

Appendix B

Shear and Compression Wave Velocity Test Results



Project Hardin County Wind
Sounding Location Turbine 118
Test # 118
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 29-7-2011
Time 7:24
Source Offset (ft): 4.50
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	6.6				
9.9	8.1	9.3	3.3	2.95	6.5	907
13.2	11.4	12.3	3.3	2.20	9.8	1351
16.4	14.7	15.3	3.2	2.30	13.0	1333
19.7	17.9	18.5	3.3	3.30	16.3	958
23.0	21.2	21.7	3.3	2.80	19.6	1153
25.1	23.3	23.7	2.1	1.75	22.3	1157

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/- 50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



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Project Hardin County Wind
Sounding Location Turbine 12
Test # 12
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 28-7-2011
Time 9:58
Source Offset (ft): 4.50
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	6.6				
9.8	8.1	9.3	3.3	3.35	6.5	797
13.2	11.4	12.3	3.3	4.35	9.7	690
16.4	14.7	15.3	3.2	3.90	13.0	786
19.7	17.9	18.5	3.3	2.85	16.3	1109
23.0	21.2	21.7	3.3	4.05	19.6	789
26.2	24.4	24.8	3.2	2.20	22.8	1433

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/- 50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



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Project Hardin County Wind
Sounding Location Turbine 120
Test # 120
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 24-7-2011
Time 15:13
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	1.95	6.5	1068
13.1	11.4	13.8	3.3	2.20	9.7	1162
16.4	14.7	16.6	3.3	2.40	13.0	1172
19.7	17.9	19.5	3.3	2.90	16.3	1021
23.0	21.2	22.6	3.3	2.50	19.6	1219
26.2	24.5	25.7	3.3	2.70	22.9	1150
29.5	27.8	28.8	3.3	2.50	26.1	1258
32.8	31.1	32.0	3.3	2.00	29.4	1586
36.1	34.3	35.2	3.3	3.40	32.7	939
39.4	37.6	38.4	3.3	1.95	36.0	1644
42.6	40.9	41.6	3.3	2.65	39.3	1214
45.9	44.2	44.8	3.3	2.85	42.5	1132
50.1	48.3	48.9	4.1	3.20	46.2	1274

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/- 50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



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Project Hardin County Wind
Sounding Location Turbine 129
Test # 129
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 25-7-2011
Time 15:02
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	6.00	6.5	347
13.1	11.4	13.8	3.3	1.00	9.7	2557
16.4	14.7	16.6	3.3	2.60	13.0	1082
19.7	17.9	19.5	3.3	2.55	16.3	1161
23.0	21.2	22.6	3.3	2.95	19.6	1033
26.2	24.5	25.7	3.3	3.20	22.9	970

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/-50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



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Project Hardin County Wind
Sounding Location Turbine 23
Test # 23
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 29-7-2011
Time 6:13
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
12.0	10.2	12.8	5.4	6.95	7.5	533
13.9	12.2	14.4	2.0	2.60	11.2	622
16.4	14.7	16.6	2.5	1.85	13.4	1151
19.7	17.9	19.5	3.3	2.40	16.3	1233
23.0	21.2	22.6	3.3	2.90	19.6	1062
26.2	24.5	25.7	3.2	3.60	22.9	854
29.5	27.8	28.8	3.3	3.05	26.1	1031
32.8	31.1	32.0	3.3	2.65	29.4	1197
34.6	32.9	33.8	1.8	0.90	32.0	1983

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/-50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



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Project Hardin County Wind
Sounding Location Turbine 3
Test # 3
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 28-7-2011
Time 13:05
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	0.40	6.5	5205
13.9	12.1	14.4	4.0	2.50	10.1	1275
16.4	14.7	16.6	2.5	1.15	13.4	1899
19.7	17.9	19.5	3.3	2.65	16.3	1117
23.0	21.2	22.6	3.3	2.60	19.6	1172
26.2	24.5	25.7	3.3	3.40	22.9	913
29.6	27.9	28.9	3.4	3.55	26.2	912
32.8	31.1	32.0	3.2	2.75	29.5	1119
34.1	32.4	33.3	1.3	0.90	31.7	1416

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/-50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



Project Hardin County Wind
Sounding Location Turbine 33
Test # 33
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 28-7-2011
Time 14:32
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	0.85	6.5	2449
13.1	11.4	13.8	3.3	1.85	9.7	1382
16.4	14.7	16.6	3.3	3.00	13.0	938
19.7	17.9	19.5	3.3	3.30	16.3	897
23.0	21.2	22.6	3.3	3.80	19.6	802
27.0	25.2	26.4	4.0	3.75	23.2	1020
29.5	27.8	28.8	2.5	2.15	26.5	1127

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/- 50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



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Project Hardin County Wind
Sounding Location Turbine 38
Test # 2038
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 27-7-2011
Time 14:40
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	5.90	6.5	353
13.1	11.4	13.8	3.3	2.10	9.7	1218
16.4	14.7	16.6	3.3	2.55	13.0	1103
19.7	17.9	19.5	3.3	1.90	16.3	1558

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/- 50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



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Project Hardin County Wind
Sounding Location Turbine 38
Test # 38
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 27-7-2011
Time 13:59
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
9.9	8.2	11.3	3.3	0.15	6.5	14195
13.1	11.4	13.8	3.2	1.70	9.8	1476
16.4	14.7	16.6	3.3	2.40	13.0	1172
19.8	18.0	19.6	3.4	2.60	16.3	1173

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/-50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



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Project Hardin County Wind
Sounding Location Turbine 41
Test # 41
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 31-7-2011
Time 9:43
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	2.75	6.5	757
13.1	11.4	13.8	3.3	4.55	9.7	562
16.4	14.7	16.6	3.3	5.10	13.0	552
19.7	17.9	19.5	3.3	5.60	16.3	529
23.7	22.0	23.3	4.0	6.05	19.9	621
26.2	24.5	25.7	2.5	2.90	23.2	826
29.5	27.8	28.8	3.3	3.65	26.1	861
32.8	31.1	32.0	3.3	5.35	29.4	599
36.1	34.3	35.2	3.2	5.65	32.7	559

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/-50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



Project Hardin County Wind
Sounding Location Turbine 48
Test # 48
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 27-7-2011
Time 9:23
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	4.15	6.5	502
13.1	11.4	13.8	3.3	6.10	9.7	419
16.4	14.7	16.6	3.3	6.80	13.0	414
19.7	17.9	19.5	3.3	8.75	16.3	338
23.0	21.2	22.6	3.3	9.40	19.6	324
26.3	24.5	25.7	3.3	8.35	22.9	376
29.5	27.7	28.8	3.2	7.50	26.1	411
34.5	32.7	33.6	5.0	6.65	30.2	726
36.9	35.2	36.0	2.4	2.40	33.9	986
39.4	37.6	38.4	2.5	1.95	36.4	1234
42.6	40.9	41.6	3.3	3.65	39.3	882
45.9	44.2	44.8	3.3	3.25	42.5	993
50.1	48.3	48.9	4.1	3.80	46.2	1073

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/- 50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



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Project Hardin County Wind
Sounding Location Turbine 63
Test # 63
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 26-7-2011
Time 9:34
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	0.45	6.5	4626
13.2	11.4	13.8	3.3	1.65	9.7	1566
16.4	14.7	16.6	3.2	2.45	13.0	1137
19.7	17.9	19.5	3.3	3.40	16.3	870
23.9	22.2	23.5	4.3	4.25	20.1	935
26.2	24.5	25.7	2.3	2.55	23.3	854
29.5	27.8	28.8	3.3	5.30	26.1	593
32.8	31.1	32.0	3.3	3.50	29.4	906
36.1	34.3	35.2	3.3	3.25	32.7	982
39.7	37.9	38.7	3.6	2.95	36.1	1196
42.6	40.9	41.6	3.0	2.55	39.4	1136
45.9	44.2	44.8	3.3	0.80	42.5	4033
48.3	46.5	47.2	2.4	2.80	45.4	831

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/- 50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



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Project Hardin County Wind
Sounding Location Turbine 68
Test # 68
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 25-7-2011
Time 12:10
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	5.95	6.5	350
13.1	11.4	13.8	3.3	0.45	9.7	5682
16.4	14.7	16.6	3.3	2.60	13.0	1082
19.7	17.9	19.5	3.3	3.40	16.3	870
23.0	21.2	22.6	3.3	3.20	19.6	953
26.2	24.5	25.7	3.3	3.80	22.9	817
29.5	27.8	28.8	3.3	3.35	26.1	939
33.0	31.2	32.2	3.5	2.75	29.5	1223
36.1	34.3	35.2	3.1	2.45	32.8	1225
39.4	37.6	38.4	3.3	2.65	36.0	1210
42.7	40.9	41.7	3.3	3.35	39.3	970

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/- 50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



Project Hardin County Wind
Sounding Location Turbine 82
Test # 82
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 29-7-2011
Time 13:17
Source Offset (ft): 4.50
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	6.6				
9.9	8.1	9.3	3.3	6.40	6.5	418
13.2	11.4	12.3	3.3	8.20	9.8	363
16.4	14.7	15.3	3.2	6.50	13.0	472
19.7	17.9	18.5	3.3	3.40	16.3	930
23.0	21.2	21.7	3.3	3.95	19.6	809
26.3	24.5	24.9	3.3	2.60	22.9	1250
29.6	27.8	28.2	3.3	2.80	26.2	1154
30.5	28.8	29.1	1.0	0.75	28.3	1253

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/-50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



Project Hardin County Wind
Sounding Location Turbine 88
Test # 88
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 31-7-2011
Time 7:32
Source Offset (ft): 4.50
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	6.6				
9.9	8.1	9.3	3.3	3.35	6.5	799
16.4	14.7	15.3	6.5	10.05	11.4	601
19.7	18.0	18.5	3.3	5.15	16.3	620
23.0	21.2	21.7	3.2	5.10	19.6	620
26.3	24.5	24.9	3.3	5.50	22.9	591
29.6	27.8	28.2	3.3	5.20	26.2	622
32.8	31.1	31.4	3.3	3.85	29.4	842
35.3	33.5	33.8	2.5	2.65	32.3	919

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/-50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



Project Hardin County Wind
Sounding Location Turbine 95
Test # 95
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 24-7-2011
Time 12:44
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
9.9	8.1	11.2	3.3	1.50	6.5	1404
13.7	12.0	14.3	3.8	3.65	10.0	829
16.4	14.7	16.6	2.7	3.00	13.3	774
19.7	17.9	19.5	3.3	3.10	16.3	955
23.0	21.2	22.6	3.3	3.00	19.6	1016
26.2	24.5	25.7	3.3	2.75	22.9	1129
29.5	27.8	28.8	3.3	2.80	26.1	1123
32.8	31.1	32.0	3.3	2.70	29.4	1175
36.1	34.3	35.2	3.3	2.70	32.7	1182
39.4	37.6	38.4	3.3	2.60	36.0	1246
42.6	40.9	41.6	3.2	2.65	39.3	1202
45.9	44.2	44.8	3.3	2.40	42.5	1344
50.1	48.3	48.9	4.1	3.10	46.2	1315

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/- 50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



Project Hardin County Wind
Sounding Location Turbine 97
Test # 97
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 29-7-2011
Time 8:55
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vs Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.2	3.00	6.5	688
13.2	11.4	13.8	3.3	3.05	9.7	847
16.4	14.7	16.6	3.2	3.00	13.0	929
19.7	18.0	19.6	3.3	3.05	16.3	980
23.0	21.2	22.6	3.2	3.85	19.6	784
26.2	24.5	25.7	3.3	3.60	22.9	863
29.6	27.8	28.9	3.3	2.75	26.1	1155
32.8	31.1	32.0	3.2	2.05	29.4	1532
36.1	34.4	35.2	3.3	2.75	32.7	1172
39.4	37.6	38.4	3.3	2.25	36.0	1425
42.6	40.9	41.6	3.2	2.90	39.3	1098
45.9	44.2	44.8	3.3	1.90	42.5	1698
49.8	48.0	48.7	3.9	1.80	46.1	2120

Notes:

The Vs Interval velocity is the approximate estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

The combined error of the depth measurement and time cross-correlation estimate is generally +/- 50ft/s.

N/A indicates a value which MNGS, Inc. cannot determine by the data.



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Project Hardin County Wind
Sounding Location Turbine 3
Test # 3
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 28-7-2011
Time 13:05
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vp Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	0.75	6.5	2776
13.9	12.1	14.4	4.0	0.85	10.1	3749
16.4	14.7	16.6	2.5	0.55	13.4	3971
19.7	17.9	19.5	3.3	0.75	16.3	3946
23.0	21.2	22.6	3.3	0.45	19.6	6774
26.2	24.5	25.7	3.3	0.45	22.9	6901
29.6	27.9	28.9	3.4	0.50	26.2	6478
32.8	31.1	32.0	3.2	0.80	29.5	3846
34.1	32.4	33.3	1.3	0.50	31.7	2549

Notes:

The Vp Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



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Project Hardin County Wind
Sounding Location Turbine 12
Test # 12
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 28-7-2011
Time 9:58
Source Offset (ft): 4.45
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vp Interval Velocity (ft/s)
6.6	4.8	6.6				
9.8	8.1	9.2	3.3	1.15	6.5	2331
13.2	11.4	12.2	3.3	0.65	9.7	4627
16.4	14.7	15.3	3.2	0.50	13.0	6141
19.7	17.9	18.5	3.3	0.50	16.3	6326
23.0	21.2	21.7	3.3	0.40	19.6	7995
26.2	24.4	24.8	3.2	0.80	22.8	3943

Notes:

The Vp Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



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Project Hardin County Wind
Sounding Location Turbine 23
Test # 23
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 29-7-2011
Time 6:13
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - V_p

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	V _p Interval Velocity (ft/s)
6.6	4.8	9.1				
12.0	10.2	12.8	5.4	6.15	7.5	603
13.9	12.2	14.4	2.0	0.80	11.2	2022
16.4	14.7	16.6	2.5	0.45	13.4	4730
19.7	17.9	19.5	3.3	0.60	16.3	4933
23.0	21.2	22.6	3.3	0.35	19.6	8798
26.2	24.5	25.7	3.2	0.55	22.9	5590
29.5	27.8	28.8	3.3	0.50	26.1	6288
32.8	31.1	32.0	3.3	0.50	29.4	6343
34.6	32.9	33.8	1.8	0.50	32.0	3570

Notes:

The V_p Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



Project Hardin County Wind
Sounding Location Turbine 33
Test # 33
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 28-7-2011
Time 14:32
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vp Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	1.05	6.5	1983
13.1	11.4	13.8	3.3	0.35	9.7	7305
16.4	14.7	16.6	3.3	0.40	13.0	7034
19.7	17.9	19.5	3.3	0.60	16.3	4933
23.0	21.2	22.6	3.3	0.45	19.6	6774
27.0	25.2	26.4	4.0	0.45	23.2	8502
29.5	27.8	28.8	2.5	0.60	26.5	4040

Notes:

The Vp Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



Project Hardin County Wind
Sounding Location Turbine 38
Test # 2038
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 27-7-2011
Time 14:40
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vp Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	0.75	6.5	2776
13.1	11.4	13.8	3.3	0.55	9.7	4649
16.4	14.7	16.6	3.3	0.55	13.0	5116
19.7	17.9	19.5	3.3	0.50	16.3	5919

Notes:

The Vp Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



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Project Hardin County Wind
Sounding Location Turbine 38
Test # 38
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 27-7-2011
Time 13:59
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vp Interval Velocity (ft/s)
6.6	4.8	9.1				
9.9	8.2	11.3	3.3	4.75	6.5	448
13.1	11.4	13.8	3.2	0.50	9.8	5019
16.4	14.7	16.6	3.3	0.30	13.0	9379
19.8	18.0	19.6	3.4	0.50	16.3	6100

Notes:

The Vp Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



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Project Hardin County Wind
Sounding Location Turbine 41
Test # 41
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 31-7-2011
Time 9:43
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - V_p

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	V _p Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	10.25	6.5	203
13.1	11.4	13.8	3.3	0.35	9.7	7305
16.4	14.7	16.6	3.3	0.40	13.0	7034
19.7	17.9	19.5	3.3	0.35	16.3	8456
23.7	22.0	23.3	4.0	0.35	19.9	10738
26.2	24.5	25.7	2.5	0.35	23.2	6844
29.5	27.8	28.8	3.3	0.35	26.1	8983
32.8	31.1	32.0	3.3	0.35	29.4	9152
36.1	34.3	35.2	3.2	0.15	32.7	21063

Notes:

The V_p Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



Project Hardin County Wind
Sounding Location Turbine 48
Test # 48
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 27-7-2011
Time 9:23
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vp Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	1.05	6.5	1983
13.1	11.4	13.8	3.3	0.35	9.7	7305
16.4	14.7	16.6	3.3	0.40	13.0	7034
19.7	17.9	19.5	3.3	0.50	16.3	5919
23.0	21.2	22.6	3.3	1.40	19.6	2177
26.3	24.5	25.7	3.3	0.25	22.9	12547
29.5	27.7	28.8	3.2	1.00	26.1	3081
34.5	32.7	33.6	5.0	0.85	30.2	5681
36.9	35.2	36.0	2.4	1.05	33.9	2254
39.4	37.6	38.4	2.5	0.50	36.4	4812
42.6	40.9	41.6	3.3	1.10	39.3	2925
45.9	44.2	44.8	3.3	1.20	42.5	2689
50.1	48.3	48.9	4.1	0.30	46.2	13586

Notes:

The Vp Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



Project Hardin County Wind
Sounding Location Turbine 63
Test # 63
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 26-7-2011
Time 9:34
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - V_p

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	V _p Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	4.50	6.5	463
13.2	11.4	13.8	3.3	0.80	9.7	3230
16.4	14.7	16.6	3.2	0.60	13.0	4644
19.7	17.9	19.5	3.3	0.75	16.3	3946
23.9	22.2	23.5	4.3	0.35	20.1	11357
26.2	24.5	25.7	2.3	0.95	23.3	2293
29.5	27.8	28.8	3.3	0.55	26.1	5717
32.8	31.1	32.0	3.3	0.65	29.4	4879
36.1	34.3	35.2	3.3	0.60	32.7	5319
39.7	37.9	38.7	3.6	0.70	36.1	5039
42.6	40.9	41.6	3.0	0.50	39.4	5793
45.9	44.2	44.8	3.3	0.30	42.5	10756
48.3	46.5	47.2	2.4	0.50	45.4	4656

Notes:

The V_p Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



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Project Hardin County Wind
Sounding Location Turbine 68
Test # 68
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 25-7-2011
Time 12:10
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vp Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	4.95	6.5	421
13.1	11.4	13.8	3.3	0.85	9.7	3008
16.4	14.7	16.6	3.3	2.85	13.0	987
19.7	17.9	19.5	3.3	3.45	16.3	858
23.0	21.2	22.6	3.3	2.35	19.6	1297
26.2	24.5	25.7	3.3	2.85	22.9	1090
29.5	27.8	28.8	3.3	0.95	26.1	3310
33.0	31.2	32.2	3.5	0.65	29.5	5173
36.1	34.3	35.2	3.1	0.45	32.8	6667
39.4	37.6	38.4	3.3	0.60	36.0	5344
42.7	40.9	41.7	3.3	0.40	39.3	8125

Notes:

The Vp Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



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Project Hardin County Wind
Sounding Location Turbine 82
Test # 82
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 29-7-2011
Time 13:17
Source Offset (ft): 4.45
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - V_p

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	V _p Interval Velocity (ft/s)
6.6	4.8	6.6				
9.9	8.1	9.3	3.3	1.30	6.5	2065
13.2	11.4	12.2	3.3	0.30	9.8	9928
16.4	14.7	15.3	3.2	0.50	13.0	6141
19.7	17.9	18.5	3.3	0.50	16.3	6326
23.0	21.2	21.7	3.3	0.40	19.6	7995
26.3	24.5	24.9	3.3	1.00	22.9	3251
29.6	27.8	28.2	3.3	0.30	26.2	10778
30.5	28.8	29.1	1.0	0.65	28.3	1446

Notes:

The V_p Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



Project Hardin County Wind
Sounding Location Turbine 88
Test # 88
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 31-7-2011
Time 7:32
Source Offset (ft): 4.45
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - V_p

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	V _p Interval Velocity (ft/s)
6.6	4.8	6.6				
9.9	8.1	9.3	3.3	0.30	6.5	8950
16.4	14.7	15.3	6.5	0.80	11.4	7561
19.7	18.0	18.5	3.3	0.60	16.3	5325
23.0	21.2	21.7	3.2	0.35	19.6	9046
26.3	24.5	24.9	3.3	0.40	22.9	8129
29.6	27.8	28.2	3.3	0.50	26.2	6467
32.8	31.1	31.4	3.3	0.45	29.4	7207
35.3	33.5	33.8	2.5	0.50	32.3	4874

Notes:

The V_p Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



Project Hardin County Wind
Sounding Location Turbine 95
Test # 95
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 24-7-2011
Time 12:44
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - V_p

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	V _p Interval Velocity (ft/s)
6.6	4.8	9.1				
9.9	8.1	11.2	3.3	1.65	6.5	1276
13.7	12.0	14.3	3.8	3.40	10.0	890
16.4	14.7	16.6	2.7	0.50	13.3	4644
19.7	17.9	19.5	3.3	0.70	16.3	4228
23.0	21.2	22.6	3.3	1.00	19.6	3048
26.2	24.5	25.7	3.3	1.15	22.9	2700
29.5	27.8	28.8	3.3	3.35	26.1	939
32.8	31.1	32.0	3.3	1.35	29.4	2349
36.1	34.3	35.2	3.3	0.35	32.7	9118
39.4	37.6	38.4	3.3	0.55	36.0	5888
42.6	40.9	41.6	3.2	0.55	39.3	5792
45.9	44.2	44.8	3.3	0.25	42.5	12907
50.1	48.3	48.9	4.1	0.45	46.2	9057

Notes:

The V_p Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



Project Hardin County Wind
Sounding Location Turbine 97
Test # 97
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 29-7-2011
Time 8:55
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vp Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.2	1.75	6.5	1180
13.2	11.4	13.8	3.3	1.25	9.7	2067
16.4	14.7	16.6	3.2	0.80	13.0	3483
19.7	18.0	19.6	3.3	0.80	16.3	3737
23.0	21.2	22.6	3.2	0.40	19.6	7546
26.2	24.5	25.7	3.3	0.35	22.9	8873
29.6	27.8	28.9	3.3	0.30	26.1	10586
32.8	31.1	32.0	3.2	0.45	29.4	6977
36.1	34.4	35.2	3.3	0.80	32.7	4029
39.4	37.6	38.4	3.3	0.25	36.0	12826
42.6	40.9	41.6	3.2	0.35	39.3	9102
45.9	44.2	44.8	3.3	0.75	42.5	4302
49.8	48.0	48.7	3.9	0.85	46.1	4490

Notes:

The Vp Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



1549 Minnehaha Avenue West / Saint Paul, MN 55104
p 651.261.2072 / f 651.645.7854

Project Hardin County Wind
Sounding Location Turbine 118
Test # 118
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 29-7-2011
Time 7:24
Source Offset (ft): 4.45
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vp Interval Velocity (ft/s)
6.6	4.8	6.6				
9.9	8.1	9.3	3.3	0.85	6.5	3159
13.2	11.4	12.2	3.3	0.65	9.8	4582
16.4	14.7	15.3	3.2	0.50	13.0	6141
19.7	17.9	18.5	3.3	0.90	16.3	3514
23.0	21.2	21.7	3.3	0.40	19.6	8075
25.1	23.3	23.7	2.1	0.35	22.3	5789

Notes:

The Vp Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



1549 Minnehaha Avenue West / Saint Paul, MN 55104
p 651.261.2072 / f 651.645.7854

Project Hardin County Wind
Sounding Location Turbine 120
Test # 120
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 24-7-2011
Time 15:13
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vp Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	6.05	6.5	344
13.1	11.4	13.8	3.3	1.75	9.7	1461
16.4	14.7	16.6	3.3	2.35	13.0	1197
19.7	17.9	19.5	3.3	2.35	16.3	1259
23.0	21.2	22.6	3.3	3.85	19.6	792
26.2	24.5	25.7	3.3	2.35	22.9	1321
29.5	27.8	28.8	3.3	0.95	26.1	3310
32.8	31.1	32.0	3.3	0.90	29.4	3524
36.1	34.3	35.2	3.3	1.20	32.7	2659
39.4	37.6	38.4	3.3	0.70	36.0	4580
42.6	40.9	41.6	3.3	0.55	39.3	5850
45.9	44.2	44.8	3.3	0.95	42.5	3397
50.1	48.3	48.9	4.1	0.50	46.2	8152

Notes:

The Vp Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.



1549 Minnehaha Avenue West / Saint Paul, MN 55104
p 651.261.2072 / f 651.645.7854

Project Hardin County Wind
Sounding Location Turbine 129
Test # 129
Project # 35110001
Site Location Alger, OH
Date (day/month/year) 25-7-2011
Time 15:02
Source Offset (ft): 7.75
Source Depth (ft): 0.00
Geophone Offset (ft): 1.75

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-Interval Depth (ft)	Vp Interval Velocity (ft/s)
6.6	4.8	9.1				
9.8	8.1	11.2	3.3	1.65	6.5	1262
13.1	11.4	13.8	3.3	1.35	9.7	1894
16.4	14.7	16.6	3.3	0.65	13.0	4329
19.7	17.9	19.5	3.3	0.55	16.3	5381
23.0	21.2	22.6	3.3	0.45	19.6	6774
26.2	24.5	25.7	3.3	0.50	22.9	6211

Notes:

The Vp Interval velocity is the estimated velocity across the previous Tip Depth interval.

Reduce the significant figures for the calculated Vs to 3 figures based on the precision of the depth interval.

N/A indicates a value which MNNGS, Inc. cannot verify by the data.

Highlighted results are likely distorted by groundwater influences or phase changes.

Appendix C

Dilatometer (DMT) Test Results



Barr Engineering Company

DMT Spreadsheet- Data Summary

Hardin County Wind Project

35/33-1001

Sounding No: DMT5

August 2, 2011

Ground Water Depth (ft): 7

UTM, Zone 16N - NAD 83 (m)

Northing: 4509473.0

Easting: 261049.0

¹ Depth Below Existing Ground Surface

² Mayne, 1995

³ Marchetti, 1980

⁴ Marchetti, 1997

⁵ Campanella and Robertson, 1991

⁶ Marchetti, 1980

⁷ Schmertman, 1981

Depth ¹ (ft)	A (bar)	B (bar)	po (psf)	p1 (psf)	u _o (psf)	s _{vo} (psf)	s _{vo'} (psf)	I _d	K _D (bar)	K _o (bar)	OCR ²	OCR ³	ϕ ⁴ (deg)	ϕ ⁵ (deg)	E _D (ksf)	s _u ⁶ (psf)	s _u ⁷ (psf)	M (ksf)	
6.6	5.1	13.2	4.92	13.06	0	787	787	1.65	13.1	282	2.2			41.7	41.9	2.8	590		1623
7.6	2.95	10.6	2.80	10.46	40	917	877	2.76	6.6	266	1.4			38.6	40.4	2.1	556		1185
8.7	2.85	6.3	2.91	6.16	108	1047	939	1.14	6.3	113	1.4	3.2	6.1			2.0	236	875	596
9.8	3.9	6.45	4.00	6.31	177	1181	1004	0.59	8.1	80	1.6	4.1	8.9			2.3	167	1278	818
10.9	7.2	15.4	7.02	15.26	245	1311	1066	1.19	13.5	286	2.2	6.9	19.7			2.8	597	2556	1441
12.0	3.7	15	3.36	14.86	312	1441	1128	3.58	5.9	399	1.3			38.0	40.1	2.0	833		1707
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
14.2	6.45	15.6	6.22	15.46	450	1705	1255	1.54	10.0	321	1.8			40.5	41.3	2.5	670		1674
15.3	4.05	5.35	4.21	5.21	517	1835	1317	0.25	6.3	35	1.4	3.2	6.0			2.0	72	1213	828
16.4	3.8	7.8	3.83	7.66	587	1969	1382	1.08	5.4	133	1.2	2.7	4.7			1.9	278	1043	741
17.5	4.15	8.2	4.18	8.06	654	2098	1444	1.01	5.6	135	1.3	2.8	5.0			1.9	282	1147	807
18.6	3.75	7.5	3.79	7.36	722	2228	1506	1.04	4.8	124	1.1	2.4	3.9			1.8	259	984	719
19.7	5.6	8.55	5.68	8.41	792	2362	1571	0.51	7.0	95	1.5	3.6	7.1			2.1	198	1669	1107
20.8	7.8	19.4	7.45	19.26	859	2492	1633	1.68	9.0	410	1.7			40.0	41.1	2.4	856		2054
21.9	5.65	22.4	5.04	22.26	927	2622	1695	3.75	5.7	598	1.3			37.8	40.0	2.0	1248		2503
23.0	11.4	34.6	10.47	34.46	996	2756	1760	2.40	11.9	833	2.0			41.3	41.7	2.7	1739		4628
24.0	6.65	29.4	5.74	29.26	1064	2886	1822	4.50	6.0	816	1.3			38.1	40.1	2.1	1705		3504
25.1	9.7	35	8.66	34.86	1131	3016	1884	3.23	9.0	909	1.7			40.0	41.1	2.4	1899		4573
26.2	8.4	16.6	8.22	16.46	1201	3150	1949	1.08	8.2	286	1.6	4.2	9.0			2.3	597	2498	1596
27.3	9.1	35	8.03	34.86	1269	3280	2011	3.61	7.7	931	1.6			39.3	40.7	2.3	1944		4422
28.4	6	14.2	5.82	14.06	1336	3409	2073	1.59	5.2	286	1.2			37.4	39.8	1.9	597		1120
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
33.9	8.1	19.6	7.75	19.46	1678	2389	1.68	6.1	406	1.3				38.2	40.2	2.0	848		1718
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	



Barr Engineering Company

DMT Spreadsheet- Data Summary

Hardin County Wind Project

35/33-1001

Sounding No: DMT45

August 1, 2011

Ground Water Depth (ft): 15

UTM, Zone 16N - NAD 83 (m)

Northing: 4505759.0

Easting: 263797.0

¹ Depth Below Existing Ground Surface

² Mayne, 1995

³ Marchetti, 1980

⁴ Marchetti, 1997

⁵ Campanella and Robertson, 1991

⁶ Marchetti, 1980

⁷ Schmertman, 1981

Depth ¹ (ft)	A (bar)	B (bar)	po	p1 (psf)	u _o (psf)	s _{vo} (psf)	s _{vo'} (psf)	I _d	K _D	E _D (bar)	K _o	OCR ²	OCR ³	ϕ ⁴ (deg)	ϕ ⁵ (deg)	E _D (ksf)	s _u ⁶ (psf)	s _u ⁷ (psf)	M (ksf)	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
7.6	1.6	2.1	1.81	1.86	0	917	917	0.03	4.1	2	1.0	2.1	3.1			1.6	4	497	378	6
8.7	1.6	2.15	1.81	1.91	0	1047	1047	0.06	3.6	4	0.9	1.8	2.5			1.5	8	480	377	11
9.8	1.7	2.2	1.91	1.96	0	1181	1181	0.03	3.4	2	0.9	1.7	2.3			1.4	4	499	398	5
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
12.0	1.75	2.35	1.95	2.11	0	1441	1441	0.08	2.8	5	0.7	1.4	1.7			1.2	11	489	408	14
13.1	1.75	2.35	1.95	2.11	0	1575	1575	0.08	2.6	5	0.7	1.3	1.5			1.1	11	478	408	13
14.2	1.95	2.5	2.16	2.26	0	1705	1705	0.05	2.6	4	0.7	1.3	1.5			1.1	8	531	450	9
15.3	1.95	2.75	2.14	2.51	18	1835	1817	0.17	2.5	13	0.7	1.2	1.4			1.1	27	516	446	28
16.4	1.85	2.55	2.05	2.31	88	1969	1881	0.13	2.2	9	0.6	1.1	1.2			1.0	19	473	419	18
17.5	2	2.6	2.20	2.36	155	2098	1943	0.07	2.3	5	0.6	1.2	1.2			1.0	11	506	444	11
18.6	3.35	5.2	3.49	4.96	223	2228	2006	0.43	3.5	51	0.9	1.8	2.4			1.4	107	895	707	152
19.7	3.7	4.95	3.87	4.71	292	2362	2070	0.23	3.8	29	0.9	1.9	2.7			1.5	61	1004	779	91
20.8	2.55	3.55	2.73	3.31	360	2492	2132	0.23	2.5	20	0.7	1.3	1.4			1.1	42	622	535	45
21.9	2.3	2.8	2.51	2.56	427	2622	2195	0.02	2.2	2	0.6	1.1	1.2			0.9	4	541	481	4
23.0	2.35	2.85	2.56	2.61	497	2756	2259	0.02	2.1	2	0.6	1.1	1.1			0.9	4	542	484	4
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
25.1	2.8	3.35	3.01	3.11	632	3016	2384	0.04	2.4	4	0.6	1.2	1.3			1.0	8	648	564	8
26.2	2.85	3.4	3.06	3.16	702	3150	2448	0.04	2.3	4	0.6	1.2	1.3			1.0	8	648	568	8
27.3	2.9	3.4	3.11	3.16	769	3280	2510	0.02	2.3	2	0.6	1.2	1.2			1.0	4	650	572	4
28.4	3.1	3.6	3.31	3.36	837	3409	2573	0.02	2.4	2	0.6	1.2	1.3			1.0	4	696	607	4
29.5	3.15	3.65	3.36	3.41	907	3543	2637	0.02	2.3	2	0.6	1.2	1.3			1.0	4	697	611	4
30.6	3.35	3.9	3.56	3.66	974	3673	2699	0.03	2.4	4	0.6	1.2	1.3			1.0	8	742	645	8
31.7	3.3	4.05	3.50	3.81	1042	3803	2762	0.11	2.3	11	0.6	1.2	1.2			1.0	23	710	626	22
32.8	3.5	4.1	3.70	3.86	1111	3937	2826	0.05	2.3	5	0.6	1.2	1.3			1.0	11	758	662	12
33.9	3.65	4.25	3.85	4.01	1179	4067	2888	0.05	2.4	5	0.6	1.2	1.3			1.0	11	789	687	12
35.0	4	4.7	4.20	4.46	1246	4197	2950	0.07	2.5	9	0.7	1.3	1.5			1.1	19	879	752	21
36.1	4	4.65	4.20	4.41	1316	4331	3015	0.06	2.5	7	0.7	1.3	1.4			1.1	15	865	746	16
37.2	4.15	4.8	4.35	4.56	1384	4461	3077	0.06	2.5	7	0.7	1.3	1.4			1.1	15	896	770	16
38.3	4.3	5.1	4.49	4.86	1451	4591	3139	0.10	2.5	13	0.7	1.3	1.4			1.1	27	925	793	29
39.4	4.55	5.15	4.75	4.91	1521	4724	3204	0.04	2.6	5	0.7	1.3	1.5			1.1	11	989	841	13
40.5	4.85	5.5	5.05	5.26	1588	4854	3266	0.05	2.7	7	0.7	1.4	1.6			1.2	15	1066	896	18
41.5	5.15	6	5.34	5.76	1656	4984	3328	0.09	2.9	15	0.8	1.5	1.7			1.2	30	1142	950	37
42.7	6.15	7.15	6.33	6.91	1725	5118	3393	0.10	3.4	20	0.9	1.7	2.3			1.4	42	1443	1150	58
43.7	5.7	8.9	5.77	8.66	1793	5248	3455	0.59	3.0	100	0.8	1.5	1.9			1.3	209	1246	1026	263
44.8	5.95	9.65	6.00	9.41	1861	5378	3517	0.67	3.0	118	0.8	1.5	1.9			1.3	247	1302	1067	317
45.9	7.45	10.6	7.53	10.36	1930	5512	3582	0.43	3.8	98	1.0	2.0	2.8			1.5	205	1786	1379	313
47.0	8.55	13.2	8.55	12.96	1998	5642	3644	0.58	4.4	153	1.0	2.2	3.4			1.6	320	2119	1586	526
48.1	8.85	14	8.83	13.76	2065	5772	3706	0.63	4.4	171	1.1	2.2	3.4			1.7	358	2194	1637	595
49.2	8.3	14.2	8.24	13.96	2135	5906	3771	0.79	4.0	199	1.0	2.0	2.9			1.6	415	1971	1507	652
50.3	9.5	15.8	9.42	15.56	2202	6035	3833	0.73	4.6	213	1.1	2.3	3.6			1.7	445	2361	1747	757



Barr Engineering Company

DMT Spreadsheet- Data Summary

Hardin County Wind Project

35/33-1001

Sounding No: DMT48

August 2, 2011

Ground Water Depth (ft): 7

UTM, Zone 16N - NAD 83 (m)

Northing: 4504981.0

Easting: 264366.0

¹ Depth Below Existing Ground Surface

² Mayne, 1995

³ Marchetti 1980

⁴ Marchetti, 1997

⁵ Campanella and Robertson, 1991

⁶ Marchetti, 1980

¹ Schmertman, 1981



Barr Engineering Company
DMT Spreadsheet- Data Summary
Hardin County Wind Project
35/33-1001
Sounding No: DMT51
August 21, 2011

Ground Water Depth (ft): 7

UTM, Zone 16N - NAD 83 (m)
Northing: 4504005.0
Easting: 263477.0

- ¹ Depth Below Existing Ground Surface
- ² Mayne, 1995
- ³ Marchetti, 1980
- ⁴ Marchetti, 1997
- ⁵ Campanella and Robertson, 1991
- ⁶ Marchetti, 1980
- ⁷ Schmertman, 1981

Depth ¹ (ft)	A (bar)	B (bar)	po	p1 (psf)	u _o (psf)	s _{vo} (psf)	s _{vo'} (psf)	I _d	K _D (bar)	E _D (bar)	K _o	OCR ²	OCR ³	ϕ ⁴ (deg)	ϕ ⁵ (deg)	E _D (ksf)	s _u ⁶ (psf)	s _u ⁷ (psf)	M (ksf)
6.6	1.35	2.4	1.44	1.86	0	787	787	0.29	3.8	15	1.0	1.9	2.7			1.5	30	389	301 46
7.6	1.65	2.45	1.75	1.91	40	917	877	0.09	4.1	5	1.0	2.1	3.1			1.6	11	477	362 18
8.7	1.8	2.5	1.91	1.96	108	1047	939	0.03	4.1	2	1.0	2.1	3.1			1.6	4	511	388 6
9.8	1.8	2.55	1.91	2.01	177	1181	1004	0.06	3.8	4	0.9	1.9	2.7			1.5	8	491	380 11
10.9	1.8	2.6	1.90	2.06	245	1311	1066	0.09	3.5	5	0.9	1.8	2.4			1.4	11	472	373 16
12.0	1.9	2.6	2.01	2.06	312	1441	1128	0.03	3.4	2	0.9	1.8	2.3			1.4	4	489	388 5
13.1	1.95	2.7	2.06	2.16	382	1575	1193	0.06	3.3	4	0.8	1.7	2.2			1.4	8	487	391 10
14.2	2	2.7	2.11	2.16	450	1705	1255	0.03	3.1	2	0.8	1.6	2.0			1.3	4	487	395 5
15.3	2	2.8	2.10	2.26	517	1835	1317	0.08	2.9	5	0.8	1.5	1.8			1.2	11	469	387 14
16.4	2.05	2.8	2.16	2.26	587	1969	1382	0.06	2.8	4	0.7	1.4	1.7			1.2	8	470	391 9
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
19.7	2.2	2.95	2.31	2.41	792	2362	1571	0.05	2.6	4	0.7	1.3	1.5			1.1	8	471	402 8
20.8	2.2	3	2.30	2.46	859	2492	1633	0.08	2.4	5	0.7	1.2	1.3			1.0	11	456	395 12
21.9	2.35	3.1	2.46	2.56	927	2622	1695	0.05	2.5	4	0.7	1.3	1.4			1.1	8	487	420 8
23.0	2.4	3.1	2.51	2.56	996	2756	1760	0.03	2.4	2	0.6	1.2	1.3			1.0	4	489	424 4
24.0	2.4	3.2	2.50	2.66	1064	2886	1822	0.08	2.3	5	0.6	1.2	1.2			1.0	11	473	416 11
25.1	2.55	3.3	2.66	2.76	1131	3016	1884	0.05	2.3	4	0.6	1.2	1.3			1.0	8	505	441 8
26.2	2.65	3.35	2.76	2.81	1201	3150	1949	0.02	2.3	2	0.6	1.2	1.3			1.0	4	521	456 4
27.3	2.65	3.45	2.75	2.91	1269	3280	2011	0.07	2.2	5	0.6	1.1	1.2			1.0	11	506	448 11
28.4	2.85	3.65	2.95	3.11	1336	3409	2073	0.07	2.3	5	0.6	1.2	1.3			1.0	11	552	483 11
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
30.6	3.1	3.9	3.20	3.36	1473	3673	2200	0.06	2.4	5	0.6	1.2	1.3			1.0	11	599	522 12
31.7	3.2	3.95	3.31	3.41	1541	3803	2262	0.04	2.4	4	0.6	1.2	1.3			1.0	8	615	536 8
32.8	3.3	4.1	3.40	3.56	1610	3937	2327	0.06	2.4	5	0.6	1.2	1.3			1.0	11	630	550 12
33.9	3.75	4.75	3.84	4.21	1678	4067	2389	0.12	2.7	13	0.7	1.4	1.6			1.1	27	750	635 30
35.0	3.8	4.7	3.90	4.16	1746	4197	2451	0.09	2.6	9	0.7	1.3	1.5			1.1	19	752	639 21
36.1	3.9	4.8	4.00	4.26	1815	4331	2516	0.08	2.6	9	0.7	1.3	1.5			1.1	19	767	653 21
37.2	4.1	5.1	4.19	4.56	1883	4461	2578	0.11	2.7	13	0.7	1.4	1.6			1.1	27	812	687 30
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
39.4	4.25	5.15	4.35	4.61	2020	4724	2705	0.08	2.6	9	0.7	1.3	1.5			1.1	19	830	706 21
40.5	4.6	5.55	4.70	5.01	2087	4854	2767	0.09	2.8	11	0.7	1.4	1.7			1.2	23	923	772 27
41.5	4.55	5.55	4.64	5.01	2155	4984	2829	0.10	2.7	13	0.7	1.4	1.6			1.1	27	891	754 30
42.7	4.75	5.7	4.85	5.16	2225	5118	2893	0.08	2.7	11	0.7	1.4	1.6			1.2	23	938	789 27
43.7	4.8	5.8	4.89	5.26	2292	5248	2956	0.10	2.7	13	0.7	1.4	1.6			1.2	27	938	793 31
44.8	4.85	5.9	4.94	5.36	2360	5378	3018	0.11	2.6	15	0.7	1.3	1.5			1.1	30	938	796 35
45.9	5.05	5.95	5.15	5.41	2429	5512	3082	0.07	2.7	9	0.7	1.4	1.6			1.2	19	987	832 22
47.0	5.2	6.25	5.29	5.71	2497	5642	3145	0.10	2.7	15	0.7	1.4	1.6			1.2	30	1016	855 35
48.1	5.45	6.25	5.55	5.71	2564	5772	3207	0.04	2.8	5	0.7	1.4	1.7			1.2	11	1082	903 14
49.2	5.55	6.8	5.63	6.26	2634	5906	3271	0.14	2.8	22	0.7	1.4	1.7			1.2	46	1091	912 54
50.3	5.8	7.1	5.88	6.56	2702	6035	3334	0.15	2.9	24	0.8	1.5	1.8			1.2	49	1153	957 60



Barr Engineering Company

DMT Spreadsheet- Data Summary

Hardin County Wind Project

35/33-1001

Sounding No: DMT54

August 1, 2011

Ground Water Depth (ft): 7

UTM, Zone 16N - NAD 83 (m)

Northing: 4503270.0

Easting: 263375.0

¹ Depth Below Existing Ground Surface

² Mayne, 1995

³ Marchetti, 1980

⁴ Marchetti, 1997

⁵ Campanella and Robertson, 1991

⁶ Marchetti, 1980

⁷ Schmertman, 1981

Depth ¹ (ft)	A (bar)	B (bar)	po	p1 (psf)	u _o (psf)	s _{vo} (psf)	s _{vo'} (psf)	I _d	K _D (bar)	E _D (bar)	K _o	OCR ²	OCR ³	ϕ ⁴ (deg)	ϕ ⁵ (deg)	E _D (ksf)	s _u ⁶ (psf)	s _u ⁷ (psf)	M (ksf)	
6.6	1.2	1.85	1.40	1.61	0	787	787	0.15	3.7	7	0.9	1.9	2.6			1.5	15	375	292	23
7.6	1.55	2.15	1.75	1.91	40	917	877	0.09	4.1	5	1.0	2.1	3.1			1.6	11	477	362	18
8.7	1.8	2.45	2.00	2.21	108	1047	939	0.11	4.3	7	1.0	2.2	3.3			1.6	15	543	407	25
9.8	1.75	2.5	1.95	2.26	177	1181	1004	0.17	3.9	11	1.0	2.0	2.8			1.5	23	504	388	35
10.9	1.8	2.35	2.01	2.11	245	1311	1066	0.06	3.7	4	0.9	1.9	2.6			1.5	8	506	394	11
12.0	2	2.55	2.21	2.31	312	1441	1128	0.05	3.8	4	0.9	1.9	2.7			1.5	8	555	429	11
13.1	2.05	2.65	2.25	2.41	382	1575	1193	0.08	3.6	5	0.9	1.8	2.5			1.5	11	552	432	17
14.2	2.1	2.75	2.30	2.51	450	1705	1255	0.10	3.5	7	0.9	1.8	2.4			1.4	15	550	435	22
15.3	1.85	2.45	2.05	2.21	517	1835	1317	0.09	2.9	5	0.8	1.5	1.7			1.2	11	453	377	14
16.4	2.45	4.2	2.60	3.96	587	1969	1382	0.59	3.5	47	0.9	1.8	2.4			1.4	99	611	483	141
17.5	2.6	5.3	2.70	5.06	654	2098	1444	0.99	3.4	82	0.9	1.8	2.3			1.4	171	628	498	246
18.6	2.65	4.75	2.78	4.51	722	2228	1506	0.71	3.4	60	0.9	1.7	2.3			1.4	126	637	508	175
19.7	3.15	4.2	3.33	3.96	792	2362	1571	0.21	3.9	22	1.0	2.0	2.9			1.5	46	802	616	70
20.8	2.7	3.2	2.91	2.96	859	2492	1633	0.02	3.2	2	0.8	1.6	2.1			1.3	4	645	521	5
21.9	2.45	3.05	2.65	2.81	927	2622	1695	0.07	2.7	5	0.7	1.4	1.6			1.2	11	548	461	13
23.0	2.9	3.75	3.09	3.51	996	2756	1760	0.16	3.1	15	0.8	1.6	2.0			1.3	30	670	546	40
24.0	2.75	3.55	2.94	3.31	1064	2886	1822	0.15	2.8	13	0.7	1.4	1.7			1.2	27	607	508	32
25.1	3.25	4.95	3.40	4.71	1131	3016	1884	0.46	3.2	46	0.8	1.6	2.0			1.3	95	736	596	126
26.2	3.6	6.4	3.69	6.16	1201	3150	1949	0.79	3.3	86	0.9	1.7	2.2			1.4	179	814	651	249
27.3	3.55	5.85	3.67	5.61	1269	3280	2011	0.63	3.2	67	0.8	1.6	2.1			1.3	141	789	639	187
28.4	3.5	6.3	3.59	6.06	1336	3409	2073	0.84	3.0	86	0.8	1.5	1.9			1.3	179	749	617	228
29.5	4.05	6.15	4.18	5.91	1406	3543	2138	0.49	3.4	60	0.9	1.7	2.3			1.4	126	921	732	176
30.6	4.3	6.05	4.45	5.81	1473	3673	2200	0.37	3.6	47	0.9	1.8	2.4			1.4	99	992	781	142
31.7	5.9	11.8	5.84	11.56	1541	3803	2262	1.12	4.7	199	1.1	2.4	3.8			1.8	415	1451	1065	727
32.8	9.05	19.4	8.77	19.16	1610	3937	2327	1.30	7.2	361	1.5			39.0	40.6	2.2	753		1639	
33.9	7.55	17.2	7.30	16.96	1678	4067	2389	1.49	5.7	335	1.3			37.8	40.0	2.0	700		1367	
35.0	6.65	12.2	6.61	11.96	1746	4197	2451	0.93	4.9	186	1.1	2.5	4.1			1.8	388	1660	1205	694
36.1	9.35	17.6	9.17	17.36	1815	4331	2516	0.99	6.9	284	1.4	3.5	6.9			2.1	594	2598	1734	1263
37.2	12.6	23.2	12.30	22.96	1883	4461	2578	0.93	9.2	370	1.7	4.7	10.9			2.4	772	3840	2381	1869
38.3	11.2	21.4	10.92	21.16	1950	4591	2640	1.02	7.9	355	1.6	4.0	8.5			2.3	742	3235	2086	1681
39.4	10.8	25	10.32	24.76	2020	4724	2705	1.54	7.2	501	1.5			39.0	40.6	2.2	1046		2288	
40.5	7.15	25.2	6.48	24.96	2087	4854	2767	3.37	4.1	641	1.0			36.2	39.2	1.7	1339		2321	
0.0	0	0		0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
0.0	0	0		0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	



Barr Engineering Company

DMT Spreadsheet- Data Summary

Hardin County Wind Project

35/33-1001

Sounding No: DMT64

August 1, 2011

Ground Water Depth (ft): 7

UTM, Zone 16N - NAD 83 (m)

Northing: 4502405.0

Easting: 264954.0

¹ Depth Below Existing Ground Surface

² Mayne, 1995

³ Marchetti, 1980

⁴ Marchetti, 1997

⁵ Campanella and Robertson, 1991

⁶ Marchetti, 1980

⁷ Schmertman, 1981

Depth ¹ (ft)	A (bar)	B (bar)	po	p1 (psf)	u _o (psf)	s _{vo} (psf)	s _{vo'} (psf)	I _d	K _D (bar)	K _o	OCR ²	OCR ³	ϕ ⁴ (deg)	ϕ ⁵ (deg)	E _D (ksf)	s _u ⁶ (psf)	s _u ⁷ (psf)	M (ksf)		
6.6	4.4	11.6	4.14	10.91	0	787	787	1.64	11.0	235	1.9			40.9	41.5	2.6	491		1270	
7.6	4.2	9.7	4.02	9.01	40	917	877	1.25	9.5	173	1.8			40.3	41.2	2.5	361		887	
8.7	6.2	15.2	5.85	14.51	108	1047	939	1.49	12.9	301	2.1			41.6	41.9	2.7	628		1720	
9.8	4.6	11	4.38	10.31	177	1181	1004	1.38	8.9	206	1.7			40.0	41.1	2.4	430		1028	
10.9	2.45	5.8	2.38	5.11	245	1311	1066	1.21	4.4	95	1.1			36.6	39.4	1.7	198		336	
12.0	4.25	8.15	4.15	7.46	312	1441	1128	0.83	7.4	115	1.5	3.8	7.7			2.2	240	1276	836	527
13.1	4.05	11.4	3.78	10.71	382	1575	1193	1.93	6.3	240	1.4			38.3	40.3	2.1	502		1038	
14.2	4.9	12.8	4.60	12.11	450	1705	1255	1.71	7.3	261	1.5			39.0	40.6	2.2	544		1197	
15.3	4.8	11.4	4.57	10.71	517	1835	1317	1.42	6.8	213	1.4			38.7	40.5	2.1	445		949	
16.4	4.55	10.6	4.35	9.91	587	1969	1382	1.37	6.1	193	1.3			38.2	40.2	2.0	403		817	
17.5	7.25	14.2	7.00	13.51	654	2098	1444	0.97	9.7	226	1.8	4.9	11.7			2.5	472	2278	1397	1164
18.6	8.2	16.4	7.89	15.71	722	2228	1506	1.04	10.5	271	1.9	5.3	13.2			2.5	567	2620	1575	1441
19.7	9	15.8	8.76	15.11	792	2362	1571	0.76	11.1	220	2.0	5.7	14.6			2.6	460	2957	1750	1198
20.8	7.55	14.4	7.31	13.71	859	2492	1633	0.93	8.8	222	1.7	4.5	10.1			2.4	464	2295	1440	1102
21.9	8	14.6	7.77	13.91	927	2622	1695	0.84	9.0	213	1.7	4.6	10.5			2.4	445	2452	1530	1067
23.0	8	13.8	7.81	13.11	996	2756	1760	0.72	8.7	184	1.7	4.4	9.9			2.4	384	2432	1531	906
24.0	5.75	13	5.49	12.31	1064	2886	1822	1.37	5.7	237	1.3			37.8	40.0	2.0	495		966	
25.1	6.05	18.6	5.52	17.91	1131	3016	1884	2.49	5.5	430	1.2			37.7	39.9	2.0	898		1763	
26.2	7.85	13.8	7.65	13.11	1201	3150	1949	0.77	7.6	189	1.5	3.9	8.0			2.2	396	2268	1478	878
27.3	7.75	11.2	7.68	10.51	1269	3280	2011	0.40	7.3	98	1.5	3.7	7.6			2.2	205	2247	1476	449
28.4	6.55	10.8	6.44	10.11	1336	3409	2073	0.63	5.8	128	1.3	3.0	5.3			1.9	266	1740	1210	519
29.5	7.35	10.4	7.30	9.71	1406	3543	2138	0.36	6.5	84	1.4	3.3	6.2			2.1	175	2040	1383	359
30.6	10.8	30	9.94	29.31	1473	3673	2200	2.10	8.8	672	1.7			39.9	41.0	2.4	1404		3338	
31.7	7.2	11.8	7.07	11.11	1541	3803	2262	0.64	5.8	140	1.3	3.0	5.3			2.0	293	1901	1322	571
32.8	6.45	9.45	6.40	8.76	1610	3937	2327	0.42	5.1	82	1.2	2.6	4.2			1.8	171	1629	1175	308
33.9	6.55	9.8	6.49	9.11	1678	4067	2389	0.46	5.0	91	1.2	2.5	4.1			1.8	190	1639	1187	339
35.0	6.45	9.3	6.41	8.61	1746	4197	2451	0.40	4.7	77	1.1	2.4	3.8			1.7	160	1588	1163	277
36.1	7.15	12.8	6.97	12.11	1815	4331	2516	0.84	5.1	179	1.2	2.6	4.3			1.8	373	1766	1273	676
37.2	6.15	10.6	6.03	9.91	1883	4461	2578	0.76	4.2	135	1.0	2.1	3.1			1.6	282	1413	1070	453
38.3	9.4	15.8	9.18	15.11	1950	4591	2640	0.72	6.5	206	1.4	3.3	6.3			2.1	430	2545	1722	888
39.4	6.2	11.8	6.02	11.11	2020	4724	2705	1.01	3.9	177	1.0	2.0	2.8			1.6	369	1371	1055	576
40.5	11.8	26.4	11.17	25.71	2087	4854	2767	1.43	7.7	505	1.6			39.3	40.7	2.2	1054		2364	
41.5	8.65	27.8	7.79	27.11	2155	4984	2829	2.86	5.0	670	1.2			37.2	39.7	1.9	1400		2646	
42.7	11.4	28	10.67	27.31	2225	5118	2893	1.73	6.9	577	1.5			38.8	40.5	2.2	1206		2595	
43.7	14.8	30	14.14	29.31	2292	5248	2956	1.16	9.2	526	1.7	4.7	10.8			2.4	1100	4389	2723	2660



Barr Engineering Company

DMT Spreadsheet- Data Summary

Hardin County Wind Project

35/33-1001

Sounding No: DMT70

August 1, 2011

Ground Water Depth (ft): 7

UTM, Zone 16N - NAD 83 (m)

Northing: 4500145.0

Easting: 262959.0

¹ Depth Below Existing Ground Surface

² Mayne, 1995

³ Marchetti, 1980

⁴ Marchetti, 1997

⁵ Campanella and Robertson, 1991

⁶ Marchetti, 1980

⁷ Schmertman, 1981

Depth ¹ (ft)	A (bar)	B (bar)	po	p1 (psf)	u _o (psf)	s _{vo} (psf)	s _{vo'} (psf)	I _d	K _D (bar)	E _D (bar)	K _o	OCR ²	OCR ³	ϕ ⁴ (deg)	ϕ ⁵ (deg)	E _D (ksf)	s _u ⁶ (psf)	s _u ⁷ (psf)	M (ksf)		
6.6	1.2	2.1	1.25	1.41	0	787	787	0.13	3.3	5	0.9	1.7	2.2			1.4	11	327	262	16	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
9.8	1.4	2.2	1.46	1.51	177	1181	1004	0.04	2.9	2	0.8	1.5	1.7				1.2	4	345	287	5
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
14.2	1.45	2.25	1.51	1.56	450	1705	1255	0.04	2.2	2	0.6	1.1	1.1				0.9	4	302	270	4
15.3	1.5	2.3	1.56	1.61	517	1835	1317	0.04	2.1	2	0.6	1.1	1.1				0.9	4	304	274	3
16.4	1.65	2.5	1.71	1.81	587	1969	1382	0.07	2.2	4	0.6	1.1	1.1				0.9	8	333	297	7
17.5	1.7	2.55	1.76	1.86	654	2098	1444	0.07	2.1	4	0.6	1.1	1.1				0.9	8	335	301	7
18.6	1.35	3.9	1.32	3.21	722	2228	1506	1.94	1.4	66	0.4			29.9	35.1	0.9	137				116
19.7	2.75	4.45	2.76	3.76	792	2362	1571	0.42	3.2	35	0.8	1.6	2.1				1.3	72	614	498	96
20.8	3.25	4.7	3.28	4.01	859	2492	1633	0.26	3.7	26	0.9	1.9	2.6				1.5	53	765	598	78
21.9	3.7	5.35	3.72	4.66	927	2622	1695	0.29	4.0	33	1.0	2.1	3.0				1.6	68	895	683	107
23.0	3.5	5.15	3.52	4.46	996	2756	1760	0.31	3.6	33	0.9	1.8	2.5				1.5	68	809	634	100
24.0	3.55	5.2	3.57	4.51	1064	2886	1822	0.31	3.5	33	0.9	1.8	2.4				1.4	68	808	638	98
25.1	3.55	5.25	3.56	4.56	1131	3016	1884	0.33	3.3	35	0.9	1.7	2.2				1.4	72	789	631	100
26.2	2.65	9.25	2.42	8.56	1201	3150	1949	3.33	2.0	213	0.5			32.1	36.9	1.1	445				486
27.3	4.1	13.8	3.71	13.11	1269	3280	2011	3.03	3.2	326	0.8			34.9	38.5	1.5	681				1033
28.4	4.35	14.2	3.96	13.51	1336	3409	2073	2.88	3.3	332	0.9			35.1	38.6	1.5	692				1066
29.5	4.55	16.2	4.07	15.51	1406	3543	2138	3.37	3.3	397	0.9			35.0	38.6	1.5	829				1278
30.6	5.1	16.4	4.63	15.71	1473	3673	2200	2.82	3.7	384	0.9			35.7	38.9	1.6	803				1310
31.7	4.8	17.2	4.28	16.51	1541	3803	2262	3.46	3.3	424	0.8			35.0	38.6	1.5	887				1355
32.8	5.7	15.8	5.29	15.11	1610	3937	2327	2.17	4.1	341	1.0			36.1	39.2	1.7	711				1187
33.9	4.05	14.4	3.63	13.71	1678	4067	2389	3.57	2.5	350	0.7			33.4	37.7	1.3	731				939
35.0	4.95	16.4	4.48	15.71	1746	4197	2451	3.09	3.1	390	0.8			34.7	38.4	1.5	814				1207
36.1	4.55	15	4.13	14.31	1815	4331	2516	3.13	2.7	353	0.7			33.9	38.0	1.4	738				1007
37.2	4.05	18	3.45	17.31	1883	4461	2578	5.44	2.1	481	0.6			32.4	37.1	1.1	1004				1135
38.3	3.95	17.6	3.37	16.91	1950	4591	2640	5.57	1.9	470	0.5			32.0	36.8	1.1	982				1048
39.4	2.65	7.9	2.49	7.21	2020	4724	2705	3.11	1.2	164	0.3			29.0	34.2	0.9	342				291
40.5	2.9	11.8	2.55	11.11	2087	4854	2767	5.51	1.2	297	0.3			29.0	34.2	0.9	620				527
41.5	2.4	6.25	2.31	5.56	2155	4984	2829	2.56	0.9	113	0.2			27.6	31.7	0.9	236				201
42.7	2.7	13.6	2.25	12.91	2225	5118	2893	8.98	0.9	370	0.2			27.0	29.6	0.9	772				657
43.7	3.75	9.8	3.55	9.11	2292	5248	2956	2.27	1.7	193	0.5			31.4	36.4	0.9	403				360
44.8	7.6	14.4	7.36	13.71	2360	5378	3018	1.02	4.3	220	1.0	2.2	3.3				1.7	460	1733	1301	764
45.9	8.75	15.8	8.50	15.11	2429	5512	3082	0.90	5.0	230	1.2	2.5	4.1				1.8	479	2115	1531	861
47.0	6.15	11.8	5.97	11.11	2497	5642	3145	1.08	3.2	179	0.8	1.6	2.0				1.4	373	1229	996	506
48.1	9.35	13.8	9.23	13.11	2564	5772	3207	0.49	5.2	135	1.2	2.7	4.5				1.8	282	2334	1670	516
49.2	10.6	17	10.38	16.31	2634	5906	3271	0.65	5.8	206	1.3	3.0	5.3				1.9	430	2735	1904	837
50.3	9.55	14.6	9.40	13.91	2702	6035	3334	0.56	5.1	157	1.2	2.6	4.3				1.8	327	2349	1692	591



Barr Engineering Company

DMT Spreadsheet- Data Summary

Hardin County Wind Project

35/33-1001

Sounding No: DMT78

August 14, 2010

Ground Water Depth (ft): 7

UTM, Zone 16N - NAD 83 (m)

Northing: 4507611.0

Easting: 265800.0

¹ Depth Below Existing Ground Surface

² Mayne, 1995

³ Marchetti, 1980

⁴ Marchetti, 1997

⁵ Campanella and Robertson, 1991

⁶ Marchetti, 1980

⁷ Schmertman, 1981

Depth ¹ (ft)	A (bar)	B (bar)	po	p1 (psf)	u _o (psf)	s _{vo} (psf)	s _{vo'} (psf)	I _d	K _D (bar)	K _o	OCR ²	OCR ³	ϕ ⁴ (deg)	ϕ ⁵ (deg)	E _D (ksf)	s _u ⁶ (psf)	s _u ⁷ (psf)	M (ksf)	
6.6	2.85	5.6	2.88	5.11	0	787	787	0.78	7.6	77	1.5	3.9	8.1		2.2	162	924	601 360	
7.6	3.9	6.7	3.93	6.21	40	917	877	0.58	9.3	79	1.8	4.7	11.0		2.4	166	1318	816 402	
8.7	3.85	6.4	3.89	5.91	108	1047	939	0.53	8.5	70	1.7	4.3	9.6		2.3	146	1267	801 342	
9.8	3.65	5.55	3.72	5.06	177	1181	1004	0.37	7.6	46	1.5	3.9	8.0		2.2	97	1165	759 215	
10.9	3.7	5.6	3.77	5.11	245	1311	1066	0.37	7.2	46	1.5	3.6	7.3		2.2	97	1155	763 209	
12.0	3.25	4.9	3.33	4.41	312	1441	1128	0.34	5.9	37	1.3	3.0	5.4		2.0	78	958	665 153	
13.1	3.65	5.4	3.73	4.91	382	1575	1193	0.33	6.2	41	1.3	3.2	5.9		2.0	86	1081	741 172	
14.2	4	5.7	4.08	5.21	450	1705	1255	0.29	6.4	39	1.4	3.3	6.2		2.0	82	1189	807 168	
15.3	4.05	5.55	4.14	5.06	517	1835	1317	0.24	6.2	32	1.3	3.1	5.8		2.0	67	1186	813 134	
16.4	4.05	5.85	4.13	5.36	587	1969	1382	0.32	5.8	43	1.3	3.0	5.3		1.9	89	1153	803 174	
17.5	4.6	6.45	4.67	5.96	654	2098	1444	0.29	6.3	45	1.4	3.2	6.0		2.0	93	1335	911 189	
18.6	4.65	6.6	4.72	6.11	722	2228	1506	0.32	6.1	48	1.3	3.1	5.6		2.0	101	1326	913 200	
19.7	5.15	7.5	5.20	7.01	792	2362	1571	0.38	6.4	63	1.4	3.3	6.2		2.0	131	1481	1007 268	
20.8	6.8	9.75	6.82	9.26	859	2492	1633	0.38	8.2	85	1.6	4.2	9.0		2.3	177	2094	1338 406	
21.9	4	25.2	3.11	24.71	927	2622	1695	8.11	3.3	750	0.8			35.0	38.6	1.5	1566		2398
23.0	5.6	19	5.10	18.51	996	2756	1760	2.90	5.5	465	1.2			37.6	39.9	2.0	972		1919
24.0	1.8	4.9	1.81	4.41	1064	2886	1822	2.00	1.5	90	0.4			30.5	35.7	0.9	188		160
25.1	0.85	3.5	0.88	3.01	1131	3016	1884	6.22	0.4	74	-0.1			21.5	#NUM!	0.9	154		131
26.2	5.75	11.6	5.62	11.11	1201	3150	1949	1.09	5.4	190	1.2	2.8	4.7		1.9	398	1488	1054 751	
27.3	6.9	13.2	6.75	12.71	1269	3280	2011	0.97	6.4	207	1.4	3.2	6.1		2.1	432	1886	1283 885	
28.4	7.05	13.2	6.91	12.71	1336	3409	2073	0.93	6.3	201	1.4	3.2	6.0		2.0	420	1920	1309 857	
29.5	5.2	8.25	5.21	7.76	1406	3543	2138	0.56	4.4	88	1.1	2.3	3.5		1.7	185	1273	948 308	
30.6	24.2	40.4	23.56	39.91	1473	3673	2200	0.72	21.7	567	2.9	11.0	41.2		3.2	1185	9527	4772 3832	
31.7	4.45	7.45	4.47	6.96	1541	3803	2262	0.67	3.4	87	0.9	1.8	2.3		1.4	181	981	779 255	
32.8	4.9	7.55	4.93	7.06	1610	3937	2327	0.51	3.7	74	0.9	1.9	2.7		1.5	154	1118	869 230	
33.9	2.85	6.6	2.83	6.11	1678	4067	2389	1.62	1.8	114	0.5			31.5	36.5	0.9	238		202
35.0	5.75	9.3	5.74	8.81	1746	4197	2451	0.63	4.2	107	1.0	2.1	3.2		1.6	223	1354	1024 358	
36.1	5.6	10.8	5.51	10.31	1815	4331	2516	1.04	3.9	167	1.0	2.0	2.8		1.5	348	1255	968 539	
37.2	7.25	13	7.13	12.51	1883	4461	2578	0.86	5.0	187	1.2	2.6	4.2		1.8	390	1803	1301 706	
38.3	6.7	9.8	6.71	9.31	1950	4591	2640	0.45	4.6	90	1.1	2.3	3.6		1.7	188	1632	1207 320	
39.4	5.8	11	5.71	10.51	2020	4724	2705	1.01	3.7	167	0.9	1.9	2.6		1.5	348	1266	990 521	
40.5	5.7	10.8	5.61	10.31	2087	4854	2767	1.02	3.5	163	0.9	1.8	2.4		1.4	341	1217	963 493	
41.5	5.55	6.8	5.65	6.31	2155	4984	2829	0.14	3.4	23	0.9	1.7	2.3		1.4	48	1214	965 66	
42.7	5.3	6.6	5.40	6.11	2225	5118	2893	0.16	3.1	25	0.8	1.6	2.0		1.3	51	1114	906 67	
43.7	6.15	7.2	6.26	6.71	2292	5248	2956	0.09	3.7	15	0.9	1.9	2.6		1.5	32	1380	1079 47	
44.8	6.7	8	6.80	7.51	2360	5378	3018	0.12	3.9	25	1.0	2.0	2.9		1.5	51	1542	1184 79	
45.9	6.55	7.65	6.66	7.16	2429	5512	3082	0.09	3.7	17	0.9	1.9	2.6		1.5	36	1476	1148 54	
47.0	6.2	8.35	6.26	7.86	2497	5642	3145	0.32	3.4	56	0.9	1.7	2.2		1.4	116	1325	1057 160	
48.1	6.4	8.85	6.44	8.36	2564	5772	3207	0.37	3.4	66	0.9	1.7	2.3		1.4	139	1368	1089 193	



Barr Engineering Company

DMT Spreadsheet- Data Summary

Hardin County Wind Project

35/33-1001

Sounding No: DMT81

August 2, 2011

Ground Water Depth (ft): 7

UTM, Zone 16N - NAD 83 (m)

Northing: 4498110.0

Easting: 266085.0

¹ Depth Below Existing Ground Surface

² Mayne, 1995

³ Marchetti, 1980

⁴ Marchetti, 1997

⁵ Campanella and Robertson, 1991

⁶ Marchetti, 1980

⁷ Schmertman, 1981

Depth ¹ (ft)	A (bar)	B (bar)	po	p1 (psf)	u _o (psf)	s _{vo} (psf)	s _{vo'} (psf)	I _d	K _D (bar)	K _o	OCR ²	OCR ³	ϕ ⁴ (deg)	ϕ ⁵ (deg)	E _D (ksf)	s _u ⁶ (psf)	s _u ⁷ (psf)	M (ksf)	
6.6	1.15	2.2	1.31	1.36	0	787	787	0.04	3.5	2	0.9	1.8	2.4		1.4	4	345	273	5
7.6	4.5	13.2	4.28	12.36	40	917	877	1.90	10.1	281	1.9		40.6	41.4	2.5	586		1472	
8.7	5.45	11.6	5.35	10.76	108	1047	939	1.02	11.8	188	2.0	6.0	15.9		2.7	392	1897	1107	1041
9.8	20	30	19.71	29.16	177	1181	1004	0.48	40.8	328	4.1	20.8	110.6		3.8	685	9584	4099	2624
10.9	5.95	9.55	5.98	8.71	245	1311	1066	0.47	11.5	95	2.0	5.8	15.3		2.6	198	2085	1224	521
12.0	11.8	33.2	10.94	32.36	312	1441	1128	1.99	20.0	743	2.8		43.4	42.8	3.2	1552		4897	
13.1	6.6	17.8	6.25	16.96	382	1575	1193	1.77	10.6	372	1.9		40.8	41.5	2.6	776		1985	
14.2	10.4	30	9.63	29.16	450	1705	1255	2.07	15.7	678	2.4		42.4	42.3	2.9	1415		4140	
15.3	10.2	30	9.42	29.16	517	1835	1317	2.15	14.5	685	2.3		42.1	42.1	2.9	1431		4084	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
17.5	8.2	14.6	8.09	13.76	654	2098	1444	0.73	11.2	197	2.0	5.7	14.8		2.6	411	2751	1624	1073
18.6	8.15	17	7.92	16.16	722	2228	1506	1.09	10.5	286	1.9	5.3	13.3		2.5	597	2633	1581	1521
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
21.9	14.8	30	14.25	29.16	927	2622	1695	1.08	17.0	517	2.5	8.7	28.2		3.0	1081	5417	2884	3245
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
29.5	10.4	30	9.63	29.16	1406	3543	2138	2.18	8.8	678	1.7		39.9	41.0	2.4	1415		3364	
30.6	10.6	30	9.84	29.16	1473	3673	2200	2.12	8.7	670	1.7		39.8	41.0	2.4	1400		3316	
31.7	10.4	30	9.63	29.16	1541	3803	2262	2.20	8.2	678	1.6		39.6	40.9	2.3	1415		3281	
32.8	10.4	30	9.63	29.16	1610	3937	2327	2.20	8.0	678	1.6		39.4	40.8	2.3	1415		3240	
33.9	10.4	30	9.63	29.16	1678	4067	2389	2.21	7.7	678	1.6		39.3	40.7	2.3	1415		3201	
35.0	10.6	30	9.84	29.16	1746	4197	2451	2.15	7.7	670	1.6		39.3	40.7	2.3	1400		3157	
36.1	11	30	10.26	29.16	1815	4331	2516	2.01	7.8	656	1.6		39.4	40.8	2.3	1370		3106	
37.2	12	30	11.31	29.16	1883	4461	2578	1.71	8.4	619	1.7		39.7	40.9	2.3	1294		3024	
38.3	10	30	9.21	29.16	1950	4591	2640	2.41	6.5	692	1.4		38.5	40.4	2.1	1446		3059	
39.4	12	30	11.31	29.16	2020	4724	2705	1.73	8.0	619	1.6		39.5	40.8	2.3	1294		2957	
40.5	11	30	10.26	29.16	2087	4854	2767	2.04	7.0	656	1.5		38.8	40.5	2.2	1370		2968	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
42.7	11.4	30	10.68	29.16	2225	5118	2893	1.92	6.9	641	1.5		38.8	40.5	2.2	1339		2889	
43.7	11.2	30	10.47	29.16	2292	5248	2956	1.99	6.6	649	1.4		38.6	40.4	2.1	1355		2865	
44.8	12	30	11.31	29.16	2360	5378	3018	1.75	7.0	619	1.5		38.9	40.5	2.2	1294		2804	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	
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Barr Engineering Company

DMT Spreadsheet- Data Summary

Hardin County Wind Project

35/33-1001

Sounding No: DMT89

August 2, 2011

Ground Water Depth (ft): 7

UTM, Zone 16N - NAD 83 (m)

Northing: 4496351.0

Easting: 265582.0

¹ Depth Below Existing Ground Surface

² Mayne, 1995

³ Marchetti, 1980

⁴ Marchetti, 1997

⁵ Campanella and Robertson, 1991

⁶ Marchetti, 1980

⁷ Schmertman, 1981

Depth ¹ (ft)	A (bar)	B (bar)	po	p1 (psf)	u _o (psf)	s _{vo} (psf)	s _{vo'} (psf)	I _d	K _D (bar)	E _D (bar)	K _o	OCR ²	OCR ³	ϕ ⁴ (deg)	ϕ ⁵ (deg)	E _D (ksf)	s _u ⁶ (psf)	s _u ⁷ (psf)	M (ksf)	
6.6	14.4	27.6	13.84	26.94	0	787	787	0.95	36.7	455	3.9	18.7	93.6			3.7	949	6579	2890	3542
7.6	13.8	26	13.29	25.34	40	917	877	0.91	31.6	418	3.6	16.1	74.1			3.6	873	6076	2771	3134
8.7	16.2	27.4	15.74	26.74	108	1047	939	0.70	34.9	382	3.8	17.7	86.4			3.7	797	7363	3276	2935
9.8	17	28.6	16.52	27.94	177	1181	1004	0.69	34.2	396	3.7	17.4	83.8			3.7	828	7676	3432	3032
10.9	18.2	31.2	17.65	30.54	245	1311	1066	0.74	34.3	447	3.8	17.5	84.4			3.7	934	8198	3661	3426
12.0	15	23.6	14.67	22.94	312	1441	1128	0.57	26.9	287	3.3	13.7	57.5			3.4	599	6385	3032	2059
13.1	16.2	31.6	15.53	30.94	382	1575	1193	1.00	26.9	535	3.3	13.7	57.5			3.4	1117	6748	3205	3837
14.2	14.2	25.6	13.73	24.94	450	1705	1255	0.83	22.5	389	3.0	11.4	43.6			3.3	812	5684	2822	2654
15.3	21.6	30	21.28	29.34	517	1835	1317	0.38	33.3	280	3.7	17.0	80.6			3.6	584	9762	4392	2126
16.4	12.2	19	11.96	18.34	587	1969	1382	0.55	17.6	221	2.6	9.0	29.9			3.0	462	4623	2438	1404
17.5	11.2	19.6	10.88	18.94	654	2098	1444	0.76	15.3	280	2.4	7.8	23.9			2.9	584	4034	2206	1694
18.6	13	19.6	12.77	18.94	722	2228	1506	0.50	17.2	214	2.5	8.8	28.7			3.0	447	4888	2594	1348
19.7	11	17	10.80	16.34	792	2362	1571	0.53	13.9	192	2.2	7.1	20.5			2.8	401	3882	2176	1127
20.8	12.4	22.6	11.99	21.94	859	2492	1633	0.86	14.8	345	2.3	7.5	22.7			2.9	721	4386	2417	2070
21.9	12.2	25.2	11.65	24.54	927	2622	1695	1.15	13.8	447	2.2	7.0	20.4			2.8	934	4171	2340	2620
23.0	10.4	22.6	9.89	21.94	996	2756	1760	1.28	11.2	418	2.0			41.0	41.6	2.6	873			2274
24.0	10.6	21.4	10.16	20.74	1064	2886	1822	1.10	11.1	367	2.0	5.6	14.4			2.6	767	3398	2015	1990
25.1	12.6	25	12.08	24.34	1131	3016	1884	1.06	12.8	425	2.1	6.5	18.1			2.7	888	4214	2409	2428
26.2	10.4	18.8	10.08	18.14	1201	3150	1949	0.85	10.2	280	1.9	5.2	12.7			2.5	584	3279	1984	1470
27.3	10.8	19.4	10.47	18.74	1269	3280	2011	0.84	10.2	287	1.9	5.2	12.8			2.5	599	3407	2059	1512
28.4	10.8	18.2	10.53	17.54	1336	3409	2073	0.71	10.0	243	1.8	5.1	12.2			2.5	508	3393	2065	1268
29.5	11.6	19.2	11.32	18.54	1406	3543	2138	0.68	10.4	250	1.9	5.3	13.1			2.5	523	3692	2223	1327
30.6	11.2	19.6	10.88	18.94	1473	3673	2200	0.79	9.7	280	1.8	4.9	11.7			2.5	584	3464	2124	1439
31.7	9.4	16.2	9.16	15.54	1541	3803	2262	0.76	7.8	221	1.6	4.0	8.3			2.2	462	2715	1758	1037
32.8	9.35	13.6	9.23	12.94	1610	3937	2327	0.44	7.6	128	1.5	3.9	8.0			2.2	268	2714	1767	595
33.9	10.8	17.6	10.56	16.94	1678	4067	2389	0.65	8.5	221	1.7	4.3	9.6			2.3	462	3220	2037	1080
35.0	8	15.4	7.73	14.74	1746	4197	2451	1.02	5.9	243	1.3	3.0	5.4			2.0	508	2072	1439	1000
36.1	10.4	18	10.12	17.34	1815	4331	2516	0.78	7.7	250	1.6	3.9	8.2			2.2	523	2974	1931	1168
37.2	10.8	18.6	10.51	17.94	1883	4461	2578	0.77	7.8	258	1.6	4.0	8.3			2.2	538	3099	2006	1209
38.3	9.35	14.6	9.18	13.94	1950	4591	2640	0.58	6.5	165	1.4	3.3	6.3			2.1	344	2547	1723	710
39.4	8.95	15.4	8.72	14.74	2020	4724	2705	0.77	6.0	209	1.3	3.0	5.5			2.0	436	2344	1620	863
40.5	9.35	17.4	9.04	16.74	2087	4854	2767	0.96	6.1	267	1.3	3.1	5.7			2.0	557	2439	1680	1115
41.5	9.65	23.2	9.07	22.54	2155	4984	2829	1.68	5.9	467	1.3			38.0	40.1	2.0	976			1953
42.7	12	24.2	11.49	23.54	2225	5118	2893	1.16	7.5	418	1.5	3.8	7.9			2.2	873	3334	2176	1937
43.7	11.2	22.2	10.75	21.54	2292	5248	2956	1.12	6.8	374	1.4	3.5	6.8			2.1	782	3012	2015	1658
44.8	12.2	21	11.86	20.34	2360	5378	3018	0.79	7.4	294	1.5	3.8	7.7			2.2	614	3420	2240	1351
45.9	12	21.6	11.62	20.94	2429	5512	3082	0.89	7.1	323	1.5	3.6	7.2			2.2	675	3294	2183	1454
47.0	14	23.2	13.64	22.54	2497	5642	3145	0.72	8.3	309	1.6	4.2	9.1			2.3	645	4075	2598	1487
48.1	11.8	18.2	11.58	17.54	2564	5772	3207	0.58	6.7	207	1.4	3.4	6.7			2.1	432	3221	2161	905
49.2	12	19.2	11.74	18.54	2634	5906	3271	0.65	6.7	236	1.4	3.4	6.6			2.1	493	3254	2188	1029
50.3	13.2	20	12.96	19.34	2702	6035	3334	0.55	7.3	221	1.5	3.7	7.5			2.2	462	3704	2436	1007



Barr Engineering Company

DMT Spreadsheet- Data Summary

Hardin County Wind Project

35/33-1001

Sounding No: DMT92

August 3, 2011

Ground Water Depth (ft): 7

UTM, Zone 16N - NAD 83 (m)

Northing: 4508527.0

Easting: 267705.0

¹ Depth Below Existing Ground Surface

² Mayne, 1995

³ Marchetti, 1980

⁴ Marchetti, 1997

⁵ Campanella and Robertson, 1991

⁶ Marchetti, 1980

⁷ Schmertman, 1981

Depth ¹ (ft)	A (bar)	B (bar)	po	p1 (psf)	u _o (psf)	s _{vo} (psf)	s _{vo'} (psf)	I _d	K _D (bar)	E _D	K _o	OCR ²	OCR ³	ϕ ⁴ (deg)	ϕ ⁵ (deg)	E _D (ksf)	s _u ⁶ (psf)	s _u ⁷ (psf)	M (ksf)
6.6	3.55	8.05	3.54	7.66	0	787	787	1.16	9.4	143	1.8	4.8	11.2			2.4	299	1197	739 728
7.6	2.55	5.9	2.60	5.51	40	917	877	1.13	6.1	101	1.3	3.1	5.7			2.0	211	784	538 426
8.7	2.55	5.25	2.63	4.86	108	1047	939	0.87	5.7	77	1.3	2.9	5.2			1.9	162	770	538 314
9.8	4.2	11.2	4.06	10.81	177	1181	1004	1.70	8.3	234	1.6			39.6	40.9	2.3	489		1134
10.9	5.05	10.4	5.00	10.01	245	1311	1066	1.03	9.6	174	1.8	4.9	11.5			2.5	363	1657	1019 892
12.0	6.05	10.6	6.04	10.21	312	1441	1128	0.71	10.9	145	1.9	5.5	14.1			2.6	302	2066	1229 781
13.1	5	10.6	4.93	10.21	382	1575	1193	1.11	8.3	183	1.6	4.2	9.2			2.3	382	1559	992 886
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
15.3	6.25	13.2	6.12	12.81	517	1835	1317	1.14	9.3	232	1.8	4.7	11.0			2.4	485	1980	1226 1178
16.4	8.2	22.4	7.70	22.01	587	1969	1382	1.93	11.2	496	2.0			41.0	41.6	2.6	1037		2705
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
18.6	5.05	12.6	4.89	12.21	722	2228	1506	1.61	6.3	254	1.4			38.3	40.3	2.1	531		1091
19.7	5.75	10.2	5.74	9.81	792	2362	1571	0.76	7.1	141	1.5	3.6	7.3			2.2	295	1693	1120 636
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
21.9	5.4	8.7	5.45	8.31	927	2622	1695	0.57	6.2	99	1.3	3.1	5.8			2.0	207	1524	1045 416
23.0	7.05	18.8	6.68	18.41	996	2756	1760	1.89	7.4	407	1.5			39.1	40.6	2.2	850		1881
24.0	7.8	15.4	7.63	15.01	1064	2886	1822	1.04	8.2	256	1.6	4.2	9.0			2.3	535	2327	1488 1229
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
27.3	7.1	13.2	7.01	12.81	1269	3280	2011	0.91	6.6	201	1.4	3.4	6.5			2.1	420	1986	1337 879
28.4	7	15.2	6.80	14.81	1336	3409	2073	1.30	6.2	278	1.3			38.3	40.2	2.0	580		1180
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
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#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
36.1	6.25	9.3	6.31	8.91	1815	4331	2516	0.48	4.5	90	1.1	2.3	3.6			1.7	188	1533	1137 317
37.2	6.15	8.9	6.23	8.51	1883	4461	2578	0.43	4.3	79	1.0	2.2	3.3			1.6	166	1483	1112 271
38.3	6.25	9.05	6.32	8.66	1950	4591	2640	0.43	4.3	81	1.0	2.2	3.3			1.6	169	1496	1126 275
39.4	5.9	9.75	5.92	9.36	2020	4724	2705	0.69	3.8	119	1.0	1.9	2.8			1.5	249	1339	1035 379
40.5	6.45	9.7	6.50	9.31	2087	4854	2767	0.51	4.2	97	1.0	2.1	3.1			1.6	204	1517	1149 326
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
45.9	11.6	20.2	11.38	19.81	2429	5512	3082	0.82	6.9	292	1.5	3.5	6.9			2.1	611	3203	2135 1300
47.0	12.4	24.2	12.02	23.81	2497	5642	3145	1.09	7.2	409	1.5	3.7	7.4			2.2	854	3426	2262 1856
48.1	13.8	27.4	13.33	27.01	2564	5772	3207	1.13	7.9	475	1.6	4.0	8.5			2.3	991	3919	2528 2244
49.2	9.35	17.2	9.17	16.81	2634	5906	3271	0.97	5.0	265	1.2	2.6	4.2			1.8	554	2291	1652 1005
50.3	9.05	18.4	8.80	18.01	2702	6035	3334	1.23	4.7	320	1.1			36.9	39.5	1.8	668		1173



Barr Engineering Company

DMT Spreadsheet- Data Summary

Hardin County Wind Project

35/33-1001

Sounding No: DMT107

August 3, 2011

Ground Water Depth (ft): 7

UTM, Zone 16N - NAD 83 (m)

Northing: 4496351.0

Easting: 265582.0

¹ Depth Below Existing Ground Surface

² Mayne, 1995

³ Marchetti, 1980

⁴ Marchetti, 1997

⁵ Campanella and Robertson, 1991

⁶ Marchetti, 1980

⁷ Schmertman, 1981

Depth ¹ (ft)	A (bar)	B (bar)	po	p1 (psf)	u _o (psf)	s _{vo} (psf)	s _{vo'} (psf)	l _d	K _D (bar)	E _D (bar)	K _o	OCR ²	OCR ³	ϕ ⁴ (deg)	ϕ ⁵ (deg)	E _D (ksf)	s _u ⁶ (psf)	s _u ⁷ (psf)	M (ksf)
6.6	4.65	10.6	4.52	10.06	0	787	787	1.23	12.0	192	2.1			41.3	41.7	2.7	401		1073
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
8.7	10.8	26.2	10.20	25.66	108	1047	939	1.52	22.6	537	3.0			43.9	43.1	3.3	1121		3664
9.8	14.6	25.4	14.23	24.86	177	1181	1004	0.75	29.4	369	3.5	15.0	66.3			3.5	770	6364	2954
10.9	10.4	18.2	10.18	17.66	245	1311	1066	0.74	19.7	260	2.8	10.0	35.5			3.1	542	4096	2101
12.0	6.85	13	6.71	12.46	312	1441	1128	0.88	12.1	199	2.1	6.2	16.7			2.7	417	2366	1370
13.1	4.45	11.2	4.28	10.66	382	1575	1193	1.56	7.2	221	1.5			39.0	40.6	2.2	462		1008
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
15.3	5.9	12.2	5.75	11.66	517	1835	1317	1.07	8.7	205	1.7	4.4	10.0			2.4	428	1828	1150
16.4	4.6	8.35	4.58	7.81	587	1969	1382	0.75	6.5	112	1.4	3.3	6.3			2.1	234	1327	898
17.5	4.65	8.4	4.63	7.86	654	2098	1444	0.75	6.2	112	1.4	3.2	5.9			2.0	234	1319	902
18.6	7.3	14.2	7.12	13.66	722	2228	1506	0.96	9.4	227	1.8	4.8	11.2			2.4	474	2293	1416
19.7	6.6	11.2	6.54	10.66	792	2362	1571	0.67	8.2	143	1.6	4.2	9.0			2.3	299	2013	1286
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
21.9	12.4	30	11.69	29.46	927	2622	1695	1.58	13.9	617	2.2			41.9	42.0	2.8	1288		3617
23.0	13.2	30	12.53	29.46	996	2756	1760	1.40	14.3	588	2.3			42.1	42.1	2.8	1227		3483
24.0	9.2	27	8.48	26.46	1064	2886	1822	2.26	9.1	624	1.7			40.1	41.1	2.4	1303		3150
25.1	6.65	12.4	6.53	11.86	1131	3016	1884	0.89	6.6	185	1.4	3.4	6.5			2.1	386	1857	1251
26.2	5.2	14.6	4.90	14.06	1201	3150	1949	2.12	4.6	318	1.1			36.8	39.5	1.8	664		1187
27.3	3.85	9.25	3.75	8.71	1269	3280	2011	1.58	3.3	172	0.8			34.9	38.6	1.4	360		512
28.4	7.75	14.8	7.57	14.26	1336	3409	2073	0.97	7.0	232	1.5	3.6	7.0			2.1	485	2175	1447
29.5	7.05	16.2	6.76	15.66	1406	3543	2138	1.46	5.9	309	1.3			38.0	40.1	2.0	645		1288
30.6	10.4	18.8	10.15	18.26	1473	3673	2200	0.86	9.0	281	1.7	4.6	10.4			2.4	588	3157	1972
31.7	9.15	16.8	8.94	16.26	1541	3803	2262	0.89	7.6	254	1.5	3.9	8.0			2.2	531	2627	1712
32.8	9.55	17.6	9.32	17.06	1610	3937	2327	0.91	7.7	269	1.6	3.9	8.1			2.2	561	2747	1785
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
38.3	7.45	12.5	7.37	11.96	1950	4591	2640	0.71	5.1	159	1.2	2.6	4.3			1.8	333	1866	1343
39.4	15.4	30	14.84	29.46	2020	4724	2705	1.05	10.7	507	1.9	5.5	13.7			2.6	1060	4848	2897
40.5	8.75	19	8.41	18.46	2087	4854	2767	1.36	5.6	349	1.3			37.7	40.0	1.9	729		1408
41.5	6.45	14.2	6.23	13.66	2155	4984	2829	1.43	3.8	258	1.0			35.8	39.0	1.6	538		845
42.7	15.2	30	14.63	29.46	2225	5118	2893	1.09	9.8	515	1.8	5.0	11.9			2.5	1075	4635	2833
43.7	14.2	30	13.58	29.46	2292	5248	2956	1.27	8.8	551	1.7			39.9	41.0	2.4	1151		2735
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
0.0	0	0		0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!



Barr Engineering Company

DMT Spreadsheet- Data Summary

Hardin County Wind Project

35/33-1001

Sounding No: DMT131

August 3, 2011

Ground Water Depth (ft): 7

UTM, Zone 16N - NAD 83 (m)

Northing: 4507160.0

Easting: 264430.0

¹ Depth Below Existing Ground Surface

² Mayne, 1995

³ Marchetti, 1980

⁴ Marchetti, 1997

⁵ Campanella and Robertson, 1991

⁶ Marchetti, 1980

⁷ Schmertman, 1981

Depth ¹ (ft)	A (bar)	B (bar)	po (psf)	p1 (psf)	u _o (psf)	s _{vo} (psf)	s _{vo} ¹ (psf)			E _D (bar)				φ ⁴ (deg)	φ ⁵ (deg)		E _D (ksf)	s _u ⁶ (psf)	s _u ⁷ (psf)	M (ksf)
6.6	2.35	3.55	2.47	3.31	0	787	787	0.34	6.6	29	1.4	3.3	6.4			2.1	61	763	516	126
7.6	1.65	2.55	1.79	2.31	40	917	877	0.30	4.2	18	1.0	2.1	3.2			1.6	38	488	369	61
8.7	2.85	3.75	2.99	3.51	108	1047	939	0.18	6.5	18	1.4	3.3	6.3			2.1	38	906	613	78
9.8	2.85	3.75	2.99	3.51	177	1181	1004	0.18	6.0	18	1.3	3.1	5.6			2.0	38	878	606	75
10.9	3	4.05	3.13	3.81	245	1311	1066	0.23	5.9	24	1.3	3.0	5.4			2.0	49	906	629	97
12.0	3.2	4.1	3.34	3.86	312	1441	1128	0.16	5.9	18	1.3	3.0	5.4			2.0	38	959	665	75
13.1	3.05	4	3.18	3.76	382	1575	1193	0.19	5.3	20	1.2	2.7	4.5			1.8	42	877	626	77
14.2	3.3	4.3	3.43	4.06	450	1705	1255	0.20	5.3	22	1.2	2.7	4.6			1.9	46	944	671	85
15.3	3.1	3.95	3.24	3.71	517	1835	1317	0.16	4.7	16	1.1	2.4	3.8			1.7	34	852	624	59
16.4	3	3.9	3.14	3.66	587	1969	1382	0.18	4.3	18	1.0	2.2	3.3			1.6	38	795	596	62
17.5	3.15	4	3.29	3.76	654	2098	1444	0.16	4.3	16	1.0	2.2	3.3			1.6	34	827	621	56
18.6	3.15	3.9	3.29	3.66	722	2228	1506	0.12	4.1	13	1.0	2.1	3.0			1.6	27	809	615	42
19.7	3.25	5.3	3.33	5.06	792	2362	1571	0.59	3.9	60	1.0	2.0	2.9			1.5	126	802	616	193
20.8	3.4	4.05	3.55	3.81	859	2492	1633	0.08	4.0	9	1.0	2.0	3.0			1.6	19	857	655	30
21.9	3.35	4.1	3.49	3.86	927	2622	1695	0.12	3.8	13	0.9	1.9	2.7			1.5	27	820	637	40
23.0	3.5	4.25	3.64	4.01	996	2756	1760	0.12	3.8	13	0.9	1.9	2.7			1.5	27	851	661	40
24.0	3.7	4.65	3.83	4.41	1064	2886	1822	0.17	3.8	20	0.9	1.9	2.7			1.5	42	897	694	63
25.1	3.8	4.55	3.94	4.31	1131	3016	1884	0.11	3.8	13	0.9	1.9	2.7			1.5	27	915	710	40
26.2	3.9	4.8	4.04	4.56	1201	3150	1949	0.15	3.7	18	0.9	1.9	2.6			1.5	38	928	723	56
27.3	3.9	4.9	4.03	4.66	1269	3280	2011	0.18	3.6	22	0.9	1.8	2.5			1.4	46	908	715	66
28.4	4.05	5.5	4.16	5.26	1336	3409	2073	0.31	3.5	38	0.9	1.8	2.4			1.4	80	932	735	115
29.5	4.4	5.15	4.54	4.91	1406	3543	2138	0.09	3.8	13	0.9	1.9	2.7			1.5	27	1042	808	40
30.6	4.5	5.35	4.64	5.11	1473	3673	2200	0.12	3.7	16	0.9	1.9	2.6			1.5	34	1056	821	51
31.7	5	5.9	5.14	5.66	1541	3803	2262	0.12	4.1	18	1.0	2.1	3.0			1.6	38	1206	918	60
32.8	5.8	7.2	5.91	6.96	1610	3937	2327	0.20	4.6	36	1.1	2.3	3.7			1.7	76	1455	1073	130
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
35.0	4.6	14.2	4.30	13.96	1746	4197	2451	2.79	3.0	335	0.8			34.4	38.3	1.4	700			996
36.1	5.7	12.6	5.54	12.36	1815	4331	2516	1.46	3.9	237	1.0			35.9	39.0	1.6	495			782
37.2	6.85	25.4	6.10	25.16	1883	4461	2578	3.66	4.2	661	1.0			36.3	39.3	1.7	1381			2416
38.3	3.25	15.2	2.83	14.96	1950	4591	2640	6.39	1.5	421	0.4			30.5	35.7	0.9	879			750
39.4	2.25	9.45	2.07	9.21	2020	4724	2705	6.47	0.9	248	0.2			27.0	29.3	0.9	517			440
40.5	6.25	23	5.59	22.76	2087	4854	2767	3.74	3.5	596	0.9			35.3	38.7	1.6	1244			1966
41.5	4.8	9.9	4.73	9.66	2155	4984	2829	1.34	2.7	171	0.7			34.0	38.0	1.2	358			440
42.7	6.45	11	6.40	10.76	2225	5118	2893	0.82	3.9	151	1.0	2.0	2.8			1.5	316	1445	1115	485
43.7	7.55	22.8	6.97	22.56	2292	5248	2956	2.66	4.1	541	1.0			36.2	39.2	1.7	1130			1939
44.8	10.8	30	10.02	29.76	2360	5378	3018	2.22	6.2	685	1.3			38.2	40.2	2.1	1431			2938
45.9	9.15	26.6	8.46	26.36	2429	5512	3082	2.45	4.9	621	1.2			37.1	39.7	1.9	1297			2417
47.0	10.6	22.8	10.17	22.56	2497	5642	3145	1.38	6.0	430	1.3			38.1	40.1	2.0	898			1792
48.1	12.6	30	11.91	29.76	2564	5772	3207	1.67	7.0	619	1.5			38.8	40.5	2.2	1294			2786
49.2	10.6	30	9.81	29.76	2634	5906	3271	2.33	5.5	692	1.2			37.6	39.9	1.9	1446			2816
50.3	18.6	30	18.21	29.76	2702	6035	3334	0.68	10.6	401	1.9	5.4	13.5			2.6	837	5896	3533	2139

Appendix D

Soil Boring Logs

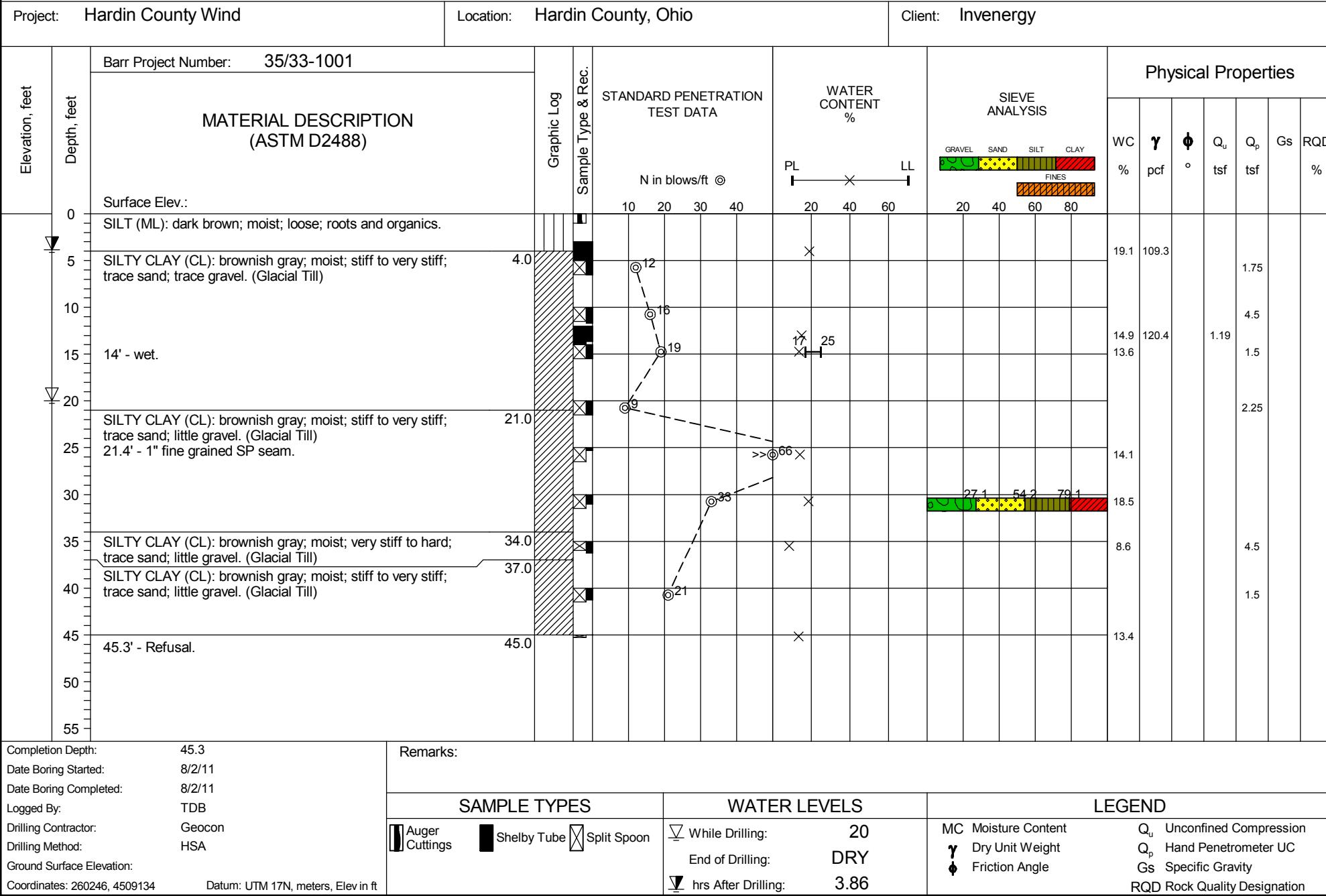


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LOG OF BORING T-02

Sheet 1 of 1

LOG BORING HORIZONTAL 85 X 11 GS GRAPH WITH COORDINATES SWITCHYARD DRAFT 2011-7-8_TDB BORINGS 2011-8-GPJ PENASCAL-TX WIND PROJECT.GPJ 1/24/12



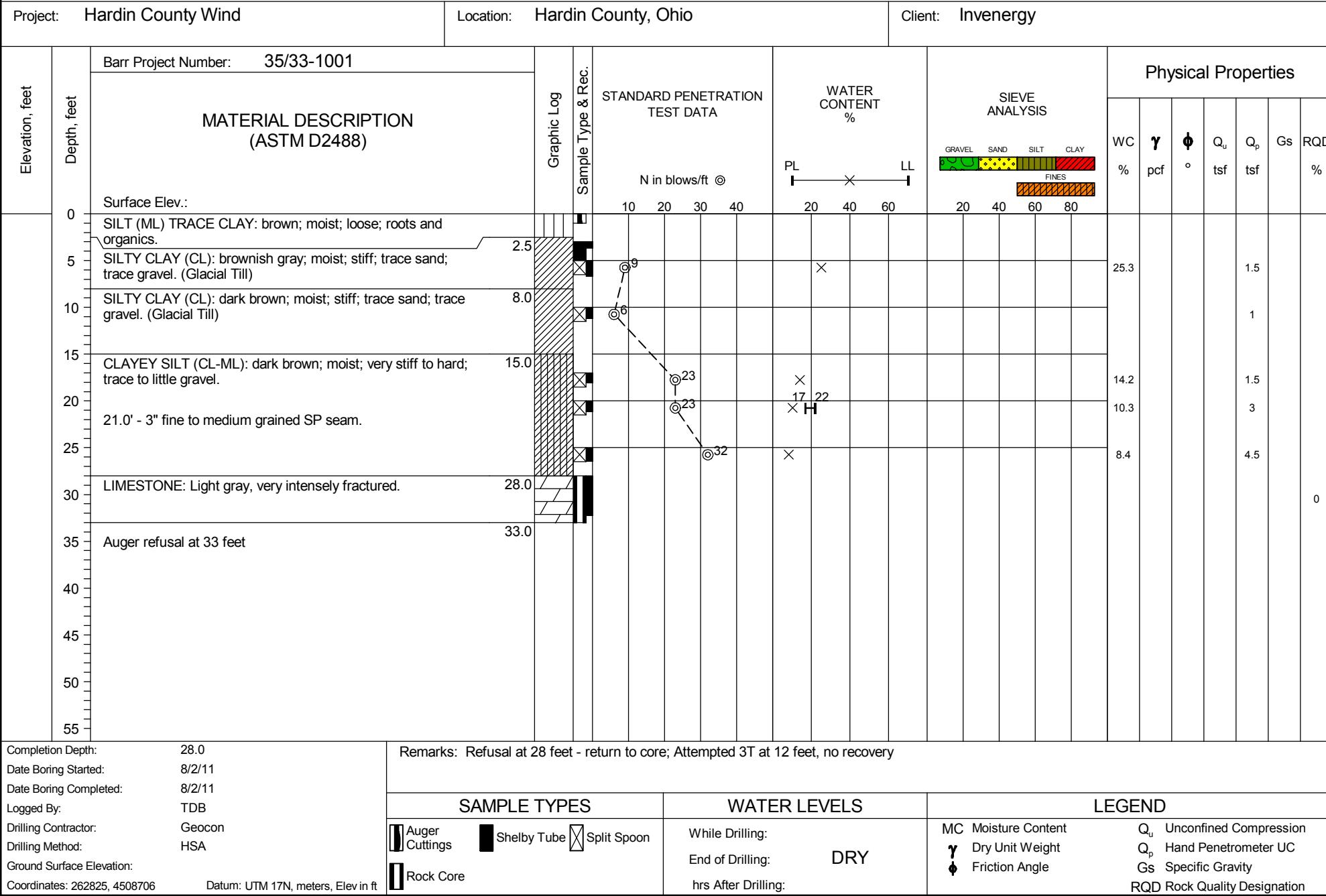
The stratification lines represent approximate boundaries. The transition may be gradual.



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LOG OF BORING T-14

Sheet 1 of 1



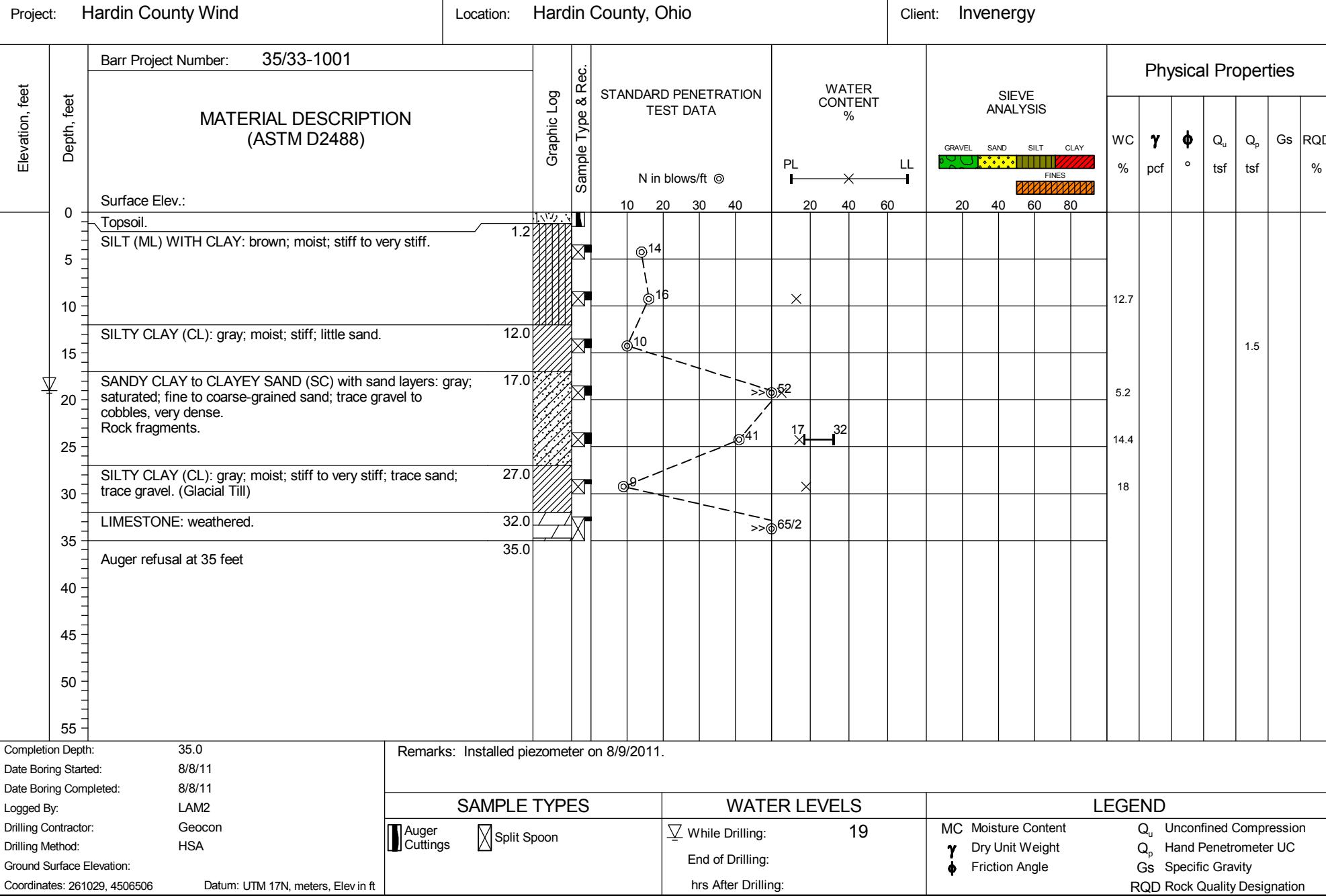
The stratification lines represent approximate boundaries. The transition may be gradual.



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LOG OF BORING T-19

Sheet 1 of 1



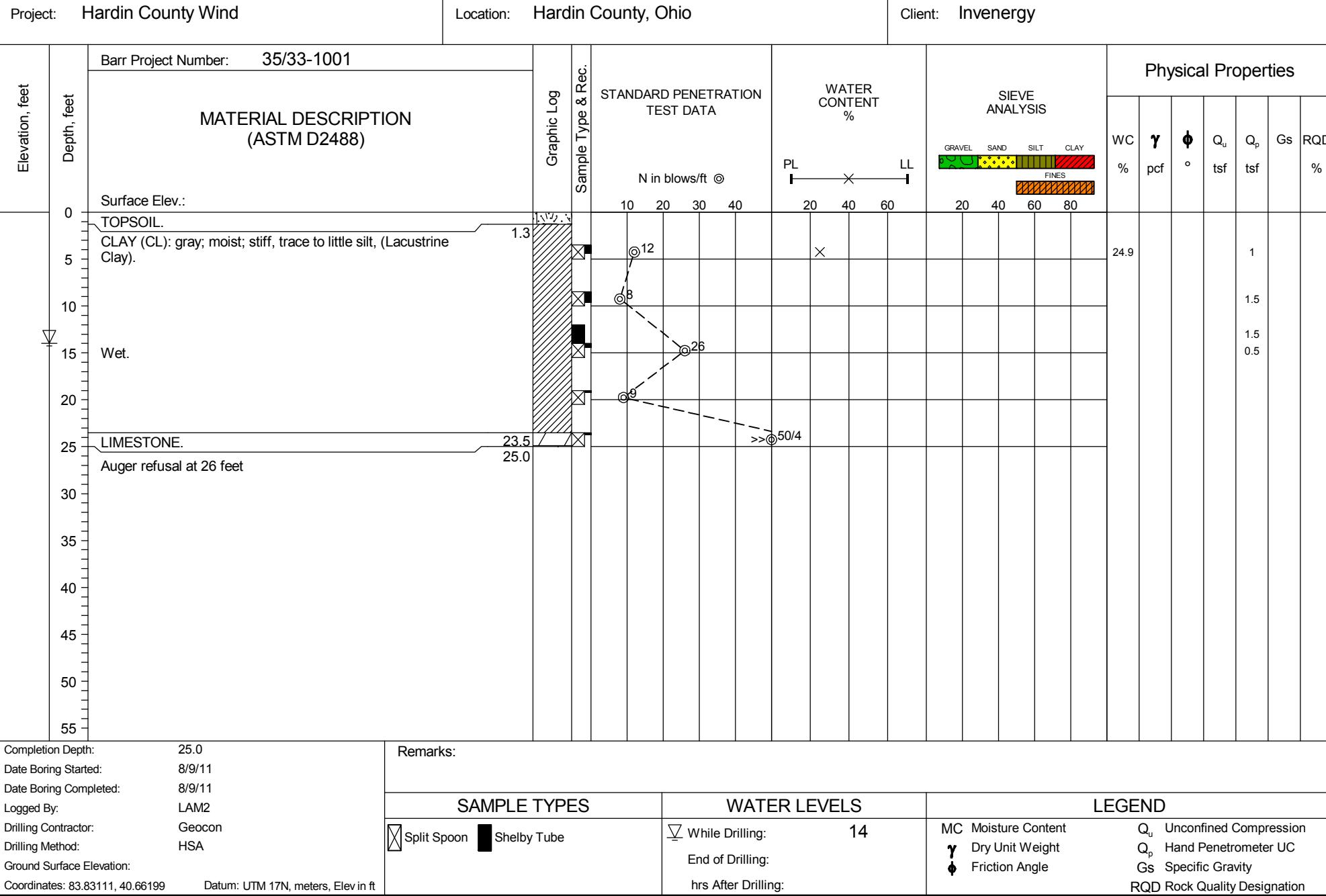
The stratification lines represent approximate boundaries. The transition may be gradual.



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LOG OF BORING T-31

Sheet 1 of 1



The stratification lines represent approximate boundaries. The transition may be gradual.

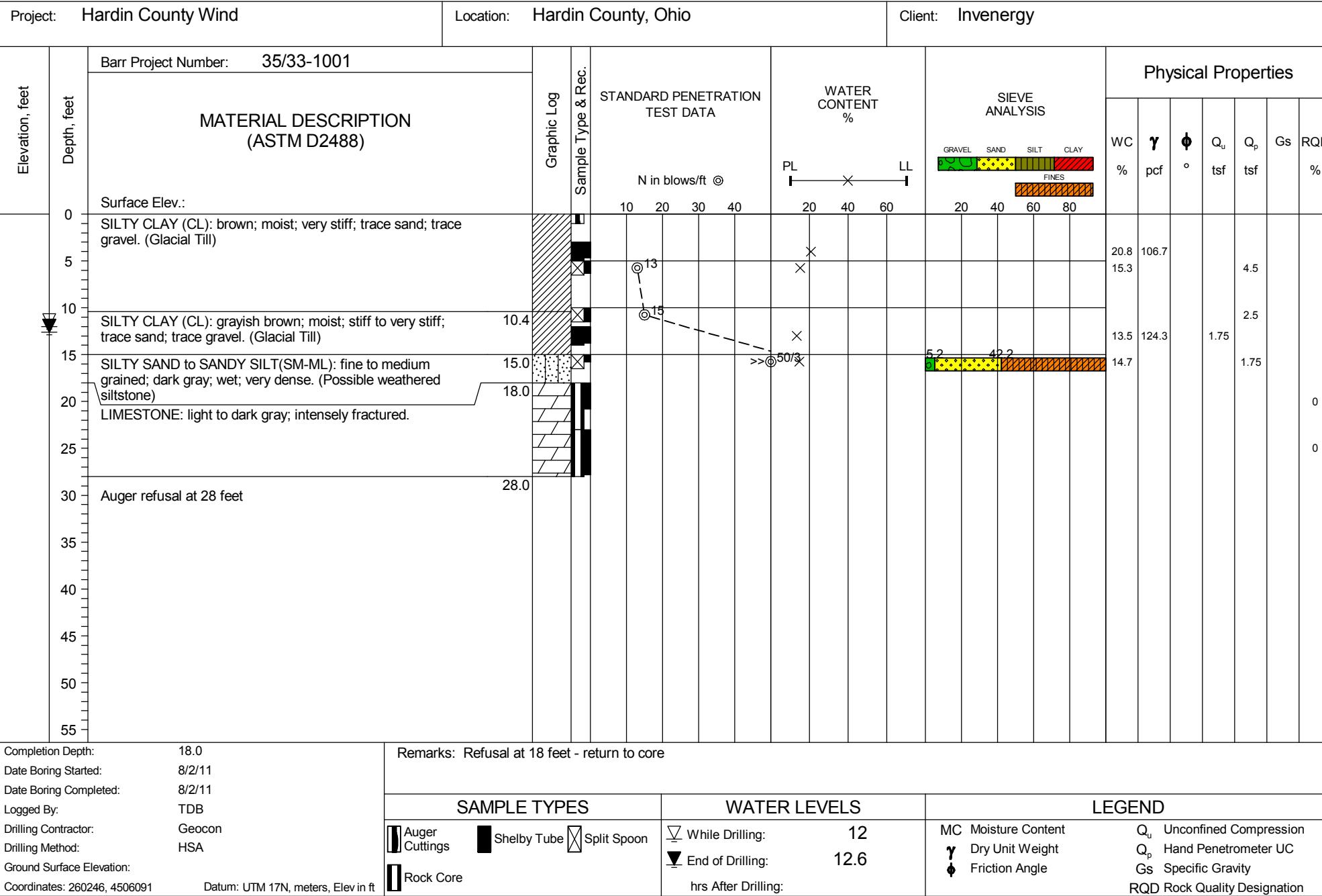


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LOG OF BORING T-35

Sheet 1 of 1

LOG BORING HORIZONTAL 85 X 11 GS GRAPH WITH COORDINATES SWITCHYARD DRAFT 2011-7-8 TDB BORINGS 2011-8-GPJ PENASCAL-TX WIND PROJECT.GPJ 1/24/12



The stratification lines represent approximate boundaries. The transition may be gradual.



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LOG OF BORING T-39

Sheet 1 of 1

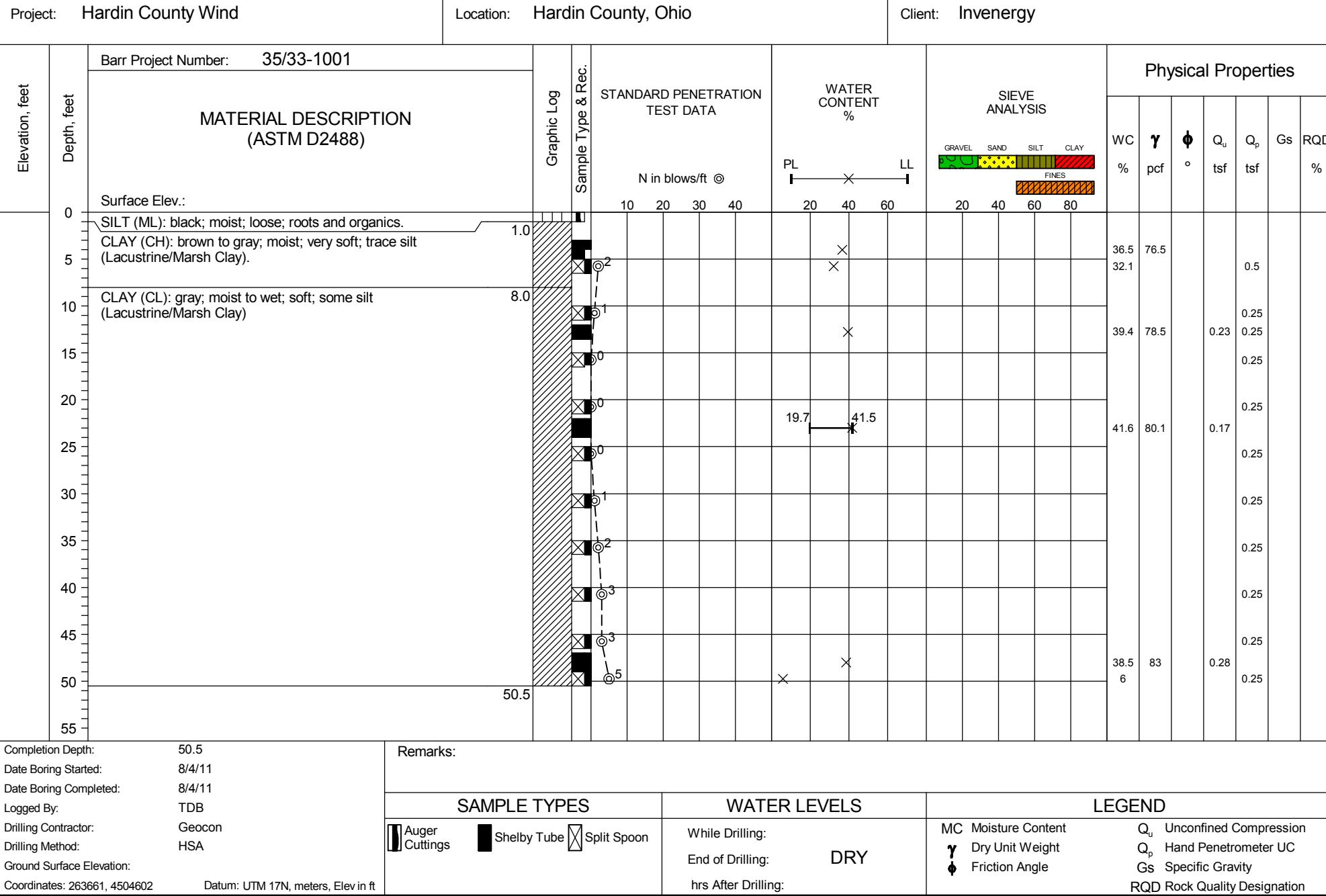
Project: Hardin County Wind			Location: Hardin County, Ohio			Client: Invenergy												
Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS		Physical Properties							
					N in blows/ft	PL	LL	GRAVEL	SAND	SILT	CLAY	FINES	WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs
0	Surface Elev.:	SILT (ML): black; moist; loose; roots and organics. LEAN CLAY (CL): gray; moist to wet; soft; some silt (Lacustrine/Marsh Clay) 5' - some large gravel.	1.0		10 20 30 40								21.4					2.5
5					17	X							22.5	102.3				0.25
10					6	X							26.2					0.25
15					5	X							27.7					0.25
20		CLAY (CL): gray; moist to wet; soft, trace to little silt. (Lacustrine/Marsh Clay)	18.0		8	X												0.25
25		SANDY LEAN CLAY (CL): gray; wet; stiff; some coarse sand; some silt.	25.0		10	X												0.25
30		CLAYEY SAND (SC): coarse grained; gray; wet; very dense; some silt.	31.0															
35		LIMESTONE. Auger refusal at 33.5 feet	33.0															
40			33.5															
45																		
50																		
55																		
Completion Depth:		33.5	Remarks: Bedrock at 33.5 feet - no additional coring; bulk sample taken from 3 to 5 feet for thermal resistivity testing															
Date Boring Started:		8/5/11																
Date Boring Completed:		8/5/11																
Logged By:		TDB																
Drilling Contractor:		Geocon																
Drilling Method:		HSA																
Ground Surface Elevation:																		
Coordinates: 263844, 4507759		Datum: UTM 17N, meters, Elev in ft																
The stratification lines represent approximate boundaries. The transition may be gradual.					SAMPLE TYPES			WATER LEVELS			LEGEND							
					Auger Cuttings	Split Spoon	Shelby Tube	While Drilling:			MC Moisture Content							
								End of Drilling:			Q_u Unconfined Compression							
								DRY			Q_p Dry Unit Weight							
								hrs After Drilling:			ϕ Friction Angle							
											Gs Specific Gravity							
											RQD Rock Quality Designation							



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LOG OF BORING T-49

Sheet 1 of 1



The stratification lines represent approximate boundaries. The transition may be gradual.

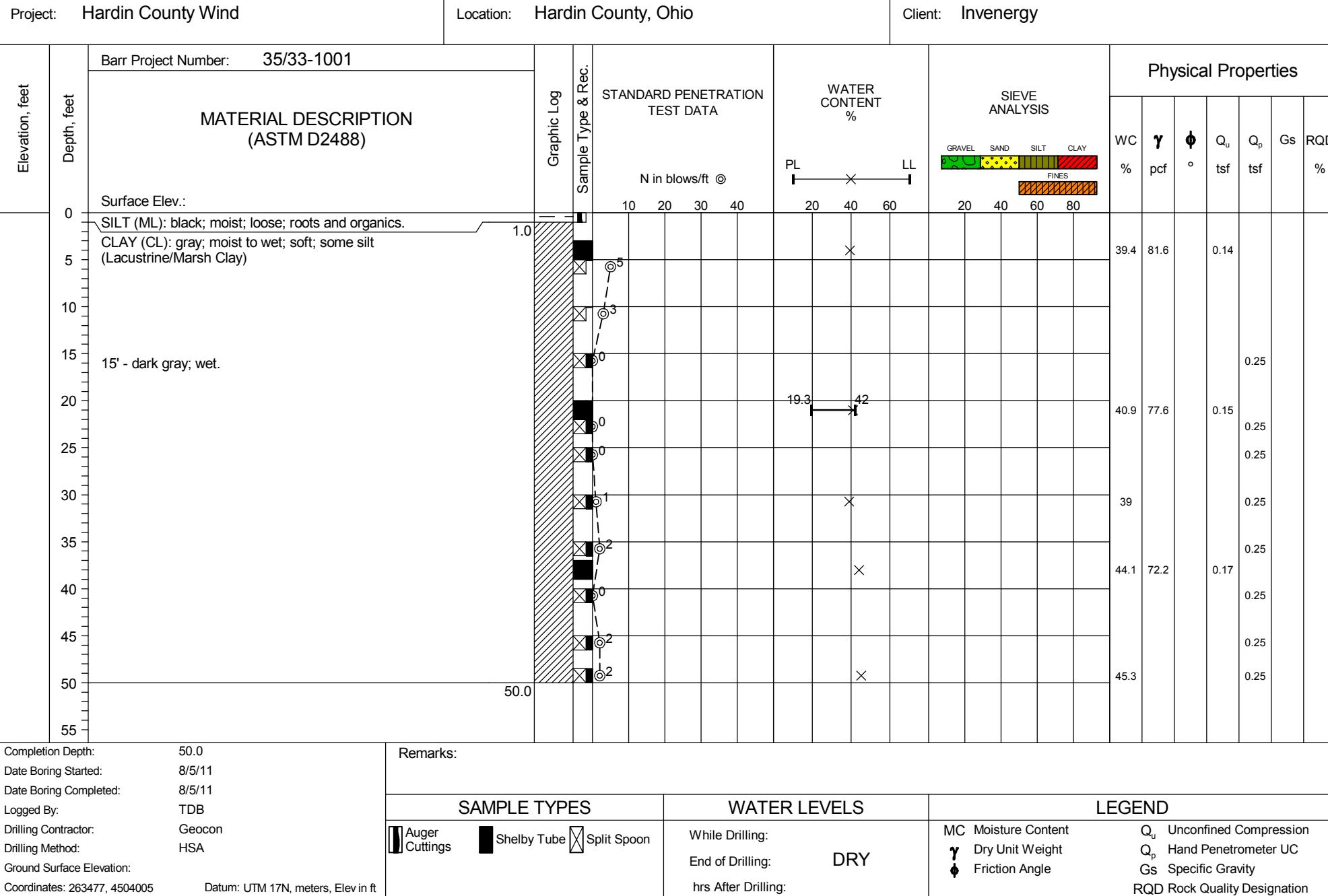


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LOG OF BORING T-51

Sheet 1 of 1

LOG BORING HORIZONTAL 85 X 11 GS GRAPH WITH COORDINATES SWITCHYARD DRAFT 2011-7-8_TDB BORINGS 2011-8-GPJ PENASCAL-TX WIND PROJECT.GPJ 1/24/12



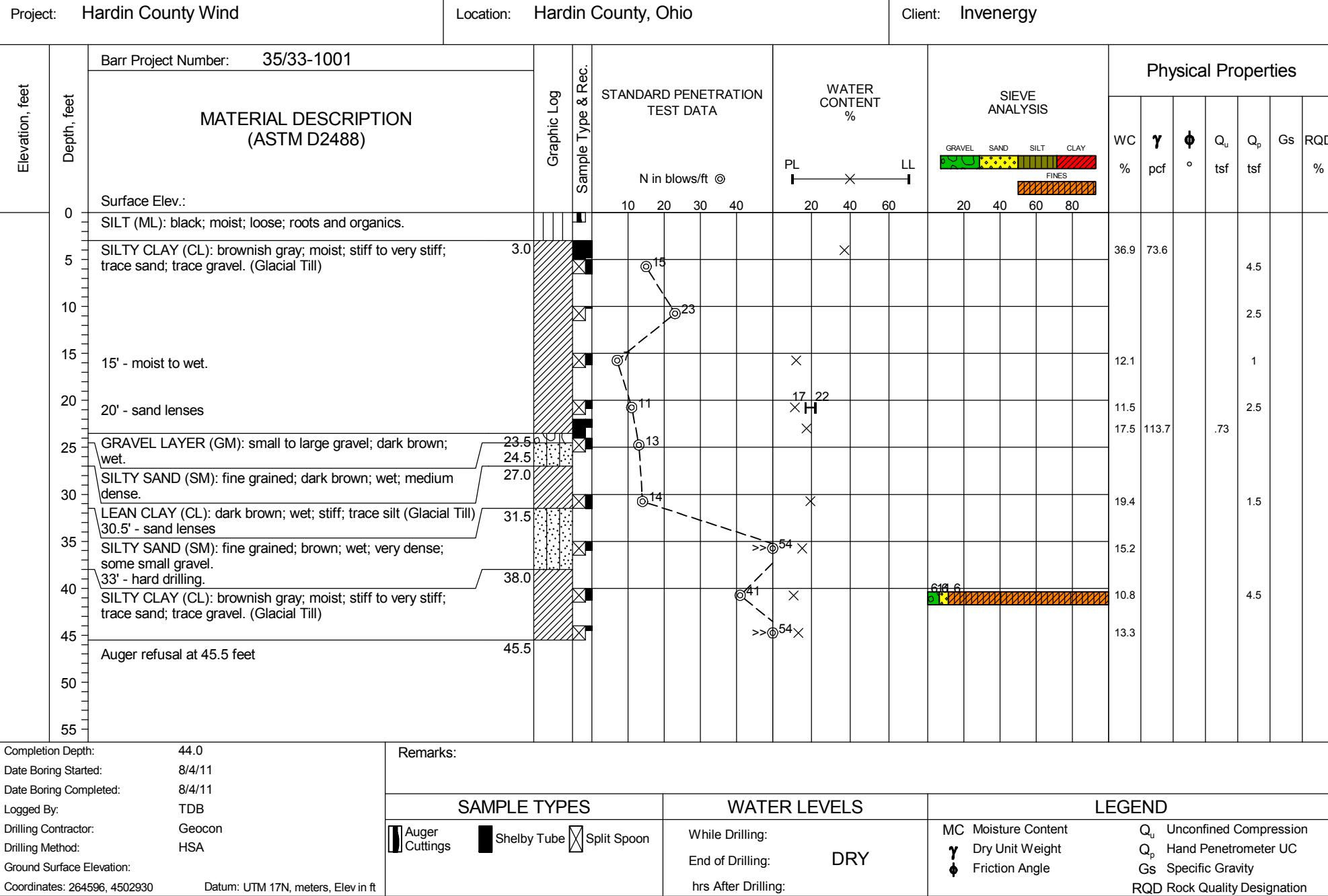
The stratification lines represent approximate boundaries. The transition may be gradual.



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LOG OF BORING T-62

Sheet 1 of 1



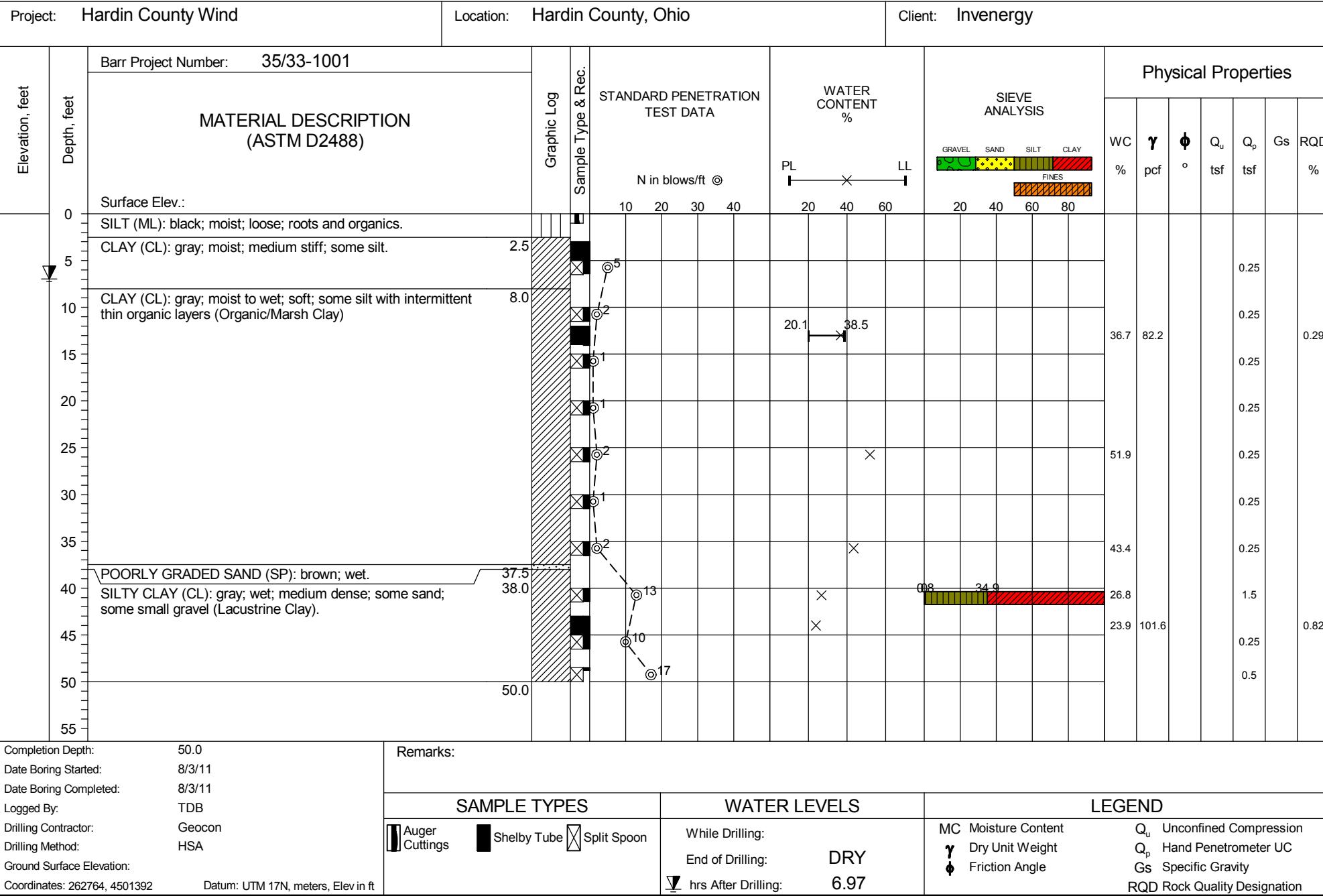
The stratification lines represent approximate boundaries. The transition may be gradual.



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LOG OF BORING T-66

Sheet 1 of 1



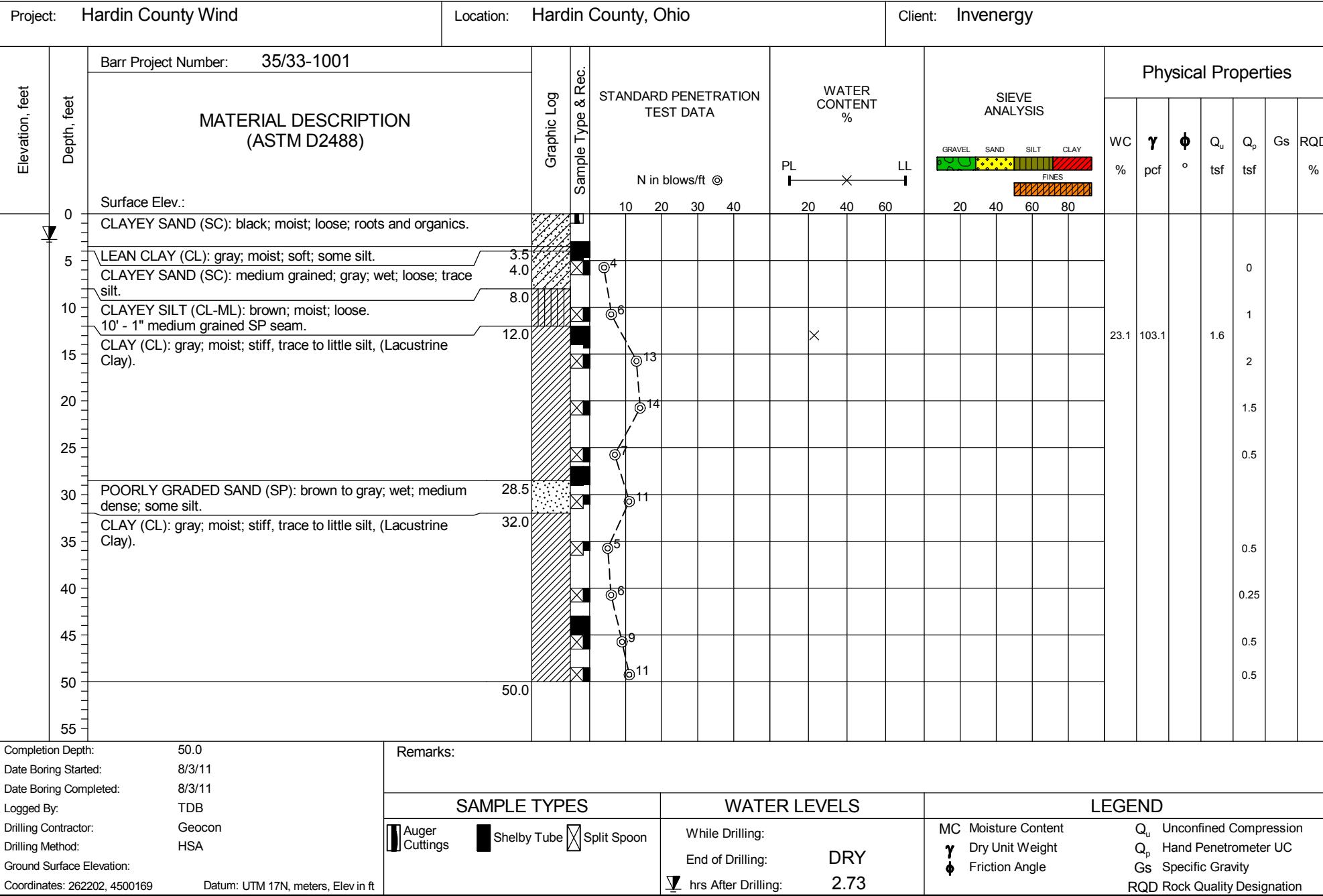


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LOG OF BORING T-72

Sheet 1 of 1

LOG BORING HORIZONTAL 85 X 11 GS GRAPH WITH COORDINATES SWITCHYARD DRAFT 2011-7-8_TDB BORINGS 2011-8.GPJ PENASCAL-TX WIND PROJECT.GPJ 1/24/12



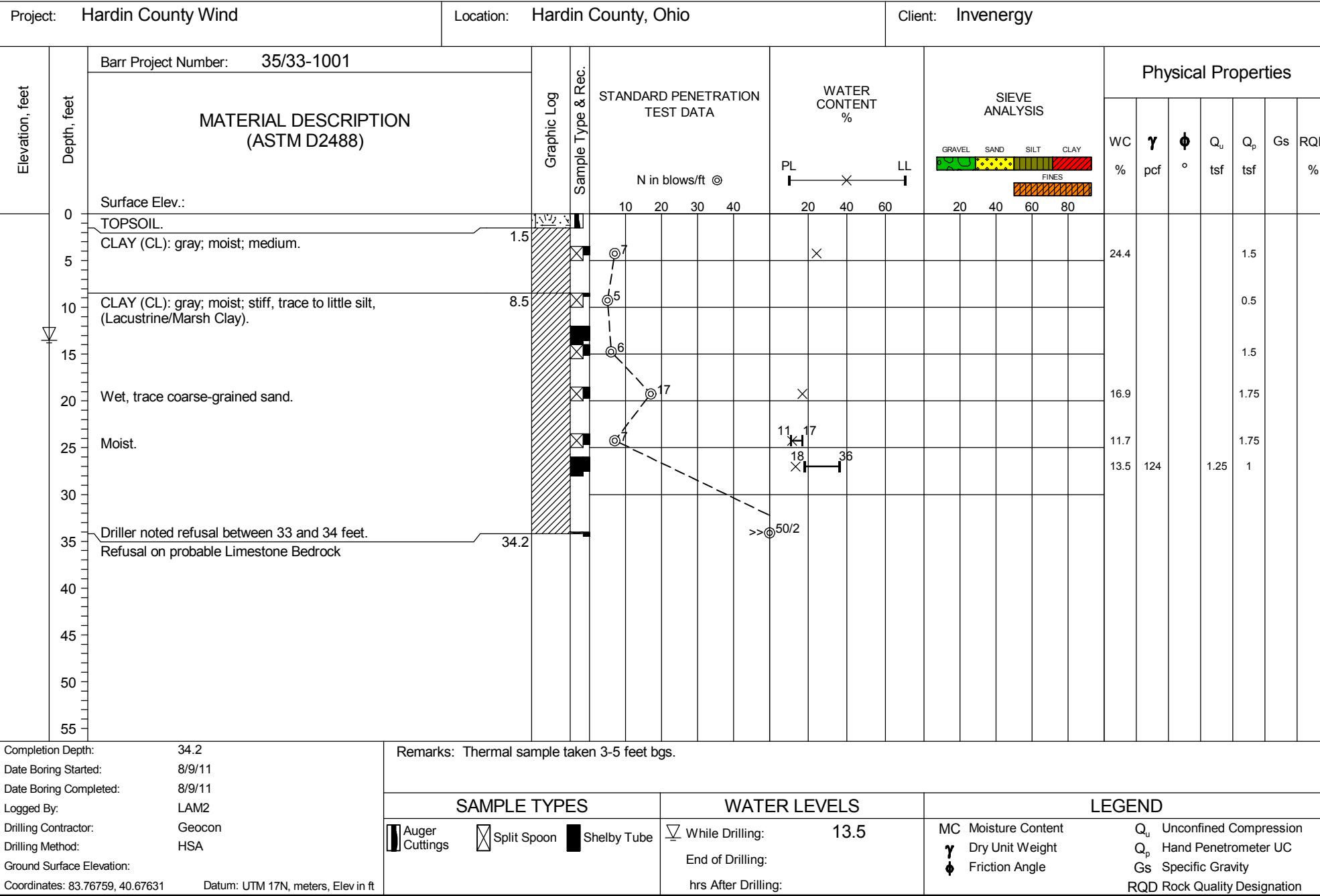
The stratification lines represent approximate boundaries. The transition may be gradual.



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LOG OF BORING T-82

Sheet 1 of 1

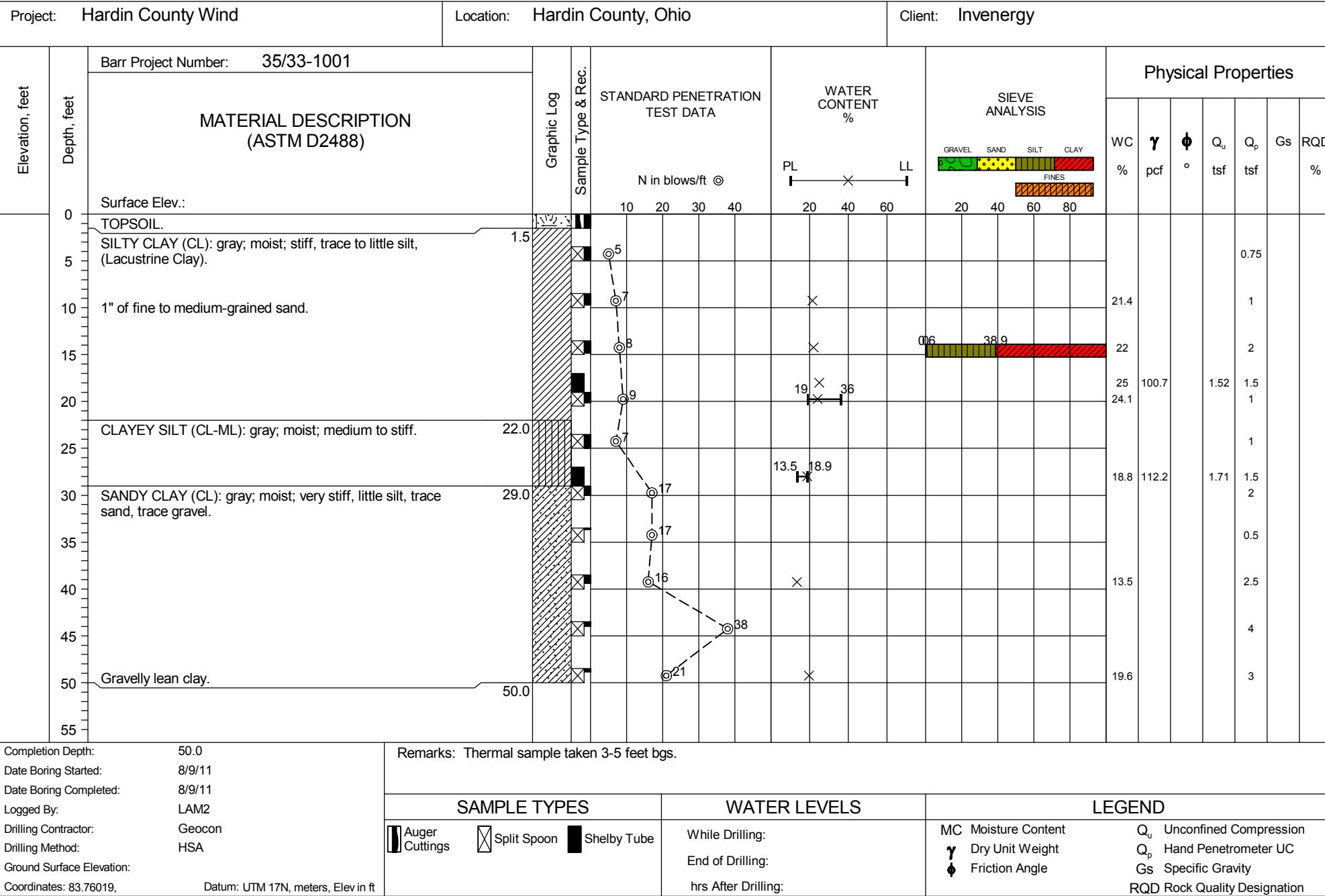




Barr Engineering Company
4700 W 77th St. Suite 200
Edina, MN 55435

LOG OF BORING T-88

Sheet 1 of 1



The stratification lines represent approximate boundaries. The transition may be gradual.



Barr Engineering Company
4700 W 77th St. Suite 200
Edina, MN 55435

LOG OF BORING T-99

Sheet 1 of 1

Project: Hardin County Wind			Location: Hardin County, Ohio			Client: Invenergy											
Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS		Physical Properties						
					N in blows/ft	PL	LL	GRAVEL	SAND	SILT	CLAY	WC %	γ pcf	ϕ °	Q _u tsf	Q _p tsf	G _s
Surface Elev.:	0	SILTY CLAY (CL): brown; moist; stiff to very stiff; trace sand; trace gravel. (Glacial Till)															
	5	SILTY CLAY (CL): dark brownish gray; moist; stiff to very stiff; trace sand; trace gravel. (Glacial Till)	7.0														
	10	SILTY CLAY (CL): dark gray; moist; stiff to very stiff; trace sand; trace gravel. (Glacial Till)	24.0														
	15	SILTY CLAY (CL): dark gray; moist; stiff to very stiff; trace sand; trace gravel. (Glacial Till)	50.0														
	20	SILTY CLAY (CL): dark gray; moist; stiff to very stiff; trace sand; trace gravel. (Glacial Till)															
	25	SILTY CLAY (CL): dark gray; moist; stiff to very stiff; trace sand; trace gravel. (Glacial Till)															
	30	SILTY CLAY (CL): dark gray; moist; stiff to very stiff; trace sand; trace gravel. (Glacial Till)															
	35	SILTY CLAY (CL): dark gray; moist; stiff to very stiff; trace sand; trace gravel. (Glacial Till)															
	40	SILTY CLAY (CL): dark gray; moist; stiff to very stiff; trace sand; trace gravel. (Glacial Till)															
	45	SILTY CLAY (CL): dark gray; moist; stiff to very stiff; trace sand; trace gravel. (Glacial Till)															
	50	SILTY CLAY (CL): dark gray; moist; stiff to very stiff; trace sand; trace gravel. (Glacial Till)															
	55	SILTY CLAY (CL): dark gray; moist; stiff to very stiff; trace sand; trace gravel. (Glacial Till)															
Completion Depth:	50.0	Remarks:															
Date Boring Started:	8/4/11																
Date Boring Completed:	8/4/11																
Logged By:	TDB																
Drilling Contractor:	Geocon																
Drilling Method:	HSA																
Ground Surface Elevation:																	
Coordinates: 265425, 4496681	Datum: UTM 17N, meters, Elev in ft		SAMPLE TYPES				WATER LEVELS				LEGEND						
			Auger Cuttings	Shelby Tube	Split Spoon		While Drilling:	DRY		MC Moisture Content	Q _u Unconfined Compression						
							End of Drilling:	DRY		γ Dry Unit Weight	Q _p Hand Penetrometer UC						
							hrs After Drilling:			ϕ Friction Angle	G _s Specific Gravity						
											RQD Rock Quality Designation						

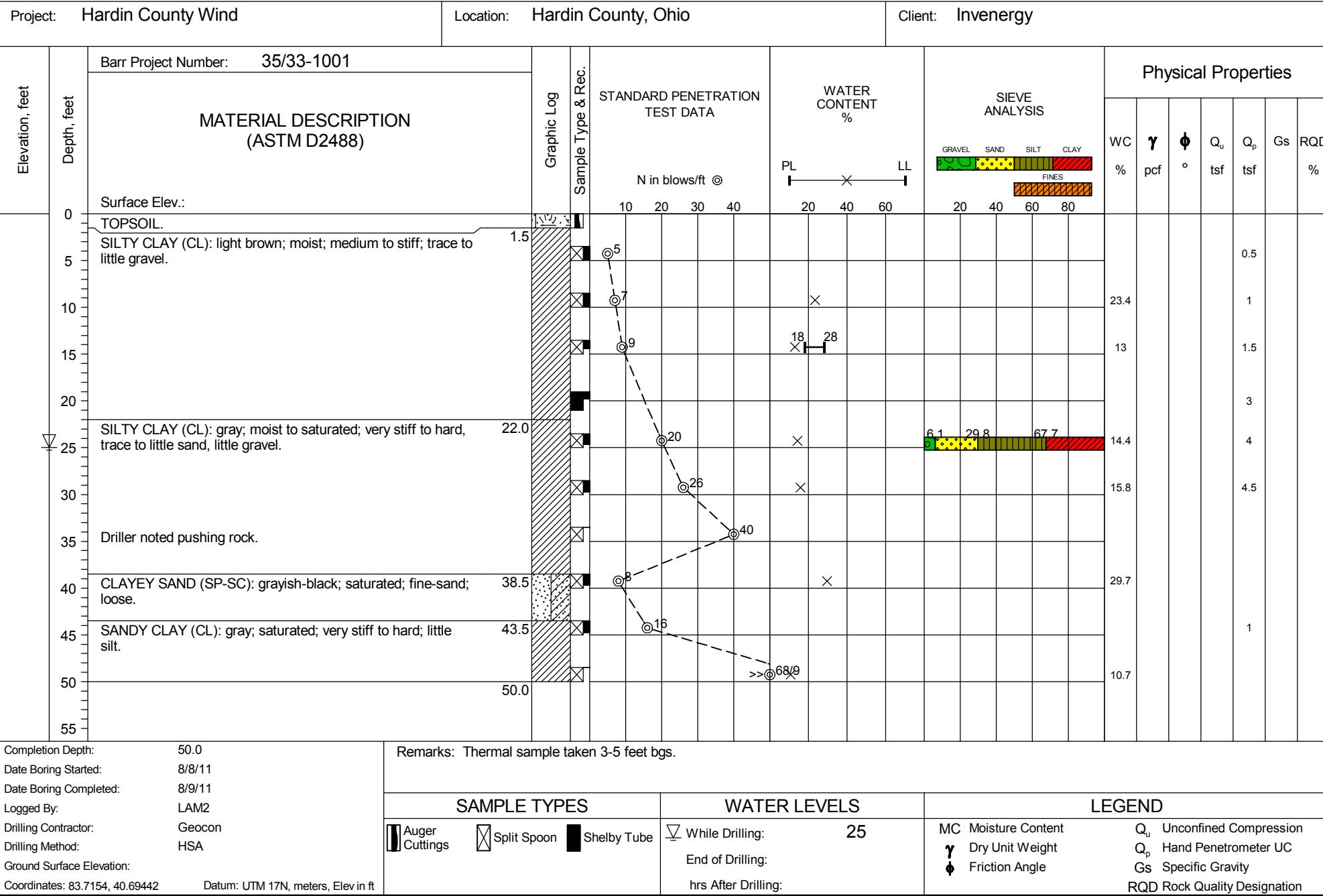
The stratification lines represent approximate boundaries. The transition may be gradual.



Barr Engineering Company
4700 W 77th St. Suite 200
Edina, MN 55435

LOG OF BORING T-117

Sheet 1 of 1



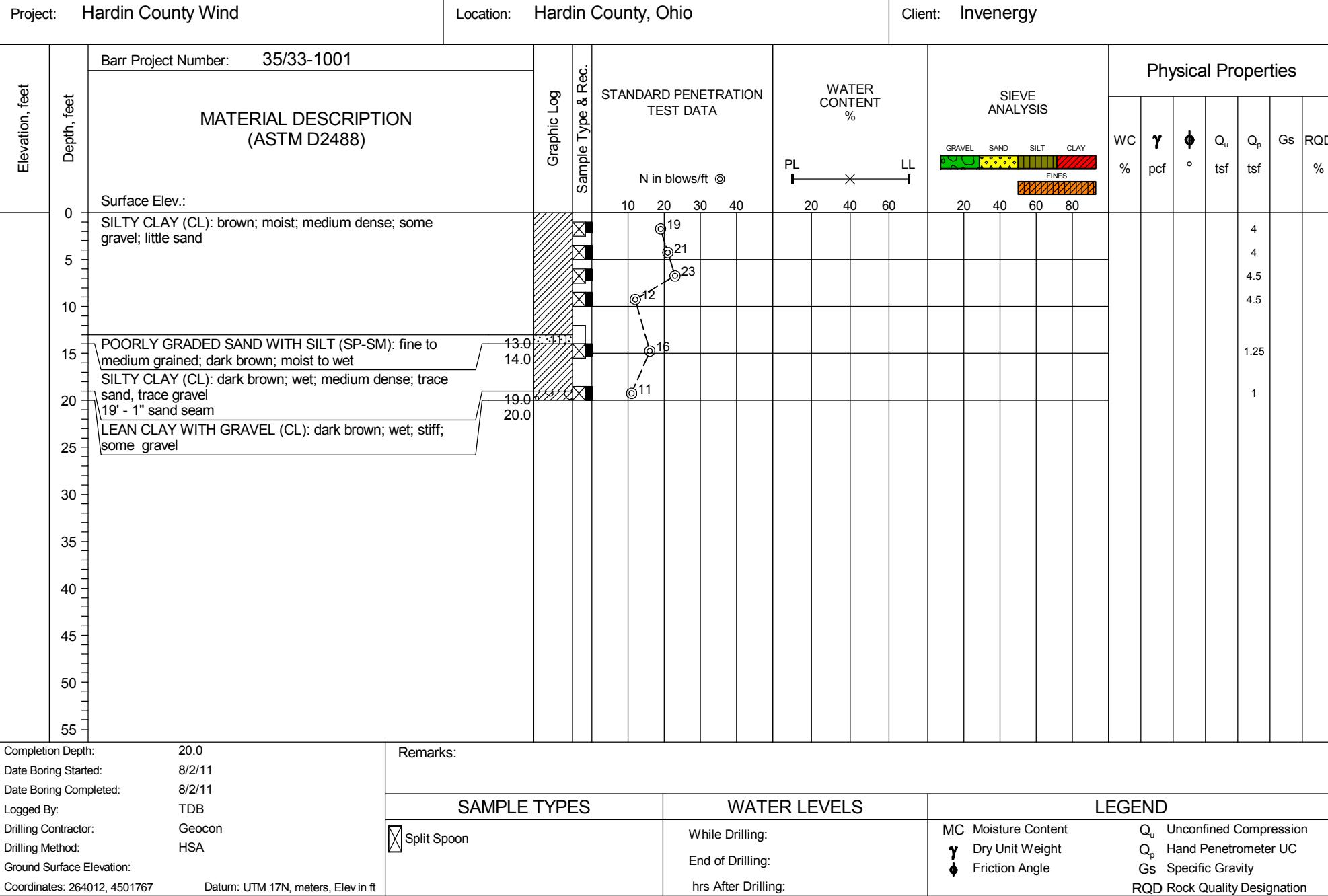
The stratification lines represent approximate boundaries. The transition may be gradual.



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Edina, MN 55435

LOG OF BORING O&M1

Sheet 1 of 1



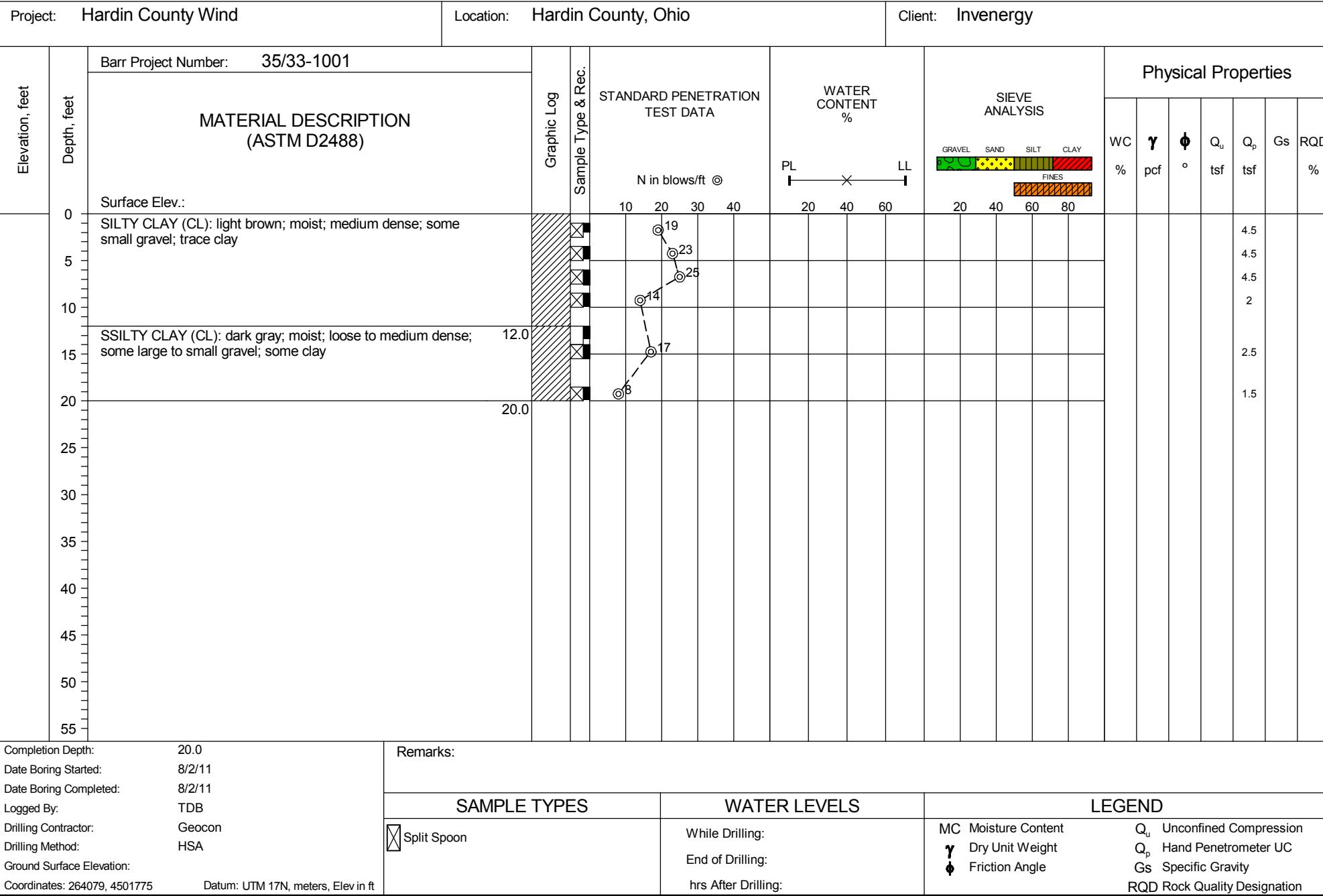
The stratification lines represent approximate boundaries. The transition may be gradual.



Barr Engineering Company
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Edina, MN 55435

LOG OF BORING O&M2

Sheet 1 of 1



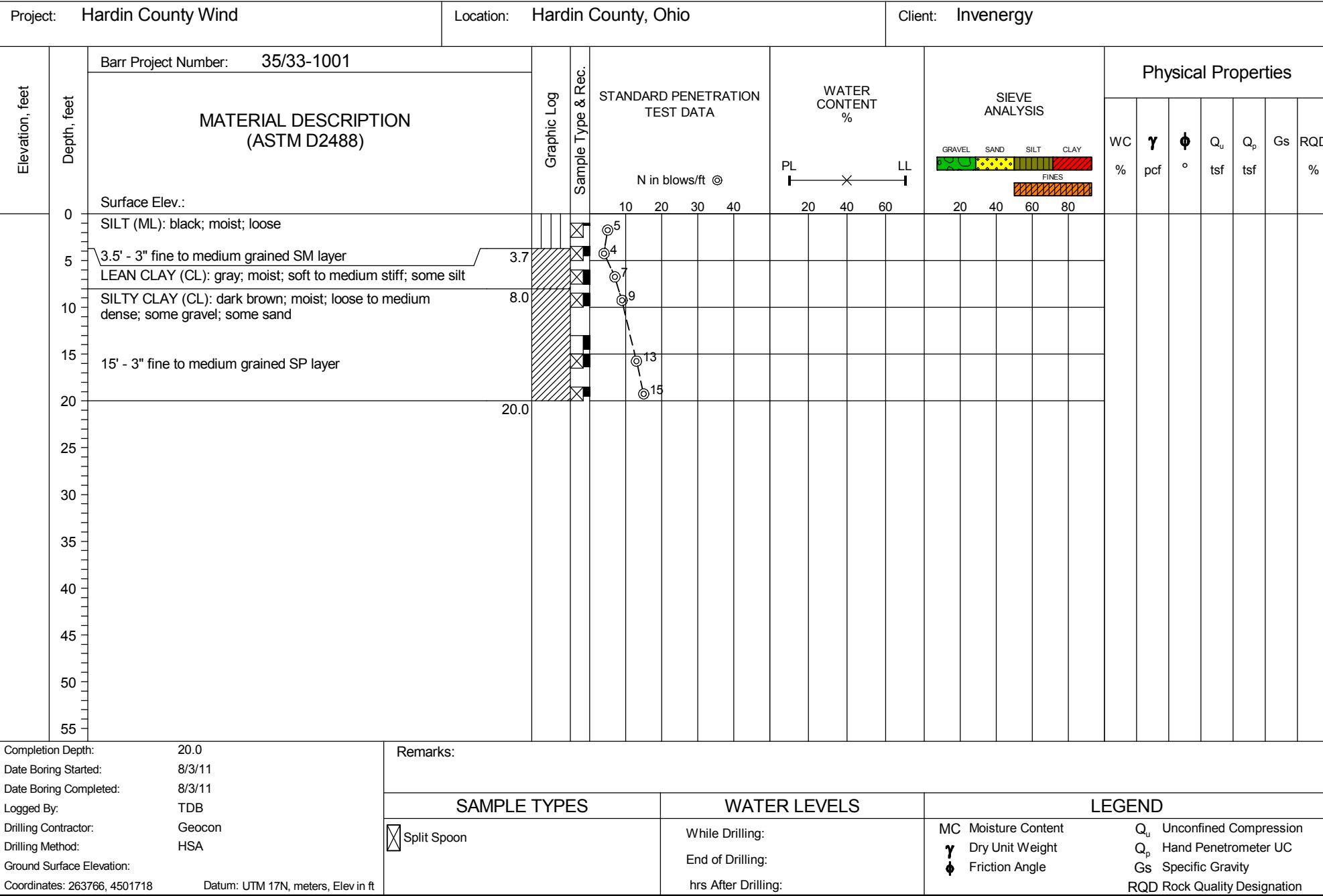
The stratification lines represent approximate boundaries. The transition may be gradual.



Barr Engineering Company
4700 W 77th St. Suite 200
Edina, MN 55435

LOG OF BORING SS-1

Sheet 1 of 1



The stratification lines represent approximate boundaries. The transition may be gradual.



Barr Engineering Company
4700 W 77th St. Suite 200
Edina, MN 55435

LOG OF BORING SS-2

Sheet 1 of 1

Project: Hardin County Wind			Location: Hardin County, Ohio				Client: Invenergy											
Elevation, feet	Depth, feet	Barr Project Number: 35/33-1001		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %	SIEVE ANALYSIS		Physical Properties							
		MATERIAL DESCRIPTION (ASTM D2488)	WC %			N in blows/ft	PL		GRAVEL	SAND	SILT	CLAY	γ pcf	ϕ °	Q _u tsf	Q _p tsf	G _s	RQD %
Surface Elev.:	0	SILTY CLAY (CL): dark brown; moist; medium dense to dense; some gravel; some sand	18.6	113.6		10 20 30 40	PL	LL	20 40 60	20 40 60 80	FINES	3.5						
7.5' to 9.0'	5	- - trace fine sand				12 22 38						4						
7.5' to 9.0' - trace fine sand	10											2.5						
15	15											2.5						
20	20	POORLY GRADED SAND (SP): fine to medium grained; dark brown; wet; medium dense; some silt	19.0	19.0	20.5	12 21 36												
25	25																	
30	30																	
35	35																	
40	40																	
45	45																	
50	50																	
55	55																	
Completion Depth:	20.0	Remarks:		SAMPLE TYPES		WATER LEVELS		LEGEND										
Date Boring Started:	8/2/11							MC	Moisture Content	Q _u	Unconfined Compression		Dry Unit Weight	Q _p	Hand Penetrometer UC	G _s	Specific Gravity	RQD Rock Quality Designation
Date Boring Completed:	8/2/11							γ				φ						
Logged By:	TDB							End of Drilling:										
Drilling Contractor:	Geocon							hrs After Drilling:										
Drilling Method:	HSA																	
Ground Surface Elevation:																		
Coordinates: 263787, 4501741	Datum: UTM 17N, meters, Elev in ft																	

The stratification lines represent approximate boundaries. The transition may be gradual.

Appendix E

Laboratory Test Results



Laboratory Testing Narrative

Client: Barr Engineering Company
4700 W. 77th Street, Suite 200
Minneapolis, Minnesota

Project: Hardin County Wind Project
Hardin Co., Ohio

Date: September 16, 2011

GEOCON Project No.: 11-G292

Sample Notes:

- T-14: Rock Qu – Core sample too fractured to test.
- T-35: Rock Qu – Core sample too fractured to test.
- T-31: Moisture Content @ 20 feet – No sample present.
- T-31: Rock Qu – No sample box present.
- T-51: Moisture Content @ 10 feet – No sample present.
- T-82: Moisture Content @ 35 feet – No sample present.



SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 2

PRINT DATE 9/16/2011

CLIENT Barr Engineering, Inc.

PROJECT NAME Hardin County Wind Project

PROJECT NUMBER 11-G292

PROJECT LOCATION Hardin County, Ohio

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Water Content (%)	Wet Density (pcf)	Dry Density (pcf)	Unconfined Comp. Strength (tsf)	Organic Content (%)	%<#200 Sieve	Classification
T-02	15.0	25	17	8	13.6						
T-02	25.0				14.1						
T-02	30.0				18.5						46
T-02	35.0				8.6						
T-02	45.0				13.4						
T-117	10.0				23.4						
T-117	15.0	28	18	10	13.0						
T-117	25.0				14.4						70
T-117	30.0				15.8						
T-117	40.0				29.7						
T-117	50.0				10.7						
T-14	5.0				25.3						
T-14	17.0				14.2						
T-14	20.0	22	17	5	10.3						
T-14	25.0				8.4						
T-19	10.0				12.7						
T-19	20.0				5.2						
T-19	25.0	32	17	15	14.4						
T-19	30.0				18.0						
T-31	5.0				24.9						
T-35	5.0				15.3						
T-35	15.0				14.7						58
T-39	5.0				21.4						
T-39	20.0	38	22	16	26.2						
T-39	30.0				27.7						
T-49	5.0				32.1						
T-49	50.0				6.0						
T-51	30.0				39.0						
T-51	50.0				45.3						
T-62	15.0				12.1						
T-62	20.0	22	17	5	11.5						
T-62	30.0				19.4						
T-62	35.0				15.2						88
T-62	40.0				10.8						
T-62	50.0				13.3						
T-66	25.0				51.9						
T-66	35.0				43.4						
T-66	40.0				26.8						99
T-82	5.0				24.4						
T-82	20.0				16.9						
T-82	25.0	17	11	6	11.7						
T-88	10.0				21.4						
T-88	15.0				22.0						99



SUMMARY OF LABORATORY RESULTS

PAGE 2 OF 2

PRINT DATE 9/16/2011

CLIENT Barr Engineering, Inc.

PROJECT NAME Hardin County Wind Project

PROJECT NUMBER 11-G292

PROJECT LOCATION Hardin County, Ohio

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Water Content (%)	Wet Density (pcf)	Dry Density (pcf)	Unconfined Comp. Strength (tsf)	Organic Content (%)	%<#200 Sieve	Classification
T-88	20.0	36	19	17	24.1						
T-88	40.0				13.5						
T-88	50.0				19.6						



ATTERBERG LIMITS' RESULTS

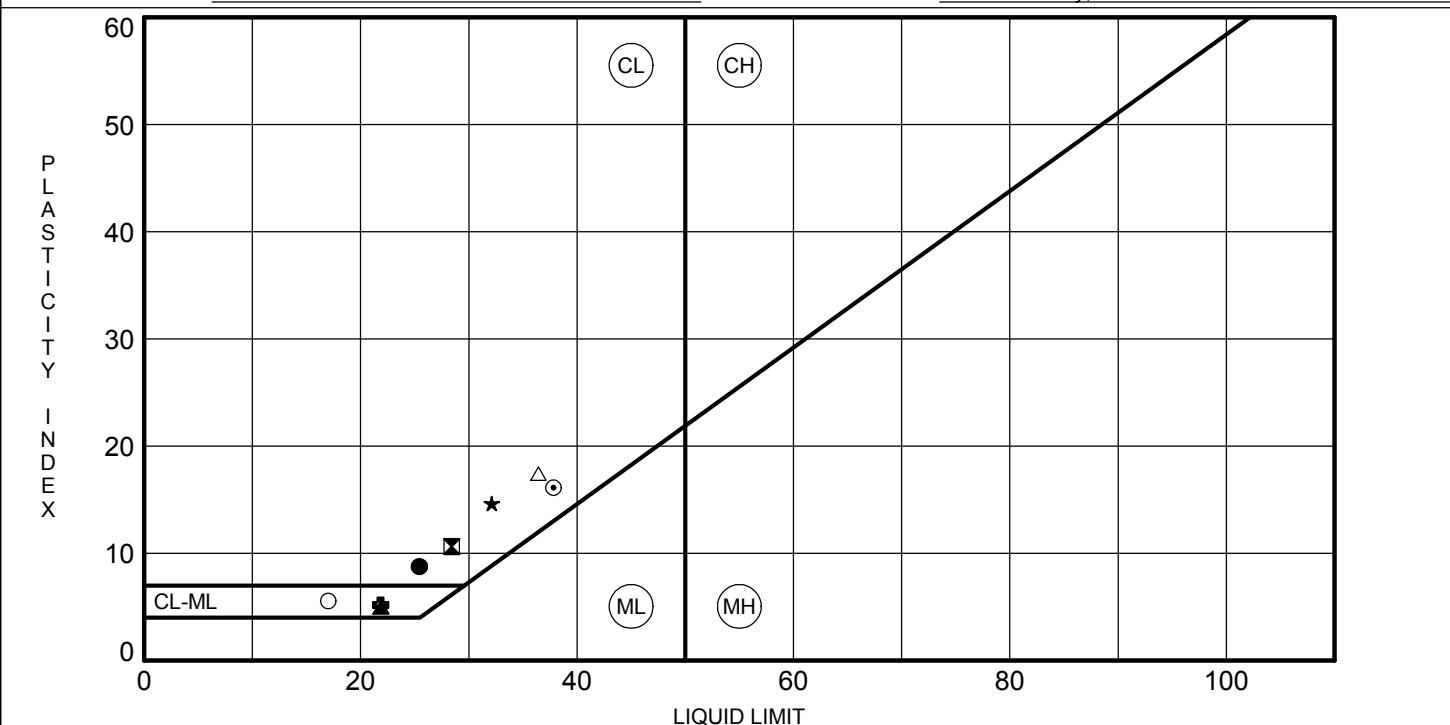
PRINT DATE 9/16/2011

CLIENT Barr Engineering, Inc.

PROJECT NUMBER 11-G292

PROJECT NAME Hardin County Wind Project

PROJECT LOCATION Hardin County, Ohio



BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
● T-02	15.0	25	17	8		
■ T-117	15.0	28	18	10		
▲ T-14	20.0	22	17	5		
★ T-19	25.0	32	17	15		
○ T-39	20.0	38	22	16		
◆ T-62	20.0	22	17	5		
○ T-82	25.0	17	11	6		
△ T-88	20.0	36	19	17		



GRAIN SIZE DISTRIBUTION

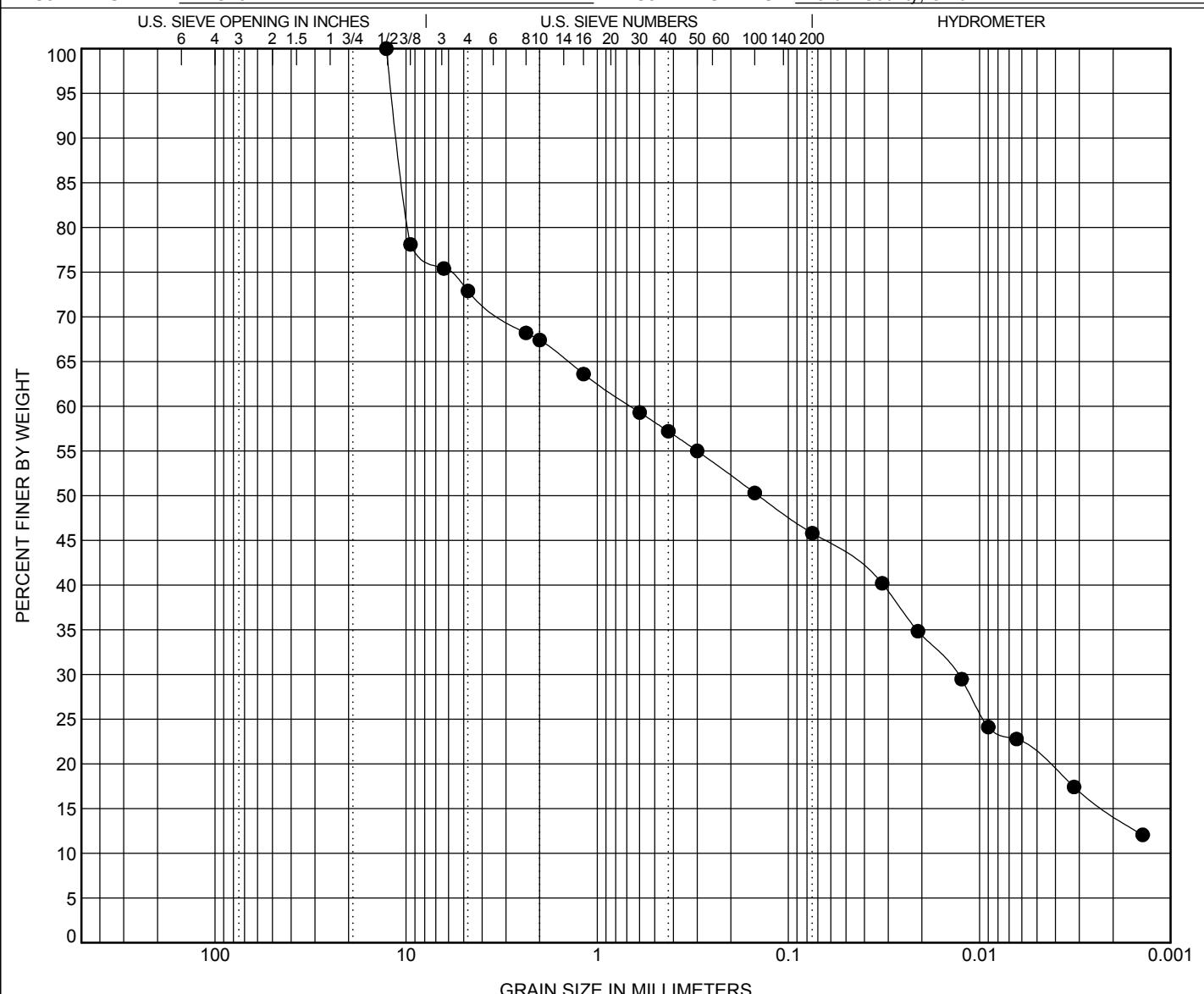
PRINT DATE 9/16/2011

CLIENT Barr Engineering, Inc.

PROJECT NAME Hardin County Wind Project

PROJECT NUMBER 11-G292

PROJECT LOCATION Hardin County, Ohio



GRAIN SIZE - GPS STD DATA TEMPLATE GDT - 09/16/11 10:51 - Y:\GINT\PPROJECTS\11-G292\HARDIN COUNTY OH\GPJ

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu		
		GRAVEL		SAND									
COBBLES		coarse	fine	coarse	medium	fine	SILT OR CLAY						
● T-02	30.0												
● T-02	30.0	12.7	0.67	0.013			27.1	27.1	24.9	20.9			



GRAIN SIZE DISTRIBUTION

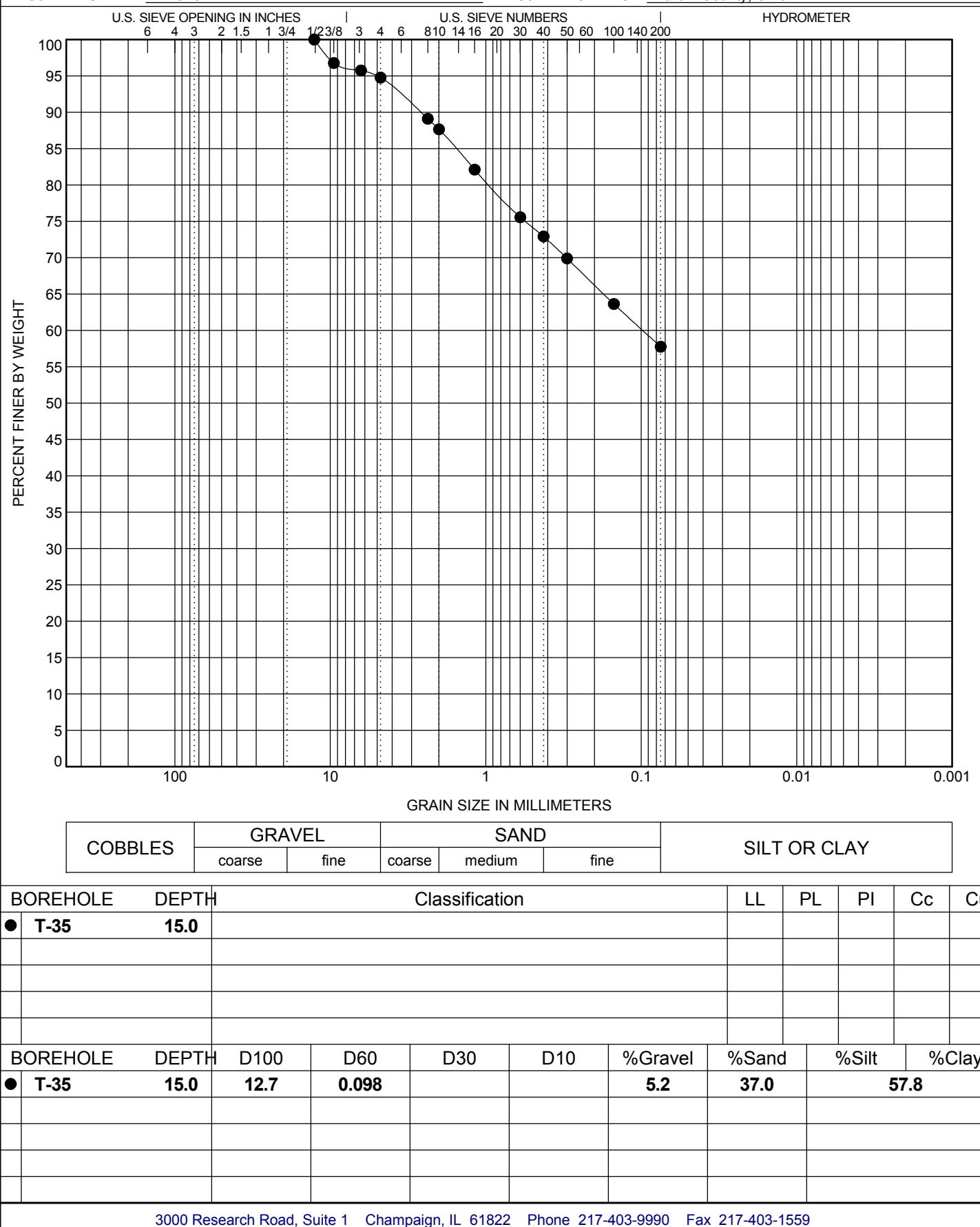
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CLIENT Barr Engineering, Inc.

PROJECT NAME Hardin County Wind Project

PROJECT NUMBER 11-G292

PROJECT LOCATION Hardin County, Ohio





GRAIN SIZE DISTRIBUTION

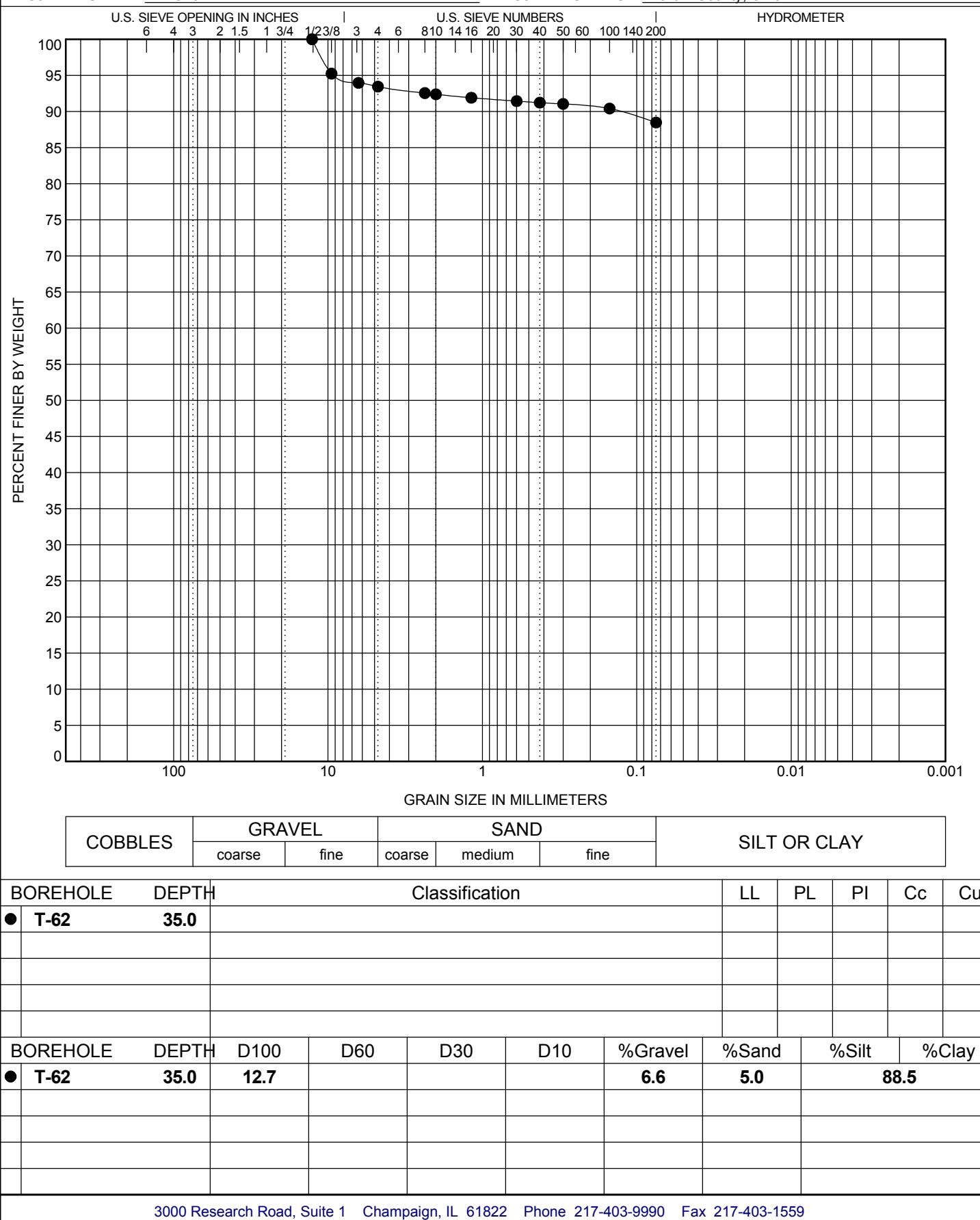
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CLIENT Barr Engineering, Inc.

PROJECT NAME Hardin County Wind Project

PROJECT NUMBER 11-G292

PROJECT LOCATION Hardin County, Ohio





GRAIN SIZE DISTRIBUTION

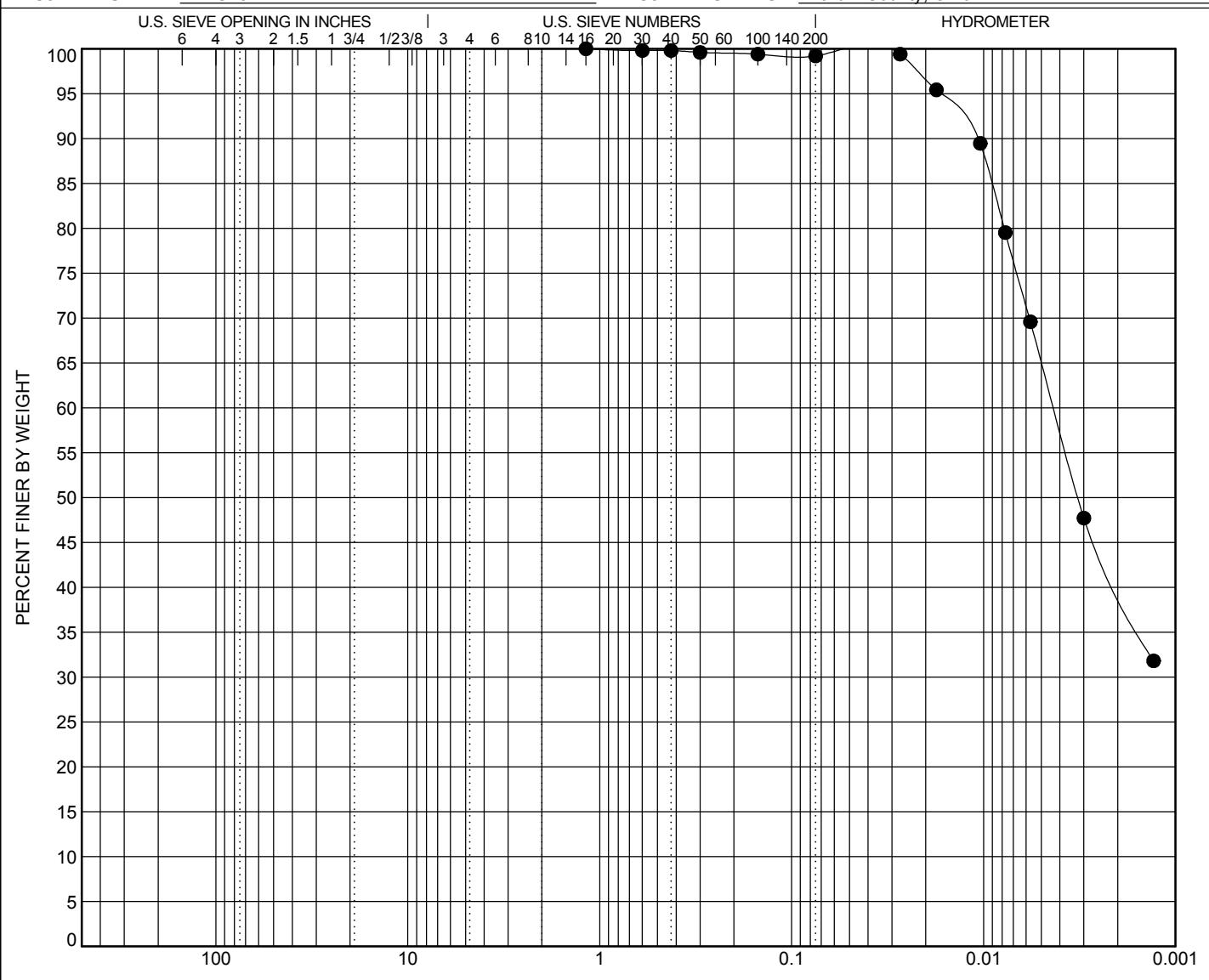
PRINT DATE 9/16/2011

CLIENT Barr Engineering, Inc.

PROJECT NAME Hardin County Wind Project

PROJECT NUMBER 11-G292

PROJECT LOCATION Hardin County, Ohio



GRAIN SIZE - GPS STD DATA TEMPLATE.GDT - 09/16/11 10:53 - Y:\GINT\PP\PROJECTS\11-G292\HARDIN COUNTY OH.GPJ

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu		
		GRAVEL		SAND									
COBBLES		coarse	fine	coarse	medium	fine	SILT OR CLAY						
● T-66	40.0												
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay				
● T-66	40.0	1.18	0.004			0.0	0.8	34.1	65.1				



GRAIN SIZE DISTRIBUTION

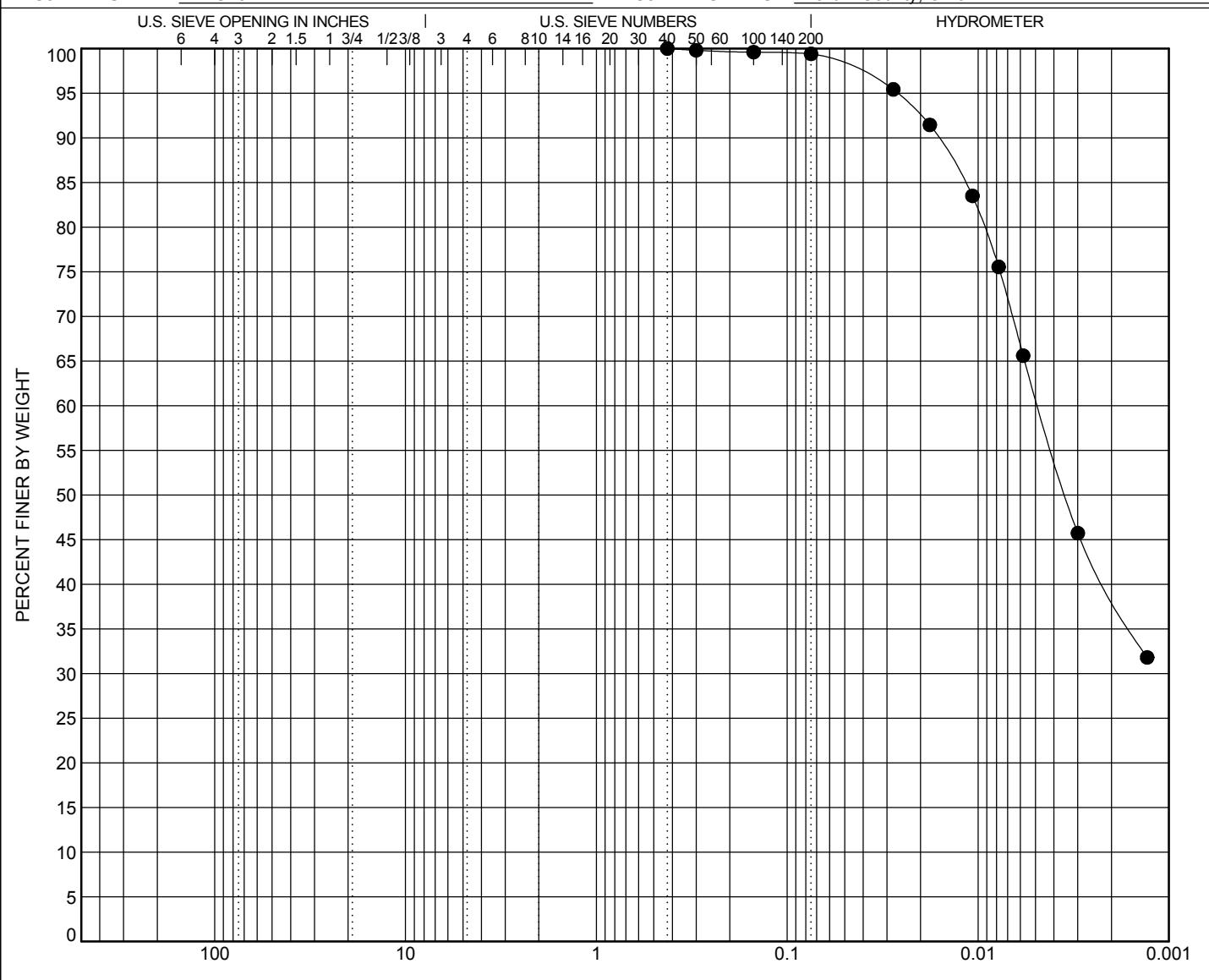
PRINT DATE 9/16/2011

CLIENT Barr Engineering, Inc.

PROJECT NAME Hardin County Wind Project

PROJECT NUMBER 11-G292

PROJECT LOCATION Hardin County, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● T-88	15.0										
● T-88	15.0	0.425	0.005				0.0	0.6	38.3	61.1	



GRAIN SIZE DISTRIBUTION

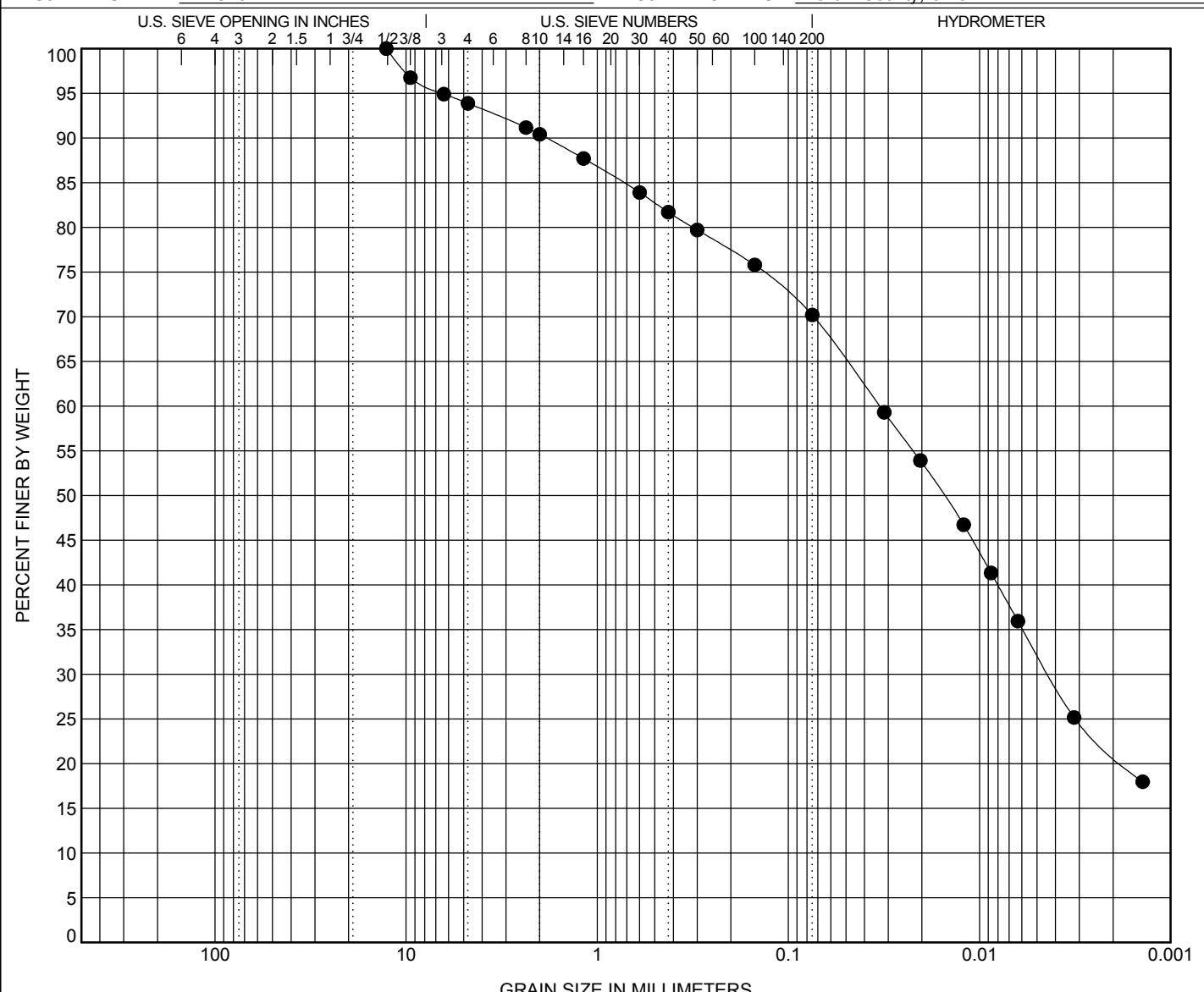
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CLIENT Barr Engineering, Inc.

PROJECT NAME Hardin County Wind Project

PROJECT NUMBER 11-G292

PROJECT LOCATION Hardin County, Ohio



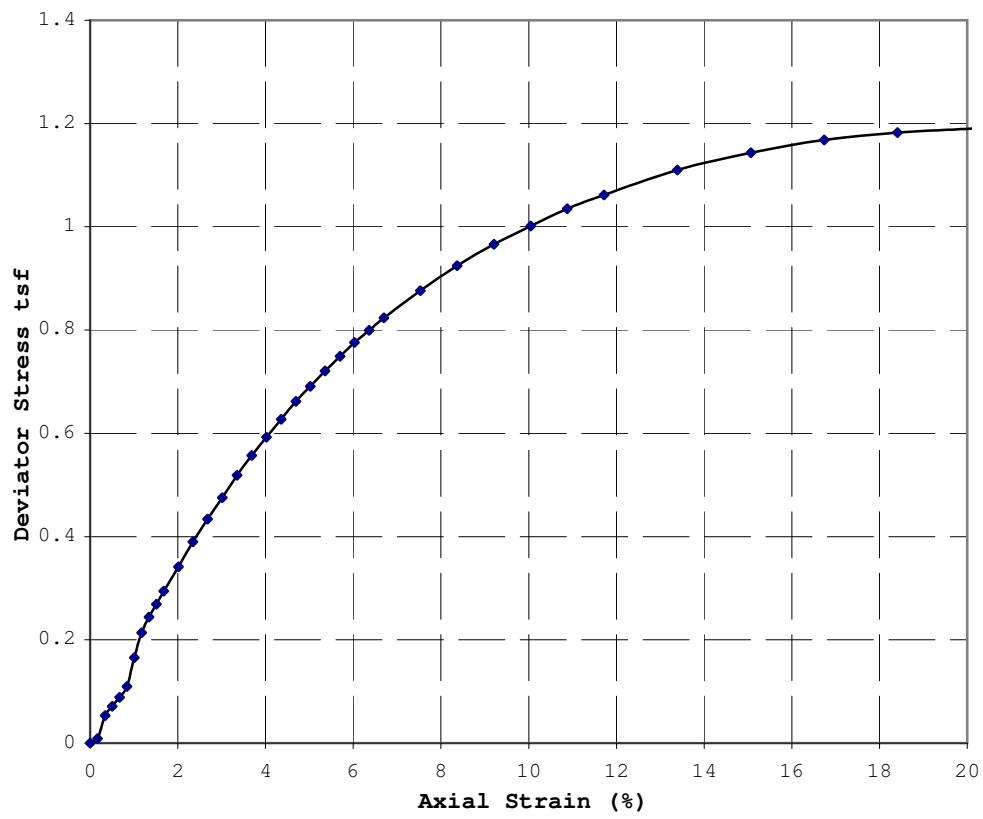
COBBLES	GRAVEL		SAND			SILT OR CLAY		
	coarse	fine	coarse	medium	fine			

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● T-117	25.0										

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● T-117	25.0	12.7	0.033	0.004		6.1	23.7	37.9	32.3

Triaxial U-U Stress/Strain Curves

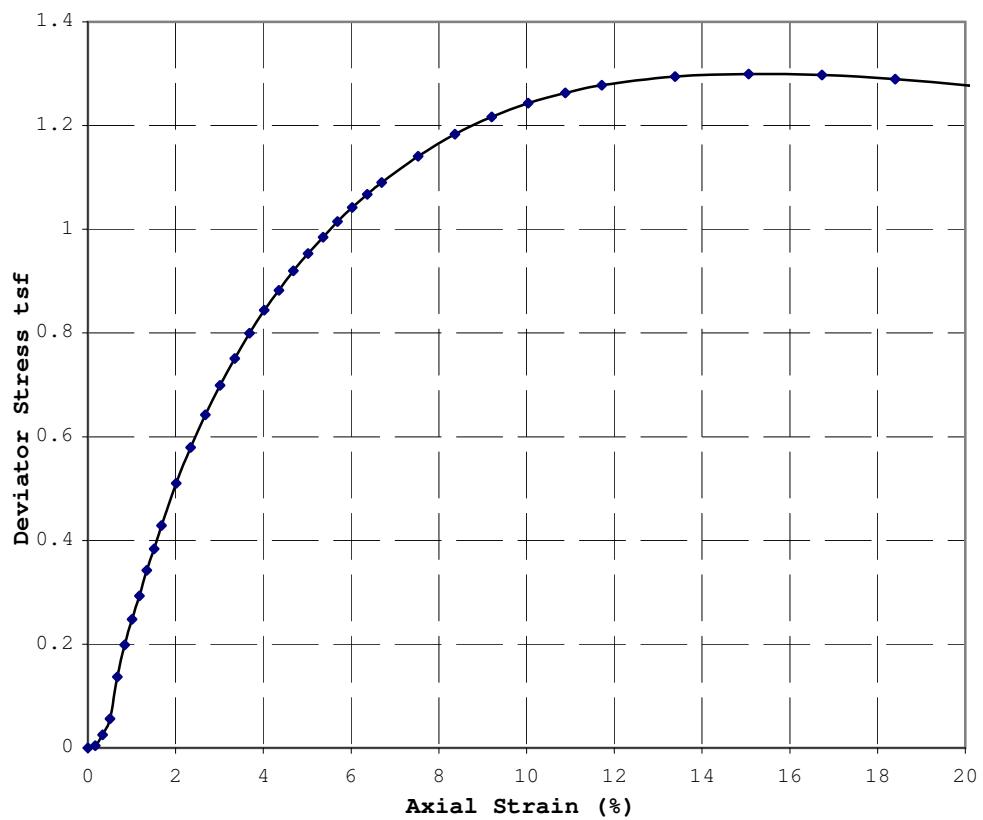
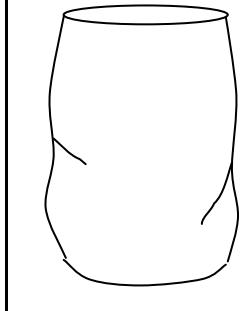
Project: Hardin County Job: 8076
 Client: Barr Engineering Company Date: 9/27/11
 Remarks:



Boring: T-02 Depth: 12-14
 Sample #: _____
 Soil Type: Lean Clay w/a little gravel (CL)
 Strain Rate (in/min): 0.050
 Sample Type: 3T
 Dia. (in) 2.88 Ht. (in) 5.98
 Height to Diameter Ratio: 2.1

Max Deviator Stress: 1.19 tsf
Strain at Failure (%): 20.45
 Confining Pressure: 0.75 tsf

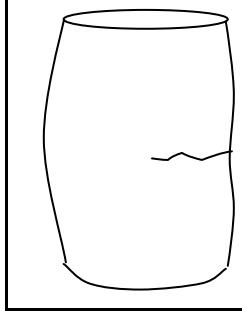
W.C. (%): 14.9 Sketch of Specimen After
 Yd (pcf): 120.4 Failure



Boring: T-35 Depth: 12-14
 Sample #: _____
 Soil Type: Lean Clay w/gravel (CL)
 Strain Rate (in/min): 0.050
 Sample Type: 3T
 Dia. (in): 2.88 Ht. (in): 5.98
 Height to Diameter Ratio: 2.1

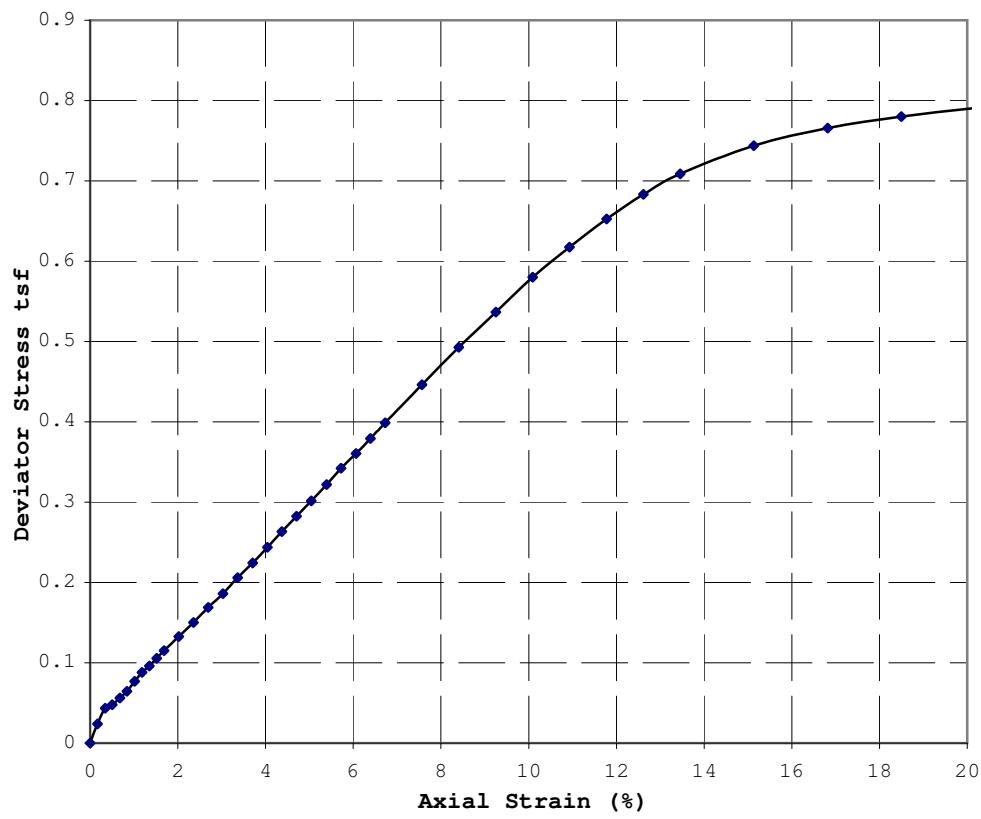
Max Deviator Stress: 1.30 tsf
Strain at Failure (%): 15.06
 Confining Pressure: 0.75 tsf

W.C. (%): 13.5 Sketch of Specimen After
 Yd (pcf): 124.3 Failure



Triaxial U-U Stress/Strain Curves

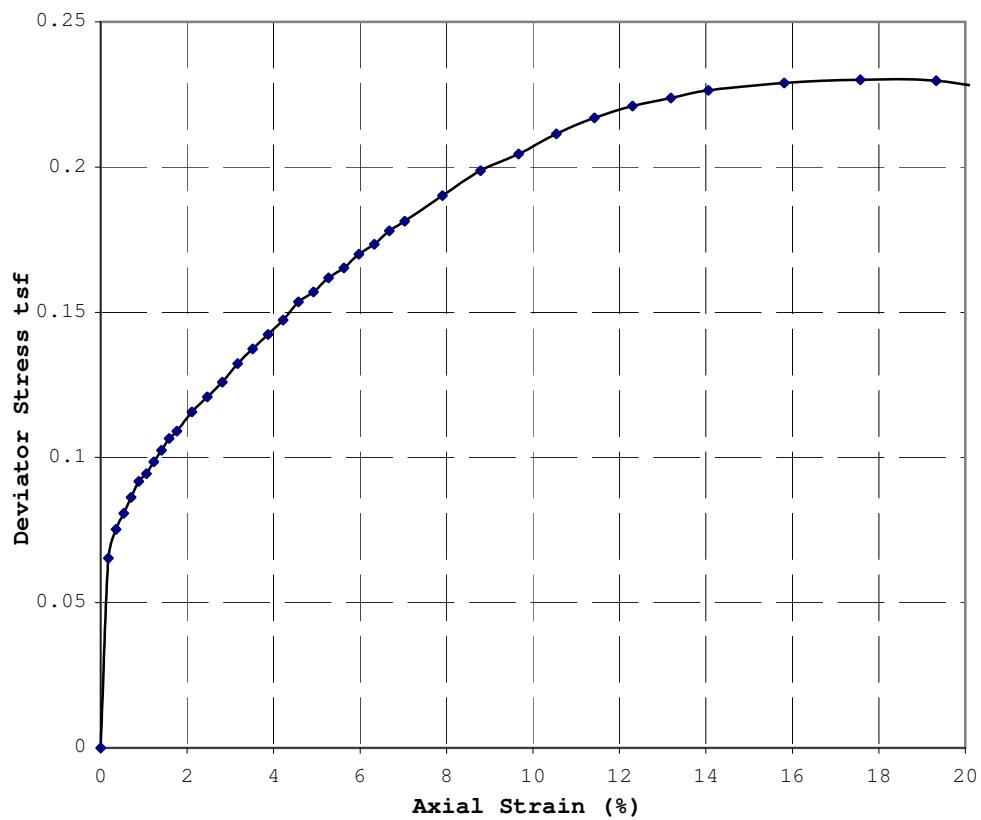
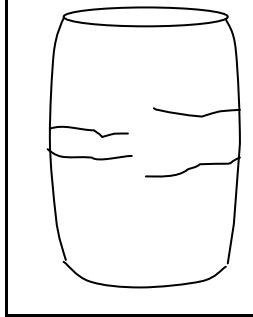
Project: Hardin County Job: 8076
 Client: Barr Engineering Company Date: 9/27/11
 Remarks:



Boring: T-39 Depth: 12-14
 Sample #: _____
 Soil Type: Lean Clay (CL)
 Strain Rate (in/min): 0.050
 Sample Type: 3T
 Dia. (in) 2.96 Ht. (in) 5.95
 Height to Diameter Ratio: 2.0

Max Deviator Stress: 0.79 tsf
Strain at Failure (%): 20.13
 Confining Pressure: 0.75 tsf

W.C. (%): 22.5 Sketch of Specimen After
 Yd (pcf): 102.3 Failure



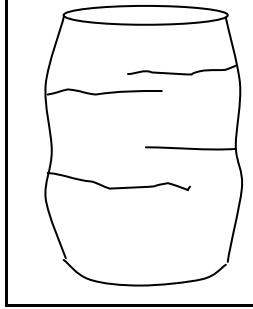
Boring: T-49 Depth: 12-14
 Sample #: _____
 Soil Type: Lean Clay (CL)

Strain Rate (in/min): 0.050
 Sample Type: 3T

Dia. (in): 2.94 Ht. (in): 5.69
 Height to Diameter Ratio: 1.9

Max Deviator Stress: 0.23 tsf
Strain at Failure (%): 17.57
 Confining Pressure: 0.75 tsf

W.C. (%): 39.4 Sketch of Specimen After
 Yd (pcf): 78.5 Failure



Triaxial U-U Stress/Strain Curves

Project:

Hardin County

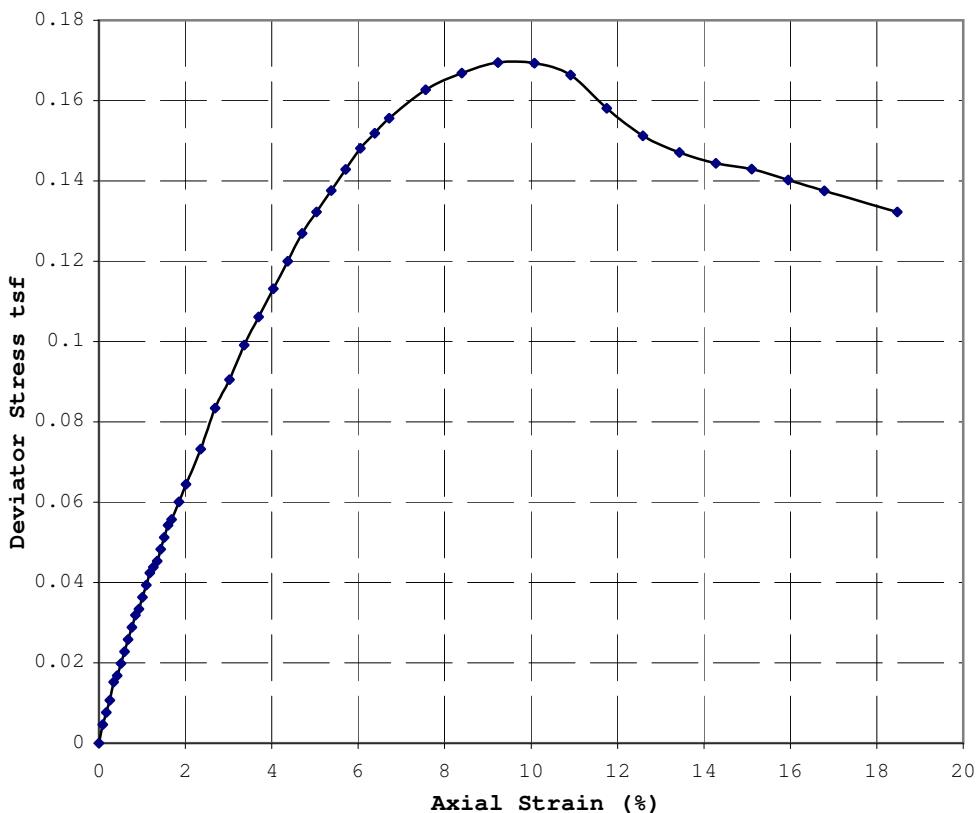
Job: 8076

Client:

Barr Engineering Company

Date: 9/27/11

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.

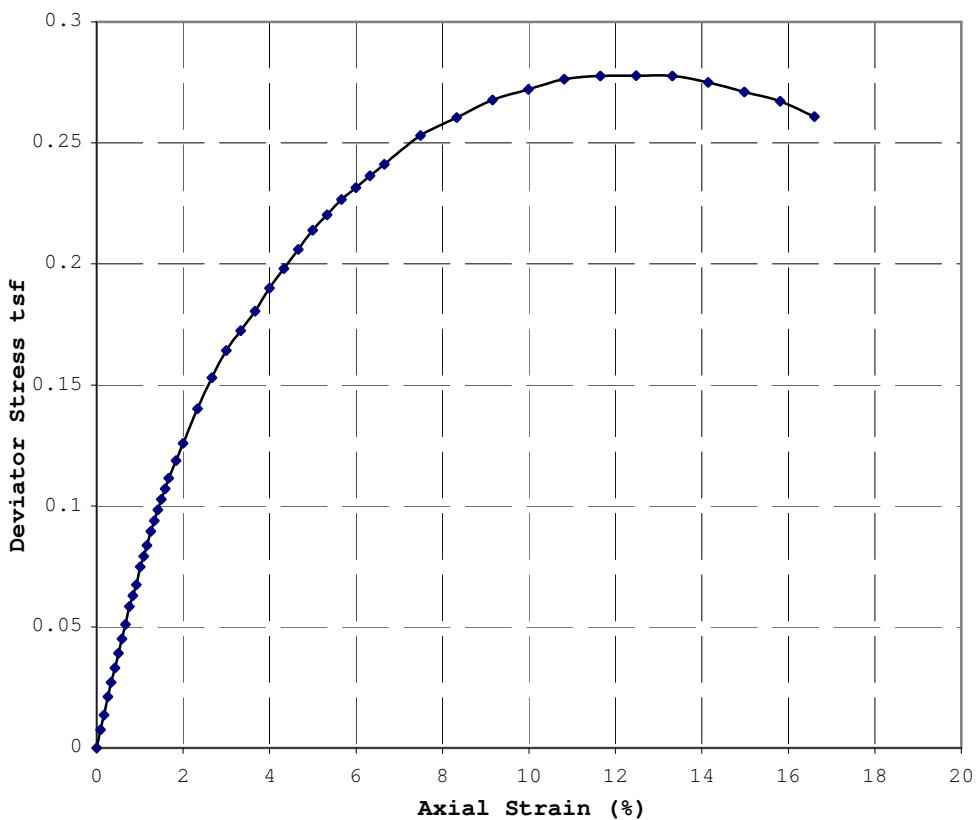
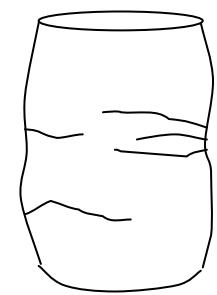


Boring: T-49 Depth: 22-24
 Sample #: _____
 Soil Type: Lean Clay (CL)
 Strain Rate (in/min): 0.050
 Sample Type: 3T
 Dia. (in) 2.84 Ht. (in) 5.96
 Height to Diameter Ratio: 2.10

Max Deviator Stress: 0.17 tsf
Strain at Failure (%): 9.24
Confining Pressure: 1.25 tsf

W.C. (%) 41.6 Sketch of Specimen After
 Yd (pcf): 80.1 Failure

LL: 41.5
 PL: 19.7
 PI: 21.8



Boring: T-49 Depth: 47-49
 Sample #: _____
 Soil Type: _____

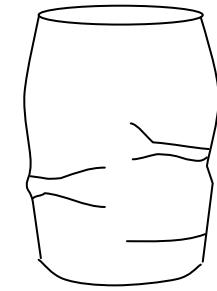
Lean Clay (CL)

Strain Rate (in/min): 0.050
 Sample Type: 3T

Dia. (in): 2.86 Ht. (in): 6.01
 Height to Diameter Ratio: 2.10

Max Deviator Stress: 0.28 tsf
Strain at Failure (%): 12.48
Confining Pressure: 2.50 tsf

W.C. (%): 38.5 Sketch of Specimen After
 Yd (pcf): 83.0 Failure



Triaxial U-U Stress/Strain Curves

Project:

Hardin County

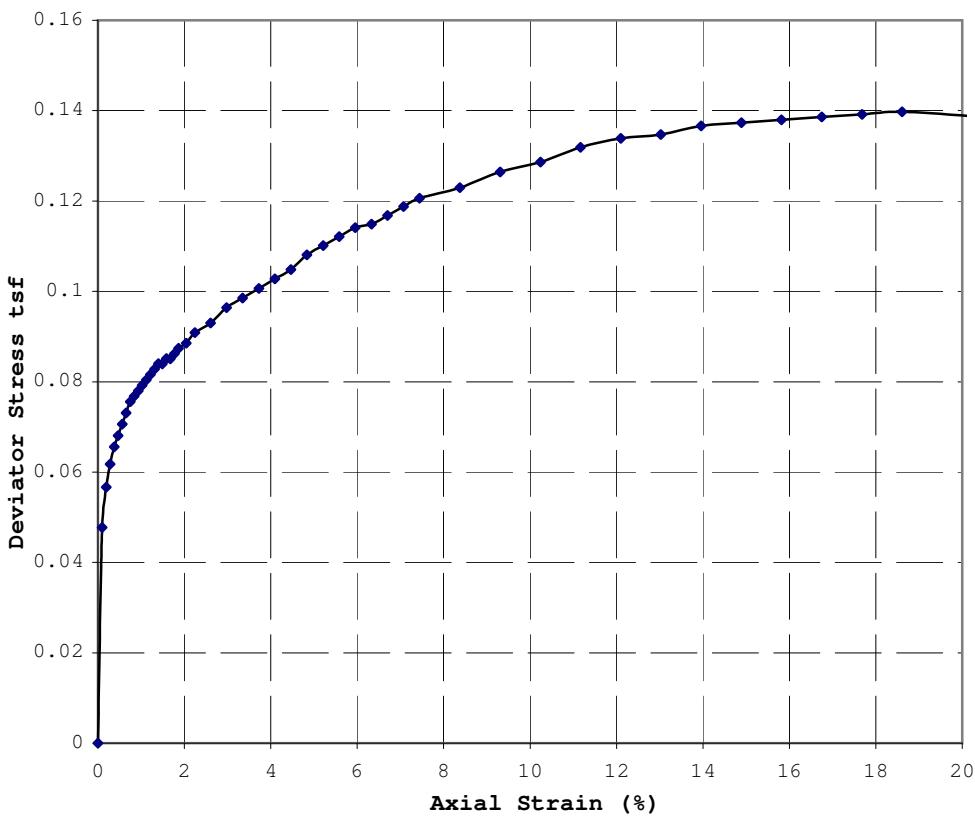
Job: 8076

Client:

Barr Engineering Company

Date: 9/27/11

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Boring: T-51 Depth: 3-5
Sample #:

Soil Type: Lean Clay (CL)

Strain Rate (in/min): 0.050

Sample Type: 3T

Dia. (in) 3.09 Ht. (in) 5.38

Height to Diameter Ratio: 1.74

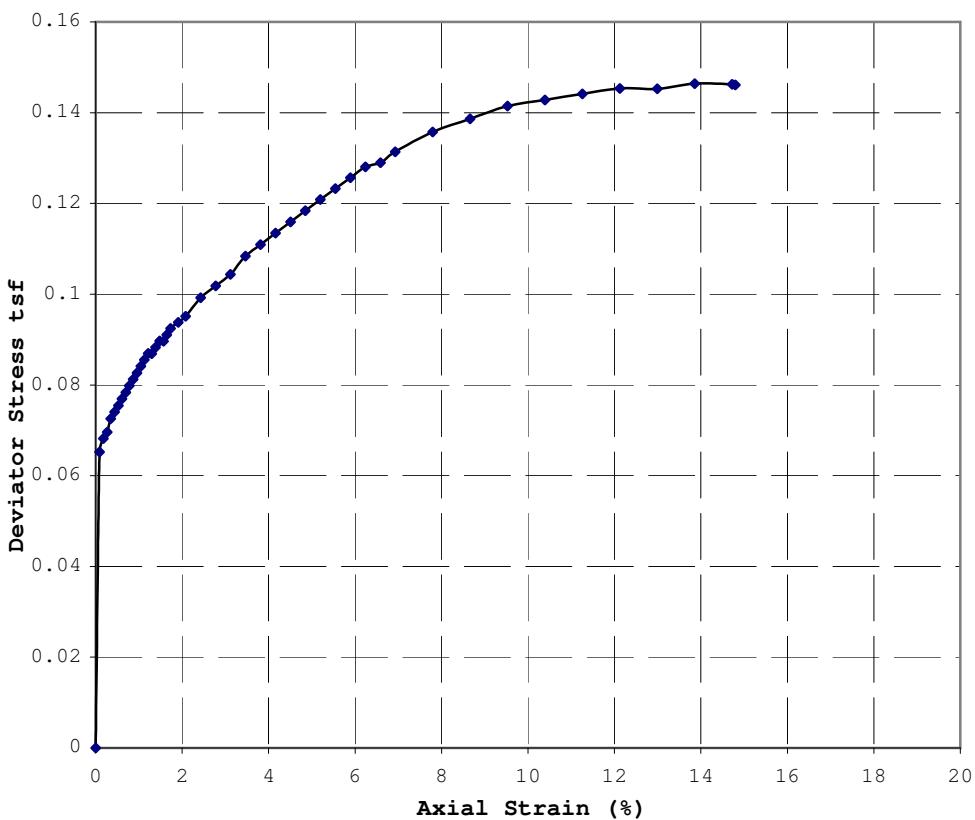
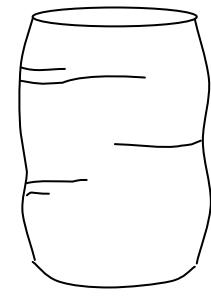
Max Deviator Stress: 0.14 tsf

Strain at Failure (%): 18.61

Confining Pressure: 0.25 tsf

W.C. (%) 35.8
Yd (pcf): 82.5

Sketch of Specimen After Failure



Boring: T-51 Depth: 20-22
Sample #:

Soil Type: Lean Clay (CL)

Strain Rate (in/min): 0.050

Sample Type: 3T

Dia. (in) 2.85 Ht. (in) 5.77

Height to Diameter Ratio: 2.03

Max Deviator Stress: 0.15 tsf

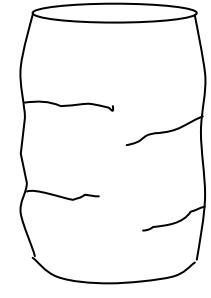
Strain at Failure (%): 13.86

Confining Pressure: 1.25 tsf

W.C. (%): 40.9
Yd (pcf): 77.6

Sketch of Specimen After Failure

LL: 42
PL: 19.3
PI: 22.7



Triaxial U-U Stress/Strain Curves

Project:

Hardin County

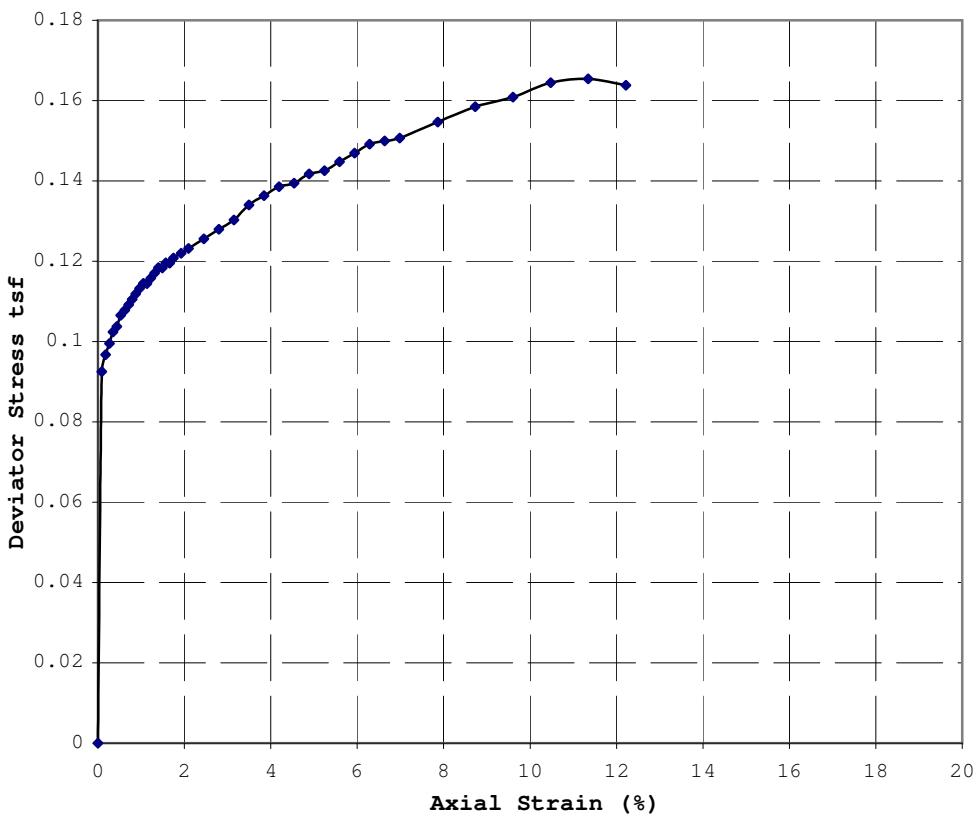
Job: 8076

Client:

Barr Engineering Company

Date: 9/27/11

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Boring: T-51 Depth: 37-39

Sample #: _____

Soil Type: Lean Clay (CL)

Strain Rate (in/min): 0.050

Sample Type: 3T

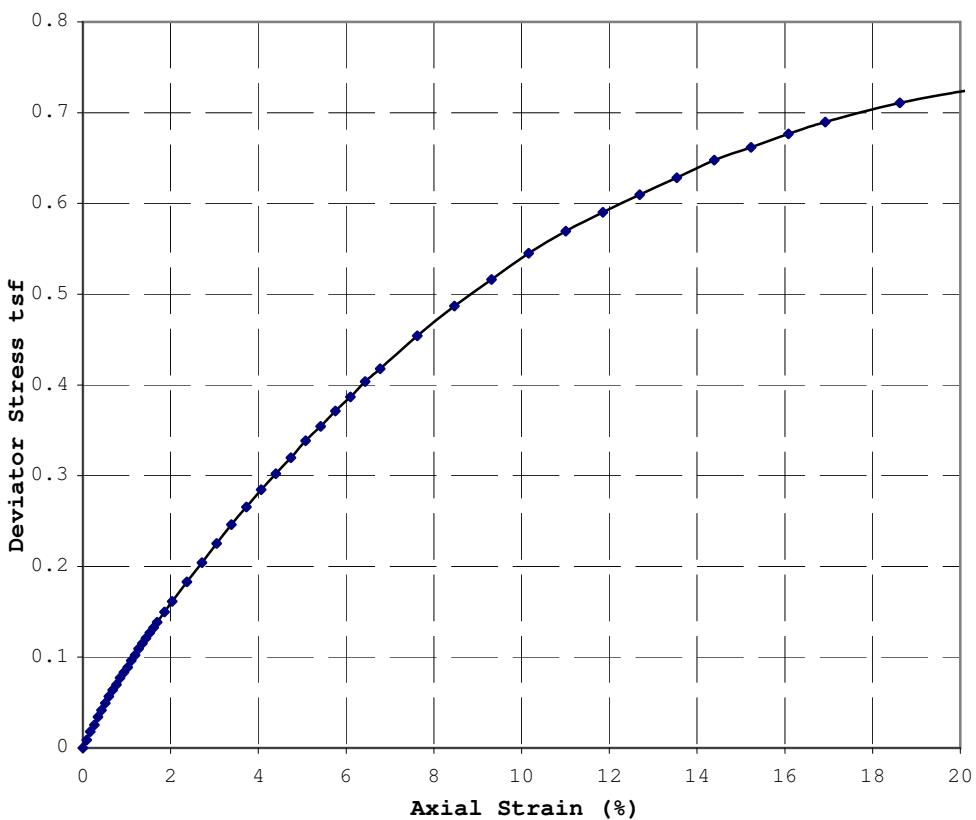
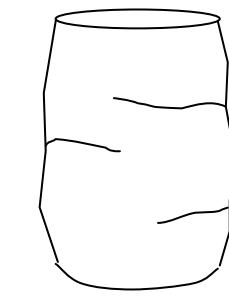
Dia. (in) 2.92 Ht. (in) 5.73

Height to Diameter Ratio: 1.96

Max Deviator Stress: 0.17 tsf

Strain at Failure (%): 11.35

Confining Pressure: 2.00 tsf

W.C. (%): 44.1 Sketch of Specimen After
Yd (pcf): 72.2 Failure

Boring: T-62 Depth: 22-24

Sample #: _____

Soil Type: Lean Clay w/sand and a little gravel (CL)

Strain Rate (in/min): 0.050

Sample Type: 3T

Dia. (in): 2.87 Ht. (in): 5.91

Height to Diameter Ratio: 2.06

Max Deviator Stress: 0.73 tsf

Strain at Failure (%): 20.47

Confining Pressure: 1.25 tsf

W.C. (%): 17.5 Sketch of Specimen After
Yd (pcf): 113.7 Failure

Triaxial U-U Stress/Strain Curves

Project:

Hardin County

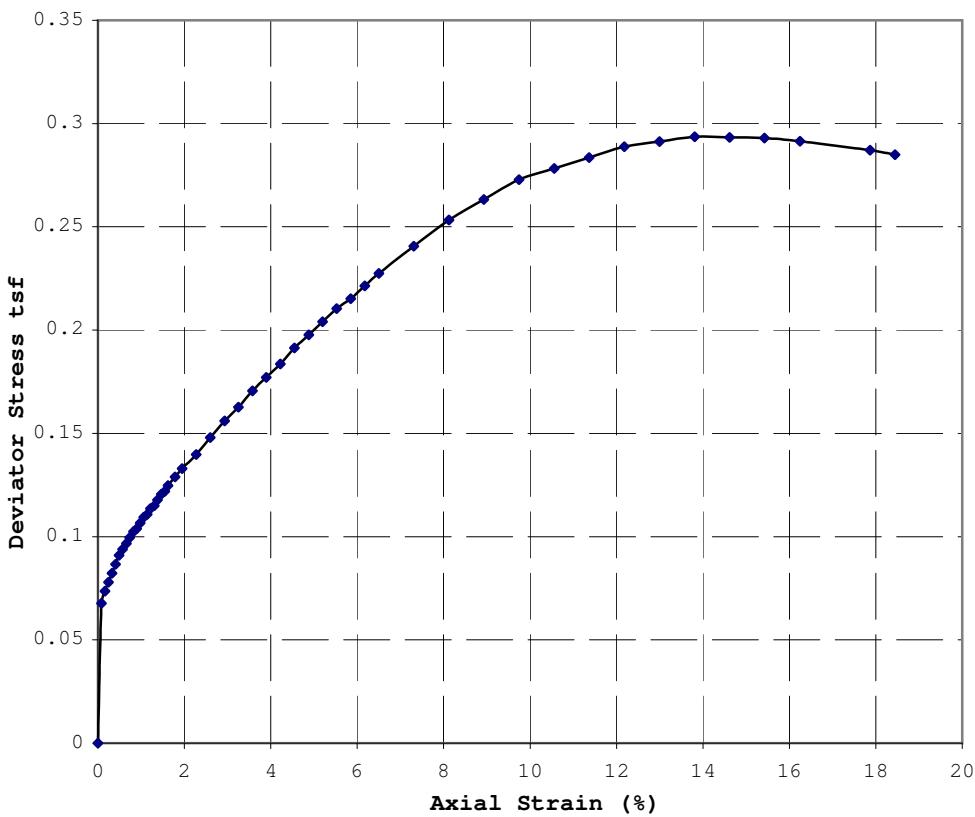
Job: 8076

Client:

Barr Engineering Company

Date: 9/27/11

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Boring: T-66 Depth: 12-14

Sample #:

Soil Type: Lean Clay w/a trace of organic material (CL)

Strain Rate (in/min): 0.050

Sample Type: 3T

Dia. (in) 2.89 Ht. (in) 6.16

Height to Diameter Ratio: 2.13

Max Deviator Stress: 0.29 tsf

Strain at Failure (%): 13.81

Confining Pressure: 0.75 tsf

W.C. (%): 36.7

Yd (pcf): 82.2

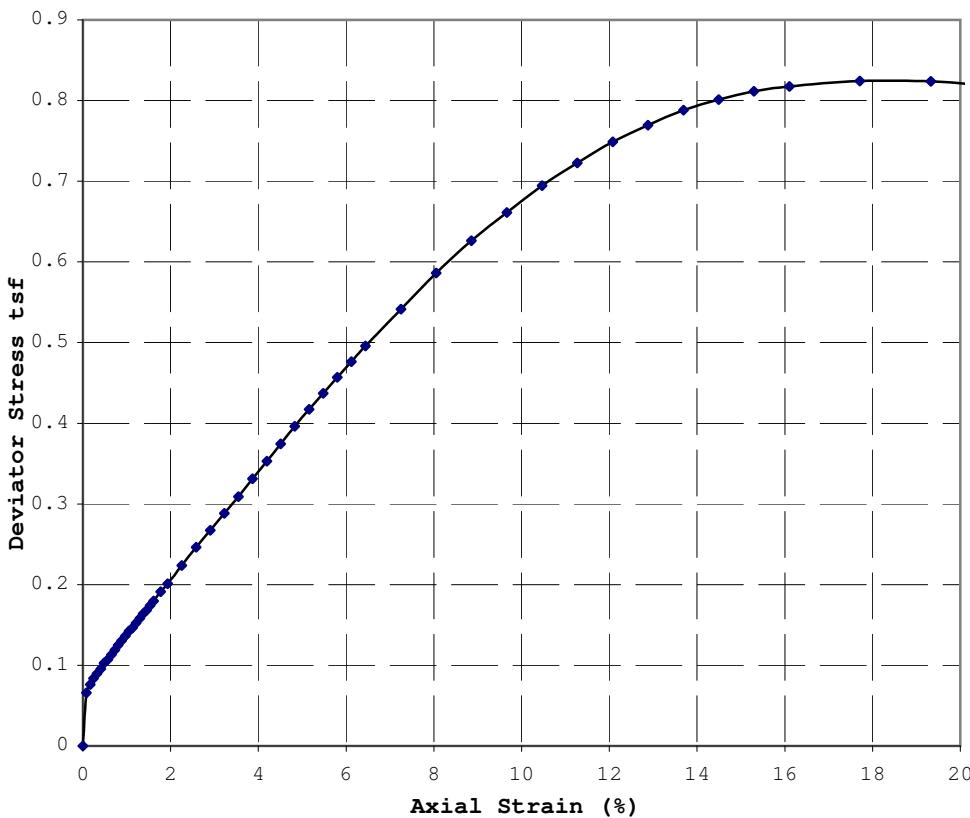
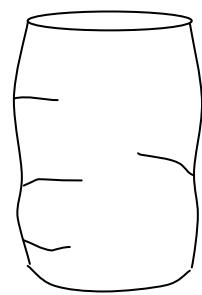
Sketch of Specimen After Failure

LL: 38.5

PL: 20.1

PI: 18.4

OC: 2.5%



Boring: T-66 Depth: 43-45

Sample #:

Soil Type: Lean Clay (CL)

Strain Rate (in/min): 0.050

Sample Type: 3T

Dia. (in) 2.87 Ht. (in) 6.21

Height to Diameter Ratio: 2.16

Max Deviator Stress: 0.82 tsf

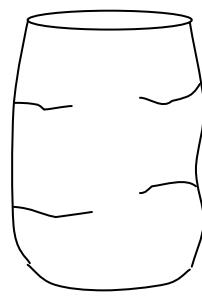
Strain at Failure (%): 17.71

Confining Pressure: 2.25 tsf

W.C. (%): 23.9

Yd (pcf): 101.6

Sketch of Specimen After Failure



Triaxial U-U Stress/Strain Curves

Project:

Hardin County

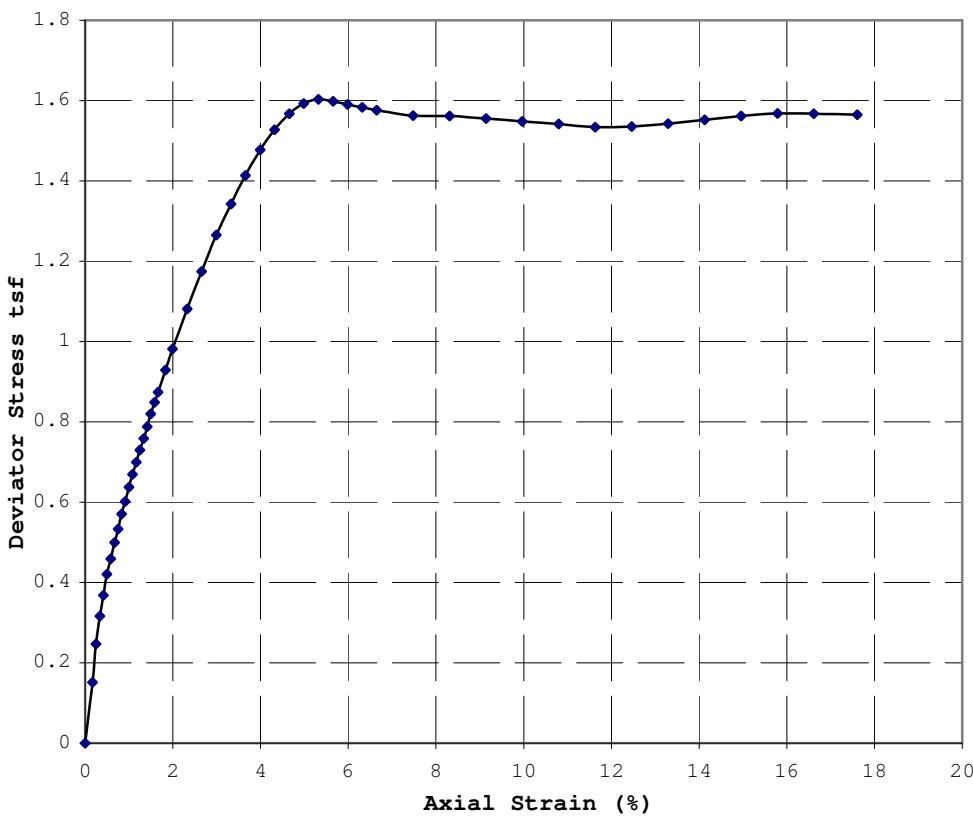
Job: 8076

Client:

Barr Engineering Company

Date: 9/27/11

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Boring: T-72 Depth: 12-14

Sample #:

Soil Type: Lean Clay (CL)

Strain Rate (in/min): 0.050

Sample Type: 3T

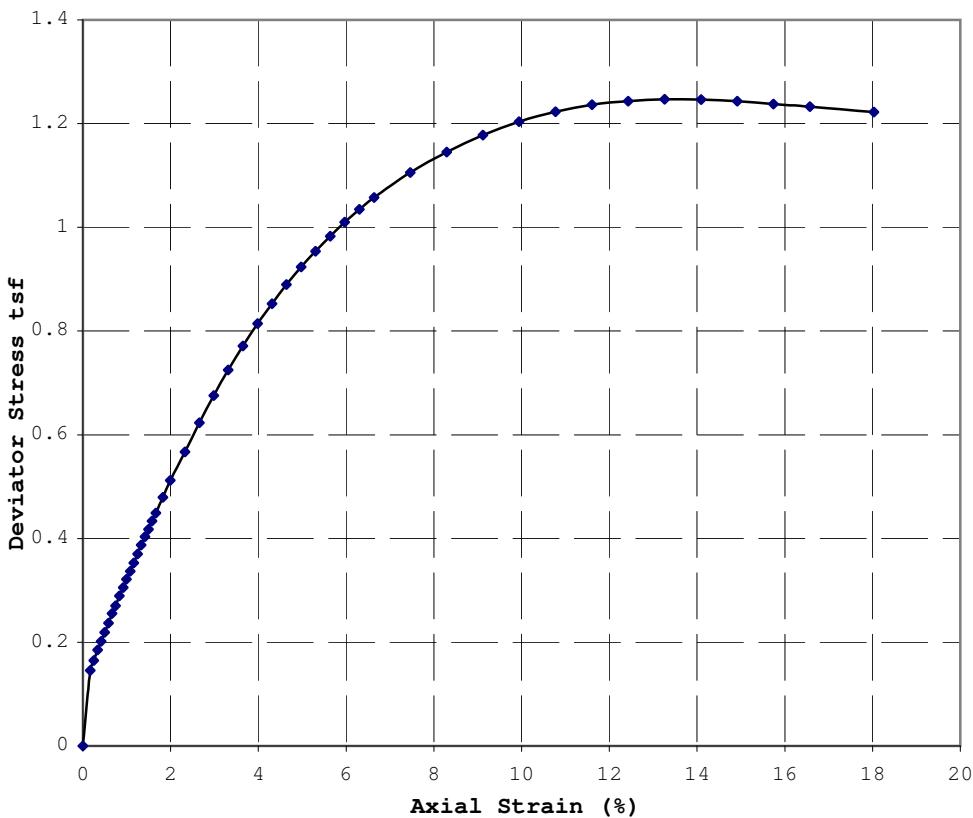
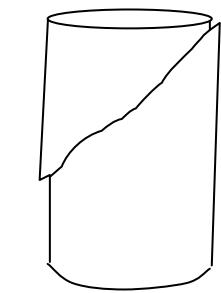
Dia. (in) 2.88 Ht. (in) 6.02

Height to Diameter Ratio: 2.09

Max Deviator Stress: 1.60 tsf

Strain at Failure (%): 5.32

Confining Pressure: 0.75 tsf

W.C. (%): 23.1 Sketch of Specimen After
Yd (pcf): 103.1 Failure

Boring: T-82 Depth: 26-28

Sample #:

Soil Type: Lean Clay w/sand and a trace of gravel (CL)

Strain Rate (in/min): 0.050

Sample Type: 3T

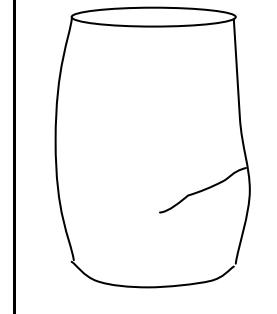
Dia. (in): 2.88 Ht. (in): 6.03

Height to Diameter Ratio: 2.10

Max Deviator Stress: 1.25 tsf

Strain at Failure (%): 13.26

Confining Pressure: 1.25 tsf

W.C. (%): 13.5 Sketch of Specimen After
Yd (pcf): 124.0 FailureLL: 36.2
PL: 17.8
PI: 18.4

Triaxial U-U Stress/Strain Curves

Project:

Hardin County

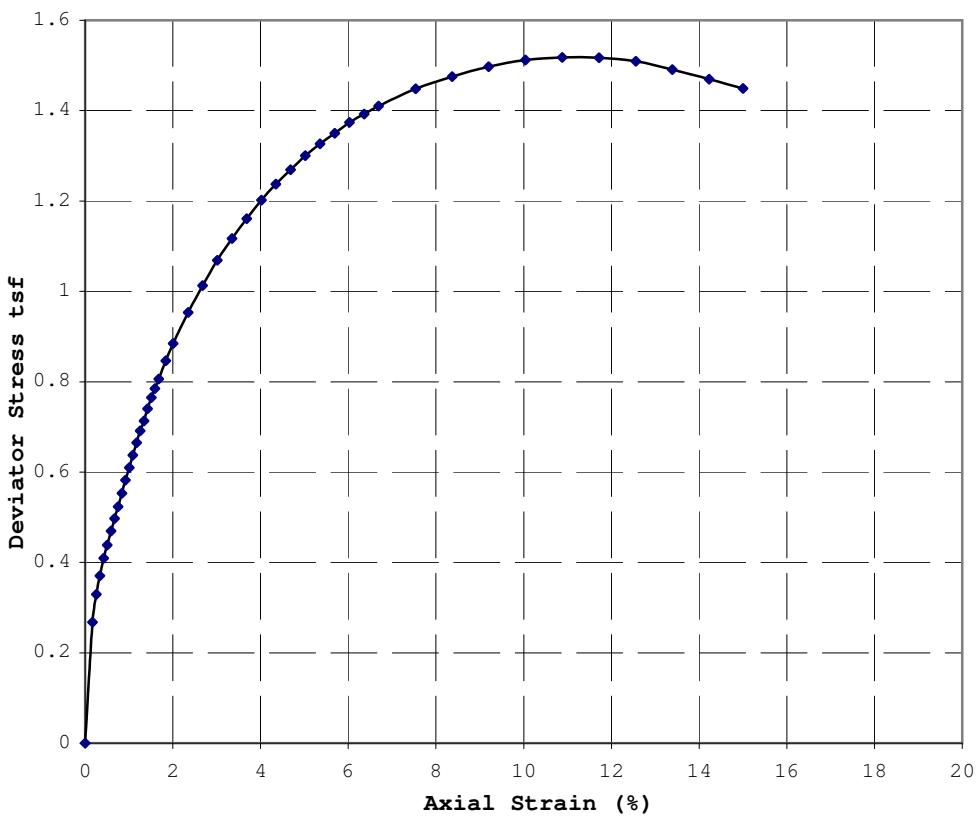
Job: 8076

Client:

Barr Engineering Company

Date: 9/27/11

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Boring: T-88 Depth: 17-19

Sample #:

Soil Type: Lean Clay (CL)

Strain Rate (in/min): 0.050

Sample Type: 3T

Dia. (in) 2.87 Ht. (in) 5.98

Height to Diameter Ratio: 2.08

Max Deviator Stress: 1.52 tsf

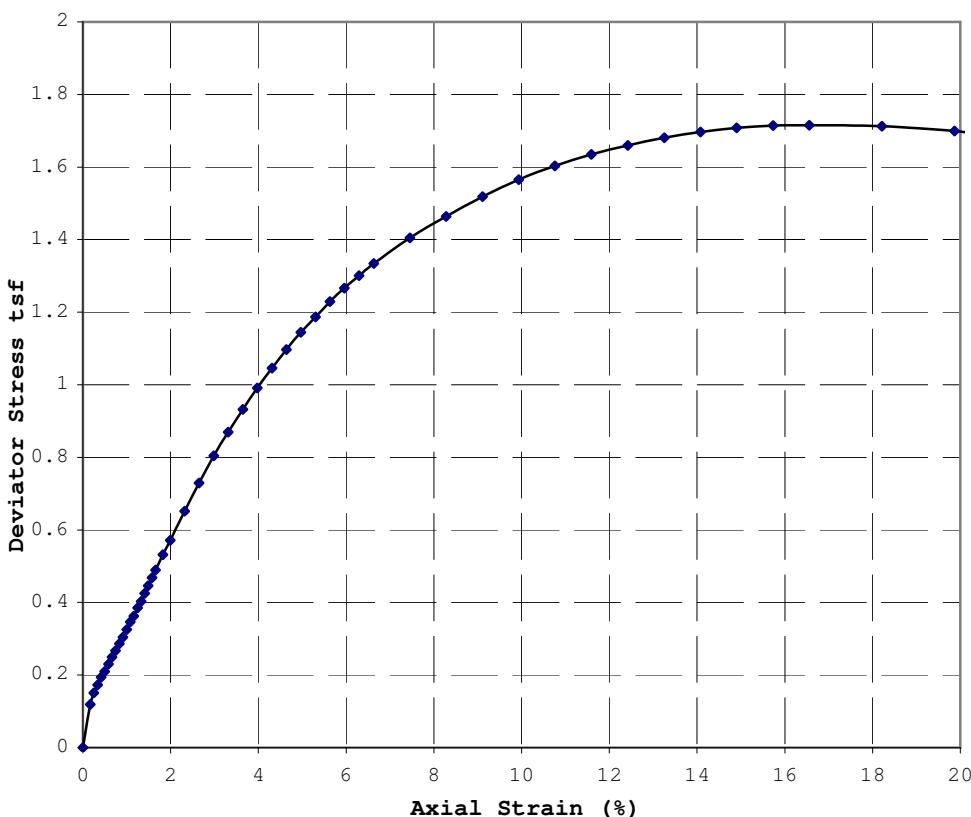
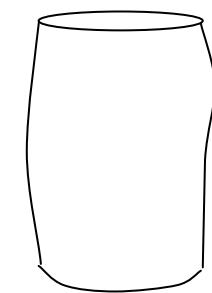
Strain at Failure (%): 10.88

Confining Pressure: 1.00 tsf

W.C. (%): 25.0

Yd (pcf): 100.7

Sketch of Specimen After Failure



Boring: T-88 Depth: 27-29

Sample #:

Soil Type: Silty Clay w/sand (CL-ML)

Strain Rate (in/min): 0.050

Sample Type: 3T

Dia. (in) 2.87 Ht. (in) 6.04

Height to Diameter Ratio: 2.10

Max Deviator Stress: 1.71 tsf

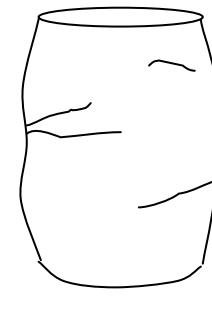
Strain at Failure (%): 16.56

Confining Pressure: 1.50 tsf

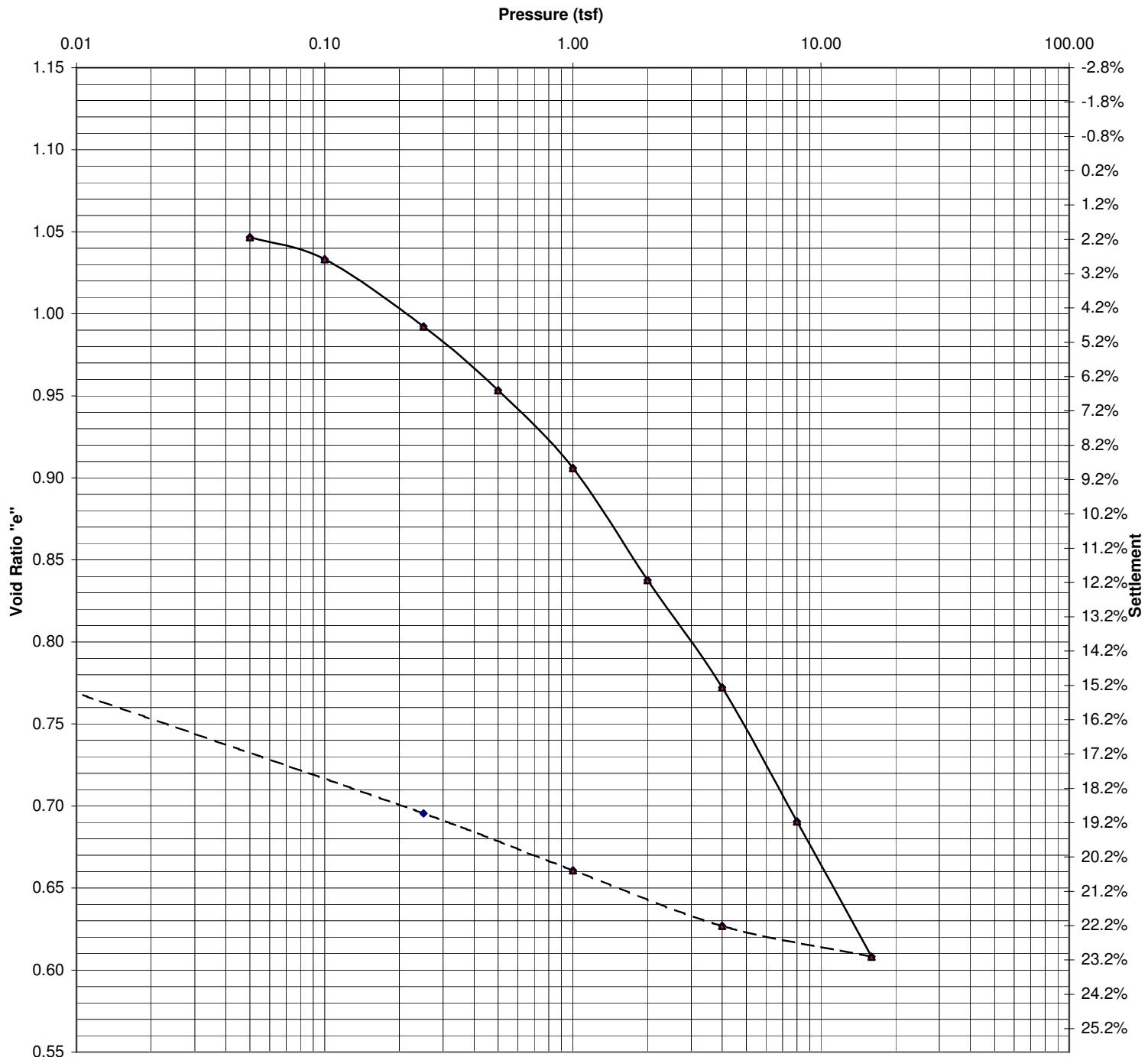
W.C. (%): 18.8

Yd (pcf): 112.2

Sketch of Specimen After Failure

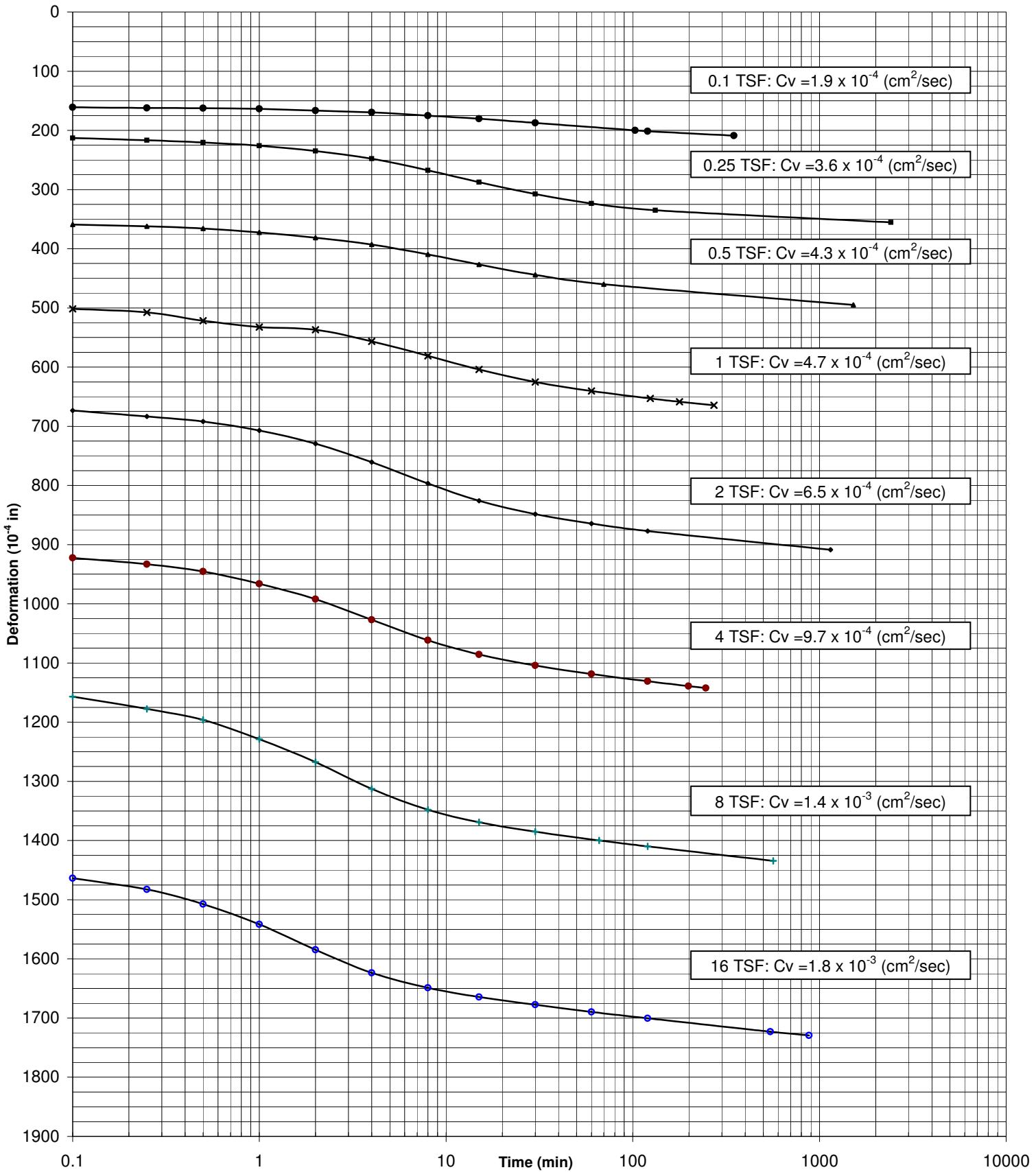
LL: 18.9
PL: 13.5
PI: 5.4

Void Ratio and % Settlement vs. Log of Pressure



Project: Hardin County				Date: 10/3/11
Sample #:	Boring #: T-49	Depth ft: 12-14 (Mid)		Job #: 8076
Soil Type: Lean Clay (CL)				
Initial W/C (%): 41.4	Dry Density (pcf): 80.0	LL:	PL:	PI: Gs: 2.68 (Assumed)
Organic Content (%):	Initial Height (in.): 0.748	Diameter (in.): 2.503	$e_0 =$	1.092
Preconsolidation Pressure (Pc): 0.56 tsf	Compression Index (Cc): 0.27	Recompression Index (Cr):	≥ 0.05	
Remarks:				

Consolidation Log of Time Curves



Project: Hardin County

Date: 10/3/11

Sample #:

Boring #: T-49

Depth ft: 12-14 (Mid)

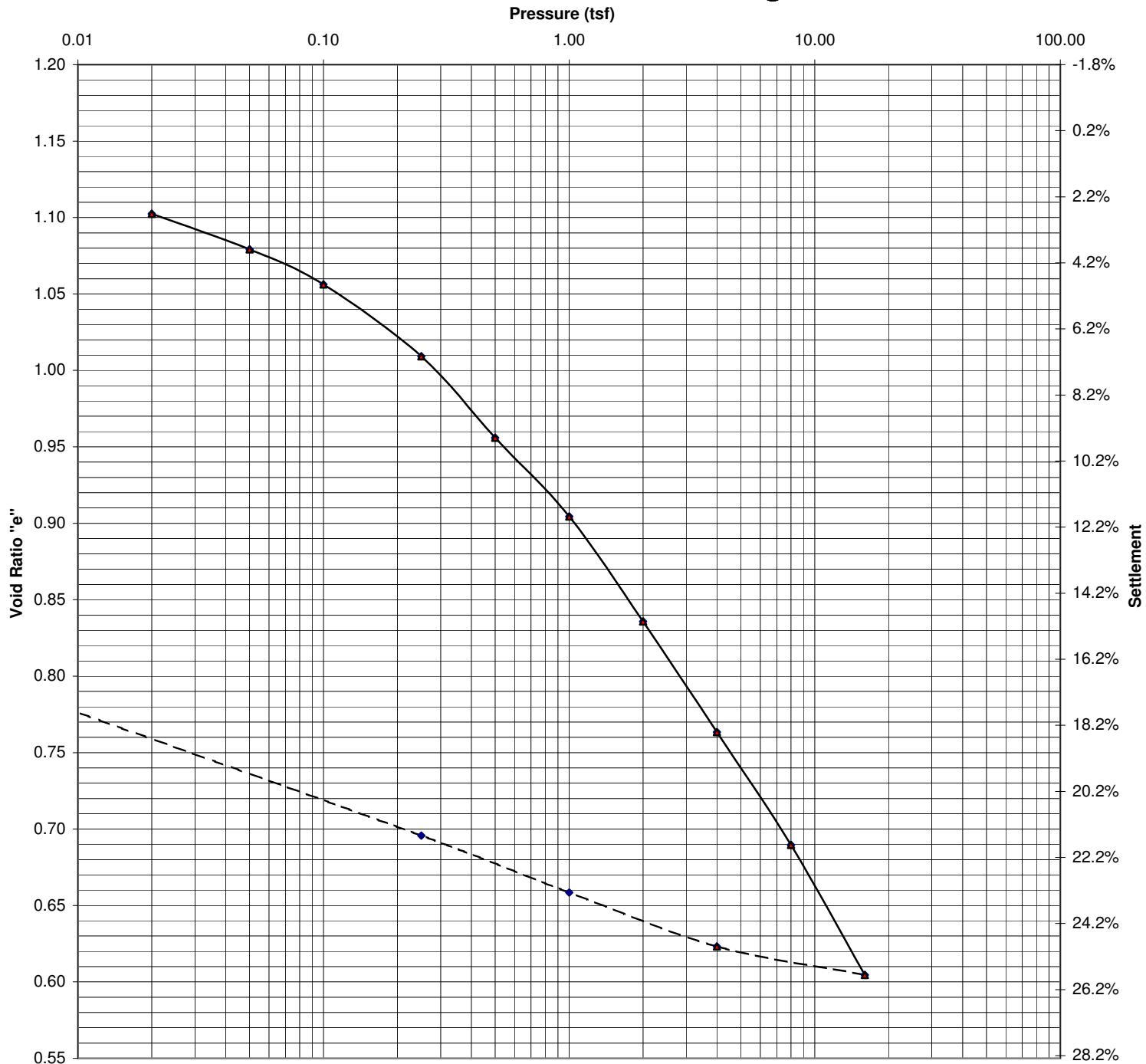
Job #: 8076

2401 W 66th Street

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TESTING, INC.**

Richfield, Minnesota 55423-2031

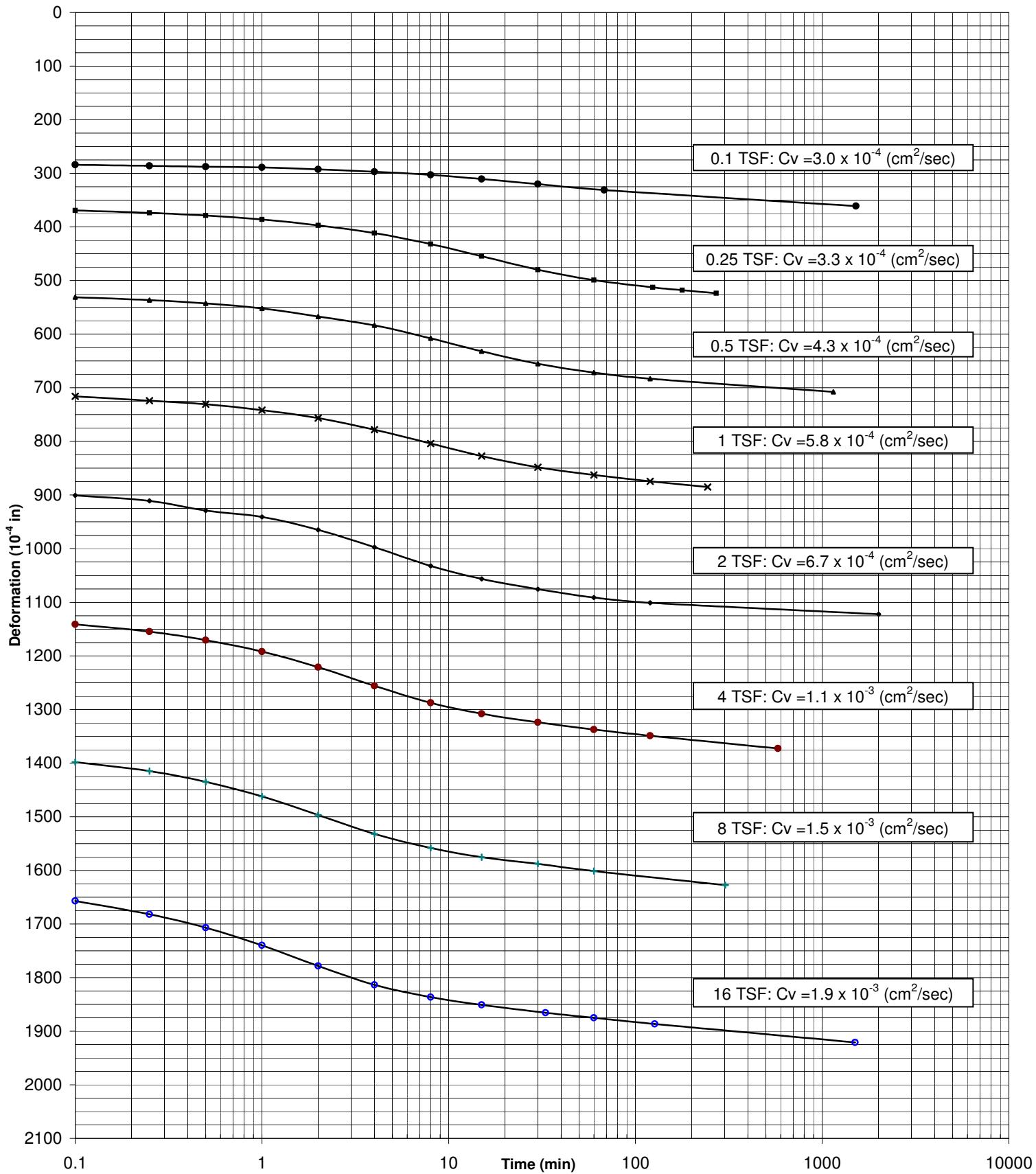
Void Ratio and % Settlement vs. Log of Pressure



Project: Hardin County				Date: 10/3/11
Sample #:	Boring #: T-51	Depth ft: 20-22	Job #: 8076	
Soil Type: Lean Clay (CL)				
Initial W/C (%): 42.0	Dry Density (pcf): 80.0	LL: 42.0	PL: 19.3	PI: 22.7 Gs: 2.77 (Assumed)
Organic Content (%):	Initial Height (in.): 0.746	Diameter (in.): 2.506	$e_0 =$	1.161
Preconsolidation Pressure (Pc):	0.42 tsf	Compression Index (Cc):	0.26	Recompression Index (Cr): ≈ 0.05
Remarks:				

2401 W 66th Street

Consolidation Log of Time Curves



Project: Hardin County

Date: 10/3/11

Sample #:

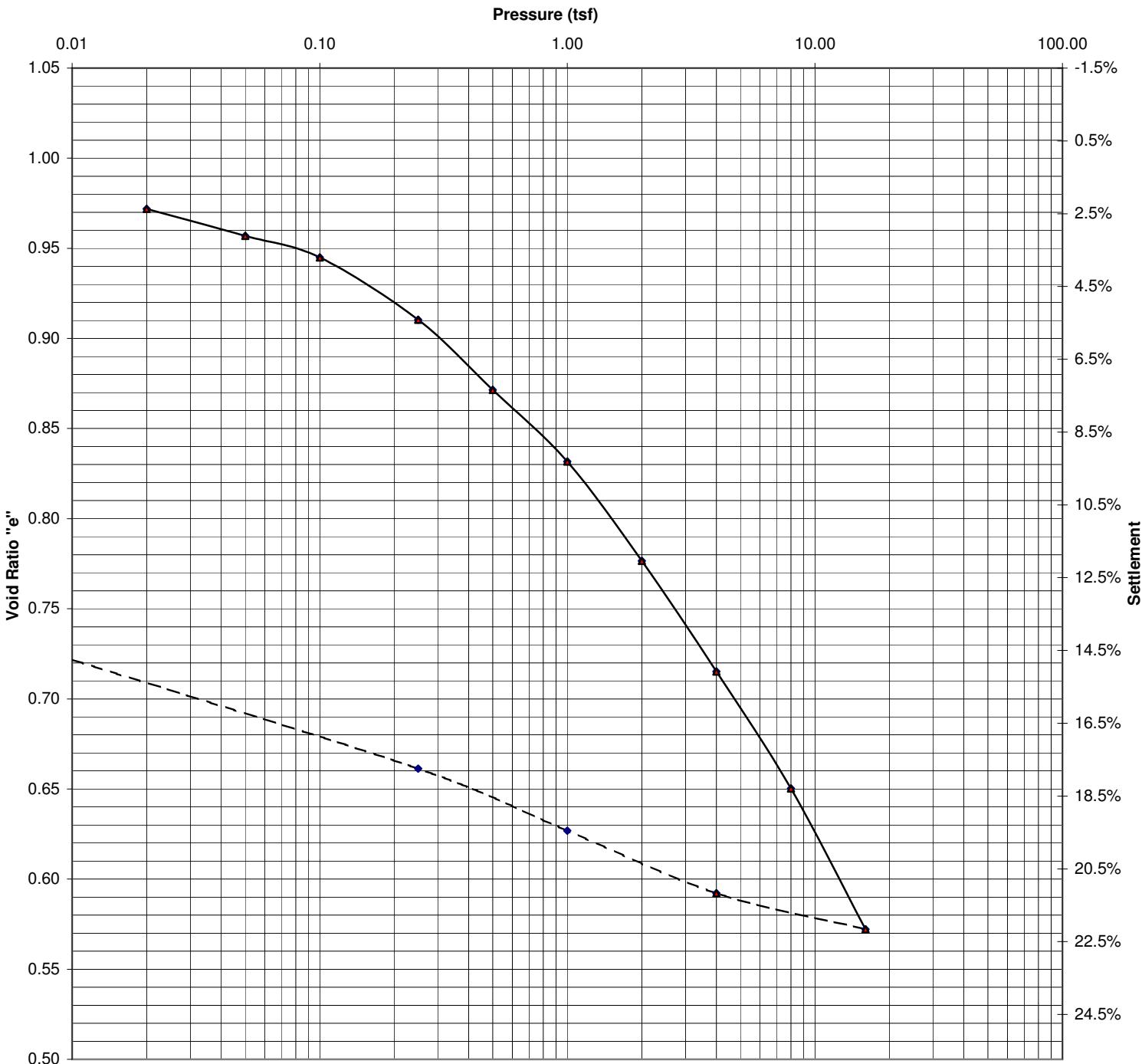
Boring #: T-51

Depth ft: 20-22

Job #: 8076

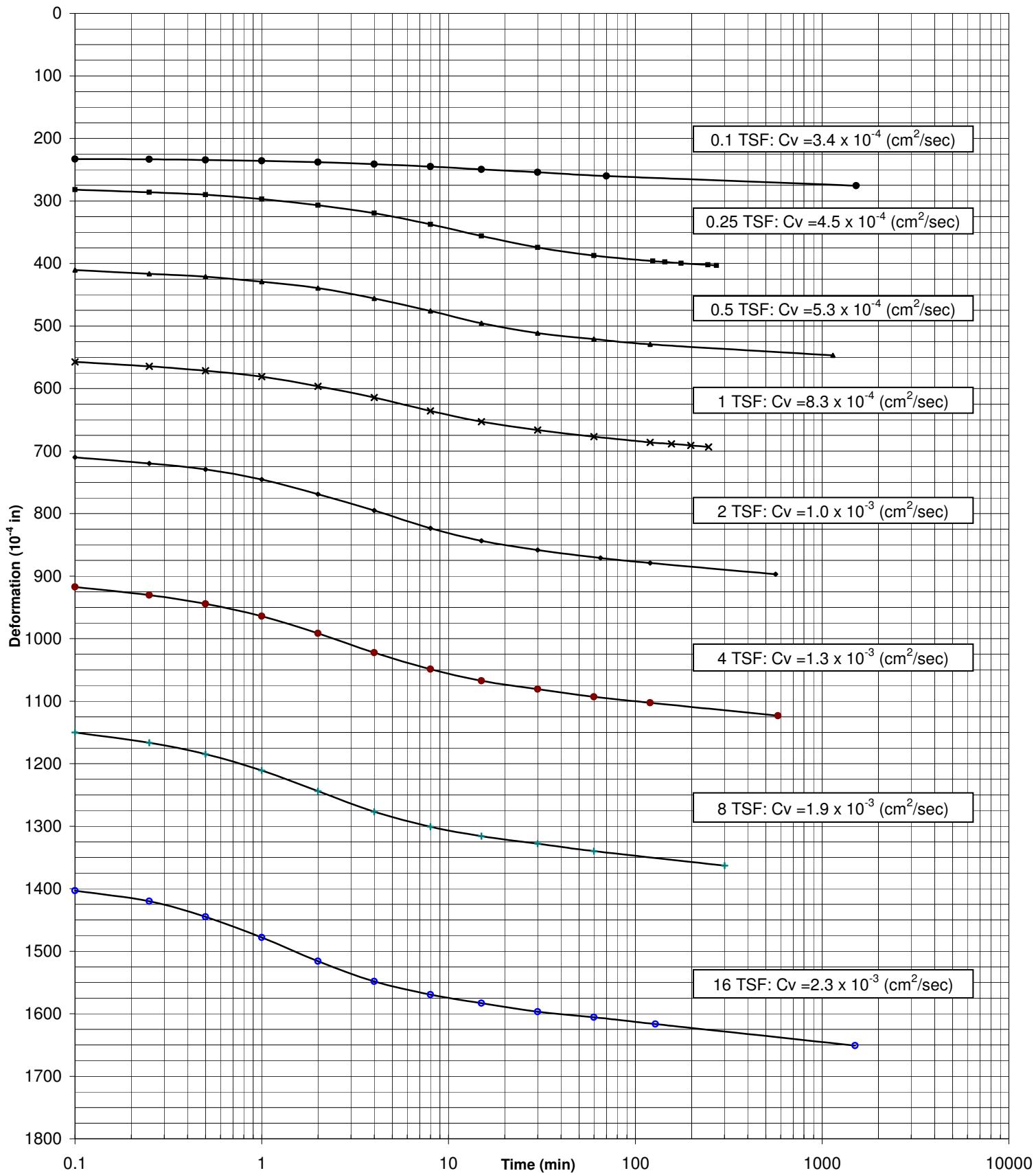
2401 W 66th Street

Void Ratio and % Settlement vs. Log of Pressure



Project: Hardin County				Date: 10/3/11
Sample #:	Boring #: T-66	Depth ft: 12-14		Job #: 8076
Soil Type: Lean Clay w/a trace of organic material (CL)				
Initial W/C (%): 37.0	Dry Density (pcf): 85.3	LL: 38.4	PL: 20.1	PI: 18.4 Gs: 2.76 (Assumed)
Organic Content (%):	Initial Height (in.): 0.745	Diameter (in.): 2.503	$e_0 =$	1.020
Preconsolidation Pressure (Pc):	0.59 tsf	Compression Index (Cc):	0.24	Recompression Index (Cr): ≤ 0.04
Remarks:				

Consolidation Log of Time Curves



Project: Hardin County

Date: 10/3/11

Sample #:

Boring #: T-66

Depth ft: 12-14

Job #: 8076

2401 W 66th Street

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ENGINEERING
TESTING, INC.**

Richfield, Minnesota 55423-2031

Appendix F

Electrical Resistivity Testing Report



Barr Engineering Company
4700 West 77th Street • Minneapolis, MN 55435-4803
Phone: 952-832-2600 • Fax: 952-832-2601 • www.barr.com An EEO Employer

Minneapolis, MN • Hibbing, MN • Duluth, MN • Ann Arbor, MI • Jefferson City, MO • Bismarck, ND

November 10, 2011

Mr. Joseph Brisebois
Invenergy LLC.
One S. Wacker Drive,
Suite 1900
Chicago, IL 60606

**Re: Soil Electrical Resistivity Testing
 Hardin County Wind Project
 Hardin County, Ohio**

Dear Mr. Brisebois,

Barr Engineering Company (Barr) collected soil resistivity measurements at the Hardin County Wind Project site from August 2 to August 10, 2011. This letter presents the methods and results.

Methods

A total of 5 electrical resistivity tests were completed by Barr personnel. Tests were conducted at the proposed substation and at twelve (12) turbine locations. The specific locations of the tests were selected by Barr to provide information at the proposed substation and for spatial coverage across the project site.

Invenergy, LLC. (Invenergy) provided GPS coordinates of the investigation locations. The test sites were located based on the provided coordinates with a hand-held GPS unit. The test locations are indicated in Figure 1, which includes the most recent site layout provided by Invenergy. Coordinates of each test location and other pertinent information can be found in Table 1.

Table 1: Testing Conditions and Coordinates

Resistivity Testing Conditions			Coordinates [UTM, NAD83]	
Location ID	Sounding Number	Ambient Air Temperature (°F)	Easting	Northing
T-02	1	80	260246	4509134
T-14	10	74	262825	4508706
T-35	11	74	260246	4506091
T-39	8	85	263844	4507759
T-49	7	85	263661	4504602
T-62	6	90	264596	4502930
T-66	4	90	262764	4501392
T-72	3	80	262202	4500169
T-82	13	73	266102	4506509
T-88	12	74	266792	4508520
T-99	5	75	265425	4496681
T-117	9	75	270579	4508384
SS-2	2	80	263787	4501741

Barr conducted the work in accordance with ASTM method G57-06 “Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method” (equivalent to IEEE Std. 81).

A single resistivity array orientation was utilized and five resistivity measurements in the array orientation were obtained. Each measurement corresponded to one of five electrode (“a”) spacings: 2, 5, 10, 20, and 40 feet.

The equipment used to collect the data consisted of a resistivity meter, four metal electrodes and connecting wire. A Mini-Res Ultra resistivity meter manufactured by L & R Instruments, Inc. was used to collect the data. The resistivity meter read in resistance (Ω) directly, and did not require the conversion of electrical potential (V) and inductance (I) to calculate resistance (V/I in Ω). Before and after each array was completed, the resistivity meter was connected to a resistor of known resistance, and the resulting values were compared to the known resistance value for quality assurance and quality control purposes. The meter was properly calibrated for all test locations and no instrument adjustments had to be made.

Co-linear arrays of four electrodes were placed in the ground for each measurement. Electrical current was input to the ground through the two outer electrodes of the array. The voltage drop produced by the resulting electrical field was measured across the two inner electrodes. The “a” spacing was increased with each measurement, expanding the array about a common center. Increasing the electrode separation increases the depth of investigation, and indicates vertical variation in resistivity.

In order to check the accuracy of the single resistivity array, a perpendicular array was set up at each test location for all electrode spacings.

Apparent resistivity (ρ_a) was calculated for each measurement and corresponding electrode spacing (a) using the resistance measurement (Ω) and the geometric factor (K) as follows:

$$\rho_a = K(V/I) \quad \text{where } K = 2\pi a$$

All field results and calculated values are presented in the attachments.

Results and Discussion

Apparent resistivity measurements for all 13 locations at the site ranged from 1,075 to 13,608 ohm centimeters (Ωcm). The average apparent resistivity for the entire data set is 3,009 Ωcm .

Soil resistivity variations are likely associated with differences in soil type, layer thicknesses and degree of water saturation in the near surface soils. Higher moisture contents and higher clay contents generally reduce the electrical resistivity of a soil.

The resistivity measured across the site was generally between 1,400 and 5,000 Ωcm at all of the a-spacings. A noted anomaly was observed at turbine sites 2, 14, and 35 where the apparent resistivity at the 40-foot a-spacings ranged from 4,700 to 13,200 Ωcm . These test results likely reflect the shallow bedrock encountered at these sites.

Table 2: Apparent Resistivity versus Electrode Spacing

Electrode Spacing (Feet)	Apparent Resistivity, $\Omega\text{-cm}$		
	Range	Mean	Standard Deviation
2	5819.6 - 1075.4	2668.40	1216.49
5	3961.5 - 1366.8	2227.38	783.17
10	4388.7 - 1310.3	2443.14	1025.37
20	7570.5 - 1402.2	3145.73	1573.78
40	13608.5 - 1823.7	4562.39	2907.39

Thank you for the opportunity to provide this service. Please call me at 952-832-2797 with questions or requests for additional information.

Sincerely,

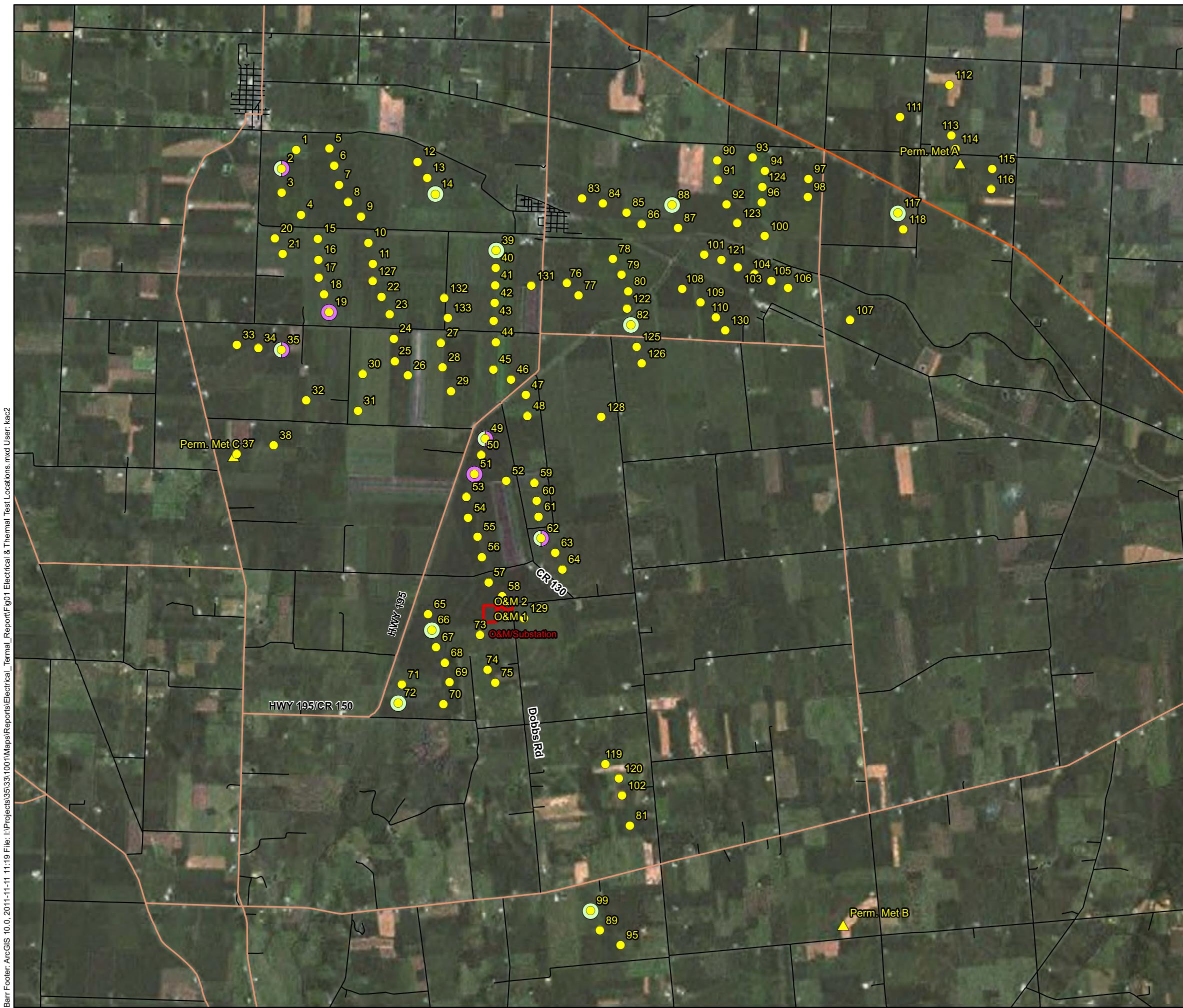


Bill Kussmann

WWK
Attachment

Attachments:

Figure 1: Thermal and Electrical Resistivity Test locations
Electrical Resistivity Test Results



WENNER SOUNDING

PROJECT: Hardin County Wind ProjectSounding Number 1
Observer WWK
Location Turbine 02Date 8/2/2011

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	5.29	12.566	66.43	2025.18
5	2.05	31.416	64.25	1958.71
10	1.64	62.832	102.73	3132.02
20	1.14	125.664	142.75	4352.27
40	0.89	251.328	223.18	6804.25
E/W Orientation				
2	4.41	12.566	55.44	1690.33
5	2.73	31.416	85.80	2615.77
10	1.62	62.832	101.79	3103.29
20	1.04	125.664	130.69	3984.47
40	0.84	251.328	210.61	6421.12

Cultural Features

Flat

Ground Cover

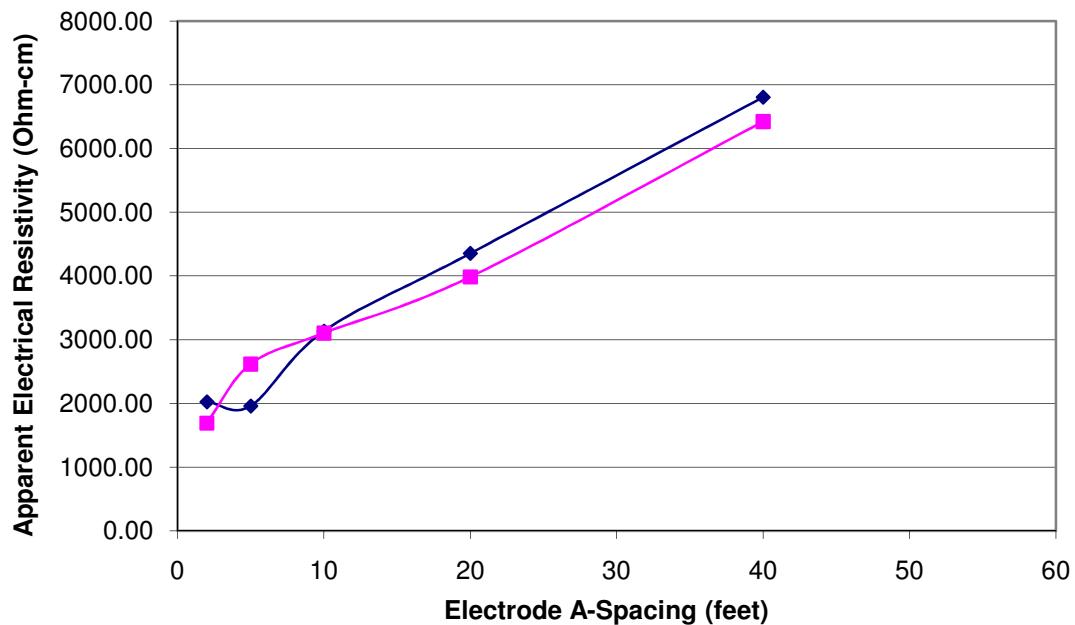
Weeds/Dirt

Ambient Air Temp. (°F)

80

Line Bearing

NS/EW

Turbine Location 02

WENNER SOUNDING

 PROJECT: Hardin County Wind Project

Sounding Number

10

 Date 8/10/2011

Observer WWK

Location

Turbine 14

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	4.37	12.566	54.93	1674.63
5	1.64	31.416	51.37	1566.01
10	0.86	62.832	53.72	1637.85
20	0.66	125.664	82.56	2517.11
40	0.62	251.328	154.57	4712.40
E/W Orientation				
2	4.45	12.566	55.96	1706.04
5	1.52	31.416	47.75	1455.86
10	0.89	62.832	55.67	1697.23
20	0.68	125.664	85.07	2593.74
40	0.61	251.328	152.56	4651.10

Cultural Features

Flat

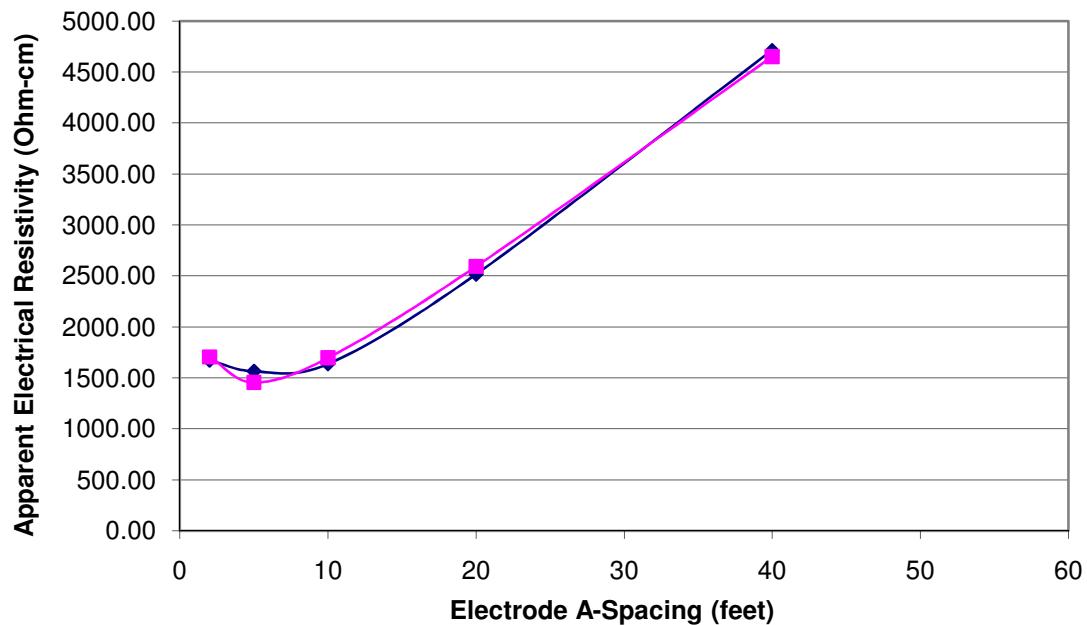
Ground Cover

Open Field

Ambient Air Temp. (°F)

74

Line Bearing

NS/EW
Turbine Location 14


WENNER SOUNDING

PROJECT: Hardin County Wind Project

Sounding Number

11Date 8/10/2011

Observer WWK

Location

Turbine 35

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	6.38	12.566	80.14	2443.17
5	2.87	31.416	90.07	2746.03
10	2.22	62.832	139.30	4246.91
20	1.98	125.664	248.31	7570.49
40	1.78	251.328	446.36	13608.49
E/W Orientation				
2	6.44	12.566	80.90	2466.54
5	2.91	31.416	91.45	2788.17
10	2.15	62.832	135.03	4116.65
20	1.78	125.664	223.05	6800.41
40	1.72	251.328	433.29	13210.04

Cultural Features

Flat

Ground Cover

Corn

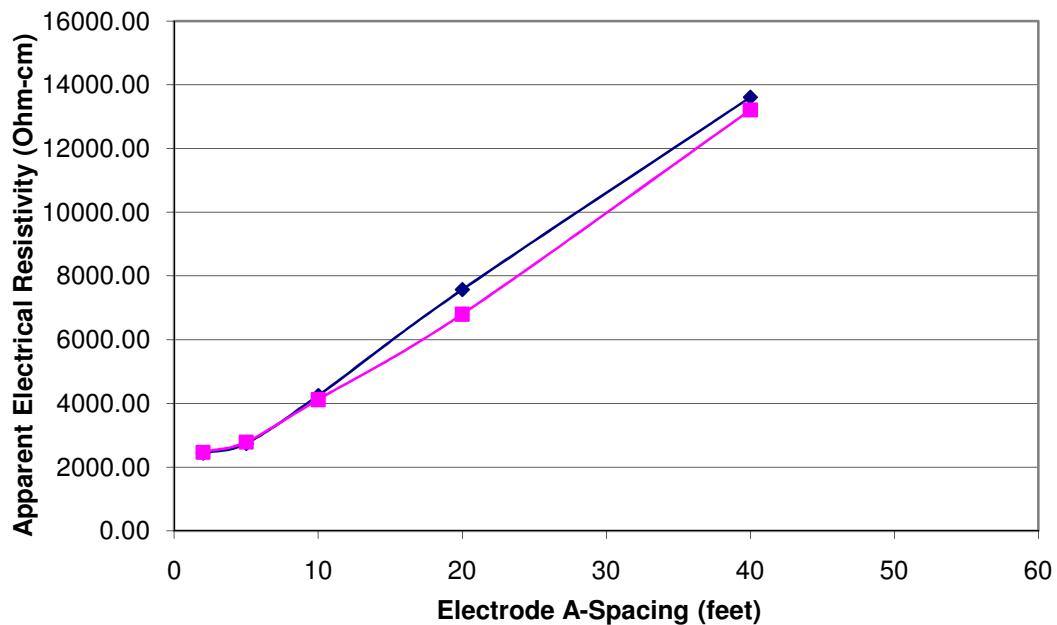
Ambient Air Temp. (°F)

74

Line Bearing

NS/EW

Turbine Location 35



WENNER SOUNDING

PROJECT: Hardin County Wind ProjectSounding Number 8
Observer WWK
Location Turbine 39Date 8/5/2011

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	5.61	12.566	70.51	2149.70
5	2.44	31.416	76.72	2338.96
10	1.06	62.832	66.66	2032.46
20	0.69	125.664	87.21	2658.87
40	0.56	251.328	141.25	4306.29
E/W Orientation				
2	4.92	12.566	61.81	1884.58
5	2.94	31.416	92.33	2814.99
10	1.06	62.832	66.79	2036.29
20	0.72	125.664	90.98	2773.80
40	0.59	251.328	147.28	4490.19

Cultural Features

Flat

Ground Cover

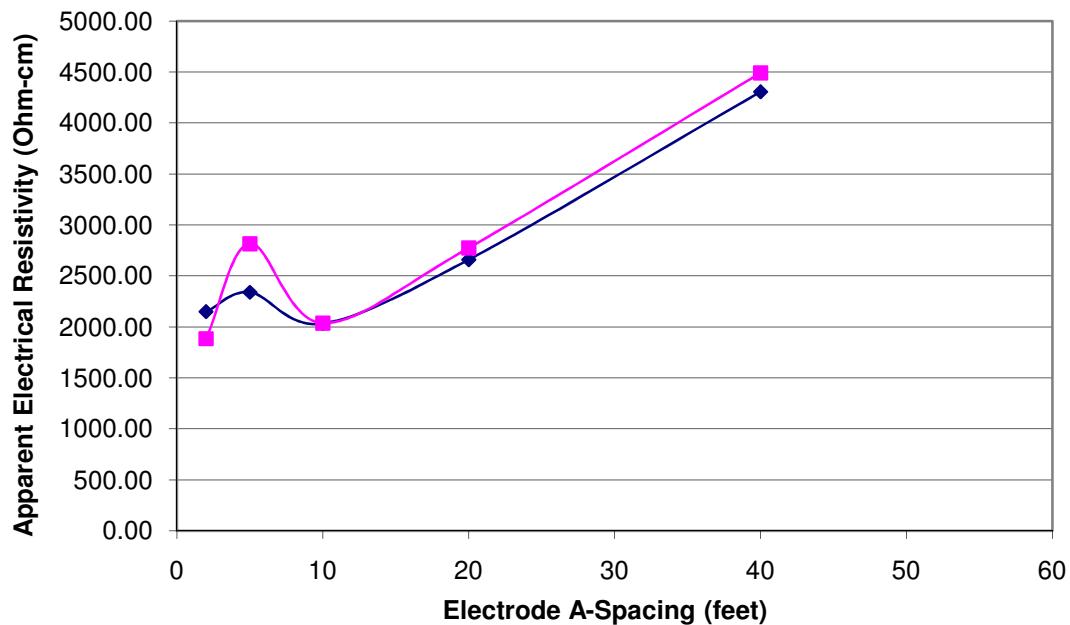
Corn

Ambient Air Temp. (°F)

85

Line Bearing

NS/EW

Turbine Location 39

WENNER SOUNDING

PROJECT: Hardin County Wind ProjectSounding Number 7
Observer WWK
Location Turbine 49Date 8/4/2011

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	5.37	12.566	67.51	2058.13
5	1.72	31.416	54.16	1651.26
10	0.68	62.832	42.98	1310.28
20	0.47	125.664	58.56	1785.35
40	0.31	251.328	78.16	2383.02
E/W Orientation				
2	7.95	12.566	99.88	3045.05
5	1.74	31.416	54.70	1667.54
10	0.75	62.832	47.12	1436.71
20	0.46	125.664	57.81	1762.36
40	0.29	251.328	73.14	2229.77

Cultural Features

Flat

Ground Cover

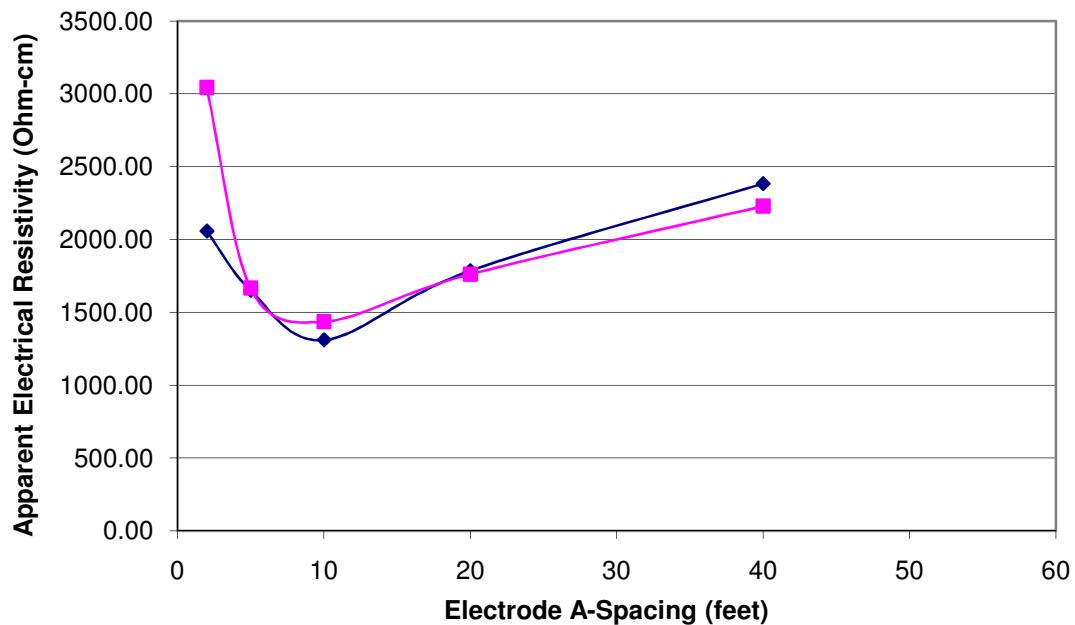
Carrots

Ambient Air Temp. (°F)

85

Line Bearing

NS/EW

Turbine Location 49

WENNER SOUNDING

PROJECT: Hardin County Wind ProjectSounding Number 6
Observer WWK
Location Turbine 62Date 8/4/2011

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	7.01	12.566	88.12	2686.45
5	3.75	31.416	117.65	3586.98
10	2.27	62.832	142.44	4342.69
20	1.37	125.664	172.03	5244.94
40	0.68	251.328	170.40	5195.13
E/W Orientation				
2	9.43	12.566	118.51	3613.22
5	4.05	31.416	127.14	3876.24
10	2.29	62.832	143.95	4388.66
20	1.28	125.664	160.35	4888.64
40	0.72	251.328	181.21	5524.62

Cultural Features

Flat

Ground Cover

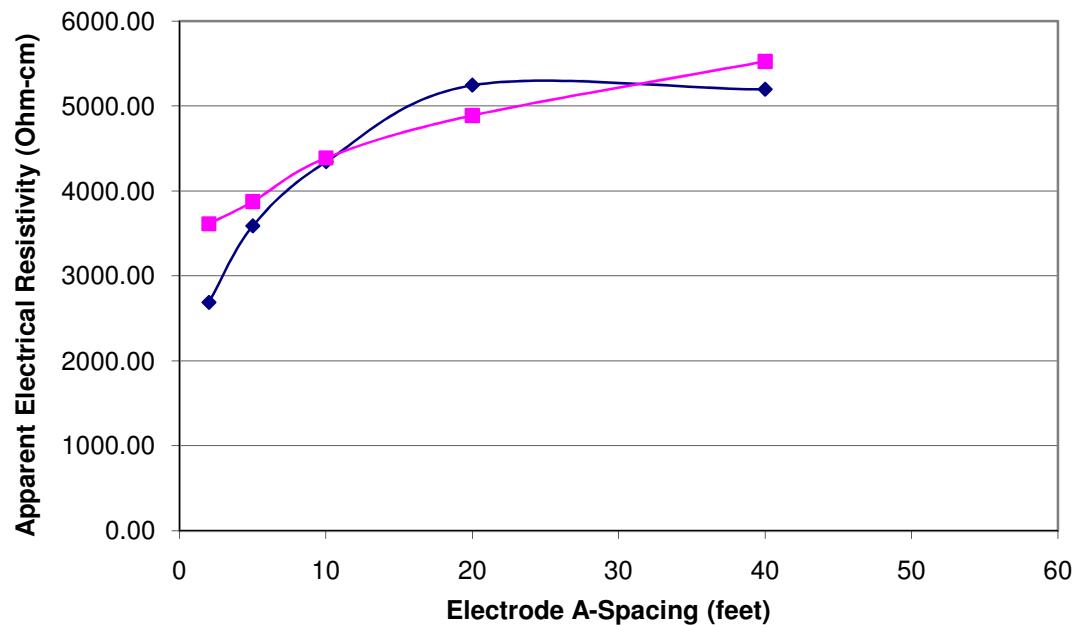
Soybeans

Ambient Air Temp. (°F)

90

Line Bearing

NS/EW

Turbine Location 62

WENNER SOUNDING

PROJECT: Hardin County Wind Project

Sounding Number

4Date 8/3/2011

Observer WWK

Location

Turbine 66

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	13.96	12.566	175.36	5346.47
5	1.50	31.416	46.97	1431.92
10	0.84	62.832	52.97	1614.86
20	0.55	125.664	68.99	2103.34
40	0.35	251.328	87.21	2658.87
E/W Orientation				
2	9.50	12.566	119.39	3640.04
5	1.71	31.416	53.63	1634.97
10	0.84	62.832	52.84	1611.03
20	0.53	125.664	65.97	2011.39
40	0.34	251.328	85.20	2597.57

Cultural Features

Flat

Ground Cover

Corn

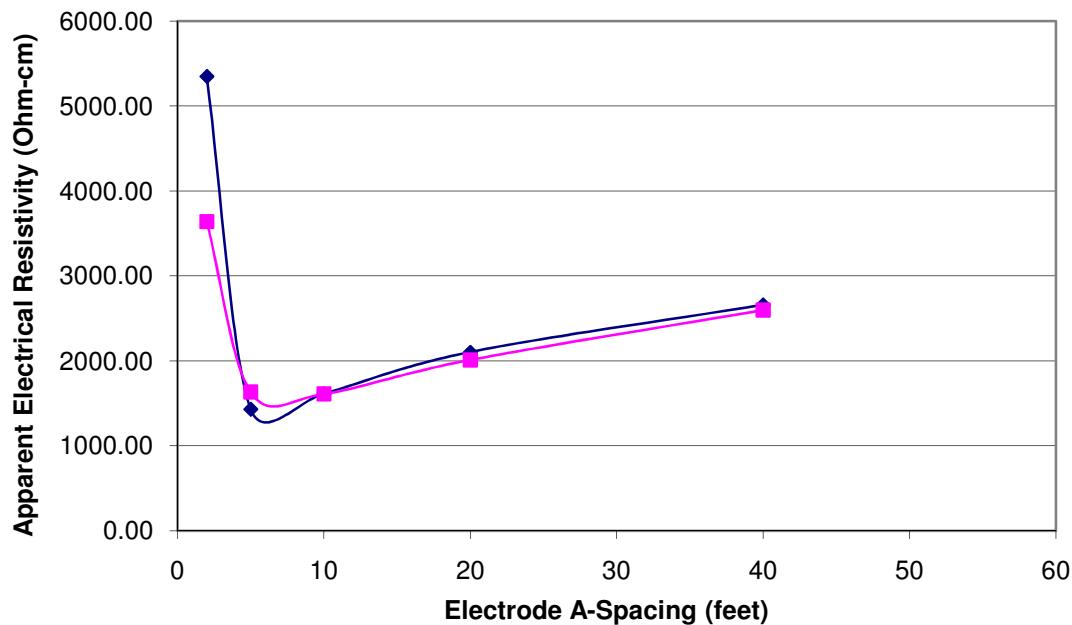
Ambient Air Temp. (°F)

90

Line Bearing

NS/EW

Turbine Location 66



WENNER SOUNDING

PROJECT: Hardin County Wind Project

Sounding Number

3Date 8/3/2011

Observer WWK

Location

Turbine 72

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	5.55	12.566	69.76	2126.71
5	1.52	31.416	47.63	1452.03
10	0.86	62.832	54.22	1653.17
20	0.57	125.664	71.63	2183.80
40	0.35	251.328	87.71	2674.19
E/W Orientation				
2	5.39	12.566	67.67	2063.11
5	1.56	31.416	48.88	1490.34
10	0.88	62.832	54.98	1676.16
20	0.56	125.664	70.37	2145.48
40	0.36	251.328	90.48	2758.48

Cultural Features

Flat

Ground Cover

Carrots

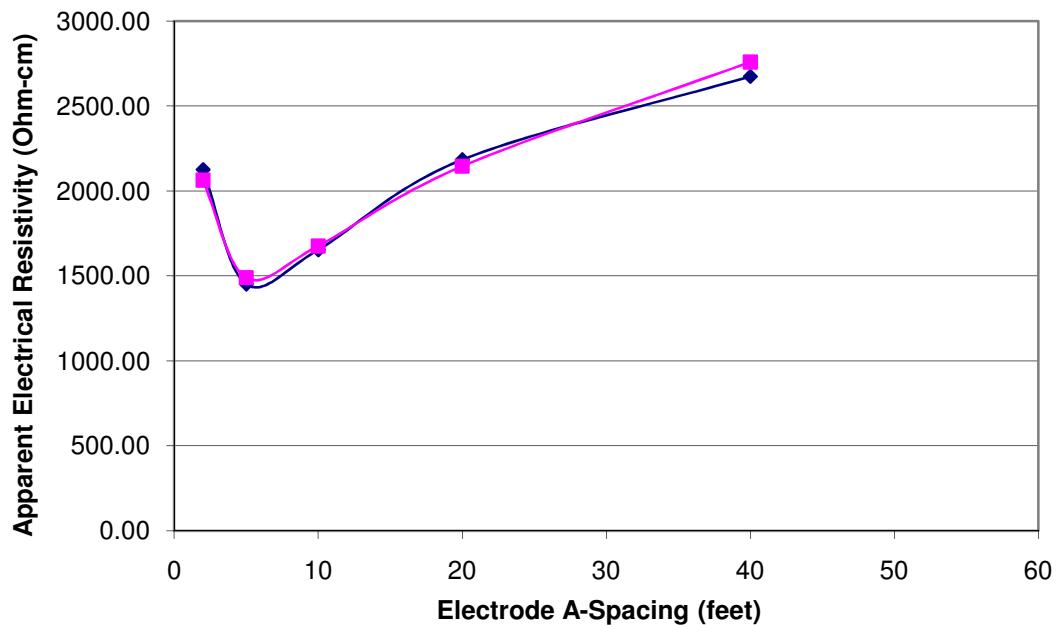
Ambient Air Temp. (°F)

80

Line Bearing

NS/EW

Turbine Location 72



WENNER SOUNDING

PROJECT: Hardin County Wind Project

Sounding Number

13Date 8/10/2011

Observer WWK

Location

Turbine 82

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	4.95	12.566	62.17	1895.30
5	1.74	31.416	54.54	1662.75
10	0.79	62.832	49.32	1503.75
20	0.51	125.664	63.71	1942.43
40	0.47	251.328	116.87	3563.03
E/W Orientation				
2	5.70	12.566	71.63	2183.80
5	1.74	31.416	54.73	1668.50
10	0.78	62.832	49.26	1501.84
20	0.52	125.664	65.85	2007.56
40	0.47	251.328	118.63	3616.67

Cultural Features

Flat

Ground Cover

Soybeans

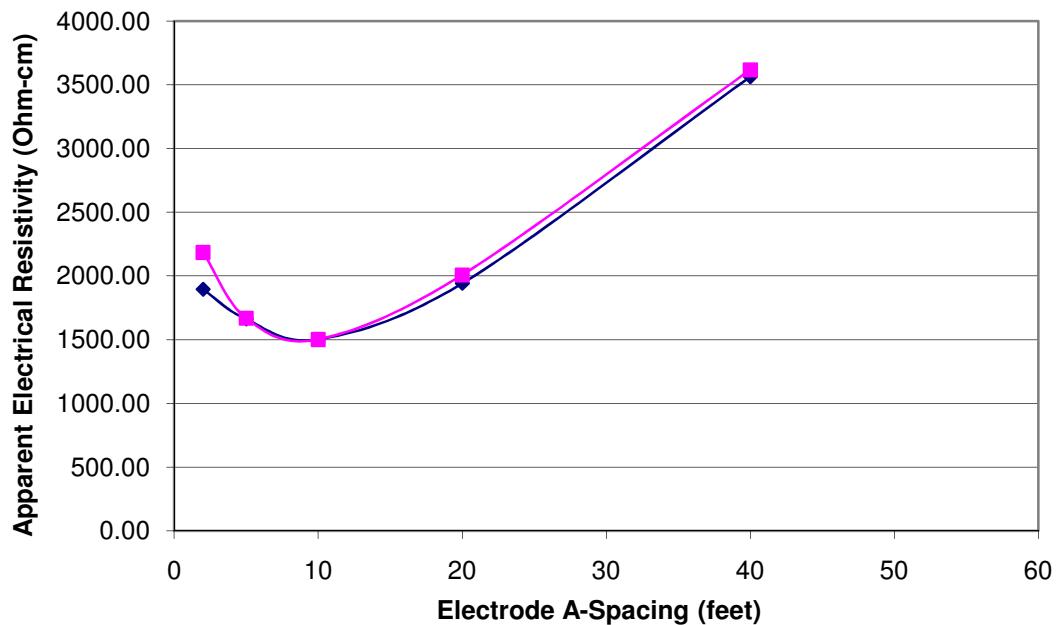
Ambient Air Temp. (°F)

73

Line Bearing

NS/EW

Turbine Location 82



WENNER SOUNDING

PROJECT: Hardin County Wind Project

Sounding Number

12Date 8/10/2011

Observer WWK

Location

Turbine 88

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	3.41	12.566	42.83	1305.68
5	1.54	31.416	48.22	1470.23
10	0.73	62.832	45.55	1388.82
20	0.37	125.664	45.99	1402.23
40	0.24	251.328	59.82	1823.66
E/W Orientation				
2	2.81	12.566	35.27	1075.42
5	1.43	31.416	44.83	1366.79
10	0.76	62.832	47.88	1459.69
20	0.41	125.664	51.90	1582.29
40	0.24	251.328	60.32	1838.99

Cultural Features

Flat

Ground Cover

Corn

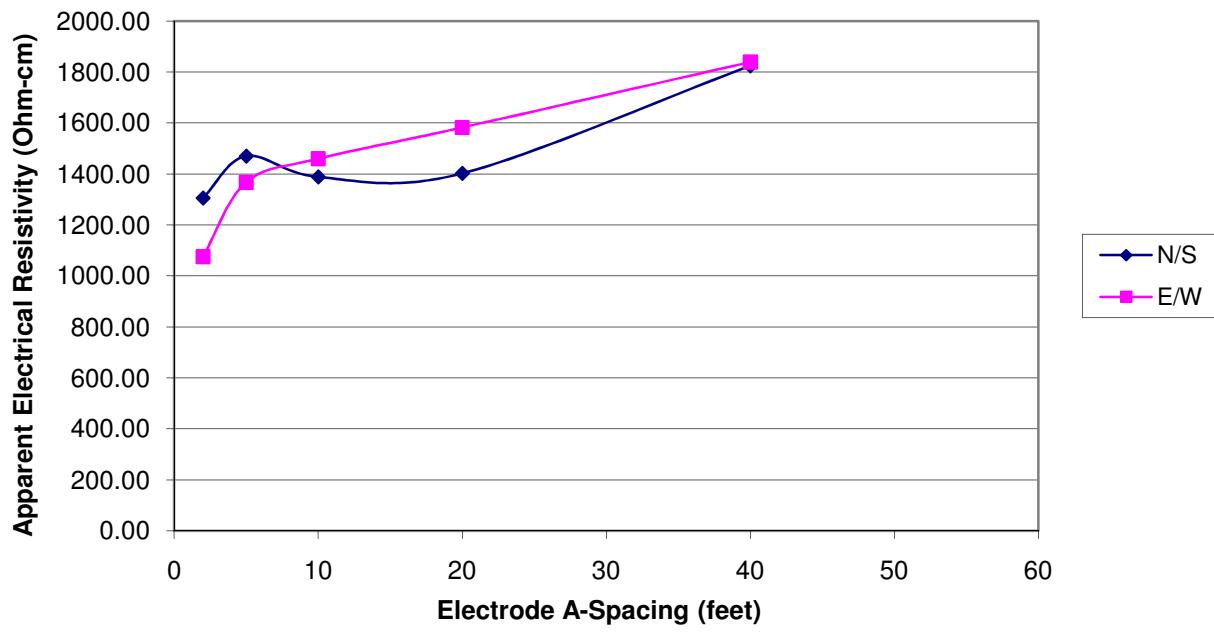
Ambient Air Temp. (°F)

74

Line Bearing

NS/EW

Turbine Location 88



WENNER SOUNDING

PROJECT: Hardin County Wind ProjectSounding Number 5
Observer WWK
Location Turbine 99Date 8/4/2011

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	9.76	12.566	122.62	3738.50
5	2.78	31.416	87.27	2660.78
10	1.66	62.832	104.49	3185.66
20	1.02	125.664	127.80	3896.35
40	0.58	251.328	146.27	4459.54
E/W Orientation				
2	9.51	12.566	119.48	3642.72
5	2.59	31.416	81.24	2476.88
10	1.66	62.832	104.05	3172.25
20	1.02	125.664	128.68	3923.17
40	0.57	251.328	143.76	4382.92

Cultural Features

Flat

Ground Cover

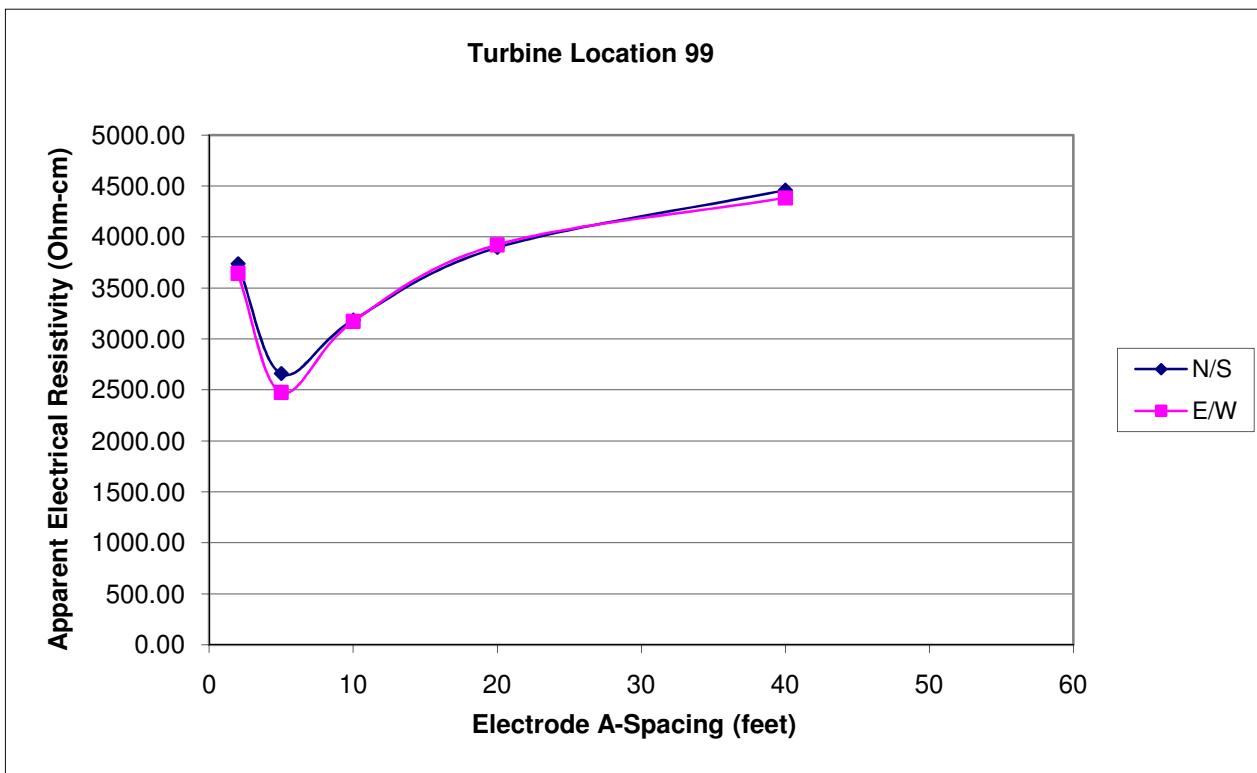
Soybeans

Ambient Air Temp. (°F)

75

Line Bearing

NS/EW



WENNER SOUNDING

PROJECT: Hardin County Wind Project

Sounding Number 9
 Observer WWK
 Location Turbine 117

Date 8/9/2011

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	5.37	12.566	67.47	2056.98
5	2.40	31.416	75.52	2302.56
10	1.46	62.832	91.55	2791.04
20	0.83	125.664	104.68	3191.41
40	0.52	251.328	131.19	3999.79
E/W Orientation				
2	5.75	12.566	72.23	2202.18
5	2.37	31.416	74.55	2272.87
10	1.44	62.832	90.73	2766.14
20	0.87	125.664	109.33	3333.16
40	0.51	251.328	128.68	3923.17

Cultural Features

Flat

Ground Cover

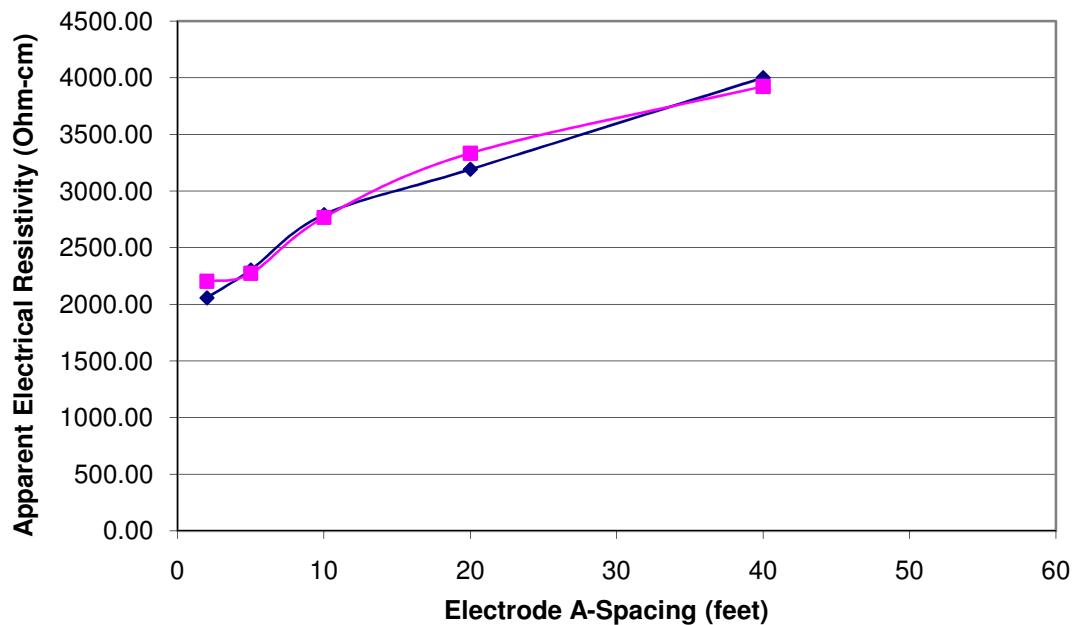
Soybeans

Ambient Air Temp. (°F)

75

Line Bearing

NS/EW

Turbine Location 117

WENNER SOUNDING

PROJECT: Hardin County Wind ProjectSounding Number 2
Observer WWK
Location SS-2Date 8/2/2011

Electrode Spacing "a" feet	Resistance V/I Ohms	Geometric Factor $K=2\pi a$ feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-feet	Apparent Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation				
2	12.63	12.566	158.71	4838.83
5	3.13	31.416	98.18	2993.14
10	1.48	62.832	93.18	2840.85
20	0.60	125.664	75.52	2302.56
40	0.44	251.328	111.34	3394.46
E/W Orientation				
2	15.19	12.566	190.88	5819.62
5	4.14	31.416	129.94	3961.48
10	1.50	62.832	94.31	2875.33
20	0.74	125.664	92.87	2831.27
40	0.44	251.328	111.34	3394.46

Cultural Features

Flat

Ground Cover

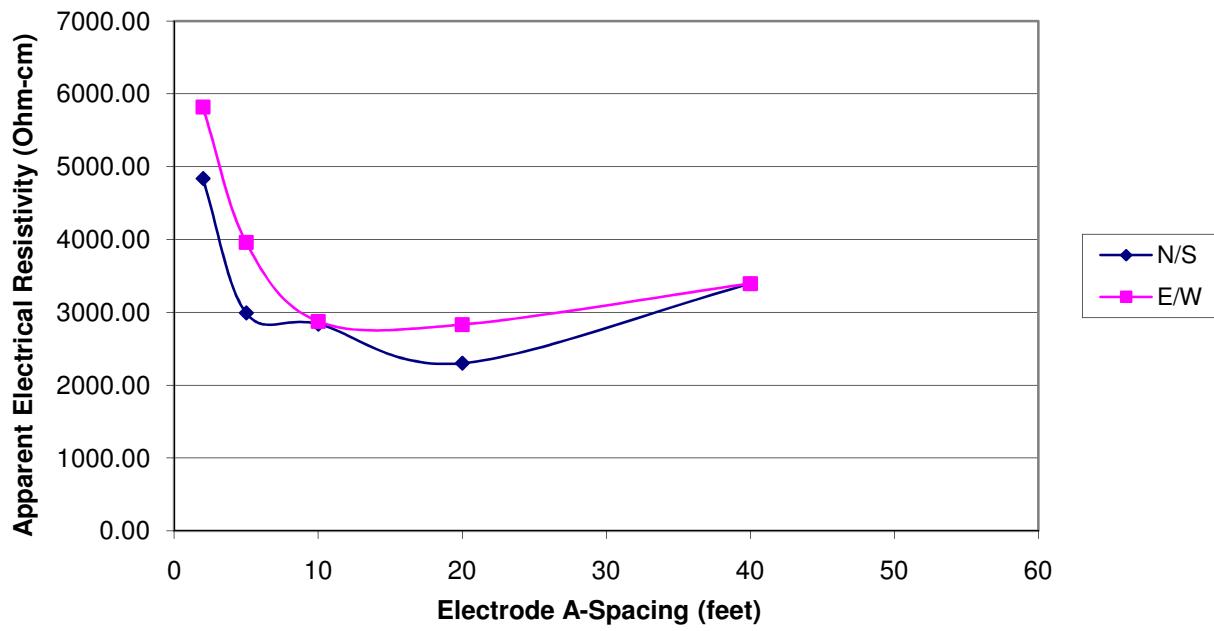
Soybeans

Ambient Air Temp. (°F)

80

Line Bearing

NS/EW

Turbine Location 117

Electrical Resistivity Test Results
Summary Table
Hardin County Wind Project
Hardin County, Ohio
35/33-1001

'a' Spacing (ft)	Turbine 2	Turbine 14	Turbine 35	Turbine 39	Turbine 49	Turbine 62	Turbine 66	Turbine 72	Turbine 82	Turbine 88	Turbine 99	Turbine 117	Substation SS-2	Range (NS & EW)	Mean (NS & EW)	St Dev (NS & EW)	
	Resistivity $\text{ra}=\text{K(V/I)}$ Ohm-cm																
E/W Orientation	2	2025.2	1674.6	2443.2	2149.7	2058.1	2686.5	5346.5	2126.7	1895.3	1305.7	3738.5	2057.0	4838.8	5346.5	1305.7	5819.6 - 1075.4
	5	1958.7	1566.0	2746.0	2339.0	1651.3	3587.0	1431.9	1452.0	1662.7	1470.2	2660.8	2302.6	2993.1	3587.0	1431.9	3961.5 - 1366.8
	10	3132.0	1637.8	4246.9	2032.5	1310.3	4342.7	1614.9	1653.2	1503.8	1388.8	3185.7	2791.0	2840.8	4342.7	1310.3	4388.7 - 1310.3
	20	4352.3	2517.1	7570.5	2658.9	1785.3	5244.9	2103.3	2183.8	1942.4	1402.2	3896.4	3191.4	2302.6	7570.5	1402.2	7570.5 - 1402.2
	40	6804.2	4712.4	13608.5	4306.3	2383.0	5195.1	2658.9	2674.2	3563.0	1823.7	4459.5	3999.8	3394.5	13608.5	1823.7	13608.5 - 1823.7
Apparent Resistivity Average-Ohm-cm														3009.41			

Appendix G

Thermal Resistivity Testing Report



Barr Engineering Company
4700 West 77th Street • Minneapolis, MN 55435-4803
Phone: 952-832-2600 • Fax: 952-832-2601 • www.barr.com An EEO Employer
Minneapolis, MN • Hibbing, MN • Duluth, MN • Ann Arbor, MI • Jefferson City, MO • Bismarck, ND

November 10, 2011

Mr. Joseph Brisebois
Invenergy LLC.
One S. Wacker Drive,
Suite 1900
Chicago, IL 60606

Re: **Thermal Resistivity Testing**
 Hardin County Wind Project
 Hardin County, Ohio

Dear Mr. Brisebois,

This letter presents the soil thermal resistivity testing results. Barr Engineering Company (Barr) personnel collected soil samples at selected locations at the Settlers Trail Wind Project site in mid August, 2010. Thermal resistivity laboratory testing was completed on the samples in late September, 2010. The methods and results are summarized below.

Methods

A total of 10 soil samples were collected by Barr personnel during drilling by GEOCON Testing Services of Frankfort, Illinois, under the direction of Barr personnel. The samples were collected at proposed turbine locations and the proposed substation and for spatial coverage across the project site. These locations were selected by Barr to provide spatial coverage across the site.

Each sample was collected by hollow-stem augering to a depth of two feet below existing grade and then collecting a shelby tube sample from 3-5 feet. The samples were sealed in the field in order to preserve the in-situ moisture content. All samples were delivered to Soil Engineering Testing, Inc. (SET) of Richfield, Minnesota, for laboratory testing.

Invenergy, LLC. (Invenergy) provided GPS coordinates of the investigation locations provided GPS coordinates of the turbine locations, and a map of the proposed substation. The test sites were located based on the provided coordinates with a handheld GPS, and the provided map of the substation location. The test locations are indicated in Figure 1, which includes the most recent turbine locations. Coordinates of each test location and other pertinent information can be found in Table 1.

Table 1: Thermal Resistivity Sample Information

Turbine/Structure Number	Sample ID	Sample Depth (ft)	Coordinates [UTM, NAD83]	
			Northing (m)	Easting (m)
2	Shelby Tube	3.0-5.0	4509134	260246
19	Shelby Tube	3.0-5.0	4506725	261043
35	Shelby Tube	3.0-5.0	4506091	260246
49	Shelby Tube	3.0-5.0	4504602	263661
51	Shelby Tube	3.0-5.0	4504005	263477
62	Shelby Tube	3.0-5.0	4502930	264596
66	Shelby Tube	3.0-5.0	4501392	262764
72	Shelby Tube	3.0-5.0	4500169	262202
82	Shelby Tube	3.0-5.0	4506509	266102
88	Shelby Tube	3.0-5.0	4508520	266792
99	Shelby Tube	3.0-5.0	4496681	265425
117	Shelby Tube	3.0-5.0	4508384	270579
SS-2	Shelby Tube	3.0-5.0	4501741	263787

SET completed the testing in accordance with ASTM method D5334-08 "Standard Test Method for Determination of Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe Procedure." Laboratory tests included measurement of the soil's in-situ moisture content, standard Proctor density and optimum moisture content and thermal dryout characteristics, which is a function of moisture content. All of the samples were extruded from Shelby tube samples and directly into the testing apparatus.

Thermal dryout characteristics were measured using a laboratory type thermal needle held central and vertical in the base plate. Thermal resistivity measurements were conducted starting at the existing moisture content of the soil sample to the totally dry condition. At the end of each drying stage, samples were sealed and brought to thermal equilibrium with the ambient air to ensure uniform moisture re-distribution through the sample. Tests were conducted using a KD2 Thermal Property Analyzer. The instrument was calibrated prior to testing.

Results

The resulting laboratory soil thermal resistivity measurements presented in tabular form with full dryout curves are included in the attached Thermal Resistivity Report by SET.

Thank you for the opportunity to provide this service. Please call me at 952-832-2797 with questions or requests for additional information.

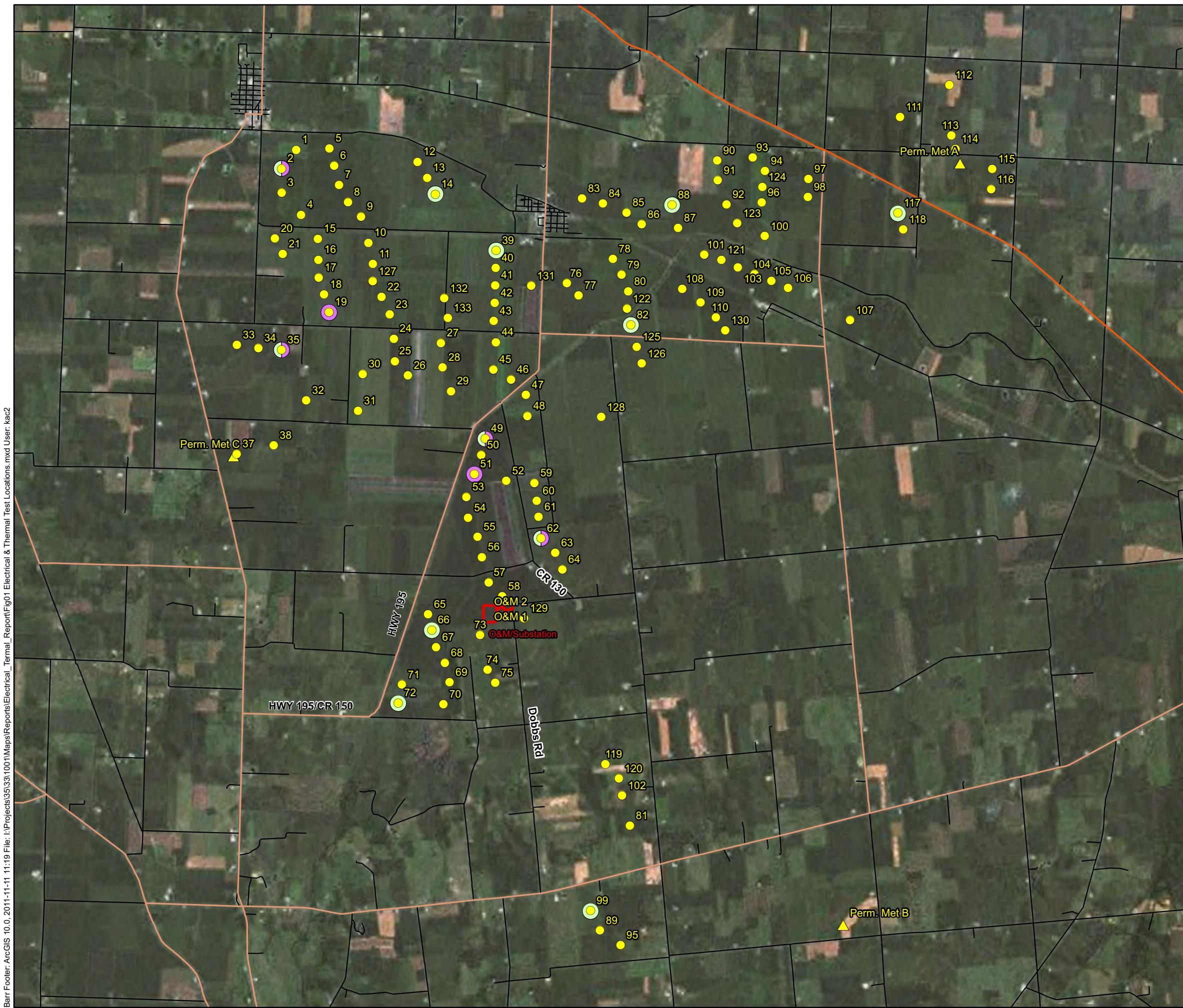
Sincerely,



Bill Kussmann, P.E.
Senior Geotechnical Engineer
Barr Engineering Co.

Attachments:

Figure 1: Thermal and Electrical Resistivity Test Locations
SET, Inc. Thermal Resistivity Test Results



Thermal Resistivity Report

ASTM D:5334

Project: **Hardin County**

Job #: **8076**

Client: **Barr Engineering Company**

Date: **9/21/11**

Boring	Specimen Condition	Depth	Type	Classification	Initial Conditions			Dry
					Dry Density (PCF)	WC (%)	Thermal Resistivity (°C-cm/W)	Thermal Resistivity (°C-cm/W)
SS-2	Undisturbed	3-5	TWT	Sandy Lean Clay (CL)	113.6	18.6%	51	114
T-2	Undisturbed	3-5	TWT	Lean Clay with Sand (CL)	109.3	19.1%	56	165
T-19	Undisturbed	3-5	TWT	Lean Clay (CL)	96.6	24.2%	69	174
T-35	Undisturbed	3-5	TWT	Lean Clay with Sand (CL)	106.7	20.8%	61	164
T-49	Undisturbed	3-5	TWT	Organic Clay (OL)	76.5	36.5%	88	279
T-51	Undisturbed	3-5	TWT	Organic Clay (OL)	81.6	39.4%	74	252
T-62	Undisturbed	3-5	TWT	Organic Clay (OH)	73.6	36.9%	121	623
				Samples extruded and selected specimens trimmed for undisturbed tests.				

2401 West 66th Street



Richfield, MN 55423

<http://www.soilengineeringtesting.com>

Thermal Resistivity Report

ASTM D:5334

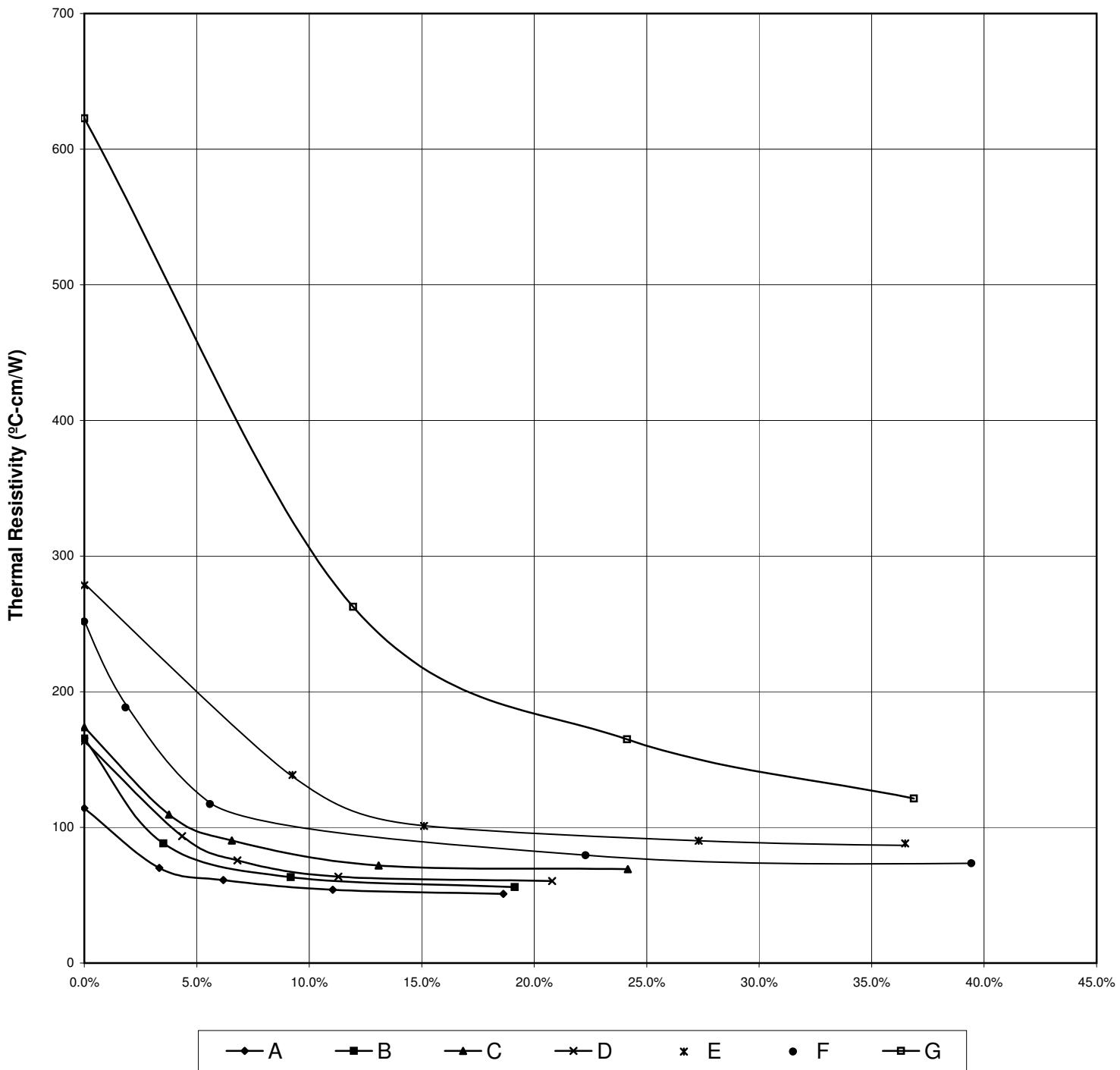
Project: _____ Client: _____ Hardin County Barr Engineering Company

Job: 8076 Date: 9/21/11

	Boring	Depth (ft)
Specimen A:	SS-2	3 - 5
Specimen B:	T-2	3 - 5
Specimen C:	T-19	3 - 5
Specimen D:	T-35	3 - 5
Specimen E:	T-49	3 - 5

	Boring	Depth (ft)
Specimen F:	T-51	3 - 5
Specimen G:	T-62	3 - 5

Thermal Dryout Curves (Resistivity vs. Water Content)



2401 West 66th Street

**OIL
ENGINEERING
TESTING, INC.**

Richfield, MN 55423

<http://www.soilengineeringtesting.com>

Thermal Resistivity Report

ASTM D:5334

Project: **Hardin County**

Job #: **8076**

Client: **Barr Engineering Company**

Date: **9/22/11**

Boring	Specimen Condition	Depth	Type	Classification	Initial Conditions			Dry
					Dry Density (PCF)	WC (%)	Thermal Resistivity (°C-cm/W)	Thermal Resistivity (°C-cm/W)
T-66	Undisturbed	3-5	TWT	Lean Clay with a little organic material (CL/OL)	78.3	41.3%	75	273
T-72	Undisturbed	3-5	TWT	Lean Clay with a trace of organic material (CL)	89.2	32.4%	68	184
T-82	Undisturbed	3-5	TWT	Lean Clay with Sand (CL)	105.7	20.8%	53	138
T-88	Undisturbed	3-5	TWT	Lean Clay (CL)	87.2	31.4%	71	180
T-99	Undisturbed	3-5	TWT	Sandy Lean Clay (CL)	112.2	16.6%	47	101
T-117	Undisturbed	3-5	TWT	Lean Clay with Sand (CL)	99.4	23.2%	59	142
	Samples extruded and selected specimens trimmed for undisturbed tests.							

2401 West 66th Street



Richfield, MN 55423

<http://www.soilengineeringtesting.com>

Thermal Resistivity Report

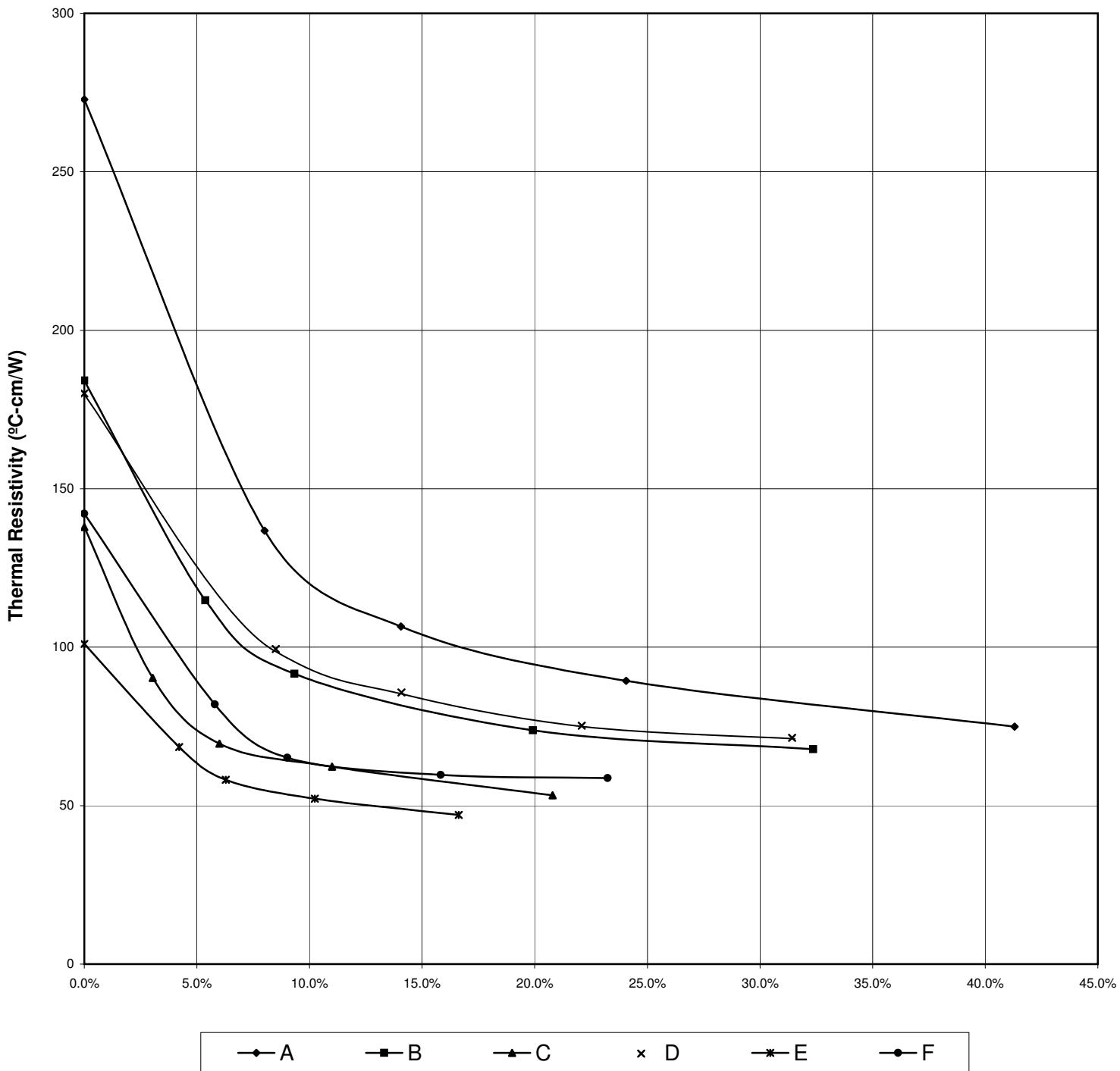
ASTM D:5334

Project: _____ Job: 8076
 Client: _____ Date: 9/22/11
 Hardin County
 Barr Engineering Company

	Boring	Depth (ft)
Specimen A:	T-66	3 - 5
Specimen B:	T-72	3 - 5
Specimen C:	T-82	3 - 5
Specimen D:	T-88	3 - 5
Specimen E:	T-99	3 - 5

	Boring	Depth (ft)
Specimen F:	T-117	3 - 5

Thermal Dryout Curves (Resistivity vs. Water Content)



2401 West 66th Street

OIL
ENGINEERING
TESTING, INC.

Richfield, MN 55423

<http://www.soilengineeringtesting.com>

Appendix H

Chemical Testing Results



YOUR LAB OF CHOICE

12065 Lebanon Rd.
Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

John Whelan
Soil Engineering Testing, Inc.
2401 West 66th Street
Richfield, MN 55423

Report Summary

Wednesday September 21, 2011

Report Number: L534906

Samples Received: 09/08/11

Client Project: 8076

Description: Hardin

The analytical results in this report are based upon information supplied by you, the client, and are for your exclusive use. If you have any questions regarding this data package, please do not hesitate to call.

Entire Report Reviewed By:

John Hawkins
John Hawkins, ESC Representative

Laboratory Certification Numbers

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT - PH-0197, FL - E87487
GA - 923, IN - C-TN-01, KY - 90010, KYUST - 0016, NC - ENV375/DW21704, ND - R-140
NJ - TN002, NJ NELAP - TN002, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ - 0612, MN - 047-999-395, NY - 11742, WI - 998093910, NV - TN000032008A,
TX - T104704245, OK-9915

Accreditation is only applicable to the test methods specified on each scope of accreditation held by ESC Lab Sciences.

Note: The use of the preparatory EPA Method 3511 is not approved or endorsed by the CA ELAP.

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YOUR LAB OF CHOICE

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Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

John Whelan
Soil Engineering Testing, Inc.
2401 West 66th Street
Richfield, MN 55423

September 21, 2011

Date Received : September 08, 2011
Description : Hardin
Sample ID : T-2 3-5FT
Collected By :
Collection Date : 09/07/11 00:00

ESC Sample # : L534906-01
Site ID :
Project # : 8076

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	37.	10.	mg/kg	9056	09/13/11	1
Sulfate	94.	50.	mg/kg	9056	09/13/11	1

BDL - Below Detection Limit

Det. Limit - Practical Quantitation Limit(PQL)

Note:

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Est. 1970

REPORT OF ANALYSIS

John Whelan
Soil Engineering Testing, Inc.
2401 West 66th Street
Richfield, MN 55423

September 21, 2011

Date Received : September 08, 2011
Description : Hardin
Sample ID : T-19 3-5FT
Collected By :
Collection Date : 09/07/11 00:00

ESC Sample # : L534906-02

Site ID :

Project # : 8076

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	55.	10.	mg/kg	9056	09/13/11	1
Sulfate	330	50.	mg/kg	9056	09/13/11	1

BDL - Below Detection Limit

Det. Limit - Practical Quantitation Limit(PQL)

Note:

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REPORT OF ANALYSIS

John Whelan
Soil Engineering Testing, Inc.
2401 West 66th Street
Richfield, MN 55423

September 21, 2011

Date Received : September 08, 2011
Description : Hardin
Sample ID : T-35 3-5FT
Collected By :
Collection Date : 09/07/11 00:00

ESC Sample # : L534906-03

Site ID :

Project # : 8076

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	37.	10.	mg/kg	9056	09/13/11	1
Sulfate	BDL	50.	mg/kg	9056	09/13/11	1

BDL - Below Detection Limit

Det. Limit - Practical Quantitation Limit(PQL)

Note:

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REPORT OF ANALYSIS

John Whelan
Soil Engineering Testing, Inc.
2401 West 66th Street
Richfield, MN 55423

September 21, 2011

Date Received : September 08, 2011
Description : Hardin
Sample ID : T-49 3-5FT
Collected By :
Collection Date : 09/07/11 00:00

ESC Sample # : L534906-04

Site ID :

Project # : 8076

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	66.	10.	mg/kg	9056	09/13/11	1
Sulfate	100	50.	mg/kg	9056	09/13/11	1

BDL - Below Detection Limit

Det. Limit - Practical Quantitation Limit(PQL)

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REPORT OF ANALYSIS

John Whelan
Soil Engineering Testing, Inc.
2401 West 66th Street
Richfield, MN 55423

September 21, 2011

Date Received : September 08, 2011
Description : Hardin
Sample ID : T-51 3-5FT
Collected By :
Collection Date : 09/07/11 00:00

ESC Sample # : L534906-05

Site ID :

Project # : 8076

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	48.	10.	mg/kg	9056	09/13/11	1
Sulfate	220	50.	mg/kg	9056	09/13/11	1

BDL - Below Detection Limit

Det. Limit - Practical Quantitation Limit(PQL)

Note:

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REPORT OF ANALYSIS

John Whelan
Soil Engineering Testing, Inc.
2401 West 66th Street
Richfield, MN 55423

September 21, 2011

Date Received : September 08, 2011
Description : Hardin
Sample ID : T-62 3-5FT
Collected By :
Collection Date : 09/07/11 00:00

ESC Sample # : L534906-06

Site ID :

Project # : 8076

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	BDL	10.	mg/kg	9056	09/13/11	1
Sulfate	690	50.	mg/kg	9056	09/18/11	1

BDL - Below Detection Limit

Det. Limit - Practical Quantitation Limit(PQL)

Note:

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REPORT OF ANALYSIS

John Whelan
Soil Engineering Testing, Inc.
2401 West 66th Street
Richfield, MN 55423

September 21, 2011

Date Received : September 08, 2011
Description : Hardin
Sample ID : T-66 3-5FT
Collected By :
Collection Date : 09/07/11 00:00

ESC Sample # : L534906-07

Site ID :

Project # : 8076

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	52.	10.	mg/kg	9056	09/13/11	1
Sulfate	3500	250	mg/kg	9056	09/14/11	5

BDL - Below Detection Limit

Det. Limit - Practical Quantitation Limit(PQL)

Note:

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REPORT OF ANALYSIS

John Whelan
Soil Engineering Testing, Inc.
2401 West 66th Street
Richfield, MN 55423

September 21, 2011

Date Received : September 08, 2011
Description : Hardin
Sample ID : T-72 3-5FT
Collected By :
Collection Date : 09/07/11 00:00

ESC Sample # : L534906-08

Site ID :

Project # : 8076

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	50.	10.	mg/kg	9056	09/13/11	1
Sulfate	2000	250	mg/kg	9056	09/14/11	5

BDL - Below Detection Limit

Det. Limit - Practical Quantitation Limit(PQL)

Note:

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REPORT OF ANALYSIS

John Whelan
Soil Engineering Testing, Inc.
2401 West 66th Street
Richfield, MN 55423

September 21, 2011

Date Received : September 08, 2011
Description : Hardin
Sample ID : T-82 3-5FT
Collected By :
Collection Date : 09/07/11 00:00

ESC Sample # : L534906-09

Site ID :

Project # : 8076

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	57.	10.	mg/kg	9056	09/13/11	1
Sulfate	250	50.	mg/kg	9056	09/13/11	1

BDL - Below Detection Limit

Det. Limit - Practical Quantitation Limit(PQL)

Note:

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REPORT OF ANALYSIS

John Whelan
Soil Engineering Testing, Inc.
2401 West 66th Street
Richfield, MN 55423

September 21, 2011

Date Received : September 08, 2011
Description : Hardin
Sample ID : T-88 3-5FT
Collected By :
Collection Date : 09/07/11 00:00

ESC Sample # : L534906-10

Site ID :

Project # : 8076

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	53.	10.	mg/kg	9056	09/14/11	1
Sulfate	55.	50.	mg/kg	9056	09/14/11	1

BDL - Below Detection Limit

Det. Limit - Practical Quantitation Limit(PQL)

Note:

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REPORT OF ANALYSIS

John Whelan
Soil Engineering Testing, Inc.
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Richfield, MN 55423

September 21, 2011

Date Received : September 08, 2011
Description : Hardin
Sample ID : T-99 3-5FT
Collected By :
Collection Date : 09/07/11 00:00

ESC Sample # : L534906-11
Site ID :
Project # : 8076

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	49.	10.	mg/kg	9056	09/14/11	1
Sulfate	59.	50.	mg/kg	9056	09/14/11	1

BDL - Below Detection Limit

Det. Limit - Practical Quantitation Limit(PQL)

Note:

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September 21, 2011

Date Received : September 08, 2011
Description : Hardin
Sample ID : T-117 3-5FT
Collected By :
Collection Date : 09/07/11 00:00

ESC Sample # : L534906-12
Site ID :
Project # : 8076

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	53.	10.	mg/kg	9056	09/14/11	1
Sulfate	BDL	50.	mg/kg	9056	09/14/11	1

BDL - Below Detection Limit

Det. Limit - Practical Quantitation Limit(PQL)

Note:

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Quality Assurance Report
Level II

L534906

September 21, 2011

Analyte	Result	Laboratory Blank			Limit	Batch	Date Analyzed		
		Units	% Rec						
Chloride	< 10	mg/kg				WG554776	09/13/11 14:25		
Sulfate	< 50	mg/kg				WG554776	09/13/11 14:25		
<u>Sulfate</u>	<u>< 50</u>	<u>mg/kg</u>				WG555594	09/17/11 11:50		
Analyte	Units	Result	Duplicate	RPD	Limit	Ref Samp	Batch		
Chloride	mg/kg	36.0	37.0	2.74	20	L534906-03	WG554776		
Sulfate	mg/kg	0	0	0	20	L534906-03	WG554776		
Chloride	mg/kg	56.0	53.0	6.39	20	L534906-10	WG554776		
Sulfate	mg/kg	52.0	55.0	6.38	20	L534906-10	WG554776		
Sulfate	mg/kg	570.	690.	19.4	20	L534906-06	WG555594		
Analyte	Units	Laboratory Control Sample			% Rec	Limit	Batch		
		Known Val	Result						
Chloride	mg/kg	200	209.		105.	85-115	WG554776		
Sulfate	mg/kg	200	208.		104.	85-115	WG554776		
Sulfate	mg/kg	200	209.		105.	85-115	WG555594		
Analyte	Units	Result	Ref	%Rec	Limit	RPD	Limit	Batch	
Chloride	mg/kg	209.	209.	104.	85-115	0	20	WG554776	
Sulfate	mg/kg	208.	208.	104.	85-115	0	20	WG554776	
Sulfate	mg/kg	209.	209.	104.	85-115	0	20	WG555594	
Analyte	Units	MS Res	Ref Res	TV	% Rec	Limit	Ref Samp	Batch	
Chloride	mg/kg	551.	66.0	500	97.0	80-120	L534906-04	WG554776	
Sulfate	mg/kg	611.	100.	500	102.	80-120	L534906-04	WG554776	
Analyte	Units	MSD	Ref	%Rec	Limit	RPD	Limit	Ref Samp	Batch
Chloride	mg/kg	563.	551.	99.4	80-120	2.15	20	L534906-04	WG554776
Sulfate	mg/kg	626.	611.	105.	80-120	2.43	20	L534906-04	WG554776

Batch number /Run number / Sample number cross reference

WG554776: R1858095: L534906-01 02 03 04 05 06 07 08 09 10 11 12
WG555288: R1861372: L534906-06
WG555594: R1863712: L534906-06

* * Calculations are performed prior to rounding of reported values.

* Performance of this Analyte is outside of established criteria.

For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

pH Testing Summary Sheet

Project: Hardin Job: 8076
 Client: Barr Engineering Company Date: 9/13/2011

Boring	Sample Type	Depth (ft)	pH	Visual Classification
T-2	TWT	3 - 5	7.7	Lean clay with Sand (CL)
T-19	TWT	3 - 5	7.4	Lean Clay (CL)
T-35	TWT	3 - 5	7.7	Lean clay with Sand (CL)
T-49	TWT	3 - 5	7.6	Organic Clay (OL)
T-51	TWT	3 - 5	7.7	Organic Clay (OL)
T-62	TWT	3 - 5	7.6	Organic Clay (OH)
T-66	TWT	3 - 5	7.6	Lean Clay with a little organic material (CL)
T-72	TWT	3 - 5	7.5	Lean Clay with a trace of organic material (CL)
T-82	TWT	3 - 5	7.4	Lean clay with Sand (CL)
T-88	TWT	3 - 5	7.2	Lean Clay (CL)
T-99	TWT	3 - 5	7.2	Sandy Lean Clay (CL)
T-117	TWT	3 - 5	6.0	Lean clay with Sand (CL)

**YOUR LAB OF CHOICE**

Soil Engineering Testing, Inc.
John Whelan
2401 West 66th Street
Richfield, MN 55423

**Quality Assurance Report
Level II**

L534906

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September 21, 2011

The data package includes a summary of the analytic results of the quality control samples required by the SW-846 or CWA methods. The quality control samples include a method blank, a laboratory control sample, and the matrix spike/matrix spike duplicate analysis. If a target parameter is outside the method limits, every sample that is effected is flagged with the appropriate qualifier in Appendix B of the analytic report.

Method Blank - an aliquot of reagent water carried through the entire analytic process. The method blank results indicate if any possible contamination exposure during the sample handling, digestion or extraction process, and analysis. Concentrations of target analytes above the reporting limit in the method blank are qualified with the "B" qualifier.

Laboratory Control Sample - is a sample of known concentration that is carried through the digestion/extraction and analysis process. The percent recovery, expressed as a percentage of the theoretical concentration, has statistical control limits indicating that the analytic process is "in control". If a target analyte is outside the control limits for the laboratory control sample or any other control sample, the parameter is flagged with a "J4" qualifier for all effected samples.

Matrix Spike and Matrix Spike Duplicate - is two aliquots of an environmental sample that is spiked with known concentrations of target analytes. The percent recovery of the target analytes also has statistical control limits. If any recoveries that are outside the method control limits, the sample that was selected for matrix spike/matrix spike duplicate analysis is flagged with either a "J5" or a "J6". The relative percent difference (%RPD) between the matrix spike and the matrix spike duplicate recoveries is all calculated. If the RPD is above the method limit, the effected samples are flagged with a "J3" qualifier.

Appendix I

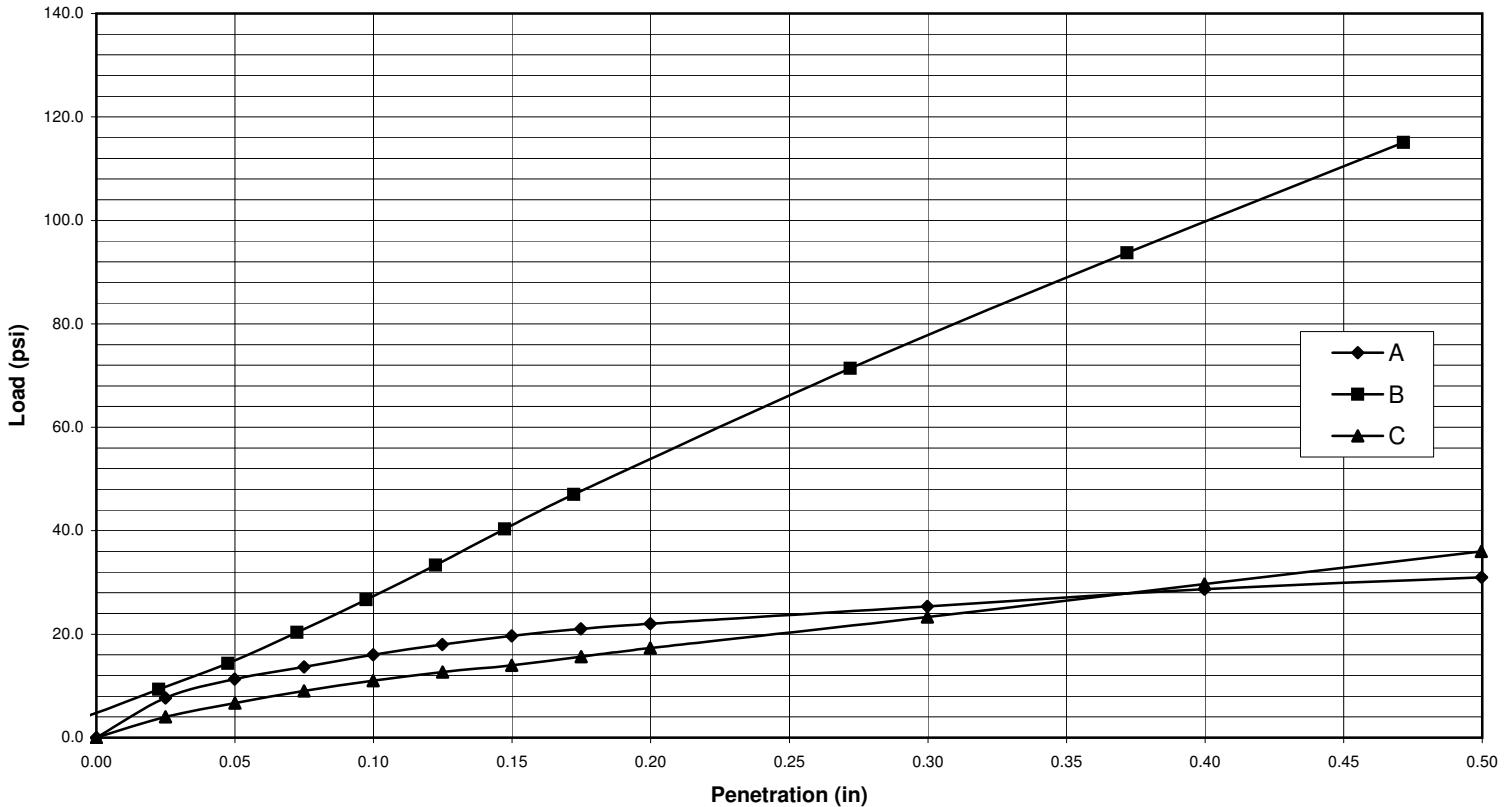
CBRs for Roadways

California Bearing Ratio ASTM:D1883

Project:	Hardin County		Job:	8076-A	
Client:	Barr Engineering Company		Date:	12/7/11	
Boring #:	T-02 - T-14 - T-19	Procedural Method:			
Sample:	Specimens compacted to approximately 95% of maximum standard proctor density at optimum moisture content. Specimens soaked for a period of 4 days before CBR test was performed.				
Depth (ft):	Type: Bulk				
Location:					
Classification:	Lean Clay w/sand (CL)	-	Lean Clay w/sand (CL)	-	Fat Clay (CH)
Laboratory Moisture-Density Values			Index Properties		
Method:	ASTM:D698 Method B		LL:	Gs:	
Maximum Dry Density (PCF):	102.2 - 109.2 - 95.5	PL:	Organic Content:		
Optimum Water Content:	22.5% - 16.8% - 25.8%	PI:	pH:		
Initial Molding Conditions					
Boring	T-02		T-14	T-19	
Specimen	A		B	C	
Number of Layers:	3		3	3	
Blows per Layer:	NA		NA	NA	
Initial Moisture Content:	22.5%		16.8%	25.8%	
Initial Dry Density (PCF)	97.3		104.0	90.9	
Relative Compaction	95.2%		95.3%	95.1%	
Soaking Phase					
Days Soaked	4		4	4	
Surcharge (psf)	50		50	50	
Total Swell (%)	0.1%		1.3%	3.2%	
Penetration Phase					
Surcharge (psf)	50		50	50	
Corrected CBR Values					
at 0.1 inch (%)	1.6%		2.7%	1.1%	
at 0.2 inch (%)	1.5%		3.6%	1.2%	
Moisture Content After Penetration					
Top 1" of Specimen:	20.7%		22.3%	30.9%	
Average of specimen:	20.7%		20.6%	28.8%	

Stress vs. Penetration Graph

Corrected Penetration Plot

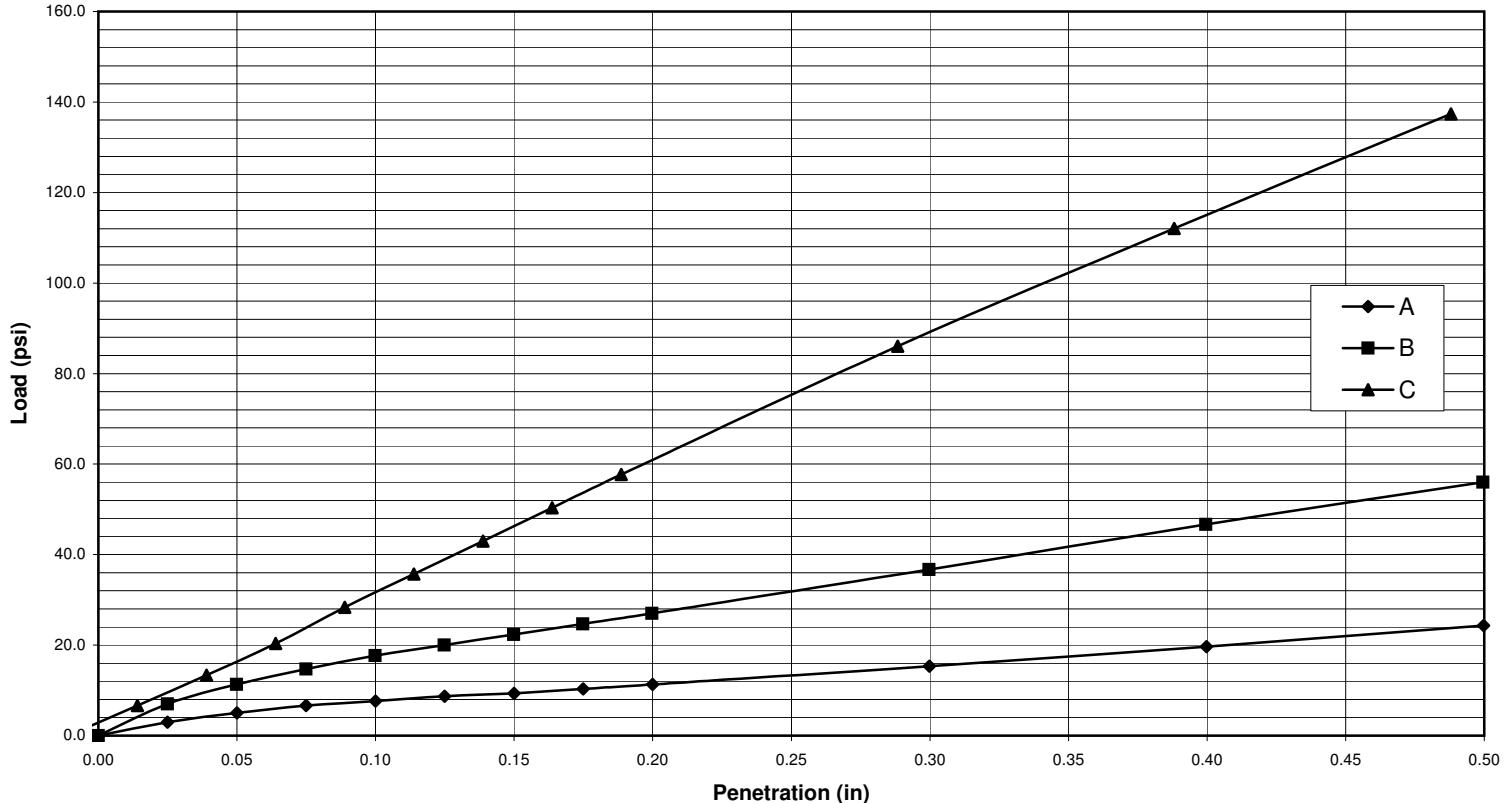


California Bearing Ratio ASTM:D1883

Project:	Hardin County		Job:	8076-A
Client:	Barr Engineering Company		Date:	12/7/11
Boring #:	T-31 - T-35 - T-39	Procedural Method:		
Sample:	Specimens compacted to approximately 95% of maximum standard proctor density at optimum moisture content. Specimens soaked for a period of 4 days before CBR test was performed.			
Depth (ft):	Type: Bulk			
Location:				
Classification:	Fat Clay (CH) - Lean Clay w/sand (CL)	-	Lean Clay w/sand (CL)	
Laboratory Moisture-Density Values			Index Properties	
Method:	ASTM:D698 Method B		LL:	Gs:
Maximum Dry Density (PCF):	96.9 - 102.0 - 108.9	PL:	Organic Content:	
Optimum Water Content:	25.1% - 21.3% - 17.9%	PI:	pH:	
Initial Molding Conditions				
Boring	T-31		T-35	T-39
Specimen	A		B	C
Number of Layers:	3		3	3
Blows per Layer:	NA		NA	NA
Initial Moisture Content:	25.1%		21.3%	17.9%
Initial Dry Density (PCF)	92.4		97.1	103.7
Relative Compaction	95.3%		95.2%	95.3%
Soaking Phase				
Days Soaked	4		4	4
Surcharge (psf)	50		50	50
Total Swell (%)	4.5%		1.9%	1.0%
Penetration Phase				
Surcharge (psf)	50		50	50
Corrected CBR Values				
at 0.1 inch (%)	0.8%		1.8%	3.2%
at 0.2 inch (%)	0.8%		1.8%	4.1%
Moisture Content After Penetration				
Top 1" of Specimen:	31.3%		25.9%	21.8%
Average of specimen:	28.6%		23.4%	21.0%

Stress vs. Penetration Graph

Corrected Penetration Plot

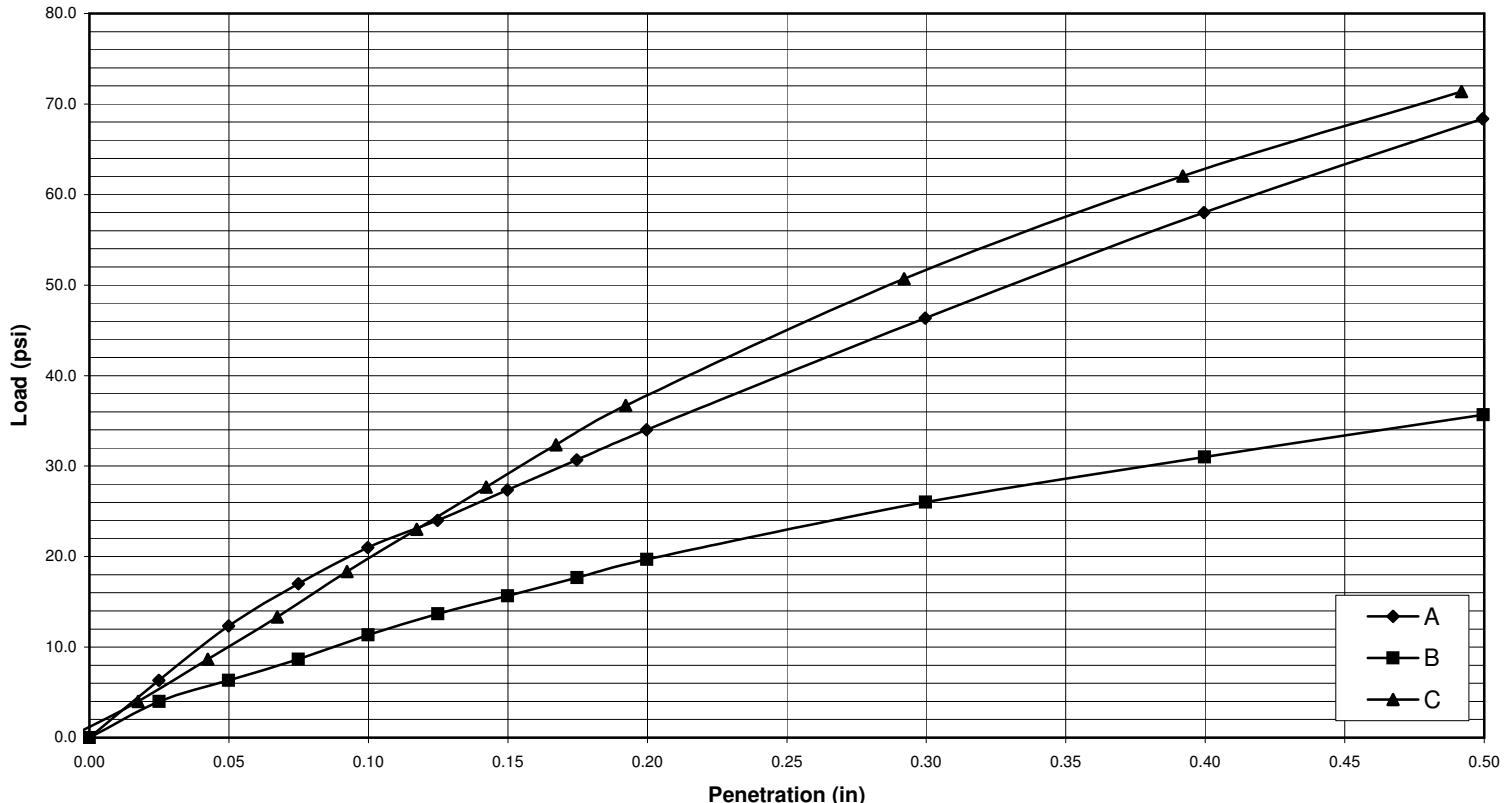


California Bearing Ratio ASTM:D1883

Project:	Hardin County		Job:	8076-A			
Client:	Barr Engineering Company		Date:	12/7/11			
Boring #:	T-50 - T-66 - T-72	Procedural Method:					
Sample:	Specimens compacted to approximately 95% of maximum standard proctor density at optimum moisture content. Specimens soaked for a period of 4 days before CBR test was performed.						
Depth (ft):	Type: Bulk						
Location:							
Classification:	Lean Clay w/sand (CL)	-	Organic Clay (OH)	-	Sandy Lean Clay w/organic material (CL)		
Laboratory Moisture-Density Values			Index Properties				
Method:	ASTM:D698 Method B		LL:	Gs:			
Maximum Dry Density (PCF):	103.0	-	67.5	-	98.7	PL:	Organic Content:
Optimum Water Content:	21.4%	-	47.5%	-	21.0%	PI:	pH:
Initial Molding Conditions							
Boring	T-50		T-66		T-72		
Specimen	A		B		C		
Number of Layers:	3		3		3		
Blows per Layer:	NA		NA		NA		
Initial Moisture Content:	21.4%		47.5%		21.0%		
Initial Dry Density (PCF)	98.2		64.2		93.8		
Relative Compaction	95.3%		95.1%		95.0%		
Soaking Phase							
Days Soaked	4		4		4		
Surcharge (psf)	50		50		50		
Total Swell (%)	1.4%		4.6%		2.6%		
Penetration Phase							
Surcharge (psf)	50		50		50		
Corrected CBR Values							
at 0.1 inch (%)	2.1%		1.1%		2.0%		
at 0.2 inch (%)	2.3%		1.3%		2.5%		
Moisture Content After Penetration							
Top 1" of Specimen:	26.2%		62.0%		27.2%		
Average of specimen:	23.9%		55.0%		25.0%		

Stress vs. Penetration Graph

Corrected Penetration Plot

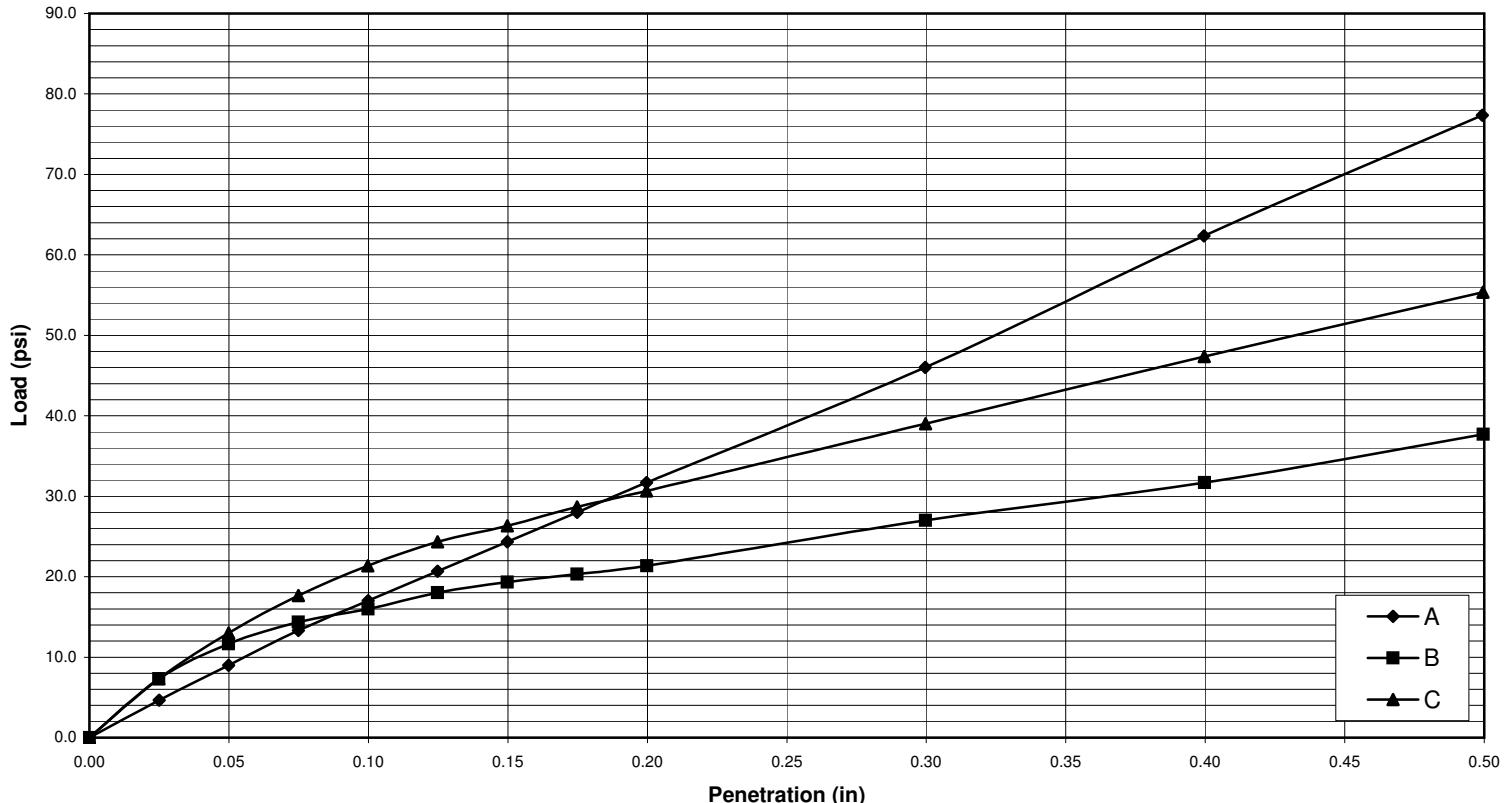


California Bearing Ratio ASTM:D1883

Project:	Hardin County		Job:	8076-A
Client:	Barr Engineering Company		Date:	12/7/11
Boring #:	T-82 - T-88 - T-117	Procedural Method:		
Sample:	Specimens compacted to approximately 95% of maximum standard proctor density at optimum moisture content. Specimens soaked for a period of 4 days before CBR test was performed.			
Depth (ft):	Type: Bulk			
Location:				
Classification:	Lean Clay w/sand (CL)	-	Lean Clay w/sand (CL)	-
	Lean Clay w/sand (CL)	-	Lean Clay w/sand (CL)	
Laboratory Moisture-Density Values			Index Properties	
Method:	ASTM:D698 Method B		LL:	Gs:
Maximum Dry Density (PCF):	108.8	-	105.1	-
Optimum Water Content:	18.2%	-	20.1%	-
	103.3		20.2%	
PI:			pH:	
Initial Molding Conditions				
Boring	T-82		T-88	T-117
Specimen	A		B	C
Number of Layers:	3		3	3
Blows per Layer:	NA		NA	NA
Initial Moisture Content:	18.2%		20.1%	20.2%
Initial Dry Density (PCF)	103.6		100.2	98.5
Relative Compaction	95.3%		95.3%	95.3%
Soaking Phase				
Days Soaked	4		4	4
Surcharge (psf)	50		50	50
Total Swell (%)	1.4%		3.8%	2.5%
Penetration Phase				
Surcharge (psf)	50		50	50
Corrected CBR Values				
at 0.1 inch (%)	1.7%		1.6%	2.1%
at 0.2 inch (%)	2.1%		1.4%	2.0%
Moisture Content After Penetration				
Top 1" of Specimen:	23.2%		27.5%	25.8%
Average of specimen:	20.9%		23.8%	23.6%

Stress vs. Penetration Graph

Corrected Penetration Plot





October 5, 2016

Ms. Raquel Justa
Invenergy, LLC
1 South Wacker Drive
Chicago, IL 60606

**Re: Supplemental Geotechnical Investigation and Analysis
Hardin Wind Project – Hardin County, Ohio**

Dear Ms. Justa:

Barr Engineering Co. (Barr), under authorization and contract with Invenergy, LLC (Invenergy) has completed a supplementary geotechnical investigation in support of foundation design for two proposed turbine sites. These turbine sites were previously unexplored during the previous geotechnical site investigations.

Attachment A shows the plan location of all additional borings completed. The geographic coordinates for the turbine and bridge borings are provided on the boring logs in Attachment B. Under subcontract to Barr, Olsson Associates (Olsson) performed soil borings. Barr observed all soil borings, classified the soil, and logged each boring. The soil samples were transported to Olsson's laboratory in Lincoln, Nebraska for laboratory testing. The supplemental geotechnical investigation was performed in mid-September 2016.

This letter report, and its attachments, supplement the final geotechnical report for the proposed turbine locations prepared by Barr dated January 2012, and submitted to Invenergy. As such, detailed methods, results, analysis, and recommendations pertaining to the turbine locations are not included herein. This letter report serves to evaluate the new locations with respect to the minimum criteria set forth during the previous phase of investigation. Each turbine location was evaluated for support of the anticipated spread foundation design based upon stiffness, settlement, and bearing capacity criteria.

Results

Turbine Borings

Borings performed at the turbine locations T-1 and T-4 were performed to depths of 32.5 and 50 feet below the existing grade, respectively. The boring for T-1 was terminated on limestone bedrock. Bedrock was not encountered in the boring for T-4. The results of the soil borings indicate that similar conditions as those reported in the geotechnical report were encountered:

- Soil conditions consisted primarily of cohesive soils with a few thin sand or gravel layers (Attachment B).

- The soils below the foundation depth of approximately 8.5-feet were observed to exhibit undrained shear strengths in excess of the 1,100 psf design value recommended in the previously submitted geotechnical report except as noted below. The field SPT testing and hand penetrometer results are provided in Attachment B and laboratory test results are included in Attachment C. The following layers were analyzed for low strengths below the 1,100 psf undrained shear strength design value:
 - A Low strength soil zone was encountered in boring T-1 between about 8 and 15 feet below grade as indicated by an SPT N-value of 2 blows per foot and a laboratory unconfined compressive strength of 0.7 tsf (corresponding to an undrained shear strength of 700 psf). This layer would require removal and replacement or improvement (likely through use of Geopiers/stone columns) to a minimum depth of 17 feet for turbine foundation support.
 - A zone of clayey sand was encountered in boring T-4 at a depth of about 17 feet below grade. This layer had an unconfined compressive strength of 0.5 tsf, but had a medium dense SPT N-value of 12 and a hand penetrometer value of 3 tsf. Further, unconfined compressive strength testing of sand soils is generally not representative of their shear strength, so this layer is not considered to reduce the bearing capacity at this site from the design value provided in the original geotechnical engineering report.
- Groundwater levels from the soil borings indicated that groundwater was observed at depths of 8 feet below grade at turbine site T-1 and at 16 feet below grade at turbine site T-4. Water levels indicated on the boring logs in Attachment B. However, based on previous long-term piezometer monitoring at the site, a design groundwater level of 0.5 feet below grade is recommended for turbine foundation designs at all of the locations. It is anticipated that this design groundwater level will also be used for turbines T-1 and T-4.

Analysis and Recommendations

Based on the results of the soil boring the turbine locations, it appears that the soils encountered at turbine location T-4 will meet or exceed the design bearing capacity used for the existing foundation design without remediation. Based on the results of unconfined compressive strength testing less than the 1,100 psf design value and low SPT N-value between a depth of 8 and 15 feet at turbine location T-1, either removal and replacement of the low strength soils with engineered fill or improvement with Geopiers/stone columns will be needed to at least 17 feet below existing grade for proper turbine support.

The results of the previous groundwater measurements indicate that a buoyant foundation will be required at both turbine locations. The recommended design groundwater depth for foundation design is 0.5 feet below grade.

The soil boring and laboratory test results indicate that the soil stiffness and compressibility are similar to those indicated in the original geotechnical engineering report and provided the improvement recommendations are performed for T-1, should be suitable for turbine foundation support.

Sincerely,



Bill W. Kussmann, PE

Date: October 5, 2016 License No.: PE.74783

BARR ENGINEERING CO.

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Ohio.

Attachments

- A – Supplemental Geotechnical Investigation Locations
- B – Soil Boring Logs
- C – Laboratory Test Results

Attachments

Attachment A

Supplemental Geotechnical Investigation Locations

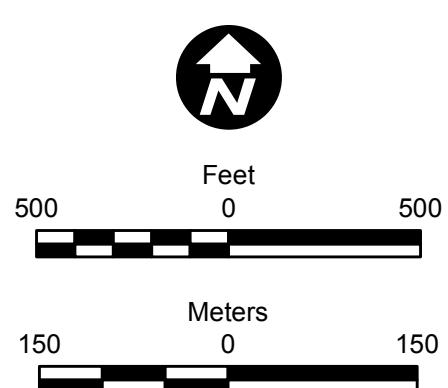
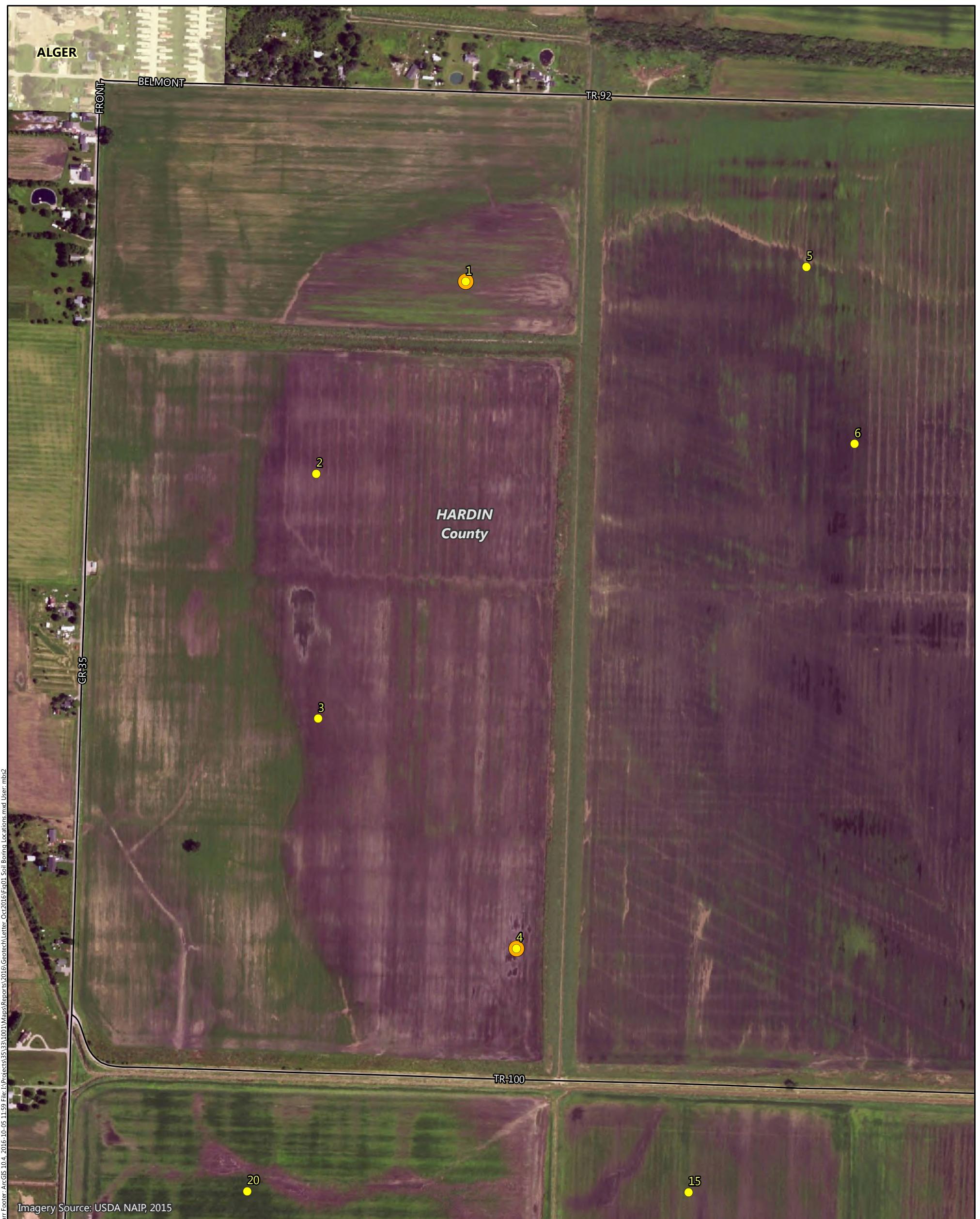


Figure 1

SOIL BORING LOCATIONS
 Hardin Wind Project
 Invenergy LLC
 Hardin County, Ohio

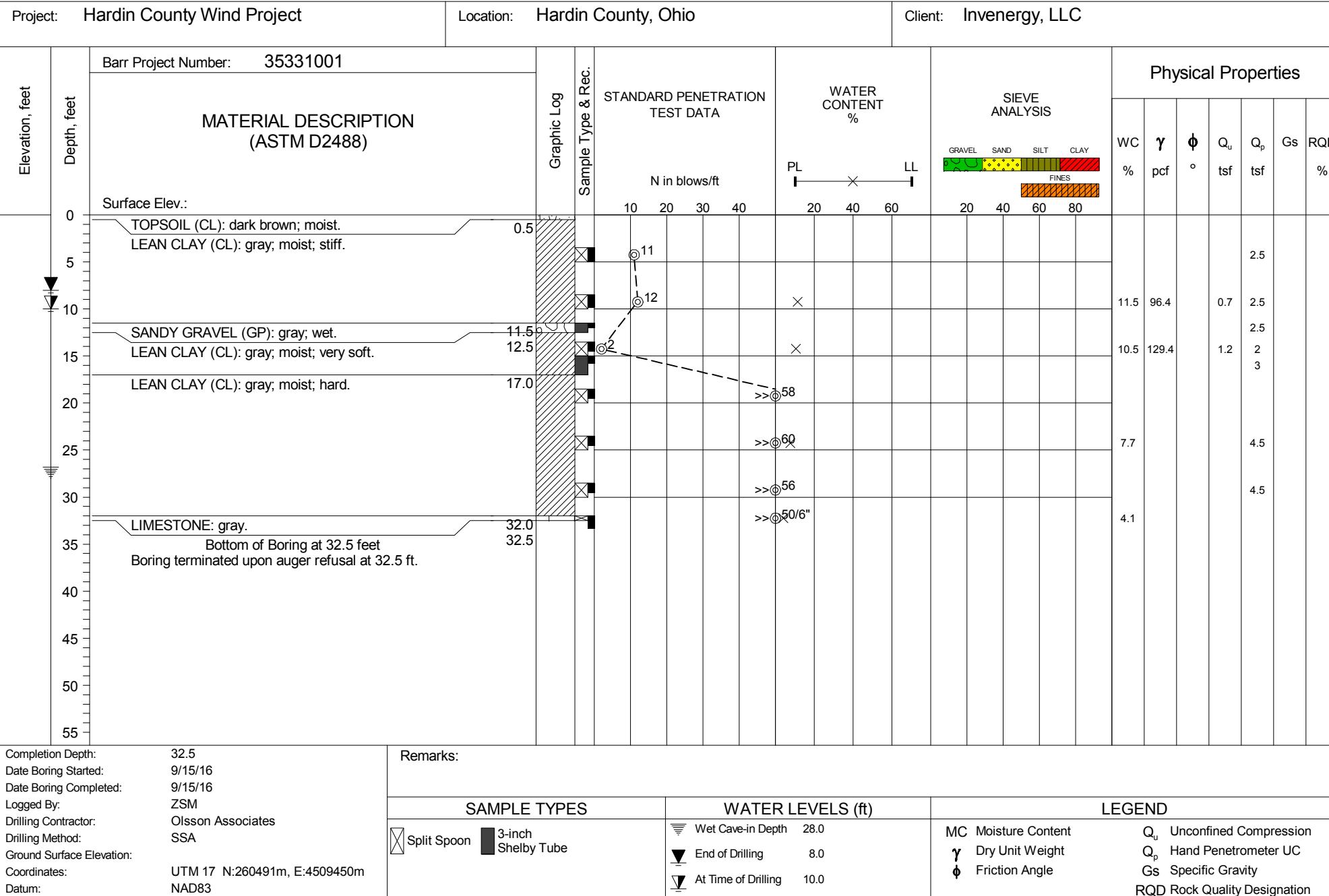
Attachment B
Soil Boring Logs



Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING T-1

Sheet 1 of 1



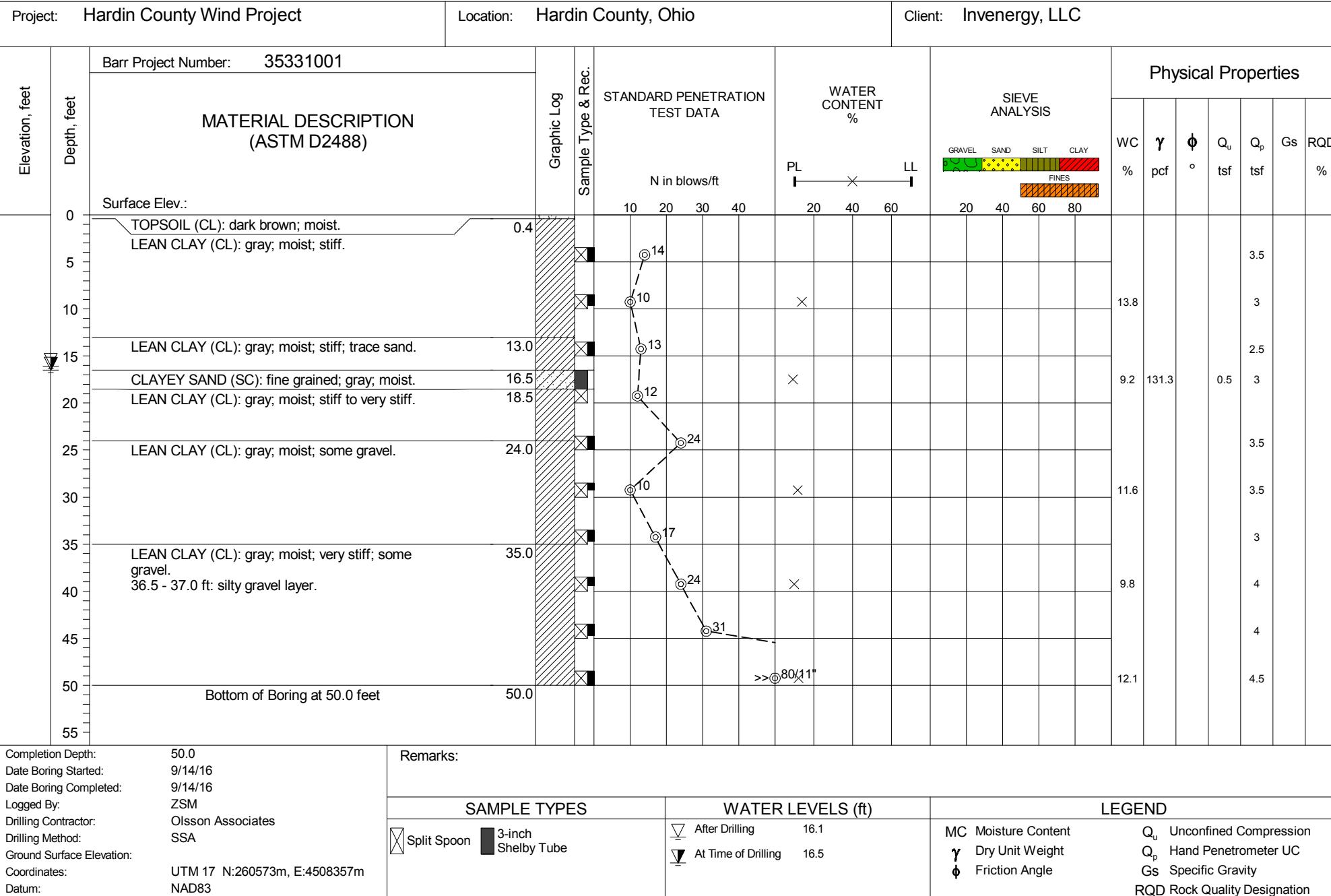
The stratification lines represent approximate boundaries. The transition may be gradual.



Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING T-4

Sheet 1 of 1



The stratification lines represent approximate boundaries. The transition may be gradual.

Attachment C

Laboratory Test Results

OLSSON ASSOCIATES
11627 VIRGINIA PLAZA, STE 103
LA VISTA, NEBRASKA 68128



SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

PROJECT NAME: Barr Hardin County Wind Project

CLIENT: Barr Engineering Company

PROJECT NUMBER: 016-2776

PROJECT LOCATION:

This foregoing document was electronically filed with the Public Utilities

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Case No(s). 09-0479-EL-BGN

Summary: Correspondence of Hardin Wind Energy LLC in Compliance with Certificate Condition No. 22 - Geotechnical Report, Part 3 of 3 electronically filed by Teresa Orahood on behalf of Sally W. Bloomfield