 | 27 | 15.6 | 0.273 | 78.1 |
| 7/17/2007 | 12:34:52 | 45.5 | 40.0-40.5 | 23 | 30 | 0 | 26 | 15.6 | 0.275 | 78.5 |
| 7/17/2007 | 12:34:53 | 45.5 | 40.0-40.5 | 23 | 31 | 55.1 | 26 | 15.4 | 0.260 | 74.3 |
| 7/17/2007 | 12:34:54 | 45.5 | 40.0-40.5 | 23 | 32 | 52.7 | 26 | 15.6 | 0.267 | 76.1 |
| 7/17/2007 | 12:34:55 | 45.5 | 40.0-40.5 | 23 | 33 | 53.1 | 27 | 15.6 | 0.267 | 76.2 |
| 7/17/2007 | 12:34:56 | 45.5 | 40.0-40.5 | 23 | 34 | 53.4 | 27 | 15.6 | 0.266 | 75.9 |
| 7/17/2007 | 12:34:58 | 45.5 | 40.0-40.5 | 23 | 35 | 53.2 | 27 | 15.5 | 0.266 | 75.9 |
| 7/17/2007 | 12:34:59 | 45.5 | 40.5-41.0 | 23 | 36 | 53.1 | 27 | 15.4 | 0.264 | 75.3 |
| 7/17/2007 | 12:35:00 | 45.5 | 40.5-41.0 | 23 | 37 | 52.9 | 27 | 15.5 | 0.265 | 75.6 |
| 7/17/2007 | 12:35:01 | 45.5 | 40.5-41.0 | 23 | 38 | 53.3 | 27 | 15.6 | 0.263 | 75.1 |
| 7/17/2007 | 12:35:02 | 45.5 | 40.5-41.0 | 23 | 39 | 53.2 | 27 | 15.5 | 0.266 | 75.9 |
| 7/17/2007 | 12:35:03 | 45.5 | 40.5-41.0 | 23 | 40 | 53.3 | 27 | 15.7 | 0.268 | 76.5 |
| 7/17/2007 | 12:35:04 | 45.5 | 40.5-41.0 | 23 | 41 | 52.7 | 27 | 15.6 | 0.268 | 76.7 |
| 7/17/2007 | 12:35:05 | 45.5 | 40.5-41.0 | 23 | 42 | 53.2 | 27 | 15.7 | 0.272 | 77.7 |
| 7/17/2007 | 12:35:06 | 45.5 | 40.5-41.0 | 23 | 43 | 53.2 | 27 | 15.7 | 0.264 | 75.5 |
| 7/17/2007 | 12:35:08 | 45.5 | 41.0-41.5 | 23 | 44 | 53 | 27 | 15.6 | 0.268 | 76.6 |
| 7/17/2007 | 12:35:09 | 45.5 | 41.0-41.5 | 23 | 45 | 53.2 | 27 | 15.7 | 0.265 | 75.8 |
| 7/17/2007 | 12:35:10 | 45.5 | 41.0-41.5 | 23 | 46 | 52.9 | 27 | 15.8 | 0.268 | 76.5 |
| 7/17/2007 | 12:35:11 | 45.5 | 41.0-41.5 | 23 | 47 | 53.2 | 27 | 15.7 | 0.264 | 75.5 |
| 7/17/2007 | 12:35:12 | 45.5 | 41.0-41.5 | 23 | 48 | 52.9 | 27 | 15.7 | 0.267 | 76.3 |
| 7/17/2007 | 12:35:13 | 45.5 | 41.0-41.5 | 23 | 49 | 52.8 | 27 | 15.6 | 0.268 | 76.7 |
| 7/17/2007 | 12:35:14 | 45.5 | 41.0-41.5 | 23 | 50 | 52.8 | 27 | 15.6 | 0.267 | 76.2 |
| 7/17/2007 | 12:35:15 | 45.5 | 41.0-41.5 | 23 | 51 | 52.9 | 26 | 15.7 | 0.268 | 76.7 |
| 7/17/2007 | 12:35:16 | 45.5 | 41.0-41.5 | 23 | 52 | 52.9 | 26 | 15.5 | 0.267 | 76.2 |
| 7/17/2007 | 12:35:18 | 45.5 | 41.0-41.5 | 23 | 53 | 52.7 | 27 | 15.7 | 0.270 | 77.1 |
| 7/17/2007 | 12:35:19 | 45.5 | 41.0-41.5 | 23 | 54 | 52.9 | 26 | 15.8 | 0.269 | 77.0 |
| 7/17/2007 | 12:35:20 | 45.5 | 41.0-41.5 | 23 | 55 | 52.8 | 27 | 15.7 | 0.267 | 76.2 |
| 7/17/2007 | 12:35:21 | 45.5 | 41.0-41.5 | 23 | 56 | 52.9 | 27 | 15.6 | 0.268 | 76.5 |
| 7/17/2007 | 12:35:22 | 45.5 | 41.0-41.5 | 23 | 57 | 52.8 | 27 | 15.8 | 0.270 | 77.0 |
| 7/17/2007 | 12:35:23 | 45.5 | 41.0-41.5 | 23 | 58 | 52.8 | 26 | 15.8 | 0.270 | 77.3 |
| 7/17/2007 | 13:00:20 | 63.5 | 60-60.5 | 32 | 61 | 0 | 27 | 15.6 | 0.282 | 80.6 |
| 7/17/2007 | 13:00:22 | 63.5 | 60-60.5 | 32 | 62 | 54.1 | 27 | 16.0 | 0.292 | 83.3 |
| 7/17/2007 | 13:00:23 | 63.5 | 60-60.5 | 32 | 63 | 53.6 | 28 | 16.3 | 0.298 | 85.1 |
| 7/17/2007 | 13:00:24 | 63.5 | 60-60.5 | 32 | 64 | 54.9 | 27 | 15.7 | 0.264 | 75.5 |
| 7/17/2007 | 13:00:25 | 63.5 | 60-60.5 | 32 | 65 | 52.8 | 27 | 16.1 | 0.271 | 77.3 |
| 7/17/2007 | 13:00:26 | 63.5 | 60-60.5 | 32 | 66 | 54.1 | 27 | 16.0 | 0.270 | 77.1 |
| 7/17/2007 | 13:00:27 | 63.5 | 60.5-61.0 | 32 | 67 | 53.9 | 27 | 15.7 | 0.271 | 77.4 |
| 7/17/2007 | 13:00:28 | 63.5 | 60.5-61.0 | 32 | 68 | 53.9 | 27 | 15.8 | 0.270 | 77.2 |
| 7/17/2007 | 13:00:29 | 63.5 | 60.5-61.0 | 32 | 69 | 53.7 | 27 | 15.7 | 0.271 | 77.4 |
| 7/17/2007 | 13:00:30 | 63.5 | 60.5-61.0 | 32 | 70 | 53.6 | 27 | 15.9 | 0.271 | 77.6 |
| 7/17/2007 | 13:00:31 | 63.5 | 60.5-61.0 | 32 | 71 | 53.5 | 27 | 15.7 | 0.274 | 78.3 |

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|---|---|---|---|---|---|---|---|---|---|---|
| 7/17/2007 | 13:00:32 | 63.5 | 60.5-61.0 | 32 | 72 | 53.7 | 27 | 15.8 | 0.273 | 78.0 |
| 7/17/2007 | 13:00:34 | 63.5 | 60.5-61.0 | 32 | 73 | 54 | 27 | 15.8 | 0.273 | 77.9 |
| 7/17/2007 | 13:00:35 | 63.5 | 60.5-61.0 | 32 | 74 | 53.6 | 27 | 15.9 | 0.274 | 78.4 |
| 7/17/2007 | 13:00:36 | 63.5 | 60.5-61.0 | 32 | 75 | 54 | 27 | 15.6 | 0.272 | 77.8 |
| 7/17/2007 | 13:00:37 | 63.5 | 60.5-61.0 | 32 | 76 | 53.5 | 27 | 15.9 | 0.278 | 79.5 |
| 7/17/2007 | 13:00:38 | 63.5 | 60.5-61.0 | 32 | 77 | 53.8 | 27 | 15.8 | 0.274 | 78.3 |
| 7/17/2007 | 13:00:39 | 63.5 | 60.5-61.0 | 32 | 78 | 53.6 | 27 | 15.7 | 0.272 | 77.7 |
| 7/17/2007 | 13:00:40 | 63.5 | 60.5-61.0 | 32 | 79 | 53.7 | 27 | 15.9 | 0.273 | 78.1 |
| 7/17/2007 | 13:00:41 | 63.5 | 60.5-61.0 | 32 | 80 | 53.5 | 27 | 15.8 | 0.272 | 77.8 |
| 7/17/2007 | 13:00:42 | 63.5 | 61.0-61.5 | 32 | 81 | 53.8 | 27 | 15.8 | 0.272 | 77.8 |
| 7/17/2007 | 13:00:43 | 63.5 | 61.0-61.5 | 32 | 82 | 53.3 | 27 | 15.9 | 0.273 | 78.0 |
| 7/17/2007 | 13:00:45 | 63.5 | 61.0-61.5 | 32 | 83 | 53.6 | 27 | 15.9 | 0.275 | 78.5 |
| 7/17/2007 | 13:00:46 | 63.5 | 61.0-61.5 | 32 | 84 | 53.6 | 27 | 15.9 | 0.273 | 78.0 |
| 7/17/2007 | 13:00:47 | 63.5 | 61.0-61.5 | 32 | 85 | 53.4 | 27 | 15.8 | 0.275 | 78.5 |
| 7/17/2007 | 13:00:48 | 63.5 | 61.0-61.5 | 32 | 86 | 53.7 | 27 | 15.8 | 0.273 | 77.9 |
| 7/17/2007 | 13:00:49 | 63.5 | 61.0-61.5 | 32 | 87 | 53.6 | 27 | 15.9 | 0.274 | 78.4 |
| 7/17/2007 | 13:00:50 | 63.5 | 61.0-61.5 | 32 | 88 | 53.5 | 27 | 15.8 | 0.272 | 77.7 |
| 7/17/2007 | 13:00:51 | 63.5 | 61.0-61.5 | 32 | 89 | 53.7 | 27 | 15.9 | 0.273 | 78.0 |
| 7/17/2007 | 13:00:52 | 63.5 | 61.0-61.5 | 32 | 90 | 53.5 | 27 | 15.9 | 0.272 | 77.8 |
| 7/17/2007 | 13:00:53 | 63.5 | 61.0-61.5 | 32 | 91 | 53.6 | 27 | 16.0 | 0.273 | 77.9 |
| 7/17/2007 | 13:00:54 | 63.5 | 61.0-61.5 | 32 | 92 | 53.4 | 27 | 15.8 | 0.273 | 78.0 |
| 7/17/2007 | 13:00:56 | 63.5 | 61.0-61.5 | 32 | 93 | 53.7 | 27 | 15.6 | 0.269 | 77.0 |
| 7/17/2007 | 13:00:57 | 63.5 | 61.0-61.5 | 32 | 94 | 53.3 | 27 | 15.9 | 0.271 | 77.3 |
| 7/17/2007 | 13:00:58 | 63.5 | 61.0-61.5 | 32 | 95 | 53.5 | 27 | 15.9 | 0.271 | 77.4 |
| 7/17/2007 | 13:00:59 | 63.5 | 61.0-61.5 | 32 | 96 | 53.5 | 27 | 15.8 | 0.270 | 77.2 |
| 7/17/2007 | 13:01:00 | 63.5 | 61.0-61.5 | 32 | 97 | 53.6 | 27 | 16.0 | 0.270 | 77.3 |
| 7/17/2007 | 13:01:01 | 63.5 | 61.0-61.5 | 32 | 98 | 53.6 | 27 | 16.0 | 0.271 | 77.3 |
| 7/17/2007 | 13:52:14 | 85.5 | 80.0-80.5 | *49=8" | 100 | 0 | 26 | 15.4 | 0.268 | 76.6 |
| 7/17/2007 | 13:52:15 | 85.5 | 80.0-80.5 | *49=8" | 101 | 55.5 | 27 | 16.0 | 0.273 | 77.9 |
| 7/17/2007 | 13:52:16 | 85.5 | 80.0-80.5 | *49=8" | 102 | 55 | 27 | 16.1 | 0.278 | 79.5 |
| 7/17/2007 | 13:52:17 | 85.5 | 80.0-80.5 | *49=8" | 103 | 55.1 | 27 | 16.0 | 0.276 | 78.9 |
| 7/17/2007 | 13:52:18 | 85.5 | 80.0-80.5 | *49=8" | 104 | 55.2 | 27 | 16.0 | 0.274 | 78.2 |
| 7/17/2007 | 13:52:19 | 85.5 | 80.0-80.5 | *49=8" | 105 | 54.9 | 27 | 15.9 | 0.273 | 78.0 |
| 7/17/2007 | 13:52:20 | 85.5 | 80.0-80.5 | *49=8" | 106 | 55 | 27 | 16.1 | 0.276 | 78.9 |
| 7/17/2007 | 13:52:21 | 85.5 | 80.0-80.5 | *49=8" | 107 | 55.1 | 27 | 16.1 | 0.274 | 78.4 |
| 7/17/2007 | 13:52:22 | 85.5 | 80.0-80.5 | *49=8" | 108 | 54.8 | 27 | 16.1 | 0.276 | 78.8 |
| 7/17/2007 | 13:52:23 | 85.5 | 80.0-80.5 | *49=8" | 109 | 55.2 | 27 | 16.2 | 0.274 | 78.4 |
| 7/17/2007 | 13:52:24 | 85.5 | 80.0-80.5 | *49=8" | 110 | 54.8 | 27 | 16.2 | 0.276 | 79.0 |
| 7/17/2007 | 13:52:25 | 85.5 | 80.0-80.5 | *49=8" | 111 | 55 | 27 | 16.1 | 0.274 | 78.2 |
| 7/17/2007 | 13:52:26 | 85.5 | 80.0-80.5 | *49=8" | 112 | 55 | 27 | 16.0 | 0.273 | 77.9 |
| 7/17/2007 | 13:52:27 | 85.5 | 80.0-80.5 | *49=8" | 113 | 55 | 27 | 16.3 | 0.278 | 79.3 |
| 7/17/2007 | 13:52:28 | 85.5 | 80.5-81.0 | *49=8" | 114 | 54.9 | 27 | 16.3 | 0.276 | 78.7 |
| 7/17/2007 | 13:52:30 | 85.5 | 80.5-81.0 | *49=8" | 115 | 55.1 | 27 | 16.4 | 0.277 | 79.1 |
| 7/17/2007 | 13:52:31 | 85.5 | 80.5-81.0 | *49=8" | 116 | 54.8 | 27 | 16.3 | 0.276 | 78.9 |
| 7/17/2007 | 13:52:32 | 85.5 | 80.5-81.0 | *49=8" | 117 | 55.3 | 27 | 16.4 | 0.276 | 78.9 |
| 7/17/2007 | 13:52:33 | 85.5 | 80.5-81.0 | *49=8" | 118 | 54.7 | 27 | 16.4 | 0.279 | 79.7 |
| 7/17/2007 | 13:52:34 | 85.5 | 80.5-81.0 | *49=8" | 119 | 55 | 27 | 16.2 | 0.276 | 79.0 |
| 7/17/2007 | 13:52:35 | 85.5 | 80.5-81.0 | *49=8" | 120 | 55.4 | 27 | 16.2 | 0.276 | 78.8 |
| 7/17/2007 | 13:52:36 | 85.5 | 80.5-81.0 | *49=8" | 121 | 54.8 | 27 | 16.2 | 0.278 | 79.3 |
| 7/17/2007 | 13:52:37 | 85.5 | 80.5-81.0 | *49=8" | 122 | 55.1 | 27 | 16.3 | 0.275 | 78.6 |
| 7/17/2007 | 13:52:38 | 85.5 | 80.5-81.0 | *49=8" | 123 | 54.5 | 27 | 16.3 | 0.275 | 78.6 |
| 7/17/2007 | 13:52:39 | 85.5 | 80.5-81.0 | *49=8" | 124 | 55.2 | 27 | 16.2 | 0.274 | 78.4 |

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|---|---|---|---|---|---|---|---|---|---|---|
| 7/17/2007 | 13:52:40 | 85.5 | 80.5-81.0 | *49=8" | 125 | 54.7 | 27 | 16.4 | 0.273 | 78.0 |
| 7/17/2007 | 13:52:41 | 85.5 | 80.5-81.0 | *49=8" | 126 | 55.4 | 27 | 16.2 | 0.272 | 77.7 |
| 7/17/2007 | 13:52:42 | 85.5 | 80.5-81.0 | *49=8" | 127 | 54.6 | 27 | 16.0 | 0.269 | 76.9 |
| 7/17/2007 | 13:52:43 | 85.5 | 80.5-81.0 | *49=8" | 128 | 54.9 | 27 | 16.1 | 0.271 | 77.4 |
| 7/17/2007 | 13:52:45 | 85.5 | 80.5-81.0 | *49=8" | 129 | 55 | 27 | 16.1 | 0.270 | 77.1 |
| 7/17/2007 | 13:52:46 | 85.5 | 80.5-81.0 | *49=8" | 130 | 55.2 | 27 | 16.2 | 0.275 | 78.5 |
| 7/17/2007 | 13:52:47 | 85.5 | 80.5-81.0 | *49=8" | 131 | 54.9 | 27 | 16.4 | 0.274 | 78.2 |
| 7/17/2007 | 13:52:48 | 85.5 | 80.5-81.0 | *49=8" | 132 | 54.9 | 26 | 16.2 | 0.270 | 77.2 |
| 7/17/2007 | 13:52:49 | 85.5 | 80.5-81.0 | *49=8" | 133 | 54.9 | 27 | 16.3 | 0.275 | 78.6 |
| 7/17/2007 | 13:52:50 | 85.5 | 80.5-81.0 | *49=8" | 134 | 54.8 | 27 | 16.1 | 0.269 | 77.0 |
| 7/17/2007 | 13:52:51 | 85.5 | 80.5-81.0 | *49=8" | 135 | 55.2 | 27 | 16.2 | 0.273 | 78.1 |
| 7/17/2007 | 13:52:52 | 85.5 | 80.5-81.0 | *49=8" | 136 | 54.9 | 27 | 16.2 | 0.274 | 78.3 |
| 7/17/2007 | 13:52:53 | 85.5 | 80.5-81.0 | *49=8" | 137 | 54.8 | 26 | 16.3 | 0.276 | 78.8 |
| 7/17/2007 | 13:52:54 | 85.5 | 80.5-81.0 | *49=8" | 138 | 55.1 | 27 | 16.0 | 0.271 | 77.5 |
| 7/17/2007 | 13:52:55 | 85.5 | 80.5-81.0 | *49=8" | 139 | 54.5 | 27 | 16.3 | 0.277 | 79.0 |
| 7/17/2007 | 13:52:56 | 85.5 | 80.5-81.0 | *49=8" | 140 | 55.1 | 27 | 16.2 | 0.275 | 78.5 |
| 7/17/2007 | 13:52:57 | 85.5 | 80.5-81.0 | *49=8" | 141 | 54.6 | 27 | 16.1 | 0.276 | 78.8 |
| 7/17/2007 | 13:52:59 | 85.5 | 80.5-81.0 | *49=8" | 142 | 55 | 26 | 16.3 | 0.273 | 78.1 |
| 7/17/2007 | 13:53:00 | 85.5 | 80.5-81.0 | *49=8" | 143 | 54.6 | 27 | 16.2 | 0.274 | 78.2 |
| 7/17/2007 | 13:53:01 | 85.5 | 80.5-81.0 | *49=8" | 144 | 55 | 27 | 16.1 | 0.270 | 77.3 |
| 7/17/2007 | 13:53:02 | 85.5 | 80.5-81.0 | *49=8" | 145 | 55.2 | 27 | 16.3 | 0.274 | 78.2 |
| 7/17/2007 | 13:53:03 | 85.5 | 81.0-81.5 | *49=8" | 146 | 54.2 | 26 | 15.8 | 0.265 | 75.7 |
| 7/17/2007 | 13:53:04 | 85.5 | 81.0-81.5 | *49=8" | 147 | 55.7 | 27 | 16.1 | 0.275 | 78.7 |
| 7/17/2007 | 13:53:05 | 85.5 | 81.0-81.5 | *49=8" | 148 | 54.8 | 27 | 16.2 | 0.275 | 78.5 |
| 7/17/2007 | 13:53:06 | 85.5 | 81.0-81.5 | *49=8" | 149 | 55.1 | 27 | 16.3 | 0.277 | 79.1 |
| 7/17/2007 | 13:53:07 | 85.5 | 81.0-81.5 | *49=8" | 150 | 54.9 | 27 | 16.2 | 0.274 | 78.2 |
| 7/17/2007 | 13:53:08 | 85.5 | 81.0-81.5 | *49=8" | 151 | 55 | 26 | 16.4 | 0.276 | 78.9 |
| 7/17/2007 | 13:53:09 | 85.5 | 81.0-81.5 | *49=8" | 152 | 54.8 | 27 | 16.3 | 0.279 | 79.7 |
| 7/17/2007 | 13:53:10 | 85.5 | 81.0-81.5 | *49=8" | 153 | 54.4 | 27 | 15.9 | 0.270 | 77.1 |
| 7/17/2007 | 13:53:11 | 85.5 | 81.0-81.5 | *49=8" | 154 | 55.7 | 27 | 16.2 | 0.278 | 79.5 |
| 7/17/2007 | 13:53:12 | 85.5 | 81.0-81.5 | *49=8" | 155 | 54.4 | 27 | 15.9 | 0.268 | 76.7 |
| 7/17/2007 | 13:53:14 | 85.5 | 81.0-81.5 | *49=8" | 156 | 55.1 | 27 | 16.0 | 0.276 | 78.9 |
| 7/17/2007 | 13:53:15 | 85.5 | 81.0-81.5 | *49=8" | 157 | 54.7 | 28 | 16.1 | 0.278 | 79.4 |
| 7/17/2007 | 13:53:16 | 85.5 | 81.0-81.5 | *49=8" | 158 | 54.9 | 27 | 16.1 | 0.273 | 78.0 |
| 7/17/2007 | 13:53:17 | 85.5 | 81.0-81.5 | *49=8" | 159 | 54.8 | 28 | 16.1 | 0.283 | 80.8 |
| 7/17/2007 | 13:53:18 | 85.5 | 81.0-81.5 | *49=8" | 160 | 55.1 | 28 | 16.2 | 0.283 | 80.8 |
| 7/17/2007 | 13:53:19 | 85.5 | 81.0-81.5 | *49=8" | 161 | 55 | 27 | 16.1 | 0.277 | 79.3 |
| 7/17/2007 | 13:53:20 | 85.5 | 81.0-81.5 | *49=8" | 162 | 54.9 | 27 | 16.2 | 0.282 | 80.6 |
| 7/17/2007 | 14:31:13 | 105.5 | 100.0-100.5 | *33=4" | 163 | 0 | 26 | 16.2 | 0.282 | 80.6 |
| 7/17/2007 | 14:31:14 | 105.5 | 100.0-100.5 | *33=4" | 164 | 54.4 | 27 | 16.1 | 0.275 | 78.6 |
| 7/17/2007 | 14:31:15 | 105.5 | 100.0-100.5 | *33=4" | 165 | 54.4 | 27 | 16.1 | 0.278 | 79.6 |
| 7/17/2007 | 14:31:16 | 105.5 | 100.0-100.5 | *33=4" | 166 | 53.8 | 27 | 16.2 | 0.276 | 78.8 |
| 7/17/2007 | 14:31:17 | 105.5 | 100.0-100.5 | *33=4" | 167 | 53.9 | 27 | 16.0 | 0.277 | 79.3 |
| 7/17/2007 | 14:31:18 | 105.5 | 100.0-100.5 | *33=4" | 168 | 53.7 | 27 | 16.0 | 0.276 | 78.7 |
| 7/17/2007 | 14:31:19 | 105.5 | 100.0-100.5 | *33=4" | 169 | 54 | 26 | 15.8 | 0.274 | 78.2 |
| 7/17/2007 | 14:31:20 | 105.5 | 100.0-100.5 | *33=4" | 170 | 53.9 | 27 | 15.8 | 0.271 | 77.5 |
| 7/17/2007 | 14:31:22 | 105.5 | 100.0-100.5 | *33=4" | 171 | 53.6 | 27 | 15.8 | 0.274 | 78.3 |
| 7/17/2007 | 14:31:23 | 105.5 | 100.0-100.5 | *33=4" | 172 | 54 | 27 | 15.7 | 0.271 | 77.4 |
| 7/17/2007 | 14:31:24 | 105.5 | 100.0-100.5 | *33=4" | 173 | 53.9 | 27 | 15.8 | 0.276 | 79.0 |
| 7/17/2007 | 14:31:25 | 105.5 | 100.0-100.5 | *33=4" | 174 | 53.9 | 27 | 15.8 | 0.272 | 77.8 |
| 7/17/2007 | 14:31:26 | 105.5 | 100.0-100.5 | *33=4" | 175 | 53.9 | 28 | 16.0 | 0.279 | 79.8 |
| 7/17/2007 | 14:31:27 | 105.5 | 100.0-100.5 | *33=4" | 176 | 54.1 | 27 | 15.9 | 0.273 | 78.1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 7/17/2007 | 14:31:28 | 105.5 | 100.0-100.5 | *33=4" | 177 | 53.9 | 28 | 15.9 | 0.276 | 78.7 |
| 7/17/2007 | 14:31:29 | 105.5 | 100.0-100.5 | *33=4" | 178 | 53.7 | 28 | 15.9 | 0.272 | 77.7 |
| 7/17/2007 | 14:31:30 | 105.5 | 100.0-100.5 | *33=4" | 179 | 53.9 | 28 | 15.9 | 0.272 | 77.6 |
| 7/17/2007 | 14:31:31 | 105.5 | 100.0-100.5 | *33=4" | 180 | 53.9 | 27 | 15.7 | 0.270 | 77.2 |
| 7/17/2007 | 14:31:32 | 105.5 | 100.0-100.5 | *33=4" | 181 | 53.9 | 27 | 15.7 | 0.270 | 77.0 |
| 7/17/2007 | 14:31:34 | 105.5 | 100.0-100.5 | *33=4" | 182 | 53.8 | 27 | 15.9 | 0.270 | 77.1 |
| 7/17/2007 | 14:31:35 | 105.5 | 100.0-100.5 | *33=4" | 183 | 54.1 | 28 | 15.9 | 0.272 | 77.7 |
| 7/17/2007 | 14:31:36 | 105.5 | 100.5-101.0 | *33=4" | 184 | 53.9 | 27 | 15.9 | 0.273 | 77.9 |
| 7/17/2007 | 14:31:37 | 105.5 | 100.5-101.0 | *33=4" | 185 | 53.6 | 28 | 16.0 | 0.274 | 78.3 |
| 7/17/2007 | 14:31:38 | 105.5 | 100.5-101.0 | *33=4" | 186 | 54 | 28 | 16.0 | 0.273 | 78.1 |
| 7/17/2007 | 14:31:39 | 105.5 | 100.5-101.0 | *33=4" | 187 | 53.7 | 28 | 15.9 | 0.272 | 77.6 |
| 7/17/2007 | 14:31:40 | 105.5 | 100.5-101.0 | *33=4" | 188 | 53.9 | 28 | 16.0 | 0.271 | 77.5 |
| 7/17/2007 | 14:31:41 | 105.5 | 100.5-101.0 | *33=4" | 189 | 54 | 28 | 16.1 | 0.275 | 78.6 |
| 7/17/2007 | 14:31:42 | 105.5 | 100.5-101.0 | *33=4" | 190 | 53.8 | 27 | 15.9 | 0.273 | 78.1 |
| 7/17/2007 | 14:31:43 | 105.5 | 100.5-101.0 | *33=4" | 191 | 53.8 | 27 | 16.0 | 0.275 | 78.6 |
| 7/17/2007 | 14:31:45 | 105.5 | 100.5-101.0 | *33=4" | 192 | 53.9 | 27 | 16.2 | 0.275 | 78.6 |
| 7/17/2007 | 14:31:46 | 105.5 | 100.5-101.0 | *33=4" | 193 | 53.9 | 27 | 15.9 | 0.275 | 78.4 |
| 7/17/2007 | 14:31:47 | 105.5 | 100.5-101.0 | *33=4" | 194 | 53.7 | 27 | 16.2 | 0.275 | 78.5 |
| 7/17/2007 | 14:31:48 | 105.5 | 100.5-101.0 | *33=4" | 195 | 53.7 | 27 | 16.0 | 0.277 | 79.3 |
| 7/17/2007 | 14:31:49 | 105.5 | 100.5-101.0 | *33=4" | 196 | 53.9 | 28 | 16.2 | 0.277 | 79.2 |
| 7/17/2007 | 14:31:50 | 105.5 | 100.5-101.0 | *33=4" | 197 | 53.7 | 28 | 16.2 | 0.279 | 79.6 |
| 7/17/2007 | 14:31:51 | 105.5 | 100.5-101.0 | *33=4" | 198 | 53.8 | 27 | 16.0 | 0.275 | 78.5 |
| 7/17/2007 | 14:31:52 | 105.5 | 100.5-101.0 | *33=4" | 199 | 53.7 | 28 | 16.1 | 0.278 | 79.3 |
| 7/17/2007 | 14:31:53 | 105.5 | 100.5-101.0 | *33=4" | 200 | 53.5 | 27 | 16.1 | 0.275 | 78.6 |
| 7/17/2007 | 14:31:54 | 105.5 | 100.5-101.0 | *33=4" | 201 | 54.2 | 28 | 16.0 | 0.273 | 78.0 |
| 7/17/2007 | 14:31:55 | 105.5 | 100.5-101.0 | *33=4" | 202 | 53.7 | 27 | 16.1 | 0.273 | 78.1 |
| 7/17/2007 | 14:31:57 | 105.5 | 100.5-101.0 | *33=4" | 203 | 53.6 | 27 | 15.9 | 0.275 | 78.6 |
| 7/17/2007 | 14:31:58 | 105.5 | 100.5-101.0 | *33=4" | 204 | 53.9 | 27 | 16.2 | 0.275 | 78.6 |
| 7/17/2007 | 14:31:59 | 105.5 | 100.5-101.0 | *33=4" | 205 | 53.9 | 28 | 16.1 | 0.276 | 78.8 |
| 7/17/2007 | 14:32:00 | 105.5 | 100.5-101.0 | *33=4" | 206 | 53.9 | 27 | 16.1 | 0.274 | 78.3 |
| 7/17/2007 | 14:32:01 | 105.5 | 100.5-101.0 | *33=4" | 207 | 53.3 | 27 | 16.0 | 0.273 | 78.1 |
| 7/17/2007 | 14:32:02 | 105.5 | 100.5-101.0 | *33=4" | 208 | 54 | 27 | 16.1 | 0.271 | 77.6 |
| 7/17/2007 | 14:32:03 | 105.5 | 100.5-101.0 | *33=4" | 209 | 53.5 | 27 | 16.0 | 0.271 | 77.6 |
| 7/17/2007 | 14:32:04 | 105.5 | 100.5-101.0 | *33=4" | 210 | 54.4 | 27 | 16.0 | 0.273 | 78.0 |
| 7/17/2007 | 14:32:05 | 105.5 | 100.5-101.0 | *33=4" | 211 | 53.6 | 27 | 16.1 | 0.274 | 78.4 |
| 7/17/2007 | 14:32:06 | 105.5 | 100.5-101.0 | *33=4" | 212 | 53.8 | 27 | 15.9 | 0.272 | 77.7 |
| 7/17/2007 | 14:32:08 | 105.5 | 100.5-101.0 | *33=4" | 213 | 53.8 | 27 | 16.2 | 0.277 | 79.2 |
| 7/17/2007 | 14:32:09 | 105.5 | 100.5-101.0 | *33=4" | 214 | 53.9 | 27 | 16.2 | 0.274 | 78.2 |
| 7/17/2007 | 14:32:10 | 105.5 | 100.5-101.0 | *33=4" | 215 | 53.8 | 27 | 16.1 | 0.277 | 79.0 |
| 7/17/2007 | 14:32:11 | 105.5 | 100.5-101.0 | *33=4" | 216 | 53.8 | 27 | 16.2 | 0.275 | 78.6 |

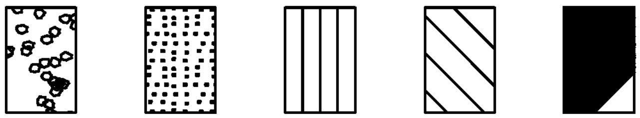
* SPT Test halted to reduce wear on SPT energy measuring equipment

# Appendix B
# BORING LOGS

# LEGEND

## SOIL TYPES

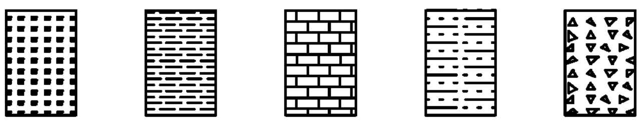
(SHOWN IN SYMBOL COLUMN)
(PREDOMINANT TYPE SHOWN HEAVY)



GRAVEL SAND SILT CLAY ORGANIC MATTER

## ROCK TYPES

(SHOWN IN SYMBOL COLUMN)

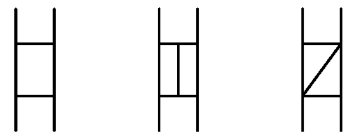


SANDSTONE | SHALE or SILTSTONE | LIMESTONE or DOLOMITE | ALTERNATING LAYERS of SHALE and SANDSTONE | OTHER

## SAMPLER TYPES

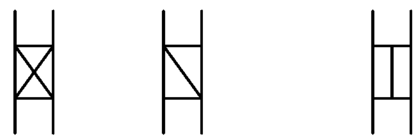
(SHOWN IN SAMPLE COLUMN)

SHELBY TUBE



UNDISTURBED SAMPLE RECOVERY | DISTURBED SAMPLE RECOVERY | NO RECOVERY

SPLIT SPOON ROCK CORING



SAMPLE RECOVERY | NO RECOVERY | % RECOVERY INDICATED ON LOGS

## TERMS DESCRIBING CONSISTENCY OR CONDITION

| GRANULAR SOIL | | CLAY | | CLAY-SHALE | | SHALE | |
|---|---|---|---|---|---|---|---|
| "N" Value | Density | "N" Value | Consistency | "N" Value | Consistency | "N" Value | Consistency |
| 0-4 | Very Loose | 0-1 | Very Soft | 0-1 | Very Soft | | |
| 5-10 | Loose | 2-4 | Soft | 2-4 | Soft | 31-60 | Soft |
| 11-30 | Medium Dense | 5-8 | Medium Stiff | 5-8 | Medium Stiff | Over 60 | |
| 31-50 | Dense | 9-15 | Stiff | 9-15 | Stiff | More than 2" | |
| Over 50 | Very Dense | 16-30 | Very Stiff | 16-30 | Very Stiff | Penetration | |
| | | 31-60 | Hard | 31-60 | Hard | in 60 Blows: | Medium Hard |
| | | Over 60 | Very Hard | Over 60 | Very Hard | Less than 2" | |
| | | | | | | Penetration | |
| | | | | | | in 60 Blows: | Hard |

1. Ground water elevations indicated on boring logs represent ground water elevation at date or time shown on drilling log. Absence of water surface implies that no ground water data is available but does not necessarily mean that ground water will not be encountered at locations or within the vertical reaches of these borings.

2. Borings represent subsurface conditions at their respective locations for their respective depths. Variations in conditions between or adjacent to boring locations may be encountered.

3. Terms used for describing soils according to their texture or grain size distribution are in accordance with the Unified Soil Classification System.

Standard Penetration Test - Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. It is customary to drive the spoon 6.0 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and performing the test are recorded for each 6.0 inches of penetration on the drill log (The "N" Value can be obtained by adding the bottom two numbers (i.e. $\frac{6}{8 - 9}$, 8+9 = 17 blows/ft). Unless otherwise noted on the drill log, the Standard Penetration Test was performed utilizing a Central Mine Equipment (CME) automatic hammer.

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. Failing-1500
PAGE 1 OF αα

JOB NO. E457 Pulaski County
JOB NAME: SPT Hammer Test
STATION:
LOCATION: Primary Test Site

DATE: November 21, 2006
TYPE OF DRILLING: Rotary Wash - Test Hammer
EQUIPMENT: Failing 1500 w/Dietrich Automatic Hammer
LOGGED BY: Richard Martin

COMPLETION DEPTH: 100.8

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | | | | | | | | | | |
| 10 | | | Moist, Very Loose, Brown Sand | | | | | | | | |
| 15 | | | | | | | | | | | |
| 20 | | | | | | | | | | | |
| | | X | Moist, Very Loose, Brown Silty Sand | | | | | | 2<br>2-2 | | |
| 25 | | | | | | | | | | | |
| 30 | | | Moist, Very Loose, Brown Silty Sand with Traces of Gravel | | | | | | | | |
| 35 | | | | | | | | | | | |

REMARKS:

| ARKANSAS HWY. & TRANS. DEPARTMENT<br>MATERIALS DIVISION - GEOTECHNICAL SEC. | BORING NO. Failing-1500<br>PAGE 2 OF αα |
|---|---|
| JOB NO. E457 Pulaski County<br>JOB NAME: SPT Hammer Test<br>STATION:<br>LOCATION: Primary Test Site | DATE: November 21, 2006<br>TYPE OF DRILLING: Rotary Wash - Test Hammer<br>EQUIPMENT: Failing 1500 w/Dietrich Automatic Hammer<br>LOGGED BY: Richard Martin |

COMPLETION DEPTH: 100.8

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | | | | | | | | | | | |
| | | X | Moist, Medium Dense, Brown Sand with Traces of Gravel | | | | | | 8<br>8-12 | | |
| 45 | | | | | | | | | | | |
| 50 | | | | | | | | | | | |
| 55 | | | | | | | | | | | |
| 60 | | | | | | | | | | | |
| | | X | Moist, Medium Dense, Brown Sand | | | | | | 10<br>13-16 | | |
| 65 | | | | | | | | | | | |
| 70 | | | | | | | | | | | |

REMARKS:

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. Failing-1500
PAGE 3 OF αα

JOB NO. E457 Pulaski County
JOB NAME: SPT Hammer Test
STATION:
LOCATION: Primary Test Site

DATE: November 21, 2006
TYPE OF DRILLING: Rotary Wash - Test Hammer
EQUIPMENT: Failing 1500 w/Dietrich Automatic Hammer
LOGGED BY: Richard Martin

COMPLETION DEPTH: 100.8

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL (SURFACE ELEVATION: ) | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 75 | | | Moist, Medium Dense, Brown Sand with Traces of Gravel | | | | | | | | |
| 80 | | X | Moist, Very Dense, Brown Silty Sand with Traces of Gravel | | | | | | 24 / 60 (6") | | |
| 85 | | | | | | | | | | | |
| 90 | | | | | | | | | | | |
| 95 | | | | | | | | | | | |
| 100 | | X | | | | | | | 36 / 52 (4") | | |
| | | | Boring Terminated | | | | | | | | |
| 105 | | | | | | | | | | | |

REMARKS:

| ARKANSAS HWY. & TRANS. DEPARTMENT<br>MATERIALS DIVISION - GEOTECHNICAL SEC. | BORING NO. CME-750<br>PAGE 1 OF αα |
|---|---|
| JOB NO. E457 Pulaski County<br>JOB NAME: SPT Hammer Test<br>STATION:<br>LOCATION: Primary Test Site | DATE: December 4, 2006<br>TYPE OF DRILLING: Rotary Wash - Test Hammer<br>EQUIPMENT: CME 750 w/CME Automatic Hammer<br>LOGGED BY: Josh Higginbottom |

COMPLETION DEPTH: 100.4

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |
| 15 | | | | | | | | | | | |
| 20 | | X | Wet, Medium Dense, Brown Sand | | | | | | 5<br>8-10 | | |
| 25 | | | | | | | | | | | |
| 30 | | | | | | | | | | | |
| 35 | | | | | | | | | | | |

REMARKS: Hollow stem augers were utilized to a depth of 9.5'.

| ARKANSAS HWY. & TRANS. DEPARTMENT<br>MATERIALS DIVISION - GEOTECHNICAL SEC. | BORING NO. CME-750<br>PAGE 2 OF αα |
|---|---|
| JOB NO. E457 Pulaski County<br>JOB NAME: SPT Hammer Test<br>STATION:<br>LOCATION: Primary Test Site | DATE: December 4, 2006<br>TYPE OF DRILLING: Rotary Wash - Test Hammer<br>EQUIPMENT: CME 750 w/CME Automatic Hammer<br>LOGGED BY: Josh Higginbottom |

COMPLETION DEPTH: 100.4

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | | | | | | | | | | | |
| | | X | | | | | | | 8<br>13-18 | | |
| 45 | | | | | | | | | | | |
| 50 | | | Wet, Dense, Brown Sand | | | | | | | | |
| 55 | | | | | | | | | | | |
| 60 | | | | | | | | | | | |
| | | X | | | | | | | 12<br>16-21 | | |
| 65 | | | | | | | | | | | |
| 70 | | | | | | | | | | | |

REMARKS: Hollow stem augers were utilized to a depth of 9.5'.

| ARKANSAS HWY. & TRANS. DEPARTMENT<br>MATERIALS DIVISION - GEOTECHNICAL SEC. | BORING NO. CME-750<br>PAGE 3 OF αα |
|---|---|
| JOB NO. E457 Pulaski County<br>JOB NAME: SPT Hammer Test<br>STATION:<br>LOCATION: Primary Test Site | DATE: December 4, 2006<br>TYPE OF DRILLING: Rotary Wash - Test Hammer<br>EQUIPMENT: CME 750 w/CME Automatic Hammer<br>LOGGED BY: Josh Higginbottom |

COMPLETION DEPTH: 100.4

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 75 | | | Wet, Dense, Brown Sand with Traces of Gravel | | | | | | | | |
| 80 | | X | | | | | | | 22 / 28 (3") | | |
| 85 | | | | | | | | | | | |
| 90 | | | Wet, Very Dense, Brown Sand with Clay Seams and Traces of Gravel | | | | | | | | |
| 95 | | | | | | | | | | | |
| 100 | | X | Wet, Very Dense, Brown Sand | | | | | | 60 (5") | | |
| | | | Boring Terminated | | | | | | | | |
| 105 | | | | | | | | | | | |

REMARKS: Hollow stem augers were utilized to a depth of 9.5'.

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. CME-75
PAGE 1 OF αα

JOB NO. E457 Pulaski County
JOB NAME: SPT Hammer Test
STATION:
LOCATION: Primary Test Site

DATE: November 21, 2006
TYPE OF DRILLING: Rotary Wash - Test Hammer
EQUIPMENT: CME 75 w/CME Automatic Hammer
LOGGED BY: Carson Sloan

COMPLETION DEPTH: 100.7

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–20 | | | Moist, Very Loose, Brown Sand | | | | | | | | |
| 20–22 | | X | Moist, Loose, Brown Silty Sand | | | | | | 1<br>2-5* | | |
| 22–35 | | X | | | | | | | 5<br>5-7 | | |

REMARKS: Hollow stem augers were utilized to a depth of 9.5'. * SPT blow count inaccurate because hydraulic chuck release mechanism was engaged, reducing flow to SPT hammer hydraulic motor.

| ARKANSAS HWY. & TRANS. DEPARTMENT<br>MATERIALS DIVISION - GEOTECHNICAL SEC. | BORING NO. CME-75<br>PAGE 2 OF αα |
|---|---|
| JOB NO. E457 Pulaski County<br>JOB NAME: SPT Hammer Test<br>STATION:<br>LOCATION: Primary Test Site | DATE: November 21, 2006<br>TYPE OF DRILLING: Rotary Wash - Test Hammer<br>EQUIPMENT: CME 75 w/CME Automatic Hammer<br>LOGGED BY: Carson Sloan |

COMPLETION DEPTH: 100.7

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | | X | Moist, Medium Dense, Brown Sand with Traces of Gravel | | | | | | 7<br>7-10 | | |
| 45 | | | | | | | | | | | |
| 50 | | | | | | | | | | | |
| 55 | | | | | | | | | | | |
| | | | Moist, Medium Dense, Brown Gravel | | | | | | | | |
| 60 | | X | | | | | | | 8<br>13-14 | | |
| 65 | | | | | | | | | | | |
| 70 | | | Moist, Medium Dense, Brown Sand with Traces of Gravel | | | | | | | | |

REMARKS: Hollow stem augers were utilized to a depth of 9.5'. * SPT blow count inaccurate because hydraulic chuck release mechanism was engaged, reducing flow to SPT hammer hydraulic motor.

| ARKANSAS HWY. & TRANS. DEPARTMENT<br>MATERIALS DIVISION - GEOTECHNICAL SEC. | BORING NO. CME-75<br>PAGE 3 OF αα |
|---|---|
| JOB NO. E457 Pulaski County<br>JOB NAME: SPT Hammer Test<br>STATION:<br>LOCATION: Primary Test Site | DATE: November 21, 2006<br>TYPE OF DRILLING: Rotary Wash - Test Hammer<br>EQUIPMENT: CME 75 w/CME Automatic Hammer<br>LOGGED BY: Carson Sloan |

COMPLETION DEPTH: 100.7

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 75 | | | | | | | | | | | |
| 80 | | | Moist, Medium Dense, Brown Large Gravel | | | | | | | | |
| | | | | | | | | | 6<br>15-22 | | |
| 85 | | | | | | | | | | | |
| 90 | | | Moist, Dense, Brown Fine Sand with Traces of Clay | | | | | | | | |
| 95 | | | | | | | | | | | |
| 100 | | | Moist, Dense, Brown Sand with Clay Seams | | | | | | 33<br>11<br>(2") | | |
| | | | Boring Terminated | | | | | | | | |
| 105 | | | | | | | | | | | |

REMARKS: Hollow stem augers were utilized to a depth of 9.5'. * SPT blow count inaccurate because hydraulic chuck release mechanism was engaged, reducing flow to SPT hammer hydraulic motor.

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. CME45
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JOB NO. E457 Pulaski County
JOB NAME: SPT Hammer Test
STATION:
LOCATION: Secondary Test Site

DATE: March 5, 2007
TYPE OF DRILLING: Hollow Stem Auger - Test Hammer
EQUIPMENT: CME 45 w/CME Automatic Hammer
LOGGED BY: David Kraft

COMPLETION DEPTH: 9.5

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Moist, Very Loose, Gray Sandy Silt | | | | | | | | |
| | | | Moist, Loose, Reddish Brown Sandy, Clayey Silt | | | | | | 2<br>2-3 | | |
| 5 | | | Moist, Loose to Medium Dense, Reddish Brown Sandy Silt | | | | | | | | |
| | | | Moist, Medium Dense, Reddish Brown Sandy Silt with Quartz and Shale Fragments | | | | | | 15<br>13-12 | | |
| 10 | | | Boring Terminated | | | | | | | | |
| 15 | | | | | | | | | | | |
| 20 | | | | | | | | | | | |
| 25 | | | | | | | | | | | |
| 30 | | | | | | | | | | | |
| 35 | | | | | | | | | | | |

REMARKS:

| ARKANSAS HWY. & TRANS. DEPARTMENT<br>MATERIALS DIVISION - GEOTECHNICAL SEC. | BORING NO. CME45-A<br>PAGE 1 OF αα |
|---|---|
| JOB NO. E457 Pulaski County<br>JOB NAME: SPT Hammer Test<br><br>STATION:<br>LOCATION: Secondary Test Site | DATE: March 5, 2007<br>TYPE OF DRILLING: Hollow Stem Auger - Test Hammer<br>EQUIPMENT: CME 45 w/CME Automatic Hammer<br>LOGGED BY: David Kraft |

COMPLETION DEPTH: 13.8

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Moist, Very Loose to Loose, Gray Sandy Silt | | | | | | 3<br>4-4 | | |
| 5 | | | Moist, Loose, Reddish Brown and Gray Sandy Silt with some Clay | | | | | | | | |
| | | | Moist, Hard, Reddish Brown Sandy Clay with Quartz Fragments | | | | | | 12<br>16-16 | | |
| 10 | | | Medium Dense, Brown and White Quartz Fragments | | | | | | | | |
| | | | Moist, Hard, Reddish Brown Gravelly Clay | | | | | | | | |
| | | | Moist, Medium Dense, Brown and Gray Gravelly Sand with Shale Fragments | | | | | | 10<br>22<br>(3") | | |
| 15 | | | Medium Hard, Brown and Gray Weathered Shale | | | | | | | | |
| | | | Boring Terminated | | | | | | | | |
| 20 | | | | | | | | | | | |
| 25 | | | | | | | | | | | |
| 30 | | | | | | | | | | | |
| 35 | | | | | | | | | | | |

REMARKS:

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. CME-850
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JOB NO. E457 Pulaski County
JOB NAME: SPT Hammer Test
STATION:
LOCATION: Primary Test Site

DATE: July 17, 2007
TYPE OF DRILLING: Rotary Wash - Test Hammer
EQUIPMENT: CME 850 w/CME Automatic Hammer
LOGGED BY: Richard Martin

COMPLETION DEPTH: 100.8

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL / SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–9.4 | | | Wet, Loose, Brown Sand | | | | | | | | |
| 9.4–20 | | | Wet, Loose, Brown Sand with Traces of Clay | | | | | | | | |
| 20–22 | | X | Wet, Very Loose, Brown Sand with Traces of Clay | | | | | | 1 / 2-1 | | |
| 22–23.5 | | X | Wet, Medium Dense, Brown Sand | | | | | | 3 / 5-6 | | |
| 23.5–35 | | X (30–31.5) | Wet, Medium Dense, Brown Sand with Traces of Gravel | | | | | | 9 / 9-11 | | |

REMARKS: A hollow stem auger was utilized to a depth of 9.4'.

| ARKANSAS HWY. & TRANS. DEPARTMENT<br>MATERIALS DIVISION - GEOTECHNICAL SEC. | BORING NO. CME-850<br>PAGE 2 OF αα |
|---|---|
| JOB NO. E457 Pulaski County<br>JOB NAME: SPT Hammer Test<br>STATION:<br>LOCATION: Primary Test Site | DATE: July 17, 2007<br>TYPE OF DRILLING: Rotary Wash - Test Hammer<br>EQUIPMENT: CME 850 w/CME Automatic Hammer<br>LOGGED BY: Richard Martin |

COMPLETION DEPTH: 100.8

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | | X | | | | | | | 6 / 8-15 | | |
| 45–60 | | | Wet, Medium Dense, Brown Sand with Gravel | | | | | | | | |
| 60 | | X | | | | | | | 6 / 14-18 | | |
| 65 | | | Wet, Dense, Brown Sand with Gravel | | | | | | | | |
| 70 | | | | | | | | | | | |

REMARKS: A hollow stem auger was utilized to a depth of 9.4'.

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. CME-850
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JOB NO. E457 Pulaski County
JOB NAME: SPT Hammer Test
STATION:
LOCATION: Primary Test Site

DATE: July 17, 2007
TYPE OF DRILLING: Rotary Wash - Test Hammer
EQUIPMENT: CME 850 w/CME Automatic Hammer
LOGGED BY: Richard Martin

COMPLETION DEPTH: 100.8

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Wet, Dense, Brown Gravel | | | | | | | | |
| 75 | | | Wet, Dense, Brown Gravel with Sand | | | | | | | | |
| | | | Hard, Brown Cemented Sand (75.1' - 75.8') | | | | | | | | |
| 80 | | | Wet, Dense, Brown Gravel with Sand with some Cemented Sand Seams | | | | | | | | |
| 85<br>90<br>95 | | X | Wet, Very Dense, Brown Sand with Gravel and Traces of Clay | | | | | | 14<br>32-18<br>(2") | | |
| 100 | | X | Wet, Very Dense, Brown and Gray Sand with Traces of Clay and Lignite | | | | | | 21<br>33<br>(4") | | |
| 105 | | | Boring Terminated | | | | | | | | |

REMARKS: A hollow stem auger was utilized to a depth of 9.4'.

# Appendix C
# PHOTOS


Fig. C-1 SPT Energy Measurement System

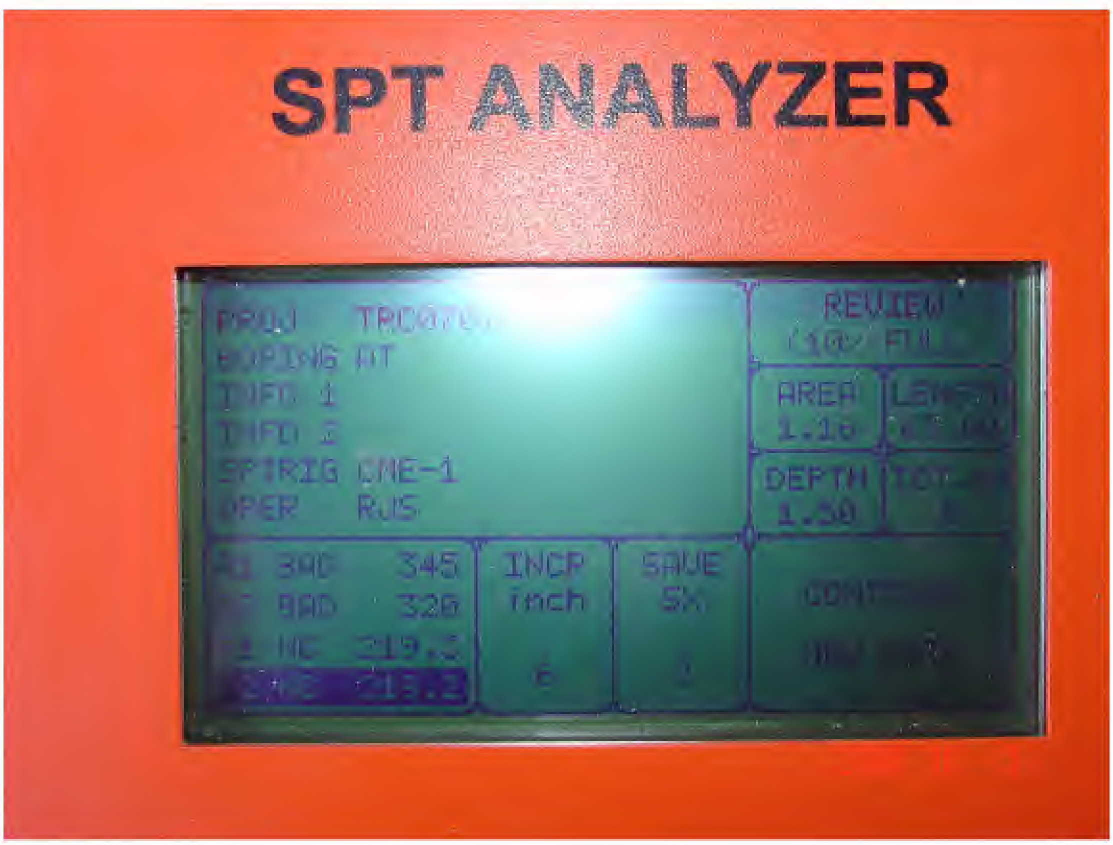


Fig. C-2 SPT Analyzer

Fig. C-3 Failing 1500 w/ Dietrich Hammer Drilling at Primary Test Site

Fig. C-4 Mounting Accelerometers on Instrumented Rod


Fig. C-5  SPT Testing Site near South Bank of Arkansas River, Primary Test Site


Fig. C-6  CME-750 All Terrain Rig with Instrumented Rod and Automatic Hammer Attached

Fig. C-7  CME-45 Skid Rig Testing at Secondary Test Site