

Prepared for

Sonoma County Water Agency

404 Aviation Boulevard
Santa Rosa, California 95406

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Geotechnical Data Report

Wohler-Mirabel Liquefaction Mitigation /Ground Improvement Study and Russian River-Cotati Intertie Crossing at the Russian River

Prepared by:



MMI Engineering, Inc.

1111 Broadway, 6th Floor
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**MMW595 and MMW596
September 26, 2011**

**Geotechnical Data Report
Wohler-Mirabel Liquefaction Mitigation
/Ground Improvement Study and
Russian River-Cotati Intertie Crossing
at the Russian River**

**Sonoma County Water Agency
Santa Rosa, California**

This report was prepared under the
supervision and direction of the undersigned.

Prepared by:



MMI Engineering, Inc.

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Attachment C: Geotechnical Laboratory Data

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1. INTRODUCTION

This Geotechnical Data Report (GDR) summarizes geotechnical data collected by MMI Engineering (MMI) a wholly owned subsidiary of Geosyntec Consultants (Geosyntec) for the Wohler-Mirabel liquefaction/ground improvement study and the Russian River-Cotati Intertie crossing at the Russian River for the Sonoma County Water Agency (Agency).

The geotechnical investigations were performed at the two sites from June 20, 2011 through June 24, 2011. The investigations were performed to provide geotechnical data to assess mitigation measures for the liquefaction and lateral spread hazards at the Agency's Mirabel 3, Mirabel 5 and Wohler 6 collectors, the River Diversion System (RDS) caisson and the Russian River crossing of the Russian River-Cotati Intertie in close proximity to Mirabel 5. Figure 1 shows the areas where investigations were performed.

The lateral spread hazard at these facilities results from potential liquefaction of loose sand layers underlying site fills during the design earthquake, and the proximity of a free face of the riverbank. The subsurface generally consists of fill overlying loose fine sand and silt, which is underlain by poorly graded fluvial gravelly sand and sandy gravel, which is then underlain by bedrock. Seismic assessment of these facilities, identified during previous studies (MMI, 2008)¹, show that loading from fill soil sliding above the liquefied soil is substantially higher than the structural capacity of the collectors.

2. FIELD INVESTIGATIONS

The geotechnical field investigation included the following components:

¹ MMI Engineering (2008) Sonoma County Water Agency, Report – Phase II for Natural Hazard Reliability Assessment of the Water Supply and Transmission System, 3/17/2008.

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- 13 Cone Penetration Tests (CPTs) up to approximately 80 feet below ground surface (bgs). The CPTs were completed between June 20, 2011 and June 24, 2011. CPT-GSC-01 through CPT-GSC-10 and CPT-GSC-12 through CPT-GSC-14 were performed for geotechnical evaluation of site conditions, including sample collection with the CPT sampler at CPT-GSC-02, CPT-GSC-07 and CPT-GSC-09
- Nine shallow (up to 31 feet bgs) direct push borings (GSC-DP-01 through GSC-DP-09) for sample collection in tandem with CPT profiling, completed between June 21, 2011 and June 23, 2011
- Two 40 feet deep hollow stem auger (HSA) borings (GSC-WEL1 and GSC-WEL2) for sample collection and well installation on either side of the Russian River Crossing. The borings were completed on June 22, 2011 and June 24, 2011.

2.1 Pre-Field Activities

The following activities were performed before mobilizing to the site:

- Site walk with the Agency to evaluate access and underground utility issues;
- Obtaining underground utility clearance from Underground Service Alert (USA);
- Obtaining Sonoma County drilling permits;
- Contracting drillers; and
- Preparing a Health and Safety Plan (HASP) for the work.

Underground Services Alert (USA) was contacted to inform the public utilities in the area of the planned drilling activities. USA issued tickets numbers 0191821 and 0191851 for all drilling locations.

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The County of Sonoma Permit and Resource Management Department permits (WEL11-0143, -0144, -0145, -0146, and -0147) were issued and obtained prior to starting drilling operations.

Gregg Drilling, Inc. (California C-57 License 485165) of Martinez, California was contracted for all CPT and drilling activities.

A Health and Safety Plan (HASP) was prepared and reviewed with the drilling contractors before starting the fieldwork. The drilling contractors and MMI performed the work following US Environmental Protection Agency (EPA), Occupational Safety & Health Administration (OSHA)-modified Level D protection (i.e., steel-toed boots, hardhat, eye protection, and hearing protection).

2.2 Cone Penetration Tests

Through discussions with the Agency, 13 locations (CPT-GSC-01 through CPT-GSC-10 and CPT-GSC-12 through CPT-GSC-14) were selected to perform CPTs, with three CPTs each at collectors 3, 5 and 6, three CPTs at the RDS, and one additional CPT on the opposite side of the Russian River from collector 5 adjacent to the Russian River crossing alignment. The CPTs records tip resistance and side friction during steady penetration of the soils with a standardized cone. The CPTs ranged in depth from 60 to 80 feet bgs. A 20-ton CPT truck was used for all locations with the exception of CPT-GSC-13 and CPT-GSC-14 where Gregg used a small anchored drill-rig unit because of access issues.

Shear wave velocity, V_s , testing was performed at 20-foot intervals for the majority of the CPTs. However, several locations did not yield sufficient quality measurements for the evaluation of V_s . A pore pressure dissipation test was performed at CPT-GSC-07 to evaluate the static water levels at the time of testing.

At three CPT locations (CPT-GSC-02, CPT-GSC-07, and CPT-GSC-09) soil sampling was performed using the CPT sampler. Sample location depths were based on the

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results from the CPT that was first pushed at that sample location. At each sample depth, two 6-inch long by 1-inch diameter samples were collected for laboratory testing.

After completion of testing, all CPT soundings were grouted per the permit requirements. After grouting, CPT locations were staked for subsequent survey by SCWA. The northings, eastings, and elevations of each CPT sounding are shown in Table 1 with their locations shown on Figure 2 and Figure 3. The Gregg Drilling report of all CPT results is included in Attachment A.

2.3 Direct Push Borings

Through discussions with the Agency, 9 shallow direct push boring locations (GSC-DP-01 through GSC-DP-09) were selected to obtain continuous soil samples. Direct push samples ranged from 7- to 31- feet bgs. Gregg Drilling performed the work using a truck-mounted direct push Geoprobe rig to push 2-inch diameter samplers in 4-foot intervals. Soil samples were contained in clear acetate tubes provided by Gregg Drilling. Visual descriptions were made in the field and the samples were saved for geotechnical laboratory testing.

While the original intent was to advance the direct-push borings deeper than 7 to 31 feet bgs, two conditions generally prevented this from occurring:

- Obstructions in the fill around the collectors resulted in refusal of the direct-push sampler; or
- Refusal occurred due to caving holes, in particular when reaching groundwater, which is indicative of the loose, cohesionless nature of the soils.

After completion of sampling, all direct push borings were grouted per the permit requirements. After grouting, locations were staked for subsequent survey by SCWA. The northings, eastings, and elevations of each boring are shown in Table 1 with their locations shown in Figures 2 and 3. Boring Logs are included in Attachment B.

2.4 Hollow Stem Auger (HSA) Borings and Well Installations

Through discussions with the Agency, two locations on opposite sides of the Russian River crossing were identified to perform 40-foot deep HSA borings, followed by installation of two open standpipe piezometers (GSC-WEL1 and GSC-WEL2). Samples were collected at approximately 3-foot intervals for visual classification and subsequent geotechnical laboratory testing.

Upon completion of sampling activities, each borehole was completed as a piezometer using the following steps:

- Install 40-feet of 2-inch PVC casing, screened in the bottom 10-feet;
- Backfill boring with Monterey #3 sand to approximately 2-feet above the well screen;
- Create a 3-foot seal above the sand using hydrated bentonite chips;
- Grout the remaining distance to the ground surface; and
- Install a flush mount well cover.

The northings, eastings, and elevations of each well are shown in Table 1 with their locations shown in Figure 2. Boring Logs are included in Attachment B.

2.5 Laboratory Testing

Based on review of boring logs, CPT logs, and sample locations and quality, soil samples from a range of borings and a range of depths were selected to be sent to Cooper Testing Laboratories in Palo Alto, California.

Borings tested included: CPT-GSC-02, CPT-GSC-07, CPT-GSC-09, GSC-DP-01, GSC-DP-03, GSC-DP-06, GSC-DP-07, GSC-DP-09, GSC-WEL1 and GSC-WEL2.

Geotechnical laboratory testing included:

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- Organics Content (ASTM D2974);
- pH (ASTM G51);
- Moisture-Density-Porosity (ASTM D2937);
- Particle Size Analysis (ASTM D422); and
- Atterberg Limits (ASTM D4318).

Organics Content and pH testing was performed to assist in future evaluation of the suitability of Deep Mixing Methods (DMM) for soil stabilization. The remaining tests were performed to assist with material classification, and to develop parameters for liquefaction and slope stability analyses. Laboratory test results are summarized in Table 2 and laboratory reports are included in Attachment C.

3. CLOSURE

This GDR provides a compilation of geotechnical field investigation data collected during June 20, 2011 through June 24, 2011. The investigations were performed to provide geotechnical data to assess mitigation measures for the liquefaction and lateral spread hazards at the Agency's Mirabel 3, Mirabel 5 and Wohler 6 collectors, the River Diversion System (RDS) caisson and the Russian River crossing of the Russian River-Cotati Intertie in close proximity to Mirabel 5. Interpretation of this data and discussion of mitigation measures is included in separate reports.

Table 1
 Survey Data of June 2011 Geotechnical Investigation
 Wohler-Mirabel Collection System Facilities
 Sonoma County, CA

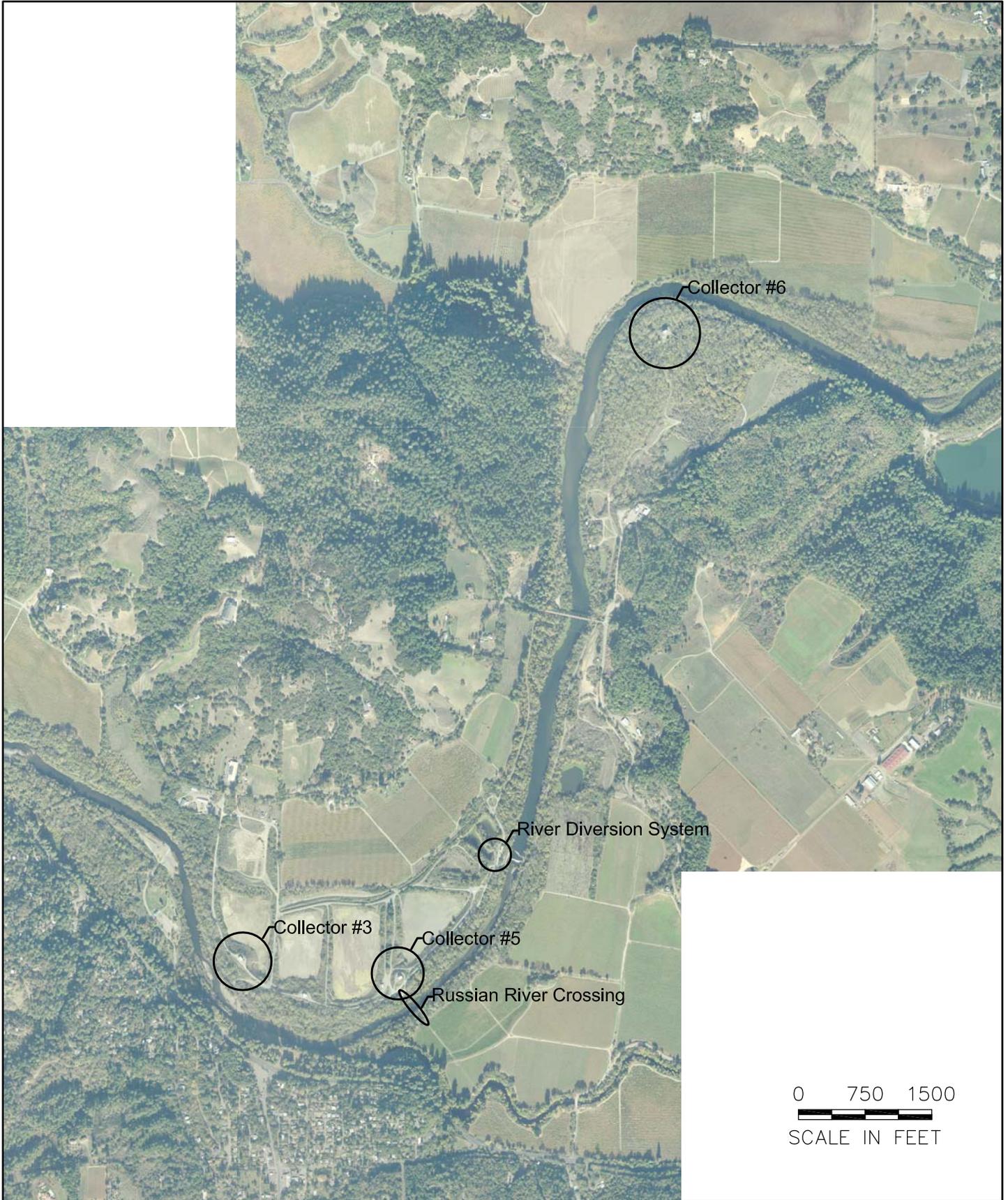
Boring ID	Northing	Easting	Elevation
CPT-GSC-01	1943731	6304956	42.9
CPT-GSC-02	1944154	6305169	34.8
CPT-GSC-03	1944053	6305061	81.2
CPT-GSC-04	1943904	6306759	57.3
CPT-GSC-05	1943775	6306848	77.1
CPT-GSC-06	1943629	6306863	56.9
CPT-GSC-07	1945053	6307810	59.9
CPT-GSC-08	1945183	6307970	66.1
CPT-GSC-09	1951107	6309828	82.2
CPT-GSC-10	1950994	6309883	65.4
CPT-GSC-12	1945179	6308050	40.6
CPT-GSC-13	1951357	6309771	47.9
CPT-GSC-14	1943298	6307120	54.7
DP-1	1943733	6304963	42.7
DP-2	1944053	6305061	81.2
DP-3	1943900	6306758	57.1
DP-4	1943771	6306848	77.4
DP-5	1945183	6307970	66.1
DP-6	1945192	6308050	40.1
DP-7	1950994	6309883	65.4
DP-8*	1943937	6305325	35.0
DP-9	1951107	6309828	82.2
GSC-WEL1	1943287	6307123	53.8
GSC-WEL2	1943620	6306867	56.6
CPT-GSC-14	1943298	6307120	54.7

* Not surveyed; location estimated from review of available topographic information.

Table 2
Summary of Geotechnical Test Results
June 2011 Geotechnical Investigation
Wohler-Mirabel Collection System Facilities
Sonoma County, CA

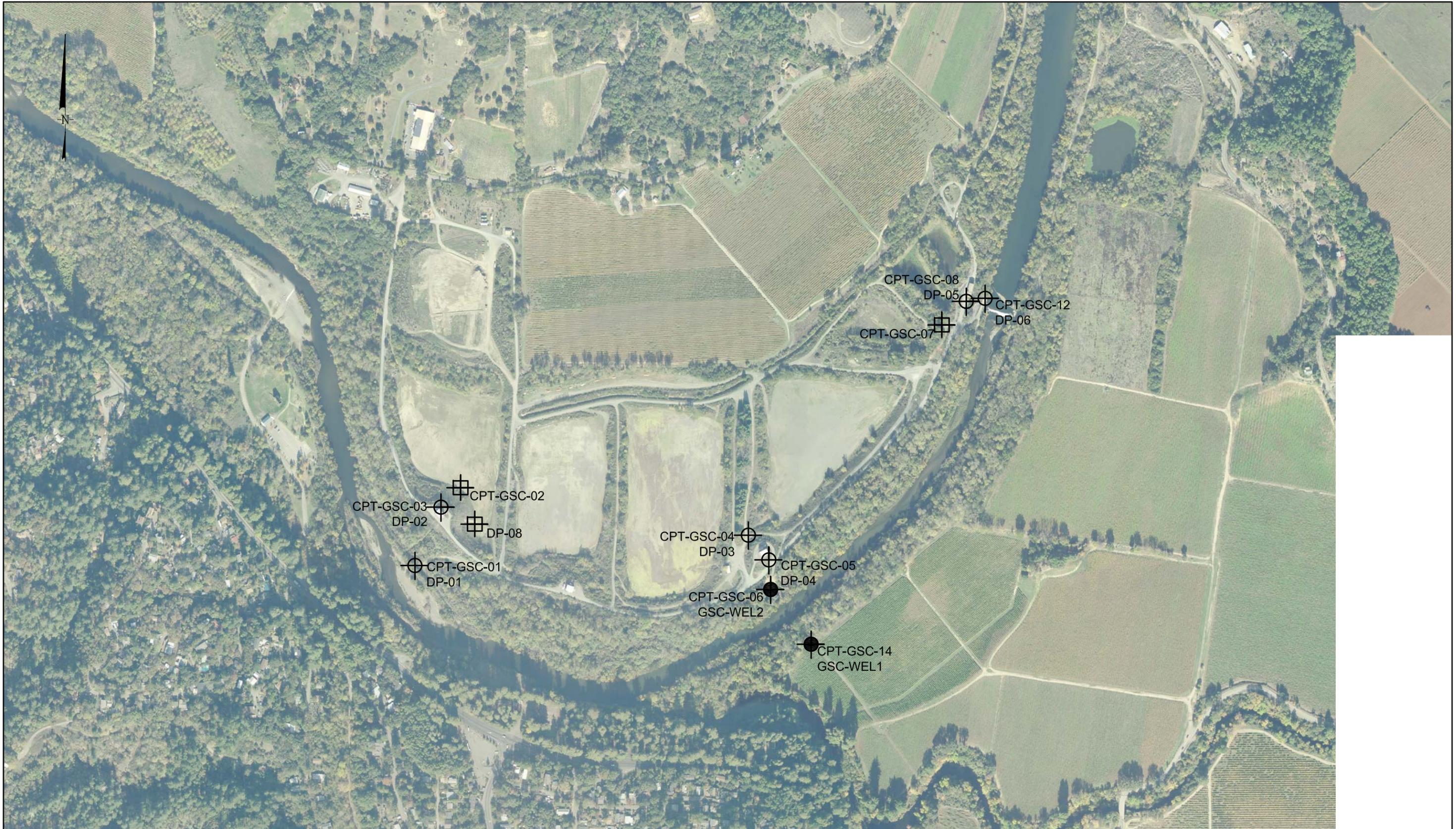
Sample ID	Depth (ft BGS)	USCS Classification	Description	Sieve Analysis (ASTM 422)			Atterberg Limits (ASTM 4318)			Moisture-Density Porosity Tests			pH	Organics Content (%)
				Gravel (%)	Sand (%)	Silt & Clay (#200) (%)	Liquid Limit LL	Plastic Limit PL	Plasticity Index PI	Dry Density (pcf)	Moisture Content (%)	Moist Unit Weight (pcf)		
Russian River Samples														
WEL1B	6-7.5	ML	Brown SILT	0	3.8	96.2	31.1	24.5	6.6	93.5	24.4	116.3	6.6	2.6
WEL1D	12-13.5	SP	Brown poorly graded SAND	0.1	97.1	2.8	25.6	18.9	6.7	84.6	5.7	89.4	7.7	0.8
WEL1F	18-19.5	SM	Brown SAND with gravel							110.4	2.6	113.3	7.1	0.7
WEL1H	24-24.5	GP-GC	Brown poorly graded GRAVEL with silty clay and sand	52.8	38.5	8.7		NP	NP	112.3	5	117.9	7.1	0.9
WEL1J	30-30.5	GW-GM	Brown well-graded GRAVEL with silt and sand	48.4	45.3	6.3		NP	NP	122.3	6.8	130.6		
WEL1K	39-40.5	SP-SM	Grayish brown poorly-graded SAND with silt and gravel	36.5	57.6	5.9							7.4	0.8
WEL2A	3-4.5	SC	Brown clayey SAND	7.2	45.3	47.5				118.9	8.9	129.5	7.5	1.6
WEL2C	9-10.5	ML	Brown sandy SILT	0	33.6	66.4		NP	NP	99.1	17.3	116.2	7.3	1.8
WEL2E	15-16.5	SM	Brown silty SAND	0	66.7	33.3		NP	NP	92.4	21.1	111.9	7.1	1.7
WEL2G	21-22.5	SP	Brown poorly-graded SAND	10	88.8	1.2				104.7	3.8	108.7	6.9	0.7
WEL2I	27-28.5	SM	Brown silty SAND with gravel	22.8	56	21.2				103.6	5.9	109.7	6.9	1.6
WEL2K	33-34.5	SW	Grayish brown well-graded SAND with gravel	45.5	50.2	4.3		NP	NP	134.6	8.2	145.6	7.3	0.9
WEL2M	39-40.5	SP	Brown poorly graded SAND	13.9	83.8	2.3				107.5	8.8	117.0	7.3	1.1
Collector #3 Samples														
DP1C	8-12	SM	Brown silty SAND	3.5	74.1	22.4		NP	NP				7.4	2.3
DP1D	12-16	SM	Brown silty SAND										7.2	0.7
DP1F	20-24	SP-SM	Brown poorly-graded SAND with silt and gravel	33.7	59.3	7							7.4	0.6
GSC-02	18-19	SW-SM	Brown well-graded SAND with silt and gravel	30.1	60.4	9.5					4.9		7.6	0.7
GSC-02	22.5-23	SM	Grayish brown silty SAND	11	70.4	18.6				128.4	10.7	142.1		
GSC-02	30-31	SP-SM	Brown poorly-graded SAND with silt and gravel	33.4	61.6	5		NP	NP	125.5	11.9	140.4	7.6	0.8
GSC-02	48.5-49	SW	Brown silty SAND	0	85.5	14.5				111.2	18.3	131.5	7.6	2.3
GSC-02	54.5-55	SW-SM	Grayish brown well-graded SAND with silt and gravel	21.9	70.4	7.7				126.3	10.6	139.7		
Collector #5 Samples														
DP3A	5-8	SM	Brown sandy SILT	0	42.6	57.4							7.3	1.8
DP3B	8-12	SM	Dark brown silty SAND	0	77.6	22.4		NP	NP				7.4	1.6
DP3C	12-16	SP-SM	Grayish brown poorly-graded SAND with silt	3	86	11							7.4	0.7
DP3D	16-20	SM	Grayish brown silty SAND	11.9	74	14.1							7.6	0.7
DP3E	20-24	SP-SM	Grayish brown poorly-graded SAND with silt	5.7	82.3	12							7.4	0.6
DP3F	24-28	SP-SM	Grayish brown poorly-graded SAND with silt and gravel	21.5	71.5	7							7.6	0.6
DP3G	28-31	SP-SM	Grayish brown poorly-graded SAND with silt and gravel	35.5	55.8	8.7							7.4	0.6
River Diversion System														
GSC-07	9-10	ML	Brown SILT with sand	0	22.3	77.7		NP	NP	87.3	28.2	111.9	7.2	1.6
GSC-07	14-15	ML	Brown sandy SILT	0	38.2	61.8		NP	NP	82.3	19.4	98.3	7.5	1.8
GSC-07	19-20	SM	Grayish brown silty SAND with gravel							120.6	3.7	125.1		
GSC-07	33-34	SW-SM	Grayish brown well-graded SAND with silt and gravel	28.6	65	6.4				124.6	8.9	135.7	7.8	0.7
GSC-07	37-38	SC	Grayish brown clayey SAND							103.6	13.9	118.0		
GSC-07	46-47	SW-SM	Grayish brown well-graded SAND with silt and gravel	27.4	62.9	9.7				124.9	10.3	137.8	7.7	0.7
GSC-07	50-51	SM	Grayish brown silty SAND with gravel	25.8	54.6	19.6				125.2	7.7	134.8		
DP6B	8-12	SM	Gray silty SAND	8.6	61.1	30.3	21.7	20.2	1.5				7.0	1.4
DP6D	16-20	SM	Gray silty SAND	12.3	44.6	43.1							7.1	1.4
DP6E	20-22	SP-SM	Grayish brown well-graded SAND with silt and gravel	29.9	62.1	8							7.0	0.6
Collector #6 Samples														
DP7A	5-8	ML	Brown sandy SILT		32.1	67.9		NP	NP				6.9	1.9
DP7D	16-20	SM	Brown silty SAND	3.3	84.6	12.1							7.4	0.7
DP7E	20-24	SP-SM	Brown poorly-graded SAND with silt and gravel	38.8	55.7	5.5							7.6	0.6
DP9A	5-8	CL	Brown CLAY with sand	3.8	22.7	73.5								
DP9B	8-12	CL	Dark grayish brown lean CLAY with sand	3.1	22.5	74.4	34.2	21.4	12.8				6.8	2.7
GSC-09	49-50	SM	Brown silty SAND	6	56.7	37.3				105.6	15.4	121.9	7.1	0.9
GSC-09	55-56	SW-SM	Grayish brown well-graded SAND with silt and gravel	36.5	57.3	6.2				112.6	6.5	119.9	7.3	0.8
GSC-09	65-66	SW-SM	Grayish brown well-graded SAND with silt and gravel	26.2	65.4	8.4				127	9.4	138.9	7.6	0.7

NOTE: Samples with ID GSC-02, GSC-07 and GSC-09 were collected using the CPT sampling tool adjacent to CPT-GSC-02, CPT-GSC-07 and CPT-GSC-09.



SITE LOCATION MAP
WOHLER-MIRABEL COLLECTION SYSTEM
FORESTVILLE, CALIFORNIA

FIGURE NO.	1
PROJECT NO.	MMW597
DATE:	SEPTEMBER 2011



LEGEND

 CPT/DP PAIR
 CPT-GSC-03
 DP-02
 DIRECT PUSH OR CPT ONLY
 DP-08

 CPT/WELL PAIR
 CPT-GSC-03
 GSC-WEL1

0 250 500

 SCALE IN FEET

SITE PLAN WITH BORING LOCATIONS
 COLLECTORS #3, 5, RUSSIAN RIVER CROSSING, AND RDS - WOHLER-MIRABEL DIVERSION SYSTEM
 FORESTVILLE, CALIFORNIA



FIGURE NO.	2
PROJECT NO.	MMW597
DATE:	SEPTEMBER 2011



LEGEND

-  CPT/DP PAIR
-  CPT-GSC-03
DP-02
-  DIRECT PUSH OR CPT ONLY
-  DP-08

0 250

 SCALE IN FEET

SITE PLAN WITH BORING LOCATIONS
 COLLECTOR #6 - WOHLER-MIRABEL DIVERSION SYSTEM
 FORESTVILLE, CALIFORNIA



Geosyntec
 consultants

FIGURE NO.	3
PROJECT NO.	MMW597
DATE:	SEPTEMBER 2011

ATTACHMENT A

CONE PENETRATION TESTING DATA



GREGG DRILLING & TESTING, INC.
 GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATION SERVICES

June 27, 2011

J. Bernardini
 Attn: Geosyntec

Subject: CPT Site Investigation
 Sonoma - Russian River
 Healdsburg, California
 GREGG Project Number: 11-087MA

Dear Mr. Bernardini:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	<input checked="" type="checkbox"/>
2	Pore Pressure Dissipation Tests	(PPD)	<input checked="" type="checkbox"/>
3	Seismic Cone Penetration Tests	(SCPTU)	<input checked="" type="checkbox"/>
4	UVOST Laser Induced Fluorescence	(UVOST)	<input type="checkbox"/>
5	Groundwater Sampling	(GWS)	<input type="checkbox"/>
6	Soil Sampling	(SS)	<input checked="" type="checkbox"/>
7	Vapor Sampling	(VS)	<input type="checkbox"/>
8	Pressuremeter Testing	(PMT)	<input type="checkbox"/>
9	Vane Shear Testing	(VST)	<input type="checkbox"/>
10	Dilatometer Testing	(DMT)	<input type="checkbox"/>

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (925) 313-5800.

Sincerely,
 GREGG Drilling & Testing, Inc.

Mary Walden
 Operations Manager



GREGG DRILLING & TESTING, INC.
 GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATION SERVICES

Cone Penetration Test Sounding Summary

-Table 1-

CPT Sounding Identification	Date	Termination Depth (Feet)	Depth of Groundwater Samples (Feet)	Depth of Soil Samples (Feet)	Depth of Pore Pressure Dissipation Tests (Feet)
CPT-GSC01	6/20/11	80	-	-	-
CPT-GSC02	6/23/11	74	-	18, 22, 30, 48, 54	-
CPT-GSC03	6/23/11	80	-	-	-
CPT-GSC04	6/20/11	78	-	-	-
CPT-GSC05	6/21/11	78	-	-	-
CPT-GSC06	6/21/11	78	-	-	-
CPT-GSC07	6/21/11	69	-	9, 14, 19, 33, 37, 46, 50	45.3
CPT-GSC08	6/22/11	80	-	-	-
CPT-GSC09	6/22/11	80	-	49, 55, 65	-
CPT-GSC10	6/23/11	79	-	-	-
CPT-GSC12	6/23/11	67	-	-	-
CPT-GSC13	6/24/11	60	-	-	-
CPT-GSC14	6/24/11	69	-	-	-



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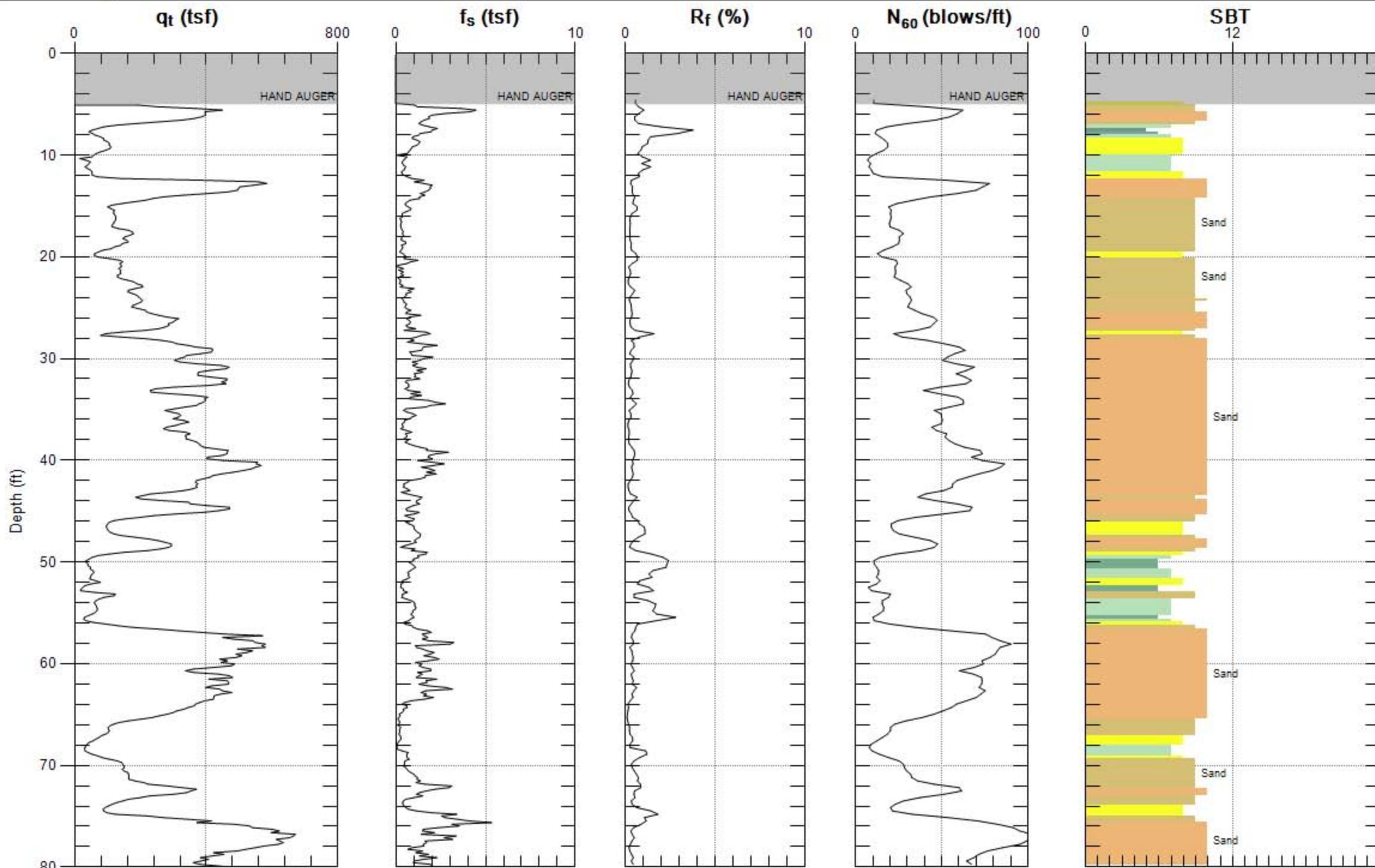
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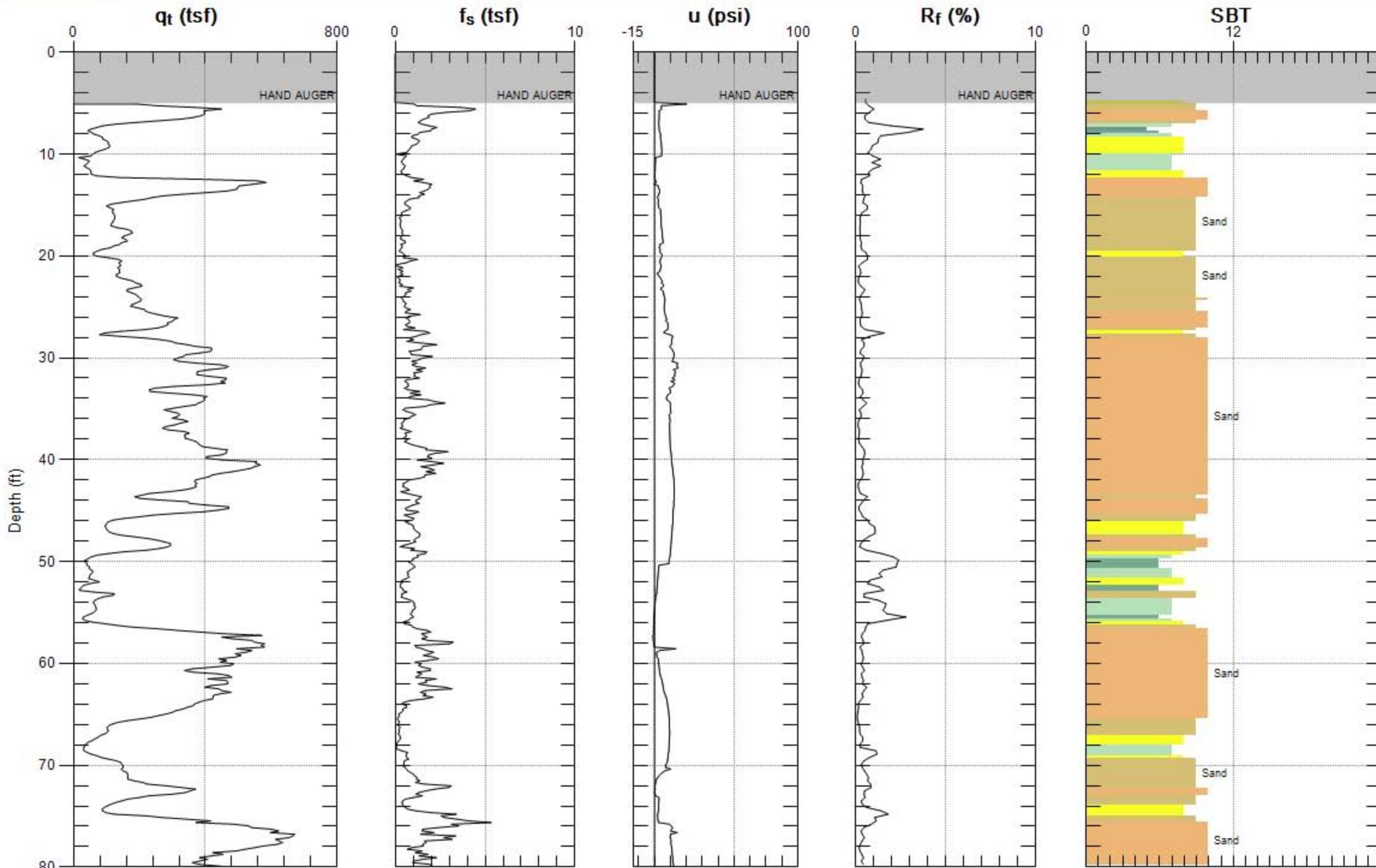
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Conference, Las Vegas, Nevada Proceedings, 1992, pp 299-312.

Copies of ASTM Standards are available through www.astm.org



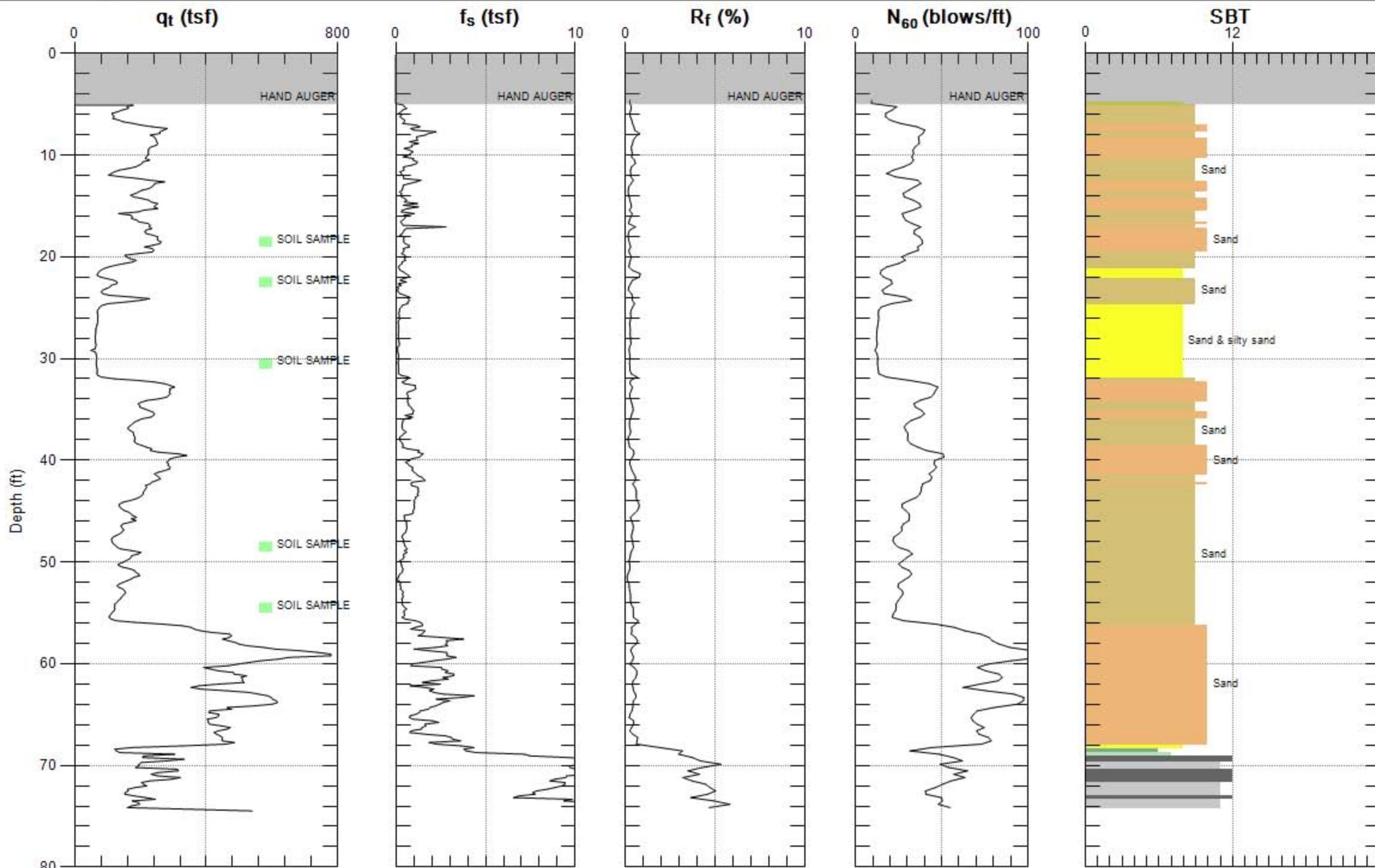
Max. Depth: 80.052 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



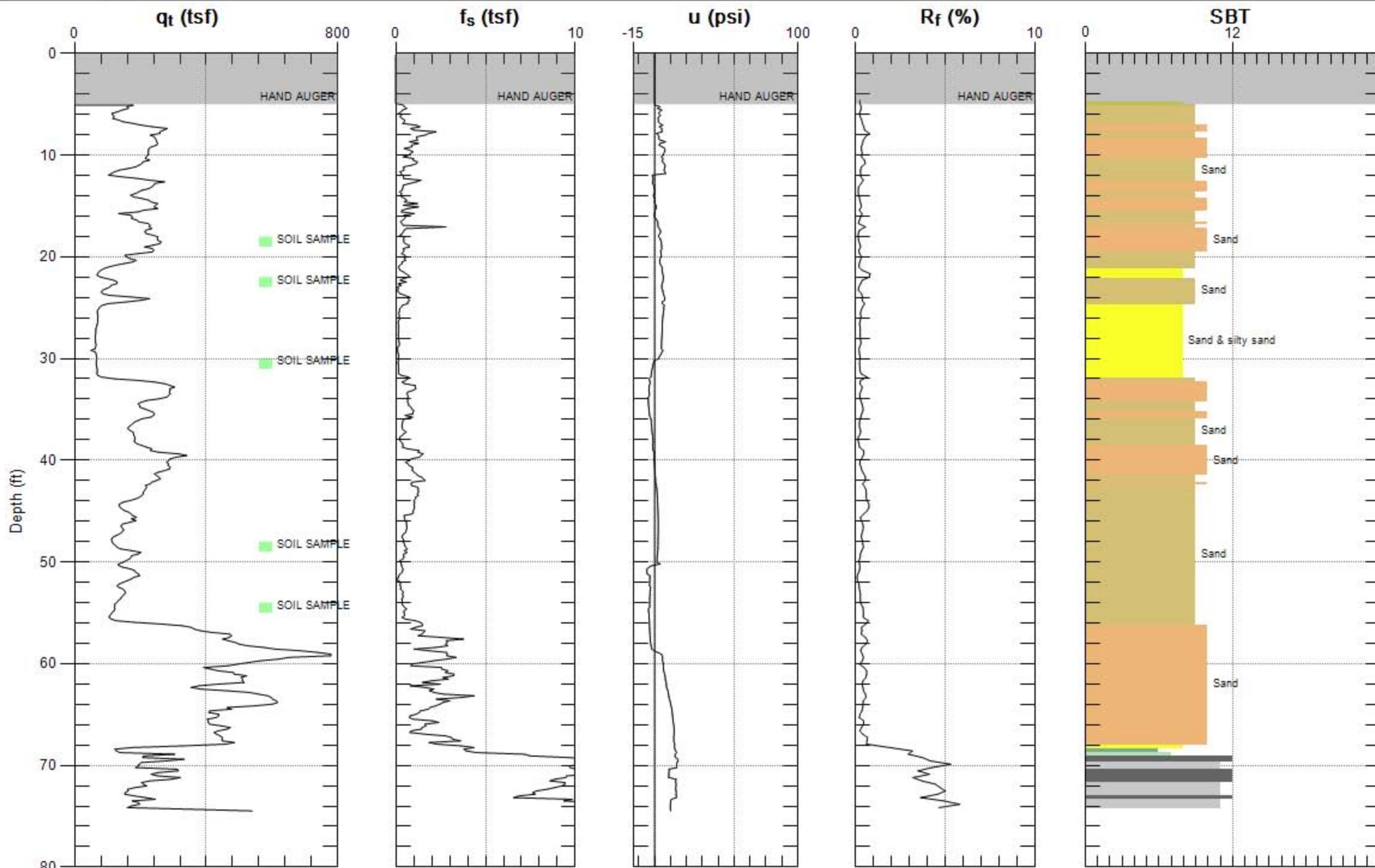
Max. Depth: 80.052 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



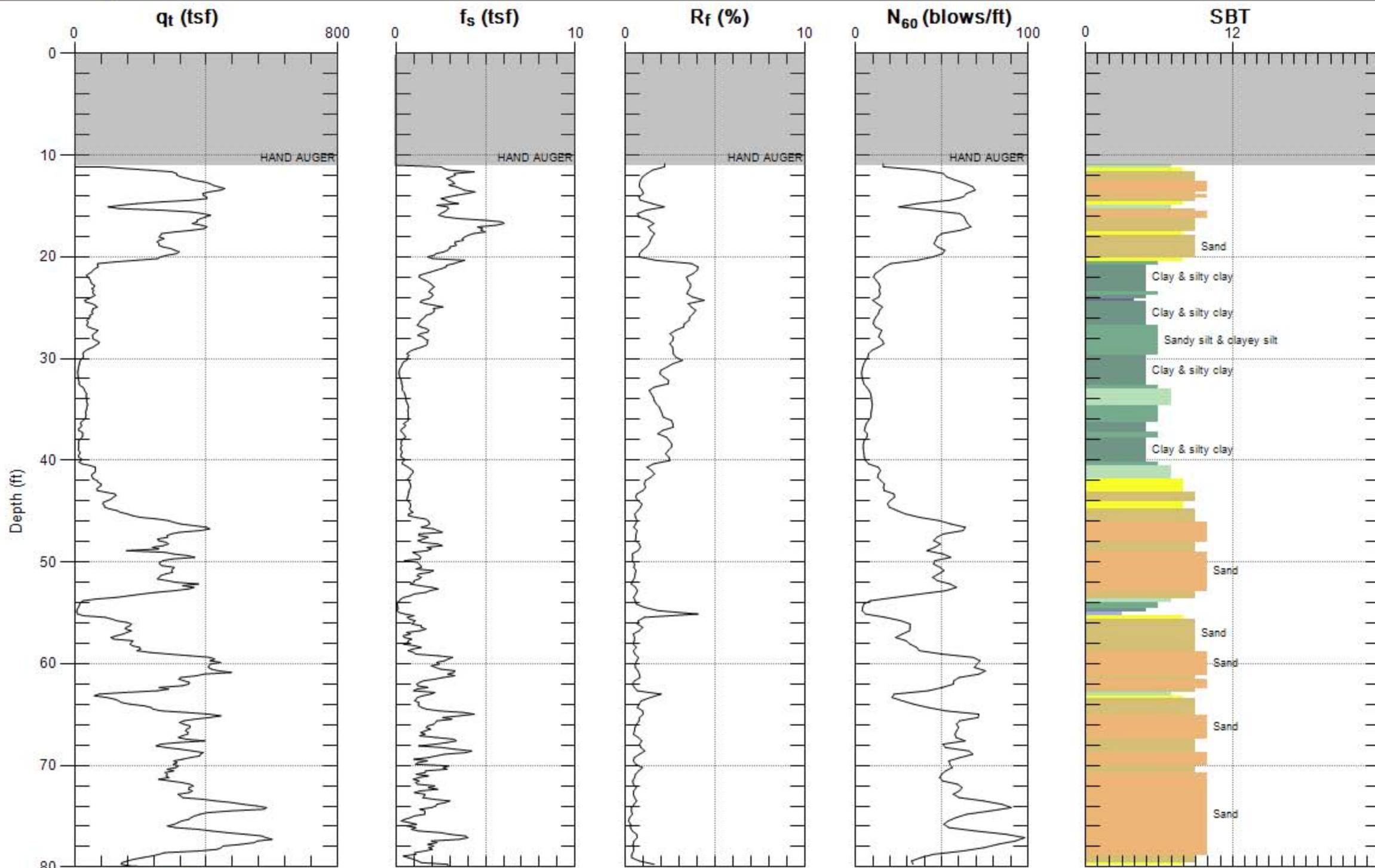
Max. Depth: 74.475 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



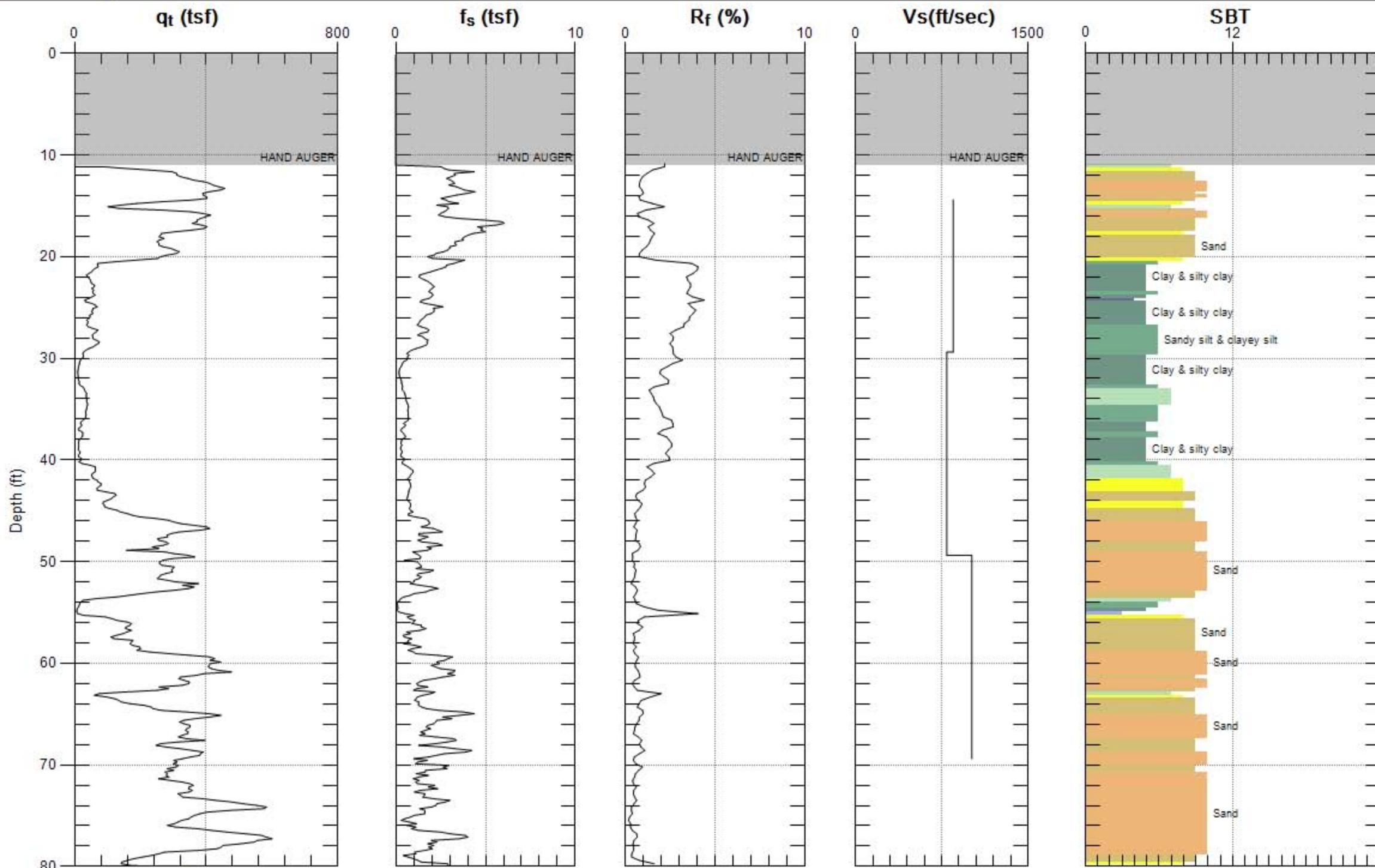
Max. Depth: 74.475 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



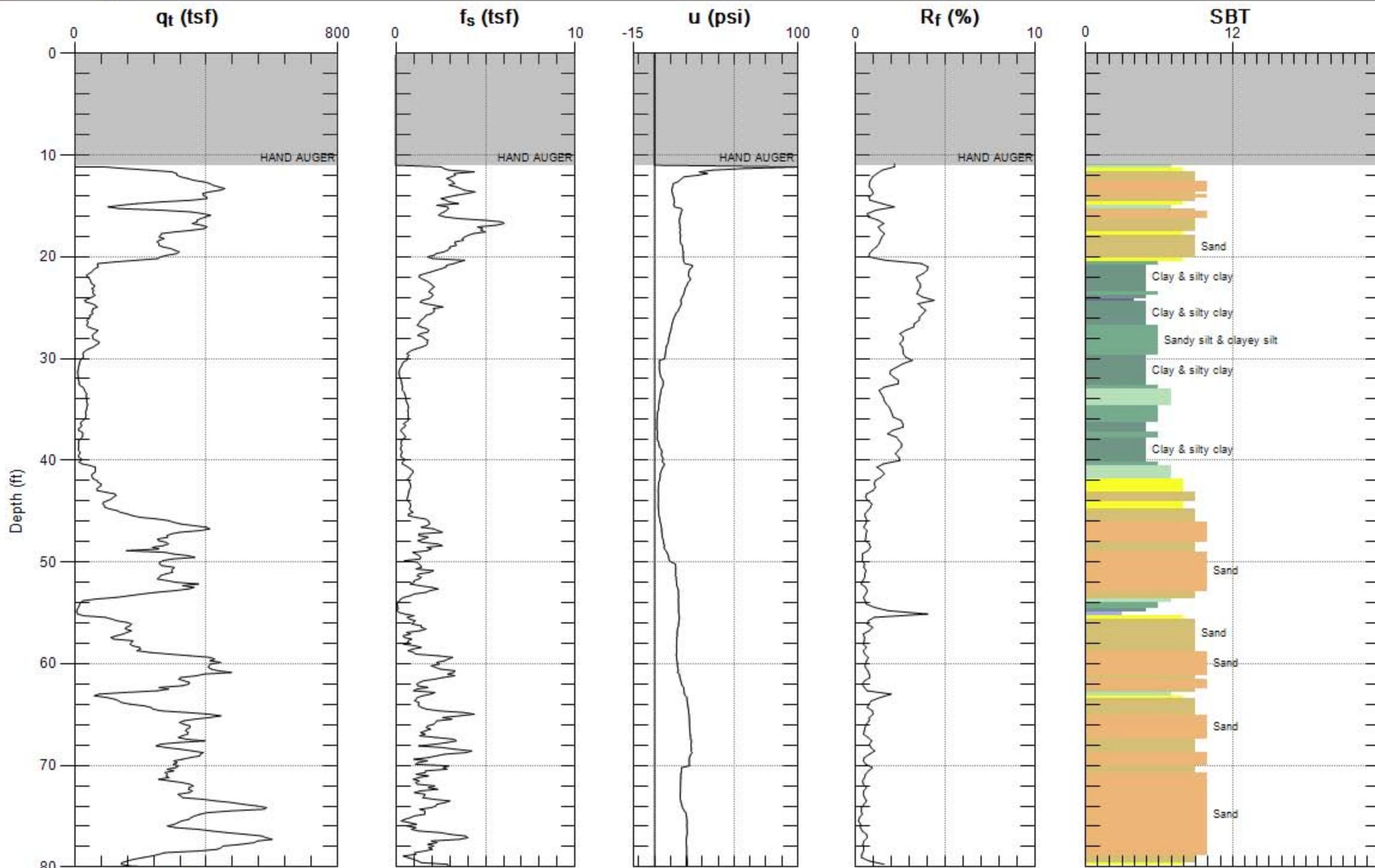
Max. Depth: 80.052 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



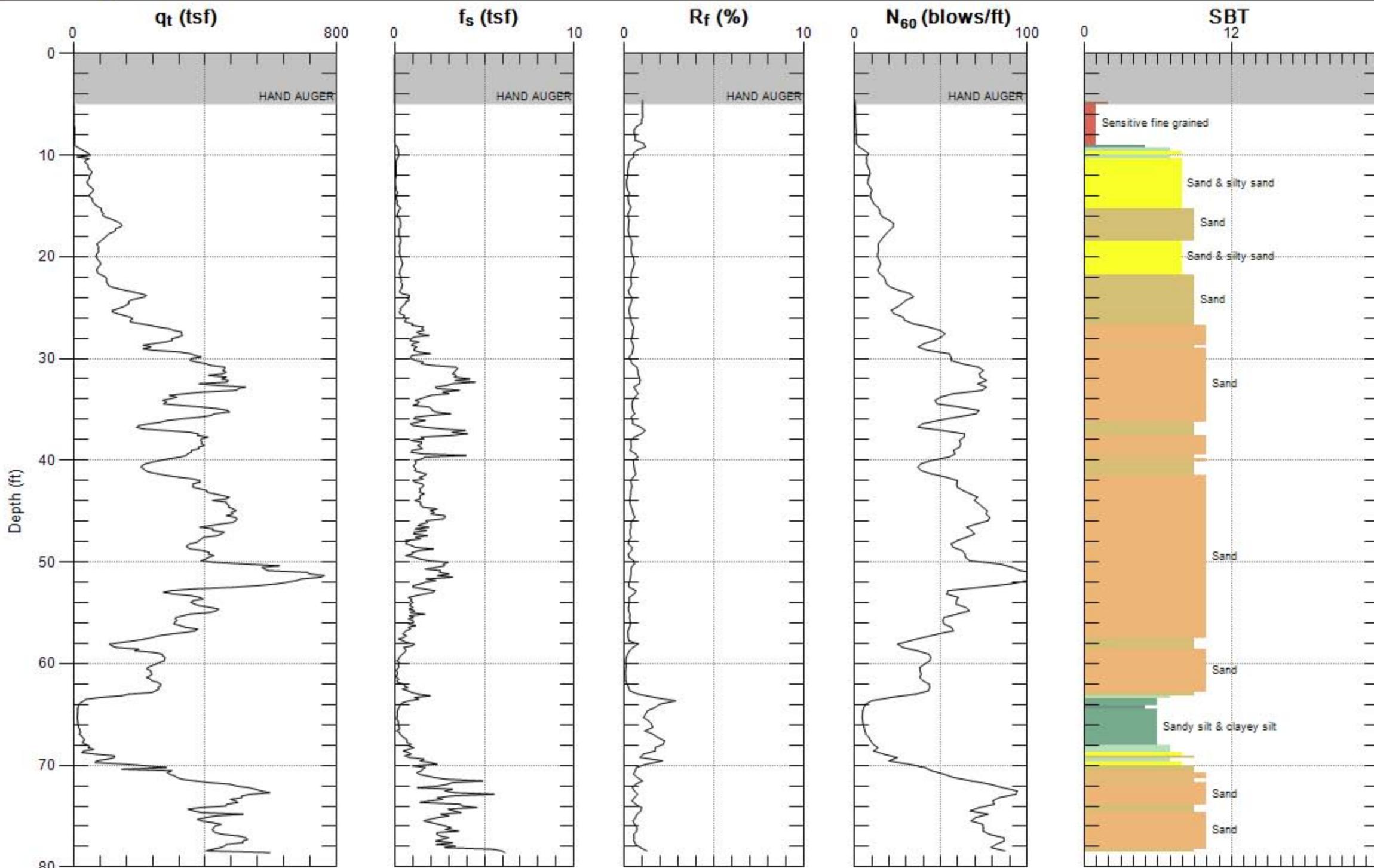
Max. Depth: 80.052 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



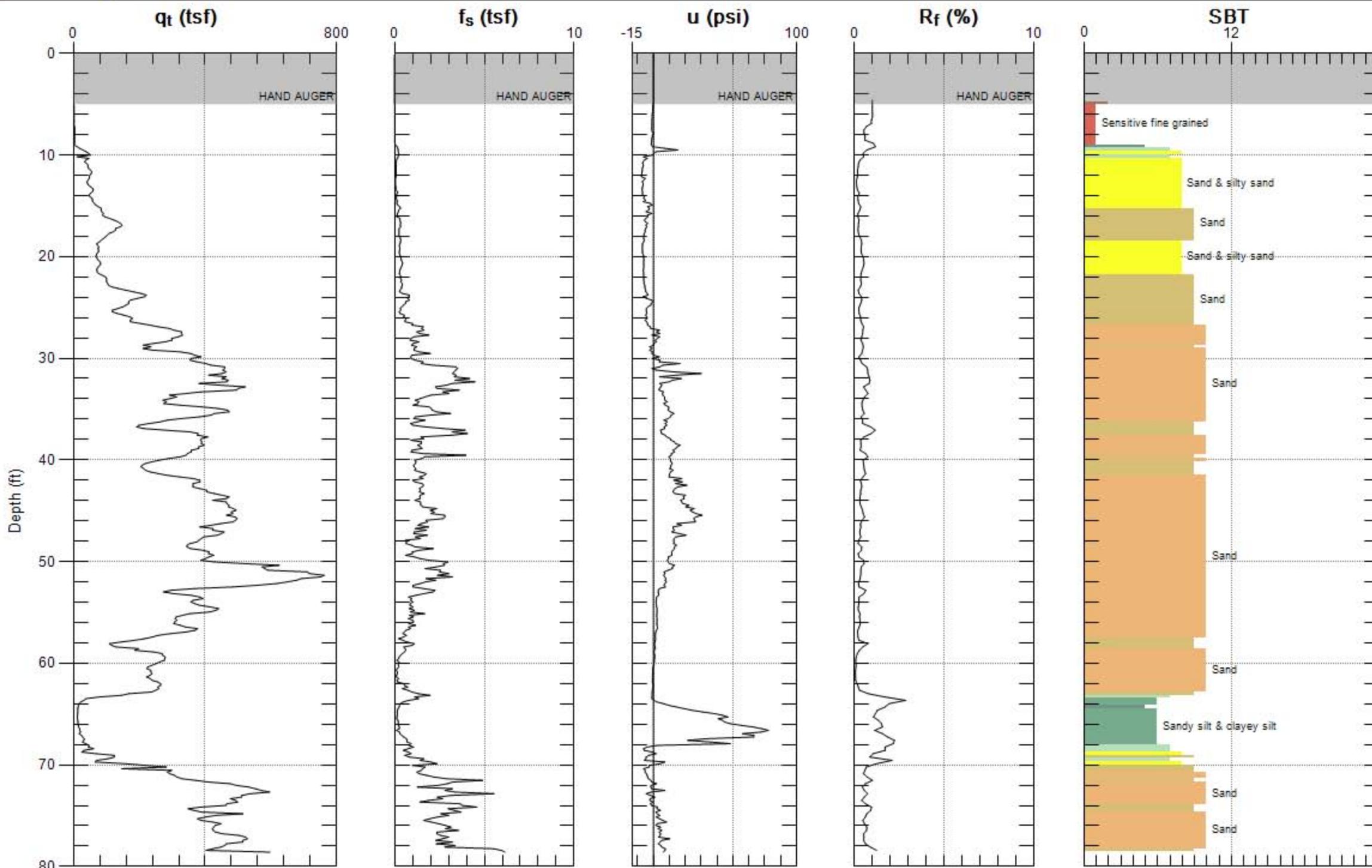
Max. Depth: 80.052 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



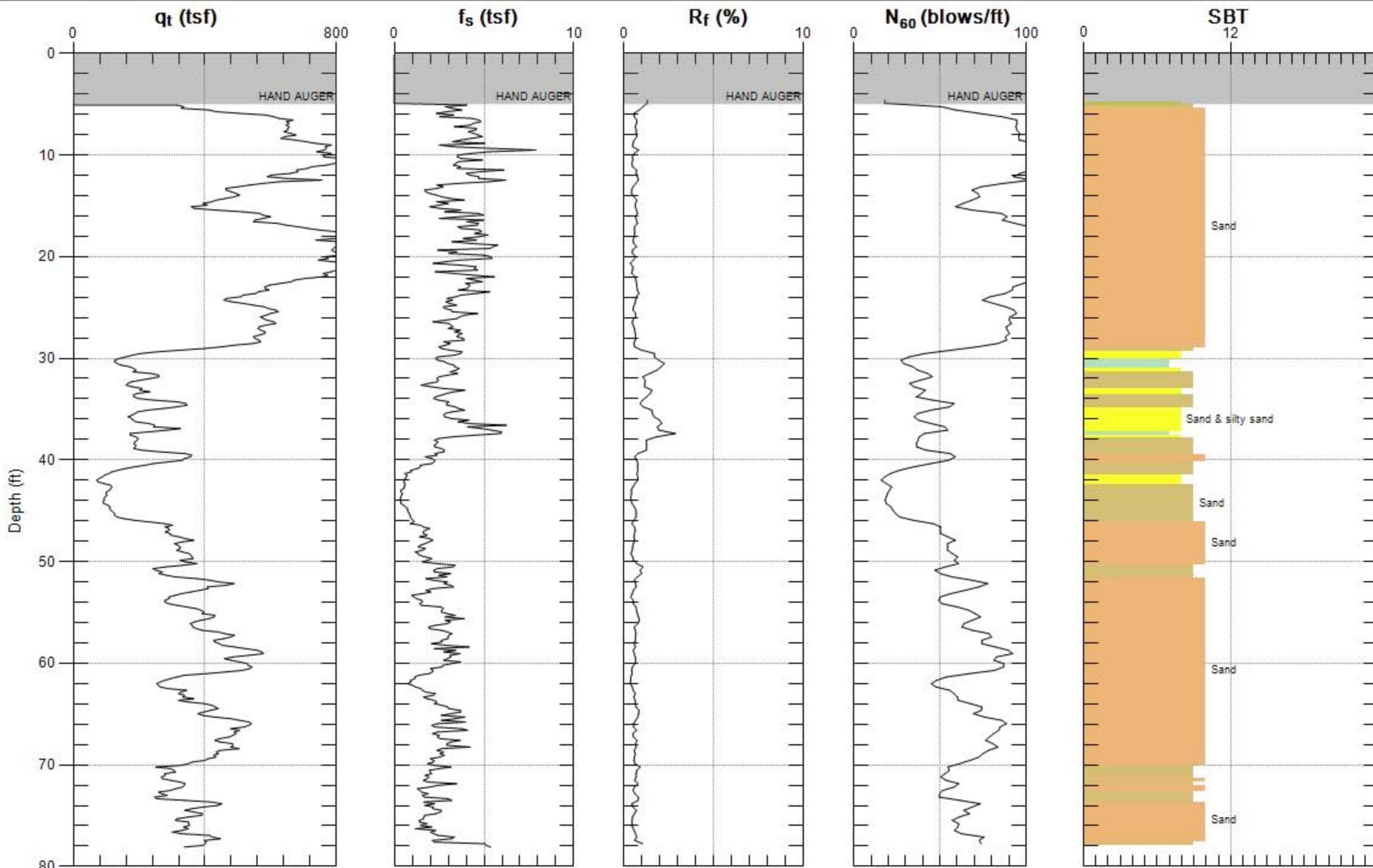
Max. Depth: 78.576 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



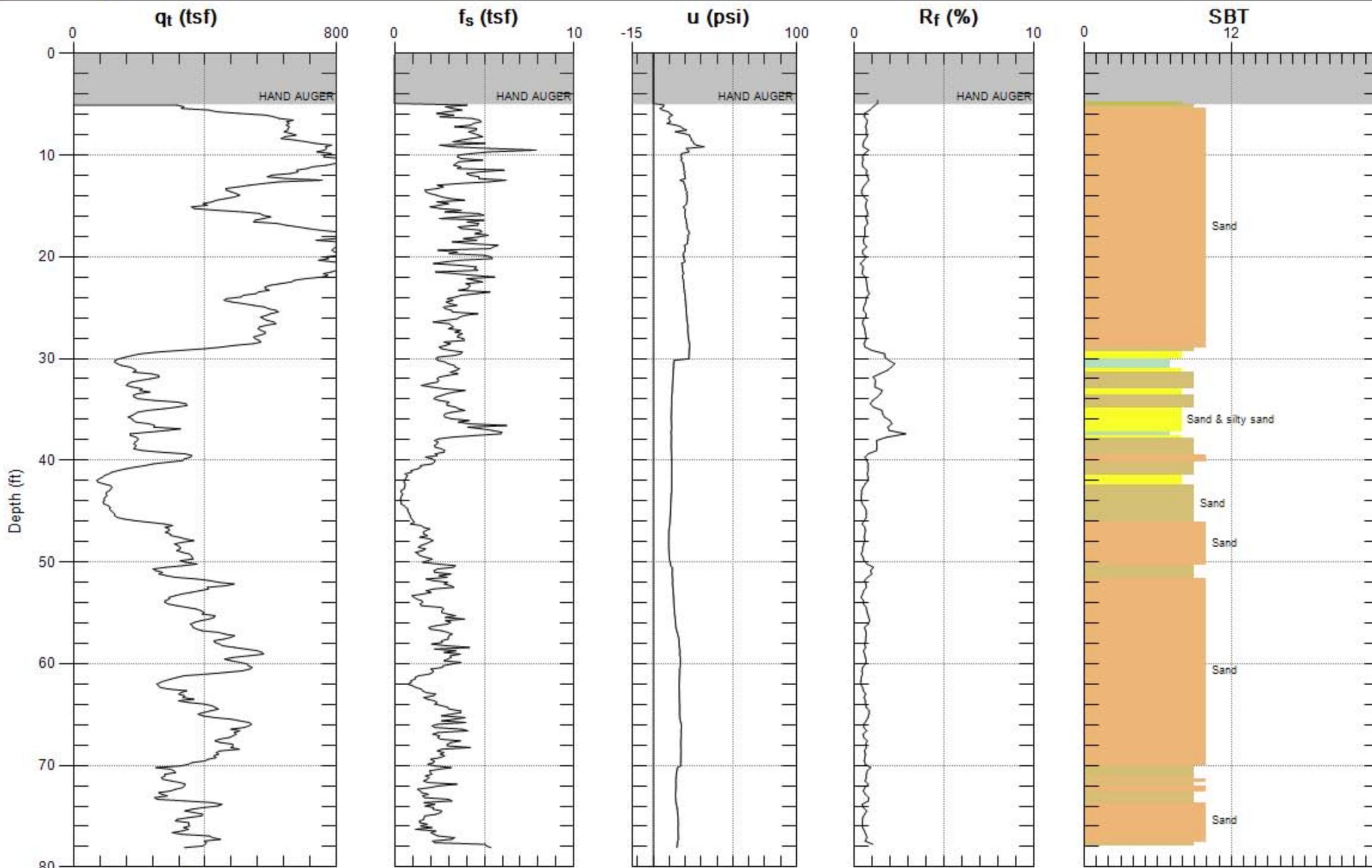
Max. Depth: 78.576 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



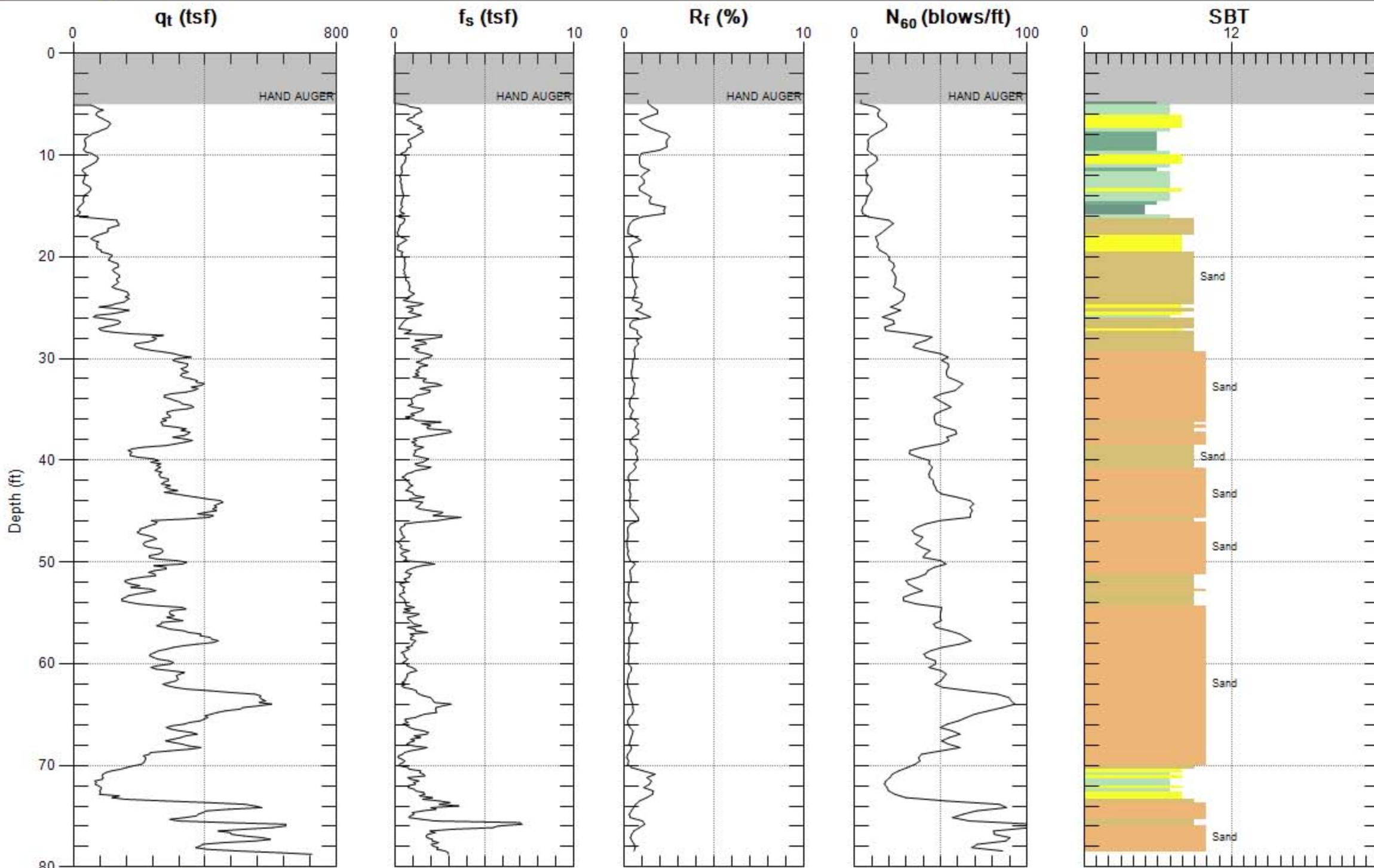
Max. Depth: 78.084 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



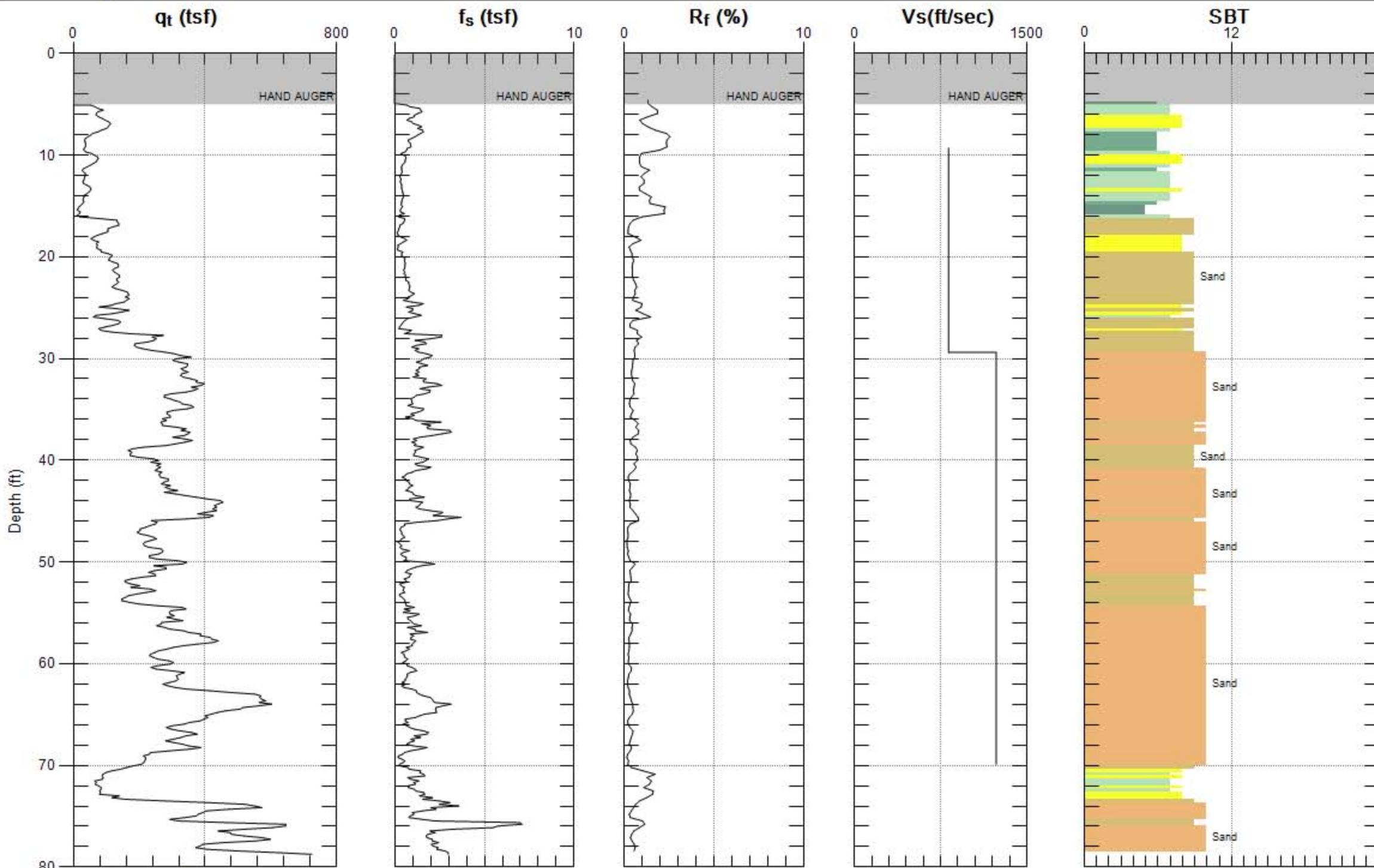
Max. Depth: 78.084 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



Max. Depth: 78.740 (ft)
Avg. Interval: 0.328 (ft)

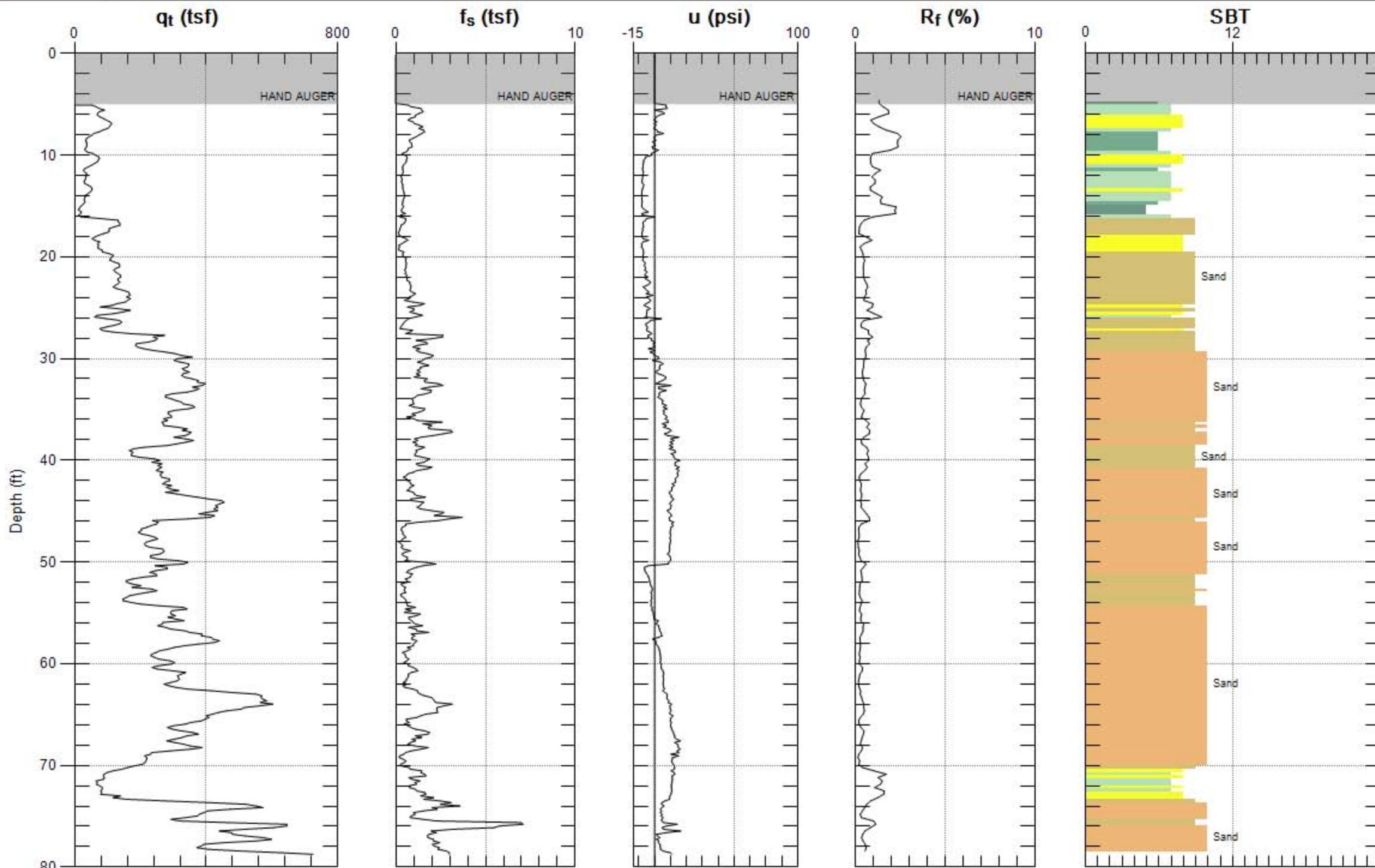
SBT: Soil Behavior Type (Robertson 1990)



Max. Depth: 78.740 (ft)

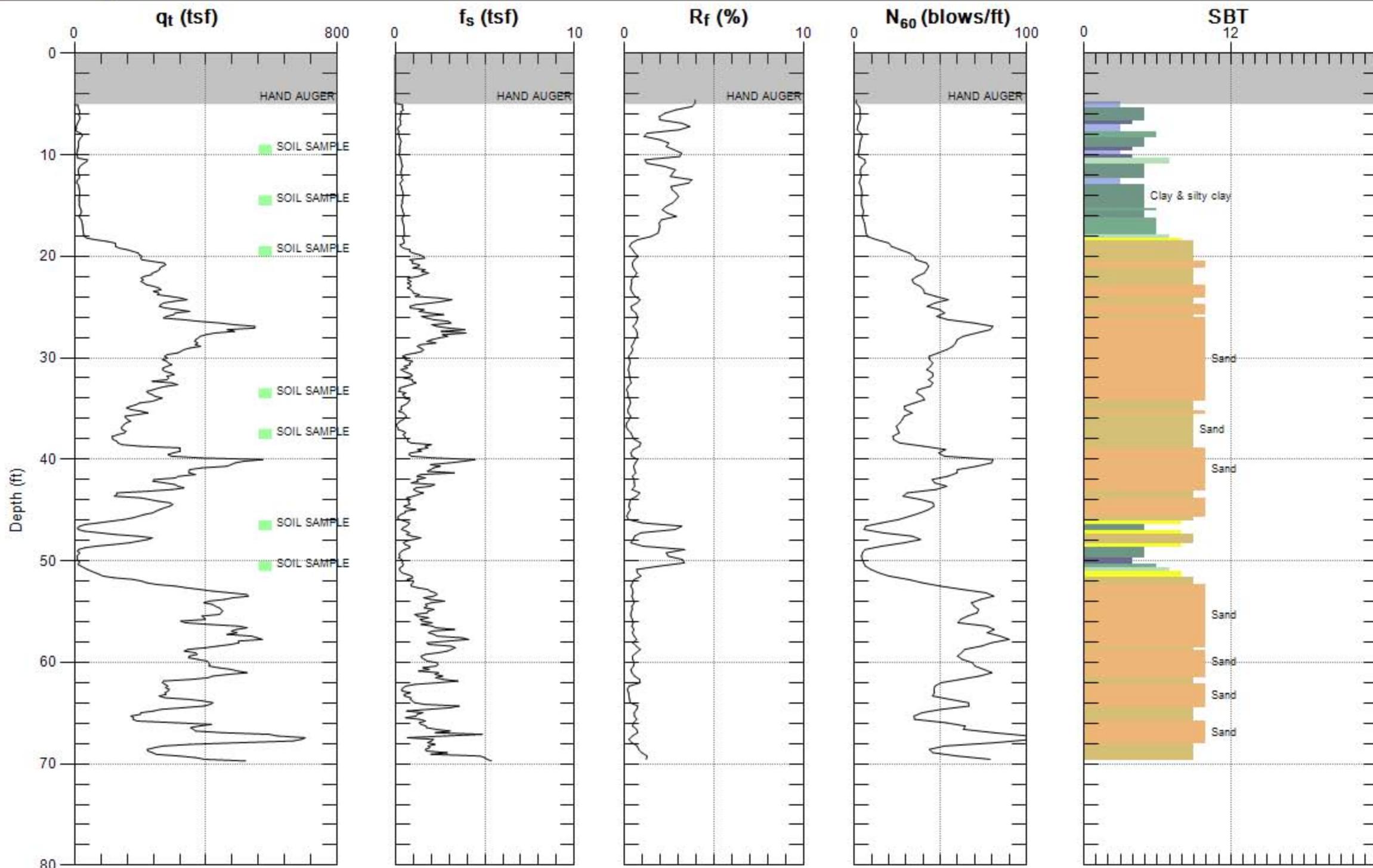
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



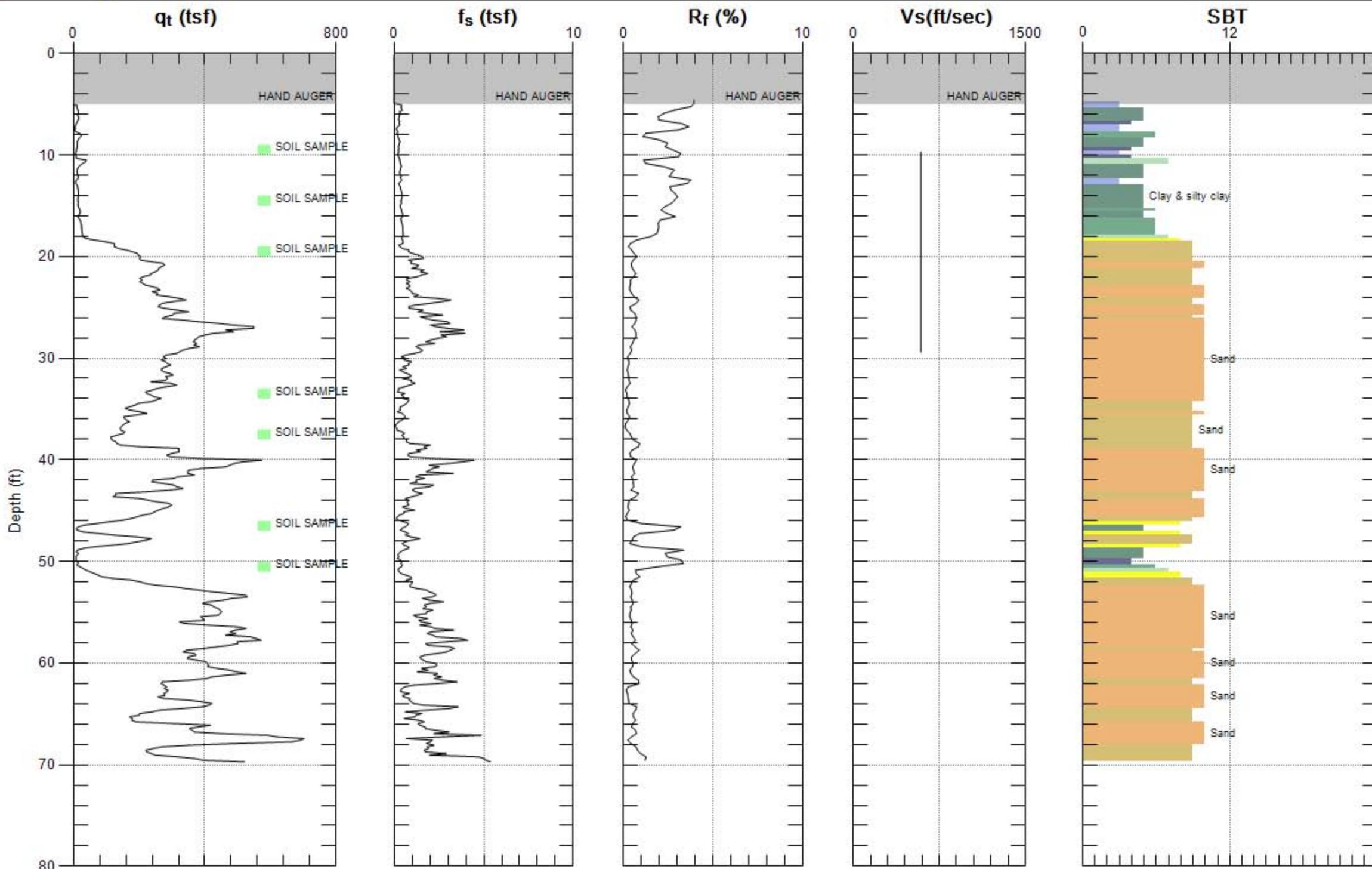
Max. Depth: 78.740 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



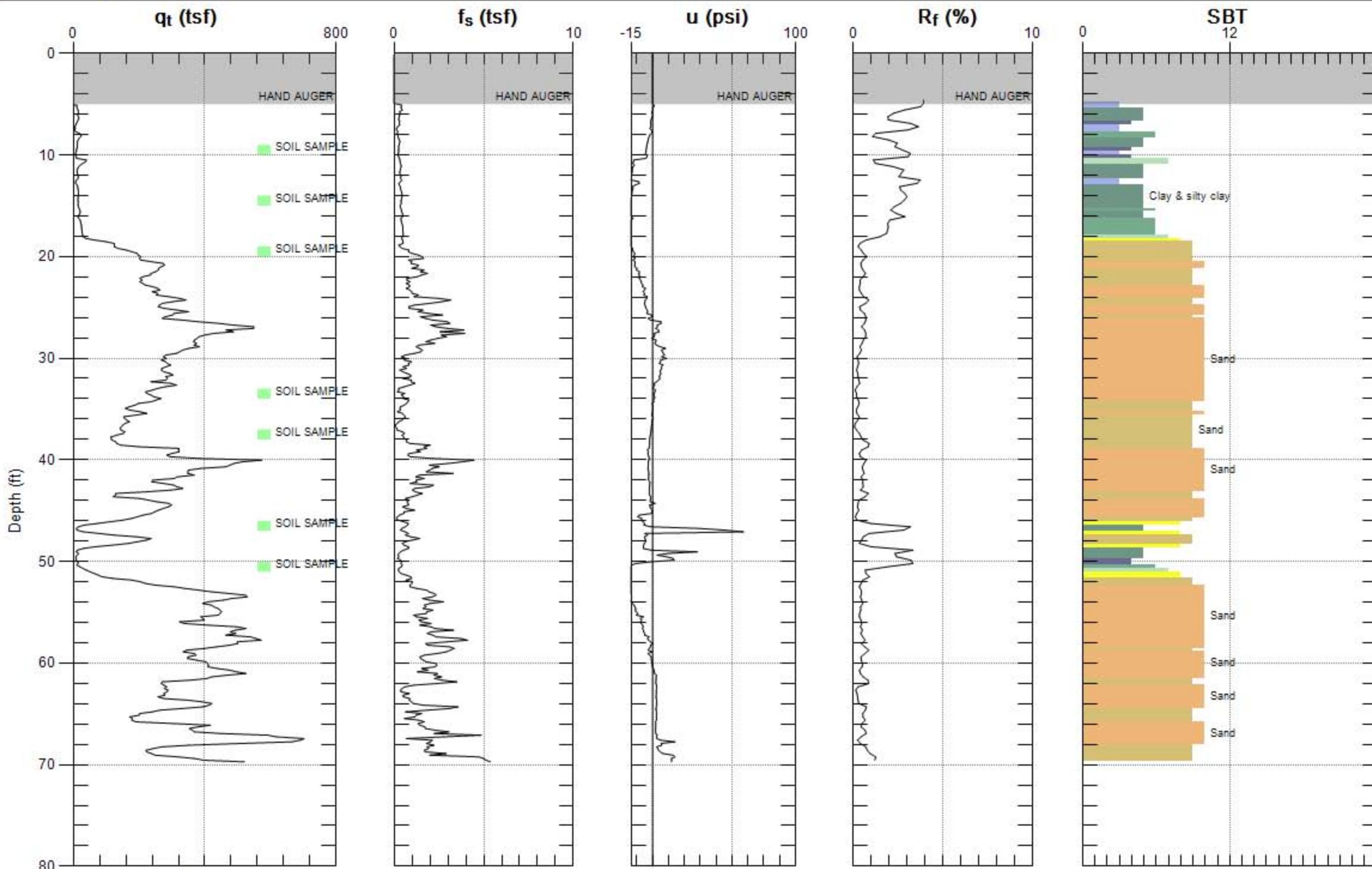
Max. Depth: 69.718 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



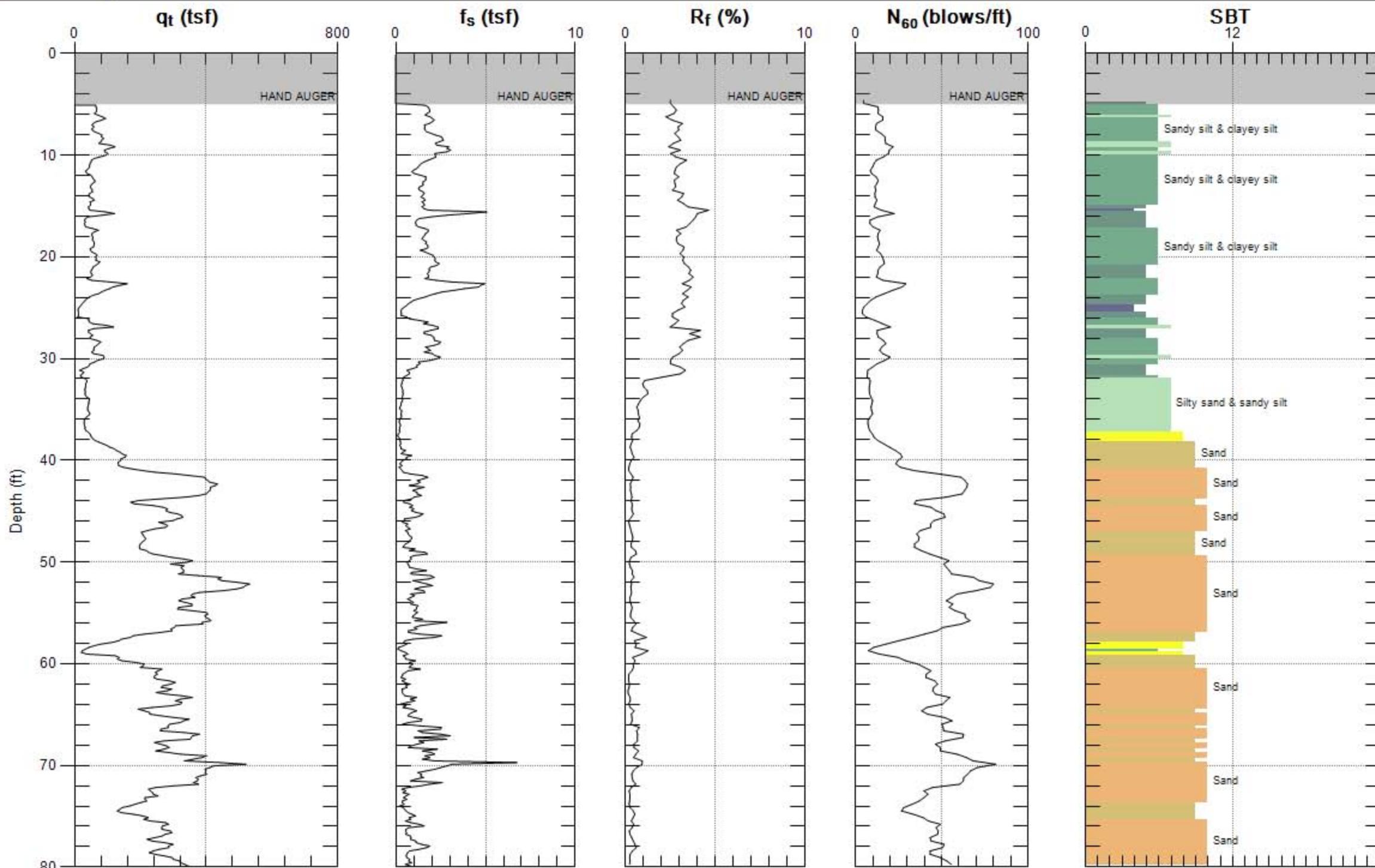
Max. Depth: 69.718 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



Max. Depth: 69.718 (ft)
 Avg. Interval: 0.328 (ft)

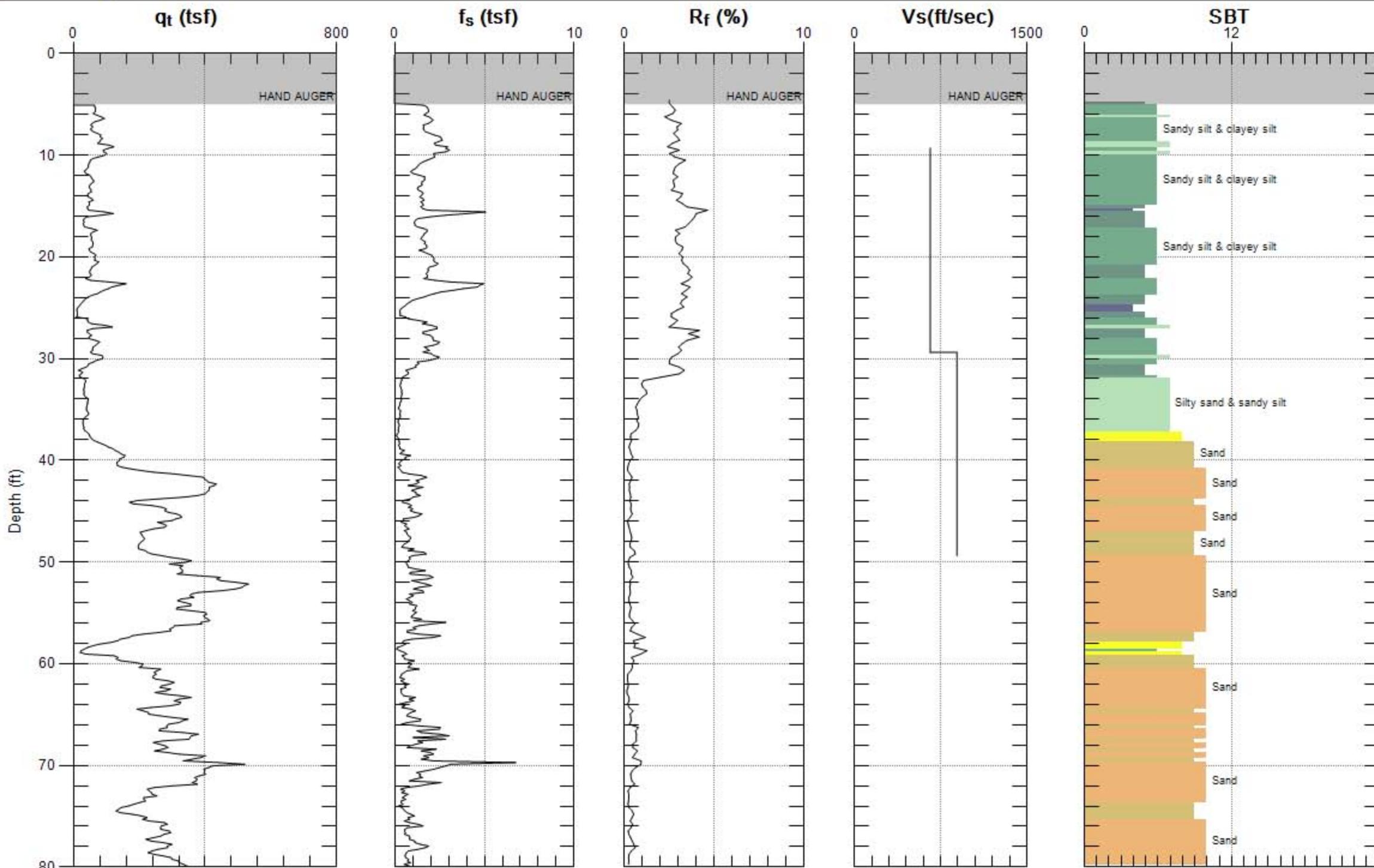
SBT: Soil Behavior Type (Robertson 1990)



Max. Depth: 80.052 (ft)

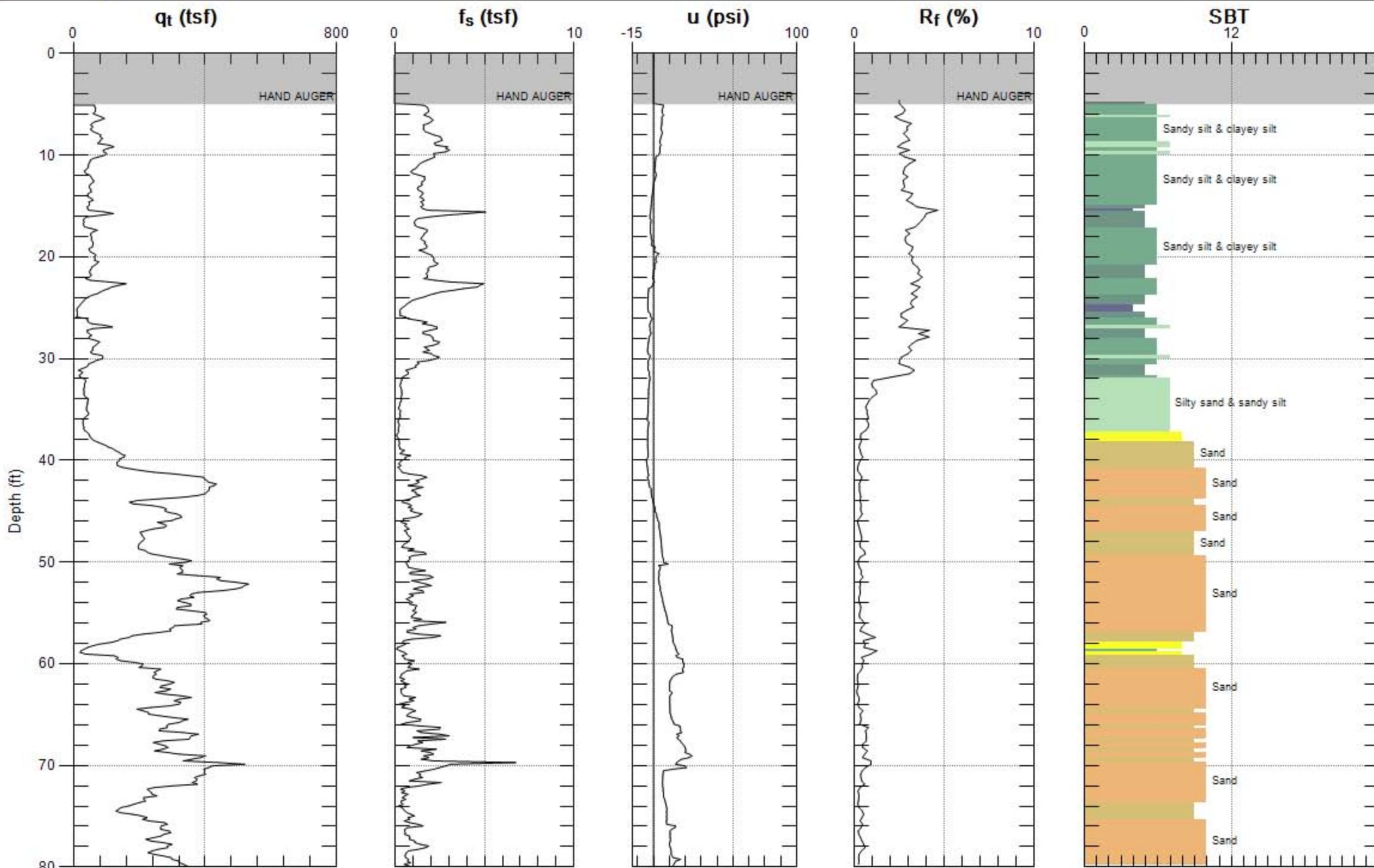
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



Max. Depth: 80.052 (ft)
 Avg. Interval: 0.328 (ft)

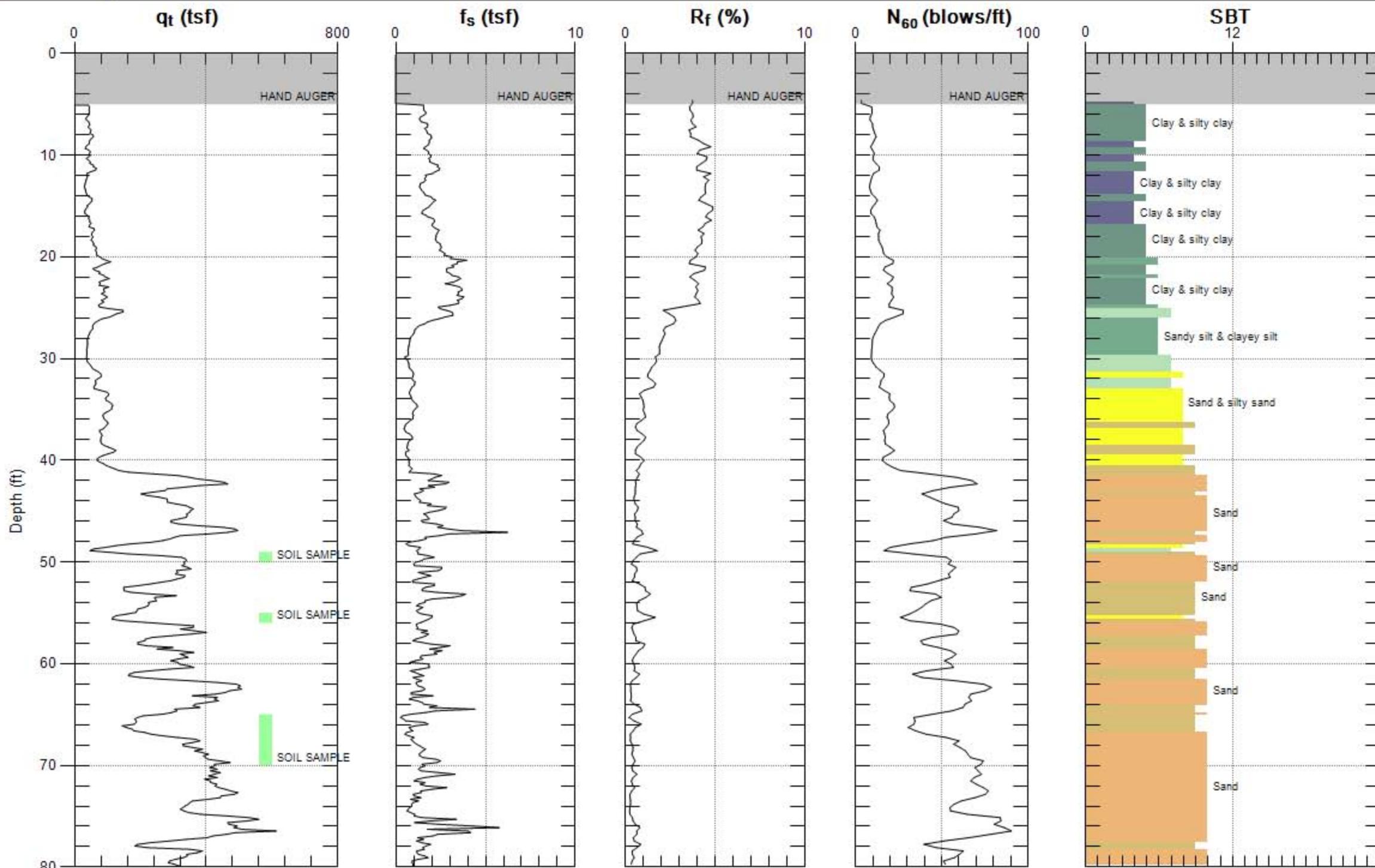
SBT: Soil Behavior Type (Robertson 1990)



Max. Depth: 80.052 (ft)

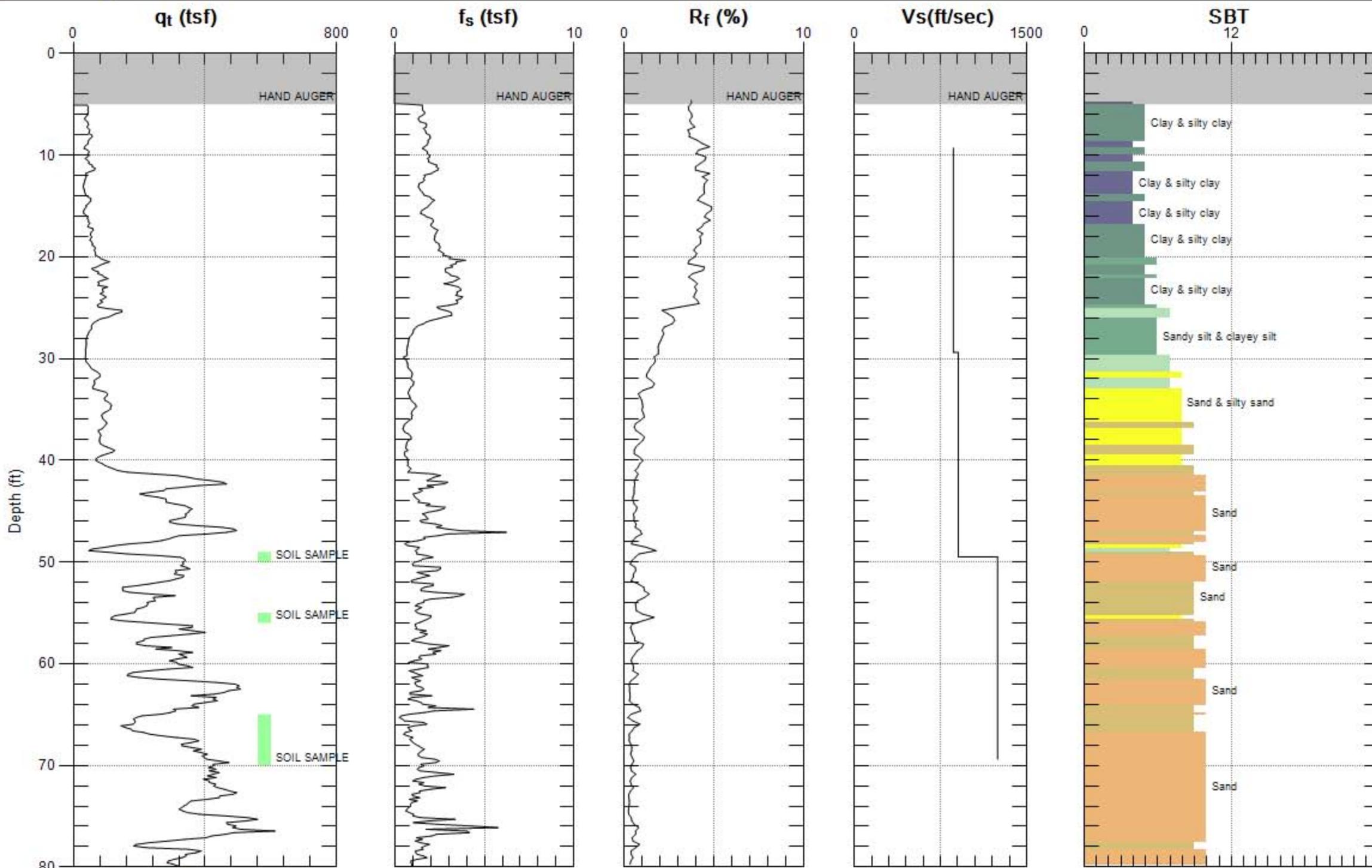
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



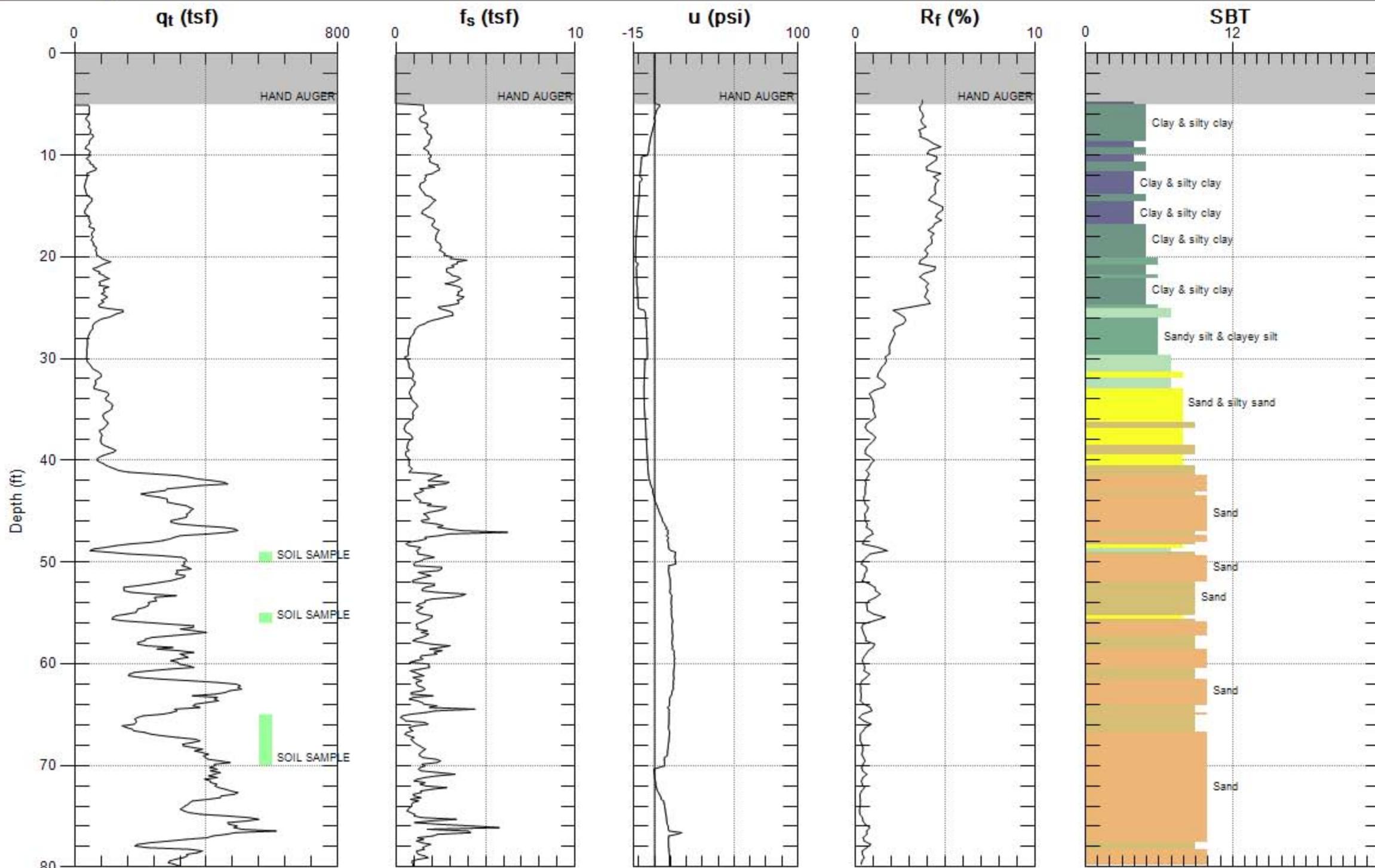
Max. Depth: 80.052 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



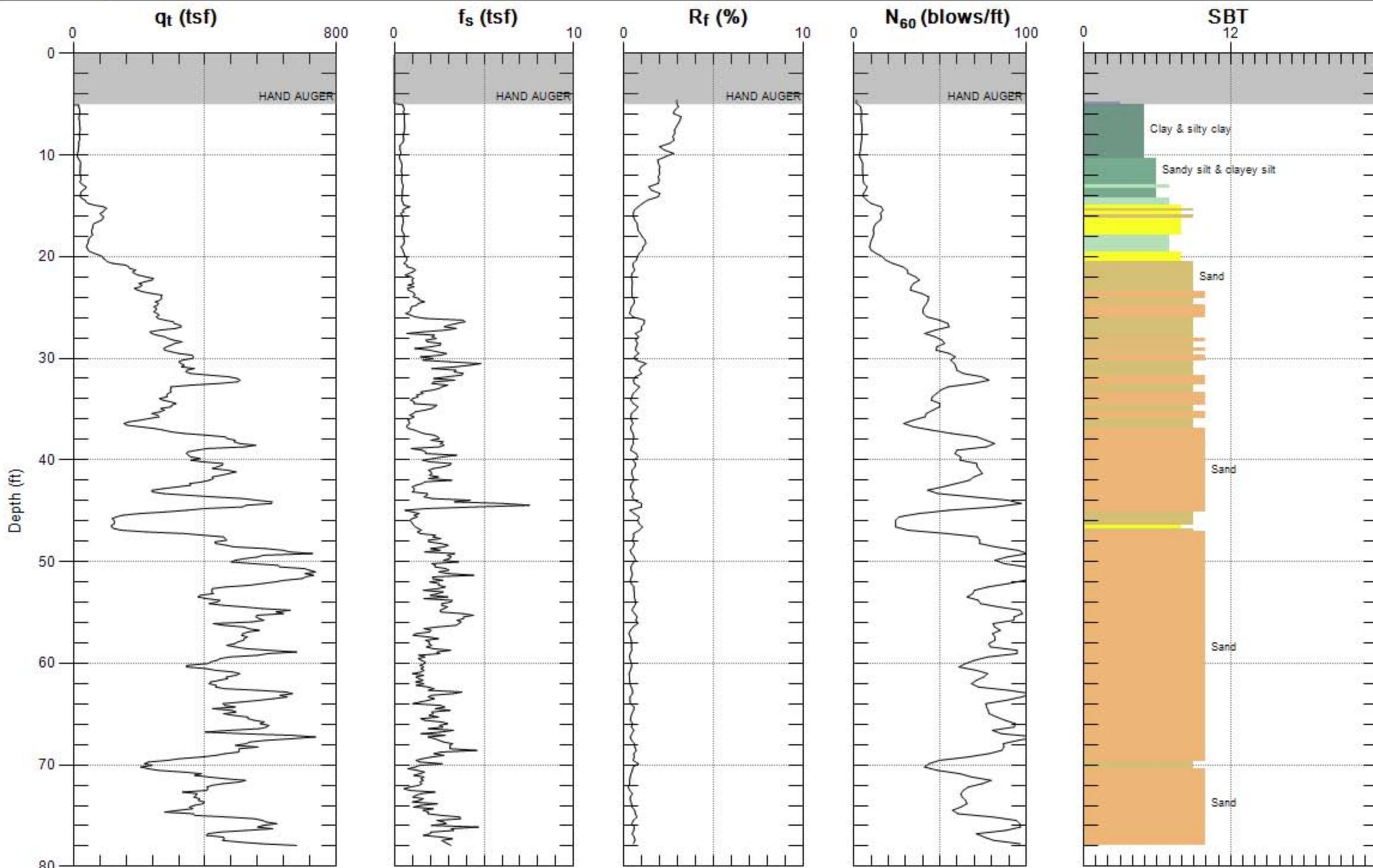
Max. Depth: 80.052 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



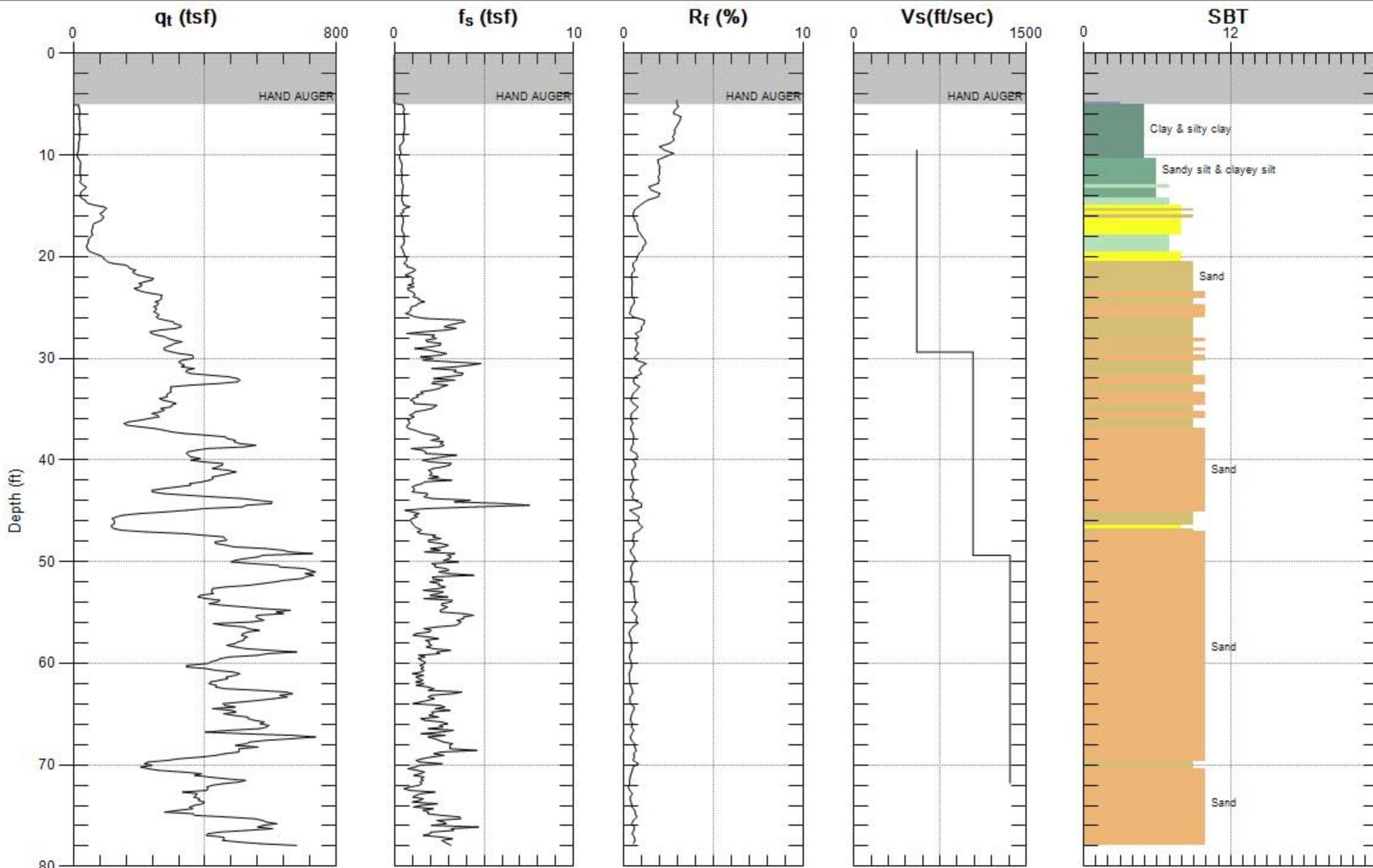
Max. Depth: 80.052 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



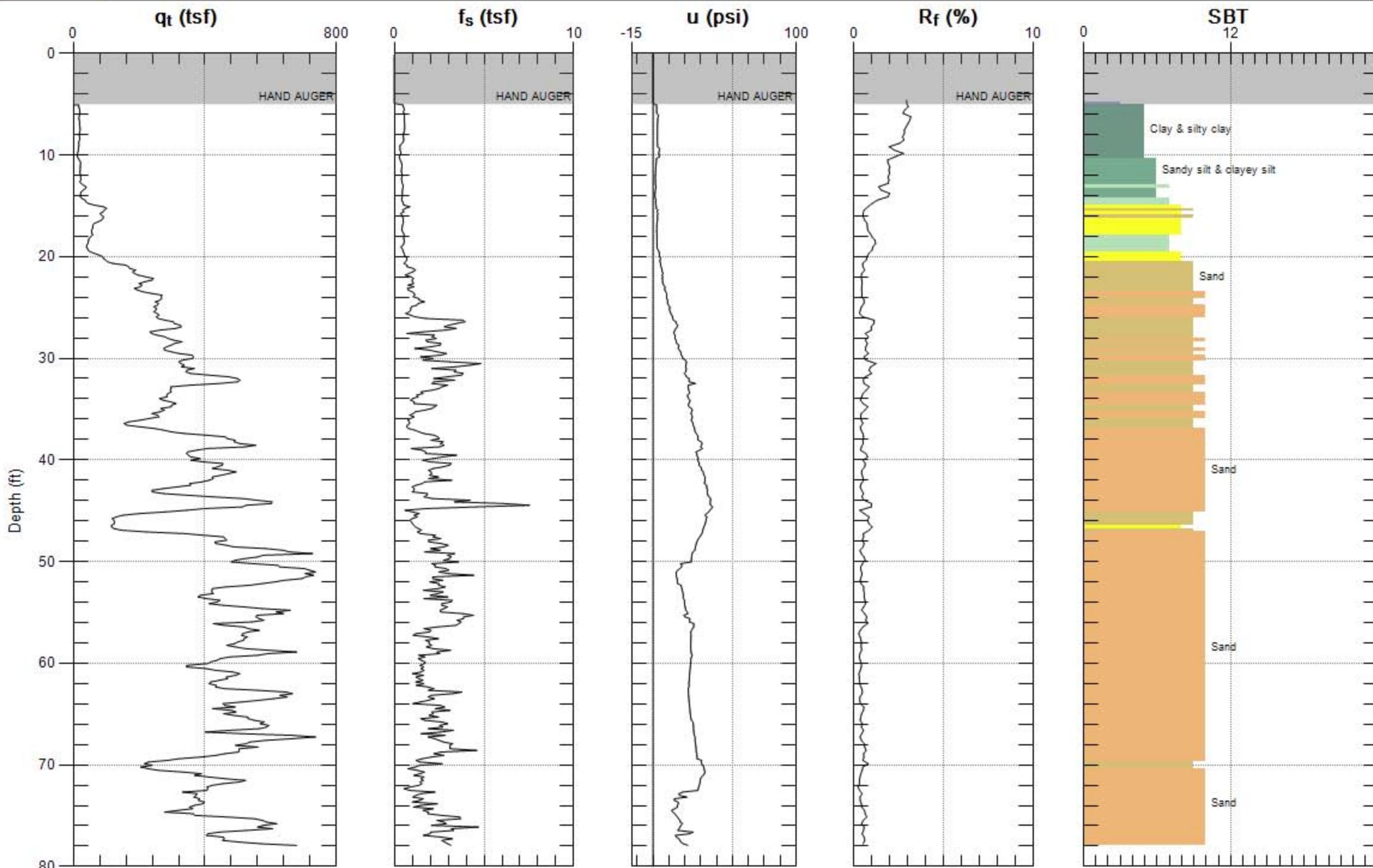
Max. Depth: 77.920 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



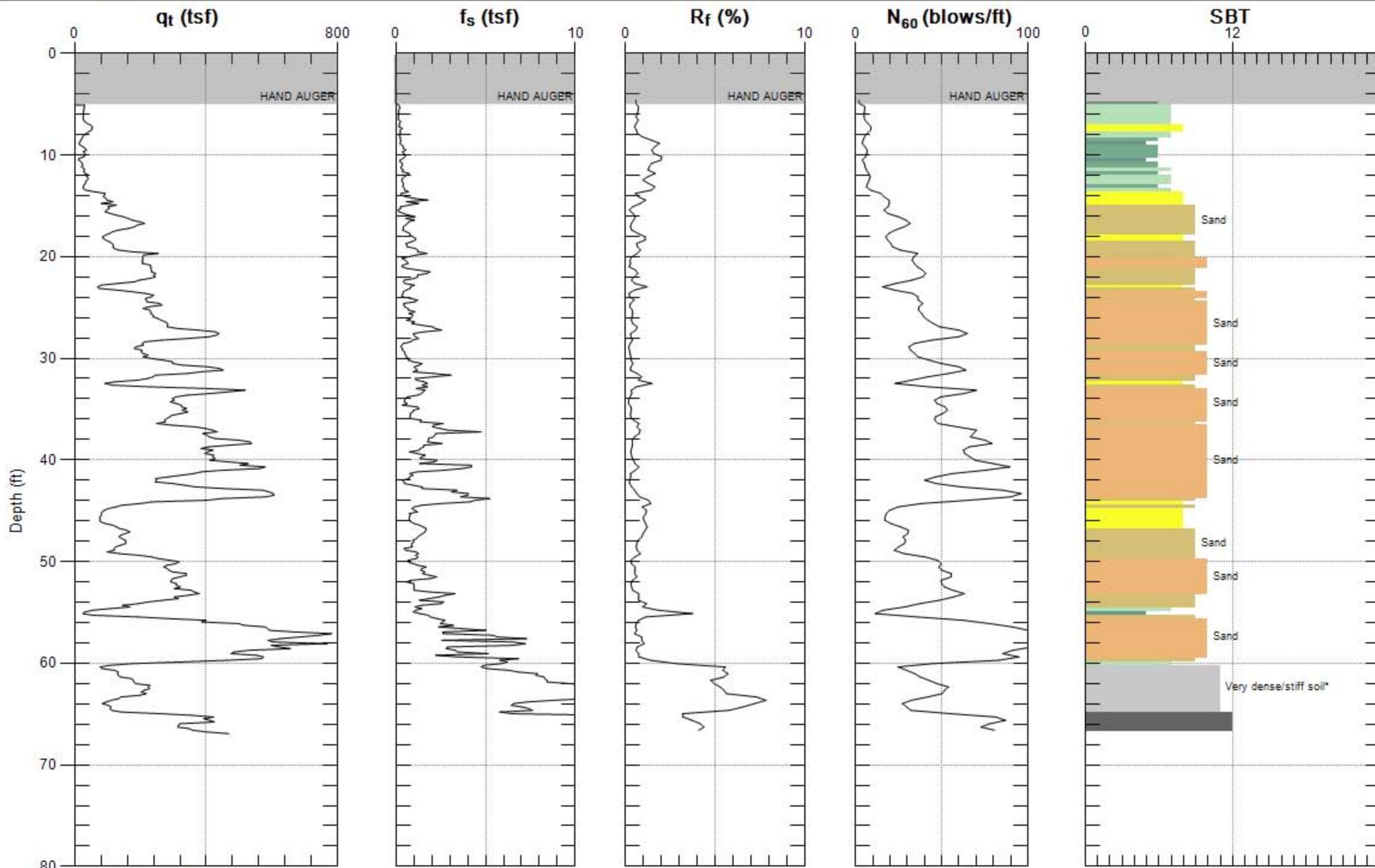
Max. Depth: 77.920 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



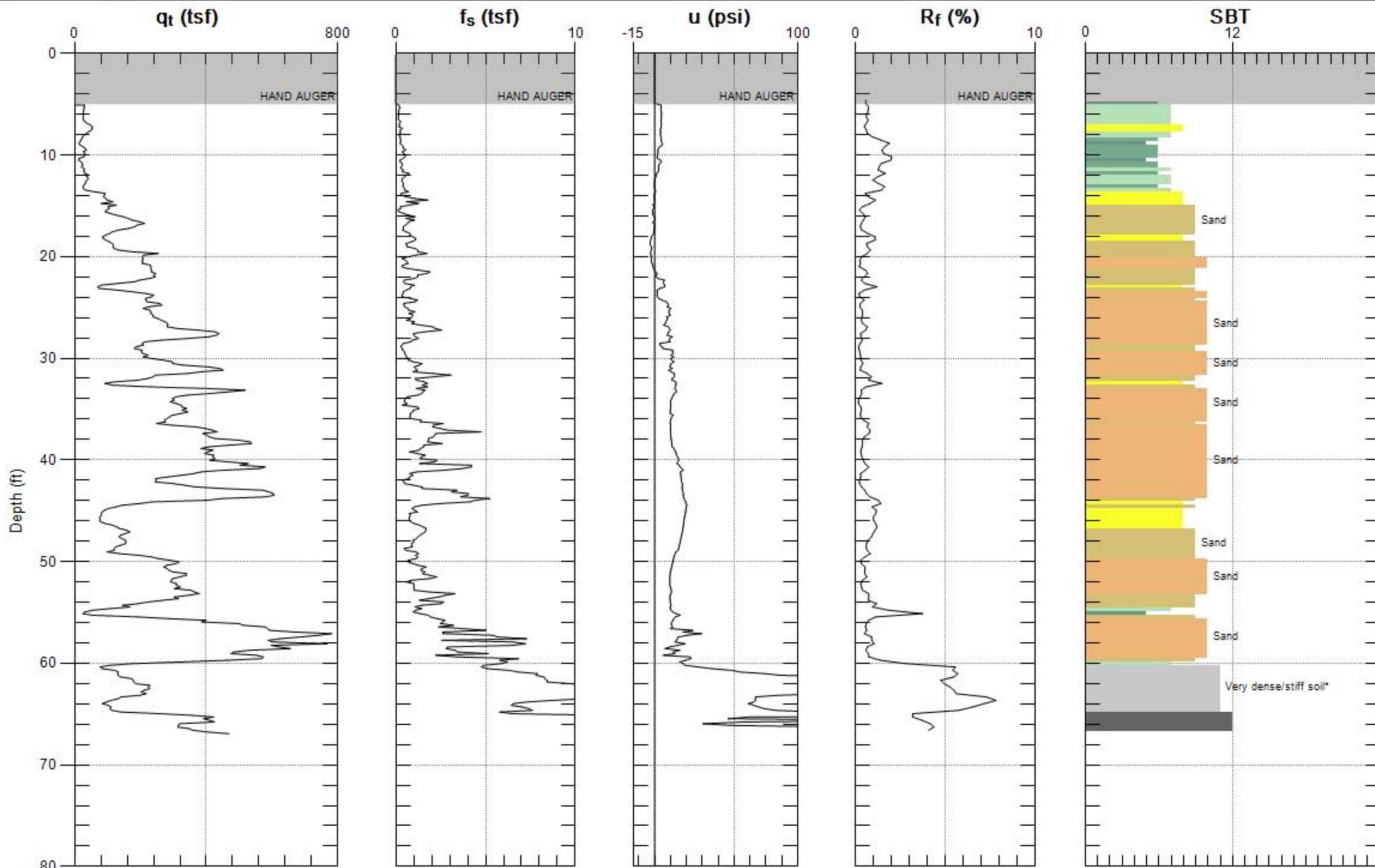
Max. Depth: 77.920 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



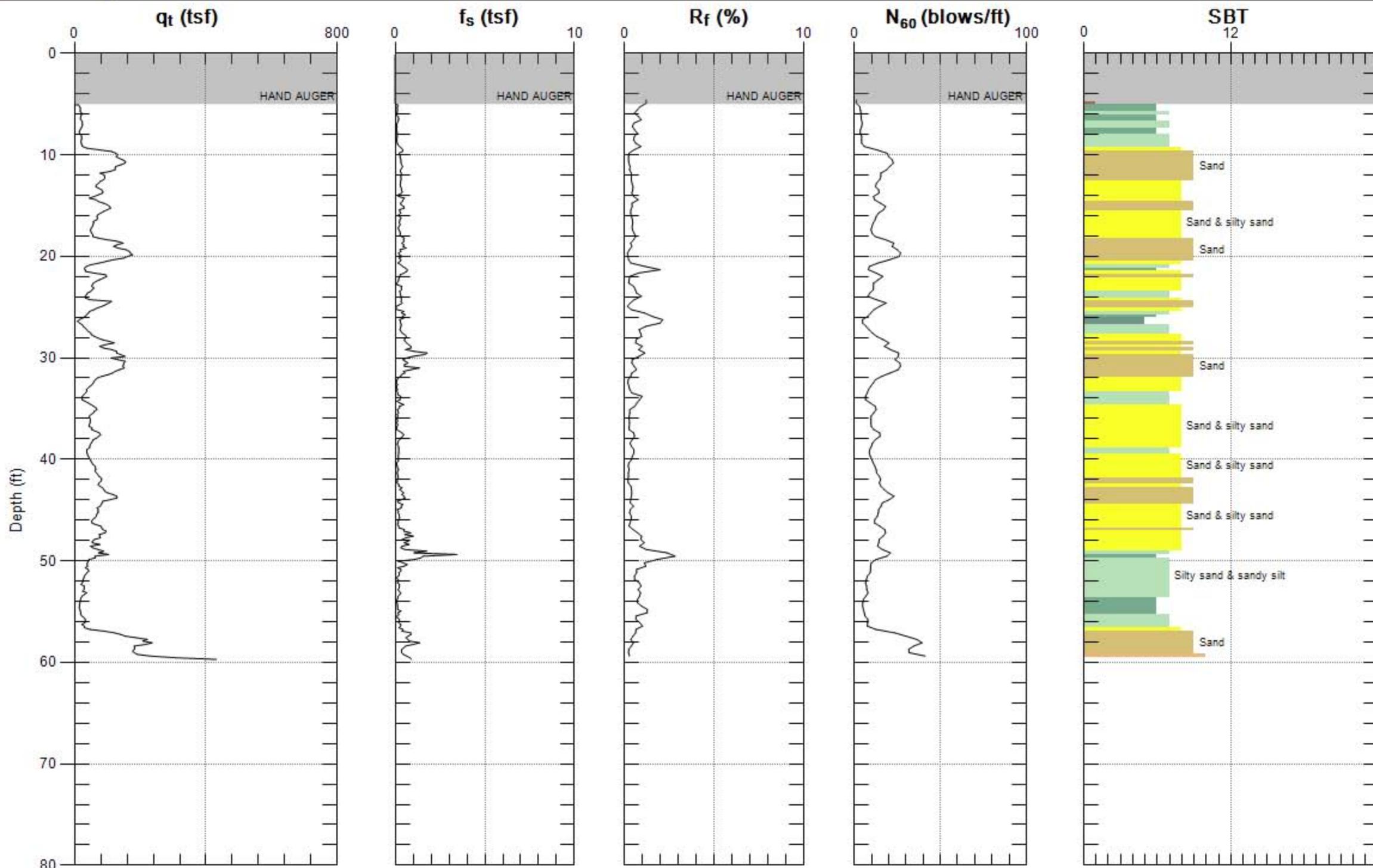
Max. Depth: 66.929 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



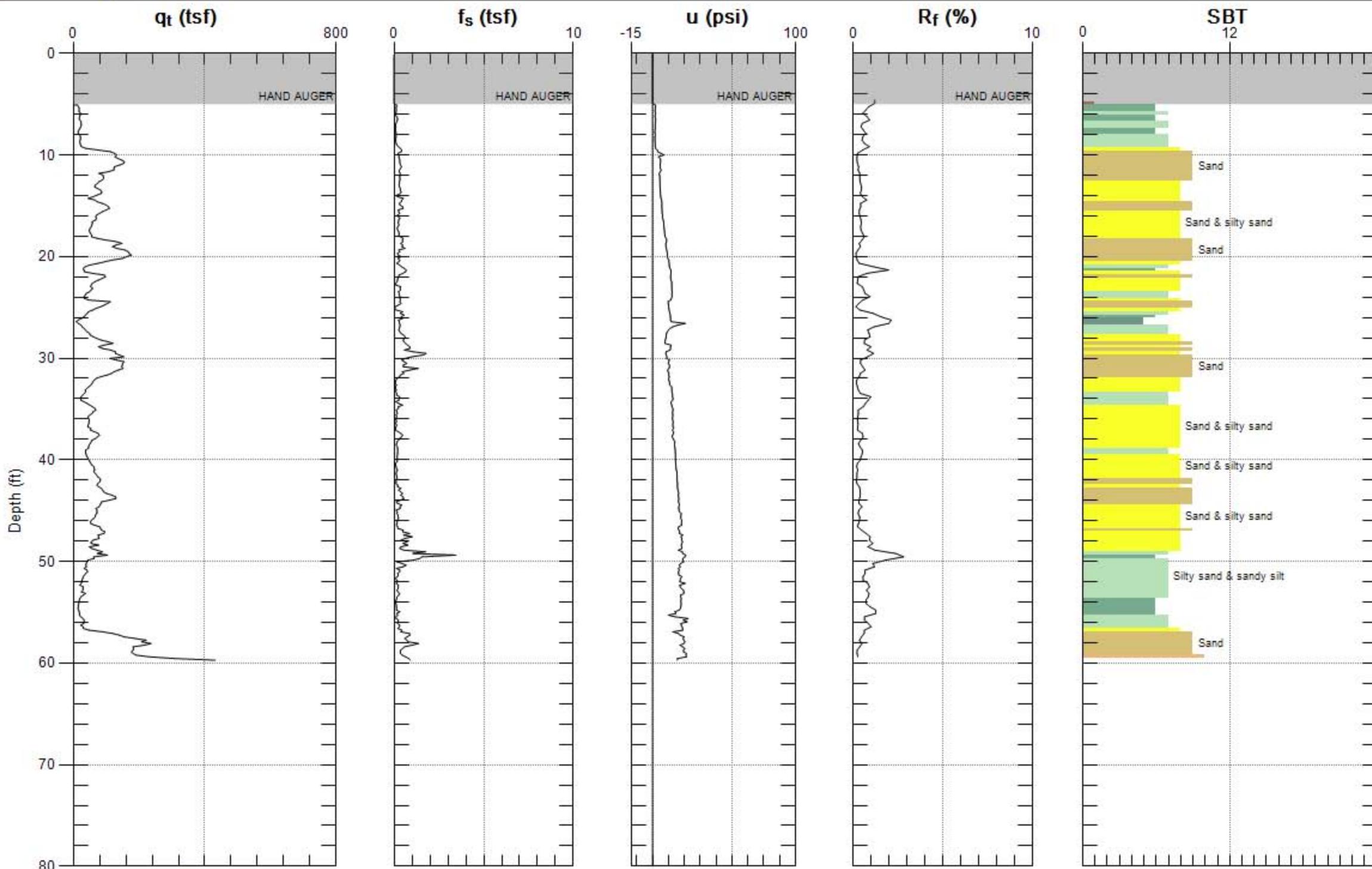
Max. Depth: 66.929 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



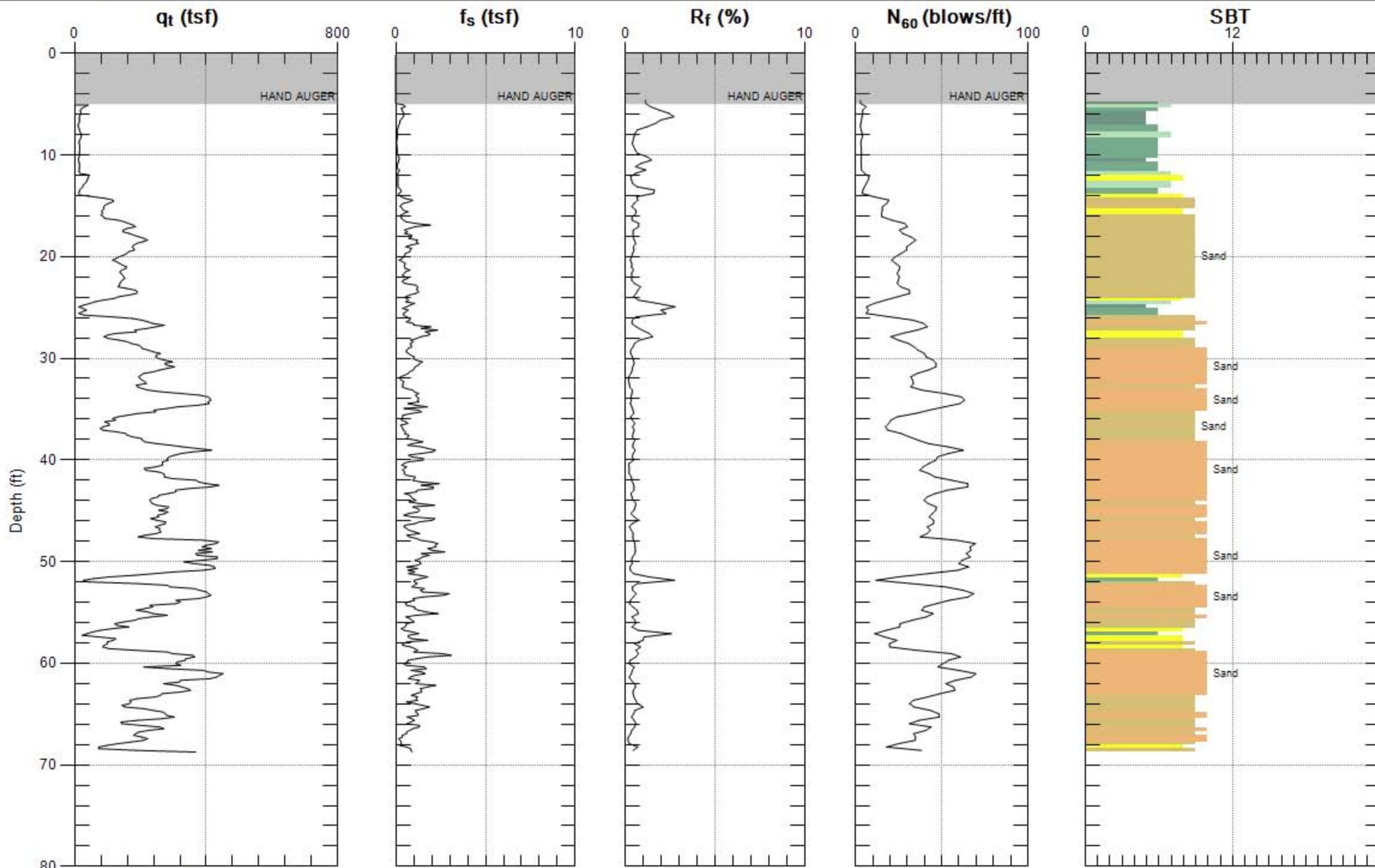
Max. Depth: 59.711 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



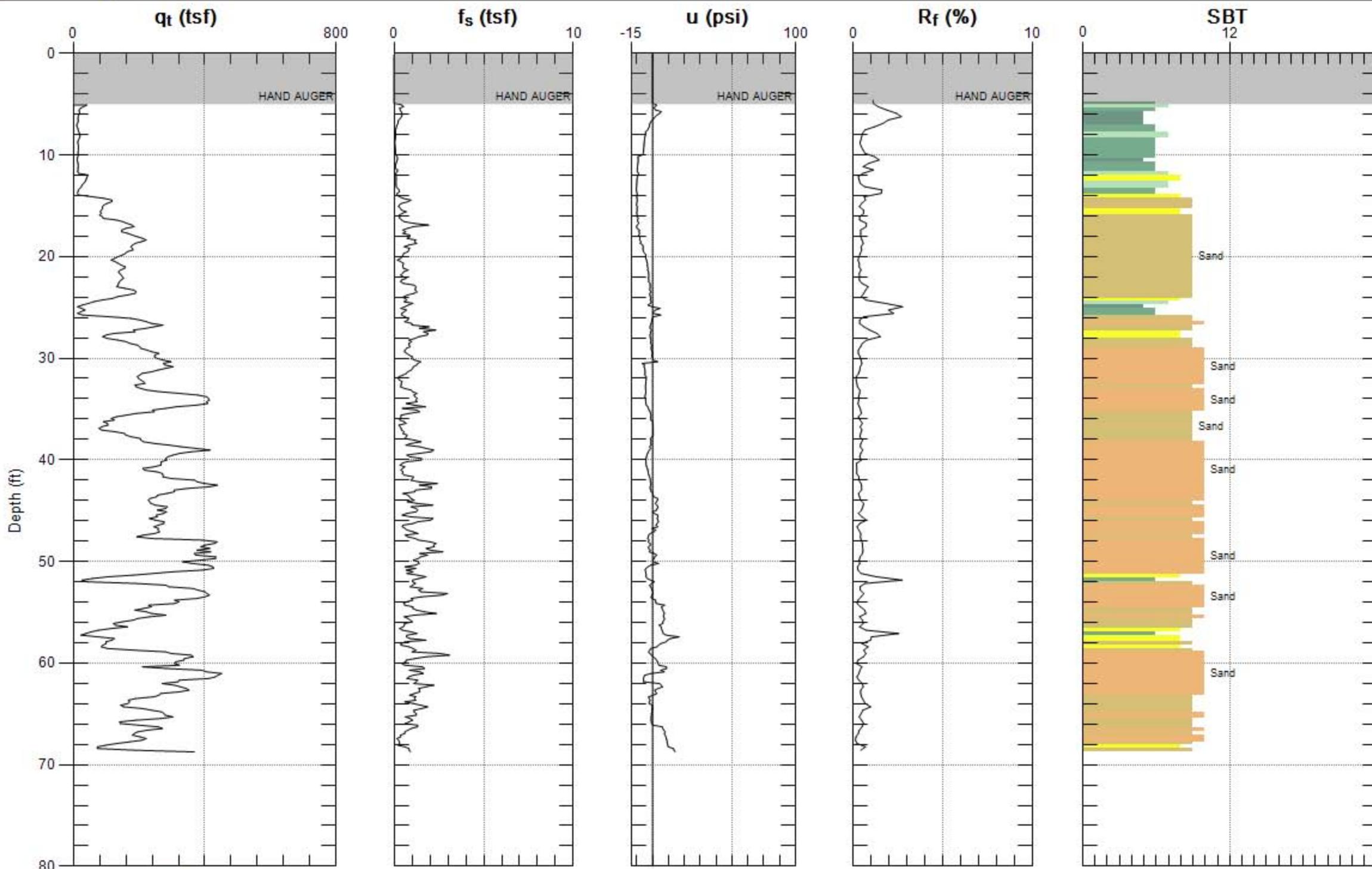
Max. Depth: 59.711 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



Max. Depth: 68.734 (ft)
 Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



Max. Depth: 68.734 (ft)
 Avg. Interval: 0.328 (ft)

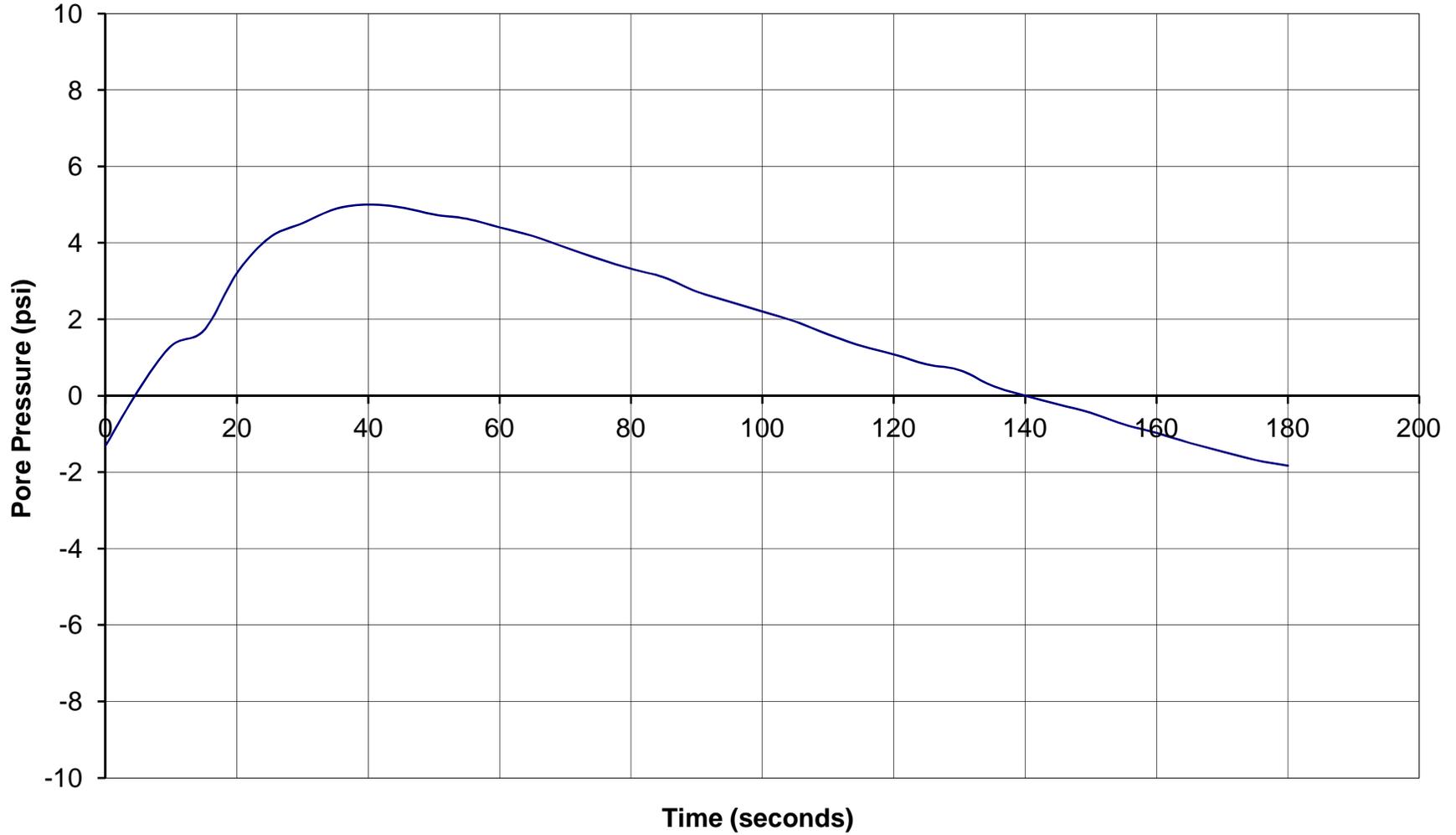
SBT: Soil Behavior Type (Robertson 1990)



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

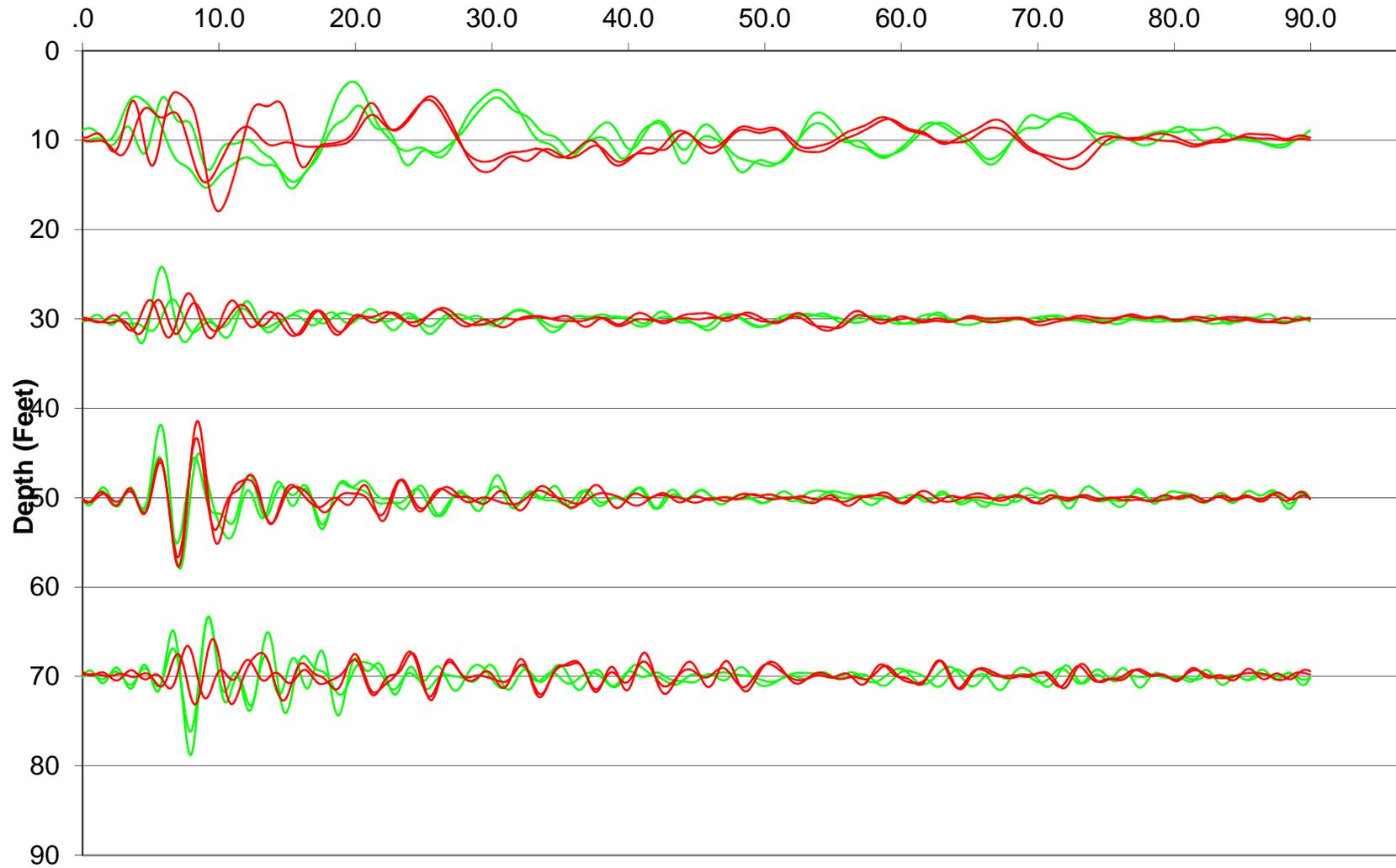
Sounding: CPT-GSC07
Depth: 45.275454
Site: SONOMA
Engineer: JESSICA B





Waveforms for Sounding CPT-GSC01

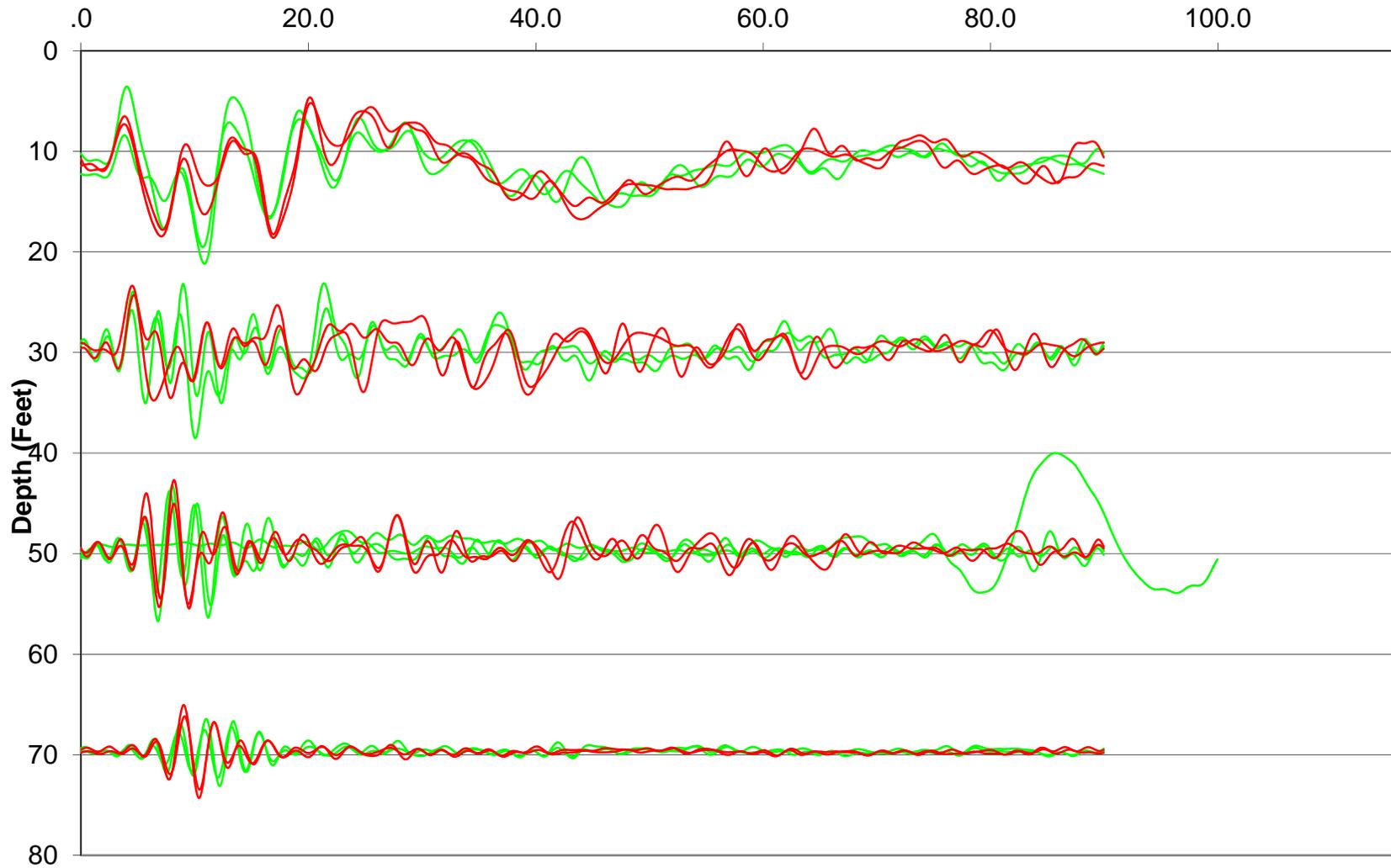
Time (ms)





Waveforms for Sounding CPT-GSC02

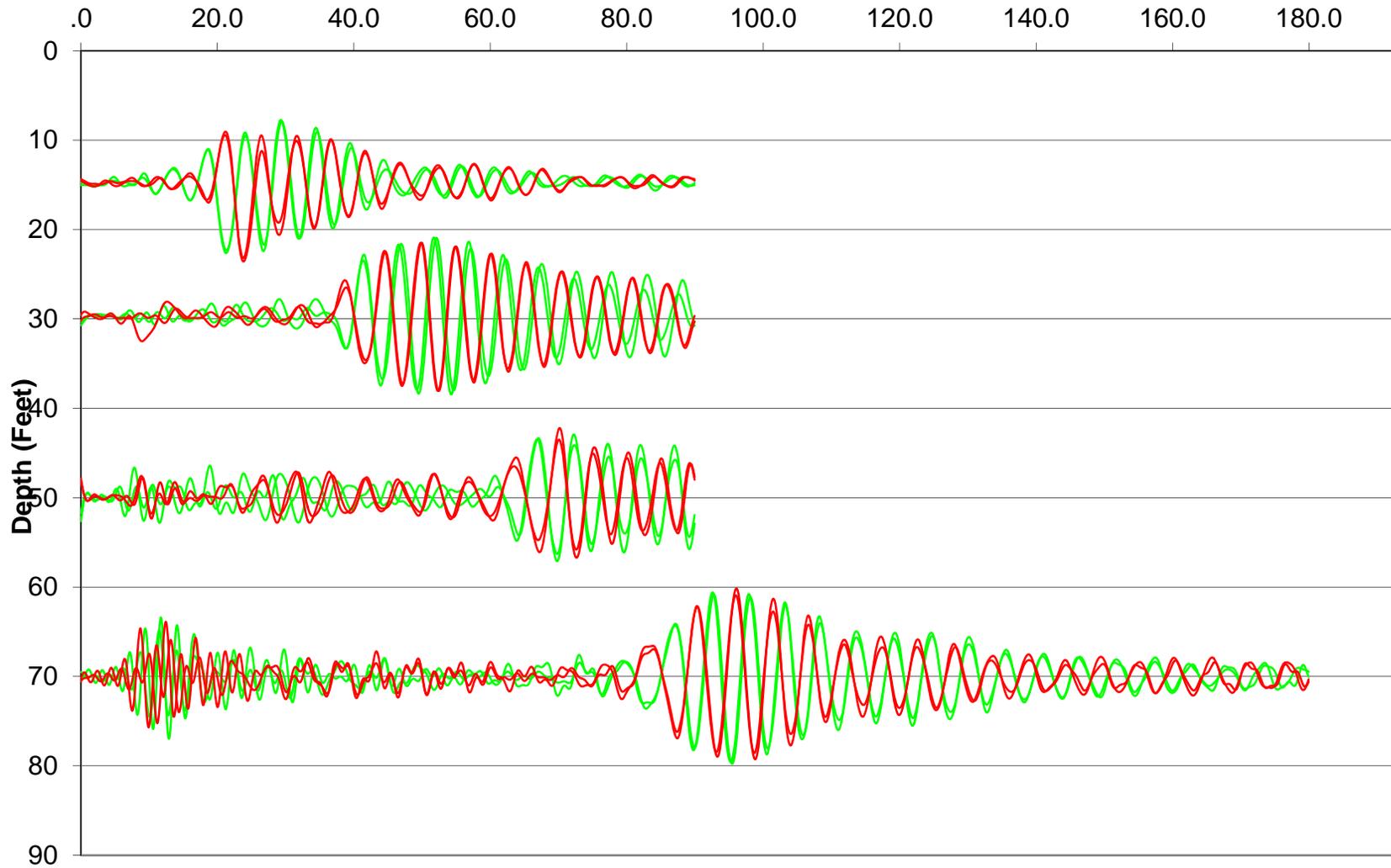
Time (ms)





Waveforms for Sounding CPT-GSC03

Time (ms)





Shear Wave Velocity Calculations

S.RUSSIAN RIVER
CPT-GSC03

Geophone Offset: 0.66 Feet
Source Offset: 1.67 Feet

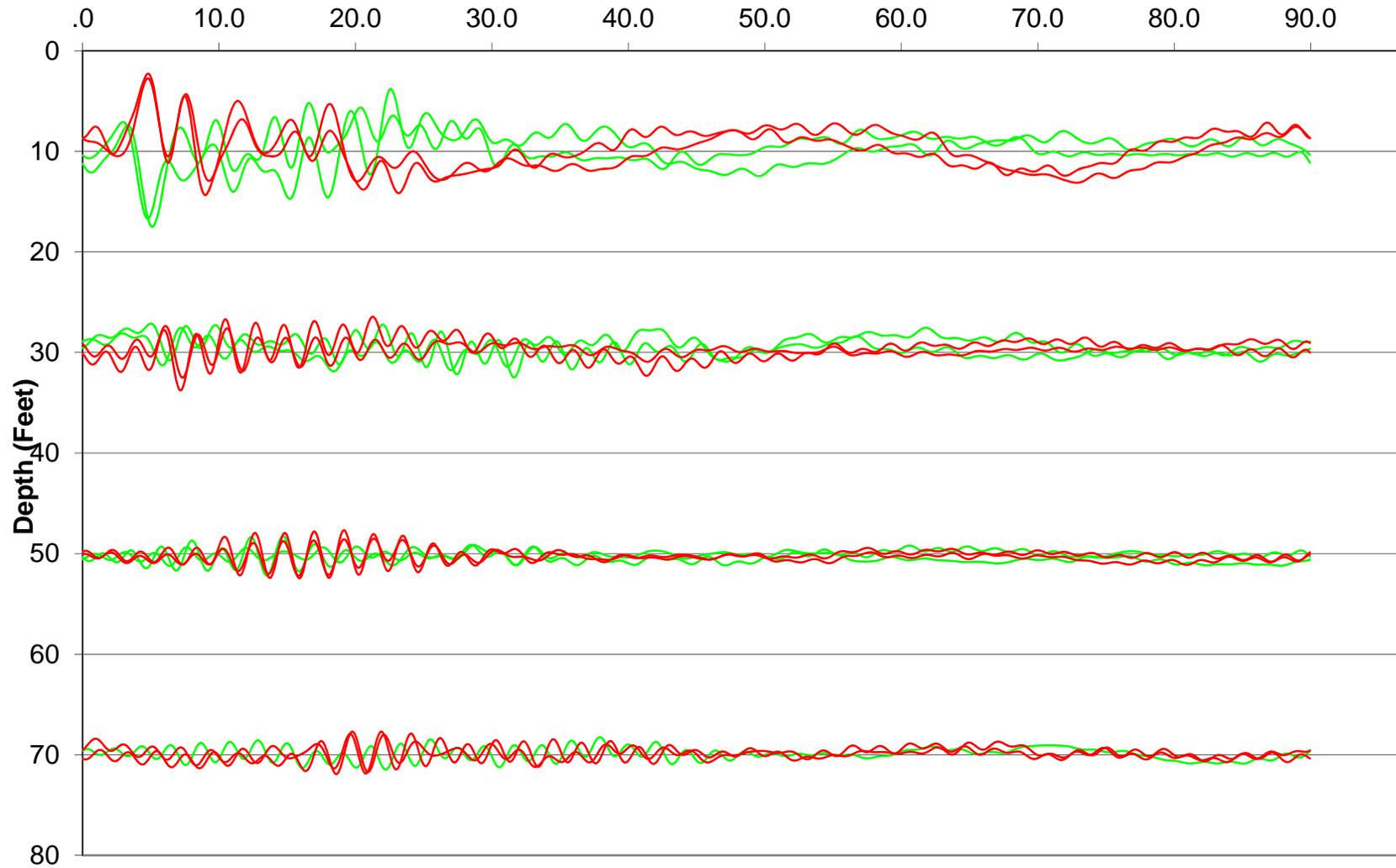
06/23/11

Test Depth (Feet)	Geophone Depth (Feet)	Waveform Ray Path (Feet)	Incremental Distance (Feet)	Characteristic Arrival Time (ms)	Incremental Time Interval (ms)	Interval Velocity (Ft/Sec)	Interval Depth (Feet)
15.09	14.43	14.53	14.53	21.1500			
30.02	29.36	29.41	14.88	38.6500	17.5000	850.2	21.90
50.03	49.37	49.40	19.99	63.8000	25.1500	795.0	39.37
70.05	69.39	69.41	20.00	83.5500	19.7500	1012.9	59.38



Waveforms for Sounding CPT-GSC05

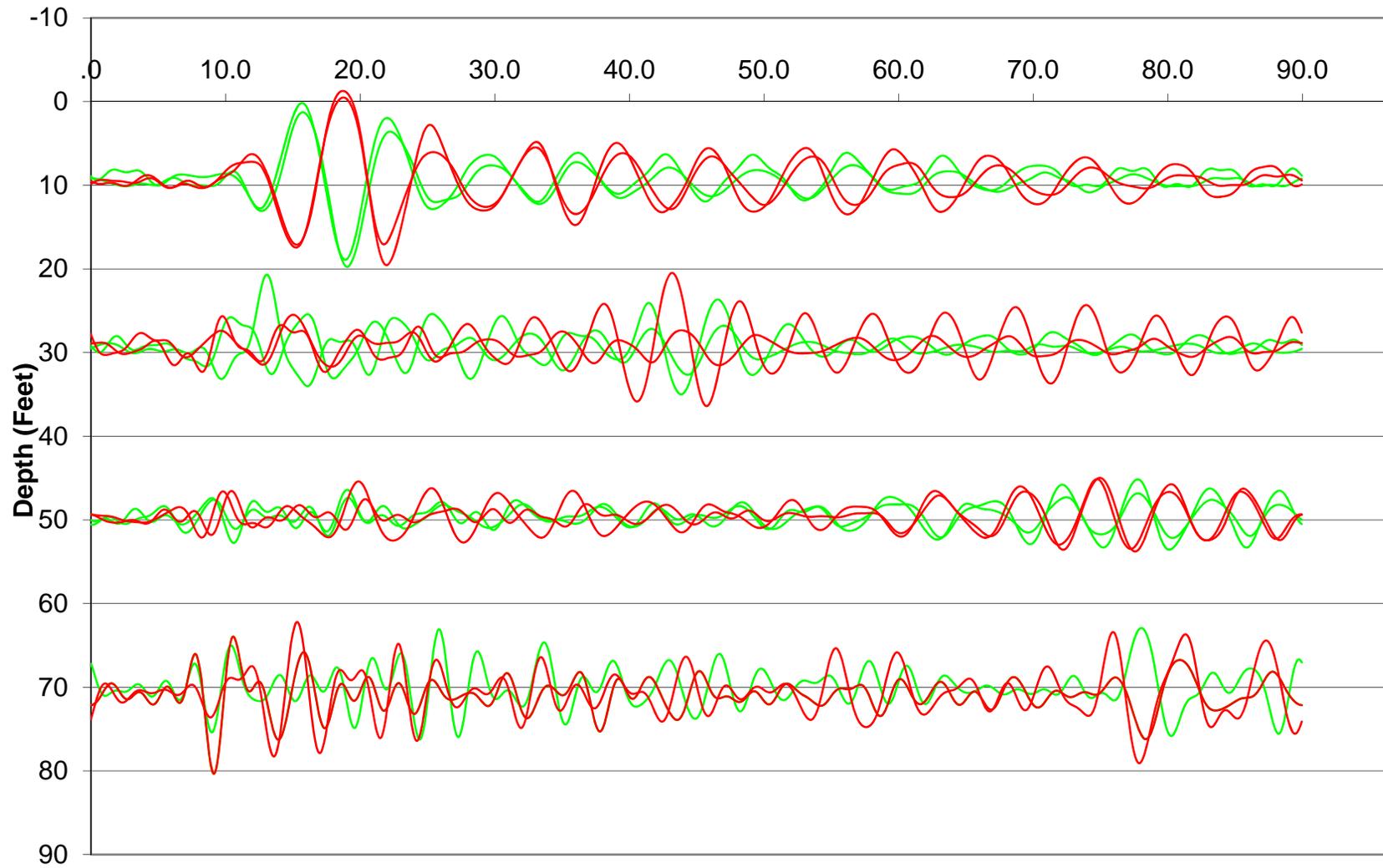
Time (ms)





Waveforms for Sounding CPT-GSC06

Time (ms)





Shear Wave Velocity Calculations

S.RUSSIAN RIVER
CPT-GSC06

Geophone Offset: 0.66 Feet
Source Offset: 1.67 Feet

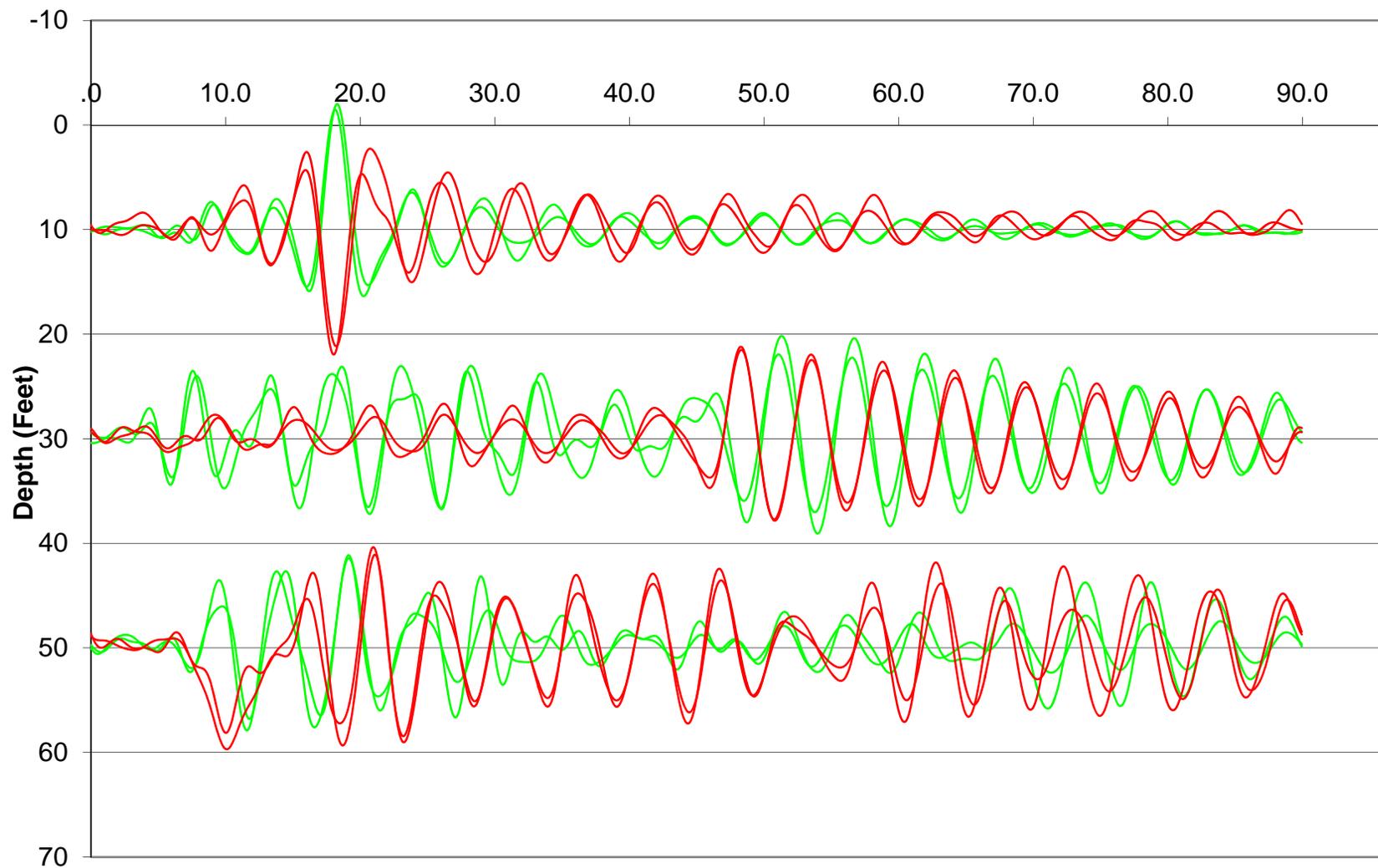
06/21/11

Test Depth (Feet)	Geophone Depth (Feet)	Waveform Ray Path (Feet)	Incremental Distance (Feet)	Characteristic Arrival Time (ms)	Incremental Time Interval (ms)	Interval Velocity (Ft/Sec)	Interval Depth (Feet)
10.01	9.35	9.49	9.49	18.9000			
30.02	29.36	29.41	19.91	43.2000	24.3000	819.4	19.35
70.54	69.88	69.90	40.49	76.0000	32.8000	1234.5	49.62



Waveforms for Sounding CPT-GSC07

Time (ms)





Shear Wave Velocity Calculations

S.RUSSIAN RIVER
CPT-GSC07

Geophone Offset: 0.66 Feet
Source Offset: 1.67 Feet

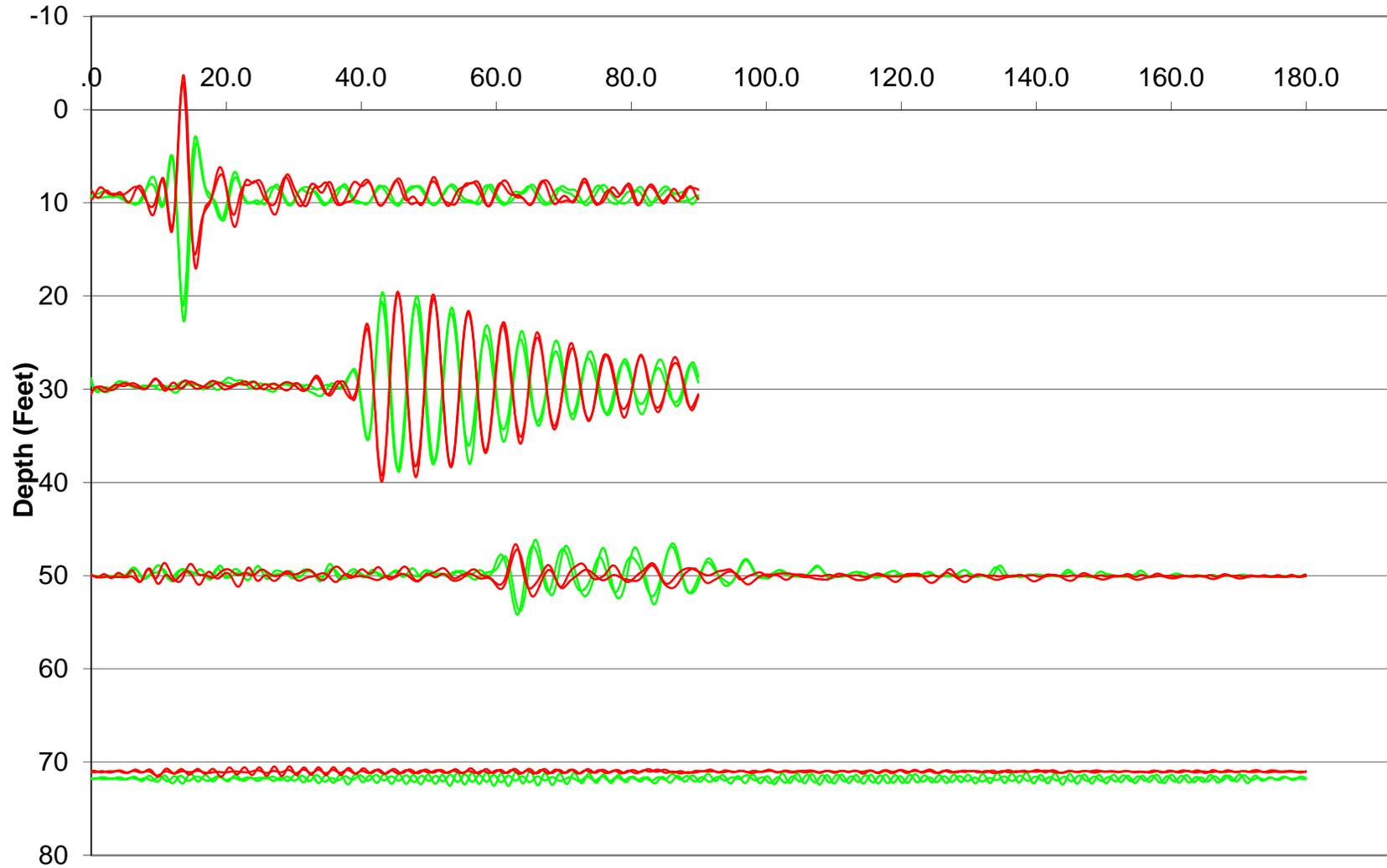
06/21/11

Test Depth (Feet)	Geophone Depth (Feet)	Waveform Ray Path (Feet)	Incremental Distance (Feet)	Characteristic Arrival Time (ms)	Incremental Time Interval (ms)	Interval Velocity (Ft/Sec)	Interval Depth (Feet)
10.33	9.67	9.82	9.82	18.1000			
30.02	29.36	29.41	19.59	51.3500	33.2500	589.2	19.52



Waveforms for Sounding CPT-GSC08

Time (ms)





Shear Wave Velocity Calculations

S.RUSSIAN RIVER
CPT-GSC08

Geophone Offset: 0.66 Feet
Source Offset: 1.67 Feet

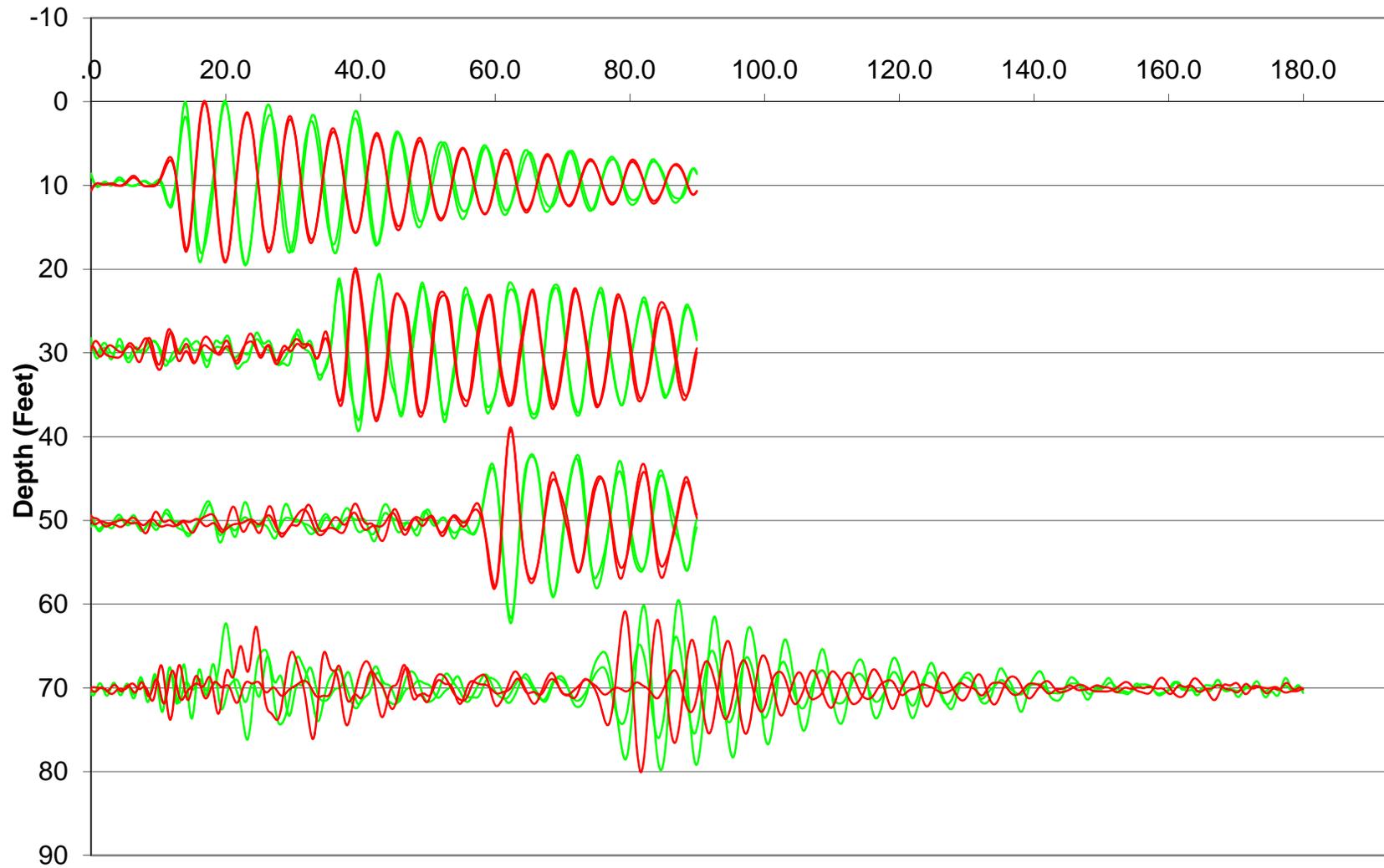
06/22/11

Test Depth (Feet)	Geophone Depth (Feet)	Waveform Ray Path (Feet)	Incremental Distance (Feet)	Characteristic Arrival Time (ms)	Incremental Time Interval (ms)	Interval Velocity (Ft/Sec)	Interval Depth (Feet)
10.01	9.35	9.49	9.49	10.6000			
30.02	29.36	29.41	19.91	40.7500	30.1500	660.4	19.35
50.03	49.37	49.40	19.99	63.1500	22.4000	892.6	39.37



Waveforms for Sounding CPT-GSC09

Time (ms)





Shear Wave Velocity Calculations

S.RUSSIAN RIVER

CPT-GSC09

Geophone Offset: 0.66 Feet

Source Offset: 1.67 Feet

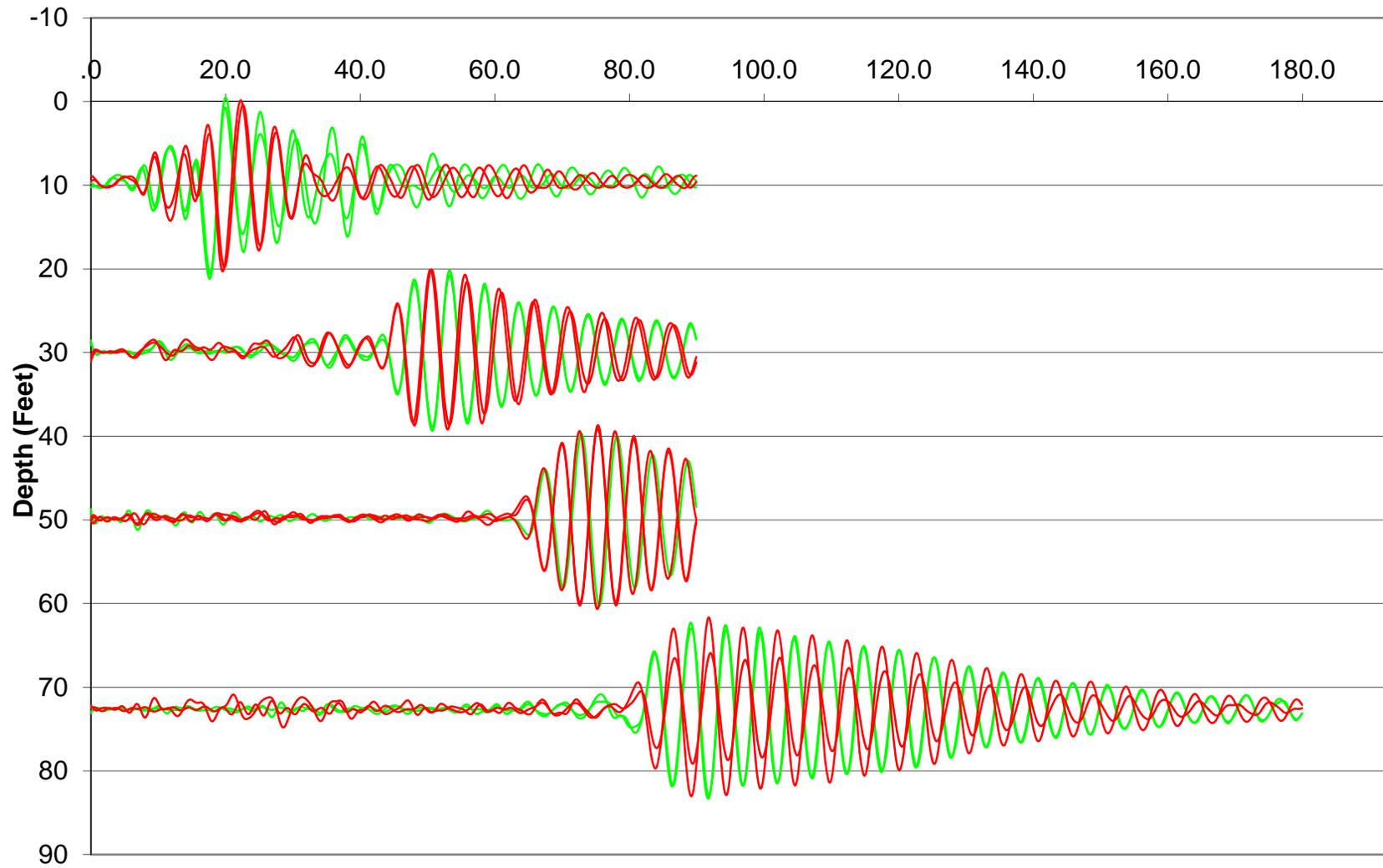
06/22/11

Test Depth (Feet)	Geophone Depth (Feet)	Waveform Ray Path (Feet)	Incremental Distance (Feet)	Characteristic Arrival Time (ms)	Incremental Time Interval (ms)	Interval Velocity (Ft/Sec)	Interval Depth (Feet)
10.01	9.35	9.49	9.49	11.7000			
30.02	29.36	29.41	19.91	34.8000	23.1000	862.0	19.35
50.20	49.54	49.56	20.16	57.0500	22.2500	906.0	39.45
70.05	69.39	69.41	19.84	72.9500	15.9000	1247.9	59.46



Waveforms for Sounding CPT-GSC10

Time (ms)





Shear Wave Velocity Calculations

S.RUSSIAN RIVER
CPT-GSC10

Geophone Offset: 0.66 Feet
Source Offset: 1.67 Feet

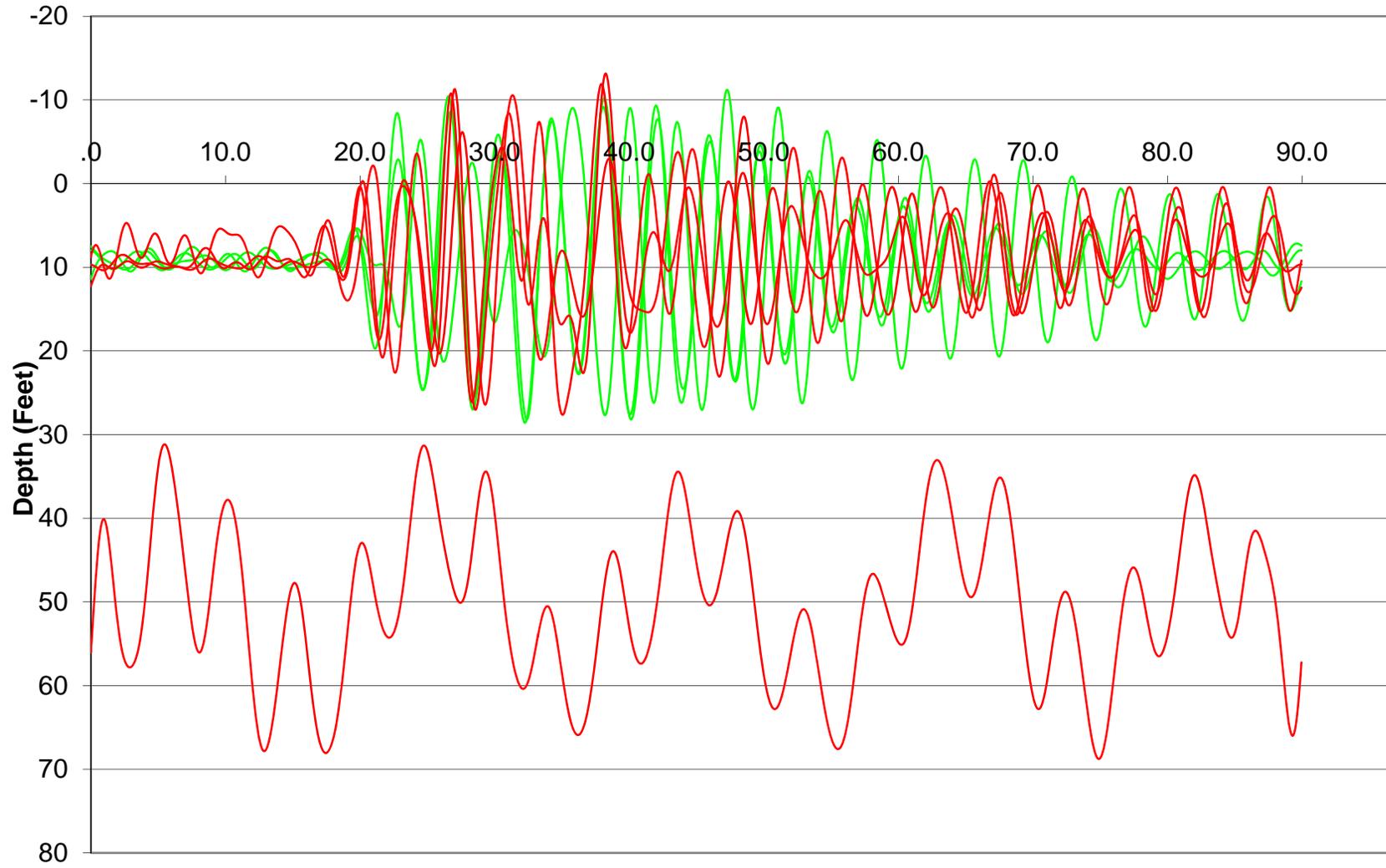
06/23/11

Test Depth (Feet)	Geophone Depth (Feet)	Waveform Ray Path (Feet)	Incremental Distance (Feet)	Characteristic Arrival Time (ms)	Incremental Time Interval (ms)	Interval Velocity (Ft/Sec)	Interval Depth (Feet)
10.17	9.51	9.66	9.66	9.5000			
30.02	29.36	29.41	19.75	45.5000	36.0000	548.6	19.44
50.03	49.37	49.40	19.99	64.7500	19.2500	1038.6	39.37
72.51	71.85	71.87	22.46	81.2500	16.5000	1361.5	60.61



Waveforms for Sounding CPT-GSC13

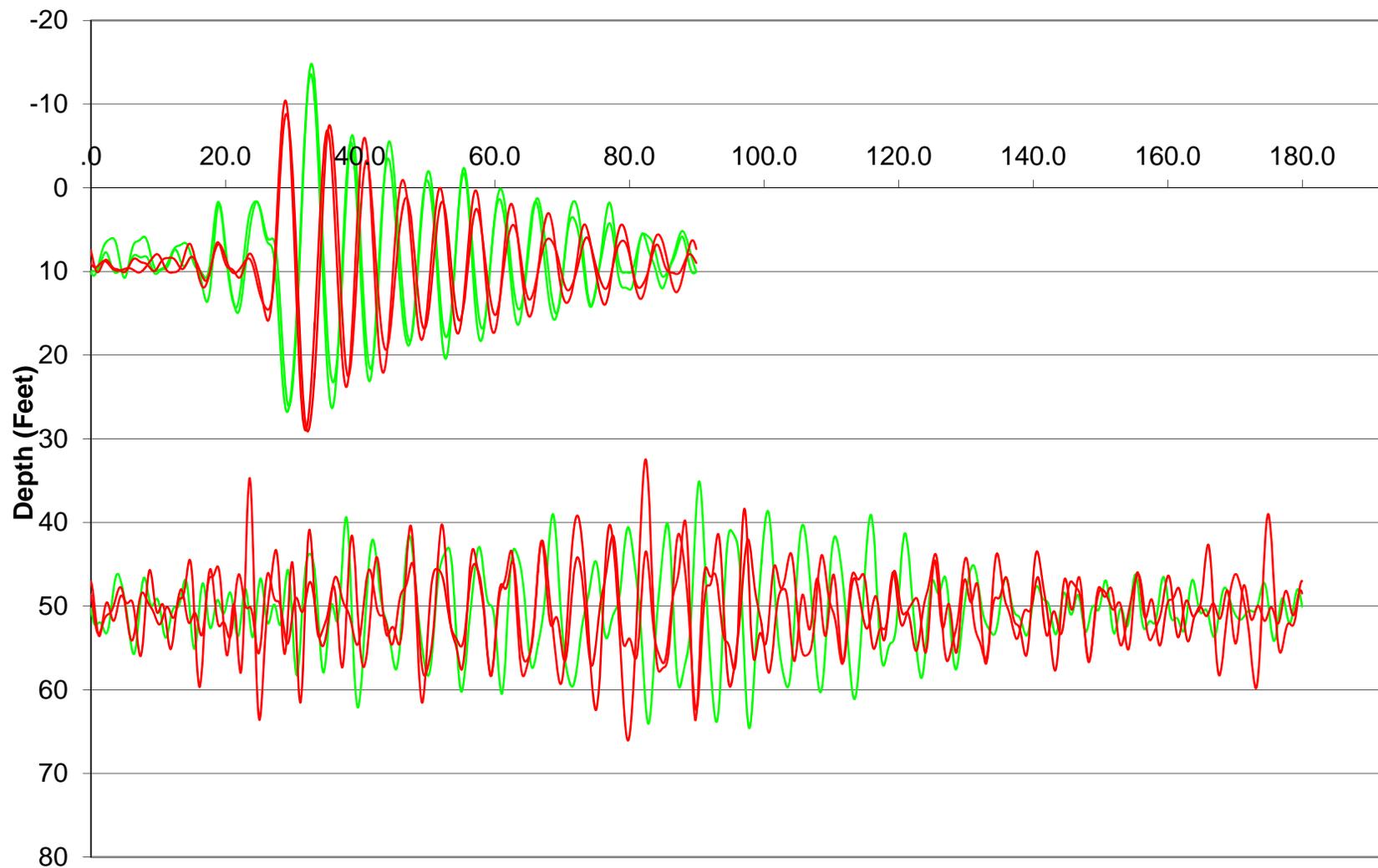
Time (ms)





Waveforms for Sounding CPT-GSC14

Time (ms)



ATTACHMENT B

BORING LOGS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			LABORATORY RESULTS							
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID	RECOVERY (%)	COMMENTS	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS
												LIQUID LIMIT	PLASTIC LIMIT	
			Top 5-ft hand augered.											
	5		Silty SAND (SM): dark brown, medium and fine sand.				100							
	35		Silty SAND (SM): dark gray, moist, fine sand, and content decreasing down sample.				100							
	10		Silty SAND (SM): brown, fine grained, specks of light brown sand, sample coming up very compressed.				50		3.5	74.1	22.4		NP	2.3
	30		Silty SAND (SM): brown, medium grained sand.				100							0.7
	15		SAND (SP): dark brown, moist, medium to fine grained, loose.				75							
	25		Poorly-graded SAND with silt and gravel (SP-SM): brown, moist, medium grained, lighter color sand mixed in.				94		33.7	59.3	7			0.6
	20		Poorly-graded SAND with silt and gravel (SP-SM): dark gray, wet, medium to large grained, gray colored gravels.				50							
	15		End of boring at 28-ft bgs due to cave in.											

CONTRACTOR: Gregg Drilling
EQUIPMENT: M 2.5 DP
DRILL MTHD: Geoprobe
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 2 1/4

NORTHING 1943732.57
EASTING 6304963.03
COORDINATE SYSTEM:

LOGGER JAB
NOTES:

REVIEWER CH

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			LABORATORY RESULTS							
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID	RECOVERY (%)	COMMENTS	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS
												LIQUID LIMIT	PLASTIC LIMIT	
80			Hole was pre-dug down to 6-ft.											
75			Fill: dark gray, gravel with some fines.											
70			Sampler hit obstruction at 11-ft. After two attempts, terminating boring at 11-ft bgs.											

CONTRACTOR: Gregg Drilling

NORTHING 1944052.54

EQUIPMENT: M 2.5 DP

EASTING 6305061.3

DRILL MTHD: Geoprobe

COORDINATE SYSTEM:

HAMMER TYPE: Automatic

BOREHOLE DIAMETER (IN): 2 1/4

LOGGER JAB

REVIEWER CH

NOTES:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			LABORATORY RESULTS							
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID	RECOVERY (%)	COMMENTS	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS
												LIQUID LIMIT	PLASTIC LIMIT	
55			Top 5-ft hand augered. Organics and very hard layer 1-2" thick, cemented gravels.											
5			Sandy SILT (SM): brown, low plasticity.			50				0	42.6	57.4		1.8
50			Silty SAND (SM): dark brown, fine grained.			63				0	77.6	22.4		1.6
10														
45			Poorly-graded SAND with silt (SP-SM): grayish brown, dry, fine grained, non-plastic fines, larger pieces of sand/gravel.			50				3	86	11		0.7
15														
40			Silty SAND (SM): grayish brown, very dry, fine grained, non-plastic fines, small gray gravel pieces.			50				11.9	84	14.1		0.7
20			Poorly-graded SAND with silt (SP-SM): grayish brown, moist, fine-medium grained, non-plastic fines, pieces of small gravel.			81				5.7	82.3	12		0.6
35														
25			Poorly-graded SAND with silt and gravel (SP-SM): grayish brown, moist, large grained sand.			100				21.5	71.5	7		0.6
30														
30			Poorly-graded SAND with silt and gravel (SP-SM): grayish brown, medium-large gravels.			100				35.5	55.8	8.7		0.6

CONTRACTOR: Gregg Drilling
EQUIPMENT: M 2.5 DP
DRILL MTHD: Geoprobe
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 2 1/4

NORTHING 1943899.52
EASTING 6306758.11
COORDINATE SYSTEM:

LOGGER JAB
NOTES:

REVIEWER CH

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			COMMENTS	LABORATORY RESULTS						
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID		RECOVERY (%)	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS
												LIQUID LIMIT	PLASTIC LIMIT	
25			Refusal at 31-ft bgs, large gravels stuck in the toe of the sampler.	X										
35														
20														
40														
15														
45														
10														
50														
5														
55														
0														
60														

CONTRACTOR: Gregg Drilling **NORTHING** 1943899.52
EQUIPMENT: M 2.5 DP **EASTING** 6306758.11
DRILL MTHD: Geoprobe **COORDINATE SYSTEM:**
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 2 1/4

LOGGER JAB **REVIEWER** CH
NOTES:
 SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			LABORATORY RESULTS							
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID	RECOVERY (%)	COMMENTS	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS
												LIQUID LIMIT	PLASTIC LIMIT	
75		[Hatched pattern]	Fill: large gravel and sand mixed with fill.											
5		[Hatched pattern]	Large gravel and sand mixed with fill.											
70			Large rock stuck in toe of sampler. Boring terminated at 7-ft BGS.											
10														
65														
15														
60														
20														
55														
25														
50														
30														

CONTRACTOR: Gregg Drilling **NORTHING** 1943770.55
EQUIPMENT: M 2.5 DP **EASTING** 6306848.37
DRILL MTHD: Geoprobe **COORDINATE SYSTEM:**
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 2 1/4

LOGGER JAB **REVIEWER** CH
NOTES:
 SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			LABORATORY RESULTS							
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID	RECOVERY (%)	COMMENTS	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS
												LIQUID LIMIT	PLASTIC LIMIT	
65			Hole previously dug to 10-ft bgs.											
55	10		Blackish brown sandy fill material.				75							
45	20		Brownish black, moist, very stiff. with small pebbles at the bottom of the sample.				90							
30	23		Refusal at 23-ft bgs. Significant difficulties with casing.				100							

CONTRACTOR: Gregg Drilling
EQUIPMENT: M 2.5 DP
DRILL MTHD: Geoprobe
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 2 1/4

NORTHING 1945183.43
EASTING 6307970.11
COORDINATE SYSTEM:

LOGGER JD
NOTES:

REVIEWER CH

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			COMMENTS	LABORATORY RESULTS						
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID		RECOVERY (%)	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS
												LIQUID LIMIT	PLASTIC LIMIT	
			Top 5-ft hand augered.											
			Silty SAND (SM): brown, poorly-graded, some small pebbles.											
35	5		Layer of gray silt, moist, slight cohesion, some pebbles. Silty SAND (SM): brownish gray, wet.				25							
			Silty SAND (SM): gray, wet.				45	30.3	61.1	8.6		21.7	20.2	1.4
30	10		No recovery - inside of sleeve is sandy, some gray clay, very moist.				0							
25	15		Silty SAND (SM): gray, grayish brown middle grades to reddish, small gravels in toes with pockets of gravel within tube.				100	43.1	44.6	12.3				1.4
20	20		Well-graded SAND with silt and gravel (SP-SM): grayish brown, large cobble in show of sampler. Lots of gravel in shoe.				90	8	62.1	29.9				0.6
			Refusal at 22-ft bgs.											
15	25													
30														

CONTRACTOR: Gregg Drilling
EQUIPMENT: M 2.5 DP
DRILL MTHD: Geoprobe
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 2 1/4

NORTHING 1945192.43
EASTING 6308050.26
COORDINATE SYSTEM:

LOGGER JD
NOTES:

REVIEWER CH

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			LABORATORY RESULTS							
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID	RECOVERY (%)	COMMENTS	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS
												LIQUID LIMIT	PLASTIC LIMIT	
65			Fill: gravel with sand.											
60	5		Sandy SILT (ML): light brown, dry, non-plastic. Sandy SILT (ML): light brown, dry, very soft.				100							NP
55	10		Sandy SILT (ML): light brown, dry, becoming sandy, soft.				30							
50	15		Silty SAND (SP): brown, fine grained, some white and black colored gravel.				20							
45	20		Silty SAND (SP): brown, fine grained, interbedded with clean medium grained sand, gravel within toe of sampler.				45			3.3	84.6	12.1		0.7
40	25		Poorly-graded SAND with silt and gravel (SP-SM): brown, interbedded fine grained sand, white colored gravel and sand.				80			38.8	55.7	5.5		0.6
30			Poorly-graded SAND with silt and gravel (SP-SM): brown, interbedded fine to medium grained sand with gravel. Refusal at 26-ft bgs.				20							

CONTRACTOR: Gregg Drilling
EQUIPMENT: M 2.5 DP
DRILL MTHD: Geoprobe
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 2 1/4

NORTHING 1950994.12
EASTING 6309882.61
COORDINATE SYSTEM:

LOGGER JD
NOTES:

REVIEWER CH

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	SAMPLE			COMMENTS	LABORATORY RESULTS									
					BLOWS PER 6" RUN TIME	SAMPLE ID	RECOVERY (%)		PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS		Other		
			SAND (SP): Brownish orange, dry, some small gravels.				50											
30	5		Silty SAND with gavel (SM): dark brown, dry, fine grained sand, non-plastic fines.				38											
25	10		SAND with silt and gravel (SM): dark brown, dry, fine grained, non-plastic fines, dense.				75											
20	15		Silty SAND with gravel (SM): dark brown, moist, fine grained.				88											
			Boring terminated at 16-ft bgs due to cave in.															

CONTRACTOR: Gregg Drilling
EQUIPMENT: M 2.5 DP
DRILL MTHD: Geoprobe
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 2 1/4
NORTHING 1943937.2
EASTING 6305324.57
COORDINATE SYSTEM:

LOGGER JAB **REVIEWER** CH
NOTES:
 SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			LABORATORY RESULTS										
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID	RECOVERY (%)	COMMENTS	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS		Other	
												LIQUID LIMIT	PLASTIC LIMIT				
			Hand augered top 5-ft.														
	5		CLAY with sand (CL): brown, dry, very stiff.			83						3.8	22.7	73.5			
	7.5		Lean CLAY with sand (CL): dark grayish brown, dry, very stiff, large piece of gravel in toe.			75						3.1	22.5	74.4	34.2	21.4	2.7
	10		Clayey SILT (ML): dark gray, dry, very stiff.			17											
	15		Refusal at 15-ft bgs.														

CONTRACTOR: Gregg Drilling
EQUIPMENT: M 2.5 DP
DRILL MTHD: Geoprobe
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 2 1/4

NORTHING 1951106.51
EASTING 6309827.64
COORDINATE SYSTEM:

LOGGER JAB

REVIEWER CH

NOTES:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			COMMENTS	LABORATORY RESULTS									
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID		RECOVERY (%)	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS		Other	
											LIQUID LIMIT	PLASTIC LIMIT					
			Topsoil, dark brown organics.														
50	5		SILT with sand (ML): dark brown, dry, fine grained, 5% sand, 2" layer of sand with some silt and then transitions back to more silt content.		3-3-3	A	100			0	3.8	96.2				2.6	
			SILT (ML): brown, dry, fine grained, medium stiff, more moist with depth of sampler.		2-2-3	B	70						24.4	116.3	31.1	24.5	
45	10		Silty SAND (SM): dark brown, moist, fine grained, 30% silt, loose to medium dense.		1-1-2	C	100										
			Transitions from Silty SAND to Poorly-graded SAND (SP): brown, moist, medium-fine grained, loose.		2-3-3	D	100			0.1	97.1	2.8	5.7	89.4	25.6	18.9	0.8
40	15		Poorly-graded SAND with silt (SP): moist, medium-fine grained, some medium subangular gravels, 5% silt.		3-5-6	E	50										
			SAND with gravel (SP): brown, moist, large-medium grained, small-large gravels, little fines (~5%), loose.		12-15-14	F	70						2.6	113.3		0.7	
35	20		Well-graded GRAVEL with sand (GW-SW): moist, little fines (~5%).		5-6-6	G	50										
			Poorly-graded GRAVEL with silty clay and sand (GP-GC): brown, very moist, large grained sand, 10% low plasticity fines, 2" lens of clay at 25-ft.		6-7-8	H	66			52.8	38.5	8.7	5	117.9		0.9	
30	25		Well-graded GRAVEL with sand (GW-GM): lens of large grained sand at 27.5-ft before transition to 4" of gray brown silty CLAY, moist, medium plasticity. Bottom of sample has red sand transition before gravel sand.		1-8-12	I	90										
25	30																

CONTRACTOR: Gregg Drilling
EQUIPMENT: Rhino
DRILL MTHD: HSA
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 4

NORTHING
EASTING
COORDINATE SYSTEM:

LOGGER JAB
NOTES:

REVIEWER CH

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			COMMENTS	LABORATORY RESULTS								
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID		RECOVERY (%)	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS		Other
			Well-graded GRAVEL with silt and sand (GW-SW): brown, transitions to less fines with depth.		12-18-22	J	50		36.5	45.3	6.3	6.8	130.6			
20			No recovery.		2-2-4		0									
35			No recovery.		8-11-20		0									
15			Poorly-graded SAND with silt and gravel (SP-SM): brown, wet, 5% silt fines.		5-6-9	K	80		7.2	57.6	5.9					0.8
40			Boring terminated at 40.5-ft bgs and backfilled with monitoring well. Boring was backfilled with a 2-in diameter well casing with bottom 10-ft screened with 0.02-in slotting; #3 Monterey sand was used to backfill from the bottom to 2-ft above the screened interval of the well; 3-ft bentonite plug was poured from a mix of 3/4-in bentonite chips; the remaining depth of the boring was backfilled with grout and a flush surface mount was placed over the well.													
45																
5																
50																
0																
55																
-5																
60																

CONTRACTOR: Gregg Drilling
EQUIPMENT: Rhino
DRILL MTHD: HSA
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 4

NORTHING
EASTING
COORDINATE SYSTEM:

LOGGER JAB
NOTES:

REVIEWER CH

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			COMMENTS	LABORATORY RESULTS						
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID		RECOVERY (%)	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS
												LIQUID LIMIT	PLASTIC LIMIT	
55			Topsoil, dark brown organics.											
5			Clayey SAND (SC): brown, dry, stiff.		21-12-17	A	80		7.2	45.3	47.5	8.9	129.5	1.6
50			Clayey SILT with sand (ML): dark brown, dry, fine grained sand, medium stiff.		5-7-7	B	50							
10			Sandy SILT (ML): brown, moist, fine grained, loose-medium dense.		3-5-6	C	80		0	33.6	66.4	17.3	116.2	1.8
45			Silty SAND (SM): brown, moist, 30% silt, loose to medium dense, few small gravels.		2-3-3	D	40							
15			Silty SAND (SM): brown, moist, fine grained, non-plastic fines, loose, some lighter color sands, no gravels.		2-2-2	E	90		0	66.7	33.3	21.1	111.9	1.7
40			Poorly-graded SAND (SP): fine to large grained, small gravels, variety of colors. 1" of clay at 19-ft.		3-3-6	F	30							
35			Poorly-graded SAND (SP): brown, moist, little non-plastic fines, loose, some gravels.		4-6-7	G	90		10	88.8	1.2	3.8	108.7	0.7
25			Well-graded SAND (SW): dark brown, moist, non-plastic fines, loose, 10% gravels, larger rounded gravels in toe of sampler.		7-9-11	H	30							
30			Top 3": same as above. Transitions to silty SAND with gravel (SM): brown, moist, non-plastic fines, loose.		7-10-13	I	66		22.8	56	21.2	5.9	109.7	1.6

CONTRACTOR: Gregg Drilling
EQUIPMENT: Rhino
DRILL MTHD: HSA
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 4

NORTHING
EASTING
COORDINATE SYSTEM:

LOGGER JAB
NOTES:

REVIEWER CH

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

GS FORM:
03-GEOTECH4

BOREHOLE LOG

ELEVATION (ft)	DEPTH (ft-bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE			COMMENTS	LABORATORY RESULTS						
				TYPE	BLOWS PER 6" RUN TIME	SAMPLE ID		RECOVERY (%)	PERCENT GRAVEL (%)	PERCENT SAND (%)	PERCENT FINES (%)	MOIST. CONTENT (%)	MOIST UNIT WEIGHT (pcf)	ATTERBERG LIMITS
											LIQUID LIMIT	PLASTIC LIMIT		
25			Well-graded SAND with gravel (SW): dark gray, moist, dense.		7-14-16	J	40							
35			Well-graded SAND with gravel (SW): grayish brown		11-14-12	K	90		45.5	50.2	4.3	8.2	145.6	0.9
20			Well-graded SAND with gravel (SW): moist, medium-large gravels, medium-large sand, non-plastic fines.		8-9-12	L	20							
40			Poorly-graded SAND (SP): brown, moist, non-plastic fines, few large gravels.		5-11-16	M	80		13.9	83.8	2.3	8.8	117.0	1.1
15			Boring terminated at 40.5-ft bgs and backfilled with monitoring well. Boring was backfilled with a 2-in diameter well casing with bottom 10-ft screened with 0.02-in slotting; #3 Monterey sand was used to backfill from the bottom to 2-ft above the screened interval of the well; 3-ft bentonite plug was poured from a mix of 3/4-in bentonite chips; the remaining depth of the boring was backfilled with grout and a flush surface mount was placed over the well.											

CONTRACTOR: Gregg Drilling
EQUIPMENT: Rhino
DRILL MTHD: HSA
HAMMER TYPE: Automatic
BOREHOLE DIAMETER (IN): 4

NORTHING
EASTING
COORDINATE SYSTEM:

LOGGER JAB **REVIEWER** CH

NOTES:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

ATTACHMENT C
GEOTECHNICAL LABORATORY DATA



Organic Content Test
ASTM D 2974-00 (Method C - 440 °C)

CTL JOB NO.: 461-181 PROJECT: Sonoma-Healdsburg DATE: 8/5/2011
 CLIENT: Geosyntec Consultants PROJECT NO.: MMW597 BY: RU

Boring :	Collector RDS	Collector RDS	Collector RDS	Collector RDS	Collector RDS	Collector RDS	Collector RDS	
Sample :	GSC-07	GSC-07	GSC-07	GSC-07	DP6B	DP6D	DP6E	
Depth (ft.):	9-10	14-15	33-34	46-47	8-12	16-20	20-22	
Visual Description:	Brown SILT w/ Sand	Brown Sandy SILT	Grayish Brown Well- Graded SAND w/ Silt & Gravel	Grayish Brown Well- Graded SAND w/ Silt & Gravel	Gray Silty SAND	Gray Silty SAND	Grayish Brown Well- Graded SAND w/ Silt & Gravel	
Dish No.								
Dish wt., gm	43.94	77.02	67.87	82.20	80.96	80.92	63.68	
Soil, Org, Dish & H ₂ O, gm	70.48	141.40	149.86	185.20	258.98	189.92	202.40	
Oven Dry wt (105°C), gm	64.18	132.31	143.36	176.32	232.69	177.45	191.66	
Furnace Dry wt. (440°C), gm	63.86	131.34	142.85	175.65	230.54	176.14	190.83	
Moisture Content, % of Oven Dry Mass	31.1	16.4	8.6	9.4	17.3	12.9	8.4	
Organic Matter, %	1.6	1.8	0.7	0.7	1.4	1.4	0.6	

Note: ASTM provides no guidelines for including information about the organic content of a sample in the description when the wet/dry liquid limit data is not available. CTL developed the following guidelines to fill this gap:

- 0-5%: The organics are either not mentioned or mentioned as being "trace".
- 5-15%: The soil is considered as inorganic and is classified, as per ASTM 2487, with "with organics" included in the description.
- 15-50%: The soil is considered as organic and is described, per ASTM 2487.
- > 50%: The soil is described as "Peat".



Organic Content Test
ASTM D 2974-00 (Method C - 440 °C)

CTL JOB NO.: 461-181 PROJECT: Sonoma-Healdsburg DATE: 8/2/2011
 CLIENT: Geosyntec Consultants PROJECT NO.: MMW597 BY: RU

Boring :	Collector #5	Collector #5	Collector #5	Collector #5	Collector #5	Collector #5	Collector #5	
Sample :	DP3A	DP3B	DP3C	DP3D	DP3E	DP3F	DP3G	
Depth (ft.):	5-8	8-12	12-16	16-20	20-24	24-28	28-31	
Visual Description:	Brown Sandy SILT	Dark Brown Silty SAND	Grayish Brown Poorly Graded SAND w/ Silt	Grayish Brown Silty SAND	Grayish Brown Poorly Graded SAND w/ Silt	Grayish Brown Poorly Graded SAND w/ Silt & Gravel	Grayish Brown Poorly Graded SAND w/ Silt & Gravel	
Dish No.								
Dish wt., gm	75.17	80.42	75.75	80.20	81.57	81.76	81.86	
Soil, Org, Dish & H ₂ O, gm	222.08	171.84	205.51	190.82	209.95	228.04	226.80	
Oven Dry wt (105°C), gm	200.78	161.94	200.79	186.68	204.68	223.61	222.74	
Furnace Dry wt. (440°C), gm	198.47	160.65	199.86	185.96	203.91	222.70	221.85	
Moisture Content, % of Oven Dry Mass	17.0	12.1	3.8	3.9	4.3	3.1	2.9	
Organic Matter, %	1.8	1.6	0.7	0.7	0.6	0.6	0.6	

Note: ASTM provides no guidelines for including information about the organic content of a sample in the description when the wet/dry liquid limit data is not available. CTL developed the following guidelines to fill this gap:

- 0-5%: The organics are either not mentioned or mentioned as being "trace".
- 5-15%: The soil is considered as inorganic and is classified, as per ASTM 2487, with "with organics" included in the description.
- 15-50%: The soil is considered as organic and is described, per ASTM 2487.
- > 50%: The soil is described as "Peat".



Organic Content Test
ASTM D 2974-00 (Method C - 440 °C)

CTL JOB NO.: 461-181 **PROJECT:** Sonoma-Healdsburg **DATE:** 8/5/2011
CLIENT: Geosyntec Consultants **PROJECT NO.:** MMW597 **BY:** RU

Boring :	Collector #6	Collector #6	Collector #6	Collector #6	Collector #6	Collector #6	Collector #6	
Sample :	GSC-09	GSC-09	GSC-09	DP9B	DP7A	DP7D	DP7E	
Depth (ft.):	49-50	55-56	65-66	8-12	5-8	16-20	20-24	
Visual Description:	Brown Silty SAND	Grayish Brown Well-Graded SAND w/ Silt & Gravel	Grayish Brown Well-Graded SAND w/ Silt & Gravel	Dark Grayish Brown Lean CLAY w/ Sand	Brown Sandy SILT	Brown Silty SAND	Brown Poorly Graded SAND w/ Silt & Gravel	
Dish No.								
Dish wt., gm	75.74	75.18	80.43	80.21	83.26	75.51	75.42	
Soil, Org, Dish & H₂O, gm	206.25	120.94	180.77	210.65	192.51	168.01	237.67	
Oven Dry wt (105°C), gm	195.94	118.17	169.35	193.40	184.54	164.18	233.44	
Furnace Dry wt. (440°C), gm	194.86	117.84	168.74	190.34	182.62	163.55	232.45	
Moisture Content, % of Oven Dry Mass	8.6	6.4	12.8	15.2	7.9	4.3	2.7	
Organic Matter, %	0.9	0.8	0.7	2.7	1.9	0.7	0.6	

Note: ASTM provides no guidelines for including information about the organic content of a sample in the description when the wet/dry liquid limit data is not available. CTL developed the following guidelines to fill this gap:

- 0-5%: The organics are either not mentioned or mentioned as being "trace".
- 5-15%: The soil is considered as inorganic and is classified, as per ASTM 2487, with "with organics" included in the description.
- 15-50%: The soil is considered as organic and is described, per ASTM 2487.
- > 50%: The soil is described as "Peat".



Organic Content Test
ASTM D 2974-00 (Method C - 440 °C)

CTL JOB NO.: 461-181 PROJECT: Sonoma-Healdsburg DATE: 7/28/2011
 CLIENT: Geosyntec Consultants PROJECT NO.: MMW597 BY: RU

Boring :	Collector #3	Collector #3	Collector #3	Collector #3	Collector #3	Collector #3		
Sample :	DP1C	DP1D	DP1F	GSC-02	GSC-02	GSC-02		
Depth (ft.):	8-12	12-16	20-24	18-19	30-31	48.5-49		
Visual Description:	Brown Silty SAND	Brown Silty SAND	Brown Poorly Graded SAND w/ Silt & Gravel	Brown Well-Graded SAND w/ Silt & Gravel	Brown Poorly Graded SAND w/ Silt & Gravel	Brown Silty SAND		
Dish No.								
Dish wt., gm	80.96	77.02	67.88	83.27	75.42	75.52		
Soil, Org, Dish & H ₂ O, gm	206.78	175.03	238.19	192.11	223.67	135.79		
Oven Dry wt (105°C), gm	182.02	167.95	225.38	185.00	199.18	122.42		
Furnace Dry wt. (440°C), gm	179.68	167.29	224.43	184.32	198.15	121.34		
Moisture Content, % of Oven Dry Mass	24.5	7.8	8.1	7.0	19.8	28.5		
Organic Matter, %	2.3	0.7	0.6	0.7	0.8	2.3		

Note: ASTM provides no guidelines for including information about the organic content of a sample in the description when the wet/dry liquid limit data is not available. CTL developed the following guidelines to fill this gap:

- 0-5%: The organics are either not mentioned or mentioned as being "trace".
- 5-15%: The soil is considered as inorganic and is classified, as per ASTM 2487, with "with organics" included in the description.
- 15-50%: The soil is considered as organic and is described, per ASTM 2487.
- > 50%: The soil is described as "Peat".



Organic Content Test
ASTM D 2974-00 (Method C - 440 °C)

CTL JOB NO.: 461-180b PROJECT: Sonoma-Healdsburg DATE: 7/26/2011
 CLIENT: Geosyntec Consultants PROJECT NO.: MMW597 BY: RU

Boring :	#2	#2	#2	#2	#2	#2	#2	#2
Sample :	WEL2A	WEL2C	WEL2E	WEL2G	WEL2I	WEL2K	WEL2M	
Depth (ft.):	3-4.5	9-10.5	15-16.5	21-22.5	27-28.5	33-34.5	39-40.5	
Visual Description:	Brown Clayey SAND	Brown Sandy SILT	Brown Silty SAND	Brown Poorly Graded SAND	Brown Silty SAND w/ Gravel	Grayish Brown Well-Graded SAND w/ Gravel	Brown Poorly Graded SAND	
Dish No.								
Dish wt., gm	75.18	75.51	81.86	81.76	81.57	63.68	80.93	
Soil, Org, Dish & H ₂ O, gm	221.75	182.33	211.27	203.23	223.01	208.34	225.49	
Oven Dry wt (105°C), gm	209.72	166.64	188.69	200.68	215.14	198.18	213.85	
Furnace Dry wt. (440°C), gm	207.57	165.00	186.91	199.81	213.03	197.00	212.38	
Moisture Content, % of Oven Dry Mass	8.9	17.2	21.1	2.1	5.9	7.6	8.8	
Organic Matter, %	1.6	1.8	1.7	0.7	1.6	0.9	1.1	

Note: ASTM provides no guidelines for including information about the organic content of a sample in the description when the wet/dry liquid limit data is not available. CTL developed the following guidelines to fill this gap:

- 0-5%: The organics are either not mentioned or mentioned as being "trace".
- 5-15%: The soil is considered as inorganic and is classified, as per ASTM 2487, with "with organics" included in the description.
- 15-50%: The soil is considered as organic and is described, per ASTM 2487.
- > 50%: The soil is described as "Peat".



Organic Content Test
ASTM D 2974-00 (Method C - 440 °C)

CTL JOB NO.: 461-180a PROJECT: Sonoma-Healdsburg DATE: 7/26/2011
 CLIENT: Geosyntec Consultants PROJECT NO.: MMW597 BY: RU

Boring :	#1	#1	#1	#1	#1			
Sample :	WEL1B	WEL1D	WEL1F	WEL1H	WEL1K			
Depth (ft.):	6-7.5	12-13.5	18-19.5	24-24.5	30-30.5			
Visual Description:	Brown SILT	Brown Poorly Graded SAND	Brown SAND w/ Gravel	Brown Poorly Graded GRAVEL w/ Silty Clay & Sand	Brown Well-Graded GRAVEL w/ Silt & Sand			
Dish No.								
Dish wt., gm	75.41	75.52	82.21	80.42	80.20			
Soil, Org, Dish & H ₂ O, gm	203.73	205.21	236.60	260.31	238.55			
Oven Dry wt (105°C), gm	175.30	196.13	229.89	251.67	228.32			
Furnace Dry wt. (440°C), gm	172.66	195.18	228.91	250.12	227.18			
Moisture Content, % of Oven Dry Mass	28.5	7.5	4.5	5.0	6.9			
Organic Matter, %	2.6	0.8	0.7	0.9	0.8			

Note: ASTM provides no guidelines for including information about the organic content of a sample in the description when the wet/dry liquid limit data is not available. CTL developed the following guidelines to fill this gap:

- 0-5%: The organics are either not mentioned or mentioned as being "trace".
- 5-15%: The soil is considered as inorganic and is classified, as per ASTM 2487, with "with organics" included in the description.
- 15-50%: The soil is considered as organic and is described, per ASTM 2487.
- > 50%: The soil is described as "Peat".



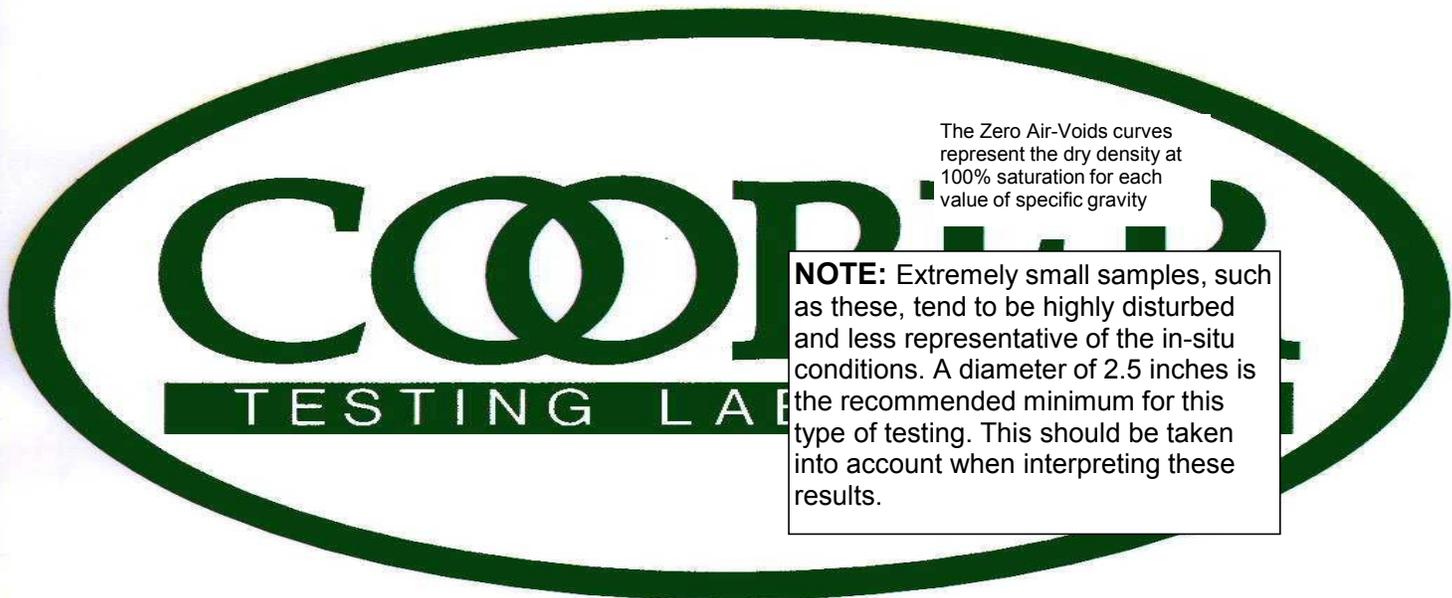
Moisture-Density-Porosity Report

Cooper Testing Labs, Inc. (ASTM D 2937)

CTL Job No: 461-181b **Project No.** MMW597 **By:** RU
Client: Geosyntec Consultants **Date:** 08/05/11
Project Name: Sonoma-Healdsburg **Remarks:**

Boring:	Collector RDS	Collector RDS	Collector RDS	Collector RDS	Collector #6	Collector #6	Collector #6	
Sample:	GSC-07	GSC-07	GSC-07	GSC-07	GSC-09	GSC-09	GSC-09	
Depth, ft:	33-34	37-38	46-47	50-51	49-50	55-56	65-66	
Visual Description:	Grayish Brown Well-Graded SAND w/ Silt & Gravel	Grayish Brown Clayey SAND	Grayish Brown Well-Graded SAND w/ Silt & Gravel	Grayish Brown Silty SAND w/ Gravel	Brown Silty SAND	Grayish Brown Well-Graded SAND w/ Silt & Gravel	Grayish Brown Well-Graded SAND w/ Silt & Gravel	
Actual G_s								
Assumed G_s	2.70	2.70	2.70	2.70	2.70	2.70	2.70	
Moisture, %	8.9	13.9	10.3	7.7	15.4	6.5	9.4	
Wet Unit wt, pcf	135.8	118.0	137.8	134.8	121.9	120.0	139.0	
Dry Unit wt, pcf	124.6	103.6	124.9	125.2	105.6	112.6	127.0	
Dry Bulk Dens. pb, (g/cc)	2.00	1.66	2.00	2.00	1.69	1.80	2.03	
Saturation, %	68.2	59.7	79.2	60.1	69.6	35.5	77.4	
Total Porosity, %	26.1	38.6	25.9	25.8	37.4	33.2	24.7	
Volumetric Water Cont., θ_w	17.8	23.0	20.6	15.5	26.0	11.8	19.1	
Volumetric Air Cont., θ_a	8.3	15.5	5.4	10.3	11.4	21.4	5.6	
Void Ratio	0.35	0.63	0.35	0.35	0.60	0.50	0.33	
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (G_s) was used then the saturation, porosities, and void ratio should be considered approximate.



The Zero Air-Voids curves represent the dry density at 100% saturation for each value of specific gravity

NOTE: Extremely small samples, such as these, tend to be highly disturbed and less representative of the in-situ conditions. A diameter of 2.5 inches is the recommended minimum for this type of testing. This should be taken into account when interpreting these results.



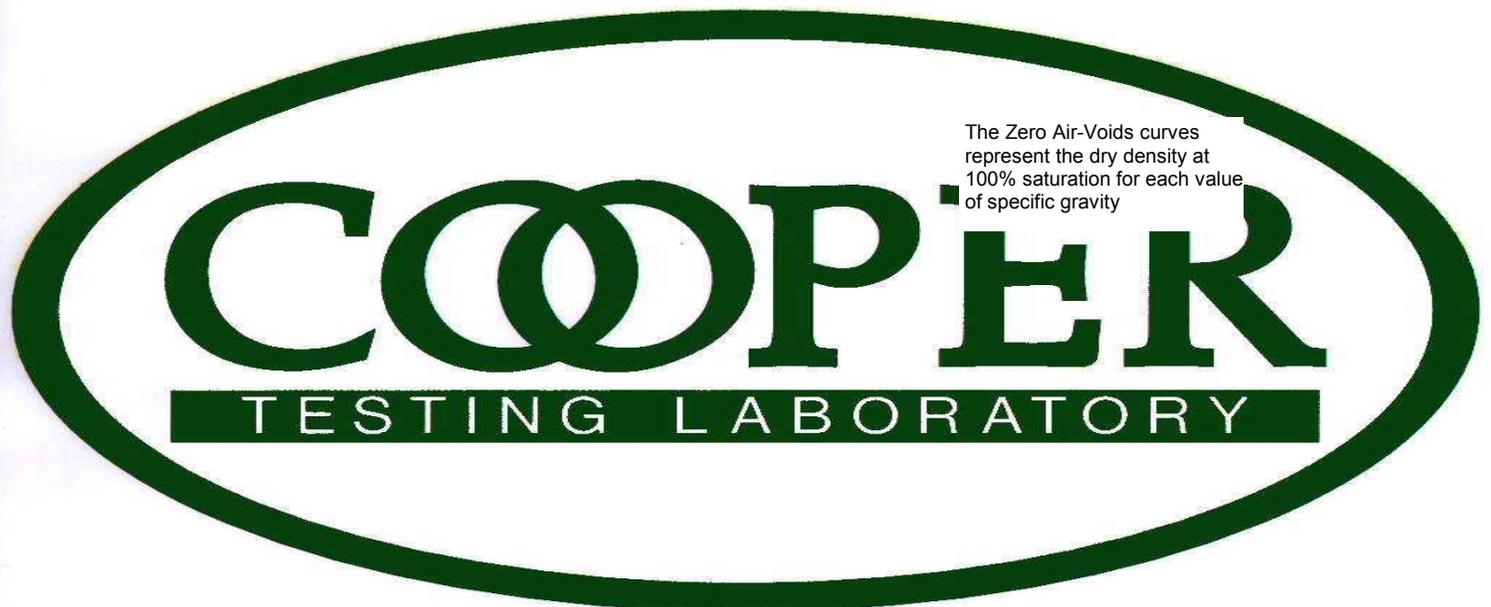
Moisture-Density-Porosity Report

Cooper Testing Labs, Inc. (ASTM D 2937)

CTL Job No: <u>461-180b</u>	Project No. <u>MMW597</u>	By: <u>RU</u>
Client: <u>Geosyntec Consultants</u>	Date: <u>07/26/11</u>	
Project Name: <u>Sonoma-Healdsburg</u>	Remarks:	

Boring:	#2	#2	#2	#2	#2	#2	#2	#2
Sample:	WEL2A	WEL2C	WEL2E	WEL2G	WEL2I	WEL2K	WEL2M	
Depth, ft:	3-4.5	9-10.5	15-16.5	21-22.5	27-28.5	33-34.5	39-40.5	
Visual Description:	Brown Clayey SAND	Brown Sandy SILT	Brown Silty SAND	Brown Poorly Graded SAND	Brown Silty SAND w/ Gravel	Grayish Brown Well-Graded SAND w/ Gravel	Brown Poorly Graded SAND	
Actual G_s								
Assumed G_s	2.70	2.70	2.70	2.70	2.70	2.70	2.70	
Moisture, %	8.9	17.3	21.1	3.8	5.9	8.2	8.8	
Wet Unit wt, pcf	129.6	116.2	111.9	108.7	109.8	145.6	116.9	
Dry Unit wt, pcf	118.9	99.1	92.4	104.7	103.6	134.6	107.5	
Dry Bulk Dens.pb, (g/cc)	1.91	1.59	1.48	1.68	1.66	2.16	1.72	
Saturation, %	57.7	66.4	69.1	16.9	25.4	87.6	41.5	
Total Porosity, %	29.5	41.2	45.2	38.0	38.6	20.2	36.3	
Volumetric Water Cont., θ_w	17.0	27.4	31.3	6.4	9.8	17.7	15.1	
Volumetric Air Cont., θ_a	12.5	13.9	14.0	31.5	28.8	2.5	21.2	
Void Ratio	0.42	0.70	0.83	0.61	0.63	0.25	0.57	
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (G_s) was used then the saturation, porosities, and void ratio should be considered approximate.





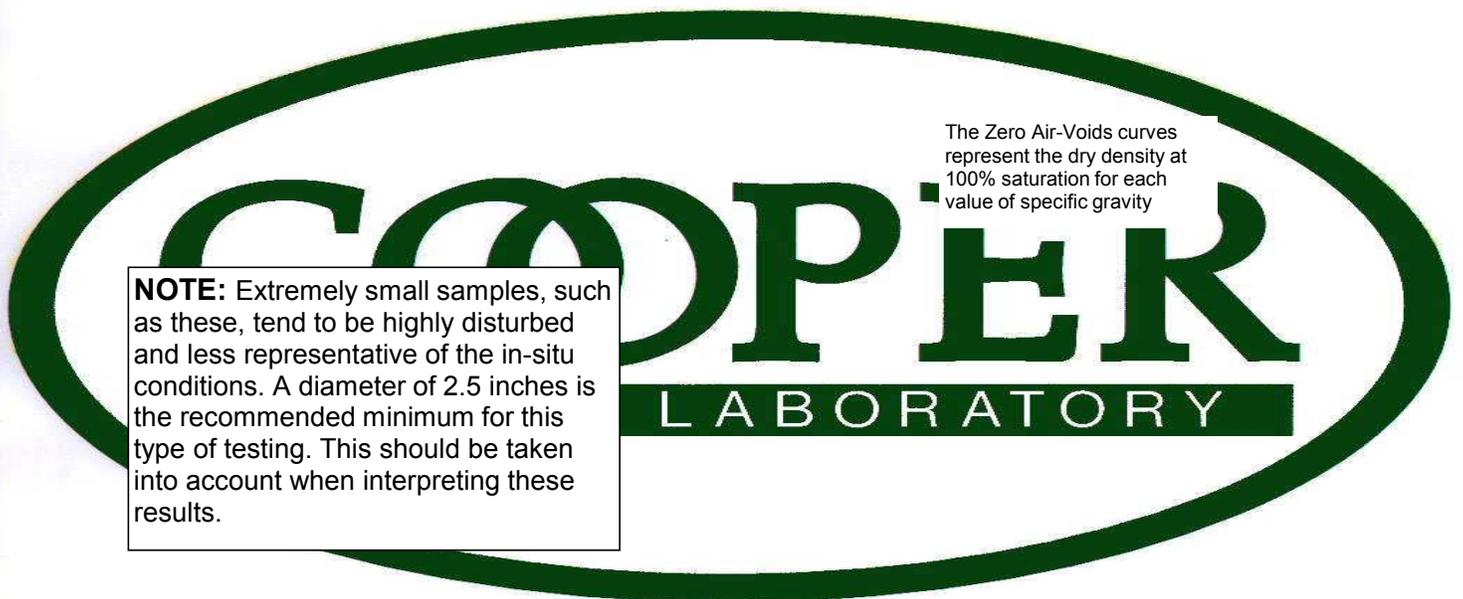
Moisture-Density-Porosity Report

Cooper Testing Labs, Inc. (ASTM D 2937)

CTL Job No: <u>461-181a</u>	Project No: <u>MMW597</u>	By: <u>RU</u>
Client: <u>Geosyntec Consultants</u>	Date: <u>08/02/11</u>	
Project Name: <u>Sonoma-Healdsburg</u>	Remarks: <u>Collector #3;GSC-02 @ 18-19' - sample disturbed; m/c only.</u>	

Boring:	Collector #3	Collector #3	Collector #3	Collector #3	Collector #3	Collector RDS	Collector RDS	Collector RDS
Sample:	GSC-02	GSC-02	GSC-02	GSC-02	GSC-02	GSC-07	GSC-07	GSC-07
Depth, ft:	18-19	22-23	30-31	54-55	48.5-49	9-10	14-15	19-20
Visual Description:	Brown Well-Graded SAND w/ Silt & Gravel	Grayish Brown Silty SAND	Brown Poorly Graded SAND w/ Silt & Gravel	Grayish Brown Well-Graded SAND w/ Silt & Gravel	Brown Silty SAND	Brown SILT w/ Sand	Brown Sandy SILT	Grayish Brown Silty SAND w/ Gravel
Actual G_s								
Assumed G_s		2.70	2.70	2.70	2.70	2.70	2.70	2.70
Moisture, %	4.9	10.7	11.9	10.6	18.3	28.2	19.4	3.7
Wet Unit wt, pcf		142.2	140.4	139.7	131.5	112.0	98.2	125.1
Dry Unit wt, pcf		128.4	125.5	126.3	111.2	87.3	82.3	120.6
Dry Bulk Dens.pb, (g/cc)		2.06	2.01	2.02	1.78	1.40	1.32	1.93
Saturation, %		92.4	93.4	85.5	95.4	81.8	49.9	25.2
Total Porosity, %		23.9	25.6	25.1	34.1	48.2	51.2	28.5
Volumetric Water Cont., θ_w		22.1	23.9	21.5	32.5	39.4	25.5	7.2
Volumetric Air Cont., θ_a		1.8	1.7	3.6	1.6	8.8	25.7	21.3
Void Ratio		0.31	0.34	0.34	0.52	0.93	1.05	0.40
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (G_s) was used then the saturation, porosities, and void ratio should be considered approximate.





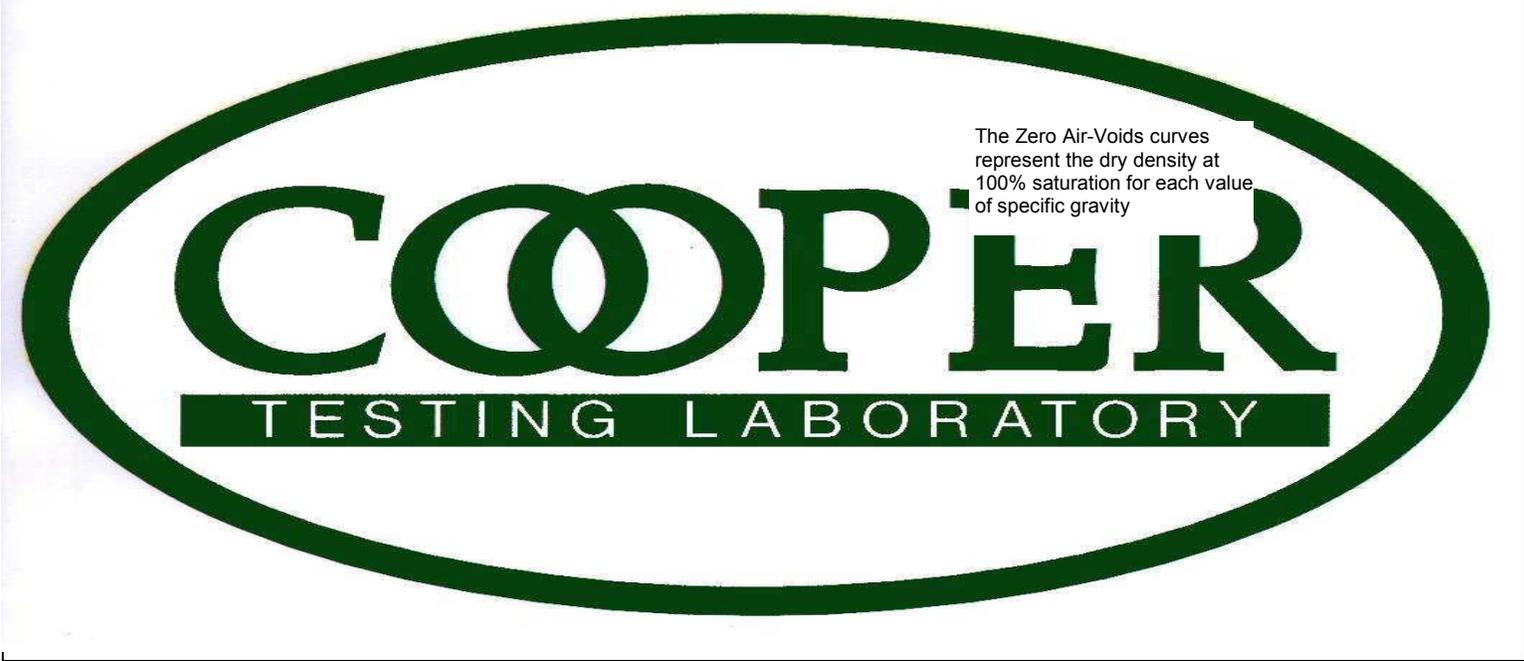
Moisture-Density-Porosity Report

Cooper Testing Labs, Inc. (ASTM D 2937)

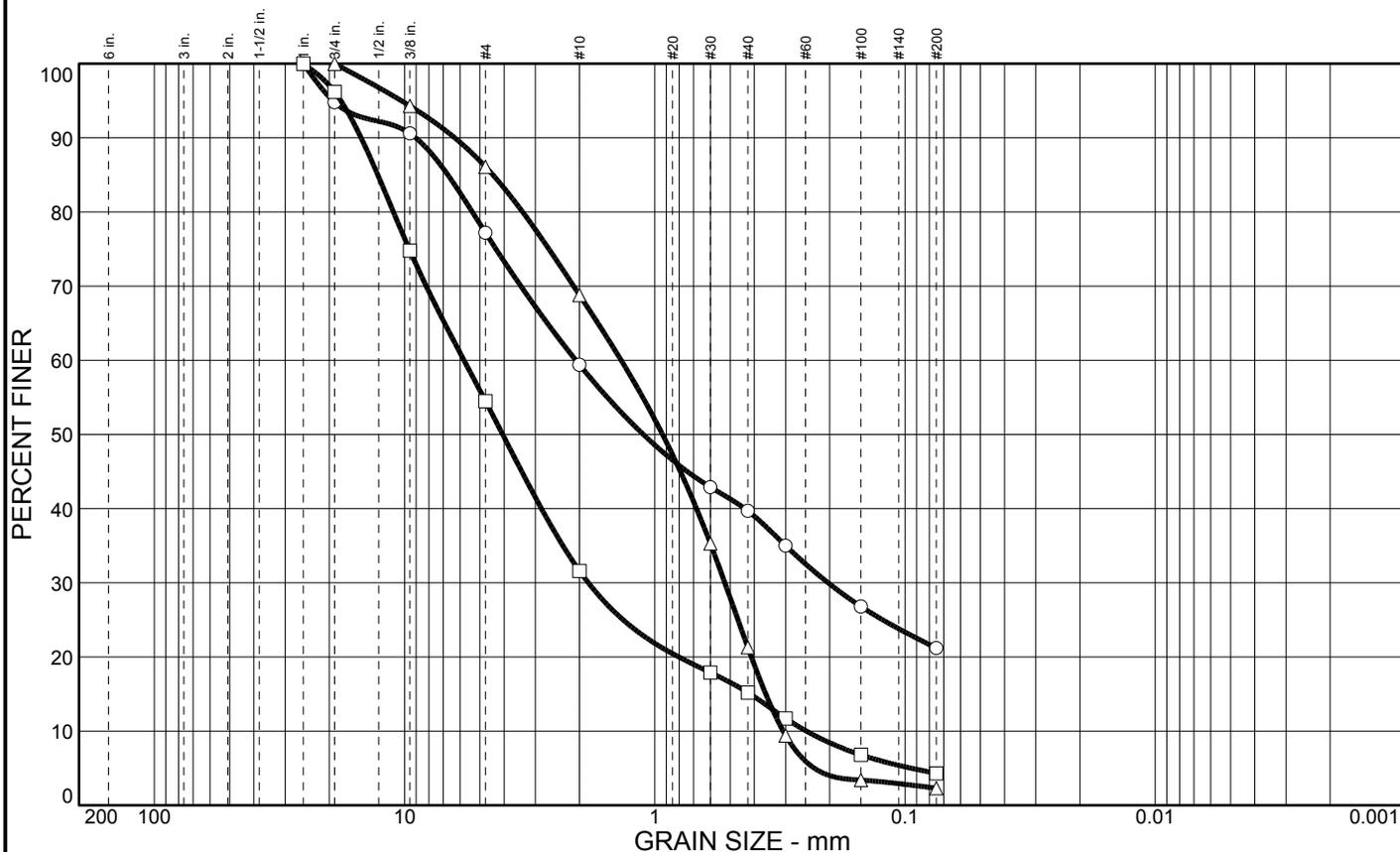
CTL Job No:	<u>461-180a</u>	Project No.	<u>MMW597</u>	By: <u>RU</u>
Client:	<u>Geosyntec Consultants</u>	Date:	<u>07/26/11</u>	
Project Name:	<u>Sonoma-Healdsburg</u>	Remarks:		

Boring:	#1	#1	#1	#1	#1			
Sample:	WEL1B	WEL1D	WEL1F	WEL1H	WEL1J			
Depth, ft:	6-7.5	12-13.5	18-19.5	24-24.5	30-30.5			
Visual Description:	Brown SILT	Brown Poorly Graded SAND	Brown SAND w/ Gravel (sample possibly disturbed)	Brown Poorly Graded GRAVEL w/ Silty Clay & Sand (sample possibly disturbed)	Brown Well-Graded GRAVEL w/ Silt & Sand			
Actual G_s								
Assumed G_s	2.70	2.70	2.70	2.70	2.70			
Moisture, %	24.4	5.7	2.6	5.0	6.8			
Wet Unit wt, pcf	116.3	89.5	113.3	118.0	130.6			
Dry Unit wt, pcf	93.5	84.6	110.4	112.3	122.3			
Dry Bulk Dens. pb, (g/cc)	1.50	1.36	1.77	1.80	1.96			
Saturation, %	82.0	15.5	13.5	27.2	48.5			
Total Porosity, %	44.6	49.8	34.6	33.4	27.5			
Volumetric Water Cont., θ_w	36.6	7.7	4.7	9.1	13.3			
Volumetric Air Cont., θ_a	8.0	42.1	29.9	24.3	14.2			
Void Ratio	0.80	0.99	0.53	0.50	0.38			
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (G_s) was used then the saturation, porosities, and void ratio should be considered approximate.



Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		22.8	56.0		21.2				
□		45.5	50.2		4.3			NP	
△		13.9	83.8		2.3				

SIEVE inches size	PERCENT FINER		
	○	□	△
1"	100.0	100.0	
3/4"	94.8	96.2	100.0
3/8"	90.6	74.8	94.3
GRAIN SIZE			
D ₆₀	2.07	5.79	1.36
D ₃₀	0.203	1.84	0.525
D ₁₀		0.248	0.307
COEFFICIENTS			
C _c		2.37	0.66
C _u		23.35	4.44

SIEVE number size	PERCENT FINER		
	○	□	△
#4	77.2	54.5	86.1
#10	59.4	31.6	68.8
#30	42.9	17.9	35.3
#40	39.7	15.2	21.3
#50	35.0	11.7	9.4
#100	26.8	6.8	3.4
#200	21.2	4.3	2.3

SOIL DESCRIPTION

- Brown Silty SAND w/ Gravel
- Grayish Brown Well-Graded SAND w/ Gravel
- △ Brown Poorly Graded SAND

REMARKS:

○

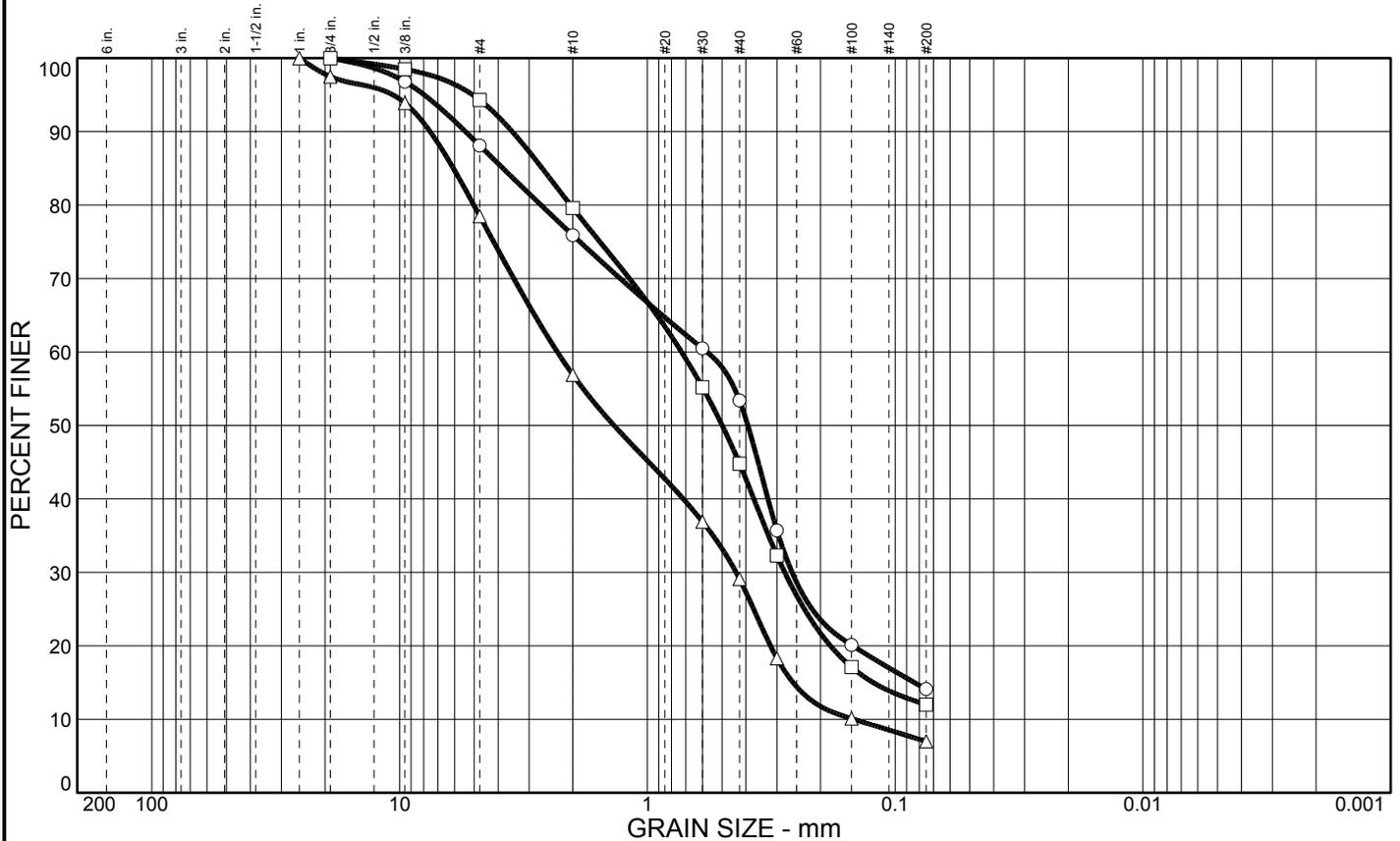
□

△

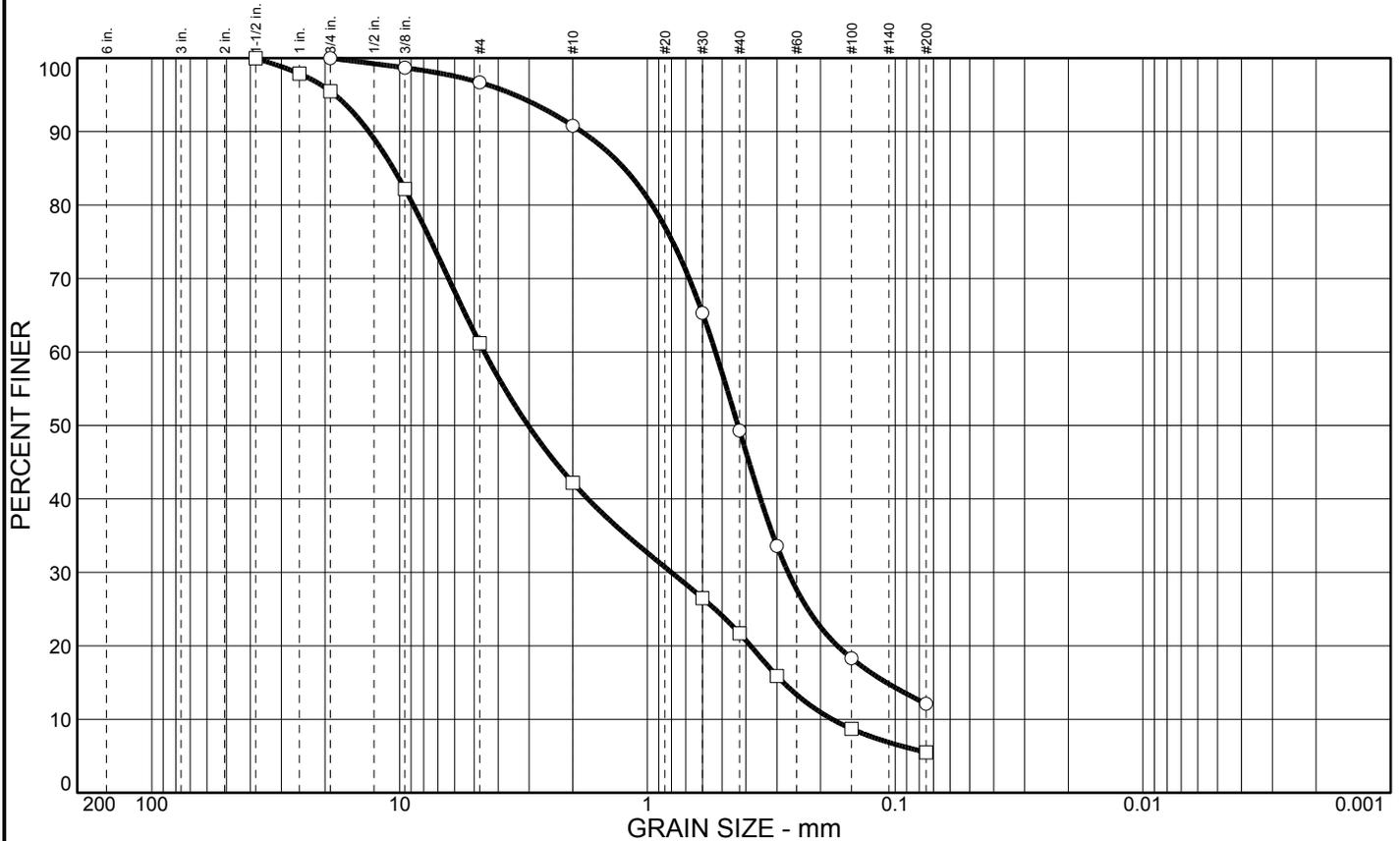
○ Source: #2
 □ Source: #2
 △ Source: #2

Sample No.: WEL2I Elev./Depth: 27-28.5'
 Sample No.: WEL2K Elev./Depth: 33-34.5'
 Sample No.: WEL2M Elev./Depth: 39-40.5'

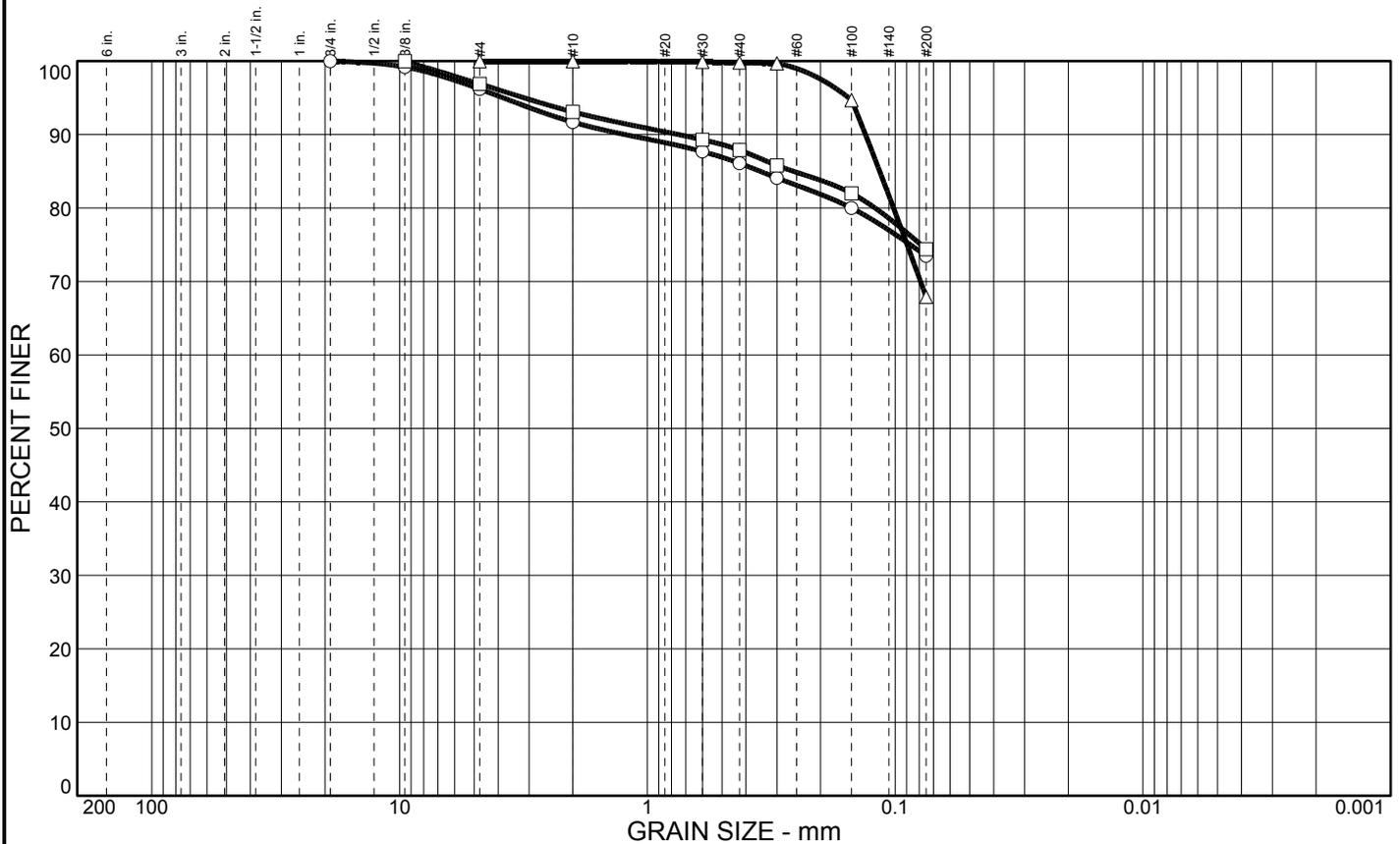
Particle Size Distribution Report



Particle Size Distribution Report



Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		3.8	22.7	73.5					
□		3.1	22.5	74.4		CL		21.4	34.2
△			32.1	67.9		ML		NP	

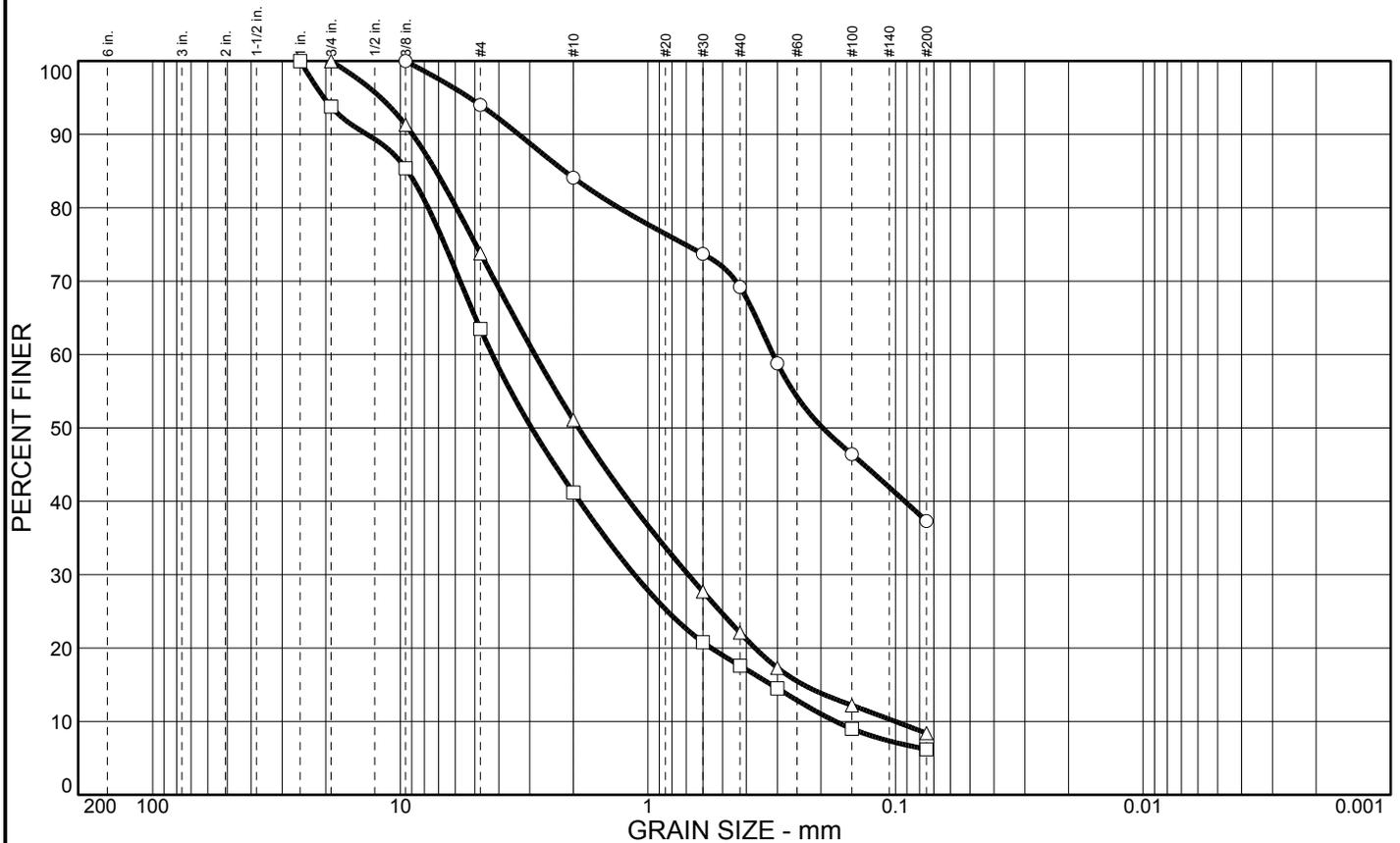
SIEVE inches size	PERCENT FINER			SIEVE number size	PERCENT FINER			SOIL DESCRIPTION
	○	□	△		○	□	△	
3/4"	100.0			#4	96.2	96.9	100.0	○ Brown CLAY w/ Sand □ Dark Grayish Brown Lean CLAY w/ Sand △ Brown Sandy SILT
3/8"	99.2	100.0		#10	91.7	93.1	100.0	
GRAIN SIZE				#30	87.7	89.3	99.9	
COEFFICIENTS				#40	86.1	87.9	99.8	
D ₆₀				#50	84.1	85.8	99.7	
D ₃₀				#100	80.0	82.0	94.7	
D ₁₀				#200	73.5	74.4	67.9	
C _c								
C _u								
REMARKS:								

○ Source: Collector #6
 □ Source: Collector #6
 △ Source: Collector #6

Sample No.: DP9A
 Sample No.: DP9B
 Sample No.: DP7A

Elev./Depth: 5-8'
 Elev./Depth: 8-12'
 Elev./Depth: 5-8'

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		6.0	56.7	37.3					
□		36.5	57.3	6.2					
△		26.2	65.4	8.4					

SIEVE inches size	PERCENT FINER		
	○	□	△
1"		100.0	
3/4"		93.8	100.0
3/8"	100.0	85.4	91.3
GRAIN SIZE			
D ₆₀	0.312	4.26	2.86
D ₃₀		1.13	0.687
D ₁₀		0.175	0.100
COEFFICIENTS			
C _c		1.73	1.65
C _u		24.36	28.54

SIEVE number size	PERCENT FINER		
	○	□	△
#4	94.0	63.5	73.8
#10	84.1	41.2	51.1
#30	73.7	20.8	27.7
#40	69.2	17.6	22.1
#50	58.8	14.5	17.3
#100	46.4	9.0	12.2
#200	37.3	6.2	8.4

SOIL DESCRIPTION

- Brown Silty SAND
- Grayish Brown Well-Graded SAND w/ Silt & Gravel
- △ Grayish Brown Well-Graded SAND w/ Silt & Gravel

REMARKS:

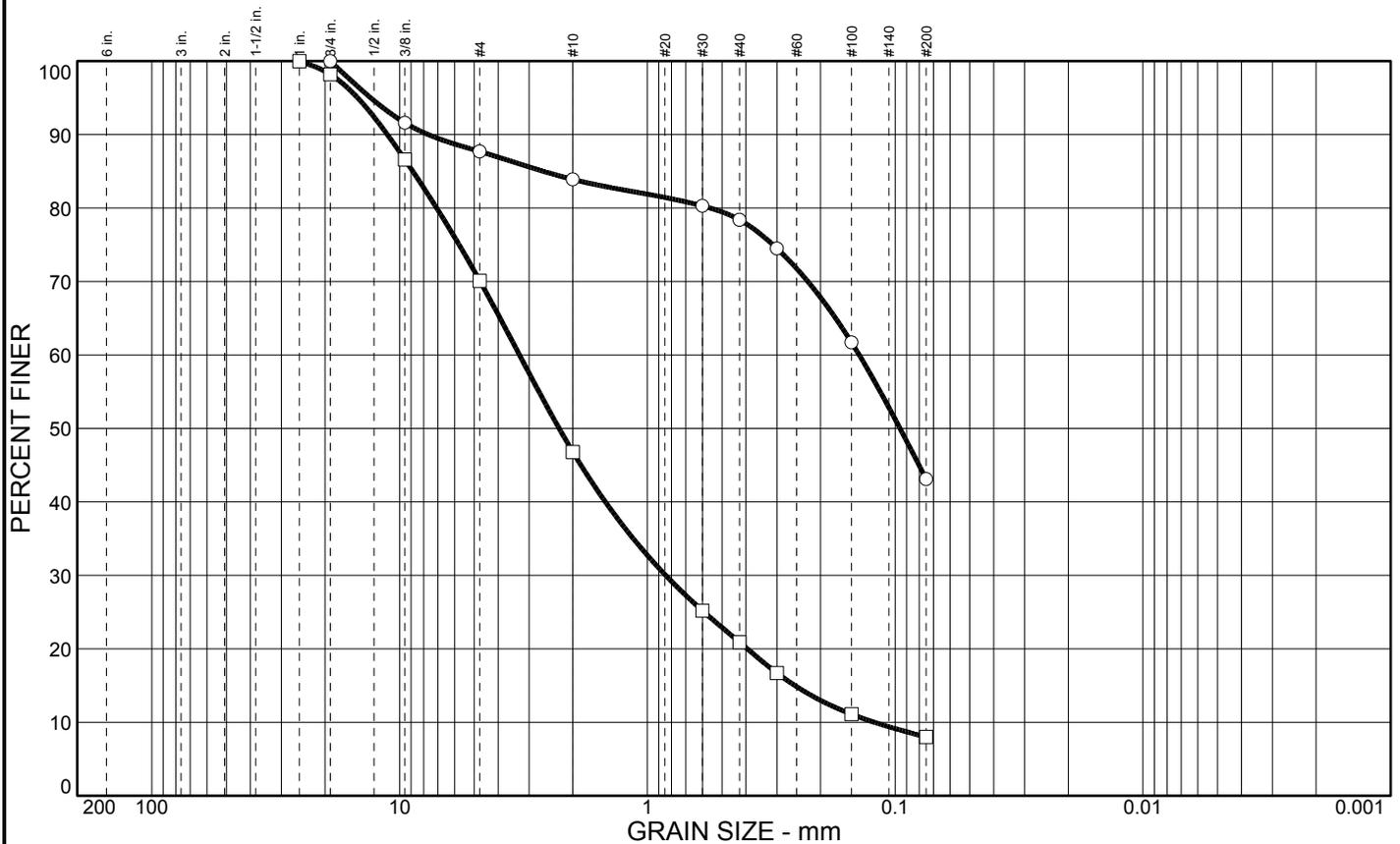
-
- Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.
- △

○ Source: Collector #6
 □ Source: Collector #6
 △ Source: Collector #6

Sample No.: GSC-09
 Sample No.: GSC-09
 Sample No.: GSC-09

Elev./Depth: 49-50'
 Elev./Depth: 55-56'
 Elev./Depth: 65-66'

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		12.3	44.6	43.1					
□		29.9	62.1	8.0					

SIEVE inches size	PERCENT FINER		SIEVE number size	PERCENT FINER		SOIL DESCRIPTION
	○	□		○	□	
1"		100.0			○ Gray Silty SAND □ Grayish Brown Well-Graded SAND w/ Silt & Gravel	
3/4"	100.0	98.2	#4	87.7		70.1
3/8"	91.6	86.6	#10	83.9		46.8
			#30	80.3	25.2	REMARKS: ○ □
			#40	78.4	20.9	
			#50	74.5	16.7	
			#100	61.7	11.1	
			#200	43.1	8.0	
GRAIN SIZE						
	D ₆₀	0.140	D ₃₀	0.843		
	D ₃₀		D ₁₀	0.121		
	D ₁₀					
COEFFICIENTS						
	C _c	1.78				
	C _u	27.06				

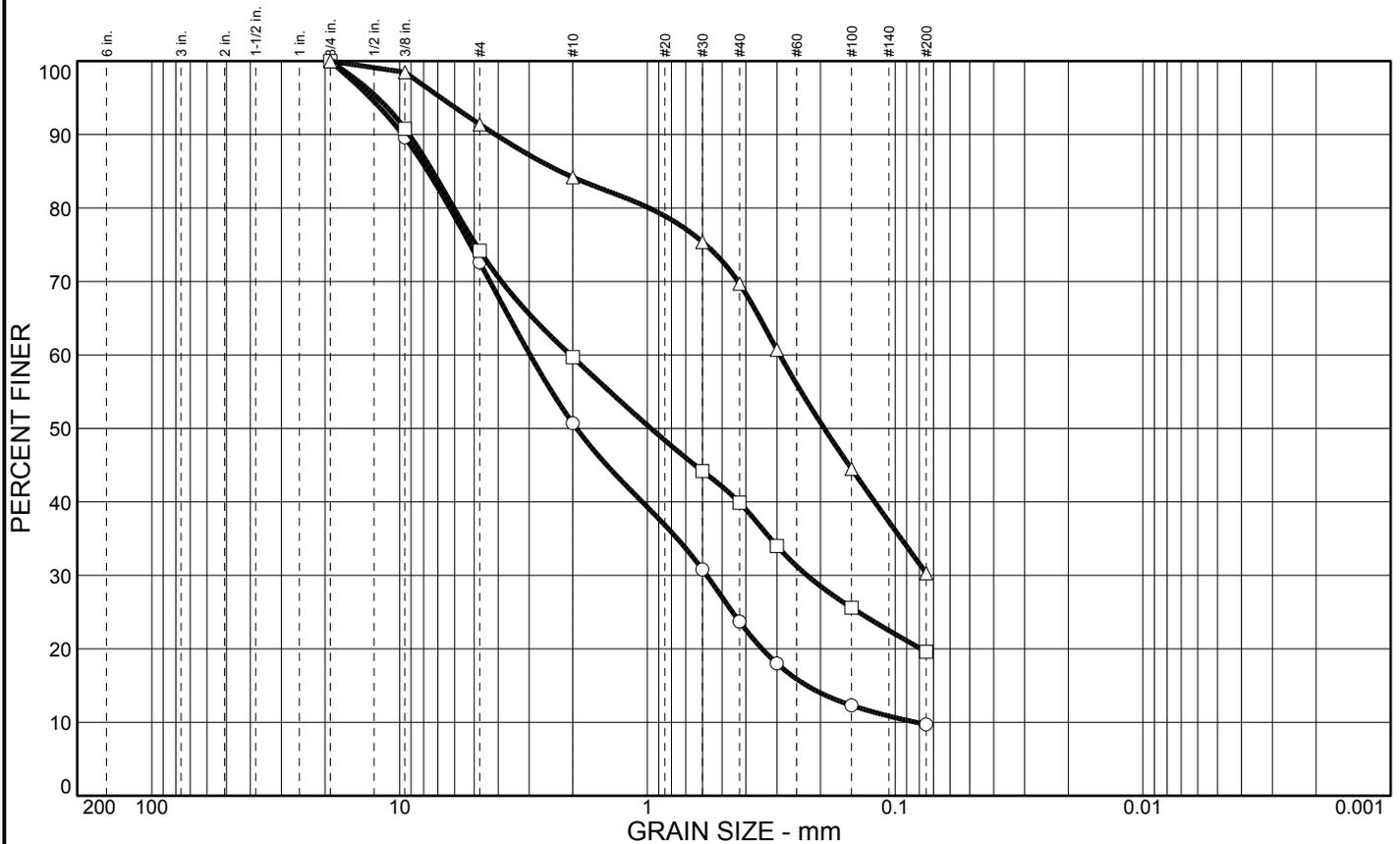
○ Source: Collector RDS
 □ Source: Collector RDS

Sample No.: DP6D
 Sample No.: DP6E

Elev./Depth: 16-20'
 Elev./Depth: 20-22'

COOPER TESTING LABORATORY	Client: Geosyntec Consultants Project: Sonoma-Healdsburg - MMW597 Project No.: 461-181
	Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		27.4	62.9	9.7					
□		25.8	54.6	19.6					
△		8.6	61.1	30.3		SM		20.2	21.7

SIEVE inches size	PERCENT FINER			SIEVE number size	PERCENT FINER			SOIL DESCRIPTION
	○	□	△		○	□	△	
3/4"	100.0	100.0	100.0	#4	72.6	74.2	91.4	○ Grayish Brown Well-Graded SAND w/ Silt & Gravel □ Grayish Brown Silty SAND w/ Gravel △ Gray Silty SAND
3/8"	89.6	90.8	98.5	#10	50.7	59.7	84.2	
				#30	30.8	44.2	75.4	
				#40	23.7	39.9	69.7	
				#50	18.0	34.0	60.7	
				#100	12.3	25.6	44.5	
				#200	9.7	19.6	30.3	
GRAIN SIZE								
D ₆₀	2.98	2.04	0.292					
D ₃₀	0.576	0.227						
D ₁₀	0.0824							
COEFFICIENTS								
C _c	1.36							
C _u	36.11							

REMARKS:

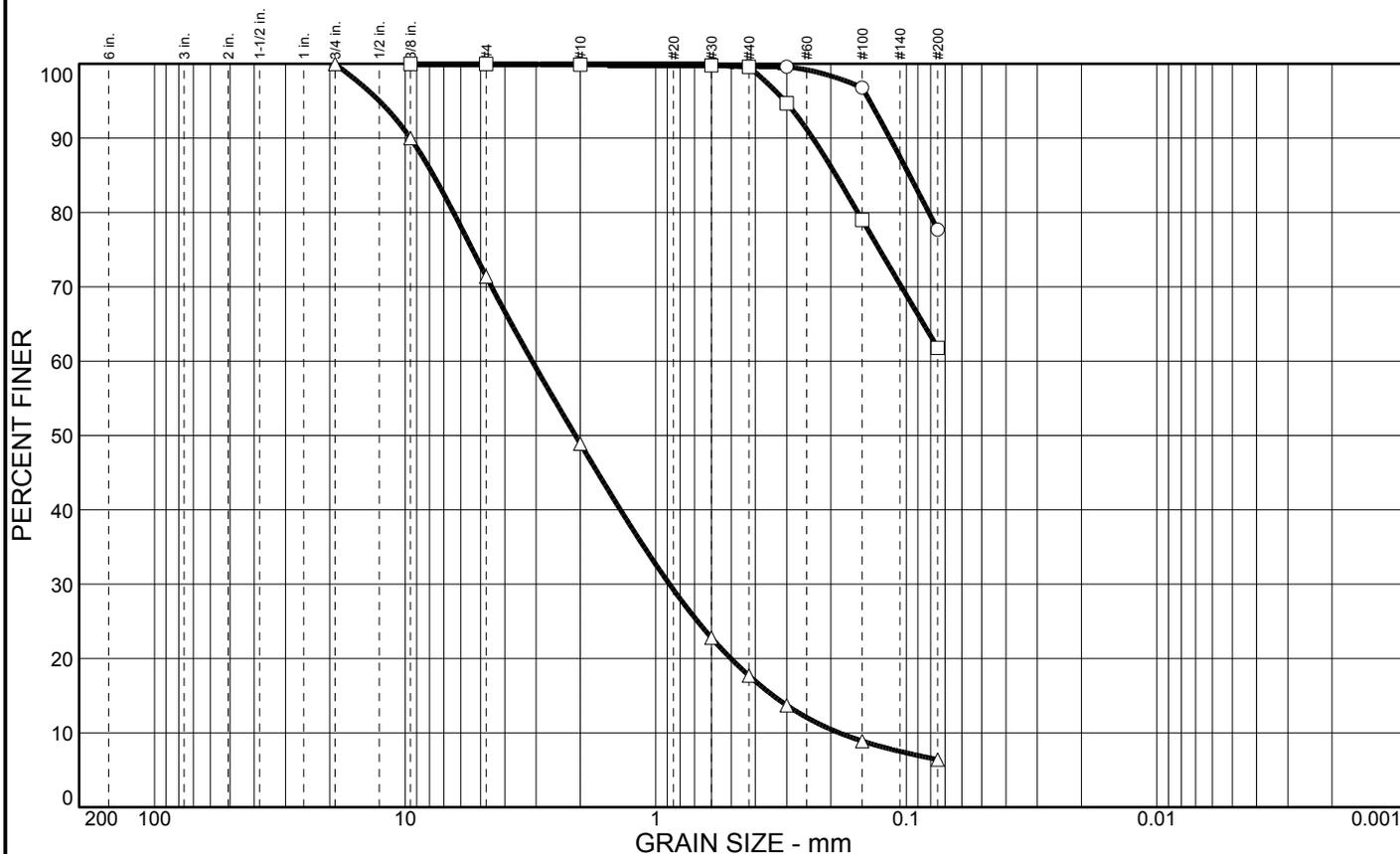
○

□

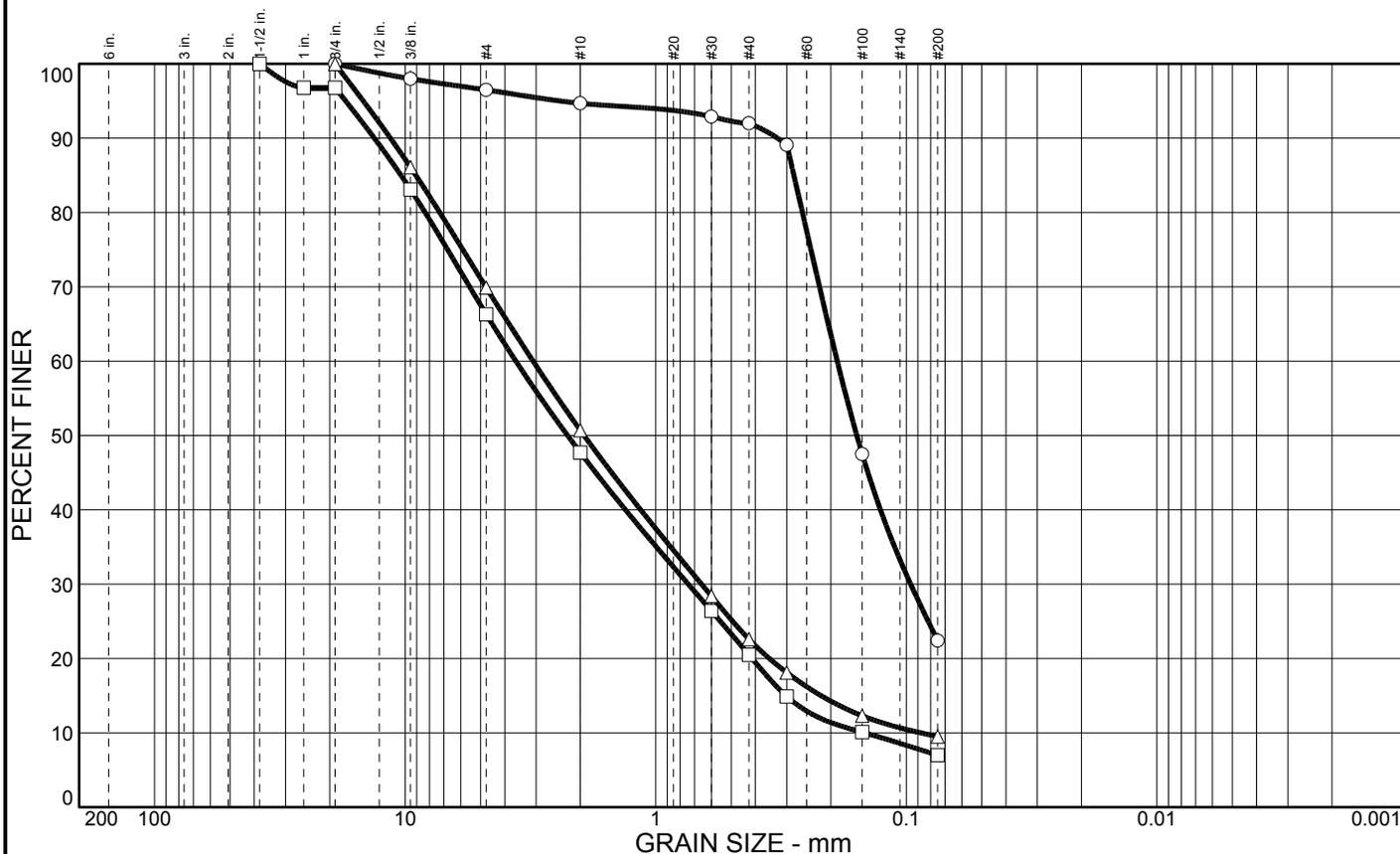
△

○ Source: Collector RDS	Sample No.: GSC-07	Elev./Depth: 46-47'
□ Source: Collector RDS	Sample No.: GSC-07	Elev./Depth: 50-51'
△ Source: Collector RDS	Sample No.: DP6B	Elev./Depth: 8-12'

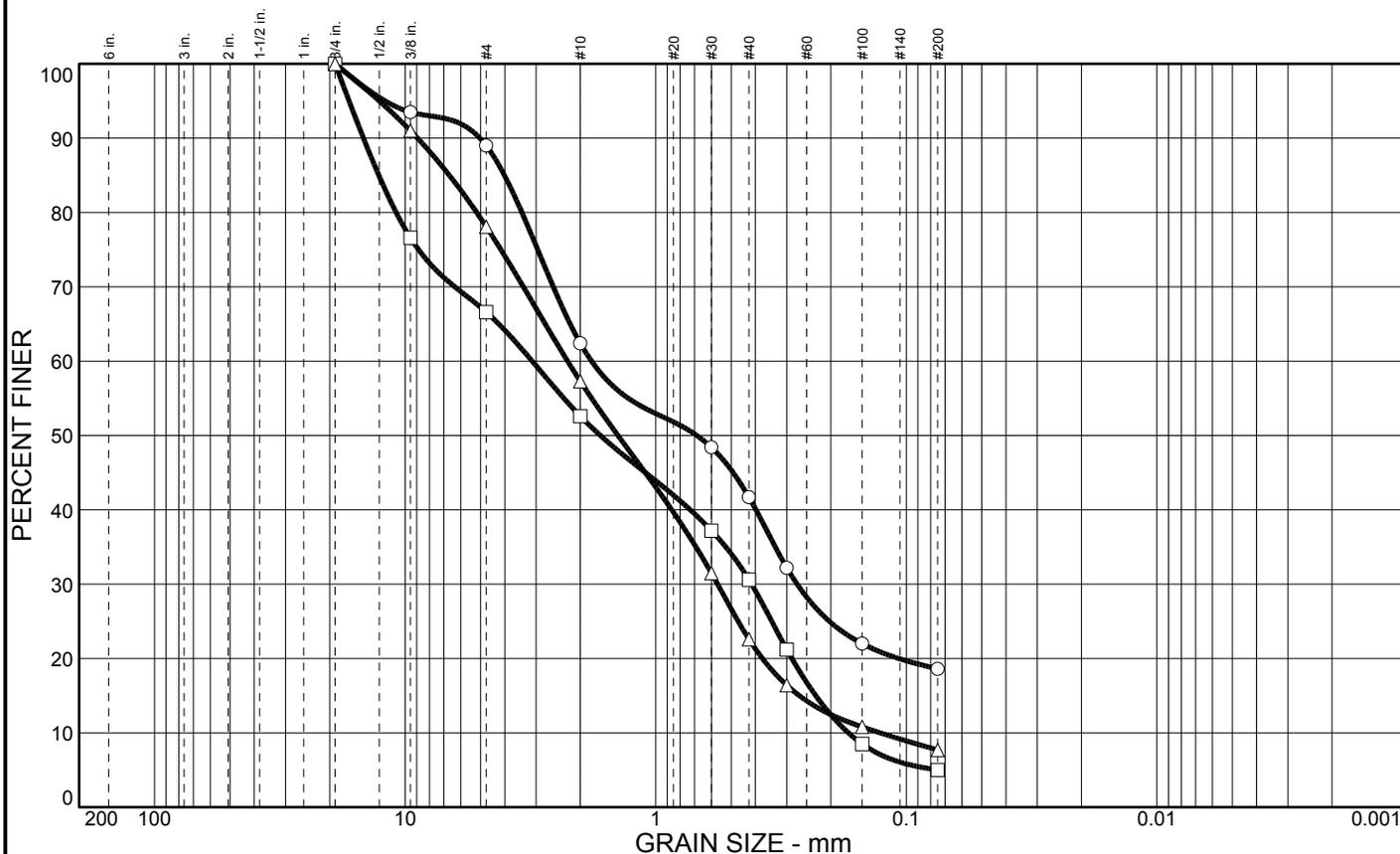
Particle Size Distribution Report



Particle Size Distribution Report



Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		11.0	70.4	18.6					
□		33.4	61.6	5.0		SP-SM		NP	
△		21.9	70.4	7.7					

SIEVE inches size	PERCENT FINER		
	○	□	△
3/4"	100.0	100.0	100.0
3/8"	93.5	76.6	91.0
GRAIN SIZE			
D ₆₀	1.80	3.11	2.25
D ₃₀	0.273	0.415	0.567
D ₁₀		0.170	0.127
COEFFICIENTS			
C _c		0.32	1.12
C _u		18.27	17.68

SIEVE number size	PERCENT FINER		
	○	□	△
#4	89.0	66.6	78.1
#10	62.4	52.6	57.3
#30	48.4	37.2	31.5
#40	41.7	30.6	22.6
#50	32.2	21.2	16.4
#100	22.0	8.5	10.8
#200	18.6	5.0	7.7

SOIL DESCRIPTION

○ Grayish Brown Silty SAND

□ Brown Poorly Graded SAND w/ Silt & Gravel

△ Grayish Brown Well-Graded SAND w/ Silt & Gravel

REMARKS:

○

□ Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

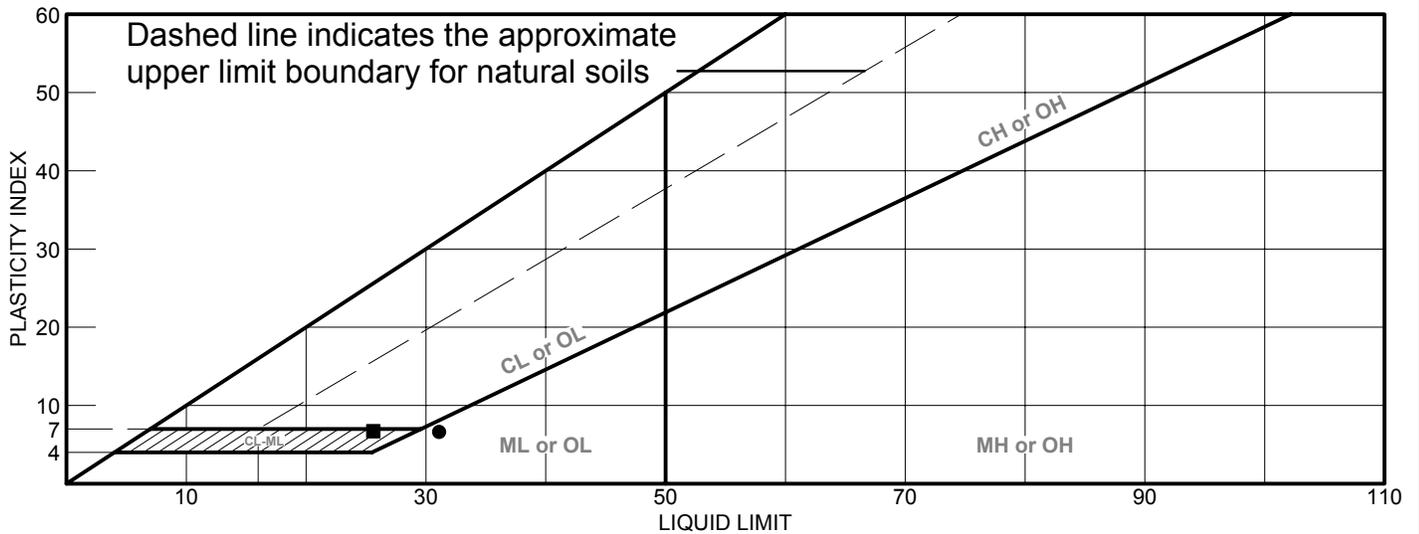
△ Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

○ Source: Collector #3
 □ Source: Collector #3
 △ Source: Collector #3

Sample No.: GSC-02
 Sample No.: GSC-02
 Sample No.: GSC-02

Elev./Depth: 22.5-23'
 Elev./Depth: 30-31'
 Elev./Depth: 54.5-55'

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown SILT	31.1	24.5	6.6	99.9	96.2	ML
■	Brown Poorly Graded GRAVEL w/ Silty Clay & Sand	25.6	18.9	6.7	13.5	8.7	GP-GC
▲	Brown Well-Graded GRAVEL w/ Silt & Sand		NP	NP	20.0	6.3	GW-GM
◆	Brown Sandy SILT		NP	NP	99.9	66.4	ML
▼	Brown Silty SAND		NP	NP	93.6	33.3	SM

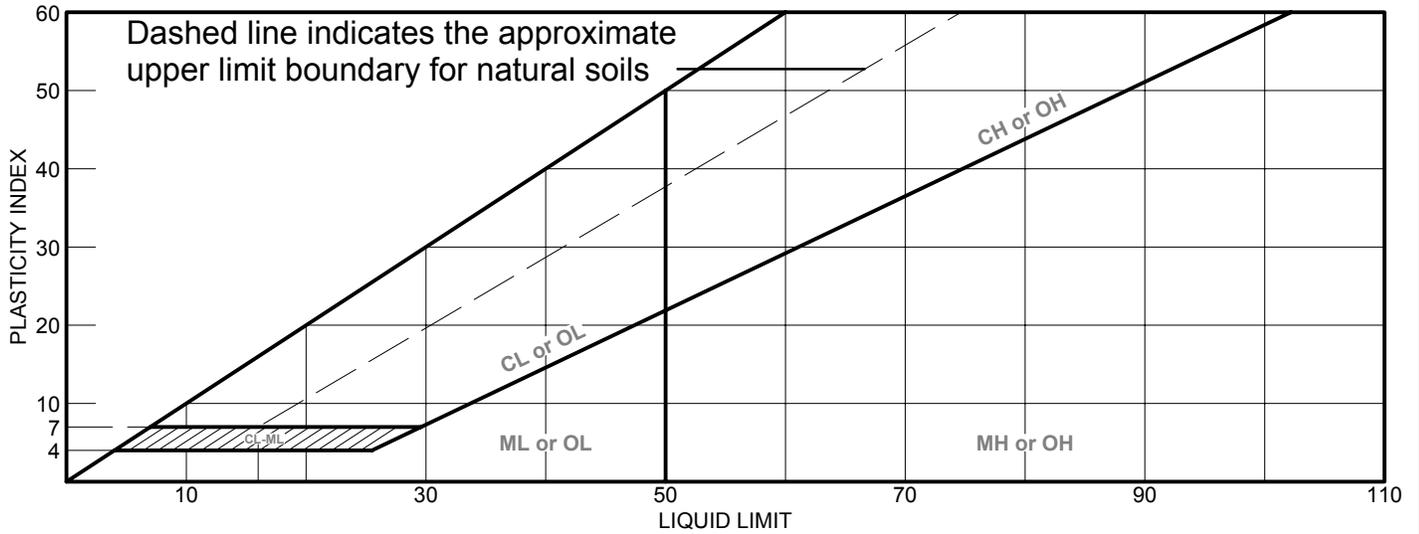
Project No. 461-180 **Client:** Geosyntec Consultants
Project: Sonoma-Healdsburg - MMW597

● Source: #1	Sample No.: WEL1B	Elev./Depth: 6-7.5'
■ Source: #1	Sample No.: WEL1H	Elev./Depth: 24-24.5'
▲ Source: #1	Sample No.: WEL1J	Elev./Depth: 30-30.5'
◆ Source: #2	Sample No.: WEL2C	Elev./Depth: 9-10.5'
▼ Source: #2	Sample No.: WEL2E	Elev./Depth: 15-16.5'

Remarks:

- Sample was prepared using the wet prep method.
- Sample was prepared using the wet prep method.
- ▲ Sample was prepared using the wet prep method. PI not possible due to coarse-grained sample. Could not roll out. Sample slides in bowl. Non-plastic.
- ◆ Sample was prepared using the wet prep method.

LIQUID AND PLASTIC LIMITS TEST REPORT

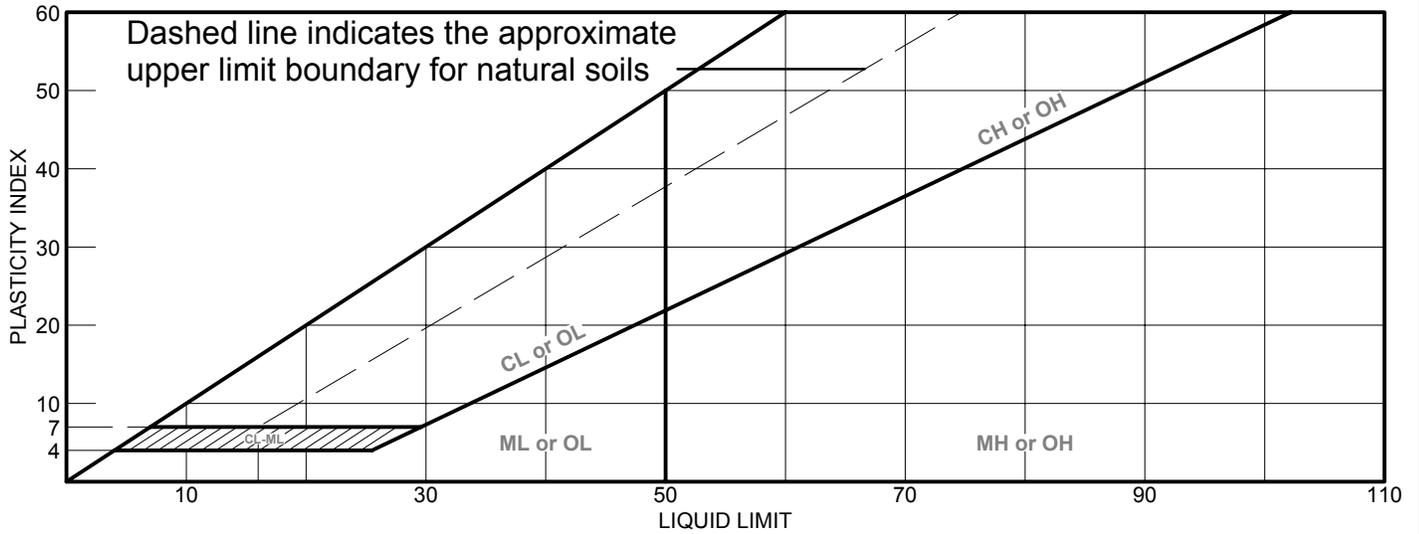


	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Grayish Brown Well-Graded SAND w/ Gravel		NP	NP	15.2	4.3	

Project No. 461-180 **Client:** Geosyntec Consultants
Project: Sonoma-Healdsburg - MMW597
Source: #2 **Sample No.:** WEL2K **Elev./Depth:** 33-34.5'

Remarks:
 ● Sample was prepared using the wet prep method. PI not possible due to coarse-grained sample. Could not roll out. Sample slides in bowl. Non-plastic.

LIQUID AND PLASTIC LIMITS TEST REPORT

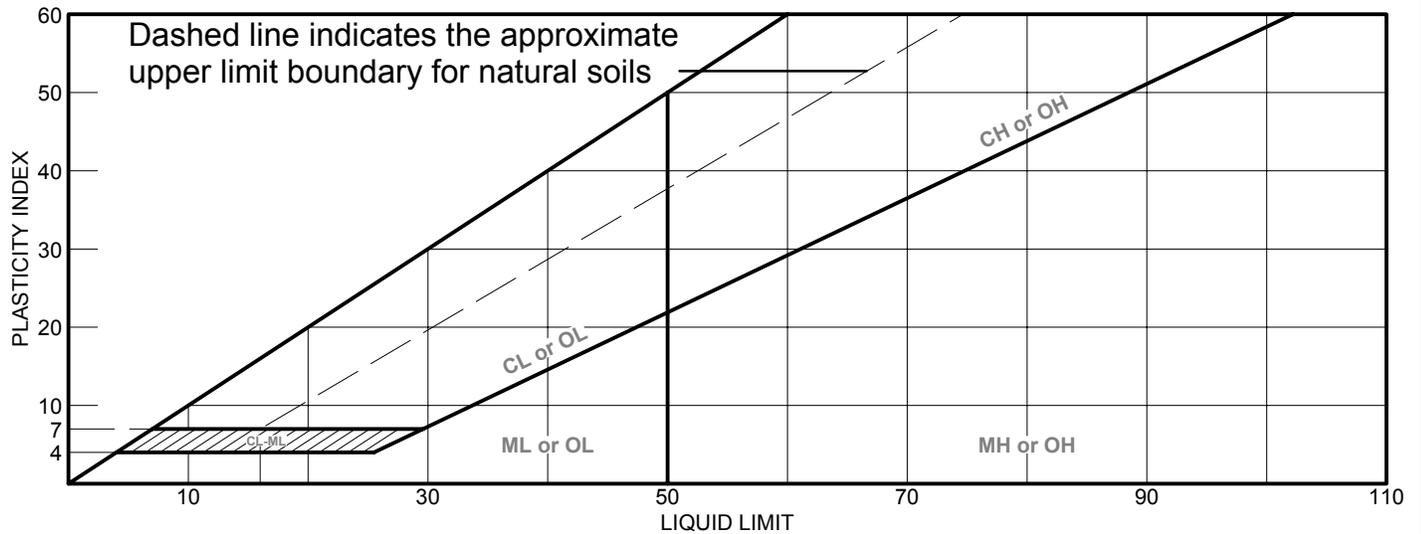


	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Brown Silty SAND		NP	NP	99.0	22.4	SM

Project No. 461-181 **Client:** Geosyntec Consultants
Project: Sonoma-Healdsburg - MMW597
Source: Collector #5 **Sample No.:** DP3B **Elev./Depth:** 8-12'

Remarks:
 ● Sample was prepared using the wet prep method. Could not roll out. Sample slides in bowl. Non-plastic.

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown Silty SAND		NP	NP	92.0	22.4	SM
■	Brown Poorly Graded SAND w/ Silt & Gravel		NP	NP	30.6	5.0	SP-SM

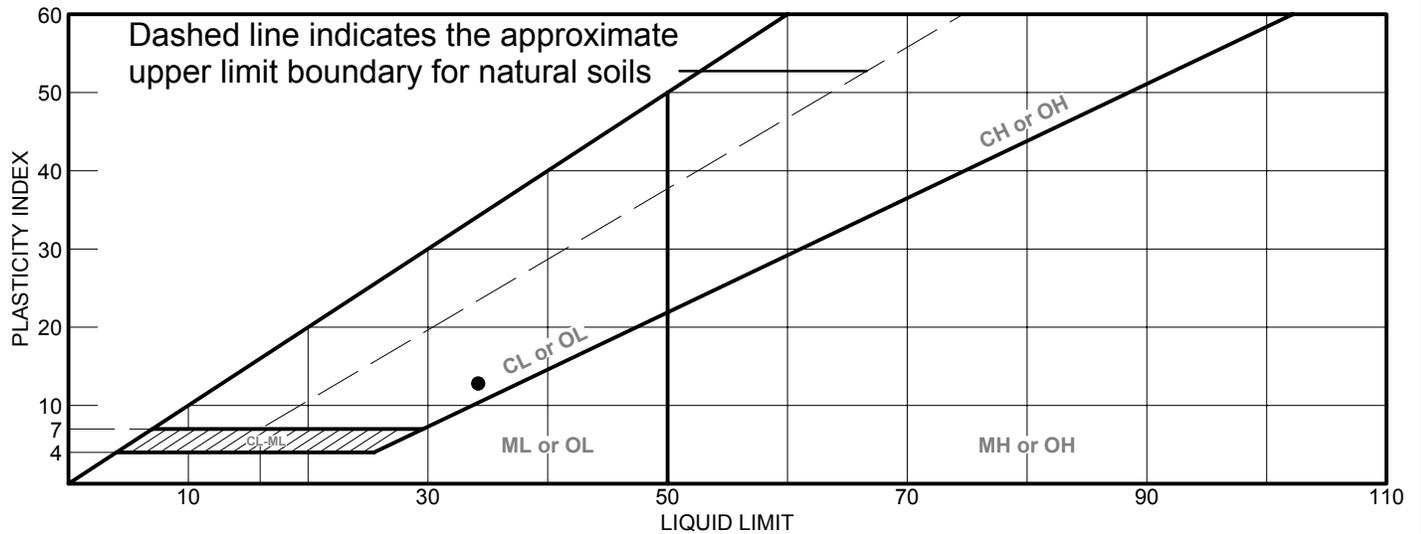
Project No. 461-181 **Client:** Geosyntec Consultants
Project: Sonoma-Healdsburg - MMW597

● **Source:** Collector #3 **Sample No.:** DP1C **Elev./Depth:** 8-12'
 ■ **Source:** Collector #3 **Sample No.:** GSC-02 **Elev./Depth:** 30-31'

Remarks:

- Sample was prepared using the wet prep method. Could not roll out. Sample slides in bowl. Non-plastic.
- Sample was prepared using the wet prep method. Could not roll out. Sample slides in bowl. Non-plastic.

LIQUID AND PLASTIC LIMITS TEST REPORT

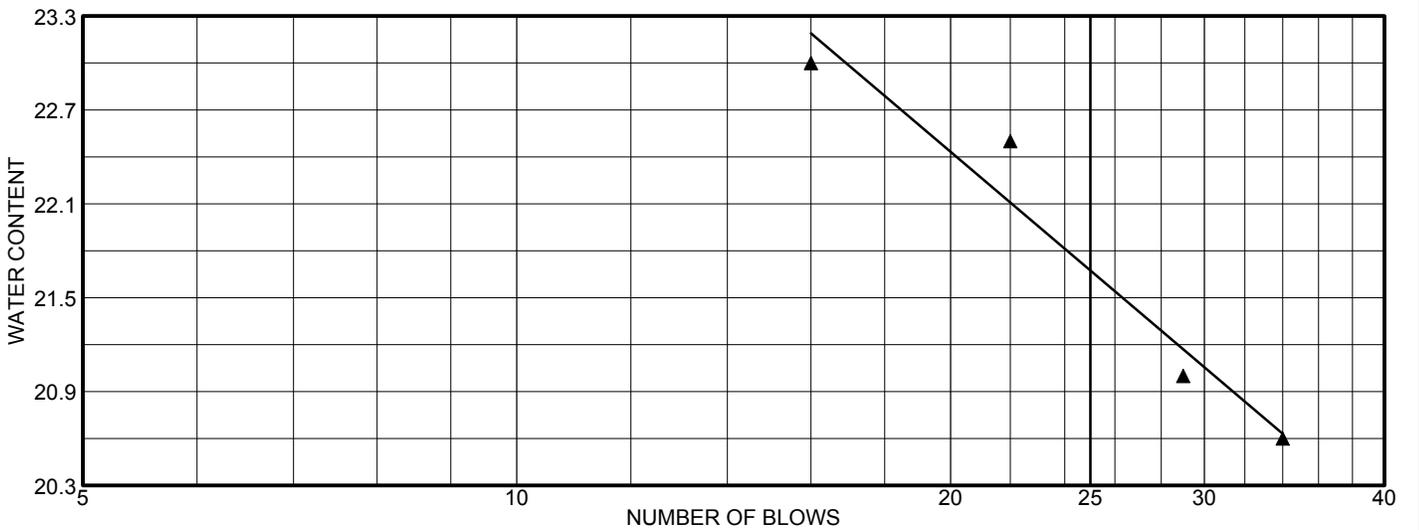
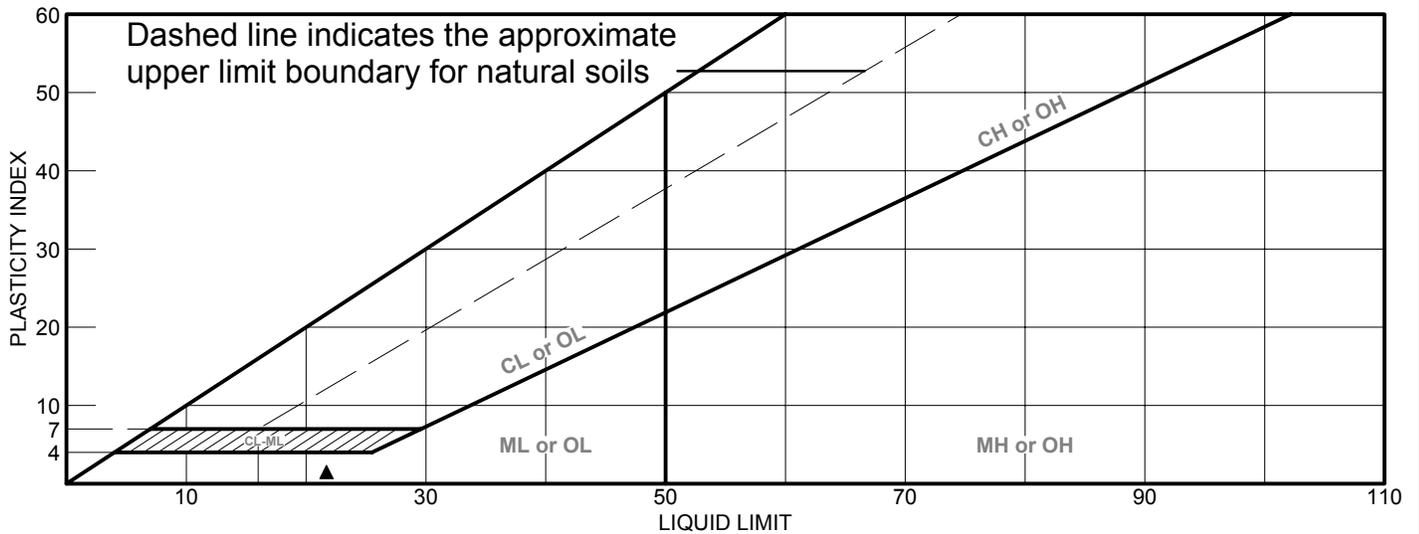


	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Grayish Brown Lean CLAY w/ Sand	34.2	21.4	12.8	87.9	74.4	CL
■	Brown Sandy SILT		NP	NP	99.8	67.9	ML

Project No. 461-181 **Client:** Geosyntec Consultants
Project: Sonoma-Healdsburg - MMW597
● Source: Collector #6 **Sample No.:** DP9B **Elev./Depth:** 8-12'
■ Source: Collector #6 **Sample No.:** DP7A **Elev./Depth:** 5-8'

Remarks:
 ● Sample was prepared using the wet prep method.
 ■ Sample was prepared using the wet prep method. Could not roll out. Sample slides in bowl. Non-plastic.

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown SILT w/ Sand		NP	NP	99.7	77.7	ML
■	Brown Sandy SILT		NP	NP	99.6	61.8	ML
▲	Gray Silty SAND	21.7	20.2	1.5	69.7	30.3	SM

Project No. 461-181 **Client:** Geosyntec Consultants

Project: Sonoma-Healdsburg - MMW597

● **Source:** Collector RDS **Sample No.:** GSC-07 **Elev./Depth:** 9-10'
 ■ **Source:** Collector RDS **Sample No.:** GSC-07 **Elev./Depth:** 14-15'
 ▲ **Source:** Collector RDS **Sample No.:** DP6B **Elev./Depth:** 8-12'

Remarks:

- Sample was prepared using the wet prep method. Could not roll out. Sample slides in bowl. Non-plastic.
- Sample was prepared using the wet prep method. Could not roll out. Sample slides in bowl. Non-plastic.
- ▲ Sample was prepared using the wet prep method.

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure