Honeywell

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July 2, 2012

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Attention: Document Control Desk
Director, Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Docket No. 40-3392
License SUB-526

Subject: Response to Request for Additional Information (RAI) for Volume 2 of Surface Impoundment Decommissioning Plan (TACL32759)

Attached is Honeywell's response to the request for additional information issued by the NRC on June 20, 2012, concerning the surface impoundment decommissioning plan (TACL32759).

In accordance with 10 CFR 2.390 there is a map within the enclosed marked "SECURITY-RELATED INFORMATION, WITHHOLD FROM PUBLIC DISCLOSURE" and it is not suitable for release to the public.

If you or your staff have any questions or require additional information, please contact Bob Stokes, Regulatory Affairs and Radiation Protection Manager, at (618) 524-6341.

Sincerely,

for Larry Smith

Larry A. Smith
Plant Manager

Enclosure

cc: John Sulima, NMSS Project Manager
Mail Stop EBB 2-C40M
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

NMSS01

REQUEST FOR ADDITIONAL INFORMATION REGARDING HONEYWELL METROPOLIS WORKS LICENSE AMENDMENT REQUEST REPORT FOR CLOSURE OF SURFACE IMPOUNDMENT PONDS B, C, D AND E, VOLUME 2, June 2012

The *License Amendment Request Report* (LARR) serves as the decommissioning plan for Honeywell's amendment request. The following requests for additional information (RAIs) pertain to Volume 2 of the LARR. The information requested in the RAIs is needed for the U.S. Nuclear Regulatory Commission's (NRC's) staff to determine compliance with the dose requirement for unrestricted use in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, Subpart E, and to assess the applicant's design of engineered barriers with respect to the guidance in NUREG-1757.

Liquefaction of Soil Unit 4

RAI 1

Section 3.6 of the LARR, Volume 2, describes the additional information needed to confirm the design conditions for liquefaction (prior to construction). The licensee specifically states that:

- *"Further characterize the extent of potentially liquefiable soils in soil unit 4 by completing additional boreholes and/or cone penetrometer soundings near the pond berms.*
- *If warranted by the additional geotechnical data, perform additional slope displacement calculations to demonstrate compliance with the slope displacement criteria.*

It is anticipated that these additional investigations and calculations will confirm that the 'partially liquefiable' condition for soil unit 4 is appropriate, with associated 'best estimate' seismic slope displacements. If this is—for some reason—not confirmed, either a subsurface improvement method would be specified to partially stabilize the potentially liquefiable soils, or the closure design would be refined to tolerate marginally larger displacements. For example, this could include localized grouting in portions of soil unit 4 around the perimeters of the pond berms."

The staff is concerned about how liquefaction of Soil Unit 4 could negatively affect the stability of the erosion protection system. Thus, the staff requests the licensee to explain when and where the new borings will be drilled.

Response to RAI 1

Seventeen cone penetrometer tests (CPT) soundings and three additional geotechnical boreholes were advanced at the Honeywell MTW facility in the third and fourth quarters of 2011 to characterize the nature and extent of the potentially liquefiable Soil Unit 4 near the ponds. Shear wave velocity measurements were performed at each CPT sounding location to provide supplemental information regarding soil stiffness. Attachment 1 contains copies of the CPT logs and soil boring logs, plus interpreted cross sections of the area west of the ponds.

Section 3 of the LARR, Volume 2 described Soil Unit 4 as a potentially liquefiable medium dense sand layer at the boundary between the silty clay of Soil Unit 3 and the very dense sand of Soil Unit 5, based on the available investigation data. Evaluation of the new data from the 17 CPTs and 3 borings refined the previous description of Soil Unit 4 as follows:

- Laterally continuous, found at most of the investigation locations near the critical ravine slopes (i.e., CPT-1, 2a, 3, 4, 5, 14, and 15, and borings GT-03, 04, and 05).
- Thickness of only a few inches to a few feet. This is thinner than that modeled in the LARR, Volume 2 (approximately 10 feet).
- Liquefied shear strength ratio (S_u/P') of 0.32, based on the average of various methods for correlating CPT tip resistance and SPT blowcount to liquefied shear strength ratio. This S_u/P' is between the values for the "partially liquefied" and "fully liquefied" conditions presented in Section 3.4 of the LARR, Volume 2 (0.42 and 0.17, respectively).

As shown on the cross sections in Attachment 1, the CPT soundings and borings also identified a thin interval within Soil Unit 3 (lower clay)—designated as Soil Unit 3a herein—that has relatively lower strength than the surrounding Soil Unit 3. Based on the field data and laboratory testing, Soil Unit 3a has an S_u/P' of 0.27 to 0.32, similar to Soil Unit 4.

Based on the S_u/P' values, and on the conservative Newmark-based slope displacement methods presented in the LARR, Volume 2, best estimate seismic slope displacements during the 2,475-year return period earthquake would be between the "partially liquefied" and "fully liquefied" conditions (a few to 14 inches). Very conservative "upper bound" displacement estimates for these conditions ranged from 6 to 40 inches. Slopes would remain stable after seismic loading ends.

Even if the very conservative "upper-bound" displacements were to occur, the erosion protection system could tolerate them. During a 2,475-year seismic event, a thin shear zone preferentially would form through the weakest soil layers (i.e., Soil Unit 3a or 4), which are at lower elevations than the riprap. Therefore, shear failure would not directly affect the riprap erosion protection layer. However, if the soil block slides on Soil Unit 3a or 4, some limited distortion could occur at the ground surface where the riprap is located. Because the riprap layer will be flexible, it is expected to handle distortion at the ground surface without losing its erosion protection function, even under the most conservative levels of displacement.

Design Flow

RAI 2

Section 5.4.4 of the LARR, Volume 2, describes calculation of design flow based on 100-year, 24-hour event, and estimation of probable maximum precipitation (PMP) flow. In order for the staff to evaluate the acceptability of design flow calculated for this site, the staff requests the licensee explain the following:

1. *Why* Hydrometeorological Report *(HMR) 51 was used for calculating the PMP instead of HMR-52, which is applicable to smaller drainage areas and smaller durations; and*
2. *What method was used to calculate the time of concentration? Given the D_{50} sizes obtained for the rip rap in the ditches (interior and exterior) for the PMP, has the licensee considered recalculation of the PMP using a shorter time of concentration interval?*

Response to RAI 2.1

The method used for the project PMP estimate, using the charts in HMR-51 and extrapolating down to account for a smaller drainage area and shorter time of concentration, resulted in a very conservative estimate of the PMP (28-inch depth in 10 minutes). Honeywell agrees that the methods in HMR-52 would provide a more realistic, and smaller, estimate of PMP for the basin and times of concentration for the project.

Honeywell commits to prepare a revised PMP calculation using the methodology outlined in HMR-52 to determine a more realistic PMP value. The revised PMP calculation results will be submitted to NRC along with the optimized ditch riprap gradations discussed in the response to RAI 3.2.

Response to RAI 2.2

The time of concentration (T_c) was calculated using the industry-standard TR-55 methodology, as outlined in Chapter 3 of the USDA's *Urban Hydrology for Small Watersheds.* T_c is computed by determining the longest travel path in a drainage basin and summing the travel times for consecutive components of the drainage path over three types of flow regimes: sheet flow, shallow concentrated flow, and open channel flow. Surface roughness, channel shape, and channel slope all factor into the T_c calculation.

The computed T_c values for the three outfalls were 13 minutes for Outfall 001, 12 minutes for Outfall 002, and 12.5 minutes for Outfall 003. Therefore, looking at the system as a whole, an overall T_c value of 10 minutes is conservative for evaluating conditions in ditch segments with the highest flow rates (i.e., nearest the outfalls).

However, shorter T_c values are appropriate to evaluate conditions at individual sub-basins. Shorter sub-basin specific T_c values (i.e., 5 minutes) will be considered in the revised PMP calculations discussed in the response to RAI 2.1, and in the optimized riprap gradations discussed in the response to RAI 3.2.

RAI 3

Table 5-4 of the LARR, Volume 2, summarizes the riprap sizing. In its description of the results presented in Table 5-4, the licensee stated that: "The interior berm and exterior perimeter ditch rip rap sizes based on the 100-year, 24-hour storm and a SF of 1.5 are unreasonably large (Table 5-4). For example, the D50 riprap size based on the 100-year event is larger than the calculated maximum flow depth in the ditches. The PMP is the storm event for which there is essentially no risk of exceedance at any recurrence interval; therefore, the riprap sizing derived from the PMP as listed in Table 5-4 is considered sufficient to manage all storms at the site and is therefore used as the design basis for riprap sizing." The staff needs the following information to determine the acceptability of the riprap design:

1. *Please explain why the D_{50} values calculated for the interior and exterior ditches using the 100-year event are greater than the D_{50} calculated for PMP.*
2. *Please explain why the rip rap's thickness value presented in Figure C-7 (18 inches) is not the same as the values listed in Table 5-4 (8 to 39 inches).*
3. *Please provide the Quality Assurance/Quality Control procedures for rip rap placement (thickness, gradation, uniformity, etc.) in accordance with guidance in NUREG-1623.*

Response to RAI 3.1

The ditch riprap D_{50} size was determined using the Safety Factors Method in accordance with NUREG 1623, Appendix D, "Procedures for Designing Riprap Erosion Protection," for both the 100-year and PMP events. A safety factor (SF) of 1.5 was assigned to the 100-year event. A safety factor of 1.0 was applied to the PMP event, since the PMP event represents a storm for which there is essentially little to no risk of exceedance. The Safety Factors Method is a mathematical calculation using flow vectors and riprap geometries. The calculations described in Section 5.4 of the LARR, Volume 2 resulted in D_{50} values for the 100-year event that were larger than the PMP event for the exterior and interior ditches using the safety factors as described above. Given that the PMP event by definition has essentially little to no risk of exceedance; the designer defaulted to the D_{50} values corresponding to the PMP event.

The table below illustrates the impact that the safety factor has on the riprap sizing by simply changing the value from 1.5 to 1.0 for the 100-year event.

Riprap Sizing and Thickness

Location	Storm Event	D_{50} (in.)	Riprap Layer Thickness (in.)
Interior berm ditch	100-year (SF = 1.5)	16	24
	100-year (SF = 1.0)	4	6
	PMP	11	16.5
Exterior perimeter ditch	100-year (SF = 1.5)	26	39
	100-year (SF = 1.0)	6	9
	PMP	18	27

PMP is the based on the HMR-51 method for this illustration. Riprap layer thickness is listed as 1.5 x D_{50}

The riprap size for the interior berm ditch, for example, computes to a minimum 16-inch D_{50} using a safety factor of 1.5, and then reduces by a factor of 4 down to 4-inches using a safety factor 1.0. In this particular case, the D_{50} for the PMP was only 11 inches, and therefore, the designer defaulted to the 11-inch value by definition of the PMP. This same approach will apply when the riprap sizes (and thicknesses) for specific ditch segments are optimized prior to construction, as described in the response to RAI 3.2.

Response to RAI 3.2

Figure C-7 calls out multiple riprap thicknesses, and notes that "Riprap thickness and ditch cross-section will vary depending on flows in that section of the ditch." The riprap D_{50} values listed in the LARR Volume 2, Table 5-4, for the interior and perimeter ditches correspond to the maximum expected flow rate for each ditch type.

Honeywell commits to optimize riprap gradations for specific ditch segments prior to construction, which may result in smaller riprap sizes in some locations. Riprap thickness will be at least 1.5 × D_{50} on all ditches and sideslopes. The optimized riprap gradations and layer thicknesses by ditch segment will be provided to NRC before construction.

Response to RAI 3.3

Honeywell commits to prepare quality assurance/quality control procedures for riprap production and placement (thickness, gradation, uniformity, etc.) in accordance with guidance in NUREG-1623. The procedures will be submitted to NRC before production or construction of riprap.

RAI 4

In Section 5.4.4 of the LARR, Volume 2, the licensee states that: "In the event of a PMP, the drainage system designed for the pond closure system would be quickly flooded. Stormwater would overtop the interior common berm ditch crests and back up flow over the 4 percent vegetated top slopes prior to natural relief over the berm side slope riprap. Stormwater would also overtop the berm perimeter ditches and flow into the nearby drainages. Runoff from the PMP would be expected to primarily flow overland to discharge points (DPs) 1, 2, and 3, and eventually offsite through the natural drainage ravines to the Ohio River.

"Even though the PMP event would flood the drainage system, it would not be expected to cause permanent damage to the drainage features nor exposure of the stabilized CaF2 material. As described below, rip rap on the berm side slopes and ditches is sized to withstand the PMP event."

The following information is needed in order for the staff to evaluate the stability of the proposed erosion protection system:

1. *What is meant by "permanent damage?"*
2. *Describe the damage to the drainage features that is expected from the PMP event.*
3. *Describe how the design accounts for sediment accumulation at the toe of the slopes, inside the ditches.*
4. *Explain the basis for proposing a V-shape for the ditches considering the difficulty in placement of rock and possible sediment accumulation.*
5. *Explain the basis for choosing 4 percent, top vegetated slopes. Was wind erosion considered in the design of the vegetated cover?*
6. *Was the probable maximum flow (PMF) for the Ohio River calculated? How would this PMF value affect the erosion protection design?*
7. *Provide additional details on the design of the discharge points.*

Response to RAI 4.1 and 4.2

Permanent damage in this context is defined as causing the system to be nonfunctional as designed. Under a PMP event, it is expected that stormwater flow off the cover will be backed up at the discharge points under outlet flow conditions. The contributing drainage basins of the cover system are small, with shallow slopes resulting in low drainage flow velocities under submerged conditions. Low flow velocities are expected to ensure that the stormwater features will remain intact and functional. Stormwater that overtops the perimeter ditches will run overland (away from the ponds) to lower elevations and ultimately to the Ohio River.

Response to RAI 4.3

It is expected that, over several years of exposure, sediment will accumulate in the drainage ditches and fill the void spaces of the riprap. To account for this, the ditches have been designed to provide the required flow sectional area within the ditch above the top of the riprap. Sediment buildup is not expected to adversely affect the performance of the riprap in preventing erosion.

Response to RAI 4.4

The V-shape ditch, commonly used in closures of this type, was selected because of space constraints within the common berms and the exterior ditches. Quality control procedures regarding ditch construction and riprap placement will be issued before construction, as discussed in the response to RAI 3.3.

Response to RAI 4.5

The standard of practice for landfill cover design, as established by U.S. EPA, is to provide a top finish slope between 3 and 5 percent to account for potential settlement. A 4 percent slope was selected for this project to provide a margin against possible differential settlement in order to preserve at least 3 percent slope, while at the same time, limiting the steepness to minimize erosion forces. A slope flatter than 3 percent (after settlement) would require EPA's approval.

Wind erosion will be prevented by establishing and maintaining a strong stand of vegetation throughout the post-closure monitoring period. An erosion rate consistent with a "permanent pasture" condition

was used as an input to the RESRAD exposure model, which represents conditions after the post-closure monitoring period has ended.

Response to RAI 4.6

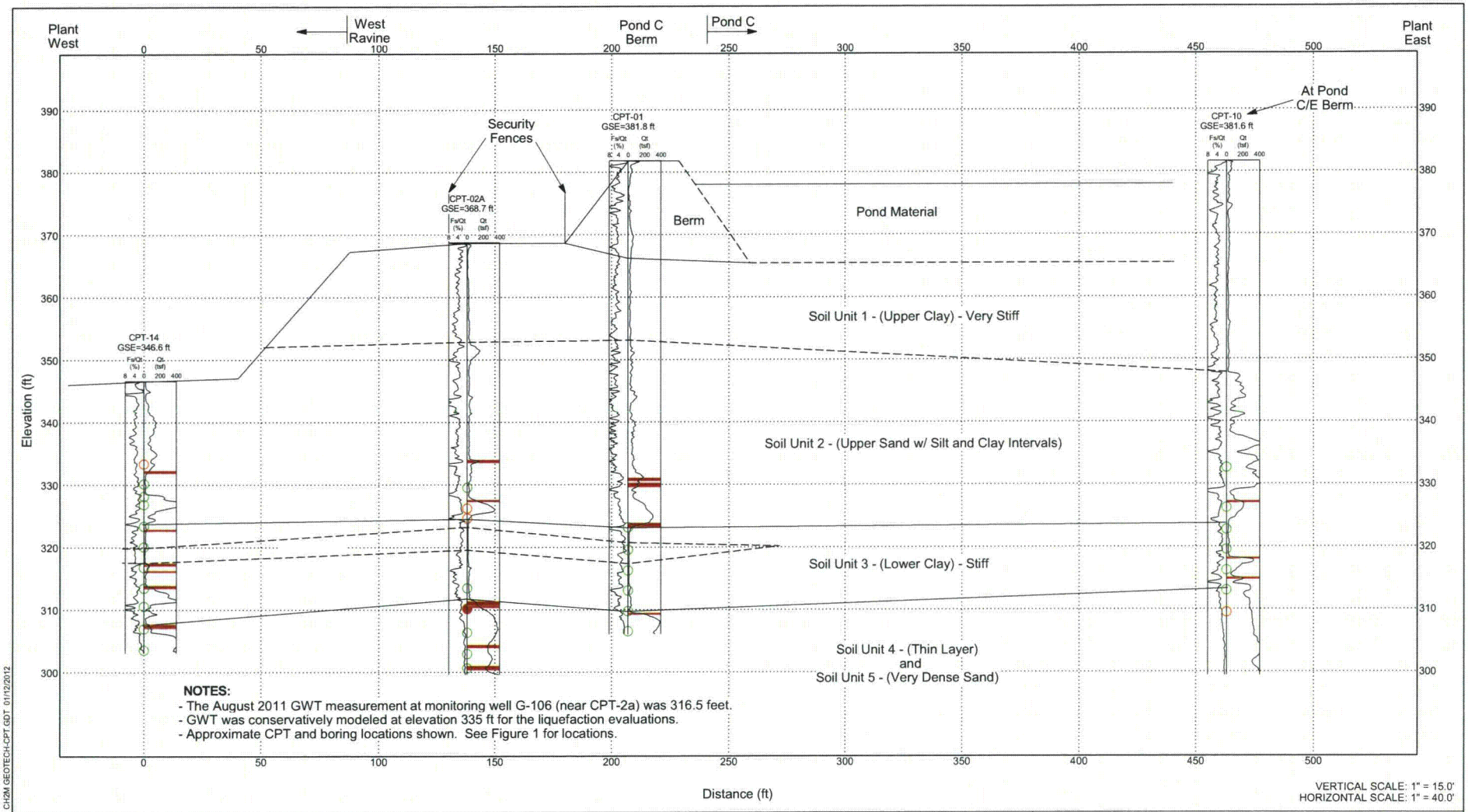
A project-specific PMF was not calculated for the Ohio River. The largest flood on record at Metropolis, Illinois, occurred in 1937. The elevation of the river, as measured at the railroad bridge at Metropolis, crested at 343 feet above mean sea level during the flood (USCOE, 2011).The Paducah Gaseous Diffusion Plant (PGDP) is located about 3.6 miles south of the Ohio River, at roughly the same location along the river as the Honeywell-MTW site. The PMF of the Ohio River at that location is discussed in the *Safety Analysis Report* for the PGDP dated September 15, 1995. As discussed in Section 2.4.3.2 of the *Safety Analysis Report*, "The PMF elevation near PGDP was calculated to be 360.6 ft when natural conditions in the Mississippi River were assumed. However, flow in the Mississippi River immediately downstream from Cairo and the confluence of the Mississippi and Ohio Rivers is controlled by the Birds Point/New Madrid Floodway. When the effects of this floodway were taken into account, the calculated PMF elevation became 365.0 ft. Since whether the floodway would be intact cannot be known a priori, the appropriate PMF stage elevation at PGDP is taken to be 365.0 ft at a discharge of 4,000,000 cfs."

At an Ohio River PMF elevation of 365.0 ft, stormwater would submerge the discharge points and partially back up in the perimeter ditches around the ponds. However, such stormwater backup is not expected to cause permanent damage the erosion control systems.

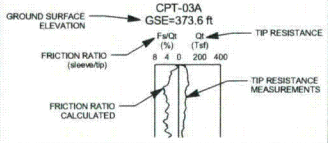
Response to RAI 4.7

Each discharge point will entail construction of a riprap discharge apron, consisting of buttressed riprap stones and a filter layer, to dissipate energy that would otherwise cause erosion. Discharge channels will be reinforced beyond the discharge point as needed to channel the stormwater into the natural drainage-ways.

Attachment 1
Supplemental Boring Logs, CPT Logs, and Cross Sections



CPT LEGEND



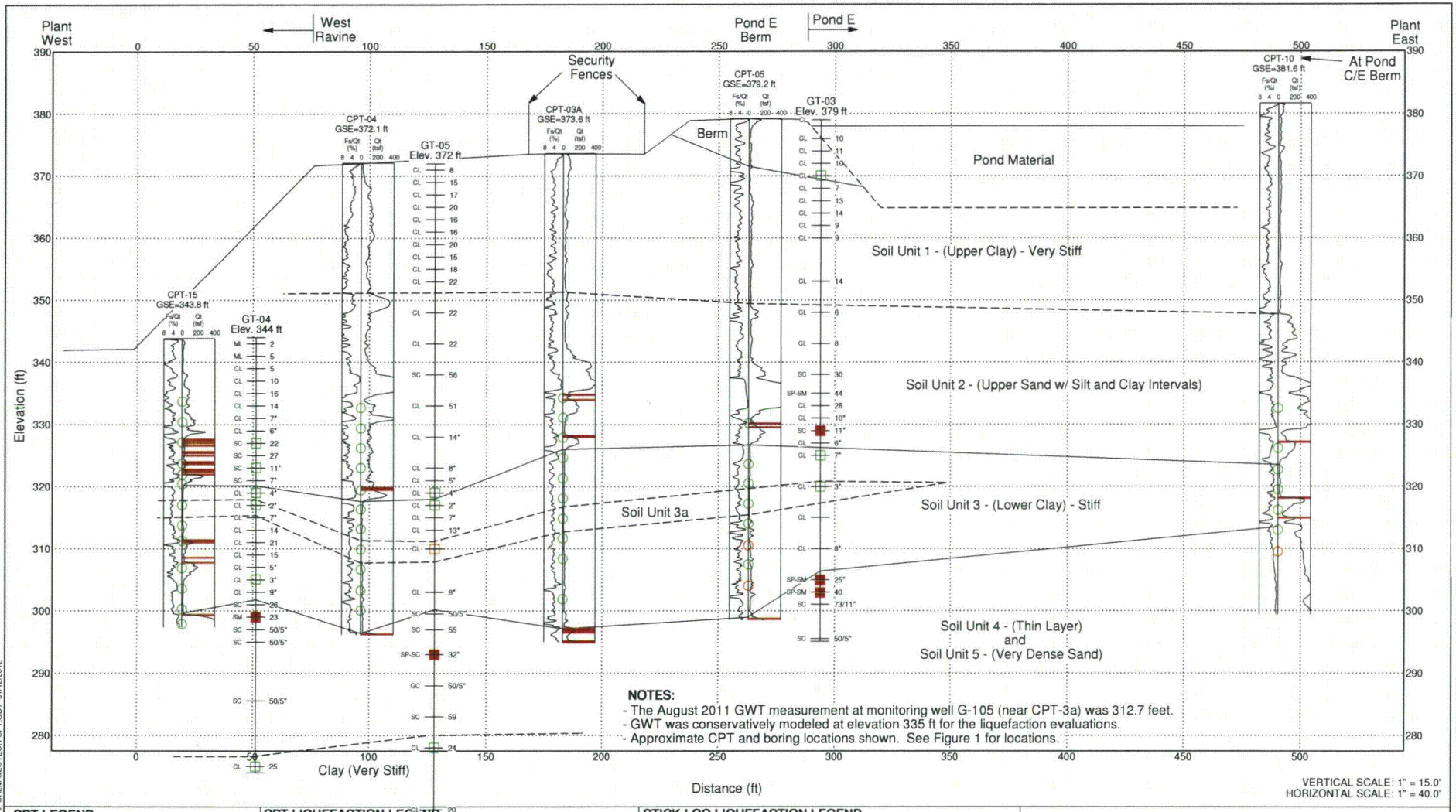
CPT LIQUEFACTION LEGEND

- Liquefaction Potential (based on Q_t)
- No Liquefaction Potential (based on V_s)
- Marginal Liquefaction Potential (based on V_s)
- Liquefaction Potential (based on V_s)

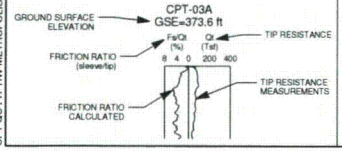
FIGURE 2A
CROSS-SECTION A-A
HONEYWELL - METROPOLIS WORKS FACILITY
METROPOLIS, ILLINOIS

CH2MHILL

CPT QC FR HW-METROPOLIS.GPJ CH2M GEOTECH-CPT.GDT 01/12/2012



CPT LEGEND



CPT LIQUEFACTION LEGEND

- Liquefaction Potential (based on Q_t)
- No Liquefaction Potential (based on V_s)
- Marginal Liquefaction Potential (based on V_s)
- Liquefaction Potential (based on V_s)

STICK LOG LIQUEFACTION LEGEND

- Not Liquefiable per Lab (Bray and Sancio)
- Marginal Liquefiable per Lab (Bray and Sancio)
- Potentially Liquefiable per Lab (Bray and Sancio)
- * SPT-Based Liquefiable Pending Lab (Youd)

FIGURE 2B
CROSS-SECTION B-B
HONEYWELL - METROPOLIS WORKS FACILITY
METROPOLIS, ILLINOIS

CH2MHILL

CPT QC.FR HW-METROPOLIS.GPJ CH2M.GEOTECH-CPT.GDT 01/12/2012

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
418776.HW.03	GT-03	SHEET 1 OF 3

SOIL BORING LOG

PROJECT : MTW - Honeywell, Metropolis, IL — LOCATION : Near CPT-5

ELEVATION : 379 ft — DRILLING CONTRACTOR : Geotechnology

DRILLING EQUIPMENT AND METHOD : Rubber Tire Mounted CME 750 with 140 lb. Automatic Hammer, 3-3/4"Hollow Stem Auger and Mud Rotary with 3-5/8" Bit

WATER LEVELS : --- — START : 9/27/11 13:15 — END : 9/27/11 17:30 — LOGGER : T. Valentine

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	2.0				Surface is gravel road.		Begin drilling with hollow stem augers. Drilled blind drill hole near GT-03 to take shelby tube sample. Blind drill hole labeled **GT-03A**.
	4.0	1.3	SS-1	4-4-6-6 (10)	**LEAN CLAY (CL)**, reddish brown with iron oxide staining throughout, dry, stiff, low plasticity fines, estimated 5% fine sand, homogeneous.		PP = 1.0 tsf
5	6.0	1.4	SS-2	2-5-6-6 (11)	**LEAN CLAY (CL)**, same as above.		PP = 2.5 tsf
	8.0	1.6	SS-3	2-4-6-7 (10)	**LEAN CLAY (CL)**, same as above.		PP = 2.75 tsf
10	10.0	0.2	ST-4	push	**LEAN CLAY (CL)**, same as above.		PP = 1.5 tsf Shelby tube **GT-03A** from 8 to 10'.
	12.0	1.3	SS-5	2-2-5-4 (7)	**LEAN CLAY (CL)**, similar to above except firm, low to medium plasticity, 0.5' lens of greenish gray clay from 10.5-11'.		ST-1: **LEAN CLAY (CL)**, brown, dry, firm, low plasticity, estimated 5-10% fine sand. Recovery = 2.0' PP = 1.25 tsf ST-1 Index Test Results Gravel = 0.1% Sand = 2.5% Silt = 80.5% Clay = 17.0% LL = 29% PL = 19% PI = 10% M.C = 21.5% Dry Density = 103 pcf
	14.0	1.5	SS-6	2-5-8-9 (13)	**LEAN CLAY (CL)**, similar to above except stiff, very soft layer from 12.6-13.1'.		
15	16.0	2.0	SS-7	2-6-8-8 (14)	**LEAN CLAY (CL)**, reddish brown with iron oxide staining throughout, moist, stiff, low plasticity, trace fine sand.		PP = 2.0 tsf Jarred dark gray material.
	18.0	1.8	SS-8	2-4-5-7 (9)	**LEAN CLAY (CL)**, brownish gray with iron oxide staining throughout, moist, stiff, low plasticity, trace fine sand.		PP = 1.75 tsf Shipped sample to Corvallis, OR for testing.
20	20.0	2.0	SS-9	3-4-5-6 (9)	**LEAN CLAY (CL)**, same as above.		Switch to mud rotary.
25	25.0						
	27.0	2.0	SS-10	3-7-7-7 (14)	**LEAN CLAY (CL)**, similar to above except less iron oxide staining in bottom 0.2', medium plasticity.		Shipped sample to Corvallis, OR for testing.
30							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
418776.HW.03	GT-03	SHEET 2 OF 3

SOIL BORING LOG

PROJECT : MTW - Honeywell, Metropolis, IL — LOCATION : Near CPT-5

ELEVATION : 379 ft — DRILLING CONTRACTOR : Geotechnology

DRILLING EQUIPMENT AND METHOD : Rubber Tire Mounted CME 750 with 140 lb. Automatic Hammer, 3-3/4"Hollow Stem Auger and Mud Rotary with 3-5/8" Bit

WATER LEVELS : --- — START : 9/27/11 13:15 — END : 9/27/11 17:30 — LOGGER : T. Valentine

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	30.0	2.0	SS-11	3-3-3-5 (6)	**LEAN CLAY (CL)**, gray with iron oxide staining throughout, moist, firm, low to medium plasticity, trace fine sand.		PP = 2.0 tsf
	32.0						
35	35.0	2.0	SS-12	3-3-5-7 (8)	**LEAN CLAY (CL)**, same as above.		
	37.0						Driller reports: harder at 38'.
40	40.0	1.9	SS-13	10-13-17-18 (30)	**CLAYEY SAND (SC)**, gray with heavy iron oxide staining throughout, moist, medium dense, fine sand, estimated 35-45% low plasticity fines.		
	42.0						
	43.0	1.7	SS-15	20-22-22-30 (44)	**POORLY GRADED SAND WITH SILT (SP-SM)**, reddish brown, moist, dense, fine sand, estimated 5-15% non-plastic fines.		Skipped sample number SS-14 (no SS-14).
45	45.0	1.6	SS-16	10-12-16-16 (28)	**LEAN CLAY WITH SAND (CL)**, gray with iron oxide staining, moist, very stiff, no to low plasticity, estimated 15-25% fine sand.		PP = 1.5 tsf
	47.0	1.5	SS-17	10-4-6-10 (10)	**LEAN CLAY (CL)**, gray with trace of iron oxide staining, wet, stiff, no to low plasticity, estimated 5-10% fine sand.		
50	49.0	1.7	SS-18	4-6-5-5 (11)	**CLAYEY SAND (SC)**, gray with trace of iron oxide staining, wet, medium dense, fine sand interbedded, low to medium plasticity fines.		SS-18 Index Test Results Gravel = 0.2% Sand = 50.0% Silt = 31.8% Clay = 18.0% LL = 18% PL = 11% PI = 7% M.C = 17%
	51.0	2.0	SS-19	1-2-4-4 (6)	**LEAN CLAY WITH SAND (CL)**, gray with heavy iron oxide staining, wet, firm, medium plasticity, fine sand.		
	53.0	2.0	SS-20	2-3-4-5 (7)	**LEAN CLAY WITH SAND (CL)**, same as above.		PP = 1.75 tsf SS-20 Index Test Results Gravel = 0.0% Sand = 20.3% Silt = 37.9% Clay = 41.8% LL = 38% PL = 17% PI = 21% M.C = 21.0%
55	55.0						
	58.0	2.0	SS-21	1-1-2-2 (3)	**LEAN CLAY WITH SAND (CL)**, similar to above except from 59.4-60' sample changed to gray and medium to high plasticity.		
60	60.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
418776.HW.03	GT-03	SHEET 3 OF 3

SOIL BORING LOG

PROJECT : MTW - Honeywell, Metropolis, IL — LOCATION : Near CPT-5

ELEVATION : 379 ft — DRILLING CONTRACTOR : Geotechnology

DRILLING EQUIPMENT AND METHOD : Rubber Tire Mounted CME 750 with 140 lb. Automatic Hammer, 3-3/4"Hollow Stem Auger and Mud Rotary with 3-5/8" Bit

WATER LEVELS : --- — START : 9/27/11 13:15 — END : 9/27/11 17:30 — LOGGER : T. Valentine

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	63.0						Jarred soft material from 59.4 to 60'. SS-21 Index Test Results Gravel = 0.0% Sand = 21.9% Silt = 40.1% Clay = 38.0% LL = 30% PL = 14% PI = 16% M.C = 23.7% PP = 2.5 tsf
65	65.0	2.0	ST-22	push	**LEAN CLAY (CL)**, reddish brown with iron oxide staining, wet, firm, low to medium plasticity, trace fine sand.		
	68.0						
70	70.0	2.0	SS-23	4-4-4-4 (8)	**LEAN CLAY WITH SAND (CL)**, reddish brown with heavy iron oxide staining, wet, firm, low plasticity fines, estimated 15-25% fine sand.		
	73.0						Driller reports: sand at 71.5'.
75	75.0	0.8	SS-24	10-13-12-14 (25)	**POORLY GRADED SAND WITH SILT (SP-SM)**, dark gray, wet, medium dense, fine sand, non-plastic fines.		SS-24 Index Test Results Gravel = 2.2% Sand = 86.7% Silt = 6.6% Clay = 4.5% M.C = 20.4%
	77.0	2.0	SS-25	10-17-23-40 (40)	**75-75.8':SANDY LEAN CLAY (CL)**, gray with some iron oxide staining, moist to wet, hard, low to medium plasticity, fine sand. (25A-SS)		SS-25A Index Test Results Gravel = 0.0% Sand = 44.0% Silt = 29.9% Clay = 26.1% LL = 24% PL = 13% PI = 11% M.C = 19.9%
	78.9	0.7	SS-26	10-23-50/5" (73/11")	**75.8-77':POORLY GRADED SAND WITH SILT (SP-SM)**, heavy iron oxide staining from 75.8-76.2', gray from 76.2-77', wet, dense, fine sand, non-plastic fines, fine to coarse subrounded gravel in shoe. (25B-SS)		SS-25B Index Test Results Gravel = 2.1% Sand = 87.6% Fines = 10.3% M.C = 13.5%
80	83.0				**CLAYEY SAND (SC)**, brownish gray, wet, very dense, fine to medium sand, estimated 15% non-plastic fines, estimated 10-15% fine subrounded gravel.		Rig chatter from 77 to 83'.
	83.9	0.4	SS-27	37-50/5" (50/5"")	**CLAYEY SAND WITH GRAVEL (SC)**, dark reddish brown, wet, very dense, fine to coarse sand, estimated 25-35% fine subrounded gravel, estimated 15-20% non-plastic fines.		
85					Bottom of Boring at 83.9 ft bgs		End of hole at elevation 295.1 ft. Abandoned hole with bentonite grout mix (48 gallons water/2 bags bentonite grout). Solid cuttings were placed in 1 labeled drum. Liquids were placed in 4 labeled drums. Composite sample was taken from solids drum and shipped to a lab for analysis.
90							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
418776.HW.03	GT-04 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : MTW - Honeywell, Metropolis, IL LOCATION : Near CPT-15

ELEVATION : 344 ft DRILLING CONTRACTOR : Geotechnology

DRILLING EQUIPMENT AND METHOD : Rubber Tire Mounted CME 750 with 140 lb. Automatic Hammer, 3-3/4"Hollow Stem Auger and Mud Rotary with 3-5/8" Bit

WATER LEVELS : 41.0 ft bgs START : 9/28/11 14:30 END : 9/29/09 09:30 LOGGER : T. Valentine

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0.0							
	2.0	1.3	SS-1	3-1-1-2 (2)	**SILT (ML)**, brown, moist, soft, low plasticity, trace fine sand, wood from 1.1-1.3'.		Begin drilling with hollow stem augers. Drilled blind drill hole near GT-04 to take shelby tube samples. Blind drill hole labeled **GT-04A**. PP = 0.2 tsf
	4.0	1.6	SS-2	1-2-3-4 (5)	**SILT (ML)**, similar to above except firm, occasional organics (roots and wood).		
5	6.0	1.9	SS-3	1-2-3-5 (5)	**LEAN CLAY (CL)** , gray with heavy iron oxide staining, moist, firm, low plasticity from 4-4.8' and low to medium plasticity from 4.8-5.9'.		
	8.0	1.7	SS-4	3-4-6-14 (10)	**LEAN CLAY (CL)**, gray with heavy iron oxide staining, moist, stiff, low to medium plasticity, trace fine sand.		PP = 1.5 tsf
10	10.0	2.0	SS-5	9-13-3-4 (16)	**LEAN CLAY (CL)**, similar to above except very stiff.		
	12.0	1.7	SS-6	6-8-6-6 (14)	**LEAN CLAY (CL)**, similar to above except stiff.		PP = 1.0 tsf
	14.0	2.0	SS-7	2-3-4-3 (7)	**LEAN CLAY (CL)**, similar to above except firm.		
15	16.0	2.0	SS-8	3-3-3-6 (6)	**14-15': LEAN CLAY (CL)**, same as above. **15-16': LEAN CLAY WITH SAND (CL)**, gray with iron oxide staining, more firm than above, low plasticity, estimated 15-20% fine sand.		PP taken in softer material from 14-15'. PP = 0.5 tsf
	18.0	2.0	SS-9	8-11-11-15 (22)	**CLAYEY SAND (SC)**, orangish brown, dry to moist, medium dense, fine sand, no to low plasticity fines.		SS-9 Index Test Results Gravel = 0.0% Sand = 71.0% Silt = 13.0% Clay = 16.0% LL = 22% PL = 16% PI = 6% M.C = 15.3%
20	20.0	2.0	SS-10	11-14-13-9 (27)	**CLAYEY SAND (SC)**, similar to above except bottom 0.2' is gray LEAN CLAY (CL) with heavy iron oxide staining and low plasticity.		Shelby Tube **GT-04A** from 19-20.2'. Push refusal after 1.2'. Description from bottom of tube.
	22.0	1.7	SS-11	5-5-6-8 (11)	**CLAYEY SAND (SC)**, gray with heavy iron oxide staining, moist, medium dense, fine sand, low plasticity.		ST-1: **CLAYEY SAND (SC)**, orangish brown, moist, fine sand, estimated 25-35% no to low plasticity fines. Recovery = 1.1'
	24.0	1.7	SS-12	3-3-4-5 (7)	**CLAYEY SAND (SC)**, similar to above except loose.		SS-11 Index Test Results Gravel = 0.0% Sand = 53.0% Silt = 28.0% Clay = 19.0% LL = 22% PL = 12% PI = 10% M.C = 16.4%
25	26.0	2.0	SS-13	2-2-2-3 (4)	Transitions from **LEAN CLAY WITH SAND (CL)** to **LEAN CLAY (CL)**, gray with heavy iron oxide staining, moist, soft, medium plasticity, fine sand from 24.5-26', transition occurs at approximately 24.5'.		Shely Tube **GT-04A** from 23-25'. ST-2: **LEAN CLAY (CL)**, gray with heavy iron oxide staining, soft to firm, low to medium plasticity, estimated 10% fine sand, more sand in bottom of tube estimated at 15-25% fine sand. Recovery = 2.0'
	28.0	2.0	SS-14	2-1-1-2 (2)	**LEAN CLAY (CL)**, gray with heavy iron oxide staining, moist, soft, medium plasticity, fine sand.		PP = 1.5 tsf
30		2.0	SS-15	2-2-5-6 (7)	**LEAN CLAY (CL)**, similar to above except firm, estimated 5-10% fine sand in bottom 0.2'.		PP = 0.5 tsf

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
418776.HW.03	GT-04 SHEET 2 OF 3

SOIL BORING LOG

PROJECT : MTW - Honeywell, Metropolis, IL LOCATION : Near CPT-15

ELEVATION : 344 ft DRILLING CONTRACTOR : Geotechnology

DRILLING EQUIPMENT AND METHOD : Rubber Tire Mounted CME 750 with 140 lb. Automatic Hammer, 3-3/4"Hollow Stem Auger and Mud Rotary with 3-5/8" Bit

WATER LEVELS : 41.0 ft bgs START : 9/28/11 14:30 END : 9/29/09 09:30 LOGGER : T. Valentine

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	30.0						
		2.0	SS-16	6-7-7-7 (14)	**SANDY LEAN CLAY (CL)**, gray with heavy iron oxide staining, moist, stiff, low to medium plasticity, estimated 35-45% fine sand, plasticity varies throughout sample in 0.3' lenses.		Shelby Tube **GT-04A** from 26-28'.
	32.0						ST-3: **LEAN CLAY WITH SAND (CL)**, gray with heavy iron oxide staining, moist, soft to firm, low to medium plasticity, fine sand.
		2.0	SS-17	10-10-11-11 (21)	**SANDY LEAN CLAY (CL)**, similar to above except very stiff, low plasticity, homogeneous.		Recovery = 2.0'
	34.0						ST-3 Index Test Results
					34-34.5':SANDY LEAN CLAY (CL), orangish brown, heavy iron oxide staining, moist, stiff, low plasticity, estimated 25-30% fine sand.		Gravel = 0.0% Sand = 29.2%
35		2.0	SS-18	8-6-9-7 (15)	**34.5-36':LEAN CLAY (CL)**, gray with some iron oxide staining, moist, firm, medium plasticity, estimated 5-10% fine sand.		Silt = 40.8% Clay = 30.0%
	36.0						LL = 27% PL = 12% PI = 15%
		1.8	SS-19	2-2-3-6 (5)	**LEAN CLAY (CL)**, same as above.		M.C = 18.1% Dry Density = 102.2
	38.0						PP = 0.5 tsf
							PP = 1.0 tsf
		2.0	SS-20	2-1-2-3 (3)	**SANDY LEAN CLAY (CL)**, similar to above except soft, alternating lenses of sandier material 0.4' thick, fines are medium plasticity.		PP =0.25 tsf
40	40.0						SS-20 Index Test Results
					LEAN CLAY WITH SAND (CL), gray with trace iron oxide staining, moist to wet, firm, low to medium plasticity, 0.2' lens of clayey sand at 41.2', wet and soft from 41.5-42'.		Gravel = 0.0% Sand = 36.2%
		1.7	SS-21	3-4-5-5 (9)			Silt = 33.6% Clay = 30.2%
	42.0						LL = 30% PL = 14% PI = 16%
					Transitions from **LEAN CLAY WITH SAND (CL)** to **CLAYEY SAND (SC)**, gray with trace iron oxide staining, wet, medium dense, sand content increases with depth, fine sand, bottom 0.4' is SC.		M.C = 16.4%
		1.7	SS-22	2-6-20-20 (26)			PP = 1.5 tsf
	44.0						Driller reports: water at 41'.
					44-45.4': SILTY SAND (SM), gray, wet, medium dense, fine to medium sand, no to low plasticity fines.		Switch to mud rotary at 42'.
45		1.6	SS-23	4-6-17-46 (23)	**45.4-45.6': SILTY SAND WITH GRAVEL (SM)**, dark gray, wet, dense, fine to coarse sand, estimated 20-30% fine subrounded gravel, estimated 15-20% no to low plasticity fines.		Jarred SM without gravels.
	46.0						SS-23 Index Test Results
					CLAYEY SAND WITH GRAVEL (SC), light brown, wet, very dense, fine to coarse sand, estimated 25-35% fine subangular to angular gravel ,estimated 15-20% non-plastic fines.		Gravel = 2.4% Sand = 66.0%
		0.8	SS-24	46-50/5" (50/5"")			Silt = 33.1% Clay = 0.5%
	48.0						M.C = 20.6%
					CLAYEY SAND WITH GRAVEL (SC), same as above.		
		0.3	SS-25	42-50/5" (50/5"")			
50	50.0						
55							
	58.0						
	58.9	0.9	SS-26	48-50/5" (50/5"")	**WELL GRADED GRAVEL WITH SAND (GW)**, orangish brown, wet, very dense, fine subrounded to subangular gravel, fine to coarse sand, low plasticity fines.		SS-26 Index Test Results
							Gravel = 72.8% Sand = 25.1%
60							Fines = 2.1% M.C. = 16.0%

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
418776.HW.03	GT-04 SHEET 3 OF 3

SOIL BORING LOG

PROJECT : MTW - Honeywell, Metropolis, IL LOCATION : Near CPT-15

ELEVATION : 344 ft DRILLING CONTRACTOR : Geotechnology

DRILLING EQUIPMENT AND METHOD : Rubber Tire Mounted CME 750 with 140 lb. Automatic Hammer, 3-3/4"Hollow Stem Auger and Mud Rotary with 3-5/8" Bit

WATER LEVELS : 41.0 ft bgs START : 9/28/11 14:30 END : 9/29/09 09:30 LOGGER : T. Valentine

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
65							Driller reports: tough drilling from 60 to 68'.
68.0							
70	2.0	2.0	SS-27	33-13-12-21 (25)	**68-68.7': CLAYEY GRAVEL WITH SAND (GC)**, orangish brown, wet, medium dense, fine subrounded to subangular gravel, estimated 30-40% fine to coarse sand, estimated 15-20% low plasticity fines. **68.7-70': SANDY LEAN CLAY (CL)**, orangish brown from 68.7-69.5', gray from 69.5-70', wet, very stiff, slight plasticity, very fine sand. Bottom of Boring at 70.0 ft bgs		Jarred clay material. SS-20 Index Test Results Gravel = 0.0% Sand = 35.5% Silt = 60.0% Clay = 4.5% LL = 49% PL = 23% PI = 26% M.C = 33.8%
70.0							End of hole at elevation 274 ft. Abandoned hole with bentonite grout (48 gallons water/2 bags bentonite grout).
75							
80							
85							
90							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
418776.HW.03	GT-05	SHEET 1 OF 4

SOIL BORING LOG

PROJECT : MTW - Honeywell, Metropolis, IL
LOCATION : Near CPT-4
ELEVATION : 372 ft
DRILLING CONTRACTOR : Geotechnology
DRILLING EQUIPMENT AND METHOD : Rubber Tire Mounted CME 750 with 140 lb. Automatic Hammer, 3-3/4"Hollow Stem Auger and Mud Rotary with 3-5/8" Bit
WATER LEVELS : ---
START : 9/29/11 15:30
END : 9/30/11 14:30
LOGGER : T. Valentine

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	0.0						Begin with hollow stem augers.
		1.6	SS-1	2-3-5-8 (8)	**LEAN CLAY (CL)**, brown, dry, firm, low plasticity, trace fine sand, trace organics (roots).		
	2.0						
		1.7	SS-2	2-6-9-12 (15)	**LEAN CLAY (CL)**, similar to above except stiff.		
	4.0						
5		2.0	SS-3	3-8-9-10 (17)	**LEAN CLAY (CL)**, grayish brown, dry, very stiff, low plasticity, trace fine sand.		PP = 2.25 tsf
	6.0						
		1.9	SS-4	6-10-10-12 (20)	**LEAN CLAY (CL)**, gray with heavy iron oxide staining, dry, very stiff, low plasticity.		
	8.0						
		2.0	SS-5	5-8-8-7 (16)	**LEAN CLAY (CL)**, gray with iron oxide staining, dry, very stiff, low plasticity.		PP = 1.25 tsf Switch to mud rotary.
10	10.0						
		1.7	SS-6	6-7-9-10 (16)	**LEAN CLAY (CL)**, same as above.		
	12.0						
		1.5	SS-7	5-9-11-11 (20)	**LEAN CLAY (CL)**, same as above.		PP = 2.25 tsf
	14.0						
15		2.0	SS-8	3-6-9-9 (15)	**LEAN CLAY (CL)**, similar to above except stiff.		
	16.0						
		2.0	SS-9	5-9-9-2 (18)	**LEAN CLAY (CL)**, similar to above except very stiff.		PP > 4.5 tsf
	18.0						
		2.0	SS-10	8-11-11-13 (22)	**LEAN CLAY (CL)**, same as above.		
20	20.0						
	23.0						
		2.0	SS-11	14-11-11-13 (22)	**LEAN CLAY (CL)**, same as above.		PP = 4.0 tsf
25	25.0						
	28.0						
		2.0	SS-12	8-11-11-13 (22)	**LEAN CLAY/SILT (CL/ML)**, gray with iron oxide staining throughout, dry to moist, very stiff, slight to low plasticity, estimated 10-15% very fine sand.		Particles are very fine and are difficult to differentiate between very fine sand and clay/silt. Material can be rolled into thin thread. Could be SC.
30	30.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
418776.HW.03	GT-05	SHEET 2 OF 4

SOIL BORING LOG

PROJECT : MTW - Honeywell, Metropolis, IL — LOCATION : Near CPT-4

ELEVATION : 372 ft — DRILLING CONTRACTOR : Geotechnology

DRILLING EQUIPMENT AND METHOD : Rubber Tire Mounted CME 750 with 140 lb. Automatic Hammer, 3-3/4"Hollow Stem Auger and Mud Rotary with 3-5/8" Bit

WATER LEVELS : --- — START : 9/29/11 15:30 — END : 9/30/11 14:30 — LOGGER : T. Valentine

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	33.0						
35	35.0	2.0	SS-13	27-28-28-45 (56)	**CLAYEY SAND (SC)**, gray, moist, very dense, fine sand, estimated 15-25% no to low plasticity fines.		
	38.0						
40	40.0	2.0	SS-14	33-33-18-45 (51)	**38-38.5':CLAYEY SAND (SC)**, similar to above except iron oxide staining throughout. **38.5-40':SANDY CLAY (CL)**, gray with heavy iron oxide staining, moist, hard, slight plasticity, estimated 30-40% very fine sand.		Difficult to distinguish between very fine sand and silt/clay. Could be SC. Jarred CL.
	43.0						Driller reports: softer at 41.'
45	45.0	2.0	SS-15	5-6-8-9 (14)	**LEAN CLAY (CL)**, dark gray with iron oxide staining, moist, stiff, low plasticity, estimated 5-10% very fine sand.		PP = 3.5 tsf
	48.0						
50	50.0	2.0	SS-16	5-4-4-9 (8)	**LEAN CLAY (CL)**, gray with heavy iron oxide staining, moist, firm, low to medium plasticity, very fine sand ranges from approximated 10% near top to 0% at bottom.		PP = 0.5 tsf
	52.0	2.0	SS-17	1-2-3-4 (5)	**SANDY LEAN CLAY (CL)**, gray with heavy iron oxide staining, moist, firm, low to medium plasticity, very fine sand content varies throughout sample.		Difficult to distinguish between very fine sand and silt/clay.
	54.0	1.6	SS-18	2-2-2-2 (4)	**SANDY LEAN CLAY (CL)**, similar to above except soft.		SS-18 Index Test Results Gravel = 0.0% Sand = 48.2% Silt = 41.4% Clay = 10.4% LL = 25% PL = 12% PI = 13% M.C = 18.4% PP < 0.25 tsf
55	56.0	1.5	SS-19	1-1-1-1 (2)	**SANDY LEAN CLAY (CL)**, gray with trace iron oxide staining, moist to wet, soft, medium plasticity, very fine sand.		SS-19 Index Test Results Gravel = 0.0% Sand = 33.3% Silt = 42.0% Clay = 24.7% LL = 27% PL = 12% PI = 15% M.C = 23.4%
	58.0	1.6	SS-20	5-3-4-5 (7)	**SANDY LEAN CLAY (CL)**, gray with iron oxide staining, moist, firm, low to medium plasticity, very fine sand, one fine subrounded gravel.		SS-20 Index Test Results Gravel = 0.0% Sand = 28.8% Silt = 32.5% Clay = 38.7% M.C = 21.5%
60	60.0	1.7	SS-21	3-6-7-8 (13)	**LEAN CLAY WITH SAND (CL)**, gray with iron oxide staining, moist, stiff, low to medium plasticity, estimated 15-25% very fine sand, sandy clay lens from 59.1-59.5.		

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
418776.HW.03	GT-05	SHEET 3 OF 4

SOIL BORING LOG

PROJECT : MTW - Honeywell, Metropolis, IL — LOCATION : Near CPT-4

ELEVATION : 372 ft — DRILLING CONTRACTOR : Geotechnology

DRILLING EQUIPMENT AND METHOD : Rubber Tire Mounted CME 750 with 140 lb. Automatic Hammer, 3-3/4"Hollow Stem Auger and Mud Rotary with 3-5/8" Bit

WATER LEVELS : --- — START : 9/29/11 15:30 — END : 9/30/11 14:30 — LOGGER : T. Valentine

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	61.0						PP = 1.5 tsf Jarred SC lens. PP = 1.5 tsf
	63.0	2.0	ST-22	push	**CLAYEY SAND (SC)**, brown, moist, loose, very fine to fine sand, low plasticity.		ST-22 Index Test Results Gravel = 0.6% Sand = 73.9% Silt = 16.5% Clay = 9.0% LL = 23% PL = 12% PI = 11% M.C = 19.0% Dry Density = 104.0
65	68.0						
	70.0	2.0	SS-23	3-3-5-5 (8)	**LEAN CLAY (CL)**, gray, moist, firm, low to medium plasticity, estimated 10-15% very fine to fine sand, sandy lean clay layer from 69.5-69.7', trace fine subrounded gravel.		
70	72.0						
	72.9	0.7	SS-24	36-50/5" (50/5"")	**CLAYEY SAND WITH GRAVEL (SC)**, gray and black with iron oxide staining, wet, very dense, fine to coarse sand, estimated 30-40% fine subrounded to subangular gravel, estimated 15-25% no to low plasticity fines.		Driller reports: stiffer at 72'.
	74.0						
	76.0	2.0	SS-25	35-33-22-20 (55)	**CLAYEY SAND (SC)**, brown, wet, very dense, fine to medium sand, estimated 10-15% fine subrounded gravel, estimated 15-20% no to slight plasticity fines, clayey gravel lenses from 74-74.2' and 75.8-76'.		Heavy rig chatter from 74 to 78'.
75	78.0						
	80.0	1.5	SS-26	14-15-17-19 (32)	**POORLY GRADED SAND WITH CLAY (SP-SC)**, gray, wet, dense, fine sand, non-plastic fines.		Driller reports: softer at 78'. SS-26 Index Test Results Gravel = 1.8% Sand = 89.9% Silt = 2.5% Clay = 5.8% M.C = 25.7%
80	83.0						Driller reports: gravels at 81'. Heavy rig chatter from 81 to 86'.
	85.0	0.4	SS-27	50/5" (50/5"")	**CLAYEY GRAVEL WITH SAND (GC)**, brown, wet, very dense, fine to coarse subangular to angular gravel, fine to coarse sand, estimated 15-20% slightly plastic fines.		
85	88.0						Driller reports: sand from 86 to 87'. Heavy rig chatter from 87 to 88'.
	90.0	1.6	SS-28	43-34-25-41 (59)	**CLAYEY SAND WITH GRAVEL (SC)**, brown, wet, very dense, fine to medium sand, estimated 30-40% fine to coarse subrounded to angular gravel, estimated 15-20% non-plastic fines.		
90							

CH2MHILL

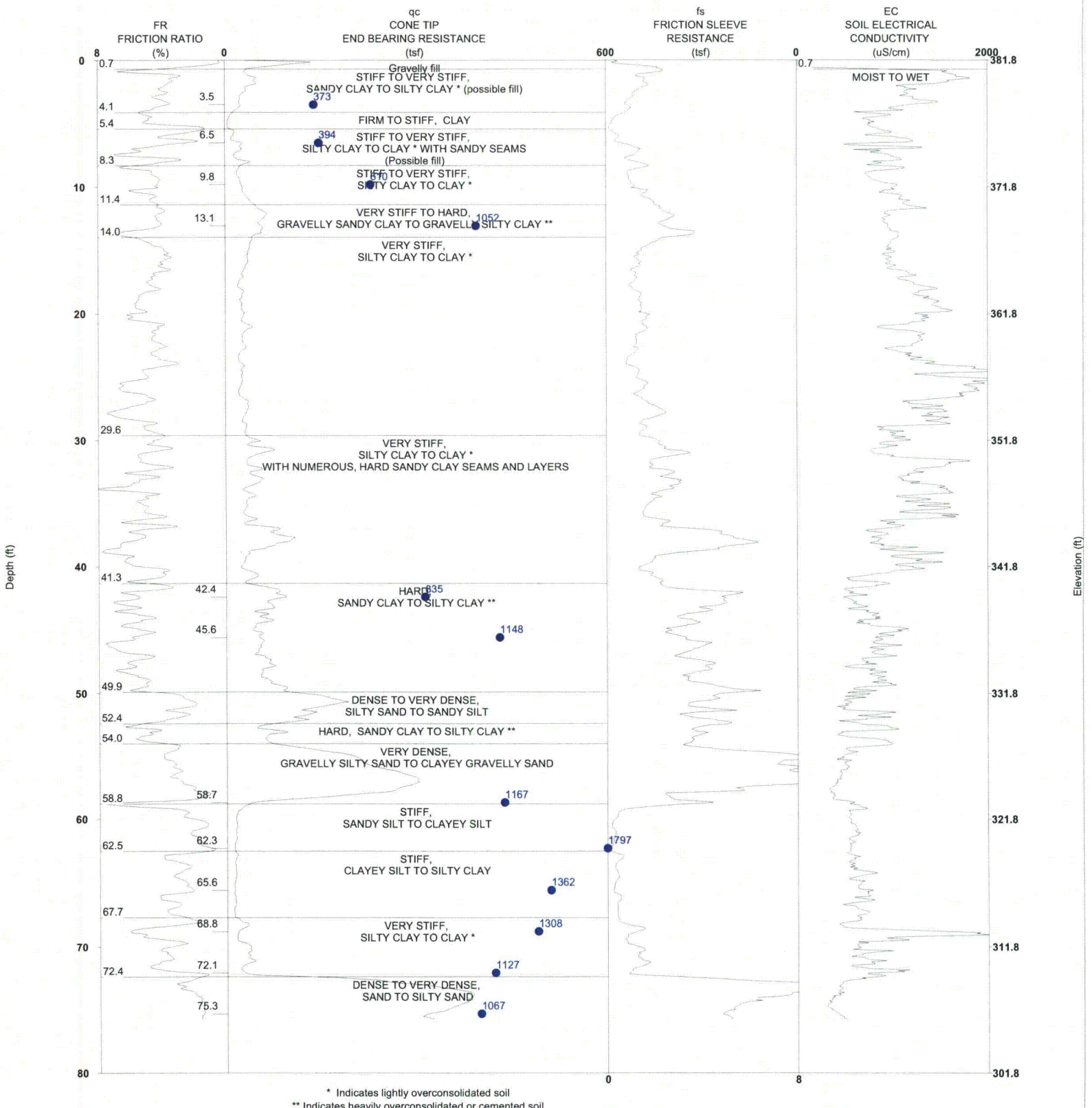
PROJECT NUMBER:	BORING NUMBER:	
418776.HW.03	GT-05	SHEET 4 OF 4

SOIL BORING LOG

PROJECT : MTW - Honeywell, Metropolis, IL
LOCATION : Near CPT-4
ELEVATION : 372 ft
DRILLING CONTRACTOR : Geotechnology
DRILLING EQUIPMENT AND METHOD : Rubber Tire Mounted CME 750 with 140 lb. Automatic Hammer, 3-3/4"Hollow Stem Auger and Mud Rotary with 3-5/8" Bit
WATER LEVELS : ---
START : 9/29/11 15:30
END : 9/30/11 14:30
LOGGER : T. Valentine

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	93.0						
	95.0	1.8	SS-29	11-11-13-14 (24)	**SANDY LEAN CLAY (CL)**, dark gray, moist to wet, very stiff, low plasticity, very fine sand.		Smooth drilling from 93 to 101'. SS-29 Index Test Results Gravel = 0.0% Sand = 49.3% Fines = 50.7% LL = 43% PL = 23% PI = 20% M.C = 33.8%
95							
100							Gravels from 101 to 102'. Softer from 102 to 103'.
	103.0						
	105.0	2.0	SS-30	8-10-10-10 (20)	**SANDY LEAN CLAY (CL)**, same as above except thin iron oxide staining throughout.		
105					Bottom of Boring at 105.0 ft bgs		End of hole at elevation 267 ft. Abandoned hole with bentonite grout (48 gallons water/2 bags bentonite grout).
110							
115							
120							

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT001



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

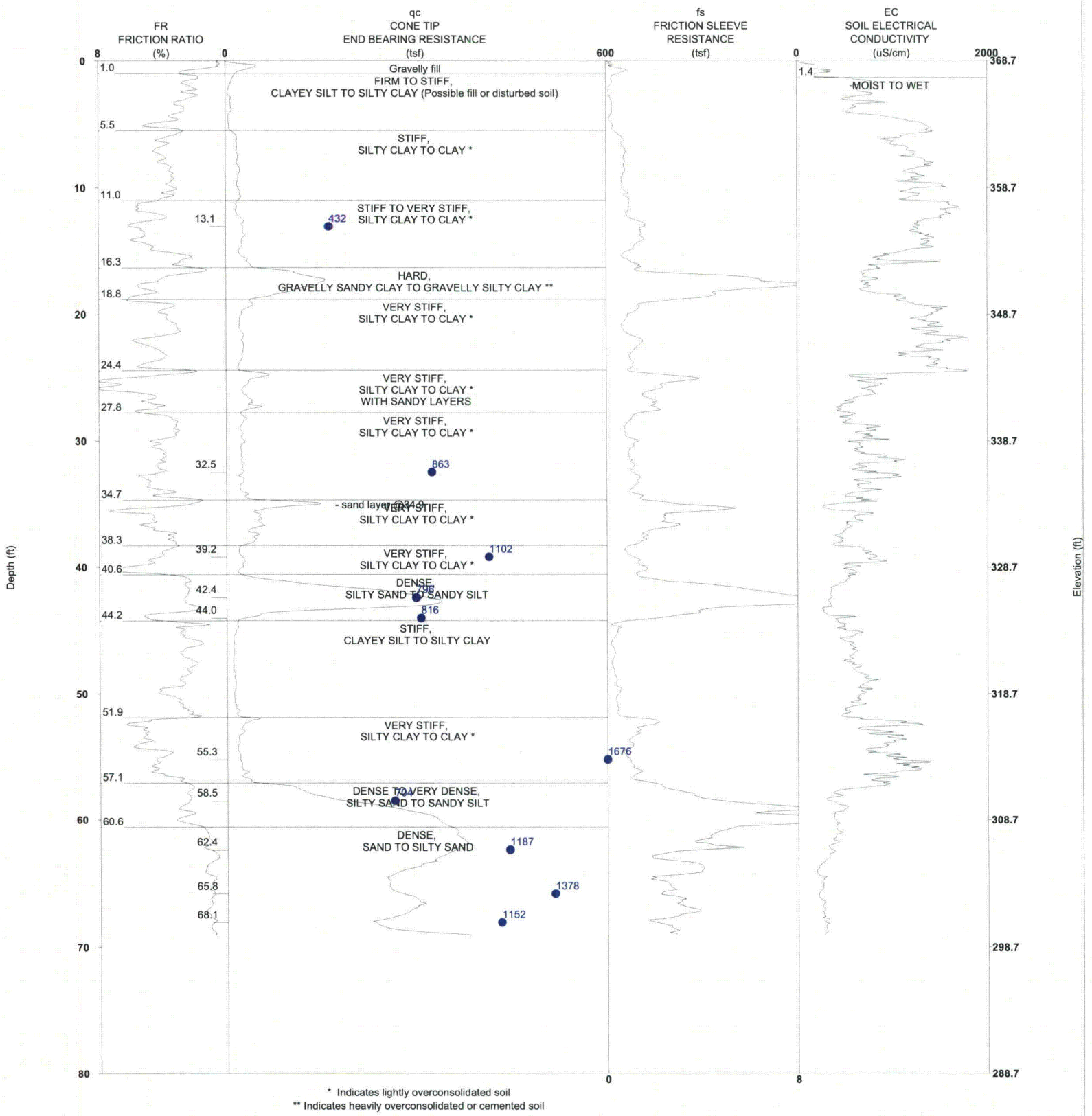
Latitude: 37.17120 Longitude: -88.75957 EL (ft): 381.8

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/23/2011 TIME:2:41 PM
SOUNDING NUMBER:CPT-017 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT002A



* Indicates lightly overconsolidated soil
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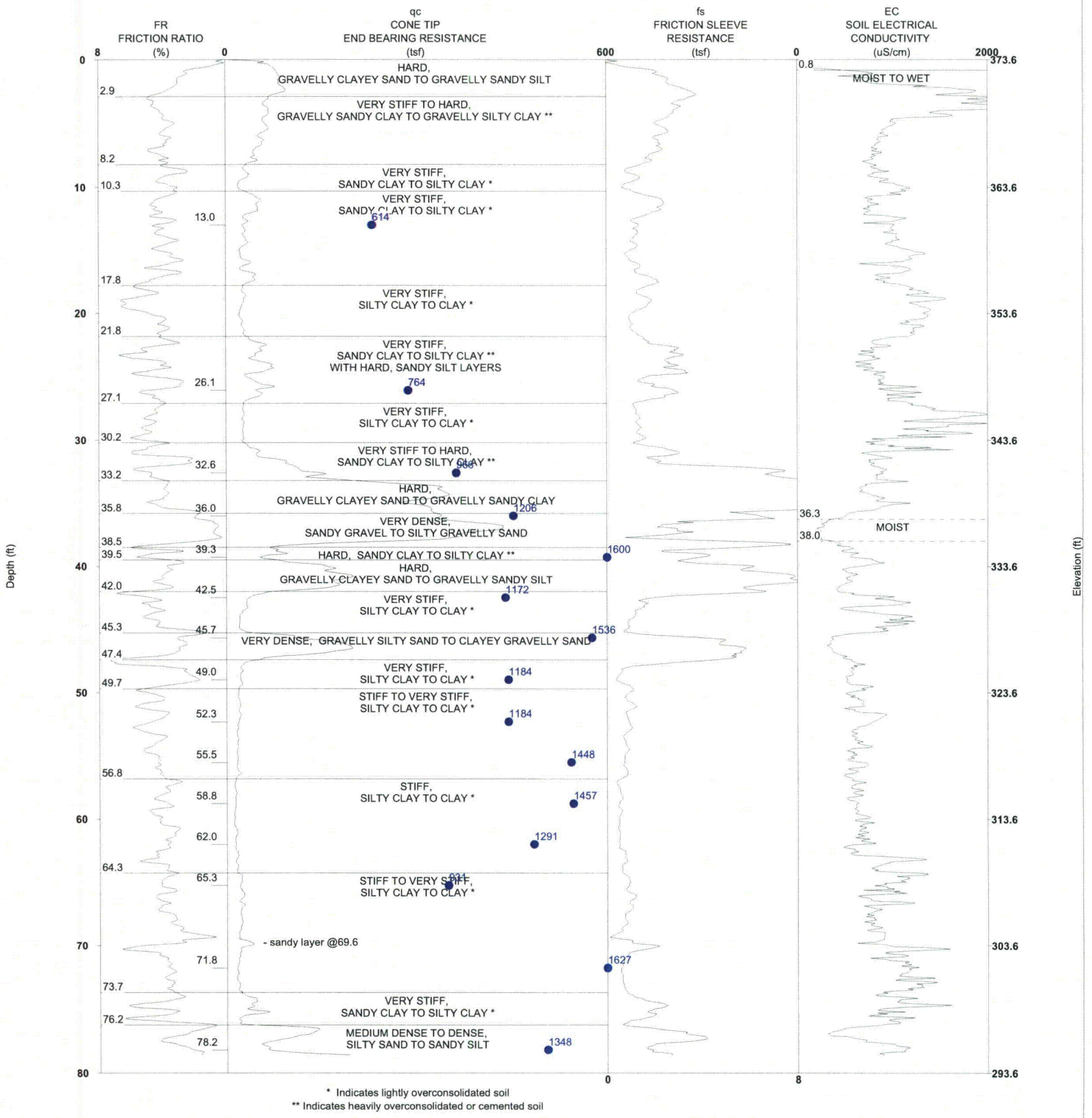
Latitude: 37.17131 Longitude: -88.75972 EL (ft): 368.7

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/21/2011 TIME:5:30 PM
SOUNDING NUMBER:CPT-002A (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT003A



* Indicates lightly overconsolidated soil

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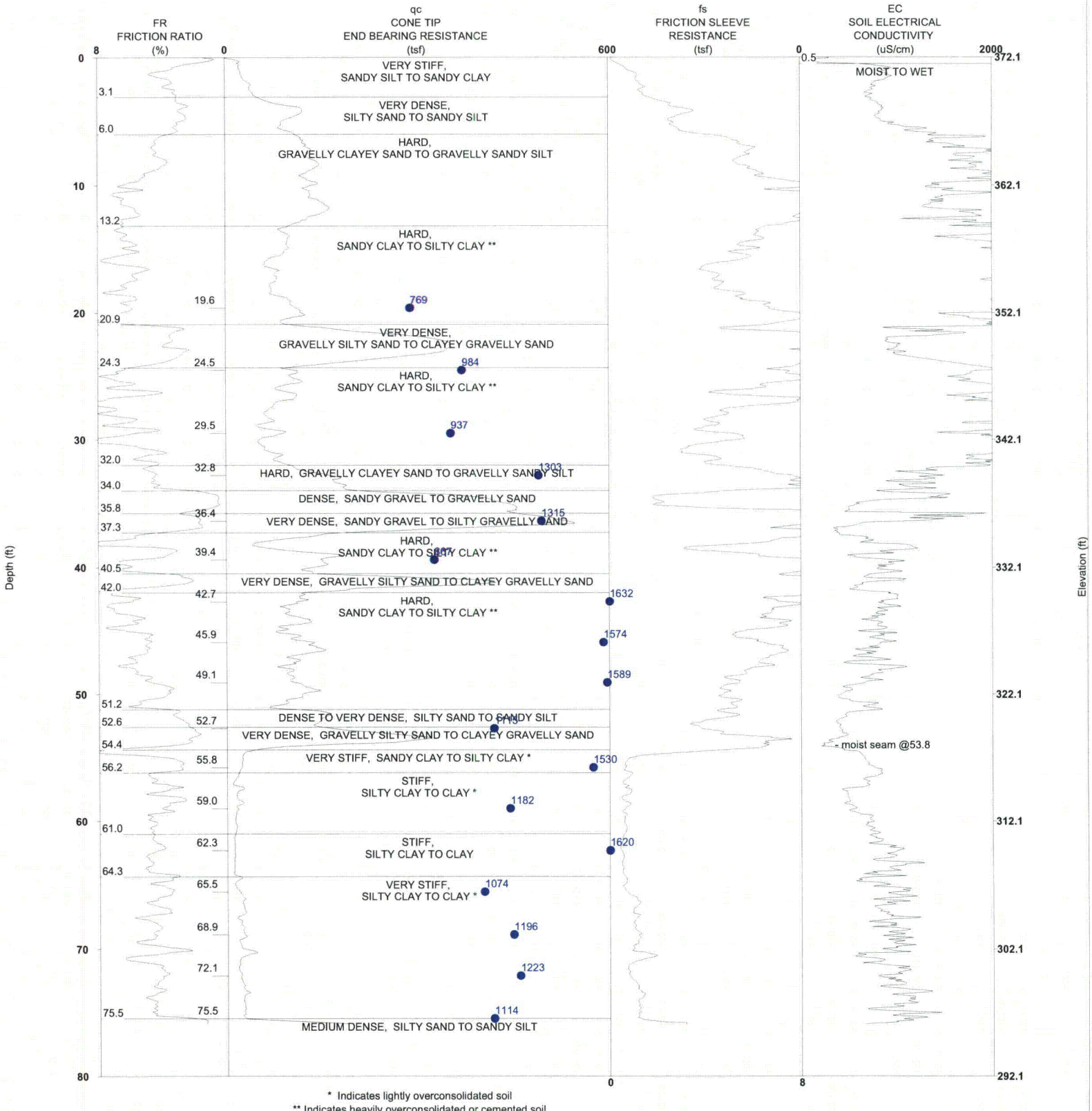
Latitude: 37.17082 Longitude: -88.76035 EL (ft): 373.6

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/22/2011 TIME:4:40 PM
SOUNDING NUMBER:CPT-0003A (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT004



* Indicates lightly overconsolidated soil
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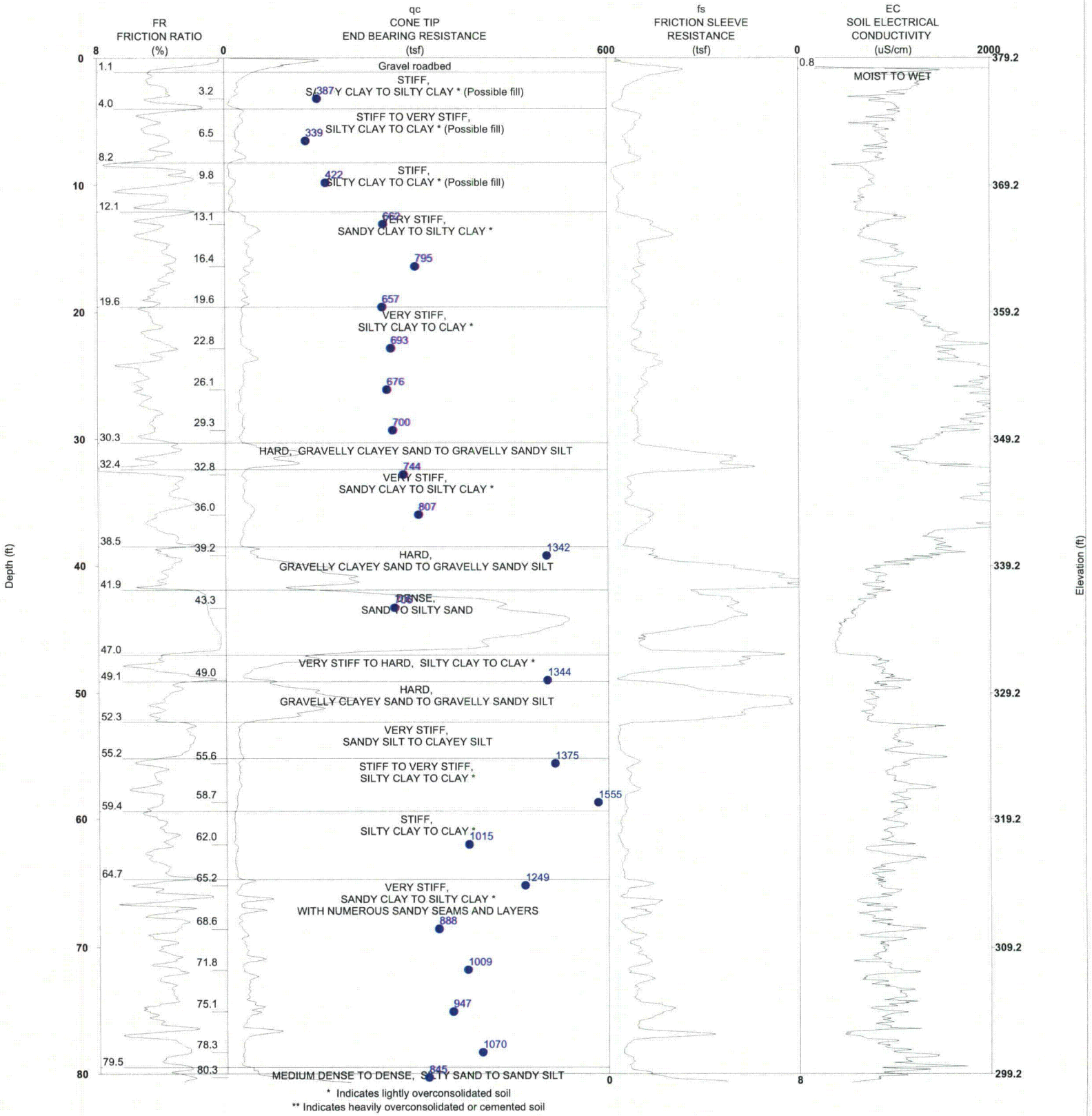
Latitude: 37.17092 Longitude: -88.76069 EL (ft): 372.1

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/23/2011 TIME:8:47 AM
SOUNDING NUMBER:CPT-004 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT005



* Indicates lightly overconsolidated soil

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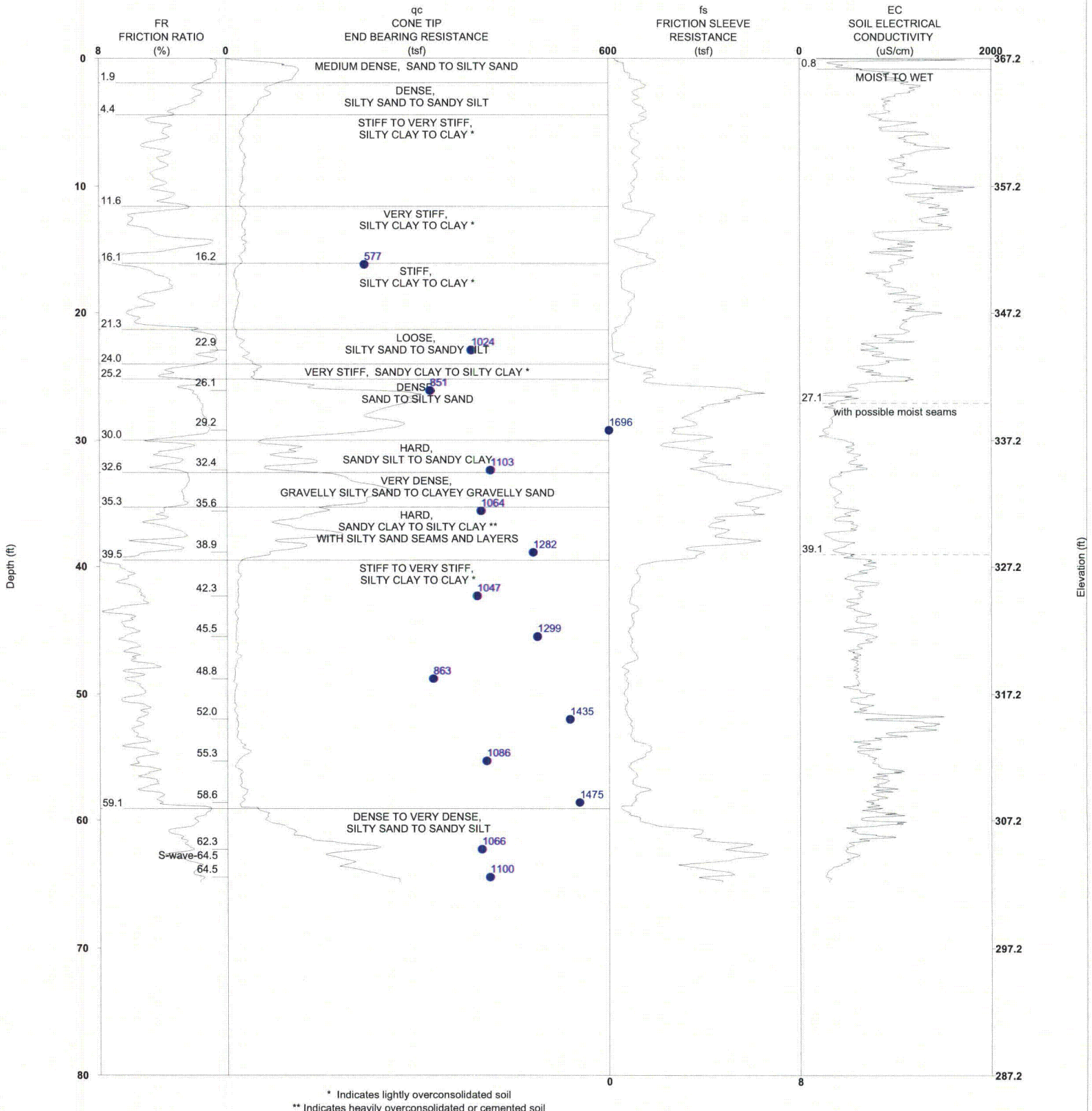
Latitude: 37.17036 Longitude: -88.76064 EL (ft): 379.2

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/23/2011 TIME:10:38 AM
SOUNDING NUMBER:CPT-004 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT006



* Indicates lightly overconsolidated soil
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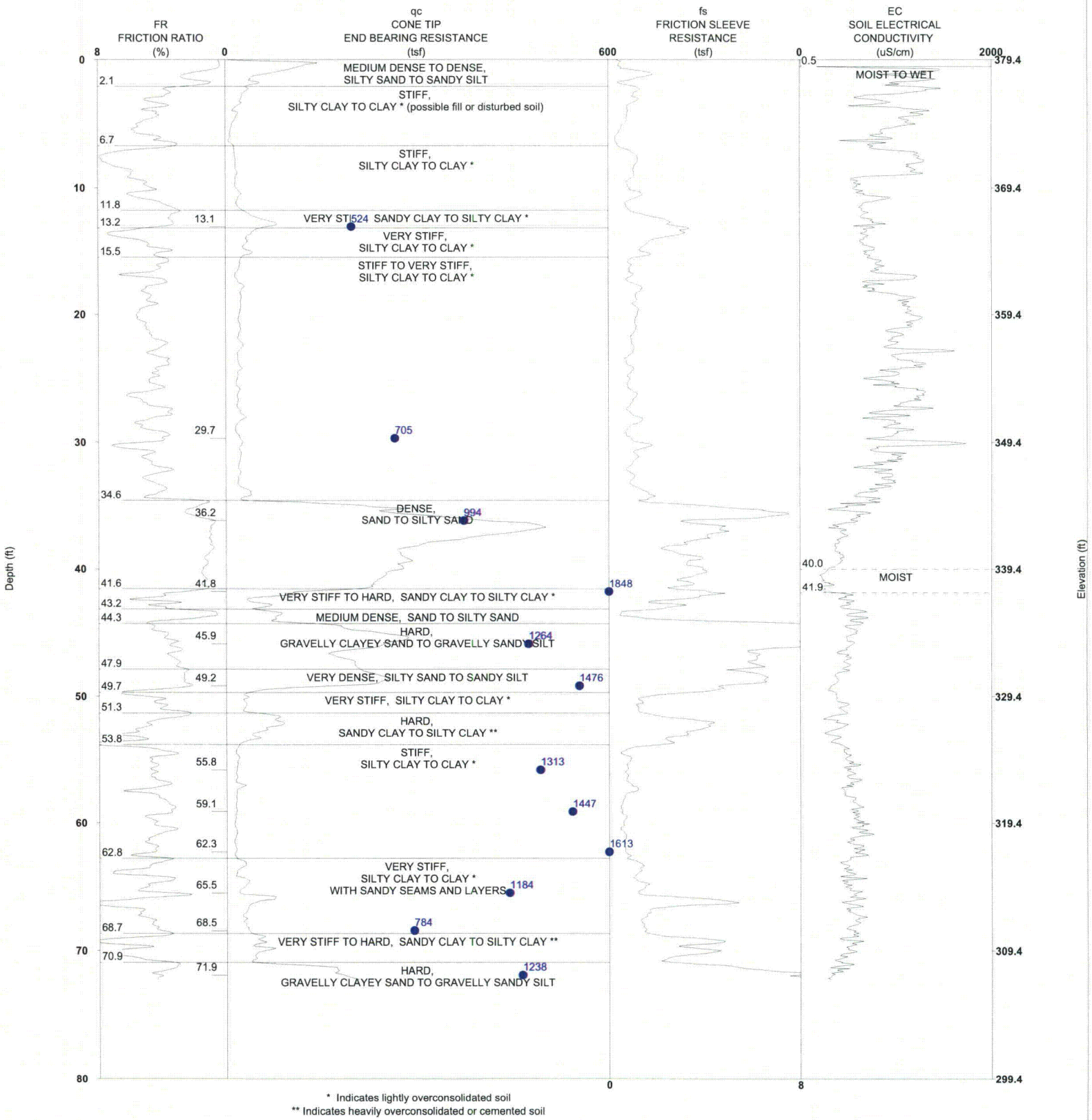
Latitude: 37.16961 Longitude: -88.76015 EL (ft): 367.2

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/21/2011 TIME:9:20 AM
SOUNDING NUMBER:CPT-006 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT007



* Indicates lightly overconsolidated soil

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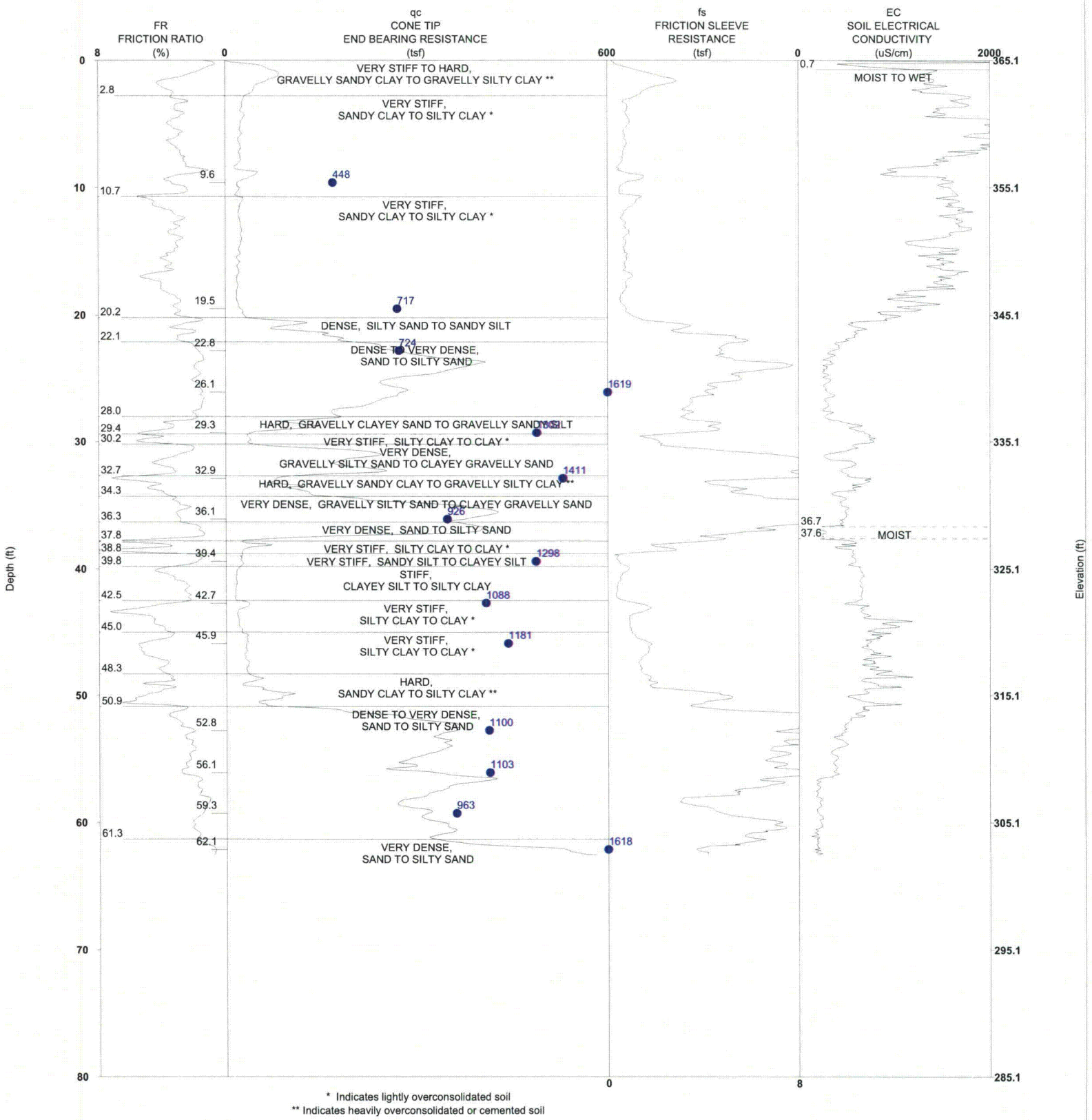
Latitude: 37.16957 Longitude: -88.75971 EL (ft): 379.4

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/23/2011 TIME:2:41 PM
SOUNDING NUMBER:CPT-017 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT008



* Indicates lightly overconsolidated soil
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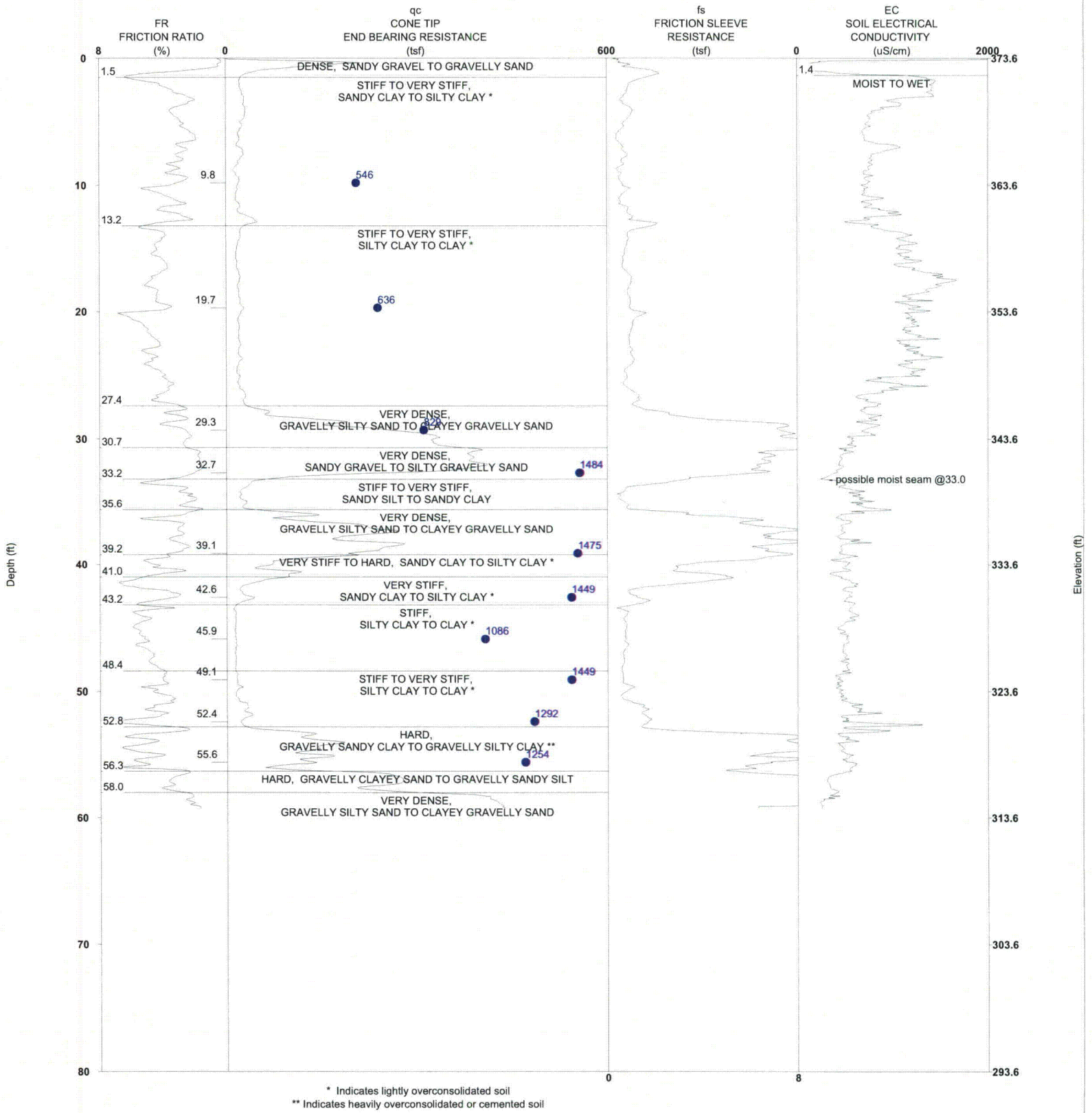
Latitude: 37.16905 Longitude: -88.75952 EL (ft): 365.1

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/21/2011 TIME:12:41 PM
SOUNDING NUMBER:CPT-008 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT009



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

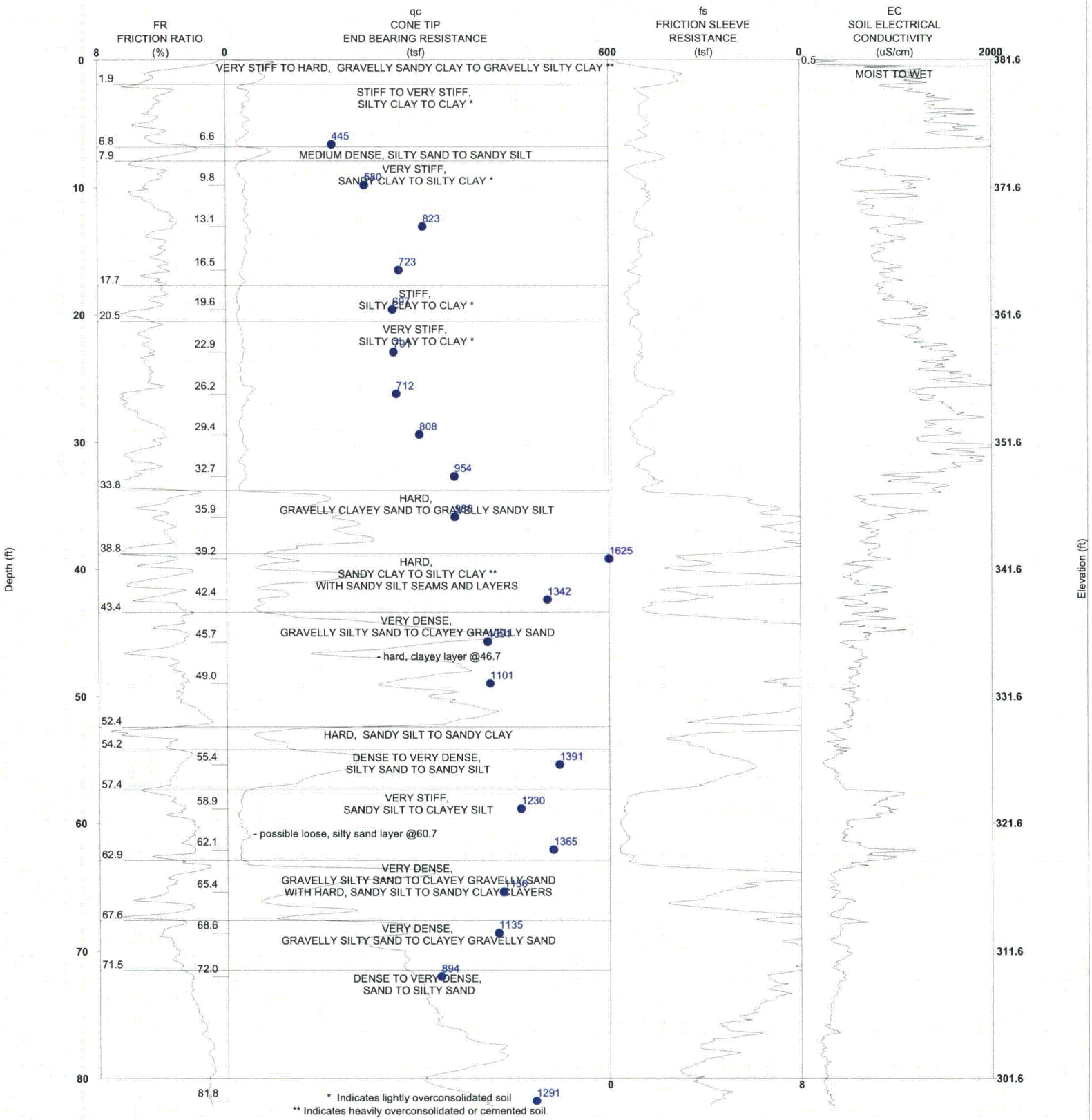
Latitude: 37.16954 Longitude: -88.75857 EL (ft): 373.6

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/21/2011 TIME:3:32 PM
SOUNDING NUMBER:CPT-009 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT010



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

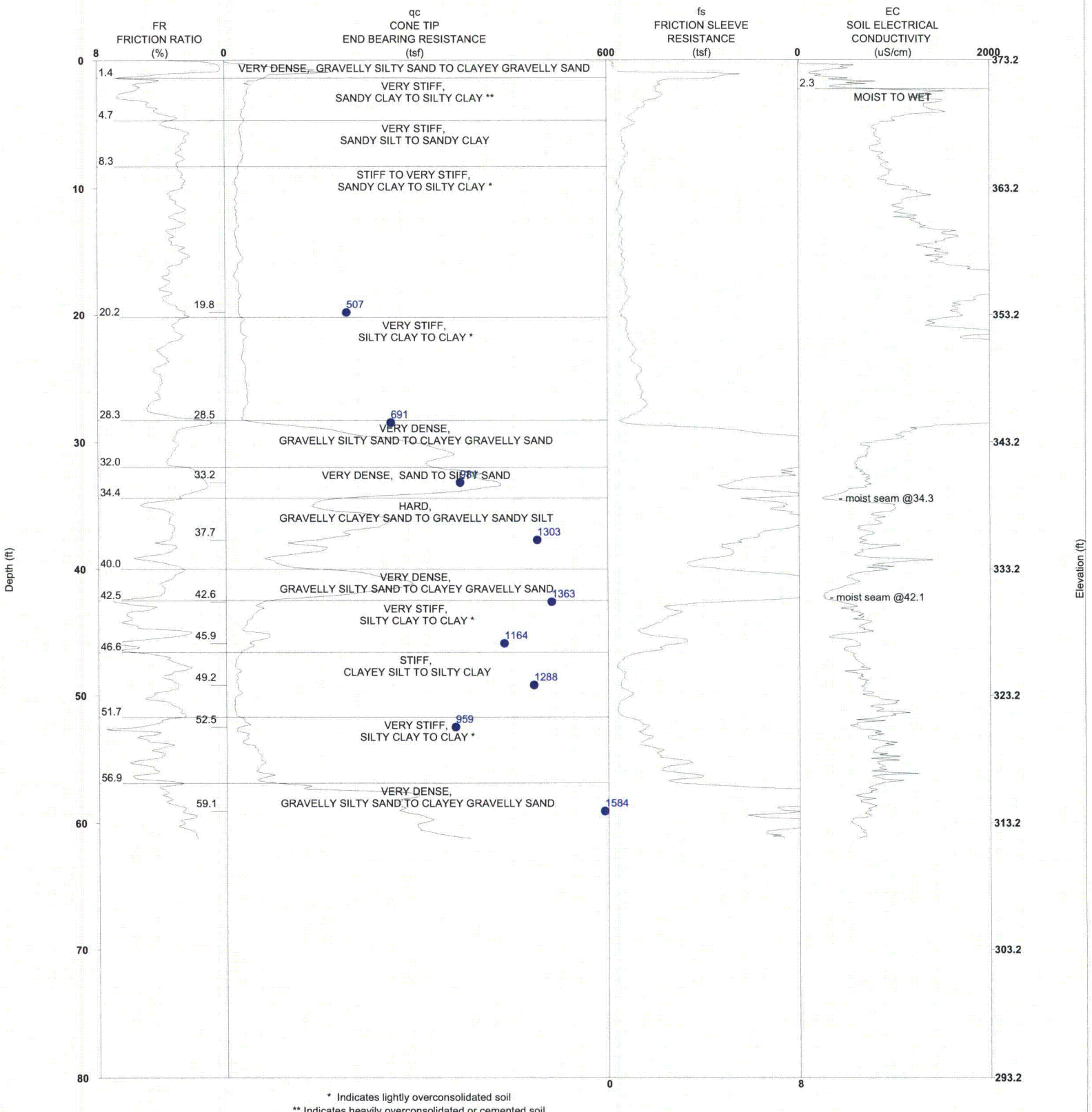
Latitude: 37.17037 Longitude: -88.75938 EL (ft): 381.6

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/25/2011 TIME:11:24 AM
SOUNDING NUMBER:CPT-010 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT011



* Indicates lightly overconsolidated soil
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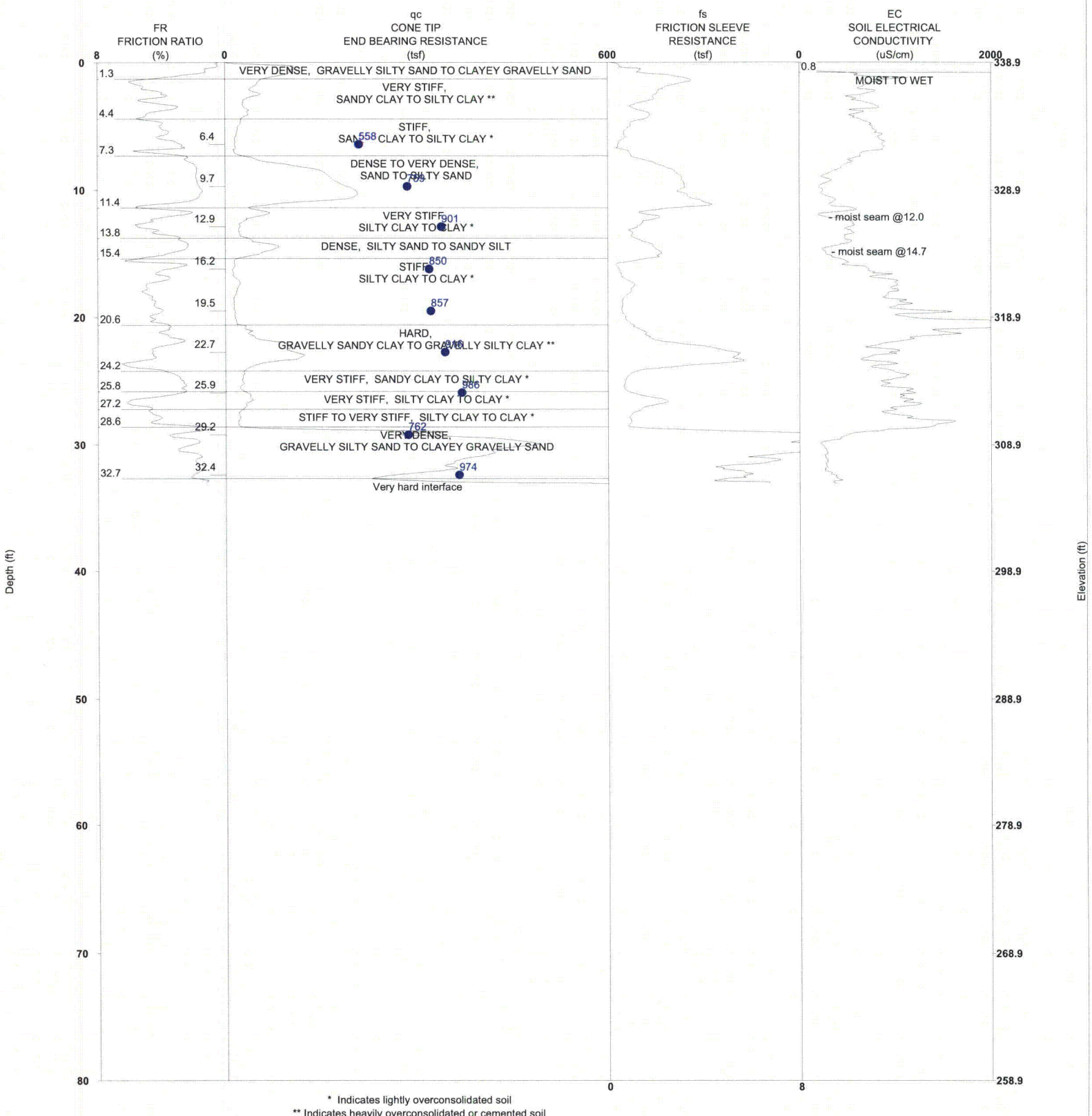
Latitude: 37.16947 Longitude: -88.75774 EL (ft): 373.2

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/25/2011 TIME:6:42 PM
SOUNDING NUMBER:CPT-011 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT012



* Indicates lightly overconsolidated soil
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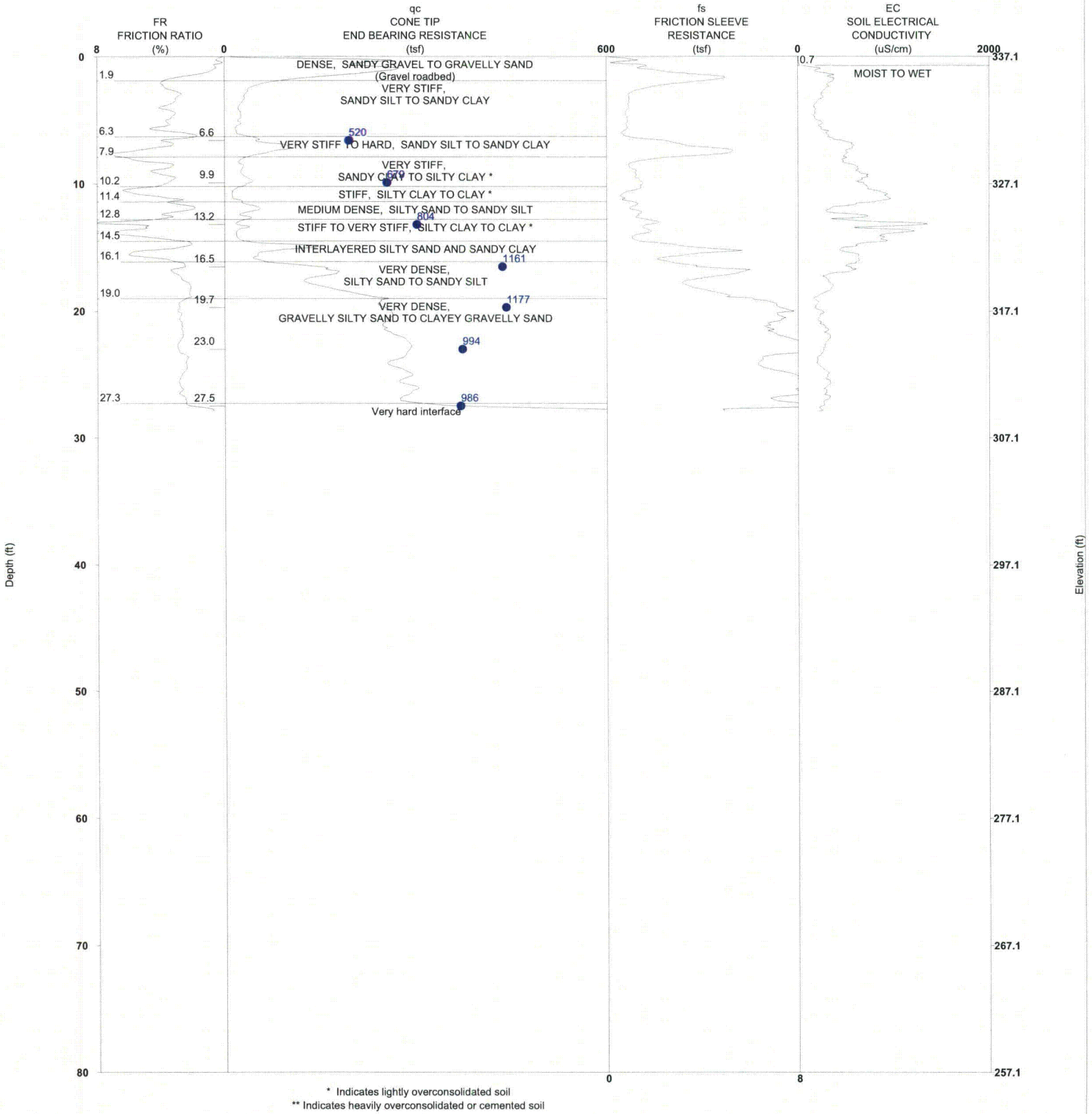
Latitude: 37.16772 Longitude: -88.76129 EL (ft): 338.9

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/23/2011 TIME:5:41 PM
SOUNDING NUMBER:CPT-012 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT013



* Indicates lightly overconsolidated soil

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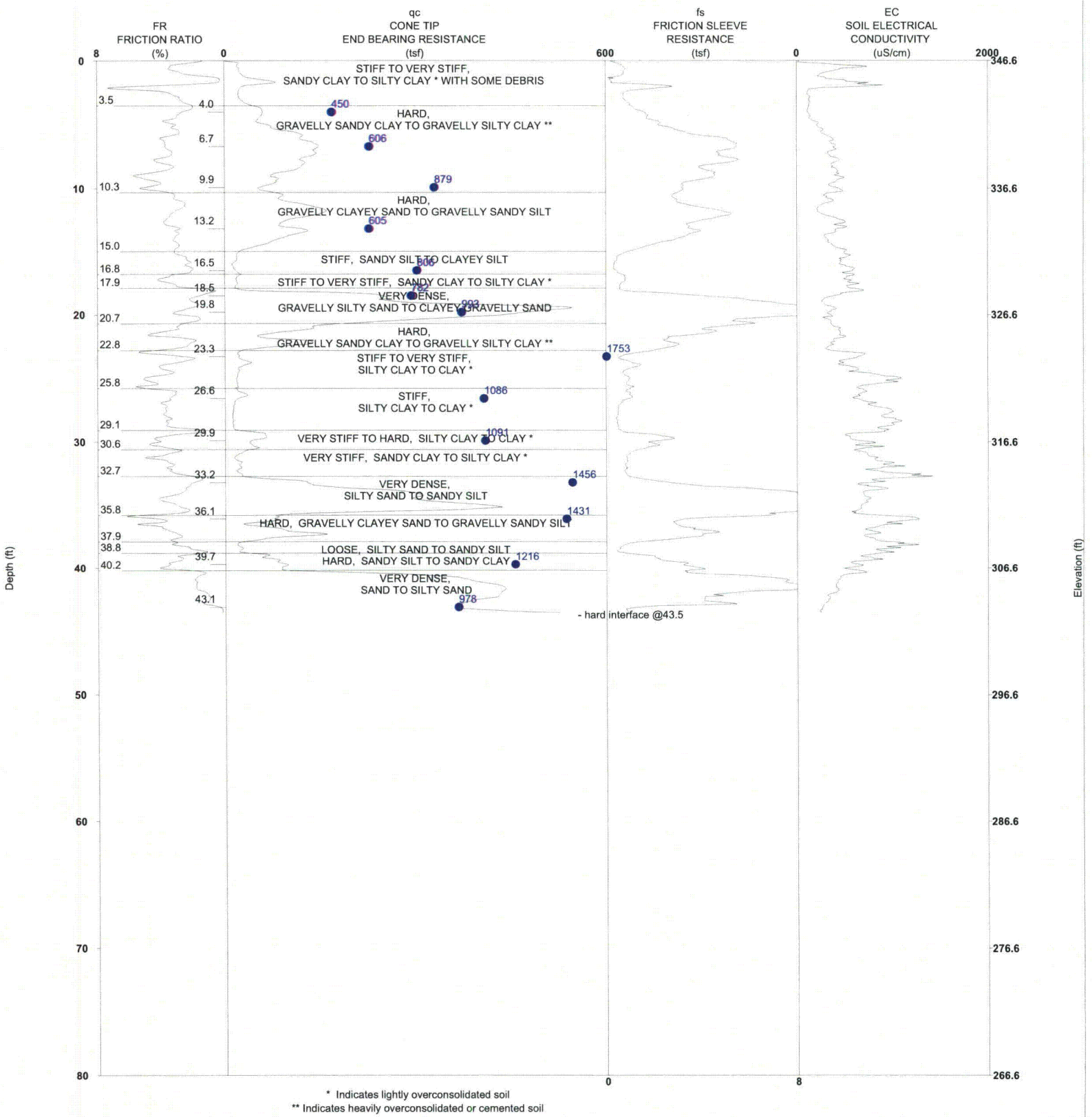
Latitude: 37.16863 Longitude: -88.76257 EL (ft): 337.1

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/23/2011 TIME:4:52 PM
SOUNDING NUMBER:CPT-013 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT014



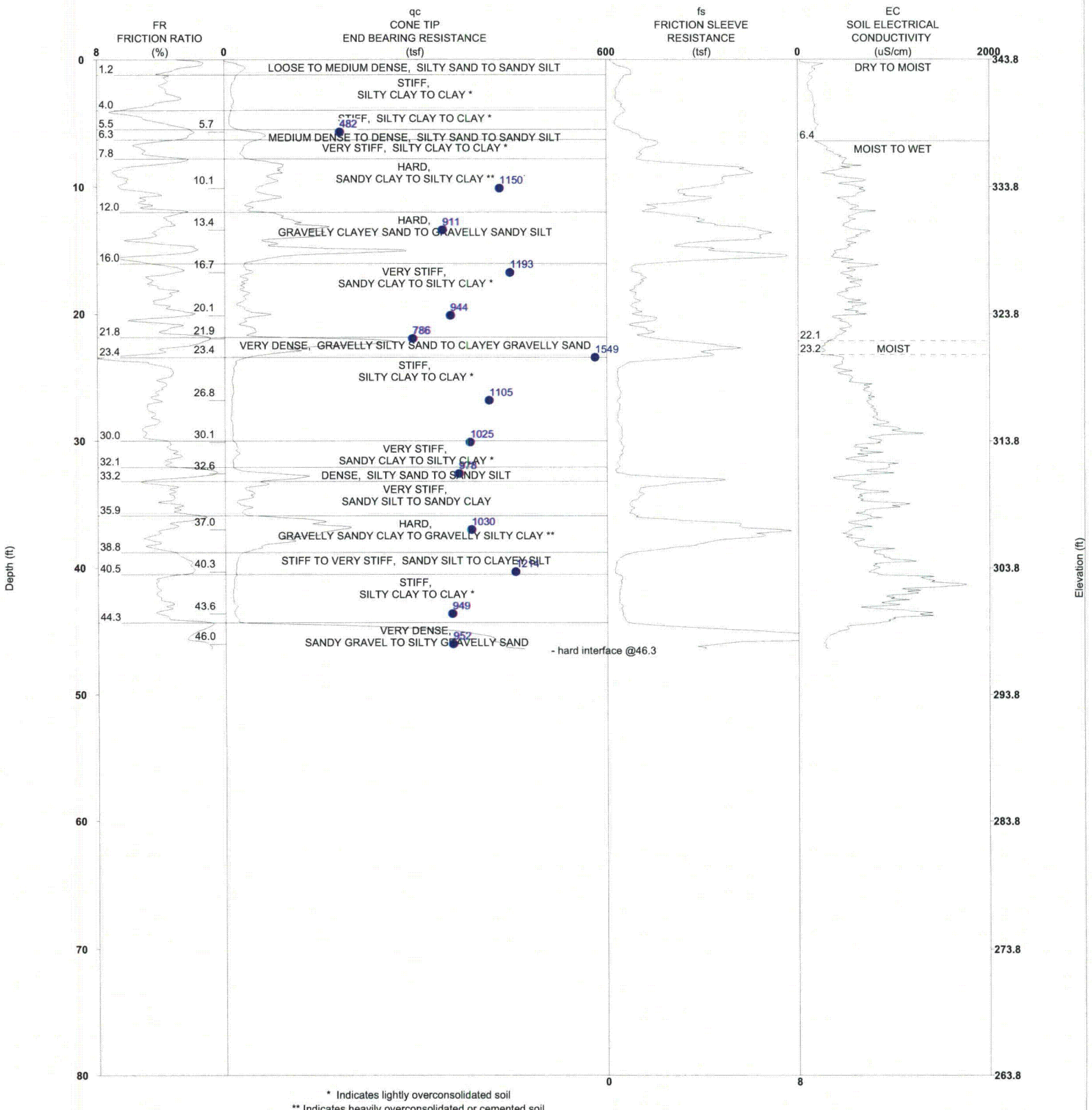
Latitude: 37.17159 Longitude: -88.76010 EL (ft): 346.6

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/22/2011 TIME:12:38 PM
SOUNDING NUMBER:CPT-014 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT015



* Indicates lightly overconsolidated soil

** Indicates heavily overconsolidated or cemented soil

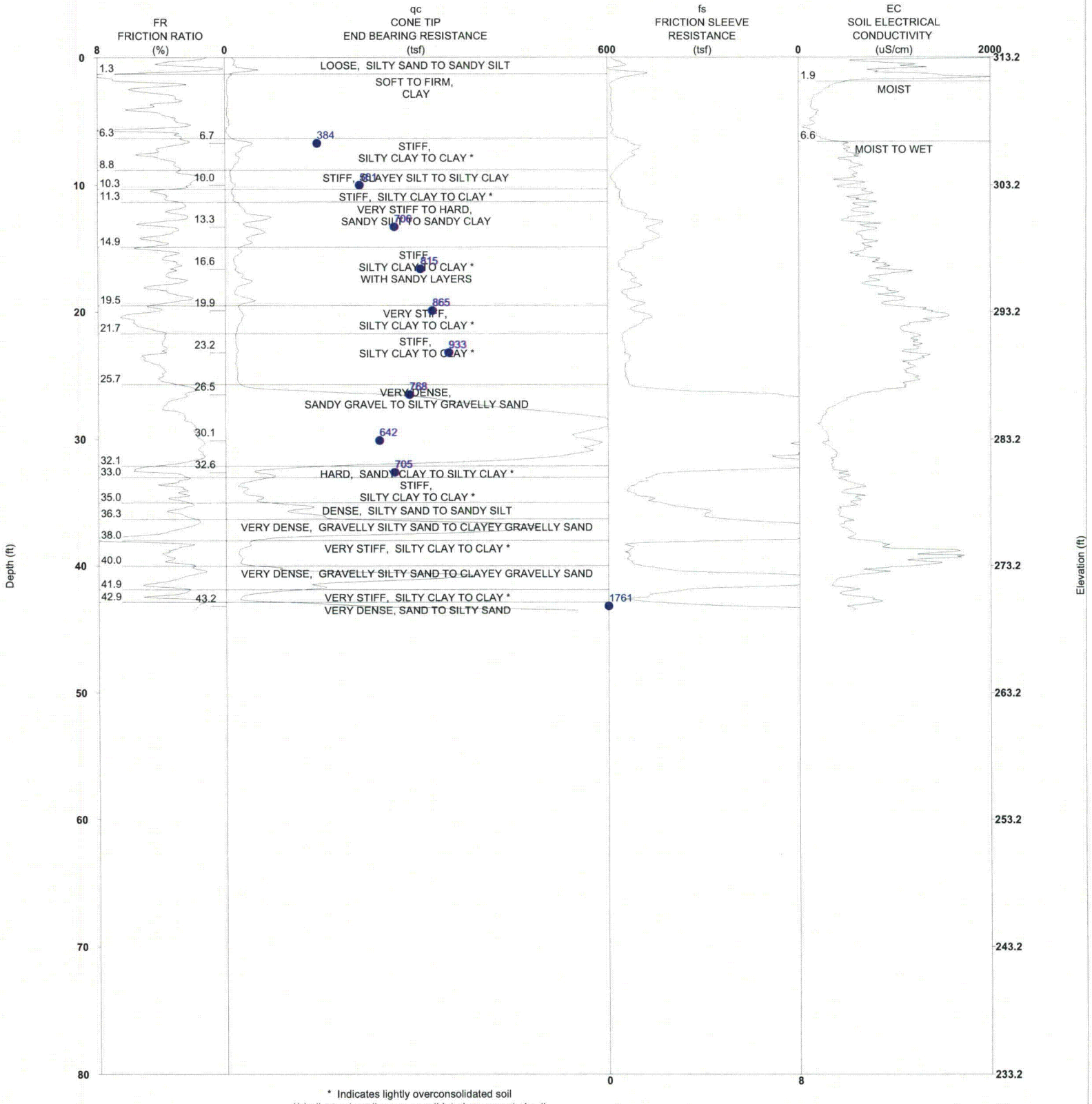
Latitude: 37.17120 Longitude: -88.76064 EL (ft): 343.8

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/22/2011 TIME:2:16 PM
SOUNDING NUMBER:CPT-015 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT016



* Indicates lightly overconsolidated soil
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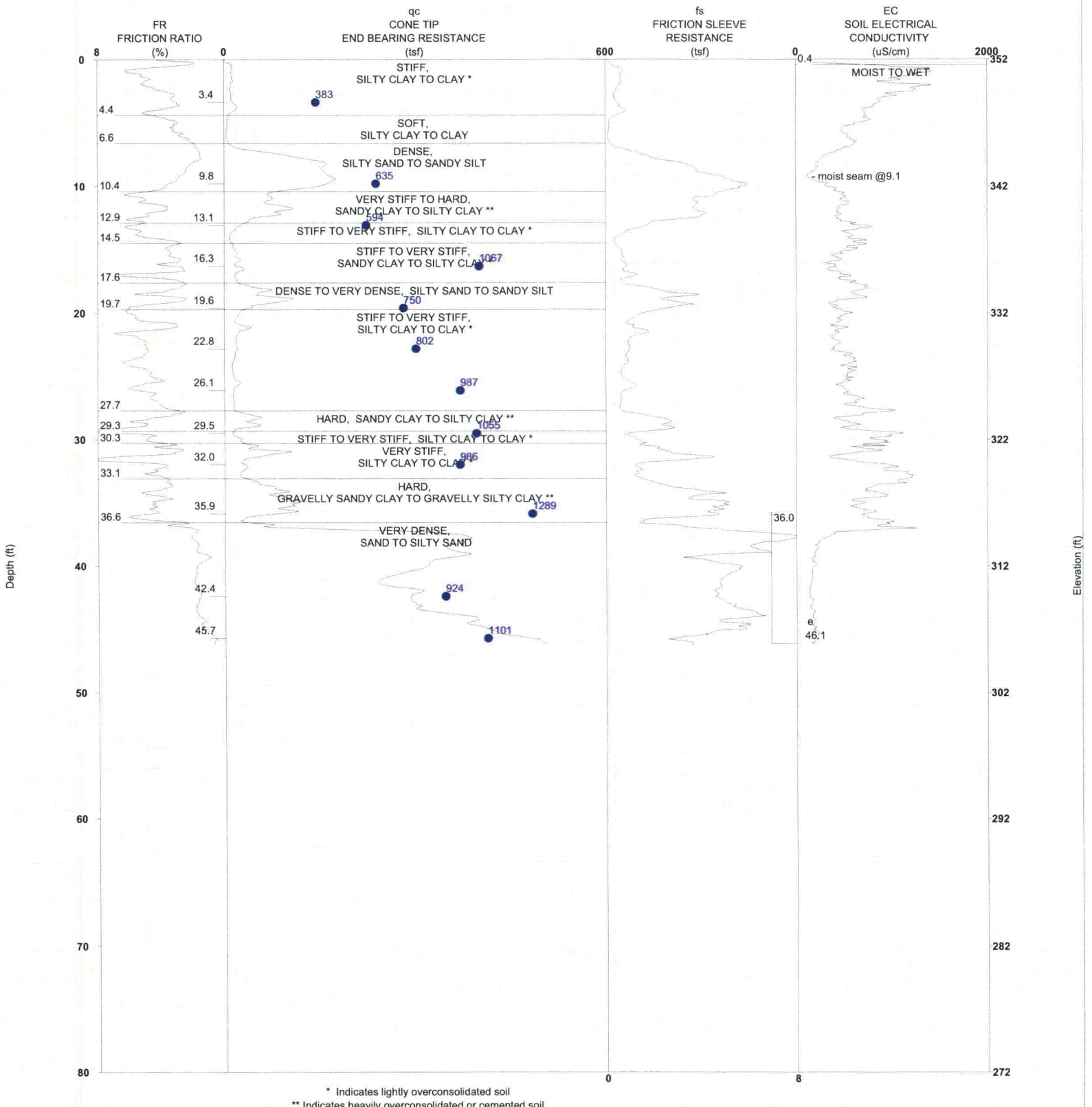
Latitude: 37.16997 Longitude: -88.76112 EL (ft): 313.2

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/23/2011 TIME:12:53 PM
SOUNDING NUMBER:CPT-016 (CPTU-EC-S)

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CPT017



* Indicates lightly overconsolidated soil
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Latitude: 37.16873 Longitude: -88.75928 EL (ft): 352.0

PROJECT NAME:Honeywell MTW
PROJECT NUMBER:11-110-060

STRATIGRAPHICS

R1 DATE:7/23/2011 TIME:2:41 PM
SOUNDING NUMBER:CPT-017 (CPTU-EC-S)